WCRP REPORT
World Climate Research Programme

ANNUAL REVIEW
OF THE WORLD CLIMATE RESEARCH PROGRAMME

AND

REPORT
OF THE TWENTY-EIGHTH SESSION OF THE JOINT SCIENTIFIC COMMITTEE

(ZANZIBAR, TANZANIA, 26-30 March 2007)

July 2007

WMO/TD-No. 1395

CONTENTS

TWENTY-EIGHTH SESSION OF THE JOINT SCIENTIFIC COMMITTEE (JSC) FOR WCRP
(Zanzibar, Tanzania, 26-30 March 2007)

SESSION REPORT SUMMARY

I. OPENING OF THE SESSION

J. Church, the Chair of the JSC, opened the JSC – 28 session at 13:00 hrs on 26 March 2007. It was held at the Zanzibar Beach Resort Hotel, Zanzibar, Tanzania, and was hosted by the Tanzania Meteorological Agency.

II. ROLE OF THE JSC, WCRP FUTURE DIRECTIONS: MAIN POINTS OF THE DISCUSSION AT THE CLOSED JSC SESSION WITH ADDITIONAL ISSUES RAISED AT THE OPEN FORUM

WCRP has two major objectives: *to determine the extent to which climate can be predicted, and to determine the extent of human influence on climate*. WCRP has made major advances in understanding specific components (ocean, land, atmosphere, cryosphere) of the climate system, and created many new opportunities and challenges for future climate research and its application for the benefit of society. Progress in understanding the variability and predictability of individual components of the climate system makes it possible to address the predictability of the total climate system, one of the original objectives of WCRP, and to apply the results for the benefit of society. In particular, it is now possible for WCRP to address the seamless prediction of the climate system from weekly weather to seasonal, interannual, decadal and centennial climate variations and anthropogenic climate change. Advances in understanding and in new technology for observations and computing also make it possible to address the broader questions of Earth system modelling and the use of comprehensive Earth system models for investigating the habitability of our planet, and contributing to the socio-economic welfare and the sustainability of modern societies. WCRP is therefore pursuing a new strategic framework, Coordinated Observation and Prediction of the Earth System, to capitalize on past progress and on the ongoing activities of its projects. The aim under this new strategy is *to facilitate analysis and prediction of Earth system variability and change for use in an increasing range of practical applications of direct relevance, benefit and value to society*. It will provide the unifying context and agenda for the wide range of climate science coordinated by and performed through WCRP projects and activities, and for demonstrating their relevance to society.

Based on the working documents 1.1 –1.4 for the session, and their brief introduction by J. Church, the discussion took place on the future of the WCRP, its current funding difficulties, existing proposals on refining WCRP's direction, possible merger with IGPB, and some other related issues, such as insufficient visibility of the WCRP and certain gaps in the program.

Points raised in the discussion that could form a basis of consensus on the way forward for the WCRP are as follows:

- It was agreed that WCRP must focus on the big science issues of relevance to society and to continue to do the things that WCRP is very good at, is uniquely positioned to do, and that only WCRP can execute by virtue of its collective worldwide expertise in coordinating and facilitating research.

- The JSC agreed that there would be no single way of addressing the current challenges facing WCRP. While major issues can be addressed by crosscutting activities, the Core projects and Working Groups will remain key agents for implementation. They may need to adjust their priorities and work plans towards new circumstances and requirements. They are valuable components of the WCRP community and the JSC needs to find ways of preserving their heritage, sustaining their well-recognized excellence and helping them to better address identified issues. Feedback from projects is essential, and the process of aligning of WCRP to deliver on its goals should build as much as possible on a bottom-up process.

- Projects and working Groups have been and will continue to be central to WCRP's basic science work and in achieving the desired outcomes of most of the crosscuts, with guidance from the JSC. Core projects have support from countries hosting IPOs and have behind them wide communities of the WCRP scientists. They have a well-defined "sunset" year and they must continue to evolve, possibly into new projects, just as WOCE and TOGA evolved into CLIVAR and ACSYS evolved into CliC. Most of the considered crosscuts (except ACC) fall naturally in one or two projects. Past WCRP structure had gaps, e.g. in atmospheric chemistry, and a major problem was lack of visibility of WCRP and lack of acknowledgement of its achievements. Crosscutting activities are capable of integrating the work of projects, filling the gaps and producing tangible results in the realm of societal needs for end users.

- Crosscutting activities should be goal-oriented and take finite (but maybe differing) time to achieve their goals. Most of the proposed crosscuts have clear plans, schedule, and expected deliverables. Some crosscuts may evolve into future projects.

- Given its breadth, ACC is a crosscut that needs to be led by the JSC with strong project and working group support in its implementation. JSC should consider whether it wishes to merge seasonal and decadal crosscuts to be led by CLIVAR. The monsoonal crosscut is to be led jointly by CLIVAR and GEWEX. The Extremes crosscut is to be led by CLIVAR with GEWEX support. SPARC and CliC are leading AC&C and IPY respectively.

- It is recognised there is a real cost in implementing the WCRP strategy and as a result there is a need for WCRP to prioritize. This could mean reduced funding for less important activities in order to focus on high priority items in a timely manner. The JSC needs to take a lead in defining these high-level priorities – it has done this be assigning high priority to the cross-cutting issues and planning the budget appropriately. It was agreed WCRP should focus on limited number of key climate science issues where only WCRP and its projects can do the work (examples of such achievements are WOCE and the WCRP Archive of IPCC model runs). IPCC AR4 documents offer a rich source of scientific questions and gaps to be dealt with in the near-term perspective. Core Projects may have to assign lower priorities to some activities in order to implement the most important crosscuts designed to address the most pressing scientific issues. WCRP may require a plan (roadmap) for its activities including the cross-cutting topics, which would be consistent with the WCRP Strategic Framework for 2005-2015 and propose a way for the development of major issues in climate science, meet requirements of WCRP sponsors and benefit national and regional stakeholders.

- WCRP would welcome a ***consolidated agreed*** statement of all its sponsors on their major needs from climate science. An opinion was expressed that the World Climate Conference III may strongly contribute to the determination of a sound way forward for WCRP.

- Several JSC members repeatedly highlighted the very important role of the WMO as a WCRP sponsor. It was proposed to fully utilise the potential of the WMO, its regional activities, the World Climate Programme and START in addressing the needs, interests and building capacity in developing countries. High priority should be given to regional climate predictions and the ability to produce them by individual nations, especially by developing countries. The La Plata Basin and AMMA projects can serve as examples of successful initiatives.

- Despite significant recent advances in climate research, its continuation is required to evaluate and where possible reduce uncertainties in climate prediction. The need for this research is well understood by the WCRP community but a case supporting it that would be convincing for funders and taking into account identified needs of stakeholders and end users has not been made adequately. To some extent the failure to make a convincing case to funders and decision makers is related to low priority historically given by WCRP to issues of visibility, promotion of WCRP as a program, getting adequate credit for achieved results, especially with respect to anthropogenic climate change and research contributions to IPCC assessments.

- WCRP should not only work to increase its funding, but it should also target development of an adequate environment and infrastructure for successful climate research and prediction, which includes a supercomputing capability for using next generation of climate models, process studies and a sustained climate observing system. WCRP is now required to not only pursue the issues of climate predictability and prediction, but also ones related to climate change impact, adaptation and mitigation.

- A number of views were expressed that WCRP has grown by accretion, that the world has evolved and that WCRP as a whole (including its structure) needs to evolve. At the same time there was need for stability to ensure continued progress.

- The group agreed that WCRP had many overlapping and complementary interests with IGBP. These interests require a concerted and coordinated action by both programmes. Several JSC members agreed with the idea of merging the two programs within 3-4 years. Several JSC members expressed various concerns about it. The JSC agreed that:

- advancing, together with IGBP, of several highly important crosscutting activities will help to increase collaboration and this could form the ground for testing the future merger and its options,
- any future possible merger should be preceded by identification of and agreement on common key scientific goals and can be only science driven, and
- a consolidated view of WCRP sponsors should be sought on the issue of merger.

- The twin foci approach that has been the hallmark of WCRP activities and development is reiterated.
  - The first focus, dealing with predictability and prediction of climate variability and change for time scales from days to decades, and at various spatial scales, has a strong connection with the meteorological, oceanographic and hydrological research and operations. Thus, cooperation with NWP, WWRP, and a focus on seamless prediction will be essential.
  - The second focus, dealing with the human impacts on climate, requires greater interaction and joint work with IGBP.

WCRP core projects will have to define carefully how they contribute to these two major thrusts of WCRP work.

- JSC expressed concern that the Directors of Core projects IPOs were not present at the session. The JSC received the letters by the core projects and CLIVAR Co-Chairs and IPO Directors. [These letters appeared very late, were not on the list of documents made available prior to the meeting, and thus could not be discussed adequately. Early tabling of documents and letters is highly recommended for the future JSC meetings.]

Actions: A1 and A2 (see Appendix B)

FUNCTIONING OF THE JSC AND JPS

With many new members and changes occurring within WCRP, the JSC elected to meet to discuss their role without the Director of the WCRP, but with representatives of the three sponsors present.

Selection of the JSC, JSC Chair, Vice-Chair and Officers and Director of WCRP

The Agreement governing the WCRP makes it clear that the three sponsors select the JSC members, with new terms commencing from 1 January. JSC Members and representatives of ICSU and IOC were unclear as to the process that occurs within WMO before nominations were forwarded to ICSU and IOC.

The Agreement governing the WCRP makes it clear that currently, the Chair, Vice-Chair and the three Officers are elected by the full JSC every two years.

The Agreement governing the WCRP makes it clear that the appointment of the Director of the WCRP is by consensus agreement between the three WCRP Sponsors (WMO, ICSU and IOC), being cognizant of the recommendation of the Officers of the JSC. In 2005, consultation occurred with the Chair of the JSC.

Recommendations:

- Prof. Thomas Rosswall to approach WMO for greater clarity on the internal selection process of JSC candidates.

- The Chair of JSC should get feedback from the three sponsors on the selection of JSC members.

- The JSC recommended that in future the Chair of the JSC should be a member of the Selection Panel for the Director of WCRP.

Responsibilities of the JSC and Director of WCRP

The duties of the JSC and its Chair are outlined in the Agreement governing the WCRP. Briefly, the JSC responsibility is:

- To formulate the concept and scope of WCRP, including defining the strategy, scientific objectives and priorities;

- To review progress of WCRP and report on progress to the sponsors;

- To facilitate exchange of information;

- To prepare budget estimates for activities of the JSC and its supporting staff in the following biennium.

Several attendees at the session expressed disappointment that the budget information was inadequately explained for them to have a clear understanding of how the budget had evolved over recent years and how it is likely to evolve in the near future. This makes the job of approaching government representatives for enhanced funding of WCRP more difficult.

There was concern about the significant decrease in funds available for activities and agreed that it would be desirable to have greater flexibility to transfer funds between salaries and activities (on at least a temporary basis). The Director (through WMO) is responsible for the implementation of the budget.

The JSC recognized that there were valuable resources within the JPS based in Geneva and elsewhere as well as the staff in the various IPOs. The JSC wished to see these resources used optimally as a single integrated entity. Telephone conference calls/video conferences offer opportunities to get greater cohesion across all of WCRP staff. Suggested names for this group included 'WCRP Joint Planning and International Offices Staff' or 'WCRP Network Management Team'. Tasks would include overall management and integration of cross-WCRP effort, including coordinated approach to funding for activities, data management, activity management etc (and including identified "Activity Managers" for Cross Cutting Activities).

It was agreed that the JSC does not have a direct role in the management of JPS and IPO staff and that WMO staff have existing mechanisms to handle management issues.

It was also agreed that to fulfill their obligations in formulating the WCRP strategy that future JSC Meetings should include time for members to meet with the Director and representatives of the sponsors but without the broader WCRP participants.

Decision:

- Chair of JSC should request the Secretary General of WMO to increase activity funds, at the expense of the staff budget on a temporary basis.

- JSC requests the Director to prepare simple and transparent budget of how the WCRP income and costs had evolved over the last four years and expectations for the next few years. In addition, The Director, in consultation with the Officers of the JSC, should propose a formal budget with income/expenditure at a level of detail that will make it possible for the JSC to make strategic decisions on an annual basis. This should be annual budgets for the past two years, the current two years and projections for the coming two years; i.e., a rolling six-year budget (on an annual basis). These budget documents should be available shortly after the upcoming WMO Congress.

- The JSC should be kept informed on budget issues, particularly in relation to any exceptional issues or major unanticipated expenditures.

- The Director of WCRP should take the lead in forming the JPS and IPO staff into a single cohesive WCRP support team with a clear definition of roles and responsibilities and regular (perhaps monthly) teleconferences between Director of WCRP and IPO Directors and face-to face meetings on an opportunity basis. The JSC should be advised of the roles and responsibilities of JPS Staff.

Actions: A3, A4, A5

III. FUND RAISING: MAIN POINTS OF THE DISCUSSION SESSION:

After a brief introduction on the current budget status, J. Shukla led a discussion on fund raising options for WCRP. The main points in the discussion (and in the budget paper for the meeting) were:

- The order of the global change research annual funding is approximately USD 5 Billion. Coordination activities cost approximately 1000 times less. They represent a very effective investment in optimisation and facilitation of the global change research. Nevertheless, all Global

Environmental Change Programs experience severe shortage of funds. GEC programmes may require a "family strategy" of fund raising.

- Precise understanding of the WCRP past and current budget was not achieved at the JSC Session. The estimates in working documents and/those presented by the sponsors were somewhat conflicting. However, one basic conclusion is clear; that is in order to maintain a steady level spending on WCRP activities, an addition of at least 500 K Swiss Francs was required. Implementation of the WCRP Strategy for 2005-2015, which involves crosscutting activities to fill significant gaps existing in the WCRP, requires a significant increase of funds.

- Factors affecting the overall situation are:
    - Increase in salaries due to both salaries growth and a small increase in number of posts occupied.
    - Reduced USD exchange rate against Swiss Franc.
    - Level funding from WMO and other funders.
    - Over the last several years WCRP has utilised reserves built up during the 1990s. These are now exhausted.

ICSU will now seek annual contribution from countries with the same numbers of Euros instead of USD and will try to apply an inflation rate coefficient. Probability of success in doing so is unknown.

- When the USA returned to UNESCO as a Member, the USA contribution to IOC funds was directed to UNESCO. IOC started to receive a smaller fraction of that payment and this made it impossible for IOC to support WCRP at previously expected level of USD 250'000 annually, which had never been achieved. Nevertheless, in 2005 the IOC Assembly reviewed the WCRP activities and agreed to contribute to WCRP Joint Climate Research Fund (JCRF) USD125'000 annually from its regular programme funds. Continuation of IOC sponsorship depends on demonstrating the relevance of WCRP and its work to the IOC Members States. IOC values its involvement into WCRP because it is its strongest link to the global science. To maintain the current level of IOC support, WCRP will need to continue convincing IOC Members States of its value. The only possibility for WCRP to increase support from the IOC is to be successful in stimulating contributions to the IOC Special Fund for WCRP.

- WMO is by far the major sponsor of WCRP. The future contribution from WMO will be nearly the same depending on the decisions of the WMO Congress, which will meet in May 2007 and determine the WMO Budget for years 2008-2011. Most of the WMO programs except for Disaster Preparedness and Mitigation Programme and Space Programme should expect certain cuts in budget. Even in order to maintain level support for WCRP, WMO Members will need to see clearly the value of WCRP research for NMHSs.

JSC considered three main lines of action for work on increasing the budget:

- Communication to PRs and Members States of WCRP sponsors and attempts to convince them of the need to increase funding. Promotional materials and clear explanation of the situation and consequences of reduced funding for climate research and prediction should be given to them in a convincing way.

- Approaching Global Environment Facility (GEF). Discussion revealed little likelihood of success of generating support for programme coordination activities from the GEF but JSC agreed that producing a pan-WCRP plan/strategy of working with GEF in support of developing countries and regional activities could be fruitful.

- If it is impossible to increase contributions to JCRF, a possibility of seeking secondments could be useful, especially if the seconded personnel are based in Geneva. Under some circumstances it is possible some staff salaries may be exchanged for activities, perhaps on a temporary basis. Cutting costs should be done in a controlled manner and this requires better information and more understanding of staffing costs vs. activities.

- Space agencies have high interest in climate science and may represent a target for seeking secondments. Equally, the European Commission may be approached.

It is naïve to think that the WCRP sponsors alone can fill the budget deficit and additional fund raising is necessary.

All participants in the JSC meeting congratulated and expressed there thanks to the Director and her staff for their efforts in raising the visibility of WCRP over the last 15 months.

Recommendations:

- Include an item on preparing proposals for fund raising in agendas of future JSC sessions.
- JPS should work more on fund raising for WCRP.
- WCRP should start preparing "packaged proposals" that have tangible deliverables and attempt to "sell" them. For exciting proposals money can be gained!
- Try to develop activities, representing such a high interest to stakeholders so they will not require WCRP funds; E.g., recent Sea Level Rise (SLR) workshop did not use WCRP funds; costs of publishing SPARC Newsletter are covered outside of SPARC, CliC held a major Symposium of Cryospheric Indicators of Climate Change with almost no WCRP core expenditures.
- It is essential to calculate not only "central" funds and funds available to IPOs and their activities but also in-kind contributions to WCRP activities. A record of such contributions should be initiated at the project level and be kept in future.
- Work more actively generating acknowledgement and appreciation in the WMO system. The local PR with WMO and other important national stakeholders of main WCRP sponsors including funders of environmental research should be invited to future JSC Sessions.
- Availability of resources is an important component in setting of achievable priorities.

.
- Consider a possibility of acquiring another sponsor.
- Focus on WCRP visibility and expand the efforts in this area, which started to develop in 2006.
- Work with policy makers at the national level.
- Explicitly ask for more funding!
- Inviting representatives of space agencies since these are the biggest consumers of the national 'climate' budgets.

Recommendation: B1

Actions: B2 –B4

IV. WCRP REVIEW OF CROSSCUTTING ACTIVITES (BEGAN ON 25 MARCH AND WAS CONCLUDED ON 29 MARCH 2007)

Anthropogenic Climate Change (ACC)

Presentation was made by V. Ramaswamy. Main points of discussion were as follows:

ACC should become a continuing cross-cutting activity reporting to JSC but drawing heavily on all Projects, Panels and Working Groups. All WCRP projects need to deliver to ACC.

- ACC should be implemented jointly with IGBP and cooperation needs to be started without any delay.
- IPCC contribution: WCRP played a major role in AR4, and we expect it will play a major role in contributing to AR5. Planning use of scenarios in AR5 has already started. IPCC recognises that WGI and III communities should work much more closely than in the past. AR5 benchmark scenarios will be produced very early in the process. There is an IPCC-sponsored Emissions Scenarios meeting in September 2007 to lay down what scenarios will be run for AR5 and the associated timelines. The climate community (including biogeochemistry, modeling and impacts)

need to have a clear understanding of their requirement by that time. It is critical that WGCM and AIMES community are centrally involved in decisions on future scenarios at this stage.

- The successful work of WCRP on ACC and its critical contribution to the success of the IPCC Assessments including the AR4 is undisputed. Nevertheless, it is in the area of climate change research where the issue of lack of WCRP visibility was the most apparent and serious. A WCRP Communications Strategy needs to be developed centred on ACC but serving the entire Programme.

- Need to ensure that ACC is more than "running models" and delivering results only "for IPCC". Models have limitations e.g., deficiencies in the representation of processes and unforced natural variability. Therefore there is a need to develop plans for relevant high-quality observations and their analysis, improve the parameterizations and formulate robust metrics for models. There needs to be a concentration on the science to estimate and reduce the uncertainty of climate projections and detection-attribution. It is essential that ACC give adequate attention to all of the scientific challenges.

- There is a need to work with sponsors, major stakeholders, and funders of environmental research and "educate" them about existing uncertainties in climate predictions and the need to continue investigating them systematically. Without delay, WCRP will need to work on a plan to estimate and address gaps in AR4. This plan needs to be made widely known.

- The WCRP not only needs to continue addressing gaps in fundamental climate science but is expected to start work on the science supporting preparedness and adaptation to climate change and consideration of what mitigation is required to avoid particular negative consequences.

- The ACC should also try to build capacity of regional institutions, making information about climate projections available and easily accessible worldwide, and engaging in particular scientists from the developing world.

- The JSC group responsible for further development of ACC is H. Le Treut (Chair), V. Ramaswamy, G.Flato, D.Griggs, and J. Church

Decision:
Approve the ACC crosscutting initiative to be led by a JSC group facilitating / coordinating ACC activities in WCRP, with support from the WCRP Support unit at IPSL, Paris, France. This group needs to develop an action Plan that will ensure timely deliverables.

Actions: C1 – C3

Atmospheric Chemistry and Climate (AC&C)

Presentation was made by T. Peter and T. Shepherd.

Main points of discussion were as follows:

- AC&C is a remarkable example of gap filling and working with existing projects. It has shown excellent progress since the Pune JSC-27 meeting. AC&C has a clear plan of work. This is a truly joint WCRP and IGBP activity co-ordinated by SPARC and IGAC projects. AC&C gives high profile to WCRP and IGBP.

- AC&C may have gaps in cooperating with GCSS of GEWEX and VOCALS of CLIVAR especially in the domain of interaction between aerosols, clouds and precipitation.

- A concern was expressed that with IPCC AR5 moving ahead with making new scenarios AC&C would not be able to come up with significant output in time. Nonetheless, AC&C should keep itself informed about the relevant developments regarding AR5, with synergistic interactions with ACC topic also to be considered.

- M. Beland proposed to interact more with real time activities like chemical weather forecasting. S. Gulev proposed to involve SOLAS to address lower boundary conditions over the ocean. J.-F. Fellous mentioned links to IGACO and the new CEOS initiative on building of a satellite constellation on atmospheric chemistry. Also, AC&C is requested to consider benefit of close cooperation with WMO AREP, and some other programmes like GEMS.

- Currently there is only glue money from IGBP and WCRP funding for AC&C but participants expressed readiness to seek new resources for implementation. JSC endorsed AC&C ideas for greater visibility and recommended considering such activities as side events at SBSTA.

- The JSC group responsible for further oversight of AC&C is V. Ramaswamy (Chair), L.A. Ogalo, J. Marotzke, and P. Cornejo.

Decision:
Approve the scientific directions of the AC&C. Recommend that it remains a joint activity of the WCRP and IGBP led by the SPARC and IGAC projects. Its day-to-day management should be provided by the IGAC IPO with the SPARC IPO and JPS for WCRP. Outreach activities of AC&C should be initially organised through SPARC and IGAC but JSC supports AC&C plans of its own outreach (website, publications in EOS, etc.)

Recommendation C4

Monsoons

Presentations were made by G. Wu (assisted by R. Lawford and H. Cattle), Yasunari and J. Shukla.
Main points of discussion are as follows:

- There is a large number of national and multi-national monsoon programmes and activities. The idea of holding an International Monsoon Year (as component of an International Monsoon Study 2007-2011) created interest and the support of the JSC.

- A need to build an integrated view of global monsoon systems was expressed by several participants. There is an even stronger need for increased coordination between the many regional monsoon activities.

- It was recommended that a short term task team (one year) be appointed (Chairs B. Wang and J. Matsumoto) to develop a 5 year Implementation Plan, building on and integrating the existing plans for Year of Tropical Convection (YOTC) (joint with THORPEX), the Asian Monsoon Year and to ensure the monsoon data sets are exchanged and appropriately archived and that the appropriate modelling studies are pursued.

- Strong links with THORPEX should continue to be developed through YOTC.

- The Implementation Plan should have a global focus, integrating the various regional studies and giving them coherence.

- The consensus was that the crosscut should be deeply rooted in CLIVAR and GEWEX projects.

- CLIVAR and GEWEX should organise further pan WCRP workshops building on the progress of the first pan WCRP Monsoon Workshop.

- The JSC group responsible for further oversight of Monsoons is G. Wu (Chair), J. Slingo, T. Yasunari, C. Vera, L. A.. Ogallo and J. Shukla.

Decision:
Endorse the WCRP crosscutting Monsoon Initiative. The JSC commented that the monsoon crosscut should include all the monsoon groups with a broader perspective, led by CLIVAR and GEWEX with participation of SPARC, CliC and WGNE and several activities outside WCRP (particularly THORPEX). Request CLIVAR and GEWEX to agree on how it will be supervised and the development of an implementation plan. The proposals for and concepts of an Asian Monsoon Year and an International Year of Tropical Convection should be considered as components of an International Monsoon Study 2007-2011, a 5-year strategy of WCRP monsoon research, which would include issues related to the East African Monsoon, capacity building and application of observations and predictions in monsoon regions for societal benefit. GEWEX and CLIVAR to rationalise the number of monsoon committees.

Action: C5

Decadal Predictability

Presentation was made by T. Palmer. Main points of discussion were as follows:

- Overwhelming support to the idea and to the proposed initial and cautious approach to the implementation of a decadal predictability experiment.
- Recommendation to consider making data on model runs available to a wide range of users and try to demonstrate to a wide range users community the magnitude of decadal variability.
- JSC was very much interested and agreed with the idea to explore the synergy between decadal and seasonal prediction, on one side, and IPCC type of predictions (e.g., AR5 simulations) on the other side.

Decision:
Endorse this initial and exploratory WCRP decadal prediction proposal. It will be led by a small Task Force organised under the CLIVAR Project and involve all other WCRP core Projects and draw on other Projects and Working Groups. Guidance from JSC on further development of the proposal should be sought in the next phase. At its initial planning the Initiative should consider in more details the proposed experiments and further development should be elaborated based on the results of these experiments. The initiative should also consider developing a communication strategy contributing to the overall WCRP communication Strategy to ensure high visibility of WCRP. An opportunity to make the model data available to a wide range of users should be explored. Involvement in the decadal prediction initiative of the research on seasonal prediction and IPCC type of modelling was recommended.

• The JSC group responsible for further oversight of Decadal Predictability is J. Marotzke (Chair), C. Vera, I. Wainer, and J. Shukla.

Recommendations: C7
Action: C6, C8

Extreme Events and Climate

Presentation was made by A. Busalacchi. Main points of discussion were as follows:

- Overwhelming support to the initiative and a very wide range of existing and possible activities in the domains of climate extremes and impact of climate change on extreme weather were apparent from the discussion. There are also links of these activities to the current interest of decision makers in the impact of climate change on human activities and environment, and needed adaptation to it and mitigation of its negative consequences.
- A need to develop a widely accepted definition for climate extremes was shared by JSC.
- Concern was expressed that extremes should be pursued through improved understanding of climate variability and how it was changing.
- A very wide range of potentially interested parties and stakeholders including (re-) insurance and industry were indicated.
- The discussion made it clear that the proposed initiative touched on almost every aspect of WCRP. At the same time, significant differences in how WCRP core projects saw the context and foci of a possible WCRP climate extreme initiative were apparent from the proposal document and interventions of the meeting participants. The research on climate extremes requires more coordination, cooperation, a potential framework, which WCRP is capable of providing through a crosscutting initiative.
- A need to involve regional centres and identify regional foci was indicated.

- This initiative will be relevant for UNFCCC and SBSTA. Linkages to NWP, seamless prediction, THORPEX, WMO Disaster Preparedness and Mitigation Programmes, WCP, and many others were suggested. The area of climate extremes is prone to duplication of efforts and caution should be exercised to avoid it.

- Existing activities and networking efforts, especially by WCRP JPS and CLIVAR, were noted with satisfaction and their continuation encouraged.

- Some members of the JSC considered the proposed initiative mature enough and proposed establishment of a full scale WCRP crosscutting initiative. Some JSC members tended to agree with the view of that at the initial phase only a small scoping team should be established.

- The JSC group responsible for further oversight of Extreme Events is A. Busalacchi (Chair), K. A. Anaman, D. Griggs, and L. A.. Ogallo.

Decision:
Endorse the WCRP crosscutting Initiative on Extreme Events and Climate. It will be led by a small Scoping Team to be organised by GEWEX and CLIVAR and reporting back to the JSC in 2008. Its day-to-day operations will be supported by mainly one of the two project offices and WCRP JPS. Momentum of current activities should be preserved. Foci of the outreach activities, networking and communications strategy should be worked out as soon as the scope and shape of the Initiative become clearer. A Workshop on Climate Extremes should be organised in 2008 (or 2009).

Action: C9

International Polar Year 2007-2008 (IPY)

Presentation was made by B. Goodison. Main points of discussion are as follows:

- The JSC expressed satisfaction with the achievements in the IPY planning, the active role the WCRP played in the preparations of IPY, and the wide scope of planned WCRP – related IPY activities. JSC agreed with the main objectives of WCRP participating in IPY and a need to contribute towards making a more coherent program from still not fully coordinated set of IPY projects but it recognised that not all of them yet know whether funding would be available.

- Discussion touched the issue which activities were WCRP or WCRP related and how WCRP could claim parentage of an initiative.

- Participation of scientists from low-latitude countries was noted with satisfaction and wish of the ICSU-Africa office to be better informed of IPY noted.

- Foci of further WCRP participation in IPY could be the work on IPY legacy in terms of observing systems and data and modelling aimed at better understanding of predictability at various time scales and role of Polar Regions in it.

- The JSC group responsible for further oversight of IPY is S. Gulev (Chair) and I. Wainer.

Decision:
Endorse continuation of WCRP participation in IPY as a WCRP crosscutting activity to be led by CliC. Day-to-day operations should be supported by CliC IPO and JPS WCRP. Recommend work on coordination of IPY legacy in terms of observing systems, in association with the IGOS Theme on Cryosphere and GEO. Active participation in the IPY outreach activities aiming to achieve better WCRP visibility, and continuation of efforts towards harmonising the IPY programme of activities so that it would contribute to better understanding of predictability of polar processes and better predictions on a wide range of time scales was encouraged.

Recommendation: C10

Sea-Level Rise (SLR)

J. Church briefly reported on a very successful SLR workshop in Paris in June 2006, its Statement, which was made available to the JSC, and output in form of a book to be acquired and sent to countries. A follow-up workshop to be coordinated by LOICZ is in the initial planning stages. JSC agreed to become its sponsor but not a direct funder, subject to a more detailed and appropriate plan for the meeting and identification of an appropriate steering committee. WCRP should encourage the Workshop to be held at UNESCO headquarters in Paris with support from IOC. The day-to-day operation to be supported through WCRP JPS.

- The JSC member responsible for further oversight of Sea Level Rise is J. Church.

Decision:
Ensure the recommendations from the 2006 Sea-level Rise workshop are communicated to all WCRP Projects and Working Groups with encouragement to act on the recommendations as appropriate.
Cosponsor (subject to the development of a detailed and appropriate plan) but without funding the WCRP Sea-Level Rise Impacts Workshop being planned by LOICZ and other participants.

Actions: C11- C13

Recommendation: C14

Seasonal Prediction

Presentation was made by T. Palmer on behalf of B. Kirtman. Main points of discussion were as follows:

- General satisfaction with the progress and anticipation of a successful outcome of the Barcelona meeting in June, 2007.
- Noted interest in getting access to experimental runs data, especially by developing countries.
- Confirmation of successful cooperation with THORPEX and fruitful contribution to the initiative by all WCRP projects.
- Potential need of harmonisation of reporting of WGSIP, TFSP, joint work with THORPEX and WWRP, and Decadal Predictability initiative, also taking into account the roles of WMP and WOAP.

Decision:
TFSP succeeded in formulating its approach and stimulating activities and interest to them. After the Barcelona workshop (June 2007), its activities will be included in the WGSIP. There is a need to ensure the continuation of CliC, GEWEX and SPARC participation in seasonal prediction activities to be coordinated by WGSIP.

Recommendation: C15

V. AFRICAN NETWORKING DAY

Efforts are underway to publish the poster presentations made at the African Networking Day in a special issue of the International Journal of Climatology.

Action: D1

VI. REVIEW OF WCRP CORE PROJECTS

Global Energy and Water Cycle Experiment (GEWEX)

Presentation was made by S. Sorooshian. His main points were:

- D/WCRP is to be commended for the WCRP JPS excellent job of outreach and attempts to promote and enhance the visibility of WCRP. The success and visibility of WCRP projects in many places around the world can also serve to further this cause.

- The tie between JPS WCRP in Geneva and the IPOs should be encouraged and strengthened. Disruption in continuity of a designated JPS individual for GEWEX has not been helpful and should be given serious consideration.

- Attention to the projects (at least attending the SSG meetings) should be a key function for WCRP Director or a WCRP JPS individual.

- JSC members may benefit from attending one of the project SSG meetings to get an appreciation for the range of WCRP activities.

- Try to stabilise the WCRP. Potential adverse impacts are already seen (attracting candidates for the IGPO director position).

- JSC may wish to review its role and its ToR with respect to its oversight of projects and WCRP. (Example: what is the formal arrangement with IPOs? To whom are the project Offices accountable and to whom do the IPO directors report?)

- Thanks to be expressed for the sustained NASA support and partial support of NOAA to GEWEX.

Main points of discussion were as follows:

- Energy and water crisis theme is demand driven and needs further consideration and approval by JSC.

- Operational modelling and stakeholders links are not strong enough; however, GEWEX science is working well.

Recommendation: E3

Actions: E1 and E2

Climate Variability and Predictability (CLIVAR)

Presentation was made by T. Palmer and J. Hurrell. Their points were:

- Along with the WCRP JPS, the IPOs represent a major and only full-time staffing resource to carry through WCRP business. Indeed the IPOs are a tremendous resource within WCRP, and WCRP cannot afford to loose it.

- The IPOs have a long tradition of working well with the JPS but historically the JPS and IPOs have not operated as a fully integrated management team. The IPOs also have a long tradition of working with the wider science community in the fields of climate science they cover.

- IPOs are funded through individual national funding which will be lost to WCRP if they close through having no clear and defined role within the future structure of WCRP.

CLIVAR requested JSC

- That CLIVAR has (joint) leadership role in the following crosscutting activities:
    - Decadal Prediction
    - Extremes
    - Monsoons
    - ACC

- That the percentage of the budget allocated to CLIVAR from the crosscutting budget will allow it to execute these new activities in the light of the proposed cuts.

- That either JSC should affirm that a major reorganisation will take place in the coming 2-3 years, in which case CLIVAR will go into "legacy mode" and major activity on the specific crosscuts will not take place, or JSC should re-affirm that no wholesale reorganisation will take place until 2013, and that this date remains the sunset date for CLIVAR. This issue is recognized as important and will be further pursued at the next JSC.

There was discussion about WGCM. The WGCM will continue under joint control by JSC and CLIVAR, with further discussion to take place at CLIVAR SSG and WGCM meeting.

Note: The JSC decisions with respect to leaderships of crosscutting activities and budget allocations are in section II.

Stratospheric Processes and their Role in Climate (SPARC)

Presentation was made by T. Peter and T. Shepherd. Their main points were:

- Need to link SPARC to various crosscuts (ACC, extremes, seasonal to decadal prediction) besides AC&C.

- A science plan is being developed to re-do the C20C simulations with "high-top" (enhanced stratospheric representation) models.

- SPARC reiterated that the project could be formally closed when the stratosphere is considered and represented as part of a coupled system with the troposphere ("one atmosphere") in models and analyses; this is now beginning to happen although there is still considerable ground to be covered. Looking ahead, all of SPARC fits thematically into one of two WCRP cross-cutting topics: ACC (via AC&C, with IGAC/IGBP) and various activities on predictability.

Main points of discussion were as follows:

- SPARC has to be involved in the International Year of Tropical Convection.

- SPARC visibility is impressive through tractable results and highly cited publications.

- SPARC has shown the value of directing own resources to joint actions, e.g. ozone assessment models and successful contributions to the WMO/ UNEP Ozone Assessment (2007).

- SPARC has shown good examples of making WCRP better.

- Data assimilation activities could involve both operational and research groups, especially in relation to IPY.
- TFSP benefited from the studies on dynamical interaction of stratosphere and troposphere including research on sudden stratospheric warmings and coolings.

Climate and Cryosphere (CliC)

Presentation was made by B. Goodison. His main points were:

- Major achievement of cryospheric community is the special chapter in the IPCC Fourth Assessment (WG I) and significant insight into cryospheric changes in the report by WG 2.

- The main goal of CliC and WCRP in IPY is to close or significantly reduce the existing gaps in our knowledge of polar processes and in our ability to predict at the poles and their influence on the rest of the globe at a variety of important time scales.

- CliC is the only project in the ESSP family with a cryosphere focus.

- Knowing base budget is essential to deliver global program and be a credible partner able to do networking for WCRP and CliC.

- CliC will work with other projects on crosscuts and is ready and willing to continue leading the WCRP crosscut on IPY.

- CliC achieved progress in observations and is now strengthening its modelling capability.

- CliC is strengthening regional activities especially in Asia, with further effort on South America and developing countries.

- Support of WCRP JPS in developing and delivering CliC to the global community has been invaluable.

- CliC will continue to strengthen working relations within WMO. As a legacy of IPY, should there be a strengthening of the focus on polar science in ICSU and WMO?

Main points of discussion were as follows:

- Attention was drawn to high uncertainty in melting rate of glaciers and a need to address it in a science program.

- Concern was expressed about ice-sheet stability research. Could CliC and WCRP take the lead and progress the science? E.g., there is a need to strengthen the 3-D models of ice sheets and link this community to the observational community.

- Amount of snow and its melt is very important for modelling; e.g. global snow depths data sets this would be very useful to enhance model and predictability studies. Algorithms are being developed, some with satellite info, but not feasible in the alpine regions with current satellite technology.

- JSC supported stronger links with UCCS of IUGG.

- JSC commended CliC on the progress of the IGOS Cryosphere Theme.

Recommendation: E4

VII. REVIEW OF WCRP ACTIVITIES

WCRP Observation & Assimilation Panel (WOAP)

K. Trenberth briefly presented WOAP. It is a crosscutting activity supporting implementation of WCRP Framework Strategy. He expressed concern that it had been given no budget in the future financial period. He referred to a preliminary agreement with GCOS indicating that because the relevance and value of WOAP are high for GCOS, it agrees to be a junior (smaller) cosponsor of WOAP while WCRP is the “senior” one. GCOS Panels (e.g. OOPC) consider WOAP as a primary way to see where the research observing systems stand. WOAP has been active in working with GCOS, CEOS, GEO, and Reanalysis workshops. WOAP was the primary WCRP mechanism to propose the reprocessing initiative. It made important steps to secure support for climate sensors on NPOESS. It works now on the 3rd Reanalysis Conference and has established a Task Force on Data Management in WCRP and a Working Group on Reanalysis Observational Data Sets. JSC requested WOAP to start reviewing data sets needed for successful implementation of WCRP crosscutting activities. There was support for continuation of WOAP, cosponsored by GCOS.

WCRP Modelling Panel (WMP)

J. Shukla briefly presented WMP. Its main focus has been the seamless prediction strategy for WCRP and it is the only panel working with all modelling panels of WCRP. He indicated the existing challenges in front of the modelling community such as climate prediction, regional downscaling, need to resolve convection and clouds. His main idea was to advocate for production of a several clusters of supercomputers capable of addressing the climate prediction problems and as well long-term forecasting.

JSC discussed the idea of development of few exceptionally powerful clusters of supercomputers, need to have model development and developers better supported, use of model ensembles versus developing one best universal model and the strategy of seamless prediction. It is clear the modelling community has not yet reached consensus on the way forward although there were some common elements. This led to a proposal to hold a WCRP modelling summit and to develop a future WCRP modelling strategy answering the question where we will be in 10 years. This would be the last activity organised by WMP in its present form.

Decision:
JSC recommended some revisions in the WMP report. The revised report is included.

Recommendation/Action: F1

Working Group on Numerical Experimentation (WGNE)

M. Miller briefly presented WGNE, which is a joint working group with WMO CAS. He noted the importance of metrics for climate models, mentioned difficulties in modelling the diurnal cycle and the need for much higher resolution climate models. There was an agreement to include metrics and parameterisation issues in the WCRP model summit (see above, WMP). These metrics could help identify models that would have a level of sophistication and accuracy required for future assessments and exclude models not complying with the minimal requirements. The JSC agreed that there was a window of opportunity for reviewing and advancing model development in view of the fact that many institutions are in the process of preparing their models for climate simulations for a possible AR5.

Recommendation: F2

Surface Ocean-Lower Atmosphere Study (SOLAS) - Working Group on Surface Fluxes (WGSF)

S. Gulev briefly presented SOLAS and WGSF. WGSF achieved success in reinvigorating SURFA, jointly with WGNE, and the first flux NWP data started to be acquired by NCEP. A Handbook on flux observation was published. WGSF publishes its FluxNews and has produced three issues. Two major reviews on gas and particle exchange are being finalised.

Merging WGSF into SOLAS was not recommended because their scopes do not match sufficiently well. Therefore, a need to accommodate the flux work in the WCRP program and embark on global (i.e. including land) fluxes was indicated. No solution was agreed at the session.

Action: F3

Earth System Science Partnership (ESSP)

M. Rice praised WCRP including its core projects for the contribution to the ESSP Open Science Conference (OSC). The ESSP Joint Project on Global Environmental Change and Human Health (GEC&HH) was launched.

Monsoon Asia Integrated Regional Studies (MAIRS)

Ailikun introduced this project, which was the first ESSP Integrated Regional Study. The main topic is how humans impact the monsoon (through ACC) and its feedback onto society. A Science Plan is available. This group could contribute to WCRP-ACC. A request was made for a good climate model with information on the uncertainties. Also, it was announced that MAIRS would hold an International workshop on anthropogenic and climate change impact on monsoons in Asia. JSC encouraged MAIRS to develop more cooperation with the ACC and Monsoon crosscutting activities and for the WCRP Monsoon groups to serve the needs of MAIRS for climate information.

Working Group on Coupled Modelling (WGCM)

Its work was briefly commented by G. Flato. An earlier discussion on WGCM took place in the course of CLIVAR presentation. Their next meeting will be in September 2007. As recommended in the section on CLIVAR, WGCM should continue to be jointly supervised by JSC and CLIVAR. Perhaps Modelling Summit will provide further guidance on this point.

Global Water System Project (GWSP)

L. Dumenil Gates presented the project. GWSP is science driven but policy relevant. It brings together multidisciplinary aspects required to quantify the impacts of humans on the water system and vice versa. The first project data including global water maps have become available on the Internet. Answering JSC members' questions L. Dumenil Gates also indicated the active role of the GWSP in the special AR4 follow-up report on water and systematic efforts of developing an efficient joint program of work with GEWEX. This may help GEWEX to better address the human dimension aspects.

VIII. REVIEW OF PARTNER ACTIVITIES

Global Climate Observing System (GCOS) (including Ocean Observations Panel for Climate (OOPC))

D. Goodrich introduced this agenda item. He highlighted the close ties GCOS has with WCRP in such areas as maintenance of research networks, endorsement of GUAN, and the upcoming "Learning from IPCC" workshop. Ties with the observing system panels were also emphasized. A proposal for co-sponsorship of WOAP was made, with WCRP as primary funding group, analogous to GCOS as primary funder of AOPC.

E. Harrison made a brief presentation on OOPC. His main point was that the sustained networks were largely based on support by research. The move from research to operational use of such systems was not happening. State of observations in some countries is a major concern because they may have no resources or even an agency to maintain the observing system. ARGO is a good example of such a network with the upper-ocean thermal and haline structure routinely sampled. Sponsorship of WCRP of OOPC has been tremendously helpful because there is a lot of science work (science-wise) to be done; Examples of science questions include the meridional overturning circulation, the continuing sea-level rise that needs to be reconciled with the global heat content. Problems were found with some ARGO profiles, mainly in the Atlantic. There is also a concern about an expected decline in the ocean satellite missions. GODAE finishes in 2008 but a science community making analysis of this data does not yet exist. Should it become a subgroup (activity) of WGNE? E. Harrison proposed that at the next JSC meeting a presentation on status of ocean analysis and reanalysis for the climate and the observing system be given.

Actions: G11- G13

Group on Earth Observations (GEO)

An introduction of the topic was made by T. Rosswall. There will be a GEO Ministerial meeting in Cape Town at the end of November 2007, which is seen as an opportunity to present a relevant climate research requirements document (note) by WCRP. A white paper on the seamless prediction topic could form the basis for such a paper. This should outline the benefits of improved resolution and the associated requirements for greatly expanded computing power (see the report below on the white paper). It was recommended that in the note to be submitted to the Meeting. JSC could also comment on the importance of supporting the core observing systems, which form the foundation for their subsequent integration.

Action: G14

THORPEX

M. Beland reported on the recent development in this project. One of key recent strategies of THORPEX was to develop working partnerships and collaboration with other programmes. THORPEX proposes to work with WCRP on the establishment of an internationally coordinated 'virtual computational-observational laboratory' to facilitate access to observational, experimental and operational global weather/climate databases and develop new diagnostic analysis packages and visualisation methods. The second proposal by M. Beland was to prepare a strategy for a coordinated observing, modelling and forecasting with emphasis on the organised tropical convection and its influence on predictive skill in the western Pacific and Indian Ocean. Note also that during the monsoon discussion there was agreement on support for the Year of Tropical Convection study. M. Beland proposed a small (10-12) workshop in 2007 to consider ways of achieving these objectives.

Action: G15

IX. SPONSORS' VIEWS ON WCRP PRIORITIES (IN ADDITION TO THEIR VIEWS ON WCRP FUNDING)

B. Nyenzi presented WMO's views. WMO works with WCRP through several programs and, mostly, WCP. The foci are ACC, operational data for climate models but the cooperation encompasses all climate related issues. WCP and WCRP jointly hired a communications officer. Active work is going on in the CCl/CLIVAR/JCOMM Expert Team on Climate Change Detection and Indices (ETCCDI). WCRP and WCP are organising a SBSTA side event in May 2007. WCP is working together with WCRP to better communicate IPCC results to the weather services. WCP and WCRP should promote capacity building (workshops for young scientists, etc.). The emphasis in this work is not on sponsorship of research but on investing in capacity building for climate science applications. The overall result has to be the benefit of the member nations. WCP looks forward to increased cooperation with WCRP in data management/data rescue. Other very important issues that WCP could collaborate with WCRP on are decadal and seasonal predictions, climate extremes and sea-level rise. WCP is participating in the Barcelona June 2007 workshop on seasonal forecasting. It is essential that regional WCRP activities involve NMHSs. E.g., WCRP should contribute to the WMO Regional Climate Outlook Forums.

T. Rosswall spoke on behalf of ICSU. ICSU will continue to plan and guide the development of WCRP. Best metric of WCRP success for ICSU is bringing first class worldwide scientists to their meetings. ICSU is happy with GCOS-WCRP collaboration as well as the outreach of WCRP to the IPCC community. ICSU also notes that WCRP is more visible than in the past. ICSU believes that Extreme Events should be a priority as well as narrowing the gap between developed and underdeveloped nations. It is essential for WCRP to work on contributing to the UN Millennium Development Goals. ICSU's view is that the network document has important information and it is absolutely essential for WCRP and IGBP think about a possible merger in the not too distant future. ICSU will conduct a review of the WCRP (all the global change programs are being reviewed). The review committee will probably attend the next JSC meeting. The Agreement on the WCRP Sponsorship may need to be updated. ICSU does not have an opinion on the internal organisation of the WCRP, however it is happy with the identification of the crosscutting themes and that they should evolve with the guidance and using the experience of the core projects. ICSU hopes the JSC will evolve and that it is bold enough to make the necessary changes.

K. Alverson emphasised that IOC was under pressure to adopt a more regional focus and move away from research into applications and impacts. He said that IOC highly valued WCRP for its role in climate research and particularly for its contribution to the ocean climate research and building its community. IOC is also a sponsor of some IGBP projects, and it relates very differently with WCRP and IGBP.

X. WORLD CLIMATE CONFERENCE (WCC) 3

The first WCC created WCP and WCRP, and the second WCC created the IPCC. The forthcoming WMO Congress will decide whether or not there should be a World Climate Conference 3. There is already a provisional organising committee to scope out a scientific content. The main theme will likely focus on seasonal to interannual prediction within the context of climate change. The JSC recommended that WCRP actively explore the opportunities to present highly relevant scientific subjects as contributions towards a WCC3; these may garner a high visibility. If WCC3 is approved, an international organising committee will be put together and WCRP will certainly be part of it. The JSC view was that it was essential for WCRP to consider how WCRP should highlight its accomplishments at this conference.

Action: G16

XI. WHITE PAPER – A REVOLUTION IN CLIMATE AND WEATHER PREDICTIONS

The JSC discussed the Paper and what should be the necessary WCRP steps. Despite the JSC feeling very positive about the goals of the document, it felt that there is a need to develop it further because at this stage there was still not a clear consensus that this was the best way forward across the full spectra of time-scales. Before the document goes any further there has to be a consensus within the community on the way forward. A logical move would also be to include the discussion of these issues in the agenda of the Modelling Summit and take the recommendations of this group into the white paper. WCRP should send a note to the next GEO Ministerial Meeting outlining the nature of the weather and climate prediction problem, the need for supercomputing, the need to address the seamless forecasting system and what its efficient development may entail and that a Modelling Summit is being planned to do further more detailed planning.

Reference: See Recommendation/Action: F1

XII. WCRP FUNDING 2008

The JSC commenced discussion on budget and deliverables in Zanzibar but failed to complete this discussion during the meeting. The Table below represents the status at the end of the meeting. Note the percentages are of USD 440,000 (CHF 545,000), which is the amount that was believed to be available at that time. There is ongoing discussion on the budget which should be finished shortly. The JSC recognized that these allocations represented a significant decrease in WCRP central funds available to the projects. It is possible that some extra fund will be available (including through extra contributions to the Trust Fund). Any additional resource allocation for activities should be allocated to priorities identified during JSC28, including implementation of the cross cutting activities and improving external communications.

Table

2008 Revised Proposal (AH-S 17 May 07) *******JSC should allocate funds for AGREED OUTCOMES

Assumption here is that the first CHF 545,000 is distributed according to the %s agreed by JSC-28. Any additional funds for Activites require a further JSC decision

Responsible	Activity	%	CHF	Approved	Deliverables in 2008	Background on Meetings in 2008
					CHF 545,000 is INCOME funds expected in 2008 (=US$440k at 1.24 see JSC-28 Doc 1.4)	CHF 545,000 is INCOME funds expected in 2008 (=US$440k at 1.24 see JSC-28 Doc 1.4)
JSC	JSC	14.6	79,570		NEW Funds raised (CHF200,000); Cross-cut priorities set; Budget monitored	JSC-29 Meeting, Bordeaux March/April 2008
IPSL	ACC	8.9	48,505		SBSTA inputs; Learning from IPCC report;	WGCM-ACC meeting; SBSTA-28;
	WOAP	1.5	8,175			3rd WCRP Re-analysis Conf (Jan 2008) & WOAP 3rd meeting
	WMP	1.5	8,175		Funds raised for WCRP Modelling Summit	Plan & develop WCRP Modelling Summit
				144,425		
JPS	LDCs	1.1	5,995		3 LDC persons supported to attend a WCRP meeting of relevance & their reports shared	
	ESSP	10.3	56,135			Shortfall on commitment of US$66k (past paid US$57k = CHF70,000)
	Ocean & SIDS	1.6	8,720		Stmt on impacts of climate change on coasts (esp relevant to SIDS) created & published	
	Modelling	3.4	18,530		WGNE Blue Book published	Regional modelling workshop, Trieste March; 50% WGNE meeting costs
	Sea-level	1.1	5,995		1st Conf book distributed; 2nd Sea-level rise Conf report;	2nd Sea-level rise Conf at IOC;
				95,375		
GEWEX	GEWEX Core	9.2	50,140			
	50% Extremes	1.5	8,175			
	50% IMS	3.5	19,075			
				77,390		
CLIVAR	CLIVAR Core	9.2	50,140			
	50% Extremes	1.5	8,175			
	50% IMS	3.4	18,530			
	Decadal prediction	1.1	5,995			
				82,840		
CliC	CliC Core	9.1	49,595			
	IPY	4.6	25,070			
				74,665		
SPARC	SPARC Core	8	43,600			
	AC&C	4.9	26,705			
				70,305		
Total check		**100**	**545,000**			
Unfunded at present						
	Communications				share into IPOs and also search for additional secondees	
	ICSU, IOC & WMO				Support for three sponsors, including attending meetings (e.g. ICSU Congress in 2008)	
	Chair JSC & Director travel				e.g. attendance at meetings other than those mentioned in approved funding	

XIII. MEMBERSHIP OF WCRP COMMITTEES

Secret paper ballot took take place on Wednesday 28 March 2007.
***Decision:* D. Griggs and C. Vera were elected as WCRP Officers until JSC 29.**

JSC unanimously approved T. Peter and T. Shepherd as Co-Chairs of SPARC with immediate effect. JSC congratulated them on being approved and wished them every success in moving the WCRP SPARC project towards new scientific achievements. JSC expressed deep appreciation to the outgoing co-chairs of SPARC, A. O'Neill and A.R. Ravishankara for their very successful and productive work as SPARC Co-Chairs.
Note: initial terms of service of T. Peter and T. Shepherd as will be from 26 March 2007 to 31 December 2010.

The JSC considered available proposals for new composition of the committees, panels and working groups. General dissatisfaction was expressed with very little compliance of membership proposals with considerations of geographical, gender, and age balance. The state of affairs was considered inadequate. Compositions of CliC, CLIVAR, GEWEX, SPARC SSGs, WGCM, and WGNE were approved with some changes to the proposals (see Appendix A for WCRP committees). WGSF will continue its activities with the current membership until the end of 2007 and ways to continue meaningful flux work in the WCRP should be worked out (see action F4). Terms of all WMP and WOAP were extended to 31 December 2008. Proposed compositions of AOPC and OOPC were approved. Composition of TOPC was noted.

Actions: G1, G8

Decision/recommendations: G2-G7, G9-G13

XIV. NEXT WCRP JSC SESSION

Decision: at the kind invitation of H. Le Treut, the JSC-29 will be held in Bordeaux, France, dates to be determined.

XV. CLOSURE OF THE SESSION

J. Church closed JSC – 28 session at 15:00 hrs on 30 March 2007. The local organisers, staff of the Tanzania Meteorological Agency (TMA), were thanked for the warm hospitality and help before and during the session. Certificates of appreciation were presented to the TMA officials.

Appendix A

Membership of WCRP scientific and working groups

Letter from Chair of JSC to all Core Project Chairs regarding the desirability of increasing committees' geographical, gender and experience diversity.

27 April 2006

Dear Chairs of Projects,

As you are aware, the Joint Scientific Committee (JSC) of WCRP has been discussing in its sessions over the past several years the issue of membership diversity in WCRP's subordinate groups. I refer here to the gender and geopolitical diversity, which our cosponsors, particularly our key sponsor, the WMO, are keen to see enforced in WCRP's various committees. Unfortunately, when one looks at the current composition of WCRP committees, one doesn't see the expected gender and geopolitical diversity, nor any signs that it is going to happen in the near future if no deliberate and serious efforts are made now. What one sees is a skewed distribution in memberships; some of our committees look more like regional committees rather than international ones. This has attracted strong adverse criticism from our sponsors.

We now need to seriously address this concern of our sponsors. It is time for us to take a serious view of this issue and to rectify the imbalance in membership distribution. This demands that we ask what the WCRP committees are supposed to do? In addition to their major responsibility of providing expertise, both technical and management, for planning, implementing, monitoring and successful conclusion of various WCRP projects, the committees are also responsible for capacity building in developing regions of the globe. Although we have a long way to go in this, especially in achieving gender equity, a beginning must and should be made. I therefore strongly urge you to consider the following when you review memberships for your committees:

1. Try to include more female scientists.
2. Try to include more people from WMO regions other than Regions IV (N. America) and VI (Europe). These people should be included for the scientific expertise and also in the spirit of training them so that they evolve into international experts.
3. There should be at least one young person (under 35 years) who joins the team to learn how it works and bring youthful ideas.

Note that I am not asking you to enforce equal representation. I am requesting that a serious and sustained effort to improve matters be undertaken.

While reviewing memberships for your committees, I would also like you to stagger membership recommendations either by prolonging some members or swapping members out early so that the group doesn't deplete *en masse* but in stages.

I look forward to your cooperation in addressing the concerns of our sponsors in the matter of membership diversity.

Yours sincerely,

J. Church
Chairman Joint Scientific Committee

Targets for membership of WCRP committees:

1. wide geographic representation (i.e. all WMO Regions at a minimum)
2. 50% female membership
3. 50% developing nation members
4. 50% members under 50 years of age
5. 10% or more members from LDCs
6. around 50% of members having served <5 years on this or any other WCRP Committee
   WMO Regions:

    1. Region 1: Africa
    2. Region 2: Asia
    3. Region 3: South America
    4. Region 4: North and Central America
    5. Region 5: Southwest Pacific
    6. Region 6: Europe

JSC/CAS Working Group on Numerical Experimentation (WGNE)

Membership of the WGNE was determined by consultation between the Chair of the JSC and the President of CAS. The current membership of the committee is:

Membership	**Expiry of appointment (end of)**
M. Miller (Chair)	2007
G. Brunet	2009
Chen Dehui	2007
M. Déqué	2007
J. Hack	2009
M. Iredell	2009
A. Lorenc	2007
D. Majewski	2007
K. Puri	2007
P. Silvas Dias	2008
Y. Takeuchi	2007
M. Tolstykh	2009

The terms of D. Majewski and Y. Takeuchi, which would expire on 31 December 2007, were each extended by two years. The term of K. Puri which would expire on 31 December 2007, was extended by one year. A. Lorenc, M. Déqué and Chen Dehui would be stepping down at the end of their terms on 31 December 2007. Roy Kershaw (UK Met Office), F. Rabier (Meteorological Service of Canada) and Xueshun Shen (Chinese Meteorological Administration) were appointed new members for a four year term beginning on 1 January 2008. Following his appointment to the WWRP Chair, G. Brunet desired to stand down immediately. P. Gauthier, (Meteorological Service of Canada) was appointed in his place. The composition of the group effective 1 January 2008 will be:

Membership	**Expiry of appointment**	
M. Miller (Chair)	31 December	2007
P. Gauthier	"	2010
J. Hack	‘’	2009
M. Iredell	"	2009
D. Majewski	"	2009
K. Puri	"	2008
F. Rabier		"2011
Roy Kershaw	"	2011
P. L. Silva Dias	"	2008
Y. Takeuchi	"	2009
M. Tolstykh	"	2009
Xueshun Shen	"	2011

JSC/CLIVAR Working Group on Coupled Modelling (WGCM)

The current membership of the committee is:

Membership	Expiry of appointment (end of)
J. Mitchell (Co-Chair)	2007
G. Meehl (Co-Chair	2007
S. Griffies, Ex officio, Chair, WGOMD	2008
S. Bony	2009
P. Braconnot	2007
T. Delworth	2006
G. Flato	2007
M. Giorgetta	2008
F. Giorgi	2008
A. Hirst	2007
D. Karoly	2008
M. Kimoto	2008
C. Le Quéré	2008
N. Nakicenovics	2009

The terms of Co-Chairs, J. Mitchell and G. Meehl, which would expire on 31 December 2007, were extended by one and two years respectively. The terms of P. Braconnot and A. Hirst which would expire on 31 December 2007, were each extended by two years. The term of G. Flato which would expire on 31 December 2007 was extended by one year. T. Delworth stepped down at the end of his term on December 2006. The composition of the group effective 1 January 2008 will be:

Membership	Expiry of appointment	
J. Mitchell (Co-Chair)	31 December	2008
G. Meehl (Co- Chair)	"	2009
S. Bony	"	2009
P. Braconnot	"	2009
G. Flato	"	2008
M. Giorgetta	"	2008
F. Giorgi	"	2008
S. Griffies (ex-officio, Chair, WGOMD)	"	2008
A. Hirst	"	2009
D. Karoly	"	2008
M. Kimoto	"	2008
C. Le Quéré	"	2008
N. Nakicenovic	‘’	2009

CLIVAR Scientific Steering Group

The current membership of the committee is:

Membership	Expiry of appointment (end of)
T. Palmer (Co-chair)	2007
J. Hurrel (Co-chair)	2010
W. Dong	2010
L. Goddard	2009
J. Marotzke	2007
B. McAvaney	2008
R. Mechoso	2010
F. Molteni	2007
M. Rienecker	2007
T. Tokioka	2007
M. Visbeck	2010
D. Waliser	2008
B. Wang	2007

The terms of T. Palmer (Co-Chair) and T. Tokioka, which would expire on 31 December 2007, were each extended by two years. J. Marotzke, F. Molteni, M. Reinecker and B. Wang would step down at the end of their terms on 31 December 2007. B. N. Goswami (Indian Institute of Tropical Meteorology, Pune, India) was appointed new member in place of B. Wang beginning 1 January 2008 for a period of four years. The membership of the group effective 1 January 2008 will be:

Membership	**Expiry of appointment**	
T. Palmer (Co-Chair)	31 December	2009
J. Hurrel (Co-Chair)	‘’	2010
W. Dong	‘’	2010
L. Goddard	"	2009
B. N. Goswami	"	2011
B. McAvaney	"	2008
R. Mechoso	‘’	2010
T. Tokioka	"	2009
D. Waliser	"	2008

Chairs of CLIVAR/WGSIP, GEWEX and Co-Chairs of WGCM are members ex officio of CLIVAR SSG.

CliC Scientific Steering Group

The current membership of the committee is:

Membership	**Expiry of appointment (end of)**
B. Goodison (Chair)	2008
A. Worby (Vice-Chair)	2008
K. Steffen (Vice-Chair)	2009
G. Casassa	2009
M. Drinkwater	2008
T. Fichefet	2007
V. Kotlyakov	2007
C. Mauritzen	2007
T. Ohata	2007
T. Prowse	2010
Qin Da He	2008
J. Turner	2008

T. Fichefet and V. Kotlyakov would be stepping down at the end of their terms on 31 December 2007 and were being replaced by A. Rinke (Univ.of Potsdam, Germany) and V. Romanovsky (University of Alaska, USA) respectively. C. Mauritzen had to resign for personal reasons. V. Katsov (Voeikov Main Geophysical Observatory, Russia) was appointed in her place for a term of four years beginning 1 January 2008. The term of T. Ohata expiring on 31 December 2007 was extended by one year. The membership of the group effective 1 January 2008 will be:

Membership	**Expiry of appointment**	
B. Goodison (Chair)	31 December	2008
A. Worby (Vice-Chair)	"	2008
K. Steffen (Vice-Chair)	‘’	2009
G. Casassa	‘’	2009
M. Drinkwater	"	2008
V. Katsov	“	2011
T. Ohata	"	2008
T. Prowse	"	2010
Qin Da He	"	2008
A. Rinke	“	2011
V. Romanovsky	“	2011
J. Turner	“	2008

GEWEX Scientific Steering Group

The current membership of the committee is:

Membership	Expiry of appointment (end of)
S. Sorooshian (Chair)	2007
U. Schumann (Vice-Chair)	2007
T. Ackerman	2007
A. Beljaars	2007
L. Bertolani	2010
F. Einaudi	2008
A. Gaye	2010
J. Matsumoto	2009
J. Polcher	2010
D. Randall	2007
K. D. Sharma	2007
K. Takeuchi	2007
R. Yu	2009

The term of S. Sorooshian (Chair) which would expire on 31 December 2007, was extended by one year. The membership of T. Ackerman which would expire on 31 December 2007 was extended by three years and he would be appointed as Vice-Chair on 1 January 2008 and as Chair on 1 January 2009. The terms of A. Beljaars and K. D. Sharma which would expire on 31 December 2007, were each extended by three years. U. Schumann, D.Randall and K.Takeuchi would stepdown at the end of their terms on 31 December 2007. R. Stewart (McGill University, Canada), K. Trenberth (NCAR, USA) and O. Zolina (P. P. Shirshov Institute of Oceanology, Russia) were appointed new members beginning 1 January 2008 for a period of four years. The membership of the group effective on 1 January 2008 will be:

Membership	Expiry of appointment	
S. Sorooshian (Chair)	31 December	2008
T. Ackerman (Vice Chair)	"	2010
A. Beljaars	"	2010
L. Bertolani	"	2010
F. Einaudi	"	2008
A. Gay	"	2010
J. Matsumoto	"	2009
J. Polcher	"	2010
K. D. Sharma	"	2010
R. Stewart	"	2011
K. Trenberth	"	2011
R. Yu	"	2009
O. Zolina	"	2011

SPARC Scientific Steering Group

The current membership of the committee is:

Membership	Expiry of appointment (end of)
A. O'Neill (Co-Chair)	2007
A. R. Ravishankara (Co-Chair)	2007
J. P. Burrows	2009
P. Canziani	2008
D. Hartmann	2008
S. Hayashida	2008
P. Haynes	2008
E. Manzini	2008
T. Peter	2008
P. Wennberg	2008
V. Yushkov	2008

The Co-Chairs A. O'Neill and A. R. Ravishankara, expressed their desire to step down after the JSC-28 session which was accepted. T. Peter was appointed as new Co-Chair beginning 1 April 2007. T. Shepherd (University of Toronto, Canada) was appointed as the other new Co-Chair beginning 1 April 2007 for a term of four years. A. Thompson (The Pennsylvania State University, USA) and G. Bodeker (National Institute of Water and Atmospheric Research, New Zealand) were appointed new members for four years from 1 January 2007. P. C. S. Devara (Indian Institute of Tropical Meteorology, Pune, India) and D. Fahey (NOAA, USA) were appointed new members for four years from 1 January 2008. P. Wennberg would step down at the end of his term on 31 December 2007. The membership of the group effective on 1 January 2008 will be:

Membership	**Expiry of appointment**	
T.Peter (Co-Chair)	31 December	2008
T. Shepherd (Co-Chair)	"	2010
G. Bodeker	"	2010
J. P. Burrows	"	2009
P. Canziani	"	2008
P. C. S. Devara	"	2011
D. Fahey	"	2011
D. Hartmann	"	2008
S. Hayashida	"	2008
P. Haynes	"	2008
E. Manzini	"	2008
A. Thompson	"	2010
V. Yushkov	"	2008

Working Group on Surface Fluxes (WGSF)

The JSC decided that WGSF should continue its activities with the current membership until the end of 2007 and ways to continue meaningful flux work in the WCRP should be worked out. The current membership of the group remains as follows:

Membership	**Expiry of appointment**	
C. Fairall (Chair)	31 December	2007
E. Andreas	“	2007
B. Barnier	“	2007
A. Bentamy	“	2007
P. Braconnot	“	2007
F. Bradley	“	2007
W. Drennan	“	2007
C. Garbe	“	2007
P. Gleckler	“	2007
E. Kent	“	2007
G. Leeuw	“	2007
W. McGillis	“	2007
R. Philipona	“	2007
S. Smith	“	2007
A. Sterl	“	2007
R.A. Weller	“	2007

WCRP Modelling Panel

The JSC decided to extend the terms of all members of WMP, which would end on 31 December 2007 to 31 December 2008. C. Jakob, the new Chair of GMPP, replaced J. Polcher. V. Meleshko, the JSC liaison member, retired from JSC on 31 December 2006.The membership of the Panel was thus:

Membership	Expiry of appointment	
J. Shukla (Chair)	31 December	2008
D. Burridge	“	2008
T. Arbetter	“	2008
S. Griffies	“	2008
C. Jakob	“	2008
B. Kirtman	“	2008
R. Koster		2008
M. Miller	“	2008
J. F. Mitchell	“	2008
S. Pawson	“	2008
D. Schimel	“	2008
K. Trenberth	“	2008

WCRP Observations and Assimilation Panel (WOAP)

The JSC decided to extend the terms of all members of WOAP, which would end on 31 December 2007, to 31 December 2008. The membership of the Panel was:

Membership	Expiry of appointment	
K. Trenberth (Chair)	31 December	2008
A. Belward	“	2008
G. Duchossois	“	2008
J. L. Fellous		2008
G. Flato	“	2008
D. E. Harrison	“	2008
E. Kent	“	2008
J. Key	“	2008
T. Koike	“	2008
A. Lorenc	“	2008
M. J. Manton	“	2008
B. Randel	“	2008
W. Rossow	“	2008
J. Shukla	“	2008
A. Simmons	“	2008
D. Stammer	“	2008
M. Tiernstrom		2008

GCOS/WCRP Atmospheric Observation Panel for Climate (AOPC)

The JSC approved the proposed composition of the Atmospheric Observations Panel for Climate, jointly sponsored by the JSC and the Scientific Committee for GCOS. Its composition was as follows:

A. Simmons (Chair)	ECMWF	
J. Butler	NOAA/ESRL, USA	
M.D. Goldberg	NOAA/NESDIS, USA	
E. Harrison	OOPC	NOAA/PMEL, USA
R. Heino	Met. Institute, Finland	
P. Jones	University of Norwich, UK	
K. Onogi	JMA, Japan	
D. Parker	Met Office, UK	
T. Peterson	NCDC, USA	
B. Rudolf	GPCC	DWD, Germany
M. Rusticucci	Univ of Buenoes Aires, Argentina	
J. Schmetz	Eumetsat	
M. Suzuki	JAXA, Japan	
M. Verstraete	EC-JRC, International	

GCOS/GOOS/WCRP Ocean Observations Panel for Climate (OOPC)

The JSC approved the proposed composition of the Ocean Observations Panel for Climate, jointly sponsored by the JSC and the Joint Scientific and Technical Committees for GCOS and GOOS. Its composition was as follows:

Ed Harrison (Chair)	NOAA/PMEL, USA
T. Dickey	University of California, Santa Barbara, CA, USA
J. Johannessen	Nansen Environmental and Remote Sensing Centre, Norway
R. Keeley	MEDS, Canada
Y. Michida	University of Tokyo, Japan
R. Reynolds	NOAA/NESDIS/NCDC, USA
F. Schott	IFM-GEOMAR, University of Kiel, Germany
P. Taylor	Southampton Oceanography Centre, UK
R. Weller	Woods Hole Oceanographic Institution, USA
A. Fischer	IOC/UNESCO

A representative from each CLIVAR basin panel, and now GSOP, are also members ex officio of the OOPC.

Terrestrial Observation Panel for Climate (TOPC)

The JSC noted the composition of TOPC. One representative from GOFC-GOLD and one representative from TCO (both GTOS Panels) have full TOPC Membership in addition to the persons listed below:

R. Barry	National Snow and Ice Data Centre CIRES/WDC
W. Haeberli	University of Zurich
S. Harrison	University of Bristol
J. M. Landwehr	U.S. Geological Survey
T. Maurer	Global Runoff Data Centre (GRDC), Federal Institute of Hydrology
S. Running	University of Montana
A. M. Solomon	U.S. Environmental Protection Agency
M. Verstraete	European Commission, Joint Research Centre
M. Menenti	Université Louis Pasteur
S. Quegan	Sheffield Centre for Earth Observation Science

New Chairperson and possibly one or two additional members to be appointed.

Appendix B

WCRP Joint Scientific Committee
Twenty-eighth Session, Zanzibar, Tanzania, 26-30 March 2007

MAIN ACTIONS/RECOMMENDATIONS

Agenda item(s)	Subject	Actions/Recommendations	Responsibility	Deadline
1	**Role of the JSC, WCRP Future Directions**	A1: JSC agreed to form a joint WCRP/IGBP group to consider a phased moving together, by defining prospective point of end delivery of a potential joint program and further bilateral projects. The Group should also define what a strategic partnership or even a merged programme could look like, its advantages/disadvantages and how WCRP and IGBP could move forward, including building community support.	DWCRP and Chair, JSC	Membership, ToRs and principles of forming the membership to be agreed in April 2007
1	**Role of the JSC, WCRP Future Directions**	A2: Prepare draft content and structure of the WCRP Strategic Framework 2005-2015 Implementation Plan	DWCRP and JSC Officers and the chairs of the JSC crosscutting teams.	JSC-29
1	**Role of the JSC, WCRP Future Directions**	A3: Chair of JSC should request the Secretary General of WMO to increase activity funds, at the expense of the staff budget on a temporary basis.	Chair, JSC	June 2007(after WMO Congress)
1	**Role of the JSC, WCRP Future Directions**	A4: DWCRP to prepare simple and transparent budget of how the WCRP income and costs had evolved over the past and expectations for the next few years. In addition, The Director, in consultation with the Officers of the JSC, should propose a formal budget with income/expenditure at a level of detail that will make it possible for the JSC to make strategic decisions on an annual basis, i.e. annual budgets. These budget documents should be available shortly after the upcoming WMO Congress.	DWCRP	June 2007(after WMO Congress)
1	**Role of the JSC, WCRP Future Directions**	A5: DWCRP should take the lead in forming the JPS and IPO' staff into a single cohesive WCRP support team with a clear definition of roles and responsibilities and regular (perhaps monthly) teleconferences between DWCRP and IPO Directors and face-to face meetings on an opportunity basis. The JSC should be advised of the roles and responsibilities of JPS Staff.	DWCRP	In progress
	Fund raising	B1: Include an item on preparing proposals for fund raising into agendas	DWCRP assisted	JSC-29

		of JSC sessions. JPS should work more actively on fund raising for WCRP.	by Directors of IPOs	
	Fund raising	B2: prepare a one-sheet leaflet describing the situation to sponsors and PRs with WMO. Projects should provide information for this leaflet indicating what will be not achieved if there is no additional funding.	DWCRP assisted by Directors of IPOs	20 April 2007
	Fund raising	B3: Establish a small group for development of a fund raising plan. Propose to approach a number of people, including L. Gates, H. Grassl, H. Kondo, P. Lemke, L.A. Ogallo	Chair, JSC	31 July 2007
	Fund raising	B4: Initiate a record of all (cash and in-kind) contributions to activities of WCRP as a whole and its projects. DWCRP to propose brief guidelines for initiating and maintaining such a record.	DWCRP assisted by Directors of IPOs	IGFA meeting, October,2007
2.1	**Review of crosscutting activities: ACC**	C1: develop a WCRP 'ACC Action Plan' identifying and addressing science gaps in AR4. This plan will be initiated at a small meeting to be hosted by IPSL in Paris to contain Chairs/Co-Chairs of the WCRP Projects, the JSC group members, other significant players to be nominated by WCRP projects and JSC members. The meeting needs to take place within then next few months (i.e. before August 2007). The report of this WCRP team will be the "WCRP ACC Implementation / Action Plan" which will be further developed at the GCOS-WCRP-IGBP Workshop (4-6 October, Sydney, Australia). A post-workshop one-day or two-day meeting will be devoted to further develop the Plan.	DWCRP with H. Le Treut and V. Ramaswamy assisted by Directors of IPOs	Workshop at IPSL in June-July 2007 (possibly at the time of releasing IPCC AR4 WG1 report). Draft ACC by Sydney Workshop.
2.1	**Review of crosscutting activities: ACC**	C2: to work to ensure WCRP is appropriately represented at the IPCC Scenarios Workshop in September and on the Organising Committee for it. V. Ramaswamy to contact WGCM chairs plus others to clarify issues and J. Church to contact S. Solomon and write directly to chair of IPCC . The letter should not only request WCRP participation in the IPCC Scenarios Workshop but also clearly indicate a need to develop important science with reference to the WCRP ACC Initiative activities summarised in the Action C1.	DWCRP, V. Ramaswamy, J. Church	30 April 2007
2.1	**Review of crosscutting activities: ACC**	C3: Ms C. Michaut of IPSL to be the JPS support staff for ACC. She will report to H. Le Treut who will act as the Chair of the JSC group facilitating/coordinating ACC activities in WCRP. H. Le Treut to organise with DWCRP work plan for Ms C. Michaut.	H. Le Treut assisted by DWCRP	31 May 2007
2.2	**Review of crosscutting activities: AC&C**	C4: The JSC approved the scientific directions of the AC&C. It recommended that AC&C should remain a joint activity of the WCRP and IGBP led by the SPARC and IGAC projects. Its day-to-day management should be provided by the IGAC IPO with the SPARC IPO and JPS for WCRP. Outreach activities of AC&C should be initially organised through SPARC and IGAC and JSC supports AC&C plans of its own outreach (website, publications in EOS, etc.)	T. Peter, T. Shepherd	JSC 29

2.3	**Review of crosscutting activities: Monsoons**	C5: develop a 5-year strategy of WCRP monsoon research including issues related to the East African Monsoon, and an implementation plan.	Directors ICPO and IGPO with support from Monsoon Initiative leadership	Report at JSC-29
2.4	**Review of crosscutting activities: Decadal Predictability**	C6: Further explore and plan an initial Decadal Predictability Experiment, with model results available to a wide range of users.	T. Palmer	Report at JSC-29
2.4	**Review of crosscutting activities: Decadal Predictability**	C7: To consider at the Seasonal Prediction Workshop (Barcelona, 4-8 June 2007) an extension of the WGSIP mandate and inclusion in it of science issues pertaining to decadal prediction.	J. Marotzke, T. Palmer	Report at JSC-29
2.4	**Review of crosscutting activities: Decadal Predictability**	C8: Develop a communication strategy for decadal predictability contributing to the overall WCRP Communication Strategy so as to ensure high visibility of WCRP.	J. Marotzke,	Report at JSC-29
2.5	**Review of crosscutting activities: Extreme Events & Climate**	C9: A Workshop on Climate Extremes should be organised in 2008 (or 2009)	A. Busalacchi, Chairs GEWEX; CLIVAR. DWCRP	???Path forward defined by end August 2007.
2.6	**Review of crosscutting activities: International Polar Year 2007-2008**	C10: The JSC recommended work on coordination of IPY legacy in terms of observing systems, in association with the IGOS Theme on Cryosphere and GEO. Active participation in the IPY outreach activities aiming to achieve better WCRP visibility, and continuation of efforts towards harmonising the IPY programme of activities so that it would contribute to better understanding of predictability of polar processes and better predictions on a wide range of time scales was encouraged.	CliC.	Ongoing, JSC29
2.7	**Review of crosscutting activities: Sea Level**	C11: Ensure the recommendations from the 2006 Sea-level Rise workshop are communicated to all WCRP Projects and Working Groups with encouragement to act on the recommendations as appropriate.	DWCRP	

	Rise(SLR)	C12: Cosponsor (subject to the development of a detailed and appropriate plan) but without funding the WCRP Sea-Level Rise Impacts Workshop being planned by LOICZ and other participants. C13: Write a letter to relevant space agencies to support JASON-3. (Need to ensure letter is consistent with other messages sent to space agencies.)	DWCRP DWCRP with J. Church and Chair OOPC	 31 July 2007
2.7	**Review of crosscutting activities: SLR**	C14: WCP to ensure that the WMO Annual Report on Climate contains a section on sea level rise and various indices.	D WCP and DWCRP with J. Church	Before the release of the WMO Statement on Global Climate 2007
2.8	**Review of crosscutting activities: TFSP**	C15: Consider measures facilitating easy access of scientists from developing countries to the TFSP model run data.	TFSP leader and C/WGSIP	2007
3	**African Networking**	D1: Together with WCP and START, prepare a short report of the African Networking Day. A DVD on the event has been distributed.	DWCRP, DWCP, START	30 September 2007
4.1	**GEWEX**	E1: Send a letter to NASA, NOAA and USGS in support of the U.S. NRC Decadal Survey recommendations for new missions.	DWCRP, GEWEX SSG Chair, WOAP Chair	30 June 2007
4.1	**GEWEX**	E2: Send a letter of appreciation to R. Lawford in late summer 2007 for his outstanding leadership and service to WCRP in his role as the Director of IGPO.	DWCRP assisted by GEWEX SSG Chair	30 April 2007
4.1	**GEWEX**	E3: WCRP through WOAP and in consultation with GCOS to continue efforts aimed at hosting and continuation of support to BSRN.	Chair of WOAP, D GCOS	Report at JSC-29
4.4	**CliC**	E4: WCRP to participate in the IGOSP meeting in May 2007 in Paris and present the IGOS Theme on Cryosphere.	V. Ryabinin, Chair of the Theme	28-30 May 2007
5.2	**WMP**	F1: Further develop the WCRP modelling strategy by organising, with relevant groups and partners, a WCRP Modelling Summit in 2008, thus leading to a strategy for how modelling activities should be coordinated in the future in WCRP (and with partners). The Summit would be the last activity organised by WMP in its present form. Organise an appropriate presentation to the GEO Ministerial Summit	Chair WMP with modeling groups and IGBP, DWCRP	Report at JSC-29 GEO interactions ongoing.
5.4	**WGNE**	F2: Consider climate model metrics in the agenda of the WCRP Modelling Summit in 2008.	Chairs WMP and WGNE	Initial progress report at JSC-29
5.5, 5.6	**SOLAS-WGSF**	F3: to propose measures to preserve current momentum in the WCRP	S. Gulev and V.	31 October 2007

		surface flux work, especially the continuation of recently reinvigorated SURFA and include in the scope of this consideration all issues related to global fluxes (i.e. fluxes on land).	Ryabinin in contact with SOLAS Chair and Exec. Officer SOLAS IPO and Chair of WGSF and with other relevant contacts	
6	**AOPC, OOPC**	G11: Composition approved. G12: The JSC agreed to the proposal by E. Harrison that at the next JSC meeting a presentation on status of ocean analysis and reanalysis for the climate and the observing system be given.	 E. Harrison	Report at JSC-29
6	**TOPC**	G13: Composition noted.		
6	**GEO**	G14: The needs of core observing systems and the white paper on seamless prediction should be offered to the GEO Ministerial Meeting in November 2007.	DWCRP	November 2007
6	**THORPEX**	G15: The JSC agreed to the proposal by M. Beland to hold a small workshop in 2007 to consider ways of achieving the objectives of preparing a strategy for a coordinated observing, modelling and forecasting with emphasis on the organised tropical convection and its influence on predictive skill in the western Pacific and Indian Ocean.	DWCRP, M. Beland	December 2007
6	**WORLD CLIMATE CONFERENCE (WCC) 3**	G16: The JSC recommended that WCRP actively explore the opportunities to present highly relevant scientific subjects as contributions towards a WCC3	DWCRP	Ongoing, report to JSC29
9.3	**Membership**	G1: send an additional letter to projects and groups insisting on compliance with membership conditions in terms of geographical, gender, and age balance. Emphasise in that letter that the state of affairs is inadequate and if new proposals from committees do not improve situation by target threshold (50%), a comprehensive statement with convincing explanation of reasons for that will be required.	DWCRP	31 August 2007
9.3	**CliC SSG**	G2: approved, seek further clarification on availability of one member, need to increase diversity	DWCRP	
9.3	**CLIVAR SSG**	G3: approved. Unbalanced expertise was noted with not enough representation of oceanographers. A Co-Chair with Oceanographic background is recommended in the future. Gender balance needs to be improved.	DWCRP	

		Note: there is an opportunity to redress the balance the next year.		
9.3	**GEWEX SSG**	G4: approved. Strong recommendation to have a member from South America. Recommendation to acquire a GCM modeller on the SSG, better if with expertise in modelling clouds. Gender balance to be improved.	DWCRP	
9.3	**SPARC SSG**	G5: approved.	DWCRP	
9.3	**WGCM**	G6: J. Mitchell extended as WGCM Co-Chair for 1 year instead of 2 years requested. Lack of members form developing countries noted with concern. An Aerosol modeller may be useful.	DWCRP	
9.3	**WGNE**	G7: approved as an exception noting dual parentage of the working group and that it mainly involves a representation of leading modelling centres. Lack of women (but one) and people younger than 50 years (but one) was noted with great concern.	DWCRP	
9.3	**WGNE**	G8: DWCRP to discuss with WGNE Chair the situation with the WGNE composition and find an acceptable way to resolve the problems for the future.	DWCRP	31 August 2007
9.3	**WMP**	G9: Extend the terms for all WMP members until 31 December 2008 to run the Modelling Summit. The committee then lapses.	DWCRP	
9.3	**WOAP**	G10: Extend the terms for all WOAP members until 31 December 2008.	DWCRP	

Appendix C

WORLD CLIMATE RESEARCH PROGRAMME

JOINT SCIENTIFIC COMMITTEE

TWENTY-EIGHTH SESSION

ZANZIBAR, TANZANIA, 26-30 MARCH 2007

JSC-XXVIII/Doc. 1.1
(9.III.2007)

Item 1

JSC Task Team on Implementing the WCRP Strategic Framework: 2005-2015
Paper for the JSC in Zanzibar – Final Version (9 March 2007)

1. Executive Summary: Implementing the WCRP Strategic Framework

The last three surveys and reviews of the World Climate Research Programme have all found that WCRP has an excellent reputation for and capability of coordinating and implementing international climate research programmes that have yielded successful outcomes. While stakeholders have expressed strong support and need for an ongoing vigorous WCRP, they also requested that processes maximise the value obtained from national investments in climate research, similar to the wishes expressed by the sponsors.

In the most recent survey, stakeholders have also indicated the world has changed and there is now a much greater interest in climate issues and their impacts on society. They also expressed strong concern that WCRP can not continue to live off past achievements and adequate funding now is dependent upon WCRP more actively moving to meet (and be seen to meet) today's (and tomorrow's) challenges through greater integration across components of WCRP and with a much stronger focus on outputs relevant to society's needs. They also acknowledge that the WCRP Strategic Framework (COPES), published in August 2005, pointed to the direction of future evolution of WCRP. Indeed, many stakeholders are now eagerly awaiting implementation of the WCRP Strategic Framework.

It is now essential to set a firm direction for future evolution of the WCRP and implementation of the WCRP Strategic Framework. The task group has considered the following four options:

a) focus on the core projects, as WCRP was prior to the development of the Strategic Framework,
b) focus on cross-cutting issues aimed at meeting society's and stakeholder's needs (WCRP is currently and tentatively heading in this direction with implementation through the Projects, Working Groups, Panels and task forces),
c) become a stronger contributor to the Earth System Science Partnership with a first step of strengthening the relationship with IGBP (going substantially further than co-sponsorship of one or two projects),
d) more actively pursue partnerships with other organisations in the broader climate network and attempt to more actively lead in this network.

These options are not mutually exclusive, and it is likely that some combination of these options should be implemented. In addition to these choices on future directions, the JSC must urgently address adequate resourcing of the WCRP which, at least in the short term, may necessitate cost-cutting considerations. In addition, JSC must move more actively to raise the visibility of WCRP, both in the developing and developed world.

The Task Team recommends that, with the rapid growth of climate science and its importance for society, b provides the optimal route for delivery of cutting-edge products and coherent information required by stakeholders, with strengths drawn from the Projects, Working Groups, Task Forces and Panels and strengthened partnerships through options d and through further exploration of option c.

2. Introduction

The purpose of this document is to bring together information on WCRP's current position and future options. The WCRP network survey presented seven options. These are detailed in the Appendix A. We recommend that the JSC consider four of these options, or some combination of these four, as outlined below. It should be noted that WCRP's current financial resources may well be currently insufficient to implement any of these options without additional sources of funding.

3. Benefiting from Past Reviews of the WCRP

In addition to reviews by WMO Congress (every four years) and by IOC and ICSU, two formal reviews and the recent WCRP Survey of stakeholders concerns provide valuable insight into the evolutionary thinking about WCRP by the community. There are a number of common themes (italicised below) in these reviews.

3.1. 1994 Review by ICSU (one sponsor)

During 1994 ICSU (apparently not WCRP's other sponsors) reviewed WCRP. The Review Panel concluded that: "The WCRP … has already produced valuable research products … demonstrated the complex nature of global climate change, and … that by conducting proper experiments relating to the atmosphere-ocean coupling, and … improving numerical weather forecasting models, one can considerably improve on long-range weather forecasts. The JSC and JPS deserve the highest accolades and rich appreciation of both the public and the scientific community … In addition to this, the task of carrying out global experiments is a very difficult one since it involves a complex coordination and exchange between a large number of scientists and policy makers of different countries. Realizing all this, we are indeed very appreciative how the JPS, under the scientific direction of JSC, could suitably lead and coordinate the global experiments so successfully and has produced viable products ....".

This 1994 Review Panel made nine recommendations of which the most pertinent are:

- JSC should sponsor a mid-term scientific conference to establish a general consensus on the scientific priorities for WCRP (held in 1997). JSC Officers should simultaneously evolve a *strategy to take into account priorities to suit the interests of policy makers and governments*.
- JSC should ensure that the CLIVAR science plan give a *high priority to identifying separately the contributions of natural variability and man's influence in climate change*.
- JSC should review and publicize the many ways in which capacity in developing countries in the field of climate research WCRP has promoted. JSC should *seek additional opportunities for participation of developing country scientists*.
- The JSC should publish a WCRP Newsletter. [Began March 2006]
- ICSU should review the wording of the Memorandum of Understanding for WCRP, in time for the next signing in 1997, in the *expectation that the WCRP would be a viable programme for the next 12 years* (i.e. before 2006):
    a) Duration of the programme;
    b) Membership, terms of reference and the appointment procedures for JSC;
    c) The role of each sponsor, and
    d) The task of the JPS and its director.

3.2. 2000 review by the USA's Climate Research Committee (one national funder)

In 2000 the USA's Climate Research Committee's (CRC) reviewed the U.S.A.'s contribution to WCRP. This review had the primary objectives of: (1) assessing the coordination (national-international and project-to-project) of the U.S. scientific contributions to the WCRP; (2) identifying potential science gaps and/or redundancies in the U.S. contributions to the WCRP, and; (3) identifying existing or emerging issues and needs that might require more attention.

The committee's findings and recommendations relevant to today are:

- The WCRP activities are scientifically strong, with broad participation by U.S. scientists in all phases of the research.
- *Joint research efforts should be organized to address scientific questions or phenomenological features that span two or more WCRP project communities*.
- There are disparities in the nature of the support that relevant US research agencies give to the different WCRP elements.
- There should be a *mechanism agreed to by the relevant agencies for establishing the nation's research priorities regarding the WCRP*, particularly for those areas in which a large-scale, concerted effort is required and where the issue lies outside the boundaries of primary responsibility of any individual agency. Two such issues, upon which the CRC places high priority, are the *attribution of the causes of observed climate change and the projection of future climate change*.
- *Adequate and timely funding* of the projects is essential to ensure the success of the WCRP. This requires that leaders of the key agencies, be aware of these projects and the interagency priorities when making commitments for their respective contribution.

3.3. 2006 Survey: Better Networking the WCRP (many stakeholders)

In 2006, WCRP initiated a survey of stakeholders concerns and needs as a means to help develop options for implementation of the WCRP Strategic Framework (and to assist in preparation for the ICSU/IGFA Review). The feedback obtained indicated an urgent and growing need for *more detailed and robust information on climate variability and change and Earth system change*. Interviewees requested *integrated knowledge, data and tools* to assist decision makers and to manage climate risk. It was also clear that *WCRP is not visible* to policy makers even when WCRP input to such processes as the IPCC AR4 was proving critical. Stakeholders and sponsors recognised that an *organisation like WCRP is critical to providing appropriate solutions* and that this would mean *integrating WCRP knowledge with that of its ESSP partners and data providers like GCOS and GEOSS*.

Eera proposed 7 strategic options based on input they received from ~100 interviewees and from 4 workshops comprising about another 100 participants. Most options require, or would benefit from, *improved regional focus, better communication* and more effort to successfully share understanding. In these respects, and in other ways, this very recent review repeats recommendations made in 1994 and 2000. Appendix A summarizes aspects of the options proposed in the Eera report.

4. **WCRP's Current Financial Situation**

WCRP's has major financial difficulties (Appendix B) both now and for the 2008/09 biennium when anticipated funding available for activities falls to just over 1 million CHF, compared with about twice this in previous biennia. This fall in available funds is a result of (1) steady to declining income in nominal dollars, (2) rising costs (particularly salaries), (3) no reserves to draw upon. *These funds are insufficient for WCRP to continue in either its present or pre-COPES form.*

5. Future Options for the WCRP

5.1 WCRP strategic options

It is critical for the JSC to decide on the strategic direction and focus, including in particular how to (and perhaps reconsider whether to) implement the WCRP Strategic Framework 2005-2015 (COPES). Determining the most appropriate orientation must also involve WCRP's sponsors.

For WCRP to be a true leader in world climate research, it must receive strong support from stakeholders (sponsors, funders etc.) and appropriate funding. Feedback from stakeholders, as captured by Eera, underline the goals in the WCRP Strategic Framework, i.e. to focus on delivering valued contributions to managing climate risks by the application of appropriate quality science. WCRP needs to provide appropriate datasets, information and tools to allow societies to detect and analyze the observed and to predict future climate variability and change. Attributing the reasons for any change, particularly that from human activities, is also critical and deemed important by stakeholders. These outputs require integration across the breadth of WCRP (and beyond) if society is to adequately manage climate risks.

It is also important to recognise the present funding restrictions limit at least the short term flexibility. **Attempting to implement the 2005-2015 Strategic Framework and have Core Projects conducting "business as usual" is not possible.** On the other hand, it may be possible to consider an evolution of some or all the elements in the present structure viz., Core Projects, WGs and Panels and cross-cutting activities in a manner that both meets the WCRP objectives and the fiscal constraints.

5.2 Evaluation of the strategic options

a. Focus solely on the core projects

Focussing solely on the core projects, without active engagement of the JSC attending to gaps, redundancies, and crosscuts across the whole of the WCRP, would imply returning WCRP to its pre-COPES form. This would be the easiest option to implement and would likely lead to continued individual elements of high quality science. However, it would fail to integrate across the breadth of WCRP and to deliver the solutions that stakeholders are demanding. By not delivering on stakeholder needs, competition for resources with other members of the climate community would intensify leading to a further decline in available resources.

b. Focus on cross-cutting issues aimed at meeting society's needs

WCRP is currently and tentatively heading in this direction with implementation through the Projects, Working Groups, Panels and Task Forces, essentially as envisioned in the WCRP Strategic Framework (COPES). This option encourages the integration and facilitation of the science across WCRP and places a greater emphasis on delivery to applications. Fundamental to the success of this option is a WCRP built upon a strong foundation of a limited number of core projects (not necessarily those in existence today) and a limited number of crosscutting themes determined to be priority research topics that do not rest within any single core project. Such a structure would enable funds to flow both through the core projects as well as to the WCRP as whole based on the needs of WCRP partners and stakeholders. For example the recent WCRP Sea-level Rise and Variability workshop was externally funded. The prospect of highlighting crosscutting themes allows the establishment of new activities that are focused on providing solutions for end-user needs.

To fully implement this option requires support for the Projects, Working Groups and Panels and for the crosscuts, and implies the need for additional resources. WCRP will face ongoing/increasing competition for funding due to overlapping aspirations from other similar programmes organisations or agencies (see the Terms of Reference of other groups in Appendix C) but WCRP may have some competitive advantages (and disadvantages). It requires more coordination capacity, with scientific proficiency. Arguably integration needs to extend beyond WCRP for some issues.

c. Become a stronger contributor to the Earth System Science Partnership
WCRP must undoubtedly be a strong contributor to the ESSP. This option would allow WCRP to more easily reach end-users using the expertise and experience of the other ESSP partners. It would also be a step towards achieving the goals set out in the WCRP Strategic Framework. It would also facilitate support for developing and least developed countries through increased collaboration (e.g. START).

One possible first step would be a stronger relationship/merger with IGBP (going substantially beyond co-sponsorship of one or two projects). This path would give the ability to do a broader spectrum of science (the science is calling for at least elements of this merger) and the capability to deliver greater benefits for society. By pooling resources, WCRP/IGBP (and ESSP) could better leverage the work they do and eliminate duplication. It should be noted that this path would involve WCRP broadening from its core research area of the physics of climate.

A straight merger of WCRP and IGBP activities would lead to a larger, more comprehensive research programme but one that faced similar difficulties to those WCRP now faces; i.e. lack of an ability to provide integrated solutions. Therefore, Option c (especially merging WCRP and IGBP) must be accompanied by a refocusing on cross-cutting issues and user needs as envisioned by COPES (Option b) and possibly a more far reaching restructure. The restructure of US CLIVAR encouraged by US funding agencies may provide a suitable model to emulate.

d. More actively pursue partnerships with other organisations
Interest in climate issues is at an all time high with an increasing number of players, some with substantial resources. Although some are aware of WCRP, too few recognise what it does or even how it contributes to solutions of climate issues.

Whichever of the above options (or combination of options) is chosen, changing our mode of operation to have a greater focus on actively partnering (networking) with other players (other ESSP programmes and projects, etc) and stakeholders (the World Bank, CGIAR, etc) in the climate network to complete major research projects and to realise the benefits of WCRP research would seem to be essential. Indeed, WCRP could seek to more actively lead this network. Success in this path would result in WCRP's sponsors more actively engaged, higher visibility for WCRP and agencies with significant resources actively seeking WCRP participation and advice to provide better information in line with end user needs.

Successful networking in today's complex environment will be hard to do and require resources (particularly human resources). One danger is that working closely with private organisations could damage WCRP's reputation in the scientific community as an independent pure science programme.

Other Options
In their Survey Report, Eera raised three other options which the present Task Force argues should not be pursed. These, together with brief comments, are:

- Incubator and Science Seeker – There was a strong and consistent call for WCRP to be absolutely unbiased and independent of any concerns about commercial benefit to WCRP such as might arise with this option. This option may also alienate both the scientists and UN-based funding agents.
- Become a Department within WMO – WCRP currently benefits from its links with ICSU and IOC as well as WMO and needs strengthened links with IGBP.
- Close WCRP having facilitated significant success over 26 years – many stakeholders clearly saw the need for a WCRP to address urgent climate issues and indeed stated that if WCRP it did not exist it would need to be invented.

If sufficient funding for any of the preferred options can not be found, either the scope of WCRP must be curtailed or the future existence of WCRP reconsidered.

Successful implementation of the WCRP Strategic Framework 2005-2015 requires active participation of the existing and evolving expert communities and structure of WCRP. The core projects, WGs and panels are included in the WCRP Strategic Framework 2005-2015 and all of them reasonably include the Strategic Framework as the basis for their mandate. Those activities that already contain essential elements which can effectively benefit the wider WCRP network should be considered as priority in the formulation of WCRP's plans.

Accountability must be an important aspect of the WCRP Strategic Framework. The implementation plan for the Framework must include a critical assessment by the JSC and Core Projects of WCRP's performance on an annual basis. The assessment should ensure that the twin foci of WCRP are being addressed, together with the need to facilitate the science of Earth system variability and change for an increasing range of societally-relevant applications [COPES document]. This requires that WCRP make sustained efforts to continually advance: climate observations and modelling, climate data sets, estimates of physical quantities, process understanding and representation, predictability, synthesis and assessment of the climate system, and input to decision support and adaptive management. The JSC must, on a regular basis, critically examine these themes in terms of process, input, output, outcome, impact of the research efforts across the WCRP, and the associated management aspects. Both important advances and critical shortcomings must be identified; the former being important for transitioning from research to operations and the latter important for addressing deficiencies. A key aspect of this process is active and continued engagement with the stakeholder community involving stakeholders from the private sector, public sector, NGOs, intergovernmental sponsors, national representatives, and academia to identify priority areas of climate research all the way through to the assessment of the ultimate impact of this research.

6. Recommendation

The Task Team recommends that, with the rapid growth of climate science and its importance for society, b provides the optimal route for delivery of cutting-edge products and coherent information required by stakeholders, with strengths drawn from the Projects, Working Groups, Task Forces and Panels and strengthened partnerships through options d and through further exploration of option c.

Appendix A. Summary of Options Proposed in EERA Networking Report

Theme and Option (Eera numbers)	Arguments For	Arguments Against	Internal Impact	Sponsors and JSC Actions Needed
1. Focus on Core Projects (Option a in Section 5)	Minimal disruption and change in the organization	Lack of focus to do WCRP wide integration and make sufficiently strengthened links with external groups. Diminishing budgets mean ongoing resource crisis.	None: slow decline and closure	Support projects and their activities as in 2005 and before
2. COPES: Focus on cross-cuts (Option b in Section 5)	Integration and facilitation of the science across WCRP and greater emphasis on delivery to applications. Possibility for some new funding. Allows refocusing. Allows the establishment of new projects or activities that are centred around providing solutions for end-user needs.	WCRP will face ongoing/increasing competition for funding due to overlap from other similar programmes, organisations or agencies. Requires more coordination capacity, with scientific proficiency.	Medium: inadequate funds	Support task forces on cross-cutting initiatives and (less) projects.
3. WCRP Central in ESSP (Option c in Section 5)	Ability to do a broader spectrum of science (the science is calling for at least elements of this merger) and to deliver greater benefits for society. By pooling resources, the ESSP partners could better leverage the work they do and minimize any duplication. WCRP would also be better able to reach end-users using the expertise and experience of the other Earth System Science partners. It would also be a step in the right direction towards achieving the goals set out in the WCRP Strategic Framework. Another benefit would be the support it could offer developing and least developed countries through this increased collaboration (e.g. START).	WCRP would broaden from its core research area of the physics of climate. The existing core projects would either have to adapt to the objectives set forth by the new merger or operate independently of WCRP.	Medium to High: who would fund this?	Manage stepped change: – merge with IGBP (2008) – become a stronger contributor to the ESSP

4. Incubator and Science Seeker	WCRP will become a more dynamic organization that is capable of identifying challenging regional or global research topics and selling its research topics to key funding agencies. Scientists will be able to focus on research and rely on WCRP (Secretariat and JSC) to deliver resources.	Requires a completely new mind-set from WCRP and experienced staff in fund raising, science and negotiations. May involve numerous projects with shorter end dates. Existing projects will have to evolve into something new or close. Danger of losing and being seen to lose independence.	High	Major overhaul to orient towards seeking opportunities and funding.
5. Network Weaver (Option d in Section 5)	Sponsors actively engaged and see high visibility of WCRP's leadership. WCRP collaborates to provide better information in line with what end users are looking for.	Hard to do. Working with private organisations could damage WCRP's reputation as an independent science programme among the scientific community.	High	New role as network leader focusing on outreach.
6. WMO (only) Department	Direct access to the origins of funding, i.e. the NMHSs and operational centres, better reach regionally, better responses to regional needs.	Dependency on WMO, and loss of links to ICSU and IOC.	Medium: better funding hopefully	Minimum leadership role for JSC becomes a WMO Commission and meets every 4 years.
7. Close WCRP	WCRP did a good job – now finished. Close WCRP before it is forced to close due to lack of available funds.	There is a need today for an international coordinator in order to produce cutting edge research in climate observation, monitoring and modelling.	High: fast decline and closure	Seek "home" for basic research in other programmes. Wind down all activities.

Notes:

1. a good article on 'how to network in the not-for profit area' can be found at http://hbswk.hbs.edu/item/4801.html.

Appendix B. WCRP Budget

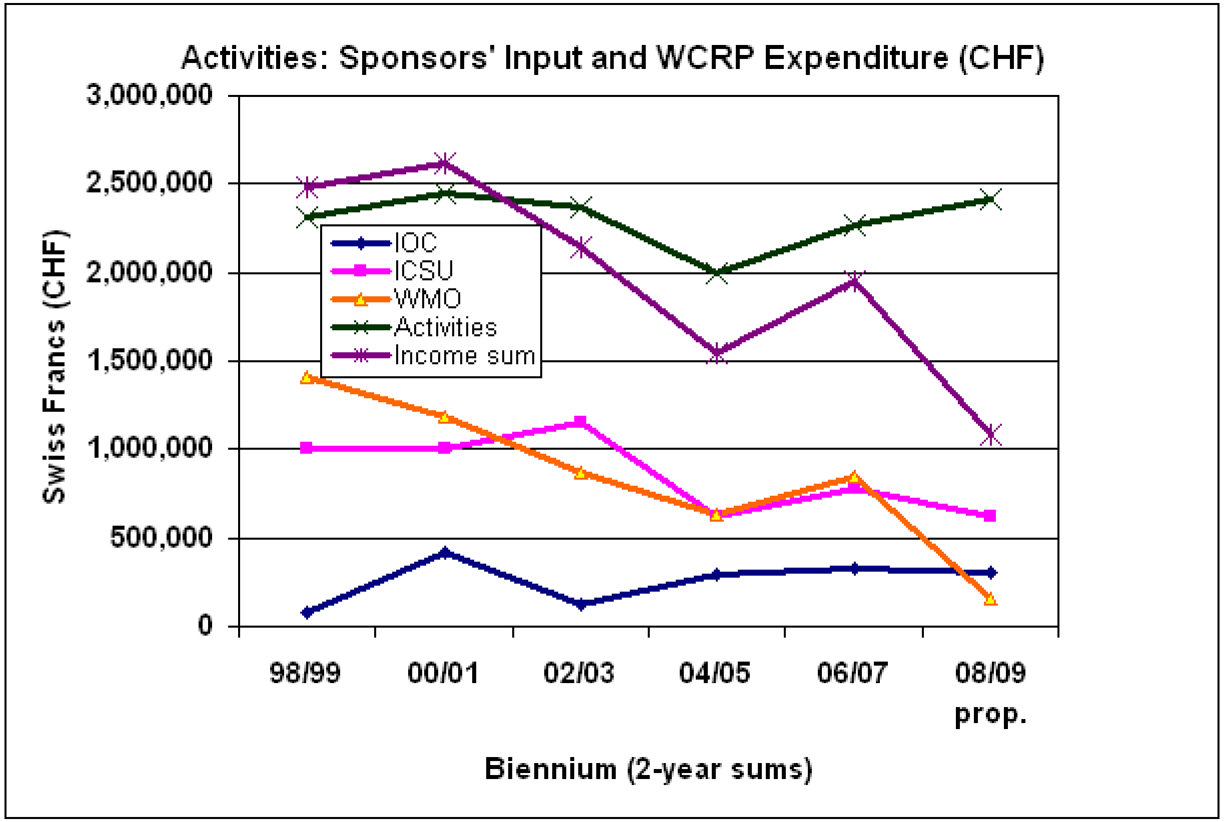
WCRP "Central" Statement of Income and Expenditure from 1996 to 2009 (proposed)

Per 2 YEARs - biennium (CHF)	96/97	98/99	00/01	02/03	04/05	06/07	08/09 prop.	Notes
balance at beginning CHF	502,918	245,376	349,648	732,639	630,020	240,531		
contribution WMO	3,823,317	4,003,200	3,507,927	3,931,700	3,928,792	4,153,100	3,797,000	
contribution IOC, ICSU, etc	1,038,750	997,300	1,511,000	1,343,416	972,944	1,105,000	2,264,100	
total income	4,759,961	5,000,500	5,020,738	5,275,126	4,901,736	5,258,100	6,061,100	
								Increases
salary costs		2,598,355	2,319,776	3,066,788	3,295,032	3,304,900	3,643,000	11% required
Activities		2,313,105	2,442,421	2,365,393	1,995,152	2,271,500	2,418,100	6% arbitrary
total expenditures	5,015,823	4,911,460	4,762,197	5,432,181	5,290,184	5,576,400		
balance at end of biennium	245,376	349,648	732,639	625,525	240,531			
2008-9 gap between funds & spend							- 1,334,100	
								-
Activities Fund								
IOC	950,000	80,000	415,000	124,000	292,000	325,000	310,000	
ICSU		1,000,000	1,009,000	1149500	621374	780,000	620,000	
WMO		1,404,845	1,188,151	864,912	633,760	848,200	154,000	
other contributions (zero to date)							(1334100)	
Income sum		2,484,845	2,612,151	2,138,412	1,547,134	1,953,200	1,084,000	
activities fund		2,313,105	2,442,421	2,365,393	1,995,152	2,271,500		

Notes on Sponsors' Income proposed for 2008 onwards

1. WMO contribution for 08/09 based on SG budget proposal 2008-2011 page 91 includes CHF3,643,000 for JPS salaries
2. ICSU contribution estimated at US$500,000 (at 1.24 CHF to USD)
3. IOC contribution estimated at US$250,000 (at 1.24 CHF to USD)

(4. WMO budget proposal to Congress has 2008-9 'spend' of CHF1209999 not CHF2418100 above which is in line with past years)



Notes on Graphs

1. Income is in 'free fall' - gap between available funds and 'usual' spend is ~US$540k pa from 2008 onwards
2. An important reason for the dramatic drop in funds (but only one) is exchange rate crash from US$ at CHF1.7 to 1.2
3. Activities 'spend' shown for 2008-9 is in line with past year's but much higher than WMO budget or available funds
4. Activities have used up savings over past 8 years (expenditure exceeding income)

Appendix C: Summary of the Goals, Objectives and TOR of the organisations with which WCRP needs to link.

Objectives of the WCRP and Terms of reference of its Joint Scientific Committee (JSC)

Source is the 1993 Agreement among Sponsors establishing the WCRP

Objectives of the World Climate Research Programme (WCRP)
Social and economic life is vulnerable to periods of climate stress. Conversely, human activity may itself influence local, regional and global climate. These are problems that the scientific community is addressing through the international World Climate Research Programme (WCRP), aiming to determine why, how and where climate changes and variations occur, and thereby attempt prediction of their future occurrence.

The overarching objectives of a World Climate Research Programme are to determine:

- To what extent climate can be predicted; and
- The extent of human influence on climate.

Joint Scientific Committee (JSC) Terms of reference
The function of the Joint Scientific Committee (JSC) is to provide scientific guidance on all aspects of the Programme, in harmony with the overall aims and interests of the sponsoring organizations.

The specific tasks of the JSC are:

1. To formulate the concept and scope of the WCRP, define the inter-disciplinary scientific strategy and determine the specific objectives and priorities for the Programme;
2. To review and assess the development of all elements of the WCRP, formulate recommendations to guide further actions and report periodically on the progress of the Programme to the sponsoring organizations; and
3. To facilitate the exchange of information among the scientists participating in the Programme and the earth system science community in general, and relevant scientific institutions and agencies, at the national and international levels.

A Joint Planning Staff, comprised of personnel seconded by sponsoring or other organizations, or supported directly by the Joint Climate Research Fund, will assist the JSC in these tasks.

Co-operation with Similarly Mandated Organisations
The WCRP is required by its sponsors to work co-operatively with the IPCC, GCOS, WCP/CCl and the ESSP.

Role of IPCC
The role of the IPCC is to assess on a comprehensive, objective, open and transparent basis the scientific, technical and socio-economic information relevant to understanding the scientific basis of risk of human-induced climate change, its potential impacts and options for adaptation and mitigation. The IPCC does not carry

out research nor does it monitor climate related data or other relevant parameters. It bases its assessment mainly on peer reviewed and published scientific/technical literature. Its role, organization, participation and general procedures are laid down in the "Principles Governing IPCC Work"

Objectives and TOR of GCOS

GCOS Objectives are intended to meet the needs for:

- Climate system monitoring, climate change detection and monitoring the impacts of and the response to climate change, especially in terrestrial ecosystems and mean sea-level;
- Climate data for application to national economic development;
- Research toward improved understanding, modelling and prediction of the climate system.

The GCOS Steering Committee (SC) consists of up sixteen scientific and technical experts selected on the basis of their personal expertise. The Chairs of standing panels are members *ex officio*. The SC is appointed jointly by the Executive Heads of the sponsoring organizations by mutual consent.

The membership of the SC includes a balanced geographical representation of major operational and research observing programmes contributing to the GCOS, as well as an appropriate mix of disciplines in atmospheric, oceanic, hydrological, cryospheric and biospheric sciences.

The functions of the GCOS Steering Committee are to formulate the overall concept and scope of the GCOS, and to provide scientific and technical guidance to sponsoring and participating organizations and agencies for the planning, implementation and further development of the GCOS.

Specifically, the Steering Committee will be called upon:

(a) To identify observational requirements, define design objectives and recommend coordinated actions by sponsoring and participating organizations and agencies, in order to optimize the system's performance and coherence, taking cognizance of the responsibilities, working arrangements and recommendations of established scientific and technical bodies of such organizations and agencies;

(b) To review and assess the development and implementation of the components of the GCOS, and report to the sponsoring organizations and to the participating agencies as required;

(c) To facilitate the exchange of information among sponsoring and participating organizations and agencies, and in general make the objectives, resource requirements capabilities and outputs of GCOS known to relevant national and international bodies.

TOR of CCl (WMO Commission that oversees the World Climate Programme, WCP)

At its fourteenth session (Beijing, China, 3-10 November 2005), the Commission reviewed its priorities for the upcoming fourteenth intersessional period, and adopted the following Terms of Reference for CCl:

(a) Promoting, supporting and facilitating WMO activities relating to climate and its relationship with human well-being, human activities, natural ecosystems and sustainable development;

(b) Coordination and consolidation of general requirements for observations, data collection, supply and exchange for all components of the World Climate Programme and its associated activities;

(c) Identification of, describing and encouraging best practices in the rescue, collection, quality control, archiving, access to and further management of climate data, including near-real-time data, proxy data, remote sensing data and associated metadata;
(d) Development of statistical and other objective methods for analysing climate data;
(e) Development of best practices for the archiving of data sets from numerical analysis
and prediction systems for climatological purposes;
(f) Provision of advice on matters relating to the access and availability of climatological data, information and services;
(g) Development of methods for climate data exchange and presenting climate information;
(h) Coordination and promotion of the analysis and monitoring of climate, its spatial and temporal variability and change, and the distribution of monitoring products for research, applications and impact assessments;
(i) Development and review of operational climate information and prediction services, and the promotion and support of applications research;
(j) Preparation of authoritative statements on climate;
(k) Capacity building, raising awareness of climate information, services and technology transfer;
(l) Preparation of guidelines for preparing and presenting climatological information for use in development and implementation of adaptation and mitigation responses to climate change, and for demonstrating the high benefit-cost ratio of climate services;
(m) Formalizing the role of CCl with respect to the cross-cutting initiatives of WMO, and evaluating the implications for each OPAG and Expert Team.
The Commission has special responsibilities to advise and guide the World Climate Applications and Services Programme, and the World Climate Data and Monitoring Programme, while providing support in collaboration with other WMO Commissions and programmes, especially AgMP, GCOS, JCOMM, ESSP, WCRP and GEO as key programme partners and benefactors.

ESSP was formed by WCRP, IGBP, IHDP and DIVERSITAS in 2001
The Scientific Committee is the governing body of the ESSP. The ESSP Scientific Committee TOR

The Scientific Committee of the ESSP (ESSP SC) provides scientific guidance on all aspects of the work of the Partnership. It develops and prioritises specific plans for the ESSP of a scientific as well as a strategic nature, guides their implementation and publicises their results. The Committee, together with the sponsor Programmes (DIVERSITAS, IGBP, IHDP, and WCRP) and ICSU, should also seek to ensure that adequate use is made of the results of the ESSP.

The Scientific Committee will promote the coordination of the national, regional and international activities that constitute the Partnership.

The Scientific Committee will ensure, and facilitate cooperation, with related international organisations, both governmental and non-governmental.

ICSU will appoint the Chairperson of the ESSP Scientific Committee. The term of the Chairperson is normally three years, renewable once.

The Scientific Committee shall be composed of 4 Programme Chairs, 4 Programme Directors, 1 ESSP Coordinator, 1 representative of each Joint Project, 1 ICSU representative, 1 START representative, 1 representative for each Integrated Regional Study, and 4 external members, of which 1 is Chair, appointed by ICSU, in consultation with the 4 Programmes.

No member of the ESSP SC should serve in any capacity for more than six consecutive years.

The ESSP SC meets at least once a year, with a frequency determined by the Committee itself.

The Chairperson may invite observers to attend meetings of the Scientific Committee.

The International Geosphere-Biosphere Programme (IGBP) formed 20 years ago

The vision of IGBP is to provide scientific knowledge to improve the sustainability of the living Earth. IGBP studies the interactions between biological, chemical and physical processes and interactions with human systems and collaborates with other programmes to develop and impart the understanding necessary to respond to global change. IGBP´s research goals are to:

• Analyze the interactive physical, chemical and biological processes that define Earth System dynamics
• The changes that are occurring in these dynamics
• The role of human activities on these changes.

1. The objective of the International Geosphere-Biosphere Programme: A Study of Global Change (IGBP) of The International Council of Scientific for Science (ICSU) is to describe and understand:
• the interactive physical, chemical and biological processes that regulate the total Earth System • the unique environment that the earth system provides for life
• the changes that are occurring in this system
• the manner in which all are influenced by human actions.
2. Priority in the Programme will fall on those areas of each of the fields involved that:
• deal with key interactions and significant changes on time scales of decades to centuries
• most affect the biosphere
• are most susceptible to human perturbation
• will most likely lead to practical, predictive capability

In concentrating on interactive biological, chemical, and physical processes, the Programme will of necessity put less emphasis on studies that, though they have great strengths and momentum of their own, are already being addressed in existing initiatives, or that will less clearly contribute to our understanding of the changing nature of the environment of life on timescales of decades to centuries.

The IGBP Scientific Committee have the responsibilities to develop and prioritize specific plans for the Programme, to guide its implementation and to publicize its results. The Committee, together with ICSU, should also seek to ensure that adequate use is made of the results of the Programme.

The Scientific Committee will promote the coordination of the national, regional and international activities that constitute the Programme and will ensure liaison, and facilitate cooperation, with related programmes of members of the ICSU family and of other international organizations, both governmental and nongovernmental.

Appendix D Examples of how WCRP might function under a combination of options b, possibly c and d.

Successful implementation of WCRP Strategic Framework 2005-2015 is not independent on the already existing structure of WCRP and existing linkages between the WCRP core projects, WGs and panels. Implementation should necessarily account for the present and evolving structure and funding capabilities of individual activities. Priority ongoing activities include those that contribute to stakeholder needs and concerns, whether they are identified in a cross cutting activity or contained wholly within a single element of WCRP.

There are several existing examples of implementation of cross cutting activities and partnering/networking with a broader range of stakeholders within WCRP.

La Plata Basin Experiment

The five countries of the La Plata Basin (LPB) have presented to Global Environment Fund (GEF) the Framework Program of the LPB water management, for which implementation was approved 2006. The Program goal is to build a framework for the sustainable management of the hydrological resources of the basin. The WCRP/CLIVAR/VAMOS group had the responsibility for the preparation of the Program component related with the prediction of hydrological impacts related with climate variability and change. The plan includes: i) the development of climate and hydrologic scenarios for the Basin in the context of climate change, ii) development of land use change scenarios for the Basin, iii) coordination, integration, and improvement of the operative systems for atmospheric and hydrological prediction (observing system improvement, conventional and remote sensing data assimilation, model transferability), iv) development of hydrological prediction systems for different users (civil warning, hydroelectric energy generation, agriculture, navigation, etc.). Since 1998, VAMOS has brought together in South America researchers from Argentina, Bolivia, Brazil, Chile, Paraguay, Peru, Uruguay and USA (~70 principal scientists plus a larger number of graduate and undergraduate students, and collaborators) to form a coherent approach to research on climate variability and predictability for the region. Funding for scientific activities related with VAMOS in South America has been provided by: NOAA/CPPA Program, NSF, National Funding Agencies of South America (Argentina, Brazil, Chile, Paraguay, Peru, Uruguay, ~\$500K/y), European Commission (CLARIS, \$200K/y), IAI (PROSUR, \$200K/y), GEF (La Plata Basin, \$3M/y, requested for observing system enhancement). The participation of the VAMOS Group in the GEF Program is unquestionably a great example of how WCRP/CLIVAR science can be applied to solve societal needs, while at the same time it provides additional funding for climate monitoring, field campaigns, as well as regional database enhancement.

AMMA

The AMMA experiment which took place recently in West Africa is another good example of the leverage provided by the WCRP network. Born from a French initiative, this project was able to gather resources beyond national possibilities, with the participation of more than 50 institutions from a wide range of countries. About 500 people could participate to the SOP, with measurements from 6 aircrafts, a variety of in situ platforms from Tamanrasset to Cotonou, balloon launching, coordination with the PIRATA oceanographic measurements, ...

Anthropogenic Climate Change

A third example is how WCRP, on the basis of the successful track record in its focus area of "determining human effects on climate" as evidenced by the contributions to the recently issued IPCC AR4 WG1 Summary for Policy Makers, can now formulate a stronger, more visible and coherent thrust on Anthropogenic Climate Change (ACC).

With increasing discernment of the human effects on the global climate system, and recognizing the need to link the advancements in physical understanding with quantitative determination of the climate impacts to be useful for society, WCRP can and has the opportunity to strongly articulate its future plans as follows:

a) Based on the "Key Uncertainties" listed by the IPCC AR4, WCRP can set a more aggressive facilitation of the research in climate change with a view towards observations, detection and attribution of the human influences on climate,and making global and regional projections of climate changes in the 21^{st} century and beyond.
b) Synthesis of elements within WCRP to produce visible, coherent and unique deliverables containing the scientific advancements on climate change over regular time intervals. Thus, the Anthropogenic Climate Change (ACC) initiative within WCRP will present to the community a continuing and timely synthesis of the state-of-the-science.
c) With the growing significance of the biogeochemical processes in climate change WCRP can cultivate links with IGBP. Other potential partners (ESSP) are looking for reliable outputs from WCRP to link climate change impacts with societal ramifications e.g., emissions, air quality, health, water, agriculture etc.
d) Synergistic interactions with the many national programs that are either dealing with research advances in climate change science and/or are focused on the impacts.
e) Growing interactions with other cross-cutting themes emerging from the Strategic Framework e.g., extremes and abrupt climate changes, monsoons, sea-level rise, Anthropogenic Chemistry and Climate, will further enhance WCRP's deliverables.
f) Enhancing the interactions involving developing countries through partnerships involving data acquisition (observations and model simulations) and distribution, diagnosis of and disseminating regional climate change information. This will enable the climate change science and outcome knowledge to become available worldwide. Augmentation through seminars/ workshops will enable a global reach.

Following the release of the IPCC AR4, WCRP has the opportunity to take a leadership role in addressing the scientific gaps and uncertainties concerning climate change at a number of meetings and workshops in 2007 and 2008.

Appendix E: One Possible Action Plan for a Networked Future for WCRP

Based on the options presented in their report, Eera suggests the following steps for WCRP to deliver long term value and securing enough funding in the short-term to ensure the success in the long term. The text that follows is a built on the final section of the Eera report.

Step 1. – Discuss way forward with current sponsors
Discuss with current sponsors the new network orientation of WCRP and convince them that this is the way to implement COPES by providing a showcase of existing successful networking cases, such as La Plata Basin Experiment. These negotiations must be commenced before the JSC meeting in March.

Step 2. – Identify additional partners
Make the access to the network easy by describing the WCRP deliverable to different stakeholders in a concrete manner.

WCRP's networking should be initiated with those who need what WCRP can deliver and have the complementary capacities to create and receive added value to WCRP's outputs. Eera suggests direct contacts to those interviewees, who have expressed clear interest towards enhanced networking with WCRP. To prepare for these meetings, WCRP should create the "networking story" to raise funding, just as companies create investment stories to raise venture funding. Potential new partners include the World Bank, Consultative Group on International Agricultural Research, International Association of Oil and Gas Producers and Munnich Re.

Step 3. – Discuss opportunities with new partners
Create processes that help produce the required deliverables, requiring:

- Communication process,
- Knowledge accumulation process,
- Access enabling process and
- Problem solving process.

After having identified the potential "end-user clients" or funding agents, collect a cross cutting and even cross-disciplinary "Round Table" from the network to figure out the potential approach to solve the challenge. Meet the key stakeholders to discuss these challenges and find out how WCRP could set forth to help solving these challenges with the climate research information.

Step 4. – Develop a delivery Plan
"Selling" the added value of WCRP to the stakeholders will require improved management and efficiency.

Step 5. – Think Big
WCRP must assume the network leadership because it will not be given. The requirements for successful network leading are:

- shared vision
- shared interest
- shared efforts

The tool of a democratic network leader is motivation, built through steps 1–5.

Eera strongly recommend that WCRP should have the courage to think big; take a big leap towards becoming something entirely new; and refuse to continue struggling to get by with the "scraps" of money they get from institutional sources.

Three possible modes of operation

Eera identified three modes of operation that may be useful for strengthening our partnerships with various groups. These are: i) Community climate resources, ii) Sharing climate knowledge, and iii) Regional research delivery. These three models provide insight and guidance on how WCRP can build its network, the role WCRP can play in the network, and who is part of the WCRP network.

Table E.1 Community Climate Resources

Objective of this path:	To enhance the efficiency of the scientific community via a virtual open innovation platform
Potential Outcomes:	- A global community connected via the Internet, 24/7. - An efficient global network of like minded individuals and organisations
Role/Mission:	To be the 'broker' of climate research information.
Methodology:	Follow the 'Plug and Play Freeware' model embraced by Linux: - Anyone in the network can contribute data from ensembles and other applications and the 'central committee' identifies and selects those of value. - A collection of climate model components including the results from ensembles and other applications are provided.
Added Value:	- Anyone can contribute additions or changes to this framework - The components are available freely to the network of participants - The information provided could be tailored for the different users (scientists/students, end-users/funding agents) via custom 'interfaces' to the information. - The stamp of excellence associated with a collaborative effort of synchronized and shared data and information.
Example:	The assembly by WCRP/CLIVAR WGCM of the coupled model results for the AR4 results and the VACS Atlas

Table E.2 Sharing Climate Knowledge

Objective of this path:	To create better regional reach and understanding of end-user needs.
Potential Outcomes:	- Cost-efficient and needs-based community of regional partners including universities, NMHSs, UN agencies, ICSU, WMO, IOC, and other research organisations. - A dynamic platform for communication and interaction that can be tailored to meet the needs of its varying users.
Role/Mission:	To offer a platform for exchanging ideas, providing information and identifying new opportunities.
Methodology:	- This model is an enhanced but more 'deliberate' and focused

	version of the present WCRP network. - Potential speakers and experts from the WCRP network are identified to service a local group. - Information on a topic related to climate research is tailored to meet the needs of the local group. - WCRP becomes a 'contract centre' that connects the needs of end users and the requirements of regional activities with the appropriate scientific expertise. - The venues for sharing knowledge become interactive exchanges of information between the scientific community and end-users.
Added Value:	WCRP offers a forum that connects scientists to the users of their research.
Example:	Trieste Workshop on Interpreting Climate Change Simulations: Capacity Building and Developing Nations

Table 2.3 Regional Research Delivery

Objective of this path:	To improve our capacity to raise funds by focusing on climate-related challenges at a *regional level*. And by integrating individual national efforts.
Potential Outcomes:	- Enhanced network that is better equipped to face regional challenges (e.g. El Nino or Tibetan plateau) that are having negative impacts on society. - Interactive and dynamic research community at the global and regional level. - Involvement of local researchers including young scientists in the global network.
Role/Mission:	To support efforts and activities that regionalize research results.
Methodology:	- Work with small groups of nations to deliver research that directly benefits them via the World Bank or other similar organisations. - Facilitate large regional applications the need and the resources exist.
Added Value:	- The WCRP international 'stamp' or 'brand' attributed to the regional application. - The identification and mobilization of resources for a group of nations facing a single challenge in a larger region. - A forum for local researchers including young scientists where they could apply the knowledge gained to meet their needs.
Example:	The VAMOS/CLIVAR La Plata Basin study

WORLD CLIMATE RESEARCH PROGRAMME

JOINT SCIENTIFIC COMMITTEE

TWENTY-EIGHTH SESSION

ZANZIBAR, TANZANIA, 26-30 MARCH 2007

JSC-XXVIII/Doc. 1.2
(16.II.2007)

Item 1

Scoping Paper on a Possible IGBP-WCRP Merger

Submitted by Peter Lemke and Will Steffen

The current WCRP and IGBP scientific landscapes

WCRP

The main objectives, set for WCRP at its inception in 1980 and still valid, are to determine the predictability of climate and to determine the effect of human activities on climate. To achieve these objectives, WCRP adopts a multidisciplinary approach and organizes large-scale observational and modelling projects focusing on aspects of climate too large and complex to be addressed by any one nation or individual scientific discipline. Today the WCRP consists of four major core projects, several working groups, and various crosscutting and co-sponsored activities that are designed to improve scientific understanding and knowledge of processes that in turn result in better models. These projects play the central role in WCRP.

WCRP has defined a new strategic framework for the next ten years under the title “Coordinated Observation and Prediction of the Earth System” (COPES). It will capitalize on past progress with the aim to facilitate analysis and prediction of Earth system variability and change for use in an increasing range of practical applications of direct relevance, benefit and value to society. This new strategy will provide the unifying context and agenda for the wide range of climate science coordinated by, and performed through, WCRP core projects and other activities, and for demonstrating their relevance to society.

Under this strategic framework, WCRP will aim to determine what aspects of climate are predictable, and how far in advance and for what regions they can be predicted. This information will provide invaluable input for climate risk management in both the public and private sectors, contribute to planning for sustainable development and form a basis for natural hazard disaster reduction and mitigation. An essential step for better prediction of climate and its application is observing and understanding the current climate state. Deficiencies in understanding will reveal the need for new observing strategies (for both remote-sensing and in situ systems), process studies and improved prediction models.

In recognition of the central role of modelling and the need to coordinate such activities across the various WCRP projects and groups, a WCRP Modelling Panel (WMP) has been established. A WCRP Observations and Assimilation Panel (WOAP) will provide a focus for the coordination of WCRP observational activities and act as the liaison to other climate observing activities.

Climate and Cryosphere (CliC)
The frozen water in the Earth's climate system – sea-, lake- and river-ice, solid precipitation and snow cover, ice caps and ice sheets, glaciers, permafrost and frozen ground – significantly influences climate locally and globally. CliC's goals are to improve observations and modelling of the cryosphere, investigate its contribution to climate predictability, and project its reaction to the warming climate. These results will be used in studies of mean sea level, water resource management, and several other applications of high practical value.

Climate Variability and Predictability (CLIVAR)
CLIVAR is the WCRP project that addresses climate variability and predictability with a particular focus on the role of ocean-atmosphere interactions in climate. The oceans' large heat capacity both exerts a moderating influence on seasonal and longer climate changes and provides a mechanism for sustained oceanic influence on the atmosphere. CLIVAR studies the El Niño/Southern Oscillation and its impacts, monsoon systems around the world, as well as climate phenomena controlling longer-term climate variability and change.

Global Energy and Water Cycle Experiment (GEWEX)
Water in the atmosphere and at the surface of the Earth is essential for life. In addition, it is the most influential factor regulating our environment, controlling clouds and radiation and driving the global circulation of the atmosphere. GEWEX carries out investigations of the atmosphere, its global water cycle and energy budget, and how they might affect and adjust to the global changes associated with the increase in greenhouse gases.

Stratospheric Processes And their Role in Climate (SPARC)
Studies of the stratosphere hold the key to the understanding of formation of polar stratospheric clouds and ozone depletion, penetration of ultra-violet radiation into the troposphere, sudden stratospheric warming, and even weather predictability beyond one week. The stratosphere exhibits long-term trends, which are different from ones in the troposphere. The SPARC project addresses these issues and provides the WCRP with expertise in atmospheric chemistry.

Modelling activities
The development of comprehensive global climate models, building on the scientific advances in the WCRP projects and other activities, is an essential unifying theme running through WCRP. Such models are the fundamental tools for understanding and predicting natural climate variations and for providing reliable estimates of anthropogenic climate change. WCRP activities in this area are centred on two main groups: the joint WMO Commission for Atmospheric Sciences/JSC Working Group on Numerical Experimentation (WGNE) and the JSC/CLIVAR Working Group on Coupled Modelling (WGCM).

Efforts continue to be devoted to a wide range of internationally-coordinated model intercomparison exercises as a means of identifying errors in climate simulations and to find ways of reducing errors. In particular, coupled (ocean-atmosphere) model intercomparison projects have been organised, and standardised experiments with coupled models are being undertaken, which should help in reaching consensus on climate change. The results produced by these activities in WCRP have been a key input to all the IPCC Assessments. WCRP will continue to strive to further reduce the uncertainty of global change predictions and to broaden the scope of considered properties thus producing a sounder scientific basis for decision making in all areas where adequate management is dependent on the current and future state of the environment. In particular, the focus is on improving seasonal climate predictions, predicting the monsoon rains and determining how fast sea-level will rise.

IGBP

The current scientific landscape of IGBP can best be understood by considering the two phases of IGBP research

Phase 1 of IGBP (1987 – 2002/3) had the following characteristics:

- Built around a collection of individual projects with little forethought (despite the objectives of the programme) of how the projects could be integrated to build an Earth System understanding.
- The programme-wide integrative project GAIM (Global Analysis, Integration and Modelling) focused primarily on biogeochemical cycles, the especially carbon cycle, and did not attempt to integrate or synthesise the work of the core projects.
- A post-hoc synthesis of the entire programme (+ additional research) to place IGBP's work in an Earth System context was carried out and published as the book "Global Change and the Earth System: A Planet Under Pressure". The synthesis project laid the foundation for the design of the collection of Phase 2 projects.

Phase 2 of IGBP (2000 – present) has the following characteristics:

- The programme has attempted to be more systemic from the outset, designing a set of projects that are meant to work together to describe the biogeochemistry of the whole Earth System, including human-driven modifications of biogeochemical cycles.
- The structure is designed around the three major domains of the Earth System (atmosphere, ocean, land), the interfaces between the pairs of domains, and an integrative approach to the whole Earth System through time, from past through present to future.
- The projects are designed, where appropriate, to have "hooks" to the other global change research programmes so that IGBP could contribute towards an eventual coordinated ESSP research effort.

The current suite of IGBP projects consists of:

IGAC (International Global Atmospheric Chemistry) – to understand the role of atmospheric chemistry in the Earth System and to determine the effects of changing regional emissions and depositions, long-range transport and chemical transformations on air quality.

iLEAPS (Integrated Land Ecosystem-Atmosphere Processes Study) – to enhance the understanding of how interacting physical, chemical and biological processes transport and transform energy and matter through the land-atmosphere interface

GLP (Global Land Project) – to measure, model and understand the coupled human-environmental system

LOICZ (Land-Ocean Interactions in the Coastal Zone) – to provide the knowledge, understanding and prediction needed to allow coastal communities to assess, anticipate and respond to the interaction of global change and local pressures which determine coastal change.

GLOBEC (Global Ocean Ecosystem Dynamics) – to advance our understanding of the structure and functioning of the global ocean ecosystem, its major subsystems, and its response to physical forcing. This understanding will help develop the capability to forecast the responses of the marine ecosystem to global change.

IMBER (Integrated Marine Biogeochemistry and Ecosystem Research) – to study the sensitivity of marine biogeochemical cycles and ecosystems to global change, on time scales ranging from years to decades.

SOLAS (Surface Ocean – Lower Atmosphere Study) – to achieve quantitative understanding of the key biogeochemical-physical interactions and feedbacks between the ocean and the atmosphere, and how this coupled system affects and is affected by climate and environmental change.

PAGES (Past Global Changes) – to support all paleo-environmental and paleo-climate research efforts directed at securing a quantitative understanding of natural and human-induced variations of the Earth System in the past, in order to make sound predictions of future climate, environment and sustainability.

AIMES (Analysis, Integration and Modelling of the Earth System) – to understand and quantify the influence of human choice on environmental change and the many subsequent feedbacks and linkages between human activities and the natural environment.

Note that SOLAS is co-sponsored by WCRP, and GLP and LOICZ are co-sponsored by IHDP. (SOLAS, GLOBEC and IMBER are also co-sponsored by SCOR; SOLAS and IGAC are co-sponsored by CACGP).

Commonalities and differences between the programmes

As both WCRP and IGBP are fundamentally natural science-based programmes, their commonalities are many. However, there are significant differences that must be taken into account in deciding whether to merge or not.

Commonalities

The research in both WCRP and IGBP is strongly grounded in the modern scientific method, and largely based on the paradigms, perspectives, methods and language of the natural sciences. Both programmes build up their much of their knowledge base on a blend of process studies, long-term operational observations (increasingly via remote sensing), modelling and integration/synthesis activities. Both place a strong emphasis on quantitative approaches to research, where possible. In terms of implementation of their research agendas, both WCRP and IGBP use similar value-adding activities at the international level – international research networks, multi-country field campaigns/experiments, common experimental protocols, and model intercomparisons and comparisons of models with data.

Differences

WCRP is strongly a physical science-based programme, although it spans many disciplines – meteorology and oceanography on various regional scales, atmospheric chemistry, glaciology, and hydrology. WCRP recognises the importance of both biology and human processes in the climate system, but works through IGBP and IHDP to access this expertise rather than trying to build it into its own programme or to form co-sponsored projects.

As noted above under "Commonalities", IGBP also has a strong legacy of research in the natural sciences, but acts much more as a "tweener" in terms of engaging a very wide range of research communities, especially in the social sciences. For example, the recently launched GLP (Global Land Project) focuses on global change and social-ecological systems, and is thus a fully integrated project between the natural and social sciences. The same is true for phase II of LOICZ (Land-Ocean Interactions in the Coastal Zone). Both GLP and LOICZ are fully co-sponsored by IHDP, whereas there are no co-sponsored projects between WCRP and IHDP.

Diversitas, which also works across the natural-social science boundary, collaborates closely with IGBP in several areas, particularly with regard to terrestrial biodiversity (GLP). However, the two IGBP projects LOICZ and GLOBEC also deal with the role of biotic diversity in their systems, and thus collaborate with Diversitas.

Historically IGBP has tended to take (i) a longer term perspective of global change through its palaeo project PAGES, and (ii) a more systems-oriented approach, typified by its post-2000 emphasis on nonlinearities, abrupt changes, intermediate complexity models, and complex systems approaches. However, this distinction between IGBP and WCRP has blurred in recent years as WCRP has also focussed more in these areas (e.g., the CLIVAR-PAGES intersection; more comprehensive modelling approaches to simulating Earth System dynamics).

Opportunities and risks of a merger

A merger of WCRP and IGBP promises enhanced scientific effectiveness and efficiency, but carries significant risks. We outline the major opportunities and risks below.

Opportunities

The opportunities are largely focused on better use of scientific and programmatic resources and on the capability to make rapid and fundamental progress on key scientific questions. More specifically:

- More rapid scientific progress through enhancement of integrative thinking and modelling – given the growing realisation that physical, chemical and biological processes are tightly coupled in many ways (especially in transport across the Earth System interfaces), closer collaboration between or merging of projects would likely accelerate scientific progress. SOLAS is an example of such a "merged WCRP-IGBP project" from its beginning.
- Scientific synergies - a merged programme would promote the co-location of major research infrastructure and activities (e.g., the GEWEX Continental Scale Experiments and iLEAPS and GLP activities) as well as bring together remote sensing and modelling activities.

- Programmatic efficiencies – fewer committees to fund and support; an integrated secretariat function requiring fewer staff and resources (e.g., a single, integrated communication effort); better coordination of meetings and other activities. These efficiencies would release scarce resources for other activities, especially for supporting new scientific initiatives and activities within the merged programme.

Risks

A merger of WCRP and IGBP entails substantial risks, perhaps the possibility of more negative consequences than one might think from a cursory examination. More specifically:

- Loss of resources. The efficiencies gained through merging (bullet 3 under opportunities) also present a risk. It could easily occur that national contributions could weaken, under the assumption that the same scientific output could be achieved with less funding in a merged programme. However, several analyses by the ESSP programmes strongly support their conclusion that "glue money" is inadequate for their current research agendas and any efficiency savings could best be re-invested to support the research. This issue would need very careful consultation with IGFA to avoid a potentially significant drop in overall funding support.
- The merger of WCRP and IGBP to create a "mega-programme" on the biophysical aspects of Earth System science would create a significant imbalance with IHDP and Diversitas in terms of resources, communities and presumably influence (dominance of the biophysical sciences). This could easily be viewed as threatening to those two programmes, and could seriously damage any attempt to re-activate and strengthen the ESSP on the basis of notional parity among the four (or now three) programmes. We believe that this risk is serious.

We believe that this second risk is indeed serious, and raises the broader issue of the future of ESSP. Thus, the possible merger of WCRP and IGBP should not be considered only from the perspectives of the two programmes, but must be considered as part of a larger, coordinated plan to deal also with the issues surrounding the future of the ESSP. In view of this, we propose two options in the next section. Option 2 deals explicitly with the risk to ESSP.

Recommendations for the future

Option 1 – WCRP-IGBP merger. This option is built around a full merger of the two programmes by 2010. The option has the following elements:

- A new name for the single programme; formal conclusion of the names WCRP and IGBP
- One set of projects, comprised of a mix of existing WCRP and IGBP projects with some integration at the project level to reduce the overall number of projects. See Annex 1 for suggestions on integration at the project level.
- A single scientific committee with a single Chair (there may need to be a transition period with two Co-Chairs, one each from the WCRP and IGBP communities.
- A single Director
- A single budget (although from a wide range of sponsors). Care must be taken not to lose financially through the merger. For example, although WCRP obtains significant income from WMO, it, like IGBP, also obtains income from national contributions. There is a danger that as countries merge their two contributions into one, the new

contributions will be less than the sum of the individual WCRP and IGBP contributions.

- Two secretariats (Geneva and Stockholm) are retained, but they function as a single unit with well defined and complementary roles.

Option 2 – Focus on ESSP. This option is designed to deal with the risk of a WCRP-IGBP merger to the ESSP. The option is built around a significant strengthening of the ESSP, but with retention of IGBP and WCRP as identifiable programmes. The option has the following elements:

- Retain names, communities, cultures of IGBP and WCRP as individual programmes, but do not continue with "business as usual".
- Emphasis on tighter collaboration and integration between WCRP and IGBP at the project level. Basically, the same or a very similar set of projects could be developed as for Option 1. See Annex 1 for suggestions on integration at this level.
- Form a single WCRP-IGBP executive group (WCRP and IGBP Officers) that guides WCRP-IGBP collaboration. Executive group meets annually. WCRP and IGBP scientific committees hold joint meetings as opportunities allow.
- Current funding strategies and management structures of the two programmes are retained.
- However, each programme shifts the equivalent of 1.5 positions (either as funding or as staff time) to an ESSP Secretariat, to create 3 FTE (Full-Time Equivalents) for ESSP. These resources are used to lever support from IGFA for a fourth position for ESSP (the Director), thus creating a 4-person ESSP Secretariat. See Annex 2 for further comments on ESSP management and resources.

Annex 1: Suggestions for project-level collaboration or merger

Existing collaborative activities

IGAC-SPARC – atmospheric chemistry and climate initiative

CLIVAR-PAGES intersection – long-standing collaboration on climate variability in the past

WGCM-AIMES (and previously GAIM) collaboration on modelling – most well-known project is C4MIP – Coupled Climate – Carbon Cycle Modelling Intercomparison Project. Model for further coupling of IGBP expertise into WCRP models – e.g., atmospheric chemistry, dynamic vegetation

GEWEX-iLEAPS collaboration on aerosols-clouds-precipitation-climate

Existing merged project

SOLAS – designed as a jointly owned project from the beginning

Possible further project collaboration or merger

CLIVAR-IMBER – should physical ocean circulation research (post-WOCE) be merged in with IMBER to give an integrated project on ocean physics, chemistry and biology/ecology?

GEWEX-CliC-GWSP-iLEAPS-GLP-LOICZ – is there potential for closer collaboration on several aspects of water-related research or perhaps even rationalisation/merger to a lesser number of projects? The two major themes would be: (i) water as an integral gas/fluid/solid in the functioning of the Earth System, and (ii) water as a fundamental resource for human well-being. Interaction of (i) and (ii) is becoming increasingly important.

A single Earth System modelling group for WCRP and IGBP, focussed on the biophysical dynamics of the Earth System. The group would focus its activities on AOGCMs, progressively building in more currently unresolved processes, chemistry and biology based on the expertise of IGBP/WCRP core projects.

Note that the difficult issue of incorporating human dimensions into Earth System dynamics is now being tackled directly by AIMES in addition to developing EMICs, and the proposed joint modelling group obviously needs to keep close watching briefs on these activities. For the development/optimisation of EMICs and the inclusion of human dimensions it seems to be appropriate, for the time being, to establish a second modelling activity (see Annex 3).

Comment: These existing and proposed collaborations involve all of the IGBP projects (except for GLOBEC, which concludes in 2009) and all of the WCRP projects. However, it should be noted that in a complete merging of projects not all activities of the merged projects will fall into the overlapping part, e.g. in a possible SPARC/IGAC merging, there are several activities in SPARC and IGAC which will not be pursued jointly. Care has to be taken that these activities find an appropriate home.

Annex 2: ESSP and the merger of WCRP and IGBP

As noted earlier, the possible merger of WCRP and IGBP must be considered as part of a larger, coordinated plan to deal also with the issues surrounding the future of the ESSP. As we understand it, there have been discussions recently about the future of ESSP. In particular, there is a need to clarify the role, governance, structure and activities of ESSP.

Option 2 described earlier makes a direct link between the proposed WCRP-IGBP merger and ESSP. It argues not to formally merge WCRP and IGBP, but rather to strengthen and re-activate ESSP as the integrating structure for not only bringing together WCRP and IGBP, but also IHDP and Diversitas, within a single framework. Such an ESSP-centric proposal could have the following elements:

Governance: An ESSP steering committee made up of: (i) representatives of the four programmes and START, and (ii) independent members ("Earth System thinkers") appointed by ICSU. Ex-officio committee membership of the leaders of ESSP activities should be considered.

Support: A 4-person ESSP secretariat should be established. Resources for 3 positions should come WCRP and IGBP, as proposed in Option 2 (each programme shifts the equivalent of 1.5 positions (either as funding or as staff time) to an ESSP Secretariat, to create 3 FTE (Full-Time Equivalents) for ESSP). These positions would be (i) a Deputy Director/Programme Officer, (ii) a Communication/Outreach Officer, and (iii) an Admim/Finance Officer. The resources donated by WCRP and IGBP should be used to lever support from IGFA for a fourth position for ESSP (the Director), and for some operating funds from IGFA members.

Location: Co-location with the ICSU Secretariat in Paris would have many benefits, although, via the IGFA process, a particular country may wish to put forward some resources to host the ESSP Secretariat. Arguments can be made both for locating the office in Europe (close to the four programme secretariats) and on another continent (better geographical balance).

Activities: The current emphasis in ESSP is on the four "joint projects" and on START, along with MAIRS as an integrated regional study. However, it would not be difficult to expand ESSP activities towards a more complete Earth System science programme. ESSP activities could include:

- the four joint projects on carbon/energy, food, water and health

- capacity-building and integrated regional studies – this would include START as the capacity-building project of the ESSP, as well as potentially five IRSs – (i) LBA, or its follow-on project; (ii) MAIRS, already established by START; (iii) AMMA (what is its current status?), (iv) an Antarctic/Southern Ocean IRS, and (v) a Northern High Latitudes IRS. The first three represent a set of tropical IRSs, all with strong human components. The last two, which should build on CliC and IPY activities in collaboration with SCAR and IASC/IBFRA, cover the important roles of the polar regions in Earth System dynamics.

- Earth System analysis and modelling (AIMES/WGCM) should be transferred from IGBP/WCRP to the ESSP, especially if (i) the focus is on incorporating the human dimensions into Earth System analysis and modelling, and (ii) an AOGCM-based biophysical modelling group is established by WCRP and IGBP.

Annex 3: ESSP Modelling Strategy: Requirements to Understand and Predict the Earth System

The current status of modelling the Earth system is characterized by sophisticated high-resolution general circulation models (GCMs) for the physical climate system, with these complex models being expanded to encompass chemical and biological aspects of the Earth system. In particular, detailed models for the atmospheric chemistry and the carbon cycle, including dynamic vegetation modules and interactive marine ecosystems, are now being developed for GCMs. Earth system Models of Intermediate Complexity (EMICs) offer a complementary approach for long-term simulations, and more holistic, exploratory models are being developed for the investigation of the interaction of human societies with the other components of the Earth system. Improvement of the present modelling capability thus requires a co-ordinated hierarchical approach with a suite of different models. In particular, there is a need for:

1. Experimentation with current GCMs to:
    a. provide the material for IPCC and other international assessments through sensitivity studies, climate hindcasts and projections of future change;
    b. assimilate and predict the coupled system on intraseasonal to interannual (and eventually longer) time-scales.

2. Continued experimentation (including 'retrospective predictions' at various time-scales) and process studies with current GCMs and comparison with observations to improve and validate the models used in 1.

3. Development of the ability to perform more detailed global modelling of the carbon cycle, hydrology, dynamic vegetation, tropospheric and stratospheric chemistry, ocean biology, lateral transport of elements and a range of other biogeochemical processes (requiring observations, process studies and modelling of the individual systems).

4. Work on extending GCMs to include each of these additional components of the Earth system in turn, as a basis for the studies in 1.

5. Development of and work with more holistic models (including EMICs) to:
    a. study the interactive aspects of the natural system;
    b. simulate longer time-scales, e.g. Ice Age Cycles;
    c. compare and validate with GCMs where possible.

6. Development of models of the interaction between the human and natural systems based on the more holistic models.

The effective development and implementation of such a modelling programme would require a range of separate but coordinated and collaborative activities. Including all of these in a single overarching ESSP activity would not be appropriate, at least at this stage. Instead, the coordination of the various modelling activities above could be achieved at least initially through presentation, discussion and agreement at the now-annual sessions of the ESSP Chairs and Directors. However, more dedicated mechanisms, procedures and fora will also be needed to make effective progress on the necessary cooperative efforts, and such issues should also be considered in the first instance and as a matter of high priority by the ESSP Chairs and Directors.

Based on experience and track-record to date, it would be most fitting for WCRP and IGBP to merge the Working Group on Coupled Modelling (WGCM) and the global coupled modelling activities in AIMES (Analysis, Integration and Modelling of the Earth System), in order to take care of the activities 1 to 4 above. This productive partnership provides a common platform for a broad range of communities to collaborate as complex models of the physical climate evolve towards more complex and integrated Earth System models.

A slightly different modelling community is concerned with Earth system Models of Intermediate Complexity (EMICs) focussing on activity 5, which must provide inputs to activities 2 and 3, linking closely with the joint WCRP-IGBP GCM-Group, with the WCRP Climate Variability and Predictability (CLIVAR) project and IGBP's Past Global Changes (PAGES) project. Activity 6 should be implemented in the first instance through a full and equal partnership between IGBP and IHDP. For the time being, it seems appropriate to establish a separate modelling group focussing on activities 5 and 6, with the joint GCM group being kept informed but with a view to playing an increasingly more active and direct role in the development, use and evaluation of such model components for future inclusion in GCMs.

WORLD CLIMATE RESEARCH PROGRAMME

JOINT SCIENTIFIC COMMITTEE

TWENTY-EIGHTH SESSION

ZANZIBAR, TANZANIA, 26-30 MARCH 2007

JSC-XXVIII/Doc. 1.3
(19.II.2007)

Item 1

WCRP NETWORK REPORT DECEMBER 2006 (SUMMARY)

World Climate Research Programme (WCRP)
Network Report

Executive Summary

As a crucial step in implementing its Strategic Framework 2005-2015, the World Climate Research Programme (WCRP) commissioned a study to map the opportunities and possibilities for enhancing its effectiveness as well as developing and improving its cooperation with key stakeholders. On behalf of WCRP, Eera Consultancy conducted more than 85 in-depth interviews and four stakeholder workshops (in Asia, Europe, and North America) in order to help identify WCRP's past successes and future challenges. Eera compiled the results and responses respecting fully the confidentiality of the participants into the WCRP Network Report, which has become the authoritative voice of WCRP's current network.

The survey of WCRP stakeholders concludes that sponsors, funding agencies, end-users and researchers are united in viewing the WCRP as an invaluable facilitator for international coordination of climate research. WCRP gets high marks for its objectivity, impartiality and the quality of the research generated from its coordination efforts. It is also clear from the interviews and workshops conducted, that WCRP's coordination efforts must continue to evolve in keeping with changing scientific and geopolitical priorities.

The strengths and advantages stakeholders perceive WCRP as having include the following:

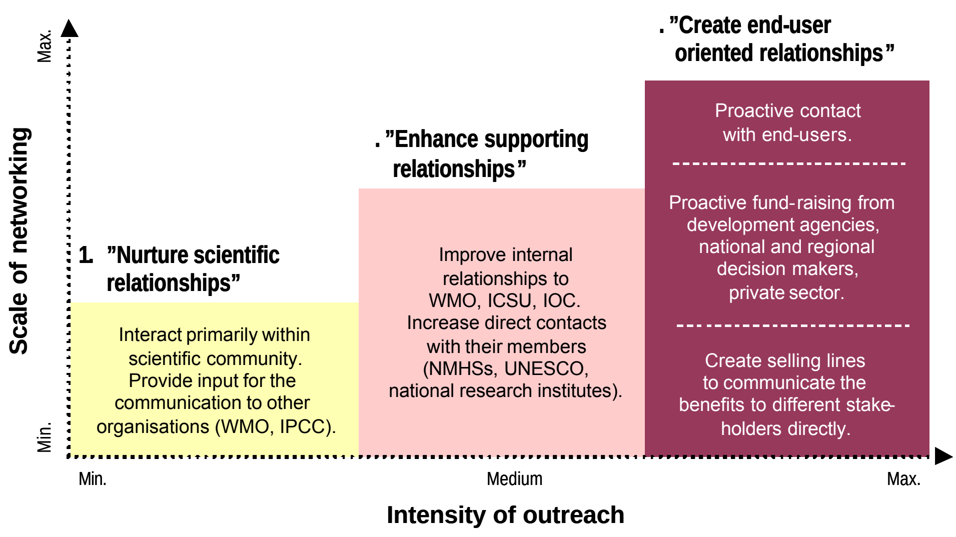
- WCRP is trustworthy, objective, and pursues *excellent science*.
- WCRP is a good *international* coordinator.
- WCRP is a *facilitator* that enables communication and cooperation within the scientific community.
- WCRP's endorsement adds a *'quality stamp'* for scientists seeking funding.
- WCRP connects stakeholders via coordinated working groups, seminars, and meetings.

Stakeholders also believe that WCRP is currently facing significant challenges including:

- WCRP comprises a myriad of activities making linking to them effectively difficult.
- WCRP does not sufficiently promote the importance of climate research to key agents and end-users.
- WCRP appears to lack clear strategic goals and the necessary resources to accomplish these.
- WCRP does not effectively seek stakeholder needs and communicate these to the scientific community.

The degree of outreach depends upon the scale of future networking (Figure 1).

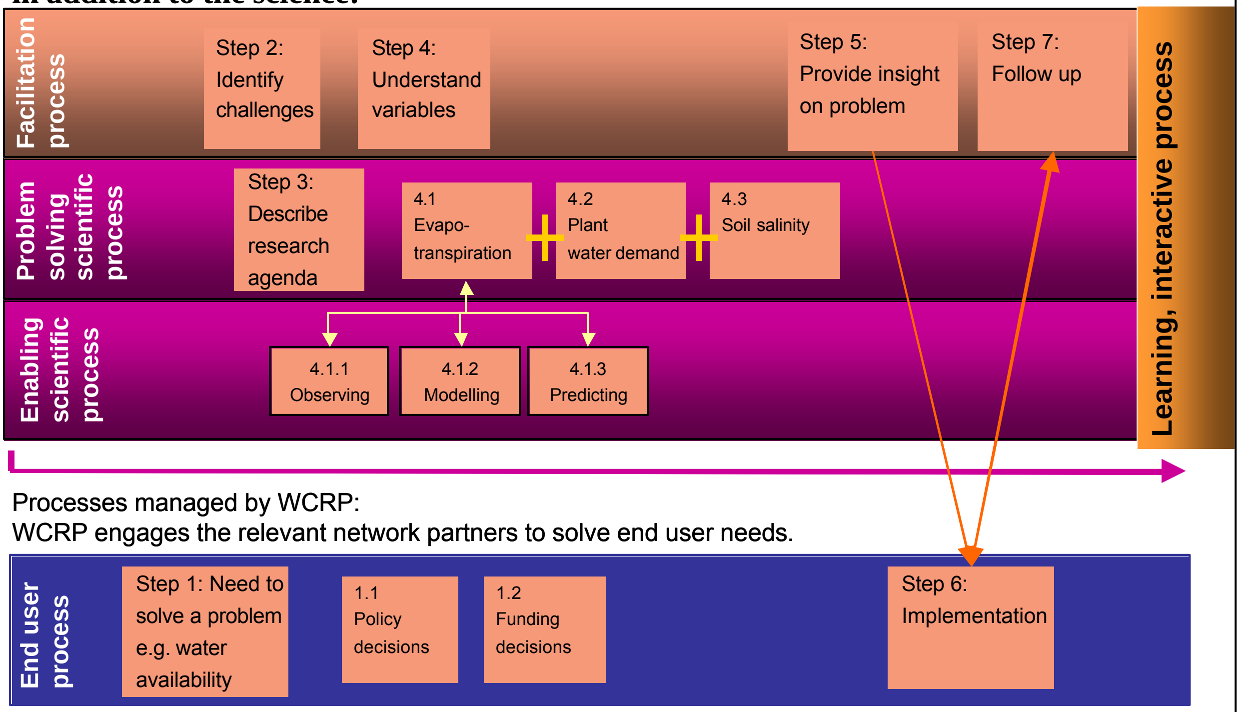
Figure 1: The survey responses suggest benefits in three approaches for outreach:



WCRP and the majority of survey participants would like to see WCRP continue to successfully pursue its climate research objectives. The scientific proficiency of WCRP is undisputed and any possible criticism expressed towards the programme should be seen as an valuable attempt to uncover areas that may require improvement in order to successfully move forward and adapt to the changing priorities of its key stakeholders.

Eera Consultancy has worked with several specialist organisations similar to WCRP, that is, with a strong core area of expertise but with less experience in dealing with the management of processes that lead to recognised and beneficial results (Figure 2). They believe that WCRP's future lies in developing the many good opportunities that currently exist for the programme by building on its existing strengths. The challenge will be for WCRP to evolve from 'business as usual' and the comforts of familiarity to a new and improved programme, a task that is difficult for any organisation to face. There is comfort, however, in knowing that there is very broad and deeply intense support for WCRP in its stakeholder community. This support will undoubtedly enable WCRP to successfully meet the difficulties it is currently facing.

Figure 2: WCRP delivers the processes that produce solutions for end users in addition to the science:



The Network Report discusses future strategic options for WCRP. These options will be further examined with WCRP's three primary sponsors and its Joint Scientific Committee (JSC) over the next 2-3 months before sharing the next steps with a wider audience.

WCRP is very grateful to all those who participated in this important study.

WORLD CLIMATE RESEARCH PROGRAMME

JSC-XXVIII/Doc.1.4
(13.2.2007)

JOINT SCIENTIFIC COMMITTEE

Item 1

TWENTY-EIGHTH SESSION

ZANZIBAR, TANZANIA, 26-30 MARCH 2007

WCRP (JCRF) FINANCES

(Submitted by the Director of the WCRP)

The financial situation of the Joint Climate Research Fund (JCRF) that funds the WCRP JPS and the WCRP's so-called 'Activities' is exceedingly precarious (see attached).

The JSC is invited to make the following resolutions:
1. Recognize the 2007 financial deficit and accept the decisions made by the Director regarding the restricted nature of funds allocated to Activities this year to achieve zero carry forward into 2008. Agree that if the cash-flow becomes worse (i.e. income fails to keep pace with spending) additional cuts will be made by the Director as needed.
2. Take IMMEDIATE actions to gain additional resources for the JCRF.
3. As an interim accept the likely situation of ONLY US$440,000 for Activities in 2008.
4. Consider the proposals (below) for JCRF spending in 2008 and determine the science priorities as percentages of whatever total funding becomes available.
5. Put a case to WMO (our main financial sponsor) that salaries be 'traded' for Activity funds in 2008-11 and in doing this the necessary people skills be acquired for the JPS.

Possible Options for spending on 2008 Activities **likely available US$437100 (attached)**

Activity	**1:WMO Budget**	**2: D/WCRP**	**Comments on Option 2**
JSC	16.4	8.0	Meeting once in 3 or 4 yrs
LDCs		1.1	essential
ESSP	8.4	10.3	committed
Ocean & SIDS		1.6	
Debt		3.4	WGNE 08, salaries 09 on
ACC		6.9	
AC&C		6.9	
Extremes		6.9	
Monsoons		6.9	
IPY		4.6	
Sea-level rise		1.1	
Decadal prediction		4.6	
GEWEX	18.6	9.2	as in IGBP
CLIVAR	18.4	9.2	as in IGBP
CliC	10.1	9.1	as in IGBP
SPARC	10.1	9.1	as in IGBP
Modelling	13.7	1.1	(+ WGNE)
JPS	4.3	0.0	***No communications etc***
TOTAL	**100**	**100**	**~ US$437,000**

Other distributions can be discussed and a % distribution decision recorded.

JSC WCRP FUNDING SUMMARY (AH-S FEB 2007) - SESSION 1

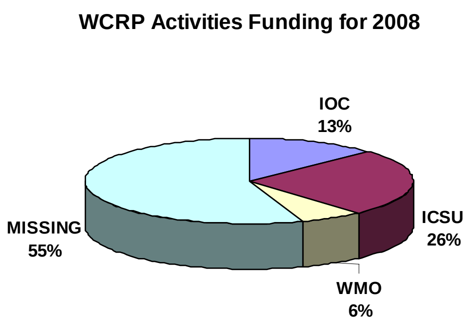
SUMMARY

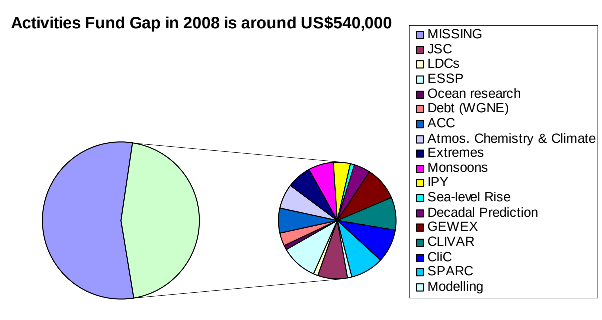
Without new funding from 1/1/2008, WCRP will be in the paradoxical situation of being able to resource its secretariat infrastructure but virtually no science activities. While this critical financial shortfall should not drive the review of WCRP's future, its implications must be understood. A clear and attractive future direction for WCRP is likely to be able to create resourcing opportunities. ***This is urgently required***.

1. BACKGROUND

There are two financial challenges for WCRP: (a) a cash-flow crisis in 2007 and (b) the greater financial shortfall from 2008 onwards. Appendix 1 summarises why this situation pertains now. These facts were presented to the Officers, Chairs and Directors of the WCRP on 8th November 2006 in Beijing.

The immediate challenge is that WCRP does not have funds on hand now for current (2007) commitments: a day-to-day cash flow crisis. This has never occurred before because previously the Joint Climate Research Fund (JCRF) operated for WCRP by WMO had reserves. The main challenge is that from 2008 there is less than half the previously available funds for 'activities' i.e. science meetings, travel, promotional materials, communications (Appendix 2).





The distribution of the available ~US$440,000 for 2008 is not a valuable investment of time: a sensible distribution of this amount each year could be accomplished by a once a year meeting of a panel of say 6-10 experts. Attention is better focussed on how to make a strong case for more funding from all sources and also considering the consequences of achieving, or failing to achieve, these.

2. CONSEQUENCES OF FINDING NEW FUNDING SOURCES FOR WCRP

In 2008 WCRP needs around US$540,000 to permit its previous level of activity. This shortfall is <u>more than the total of the funds from all three of our sponsors</u> for *'Activities'* in 2008.

If we are able to find new and additional funders, some may want to have input to, and maybe even some control over, directions and management of WCRP's research. Such a situation means that the governance of the WCRP must change i.e. the current sponsors would have to relinquish current control and the JSC would need to deal with new funders as well as existing ones. It could also have consequences for the location of the JPS (e.g. if a new funder wished to have part of the secretariat co-located with them) and the tasks of the JPS (e.g. different communications – say to fit to corporate directions, marketing etc.).

3. IF WCRP FAILS TO FIND NEW FUNDING

Without new funds this year and especially for 2008 onwards the WCRP will be left with a top-heavy infrastructure/secretariat "facilitating" virtually no science activities. No sponsor, funder or scientist wishes this situation to occur.

APPENDIX 1 (PRESENTED ON 8/11/06 IN BEIJING)
WCRP OFFICERS, CHAIRS AND DIRECTORS BRIEFING A. HENDERSON-SELLERS

SUMMARY

WCRP needs to (i) implement its current cross-cutting strategy; (ii) pursue desired new opportunities described in the Strategic Framework (COPES) and (iii) sustain existing activities. There are two challenges for WCRP's resourcing: (a) the immediate crisis for 2007 and (b) the longer term shortfall from 2008 onwards. These require firm and creative actions.

1. BACKGROUND: FINANCIAL SITUATION PRE-2006

Total resources for the WCRP 'central' facilitation has remained fairly steady over the past decade (Figure 1). The cost of JPS salaries has increased steadily and hence the balance available for activities should have decreased significantly. In the recent past, the decrease in funds available for activities has not been as great as should have been expected due mostly to carry-over savings from previous years. In 2004/05, there was a significant drop in income and savings were exhausted so that spending on activities dropped by about 15 %. WMO allocated an extra US$150k of "end-of-year" money in late 2005 for COPES development and for the ESSP Open Science Conference.

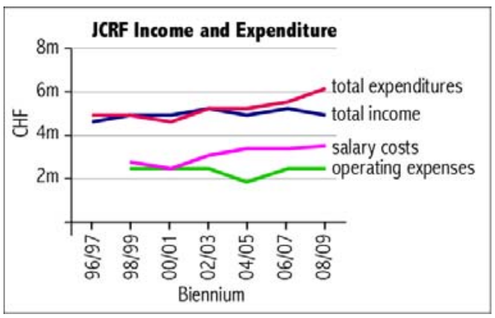


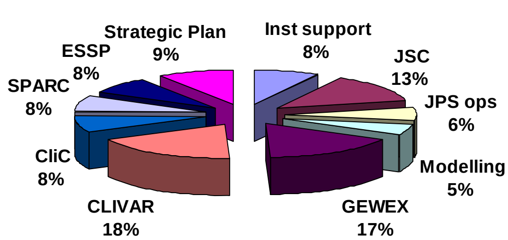
Figure 1 Decadal funds (08/09 proposed)

The WMO "injection" effectively allowed 2006 spending at the level of previous years on the assumption of sponsor expected income: IOC ≥ US$125k, ICSU (from donor nations) ≥ US$250-300k per annum and that US$ remains at 1.3 or higher. When granting WCRP the 2005 additional funds, the WMO Secretary General noted that this was an exceptional measure and that in future years more effort would be required to secure additional support from the other co-sponsors as well as from other extra budgetary sources. The latter could signal changed governance.

2. SITUATION AT NOVEMBER 2006 AND FOR 2007 OVERALL

As at 1 November 2006, we had received NO income from IOC (zero)[1] and only about half our hoped-for income through ICSU from its member academies/nations. There is an immediate cash flow crisis and, worse, shortfalls in 2006 & 2007 due to a "salary bleed" caused by salary rises in WMO, staff returning to fulltime duty (from 80%) and by the only partial compensation following a staff move within WMO (recompense < 25% continuing cost to WCRP). Savings are difficult because of prior commitments, strong expectations from 'existing' activities and failure (by projects, JPS, JSC) to recognize the extremity of the finances. The financial status was presented in JSC papers in March, to the Chair in June & again in August with a recommendation for a 6 (or 12) month 'sabbatical' from all meetings in 2007 just to ensure solvency for 2006-7. This proposal was declined.

3. OUTLOOK FOR 2007: IT'S GOING TO BE A VERY CHALLENGING YEAR



The WMO system runs 4-year budgets and subsets into 2-year sets: 2007 is the second of 2 years. Figure 2 shows the budgeted outlay for 2006-7 assuming the shortfall of ~CHF200,000 (~8% total) is actually found.

Figure 2 2006-7 CHF200k shortfall still exists

The criticality of the situation was presented

[1] Partial payment (US$65k) received in late November and the final payment in late December 2006.

to the OCDs on 8 November in Beijing, arguing for acceptance of the need to (at least) mid-2007 reduce spending planned in e.g. Core Projects, JSC, travel and cutting costs so that strategic framework (COPES) implementation be sustained. A resulting hope of a one-off injection of $80,000 from the USA (CCSP) has been stalled by its government funding 'hold'.

4. Outlook for 2008-2011

In the past,WMO has paid JPS salaries and input approximately the same as IOC and ICSU to 'activities'. The WMO budget for the quadrennium 2008-11 will be determined at the WMO Congress in May 2007. For the two options, zero nominal or zero real growth, the difference for WCRP is ~CHF 200,000 but either impact is dire (Figure 3). From 2008 funding for 'activities' is roughly halved. This is NOT because of cuts but due to salary and other 'creep', bad exchange rates and the total depletion of the WCRP central savings reserve previously used to cover shortfalls and ensure month-to-month cash flow.

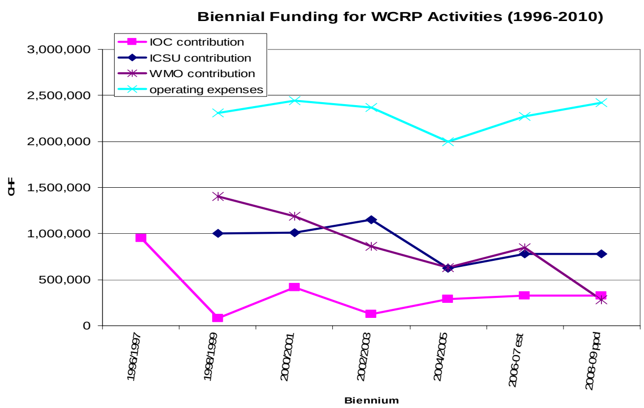
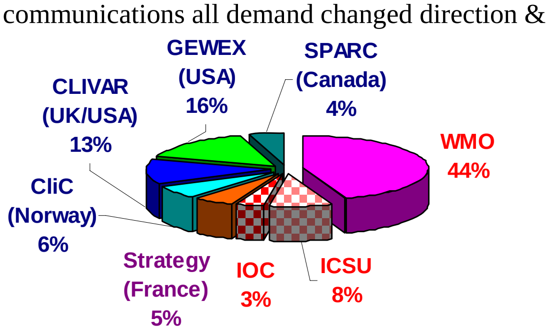


Figure 3 Past & outlook funding

It is unlikely that WCRP's current sponsors have much capability to increase funding and it is inevitable that they will pursue their expressed desire for re-direction. WMO international civil service employment locks WCRP into continuing positions and travel management, which are cumbersome and many procedures slow and difficult.

5. Resourcing Challenges and the Need for New Funds

WCRP central facilitation income (including to the project offices see Figure 4) is static or decreasing but demands are overdue and increasing. Existing sponsors, stakeholders, new communications all demand changed direction & clearer end-user value-delivery from WCRP.



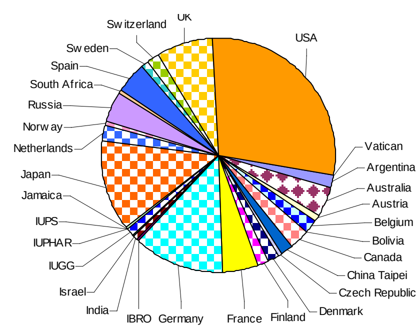


Figure 4 (a) 2006 income; (b) through ICSU for 2006 (dotted shading indicates cash flow problems)

WCRP has to seek new funds rapidly but IGFA warned (Nov 06 meeting in Montreal) of 'no new money' from governments for global environmental research. Thus, WCRP is likely to be 'in competition' with its own Core Projects, the other Earth System Science Partnership (ESSP) programmes, ESSP joint projects and ESSP itself when pursuing traditional funders.

WCRP's case for 'new' resources and perhaps new supporters could be argued around our five clear challenges: (a) strategic framework 2005-15 implementation, (b) sustaining core activities, (c) increased and increasing complexity of global networking, (d) capturing benefits from current or new synergies in the ESSP (especially with IGBP) and (e) ensuring climate research related capacity building and partnering especially with the LDCs e.g. for adaptation to climatic variability and change. ***Acquiring resources for WCRP is now very urgent.***

Appendix 2 of JSC Doc 1.4: JCRF Financials from 2008 onwards (this page in US$)

INCOME SUMMARY

Table 1: Summary of likely income for Activities in 2008

Activities Fund US$	2008 & each yr	NEEDED	Comment
IOC contribution	125000		past years spend
ICSU contribution	250000		~$1million
WMO contribution	62097		a 6% increase
other contributions	0	537944	gives Act fund
Activities fund	**437097**	975040	

Notes on Income

1. WMO contribution for 08/09 from WMO budget proposal (2008-11) less JPS salaries
2. ICSU contribution estimate pa based on income being usually ~ US$250,000
3. IOC contribution as resolution by IOC in 2005 for US$125,000 pa
4. **New sources of ~$540,000 to achieve past year's spending @ "WMO Approved" + 6% increase**

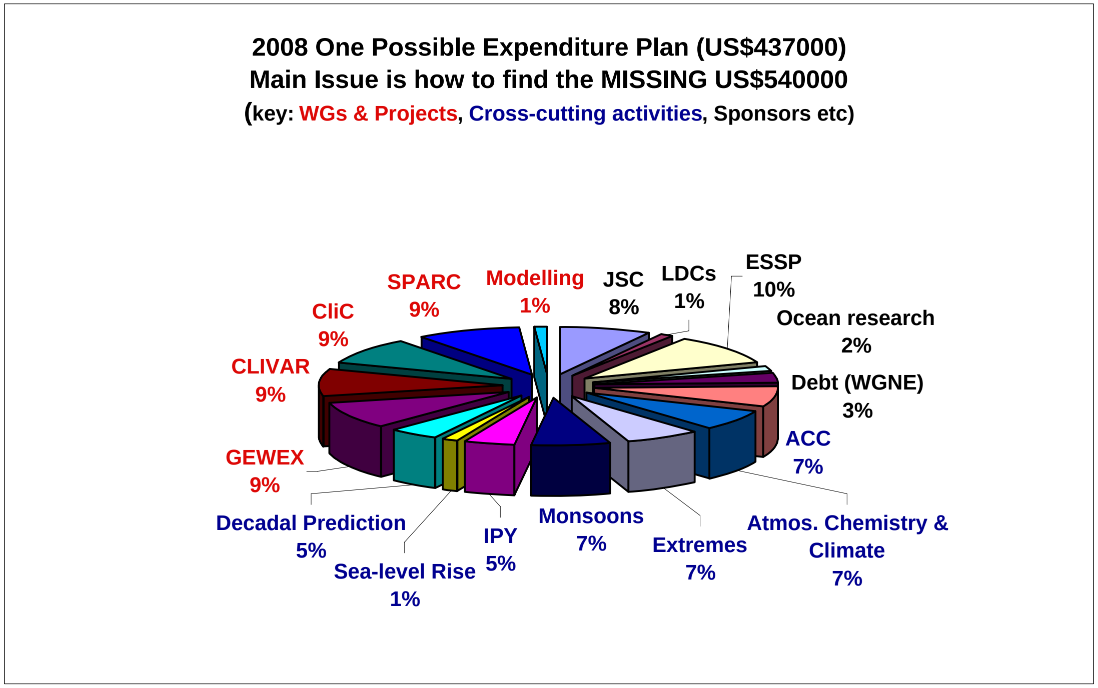
Notes on Expenditure (see comments column)

1. JSC meeting only every 3 years - not annual - no OCDs (or once every 4 years + 1 OCD per 4 yrs)
2. Core Projects given US$40k (as in IGBP) for SSC or other meeting
3. ESSP is US$15k for Co-ordinator plus half agreed i.e. US$7.5k for 4 Joint Projects
4. Debt: WGNE in 2007 funded only to AREP (repay in 2008); past 2009 on JPS (WMO) salaries
5. Zero for JPS means no communications (E-zine, Annual Report etc.)

EXPENDITURE OPTIONS for 2008 onwards

Table 2: One EXAMPLE of income spend on Activities in 2008
(note -- many other spending divisions could be proposed)

Category	annual spend for e.g. 2008	2008 %	Comment
JSC	35,000	8.0	0.3 meeting
LDCs	5,000	1.1	required
ESSP	45,000	10.3	required
Ocean research	7,000	1.6	CC ocean impact
Debt (WGNE)	15,000	3.4	salaries 09+
ACC	30,000	6.9	
Atmos. Chemistry & Clir	30,000	6.9	
Extremes	30,000	6.9	
Monsoons	30,000	6.9	
IPY	20,000	4.6	
Sea-level Rise	5,000	1.1	
Decadal Prediction	20,000	4.6	
GEWEX	40,000	9.2	as in IGBP
CLIVAR	40,000	9.2	ditto
CliC	40,000	9.2	ditto
SPARC	40,000	9.2	ditto
Modelling	5,000	1.1	WGNE 15k
JPS	0	0.0	no communc
Total:	**437,000**	100.0	of 437k



WORLD CLIMATE RESEARCH PROGRAMME

JOINT SCIENTIFIC COMMITTEE

TWENTY-EIGHTH SESSION

ZANZIBAR, TANZANIA, 26-30 MARCH 2007

JSC-XXVIII/Doc. 2.1
(16.II.2007)

Item 2

Cross-Cutting Topic: Anthropogenic Climate Change (ACC)
World Climate Research Programme

V. Ramaswamy (Lead), H. Le Treut, J. Marotzke, J. Mitchell and V. Spalding

Joint Scientific Committee 28th Session, March 26-30, 2007

1. Executive Summary

With the emergence of human-induced climate change as one of the most important scientific problems impacting society, and with WCRP positioned as the world's leading coordinating and facilitating body in the investigation of the science of the physical climate system, the Anthropogenic Climate Change (ACC) initiative is proposed as an important cross-cutting activity that will take on the responsibility of focusing on the important scientific gaps, reducing the uncertainties, addressing the key scientific issues concerning the changes in important climate variables, and preparing cutting-edge scientific information at regular intervals (~3-5 years) as deliverables for international and other climate change science assessments (e.g., "AR5", the next IPCC Assessment after AR4).

The requirement to provide the scientific basis for the climate change science assessments was outlined as an important task in the WCRP Strategic Framework 2005-2015 (COPES). The ACC initiative, to be steered and monitored at the JSC level, will: elevate substantially the visibility of human-influenced climate change research within WCRP by presenting a coherent structure that integrates across the different elements of WCRP; enhance the communication of WCRP's anthropogenic climate change research; and engage in widespread dissemination of the climate change science information including data provisions for developing countries and capacity building. Maintaining the WCRP credo of performing and delivering rigorous, high-quality science, ACC will seek to develop strong interactions with IGBP, ESSP and other agencies and institutions on the national and international levels that desire critical inputs on advancements in climate change science. The proposal is to begin ACC in a simple, tractable manner, exploiting the science that is ready and primed, with WGCM's activities forming the bulk of the initial framework for this initiative, together with appropriate elements drawn from elsewhere in WCRP, consistent with the initial targeted emphases on process-level and modeling investigations and projections of future climate change.

2. Introduction

Growing observational and modeling evidence is clearly indicating that climate change due to increasing concentrations of anthropogenic greenhouse gases has the potential of having major consequences on human societies and natural ecosystems. In 2007, the Intergovernmental Panel on Climate Change (IPCC) will publish its Fourth Assessment Report (AR4), marking a crucial year for major developments in Anthropogenic Climate Change (ACC).

To formulate a robust thrust for the ACC activity, it is thus useful to consider the outcomes from the IPCC AR4 WG1 exercise, to which WCRP, especially via the Working Group on Climate Modeling (WGCM), has contributed significantly. This report has received praises worldwide for its high scientific quality, and is widely considered a success in its assessment of the state-of-the-science. Following upon this success, it is intended that WCRP continue to build upon the efforts to provide the best possible scientific information on climate change. In the spirit of the AR4 WG1 report, it is proposed that WCRP hone in on the "Key Uncertainties" marked out by the IPCC, especially as related to modeling and process studies [consistent with the WCRP Strategic Framework 2005-2015, section B.11]. In effect, this would be a launch pad for assembling a coherent, visible research package that is facilitated and coordinated by WCRP, with steering at the JSC level, and yielding climate change science information deliverables concerning human impacts on climate. This phase of the ACC is centered on modeling, with the defined goal being to deliver products for the successive state-of-the-science assessments on climate change (e.g., AR5).

In order to assure sound traction of the initiative, the ACC thrust proposed here has a relatively simple beginning, taking advantage of science that is relatively mature and ready, which makes for ease of implementation and assures success without the need for too many additional resources. It is anticipated that the work of WGCM, together with contributions from the Projects, TFs, WGs and Panels, will be delivering cutting-edge scientific information. While the current focus is on process-level and modeling investigations, and projections of human-induced climate change, the long-term vision is that, over time, ACC will expand in scope.

3. Scientific impact, balance, and relevance

ACC has now become a highly developed research area in the field of climate. Over the past two decades, the questions have turned from "is climate changing" to "how much has the climate changed, what are the changes that are likely in the future, and what do the nature and global distribution of the change mean for society in terms of economic and social impacts?" In a sense, the importance of anthropogenic effects on climate change was foreseen when WCRP was formed in 1980, has gathered increasing momentum over the past two decades, and is now of crucial significance for a number of sectors.

Although the scientific developments have occurred owing to a number of factors, WCRP, by virtue of its collective expertise, has been responsible for some of the signature accomplishments, principally brought about through international facilitation and steering of research (e.g., WCRP/ CLIVAR-WGCM/ PCMDI's role in AR4). Thus, WCRP has played an important role in enabling the field to reach a mature state.

4. Policy Relevance

With the completion of AR4, there is an opportunity to leverage what was learned during this assessment, to identify gaps in research and develop initiatives to address them. WCRP can significantly contribute to and help advance the research related to ACC and hence provide input to the UNFCCC, its SBSTA and potentially to a next assessment by the IPCC (an AR5). In particular, WCRP considers the following research tasks as important and especially relevant to policy makers around the world:

- Improving and sustaining global climate observations (with GCOS – building on 2002 experience); ensuring reliable and comprehensive climate datasets including reanalyses;

- Steady advancement of comprehensive Earth Systems models (atmosphere-oceans-cryosphere-biosphere) and other tools (e.g., regional-scale models) to address climate change questions on the relevant space scales;
- Improving the understanding of radiative forcing and coupling including that of GHG concentrations, short-lived species, and land surface-related changes;
- Improving the understanding of feedbacks within the physical climate system, and between climate and major biogeochemical cycles, especially carbon (e.g. vulnerabilities of presently stable carbon pools to release under climate change) (with IGBP);
- Improving the treatment in climate models of convective processes and the dynamics of aerosols and clouds, and their consequences for the Earth's radiation balance and hydrologic cycle, particularly in reducing uncertainty of the response to anthropogenic forcing;
- Variability of the climate system on different time scales, and diagnosing the anthropogenic effects on the natural modes of climate variations (e.g., ENSO, NAO).
- Improving understanding of ice sheets to enable development of models of the potential dynamic response of the Greenland and West Antarctic Ice Sheets to global warming;
- Global, continental and regional-scale simulations/projections of climate change: extreme and abrupt changes in heat, precipitation, atmospheric and ocean circulation; sea-level rise; severe weather. Considerations will include shifts in precipitation patterns, continental drying, Arctic, midlatitude and tropical climate change, etc.
- Improving the descriptions of human activities in climate models so that they begin to represent true "Earth system models" (with IHDP);
- Contributing scientific understanding to the policy questions concerning “dangerous interference” with the climate system (input to UNFCCC); and
- Ensuring appropriate climate prediction and downscaling skills are utilized by policy makers and funders involved in planning national and international adaptation to climate change.

WCRP with some of its key partners will hold the following two major events during 2007 to help improve the science and better connect research to policy:

1. SBSTA 26 ESSP Side Event: Anthropogenic Climate Change Scenarios: Connecting Research to Policy (May 2007, Bonn, Germany)
2. Climate Research and Observations: Learning from IPCC AR4 Workshop (October 2007, Sydney, Australia)

5. Organization and governance

WGCM’s efforts form a natural nucleus of activities concerning ACC, represent a holistic approach, and are well known in the community. In fact, the current WGCM activities are in line with many of the AR4 Chapters’ leading topics (e.g., scenarios, forcing datasets, climate processes and feedbacks, climate responses, detection and attribution, and future projections). Elements from other Projects, TFs, WGs and Panels also have important attributes (e.g., observations; cloud, radiation data) though perhaps not having as high a profile in the ACC context. Given the overall synchronization of WCRP activities/plans with the IPCC science assessments, it is natural and rational for ACC to be an independent initiative, which will simultaneously ensure more luminosity for ACC-related research and WCRP. JSC-level coordination is essential to harness the ACC-related activities occurring in different places in WCRP, channel them and draw a clear linkage to the central focus. [“COPES” (or WCRP Strategic Framework) had this in mind, but an appropriate implementation plan is needed now.]

For clear and efficient management, the steering and monitoring of ACC has to come from the JSC. JSC as a body should ensure that there is an efficient and optimal level of ACC "cross-talk" within WCRP. It is worthwhile exploring the notion of WGCM becoming a "working group" reporting directly to JSC. As part of increased coordination, JSC should actively encourage, seek and promote contributions to the ACC initiative from all quarters of WCRP. A JSC-level team comprising of 2-3 persons will be needed to ensure an effective liaison for the ACC activities in WCRP. This would also be important for measuring the impacts and assessing continuously the deliverables towards WCRP's 2nd focus.

6. Visibility, structure and communication aspects

While WCRP can be justifiably proud of its role in leading ACC research, in contributing to the scientific basis of the IPCC climate change assessments, and in addressing tough global climate science questions that only a world body of climate experts under an international umbrella can deliver, there are areas in which WCRP needs to undergo substantial improvements.

There is a perception that WCRP is not doing enough to address the second of its foci ('human influence on climate'). Especially, ACC-related research within WCRP is perceived as somewhat diffuse and lacking in coherence. WCRP's scientific accomplishments themselves are not in question or its ability to coordinate and deliver sound research. Some of the visibility concerns could be due to ineffective communication of the ACC-related accomplishments. Despite the fact that WCRP can claim that a number of activities within the projects are doing a significant amount of research related to ACC, there is a need to link up all of the ACC-related research in an easily identifiable manner. For the research to be more effectively communicated, and for WCRP to be recognized as delivering premier scientific results on human-induced climate change, thus attracting rightfully the attention of the international and national bodies (and the private sector which too has a stake in climate change), the ACC thrust must become clear and meaningful, and must be at the frontiers of the science.

However, WCRP has to go beyond merely resolving the visibility issue. There are fundamental scientific activities that need to be pursued as part of ACC which hone in on the larger climate impact policy-relevant issues listed in Section 4. While individual projects should have the flexibility to do the appropriate basic science to build up the strong foundation for understanding climate change, the relevant activities in the various projects need to be cross-linked and synthesized at the JSC level. Additionally, some ACC research areas may require coordination and support that may be unattainable at national and other international levels, and which are possible mainly through WCRP. WCRP/JSC should be dynamic in spotting and promoting rapidly fundamental breakthroughs that hold the promise of significant improvements in applications and of substantially increasing the knowledge on climate change.

With the climate change science becoming intertwined with contemporaneous social, economic and technological development issues, WCRP's ACC science and its outcomes have to strongly consider interactions with other international organizations. On the science side, there are complementary partners like IGBP, with whom collaborations have already been successfully forged e.g., SPARC-IGAC and WGCM-AIMES. Strong linkages also need to be developed with ESSP wherein WCRP science enables optimal yet consequential outcomes. A proactive outreach by WCRP to deliver scientific inputs (e.g., climate datasets from observations and model simulations) could prove to be an effective mechanism for delivering policy-relevant results to the national and international bodies. Such interactions will enhance the stature of ACC and also establish WCRP as a prime scientific information provider in the context of anthropogenic climate impacts.

Another challenge facing WCRP is the misconception that the science is clear and therefore complete. WCRP should be continuously promoting the ongoing need for scientific research. The AR4 has clearly proved that global warming is happening but there still remain gaps in the science (observations, processes, modeling and projections) to deliver predictions of a high enough (space and time) resolution to allow valid adaptation strategies to be developed and implemented on the scales desired by society. In addition, scientific research can help determine what level of mitigation is required in order to avoid various impacts.

Any strengthening of the ACC thrust within WCRP has to be mindful of two key points. One, WCRP is a voluntary organization with limited dedicated resources, especially for setting and sponsoring climate research agendas worldwide. Second, WCRP has to be cognizant of how many directions it can stretch itself without getting thinner in its research agenda, thus risk becoming even less visible to important stakeholders and sponsors.

With a judicious selection and streamlined management of the research into ACC issues that are largely outside the scope of individual nations, WCRP will be well placed to communicate the results of its international scientific facilitation and coordination. The research topics that ACC can take up immediately will center on the important scientific gaps identified in the AR4 report. Careful planning of the type and quanta of research will ensure timely delivery of high-quality science to the assessment processes (e.g., IPCC, WMO/UNEP). Widely advertised, targeted workshops, where the frontiers of climate change science and quantification of the human-induced influences on different climate variables are critically discussed, would be useful forums for dissemination of the ACC research and establishing the solidity of the science (e.g., the 2005 Hawaii Workshop). In turn, this makes for robustness of the scientific inputs for policy circles. The increased visibility would aid the funding situation enabling ACC to be less constrained. Note that, increasingly, the opportunities for such funding are driven by calls that these be applications-oriented research; however, WCRP should be able to do this well without sacrificing its hallmark of scientific rigor.

7. Interactions with other bodies

ACC in WCRP should continue to follow a strictly scientific agenda, with the proviso that there be a strong interaction with the ESSP partners and other programs that seek to link rigorous scientific results for societal, policy actions etc.

- WCRP, by itself or through partners (including IPCC and GCOS), should continue to provide the scientific inputs to policymakers.
- Recognize what the policymakers want, and deliver the most reasonable outputs possible from current observations and model simulations.
- ESSP partners are the best conduits to carry the science forward from WCRP to society, but WCRP should itself move and interact closely with ESSP partners in communicating the results of its scientific research to society.
- Terms that suggest judgmental value e.g., ‘tipping’, ‘dangerous interference’ etc., which have relevance in policy circles, will need to be used judiciously by WCRP/ACC.

WCRP should consider working closely with bodies involved in climate negotiations, (e.g., SBSTA) appraising them on a regular basis about the results produced by the state-of-the-art knowledge on climate change. Further, WCRP should engage in dialogs with interested parties in major sectors e.g., energy, transportation, reinsurance, development agencies, aid bodies, other national and international organizations, (e.g., EPRI, UNEP, WMO, World Bank, US-

CCSP, UK-DEFRA, CNRS, CSIRO) so that the scientific results can be suitably communicated to all those desiring the most current knowledge on climate change.

8. Capacity Building

Recognizing that response to climate change requires the capability to appreciate and properly interpret research findings and to apply them to national planning initiatives, the WCRP can contribute to capacity building in developing and least developed countries. Developing countries are particularly vulnerable to climate change, partly because agriculture, water management and the spread of disease are highly dependant on weather and climate, and partly because of the inadequate adaptive and planning strategies available to properly respond to major climate anomalies.
WCRP together with partners, such as the ICTP, can help 'transfer knowledge' with respect to the science used to make input to and described in the IPCC assessment reports. By improving knowledge pertaining to climate change research can have a significant regional and global impact.

In developing countries WCRP can:

- Help develop the capacity to apply scientific results to the development of impact of climate change scenarios and hence inform development of adaptation/mitigation strategies as debated in the COP of the UNFCCC
- Improve understanding of the confidence (or its complement – the uncertainty) of the research findings, implications of climate projection results from the IPCC model simulations, and hence inform future possible assessments by the using common methodologies
- Increase the number of participants in developing countries in future IPCC assessment reports by focusing especially on the younger talented scientists in those countries.

As a step in supporting capacity building, WCRP with its partner ICTP will hold the Interpreting Climate Change Simulations: Capacity Building for Developing Nations Seminar in Trieste, Italy from November 26-30, 2007.

9. Practical considerations

The following are considerations required to move forward with the ACC initiative at WCRP:

- Recognize that WCRP is coordinating and facilitating international research.
- Although funding for stronger, newer thrusts is going to be difficult, WCRP will need to go out with ideas and get increased support for research addressing human influences on climate. WCRP should aspire to receive support not only from past sources but, with climate change looming large in the global community, should move strongly to obtain funds from other agencies.
- WGCM will ideally form the initial ACC framework, to which a few appropriate elements should be added, with due care, drawn from projects, TFs, and panels.
- ACC-related research is scattered in WCRP. WCRP should integrate these across the Projects, WGs, TFs, Panels and communicate the science in an unified ACC framework.
- Activities within a project may need re-structuring to sharpen their input for ACC. The key is to have a highly visible and efficient threading across projects that reflects the unification, with realistic but firm timelines and deliverables (such as for the next IPCC).

- JSC should be charged with the responsibility of steering, monitoring and synthesizing ACC research. In view of the high profile of the subject, JSC will likely place greater demands on the various elements of WCRP that are especially significant for ACC.
- A simplistic concept of ACC is very likely the best way to start, one that integrates across the various activities in existence, across the Projects, TFs, WGs and Panels.
- Recognize the current state-of-the-science (e.g., IPCC, WMO, CCSP assessments), and immediately formulate plans and strategies to directly address the key uncertainties.
- Plan well defined goals with the aim of delivering cutting-edge results at say 3-5 year time intervals, which directly feed into the important scientific assessments.
- The drive in ACC: Research → Applications → Deliverables to stakeholders

10. References

WCRP Strategic Framework 2005-2015

WORLD CLIMATE RESEARCH PROGRAMME

JOINT SCIENTIFIC COMMITTEE

TWENTY-EIGHTH SESSION

ZANZIBAR, TANZANIA, 26-30 MARCH 2007

JSC-XXVIII/Doc. 2.2
(14.II.2007)

Item 2

WCRP-SPARC/IGBP-IGAC Atmospheric Chemistry & Climate Initiative (AC&C)

(Submitted by A. R. Ravishankara (SPARC), Philip Rasch and Sarah Doherty (IGAC))

High Scientific Value and Policy Relevance of Initiative

A large part of human-induced climate forcing occurs through chemically active species. Further, chemically active species are more amenable to short term manipulations through changes in emissions and therefore are of major policy relevance. Changes in climate can lead to changes in the chemical composition of the atmosphere both through alteration in emissions and changes in the chemical processes that occur in the atmosphere. Studies of climate-chemistry interactions represent one of the most important and, at the same time, most difficult foci of global change research. Changes in emissions themselves can also be brought on by climate trends or a change in climate variability. These factors also strongly couple the emerging issue of the coupling of climate and air quality, both from scientific and policy perspectives. Provision of high-quality, policy-relevant information on the current state of climate and its possible future states (e.g., for the next WMO/UNEP Scientific Assessment of Ozone Depletion and/or IPCC Report), as well as options for mitigation / control / change / adaptation are strongly dependent on the progress in studies in this area.

Governance by WCRP and IGBP

The “Atmospheric Chemistry and Climate Initiative” (AC&C) was endorsed in March 2006 as a joint effort of WCRP and IGBP, with the SPARC and IGAC projects tasked to take the lead in its definition and implementation. An initial scoping meeting for AC&C (Boulder, Colorado, USA; 7-9 August 2006) laid the groundwork for the basic structure and goals of the Initiative. An open workshop was then held (Geneva, Switzerland; 22-23 January 2007), where a broader set of the community was engaged and a first set of activities was decided upon.

Phased Approach Maximizing Policy Impact

AC&C will be implemented in phases, with the first phase planned to end in roughly 2009, in time for tangible inputs to the anticipated next IPCC assessment (AR5). Also, the initial phase will make contributions to elucidating and developing policy-relevant information on the connections between air-quality and climate. The plans discussed below pertain to AC&C Phase I. The primary focus of this phase will be specifically on improving process representation in chemistry-climate models that will be used for climate predictions as well as exploring the climate-air quality connections. Despite these models are essential tools for understanding and calculating the present, hindcasting the past (an essential element for confidence in our models), and forecasting future conditions and, therefore, for making policy decisions, many critical processes in them models have either never been tested or are known to be in error, though it is not always understood why.

Under AC&C we have set out to coordinate and add value to these existing activities by:

- identifying a set of science questions around atmospheric chemistry and climate that require integration and synthesis across the projects;
- identifying atmospheric processes that are both important to addressing key science questions and yet which remain poorly understood;
- identifying a set of common diagnostics that can be used to address these uncertainties;
- coordinating the modeling and measurement communities;
- facilitating the development of improved parameterizations; and
- possibly establishing a common database for archiving model outputs and observations.

At the first Initiative meeting in Boulder, three thematic areas were decided on for AC&C:

- the impacts of climate on atmospheric chemistry,
- the impact of atmospheric chemistry on climate, and
- the impact of climate on air quality.

The direction of AC&C will be guided by the current important science questions within each of these thematic areas, coupled with other considerations as described below.

Interaction and Coordination With Relevant Partners

Advances on aspects of this problem have already been made directly through several activities which will be linked to AC&C: the Chemistry-Climate Model Validation activity of WCRP-SPARC (CCM-Val), the global Aerosol model inter-Comparison (AeroCom), and the European ACCENT project Model Inter-comParison (ACCENT-MIP). CCM-Val is a model inter-comparison and validation effort for stratospheric chemistry-climate models. Under AeroCom, global tropospheric aerosol models were inter-compared and tested against some observational data sets. The ACCENT-MIP effort focused on IPCC scenarios, contrasting 2030 vs. 2000 runs across a suite of tropospheric chemistry-climate models, with an eye toward how climate change might affect air quality. This effort has now effectively been merged into the HTAP project (Hemispheric Transport of Atmospheric Pollutants). The HTAP activities comprise an aspect of the AC&C area of interest: understanding and quantifying northern hemispheric transport of gaseous and particulate air pollutants and their precursors from source to receptor region.

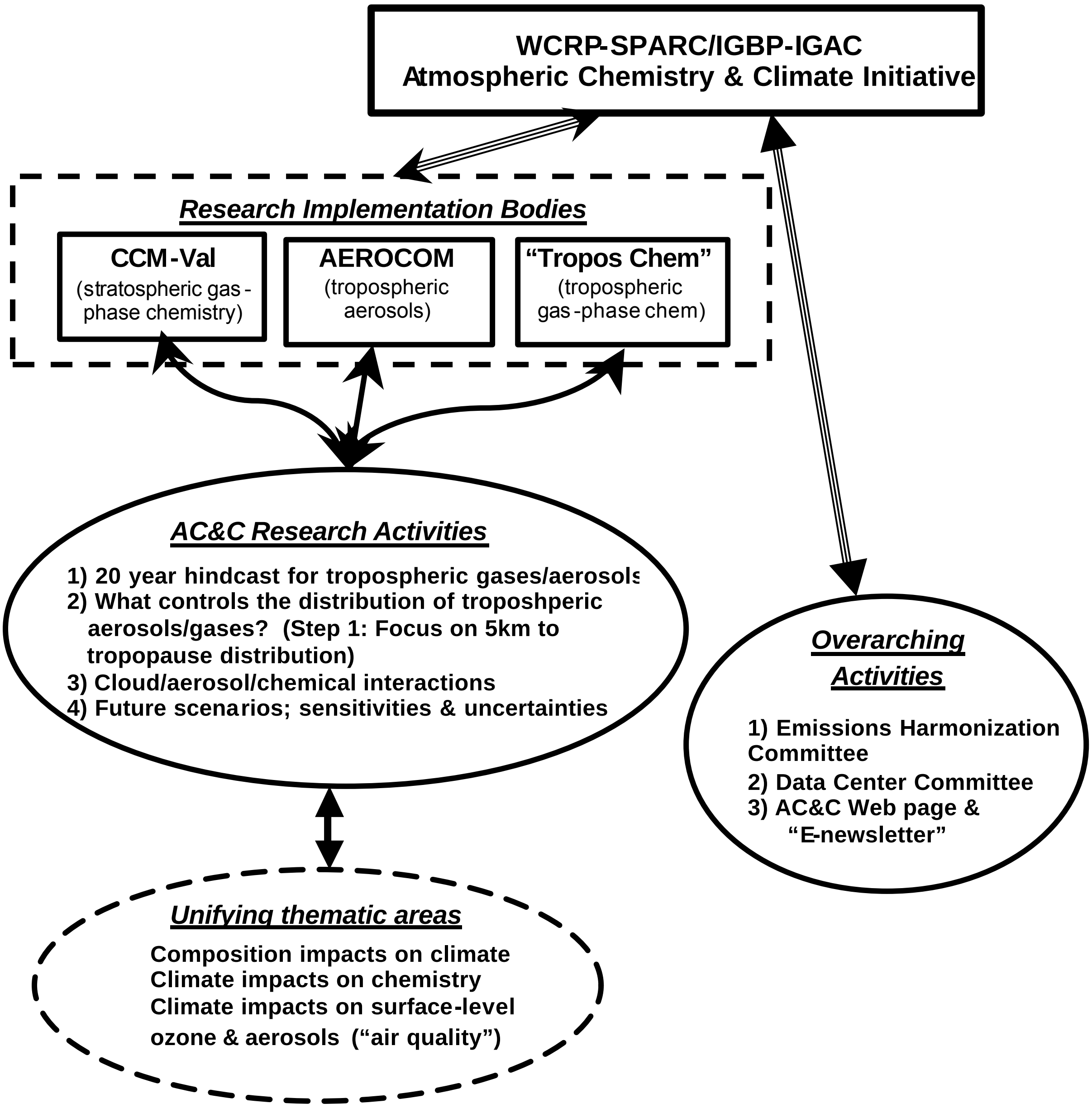
For all of these activities and for the AC&C objectives in general, characterization of emissions (amounts, nature of emissions, time-history, uncertainty, etc.) is of critical importance. Therefore, coordination with the IGBP-AIMES Global Emission Inventory Analysis (GEIA) will also be a component of the AC&C activity.

AC&C Structure and Mode of Operation

As AC&C is an unfunded activity, its success is contingent on *buy-in from the scientific community* and on being able to take *advantage of already-planned or existing activities/model runs*. Thus, the activities selected for pursuit under AC&C were selected in part on input from the community on how proposed projects rated for:

- scientific priority;
- likelihood of being tractable;
- whether research groups are likely to address this problem in the next few years;
- value of return for investment.

The activities of AC&C will be pursued under the organizational framework given in the figure below. Two existing activities – CCM-Val and AeroCom – cover two of the areas of interest under AC&C: stratospheric gas phase chemistry and tropospheric aerosols. A third area of interest, tropospheric gas phase chemistry, is covered only in part by other activities (e.g. ACCENT-MIP/HTAP). Thus the implementation body "Tropos-Chem" in the figure below will comprise a new committee formed under AC&C. This steering committee will act as an information clearinghouse, facilitate various activities, define some of the foci, and coordinate tropospheric chemical modelers working on AC&C activities.



Activities Selected for AC&C Phase 1

The selection of activities is based on the following guidelines:

- Some components of AC&C should contribute to the next WMO Ozone Assessment and the next IPCC Assessment (assuming there will be one).
- AC&C activities must require the engagement of two or more of the three implementation groups. (If only one was needed, the group could pursue it on its own and AC&C would not be needed).
- AC&C modeling exercises should involve three or more models. (Again, otherwise the integrative role of AC&C is not necessary).

- Observations are to be used wherever available to validate and test models. The observational community will be engaged in each of the AC&C activities for this purpose.

At the AC&C workshop in Geneva, four specific research activities were decided upon, based on the above set of criteria/guidelines. In addition, there was a resounding message from the community that AC&C could benefit scientific advancement in the area of chemistry and climate through several other over-arching activities, which are necessary and where AC&C can help.

Following are the four research projects that have been planned for AC&C in Phase I of the project (nominally to end in 2009). Steering committees for each were identified in Geneva, including some members who were not present but will be contacted and asked to join the effort.

Observations and laboratory data will be utilized within each of the four AC&C activities as appropriate for validating and understanding model processes and output and as a way of increasing our ability to represent processes in models.

Activity 1: 20 Year Hindcast Simulation

This activity will provide important input to the next round of assessments and will also set the "baseline" for comparison of future composition.

A series of ~5 or more models will generate a 20-25 year "hindcast" to address the questions:

- Can we understand what has happened with tropospheric chemistry, and in particular ozone and aerosols?
- Can we replicate the observed changes in composition over the past 20 years?

Models will be compared to each other and to observations as available to assess them for where uncertainties lie. Within the 20 year run there can be special "focus" or "snapshot" periods, e.g. El Nino vs. La Nina years; periods when field campaign data are available for ground-truthing; etc. To the best degree possible, everyone would run models with the same emissions (anthropogenic). Diagnostics would be designed to reveal information on model processes.

Activity 2: What controls the distribution of aerosols/gases in the troposphere?
Step 1: Investigate what controls the distribution of climate/air quality relevant chemicals between 5km and the tropopause.

> *This activity would contribute to the next WMO Ozone Assessment.*

The upper troposphere was chosen as an area of interest because a) it is known that models do a poor job of representing the distribution of species in this region, but it is not understood why; b) species in this altitude range (e.g. ozone, dust, black carbon) can have a significant radiative impact; c) the processes that control the distribution of species in this altitude range (e.g. vertical lofting; wet deposition; cloud processing) also control the long-range transport of these species; and d) the distribution of species in this region depends on and influences processes in the upper troposphere/lower stratosphere.

Activity 3: Cloud, Aerosol, Chemical Interactions

The main question here is how well we can characterize warm cloud / aerosol interactions in global models, with a specific focus on the interactions with gas phase photochemistry. This activity is aimed at exploring the impact of aerosols on atmospheric chemistry through their modification on clouds. The idea would be to employ a paradigm of controlling sets of parameters (cloud droplet number, etc.) and then let chemistry run. After that more and more links to aerosols will be included and their impacts on in-cloud chemistry investigated.

Activity 4: Future Scenarios: Sensitivities & Uncertainties

> *This activity would contribute to the next IPCC Assessment.*

The goal would be specifically to have a better representation of aerosol and chemistry in the anticipated AR5 as well as other national and international assessments. This group could define the pre-industrial to present and future scenarios, based on emissions that are consistent with other

AR5 runs (to the best degree possible). By running multiple models with constrained emissions, it would be possible to define a “best guess” and uncertainties. The model runs would further be designed to explore sensitivities to model processes.

AC&C Overarching Activities, Capacity Building and Networking

A **“Tropos-Chem” Committee** is to be formed to act as the third implementation body for AC&C. As a starting point, the group will:

- form a list of groups that should be aware of AC&C activities;
- act as a liaison to these groups so that activities are coordinated wherever possible.

A **Data Center Committee** was formed to explore issues/options for having a centralized data center/tools under AC&C. Many committee members have been defined and others being notified or are in negotiation.

An **Emissions Harmonization Committee** was formed to work with GEIA and HTAP and improve the utility of emissions databases for use by models. It includes Claire Granier (co-chair of GEIA), Terry Keating (Co-Chair of HTAP), Martin Schultz (RETRO), as well as representative of EDGAR, observational scientists and others.

Visibility and Communication

An **AC&C Web page** and **E-newsletter** (or similar) will be established to link to related activities (CCMVal, AeroCom, HTAP, GEIA, ACCENT-MIP, “Tropos-Chem”) and facilitate AC&C work.

Throughout, the AC&C steering committee will be sure to communicate and coordinate with related activities as relevant (i.e. HTAP; GEIA; other WCRP/IGBP initiatives such as the nascent “Aerosols, Clouds, Precipitation and Climate” initiative, etc.).

The Immediate Path Forward

At the meeting in Geneva, it was agreed that the committees for each of the projects above would generate a brief proposal for the activity, including: motivation, proposed simulations, implementation plan, and what observations would be needed for validation. This is to be accomplished by late March 2007. These write-ups will then be circulated to the whole group for iteration and identifying areas of overlap, etc. Each activity’s plans will be sufficiently refined for publication of an article in EOS, BAMS, or similar in approximately June 2007, which will present to the larger community the AC&C Initiative background, plans and timeline.

Between June 2007 and January 2008, participants of each activity will reiterate their implementation strategies with the goal of starting model runs in January 2008.

To Attention of JSC

The JSC is invited to comment on the Initiative progress, particularly taking into account the role of AC&C as a truly jointly developing activity by WCRP and IGBP.

WORLD CLIMATE RESEARCH PROGRAMME

JOINT SCIENTIFIC COMMITTEE

TWENTY-EIGHTH SESSION

ZANZIBAR, TANZANIA, 26-30 MARCH 2007

JSC-XXVIII/Doc. 2.3
(19.II.2007)

Item 2

MONSOON ACTIVITIES IN WCRP AND THE YEAR OF TROPICAL CONVECTION
Prepared for JSC-28
February 14, 2007

1. Scientific impact, balance and relevance of WCRP overall

Monsoons are a central component of the climate system: large enough to influence the global climate system yet small enough to have distinct regional characteristics and be responsive to the global circulation. Monsoonal circulations dominate southeast Asia and are also significant in Africa and the Americas. Through the efforts of CLIVAR and GEWEX, WCRP has clearly played a major role in launching and supporting monsoon studies. CLIVAR's Asian-Australian Monsoon and Indian Ocean Panels (AAMP and IOP) have focussed on the prediction of the Indian and Australian monsoons whilst the GEWEX Asian Monsoon Experiment (GAME) and the SCSMEX (South China Sea Monsoon Experiment), both focussed on the eastern Asian monsoon. These and the other regional monsoon experiments including the North American Monsoon Experiment (NAME), the Monsoon Experiment in South America (MESA), and the La Plata Basin (LPB), and more recently the African Monsoon Multidisciplinary Analysis (AMMA, see section 3.2) all have distinctly regional approaches to monsoon issues. These regional activities have made many contributions to our understanding of monsoon phenomena giving WCRP a high profile in the climate community and in nations affected by monsoon phenomenon.

Both CLIVAR and GEWEX have expertise in field projects, data analysis and modelling that they bring to study the three primary monsoon regions, Africa, Asia-Australia and Americas. AMMA has a focus on improving the understanding of the West African Monsoon (WAM) and its variability with an emphasis on daily-interannual timescales. Research on the Asian-Australian monsoon is directed at understanding the processes responsible for the onset, evolution and termination of the monsoon whilst research on the monsoons of the Americas emphasizes the determination of the sources and limits of predictability of warm season precipitation.

The plans developed under CLIVAR and GEWEX have provided leverage of funds for key activities such as the NAME, MESA GAME and SCSMEX field campaigns and analysis, interpretation, modelling and data banking activities. CLIVAR's AAMP has focussed on monsoon prediction and, through the IOP, has developed and is implementing plans for a sustained observing system for the Indian Ocean region. Both the Indian Ocean region and the eastern tropical Atlantic have impacts on the seasonal variability of precipitation on the African continent. The Tropical Atlantic Circulation Experiment (TACE) to run from 2006-2010, which has been organised under CLIVAR's Atlantic Panel will help to clarify the role of this region for predictions over West Africa. Likewise, CLIVAR's Pacific and Indian Ocean Panels provide relevant contributions to aspects of our understanding of the variability of the Asian and American monsoon systems as well as African climate variability more widely.

GEWEX contributed GAME, which had four regional experiments (southeast Asia, Tibetan Plateau, east Asia and Siberia). The intensive regional hydrometeorological observations during GAME revealed many new aspects of large-scale hydrometeorology, including the role of organized meso-scale convective systems in the diurnal cycle of precipitation in Asian monsoon system in these regions. Data assimilation capabilities were developed for the Tibetan Plateau region which have been used to improve the Japanese Meteorological Agency model. Since the closure of GAME, GEWEX has launched the Monsoon Asian Hydro-Atmosphere Scientific Research and prediction Initiative (MAHASRI). CLIVAR has commented on the MAHASRI plan following a request from JSC-27. Since JSC-27, a number of new national and international activities in this area have emerged (see Annex B) suggesting, as discussed in Section 3.2 below, the need for more coordination.

The CEOP Inter-Monsoon Model Study (CIMS) has begun to be analyze monsoons within a global framework. Thus, for example, use of a monsoon "continentality" index developed through a comparison of the diurnal and seasonal variations in six major monsoon systems has brought out recent trends of increasing continentality for the West Africa monsoon, and to some extent the East Asian monsoon, thereby providing diagnostics for use in evaluating IPCC GCM simulations.

The first pan-WCRP monsoon workshop (organized by CLIVAR and GEWEX) held in June 2005 in Irvine California identified, both regionally-focused needs and common challenges for monsoon prediction across all the monsoon regions. Priority concerns include the need for: 1) improved representation by models of the diurnal cycle of convection and of the role of convection for the intra-seasonal oscillation as well as monsoons more widely; 2) for improved modelling of the surface fluxes, planetary boundary layer and cloud; 3) for identification of the roles of atmosphere-land coupling and of the role of dust and aerosols in developing monsoon precipitation, atmospheric moisture distribution and transport. The physical processes that control the monsoon systems and their successful prediction are at the core of modelling activities in the GEWEX Modelling and Prediction Panel's (GMPP) activities. The GLACE-2 project will examine the role of the land-surface in the predictability of monsoons while GMPP studies of convection parameterization in models will improve monsoon prediction. In collaboration with other programs and using results from monsoon studies and the Year of Tropical Convection (see below and Annex A), GMPP will lead the model development efforts of convection in WCRP. Within CIMS, a cross-cutting activity in Aerosol-Clouds-Precipitation-Climate is being coordinated with other parts of GEWEX, iLEAPS and IGAC. One recent focus has been an evaluation of the "elevated heat pump" hypothesis for the role of the Tibetan Plateau in the Asian monsoon and the possible influence of aerosols on this heat pump effect. CEOP inter-monsoon studies of aerosol-land-water cycle interactions complement CLIVAR monsoon studies which emphasize oceanic and coupled ocean-atmosphere effects.

In spite of this progress more work is needed on the common baseline problems of monsoon prediction, the role of the monsoons in the global climate system and their influence on and response to global change (see Section 3.3). In particular, to address the issues of the global water and energy cycle integration of the existing continental monsoon studies is required. The global monsoon concept combines these continental and adjacent oceanic monsoons and portrays the dominant mode of the global water and energy annual cycle. Precipitation has been used to objectively delineate the global monsoon domain and a corresponding set of metrics has been proposed for verification of models' simulation/prediction of the interannual-interdecadal variability and trend in the global monsoon system. A global monsoon system study has the potential to facilitate integration of the GEWEX and CLIVAR monsoon studies and integration of observational and modeling studies of the paleo-, present and future changes in the monsoon systems of the world.

A key overarching issue for monsoon prediction is the fundamental need for improved representation of tropical convection. The THORPEX/WCRP Year of coordinated observing, modelling and forecasting of organised tropical convection ("Year of Tropical Convection" - YOTC) activity is intended to exploit the vast amounts of existing and emerging observational and computational resources in conjunction with the development of new high resolution modelling frameworks to advance the characterization, diagnosis, modelling and prediction of multi-scale convective/dynamic interactions and processes, including the two-way interaction between tropical and extra-tropical weather/climate. This activity and its ultimate success will be based on the coordination of a wide range of ongoing and planned international programmatic activities (e.g., GEWEX/CEOP, CLIVAR, THORPEX/TIGGE, EOS, GOOS). The significant data gathering, archiving and dissemination challenges associated with the vast amounts of satellite data, disparate in-situ data sets and high-resolution model output require the breadth and functionality of the data services anticipated to come from the new WMO Information System (WIS) which will support monsoon research as one of its initial projects. The current status of and future plans for YOTC activity is outlined in Annex A.

2. Policy relevance of monsoons in WCRP

Monsoon climates show clear seasonal variations between summer wet and winter dry seasons. Summer rains provide fundamental water resources for human activities in these regions. Thus, year-to-year variability of summer rainfall amounts and/or timing of monsoon onset/withdrawal have a striking impact on the people in these regions, particularly on those engaging in agriculture, the main industry in many parts of the monsoon regions. More than 60% of the world's population is affected by monsoons on an annual basis. Monsoons are responsible for floods leading to extensive death and damage on an annual basis. The failure of monsoon events gives rise to drought and crop failures leading to agricultural and community stresses. The capability to predict the onset and intensity of monsoons would enable societies to mitigate some of the negative impacts of the monsoons and to maximize their benefits. Facilitating the development under WCRP of effective monsoon research and prediction services would enable WCRP to demonstrate relevance to the governments responsible for many of the countries with the largest populations and the greatest vulnerability to poverty. Accurate monsoon forecasts on synoptic, subseasonal and seasonal time scales could enable aid agencies to more effectively administer their programs. *It is critical that WCRP, as the world's premiere climate research program, address the monsoon prediction issue through regional studies as well as global studies aimed at a comprehensive understanding of the role of monsoons in the climate system and an assessment of the vulnerability of these regional monsoon systems to global change.*

3. Organization and governance of WCRP

3.1 Overview

Monsoons form one of the CLIVAR SSG's cross-cutting science topics. Governance in CLIVAR is through the activities of its Asian Australian Monsoon and Indian Ocean Panels; Variability of the African Climate System (VACS) Panel (which links to AMMA–see section 3.1 below) and the Variability of the American Monsoon System (VAMOS) Panel which has, as its component activities the NAME, MESA and the VAMOS Ocean Cloud Atmosphere Land Study (VOCALS). The activities of all these panels are kept under review through the CLIVAR SSG and the CLIVAR monsoon coordinator (see below).

Governance in GEWEX is through CEOP with CIMS providing coordination on the global scale and each of the Regional Hydroclimate Projects (RHPs) providing input along with GMPP and the Global Radiation Panel through the GEWEX monsoon coordinator. LPB, LBA and CPPA report through CEOP to the GEWEX SSG on their monsoon activities. In addition, the GEWEX monsoon coordinator provides an annual brief to the GEWEX SSG on monsoon activities.

CliC also incorporates monsoon-relevant efforts, although this is primarily limited to the role of the snow and ice cover of the Tibetan Plateau, and the role of the cold Asian continent in the Asian winter monsoon.

Recognizing the strengths of CLIVAR and GEWEX to address monsoon issues, the JSC tasked CLIVAR and GEWEX to: 1) organize a follow-on to the 1st pan-WCRP monsoon workshop with an emphasis on the diurnal cycle (T. Yasunari as lead) and 2) to identify contact persons in both GEWEX and CLIVAR who would lead the implementation of coordinated monsoon activities on behalf of WCRP. These have been identified as Dr Jun Matsumoto for GEWEX and Professor Bin Wang for CLIVAR.

3.2 The regional perspective

For the American monsoon systems, both NAME and MESA are being undertaken as joint CLIVAR/GEWEX initiatives and the latest plans for MESA are included in the GEWEX LPB RHP. In terms of governance, CLIVAR leads the coordination of monsoon studies for the Americas. Good coordination has been achieved by populating the VAMOS Panel and its sub groups with a cross-representation of CLIVAR and GEWEX scientists.

The AMMA programme provides the focus for the West African Monsoon in both GEWEX and CLIVAR which co-sponsor the activity. AMMA has the status of an RHP in GEWEX whilst in CLIVAR the primary links are through the VACS Panel. AMMA objectives are being addressed through separately organised international coordination of ongoing activities, basic research, and a multi-year field campaign over West Africa and the tropical Atlantic including a special observing period in spring/summer 2006. AMMA also builds on existing surface hydrological measurements available through the GEWEX CATCH project, and CLIVAR Atlantic Panel observational projects over the ocean.

Coordination of activities over the Asian monsoon region are on-going but need to be strengthened across GEWEX and CLIVAR. Since JSC-27 when MAHASRI was approved, a number of national and international activities have emerged (see Annex B). There is general consensus on an Asian Monsoon Year (AMY, see Annex B) and some regional discussion has been initiated about an International Monsoon Year (IMY). These discussions emphasize the need for CLIVAR and GEWEX with the help of WCRP to more actively provide international coordination of monsoon research across the Asian-Australian monsoon region.

It is recommended that the JSC discuss options for strengthening coordination of Asian-Australian monsoon research. One potential mechanism that should be considered is a short term task team (one year maximum) co-chaired by the CLIVAR (B. Wang) and GEWEX (J. Matsumoto) with representations from the JSC, CLIVAR and GEWEX Panels and each of the component activities including YOTC and representatives. The team should be tasked with preparing a 5-year implementation plan for an overall integrated programme of regional monsoon research with an emphasis on the links between other monsoon studies around the world and the YOTC and on the plans for AMY activities.

3.3 The global perspective

Currently the primary coordinated global focus on the monsoons is through the CEOP CIMS activity. The GMPP and the WCRP Modeling Panel (WMP) also have a primary concern for model development related to monsoon prediction. There is a need now for a realistic assessment of our present capabilities in monsoon prediction, for which the datasets available through the CLIVAR Working Group on Seasonal to Interannual Prediction (WGSIP) and others, including SMIP (Seasonal Model Intercomparison Project), the ENSEMBLES, DEMETER and APCC CliPAS projects and GLACE-2, provide potential resources. The upcoming JSC TFSP pan-WCRP Seasonal Prediction Experiment to explore the overall predictability of the climate system on the seasonal timescale will provide another important opportunity for analysis and experimentation. In addition the present WCRP CMIP AR4 archive allows the systematic exploration of the potential response of the monsoon systems to global change. Other global (but also regionally-linked) issues include, for example the multiscale interactions extending from the convective- to the large-scale, the role of tropical modes of variability on the monsoon systems including the role of ENSO, the Indian Ocean Dipole and tropical Atlantic variability, and the overall role of the monsoons in the global climate system, including the descending branches of monsoon circulations.

It is recommended that the JSC:
(a) Carry out an assessment, initially through the current TFSP activity in collaboration with other WCRP monsoon and modelling activities, of present capabilities in monsoon prediction
(b) Request CLIVAR and GEWEX to develop an overall implementation plan for WCRP activity aimed at more reliable predictions of the monsoon systems of the world. Particular attention to be given to coordinating these activities with the YOTC.
(c) Request CLIVAR to develop a more global focus to its regional monsoon activities overall, with particular attention to the role of the oceans for the monsoon systems of the world; CLIVAR should also continue to encourage its regional monsoon panels to organise activities to analyse the available global datasets from a regional perspective with feedback to global modelling groups.
(d) Confirm their request to GEWEX and CLIVAR to organise a further pan-WCRP monsoon workshop with foci on (a) to (c) above and building on the outcomes of the 1st pan-WCRP Workshop. The lead for the science program will be T Yasunari.
(e) JSC form a task force to coordinate the IMY related international and national efforts (TF-IMY), consisting of relevant JSC members, monsoon experts, and CLIVAR and GEWEX contacts.

4. Visibility and Communication:

Monsoons are well known phenomena on a regional scale where the value of CLIVAR-GEWEX collaboration have been demonstrated. *The current successes and efforts by GEWEX and CLIVAR in this area provide an excellent basis for WCRP to demonstrate its contributions to issues that are of great concern to society.* WCRP needs to mobilize its public information capabilities to communicate this message to its stakeholders and to highlight its future plans and successes in this area.

5. Interaction with Other Bodies:

Through their monsoon research GEWEX and CLIVAR are building bridges with the Earth System Science Partnership (ESSP) Monsoon Asia Integrated Regional Study (MAIRS) program and SysTem for Analysis Research and Training (START). MAIRS and MAHASRI share a number of investigators and scientists. A number of the monsoon studies (MAHASRI, AMMA, NAME, MESA, etc) include application projects that bring the scientific understanding and predictions to decision makers primarily in the field of hydrology.

6. Capacity Building in/by WCRP:

The monsoons offer many opportunities for capacity building because a number of the countries affected by monsoons need enhanced capacity. CLIVAR is developing experience in capacity building through its VACS Panel and through the workshops of the joint CLIVAR/CCI Expert Team on Climate Change Detection, Monitoring and Indices. Leverage of CLIVAR and GEWEX research was a component in the successful bid in 2003 for GEF funds for planning and implementation of strategic actions to be taken by the governments in LPB countries for the environmental and socially sutainable economic development of the basin. GEWEX through the Integrated Global Water Cycle Observations (IGWCO) theme and the Group on Earth Observations (GEO) Capacity Building efforts has gained considerable insight into the needs for capacity building in monsoon areas. GEWEX collaborated with IGWCO and GEO in a workshop in Southeast Asia in 2006 that addressed the opportunities to build capacity in analysis and prediction in support of monsoon floods. GEWEX and particularly CEOP activities in the Asian region are being coordinated through the Asian Water Cycle Initiative while GEWEX Capacity Building activities in the Americas are being developed under a GEO task concerned with the development and implementation of a Capacity Building process for Latin America.

AMMA has successfully developed capacity in national weather services through augmentations to observing systems and by building the skill levels in local forecast offices. In particular AMMA has recently included African partners in the AMMA-EU consortium and is funding research to assess the effects of the West African Monsoon (WAM) on agriculture and food productivity, land use, water resources, health and food security. AMMA is also working with operational centres to enable them to forecast seasonal variations in the WAM. *From the perspective of the Asian Monsoon, capacity building activities, it will be important to integrate with the ESSP- MAIRS(Monsoon Asia Integrated Regional Study) activity in particular.* Integration with the WCP, in particular CLIPS, and the applications of monsoon predictions to issues of health, agriculture and water supply. MAIRS works closely with START, the capacity building arm of the WCRP.

It is recommended that the JSC request that CLIVAR and GEWEX to develop a joint plan for capacity building activities for the application of observations and predictions in monsoon regions for societal benefit.

Prepared by: Jun Matsumoto, Bin Wang, Howard Cattle, Rick Lawford, Guoxiong Wu, Duane Walliser and Tetsuzo Yasunari.

Annex A Year of Tropical Convection – Summary Current Status and Plans

1. Summary

WCRP and THORPEX are proposing a Year of coordinated observing, modelling and forecasting of organized tropical convection and its influences on predictability as a contribution to the United Nations Year of Planet Earth to compliment the International Polar Year (IPY). This effort will exploit the recent investments in Earth Science infrastructure, specifically the vast amounts of existing and emerging observations (both satellite and in-situ) and computational resources, in conjunction with the development of new, high-resolution modelling frameworks to address the following science questions:

- What are the most crucial elements of the large-scale circulation that influence the development, organization and maintenance of tropical convection?
- Under what circumstances and with what mechanisms is energy and momentum transferred between the convective, mesoscale, synoptic scale, and the large/planetary scale?
- How does organized tropical convection interact with the extra-tropical circulation?

This activity and its ultimate success will be based on the coordination and leveraging of a wide range of ongoing and planned international programmatic activities (e.g., GEWEX/CEOP, THORPEX/TIGGE, EOS, GOOS, AMY/IMY 2008). The goals of the program are to achieve significant gains in forecast skill by 2010 in:

1. Medium-range tropical weather forecasts, particularly disturbed conditions associated with organized convection,
2. Extended-range/subseasonal forecasts of the MJO, and
3. Medium-to-extended range extratropical forecasts derived from improved tropical weather/climate and tropical-extratropical interactions,

through better understanding and improved data assimilation techniques/resources and modeling capabilities.

2. Current Status

Since the conceptualization of YOTC at the WCRP-THORPEX workshop in March 2006 on the "Organization and Maintenance of Tropical Convection and the Madden Julian Oscillation", presentations on YOTC have been made at the CLIVAR SSG (Apr 06) and US CLIVAR Summit (Jul 06), the Second THORPEX International Science Symposium (Dec 06), the Pan-GEWEX (Oct 06) and GEWEX SSG (Jan 07) meetings, the joint WGNE/WMP meeting (Oct 06), the 3rd WIS Enhancement meeting (Aug 06), THORPEX/NCAR/NSF TIIMES Retreat on Convection (Jul 06), and the so-called White Paper meetings in Reading, UK (Oct 06). In addition to connections with WIS, there have also been discussions with NASA data services, NOAA/EOL (formerly JOSS), and TIGGE to lay groundwork for data support issues associated with YOTC. A draft science plan has been developed (hydro.jpl.nasa.gov/tmp/WCRP.THORPEX.YOTC.draft.pdf) and been in circulation since Oct 06 that outlines the motivation, general science questions, and overarching strategy. Requests have been made to WCRP and THORPEX, both from WGNE (letter dated 2/2/07) as well as from the instigating science community (letter dated 1/19/07) to consider more formal recognition and the formation of a science steering group (SSG) that would finalize the science plan and draft formal implementation plans.

3. Plans

Albeit the need for more formal recognition and an associated scientific body to develop, sanction and guide the proposed initiative, as presently envisioned the activity calls for a "year" of "intensive observations" and real-time/subsequent modelling activities. Nominally, this "year" would probably extend for about 15 months and possibly begin in May 2008 and extend through August 2009. The focus area would be the global tropics, although the two-way interactions with key mid-latitude regions are of high interest and priority to address. Specific target phenomena within the tropics include the diurnal cycle, easterly waves/hurricanes, convectively-coupled equatorially waves and the MJO, the monsoons and the ITCZ. These target phenomena would be addressed through the establishment of focused working groups underlying the activity's SSG. Together the SSG and the working groups, within the context of a series of both focused and international workshops, would identify the most pressing and tractable problems from the target Year, design and coordinate activities, share modeling strategies and successes, report results, and iterate on additional problems or future Years. Observation resources will be based on the traditional network, the wide array of new, research oriented satellite missions (e.g. EOS, A-Train, Envisat), time-scale relevant aspects of the global ocean observing system (GOOS; e.g. buoys, drifters and floats), a number of enhanced in-situ programs (e.g., ARM, CEOP) and opportune IOPs (e.g., AMMA, VOCALS, T-PARC). The TIGGE data set represents a keystone of the modeling component along with a variety of research-oriented multi-scale simulation/hindcast components (e.g., global and regional CRMs, MMFs, NCAR channel model, GCMs). Funding opportunities are now starting to arise and organizational infrastructure needs to be put in place to begin taking advantage of these opportunities.

Annex B: Emerging activities in the Asian-Australian Monsoon region

B2.1 The Asian Monsoon Year (AMY):
The Asian Monsoon Year (AMY) was proposed as an important element in improving observations, analyses and modelling in the monsoon regions jointly with GEWEX and CLIVAR, as well as CliC and SPARC. The time period for the AMY 2008 will be from April 2008 until March 2009 to cover the full annual cycle of boreal summer monsoon. It will link across to and contribute from plans for the Year of Tropical Convection initiative. The idea of extending this effort to the global perspective of an International Monsoon Year is being explored. The initiative will bring together the GEWEX and CLIVAR monsoon efforts in the austral Asian region, in particular the Monsoon Asian Hydro-Atmosphere Scientific Research and the prediction Initiative (MAHASRI). An Asian Monsoon Year (AMY08) International Workshop is currently being planned to be held in Beijing, China from 23-25 April 2008.

B2.2 MAHASRI
MAHASRI is a GEWEX initiative that has the goal of improving the prediction of the Asian monsoon and its hydrological cycle. It is a 10-year program for the period 2006-2015, focusing on establishing a scientific basis for predicting the hydroclimate monsoon system intraseasonal to seasonal time-scale, including developing prediction systems for droughts and flood conditions of regional river basins and similar areas in Asia. MAHASRI will address issues of diurnal cycles, intraseasonal, interannual, and decadal scale variability and their multi-scale interactions with convection and precipitation processes, and, boundary layer processes, low level jets, and interaction with complex terrains, and the warm water pool. It will target processes in both the Asian summer and winter monsoons. Its spatial coverage will include the tropics from the maritime continent to the South and Southeast Asia, Tibet/Himalaya, East Asia, and Northeast Asia. Special emphasis will be placed on the air-land-ocean interactions, the role of aerosols on monsoons, monsoon predictability, and flood/drought predictions. MAHASRI is part of CEOP, and will play an essential role in the WCRP strategic framework. It will contribute to IMY through a special observing period that is planned for 2008 and 2009 (Lead/POC: Jun Matsumoto, Tokyo Metrop. U., Japan)

B2.3 Impact on the Short-Term Climate Variation in China: (AIPO) Program (China)
China's strong and active monsoon studies supported by the Chinese Academy of Sciences (CAS), and by the Chinese Meteorological Administration (CMA) are associated with both CLIVAR and GEWEX. Recently the Chinese Ministry of Science and Technology (MOST) has approved a 5-year (2007-2011) national program, which was jointly proposed by CAS, CMA, Chinese National Natural Science Foundation (NSFC) and the Chinese State Oceanographic Administration (SOA), to study the monsoon coupled ocean-atmosphere-land interaction over the Asia, and Indian and Pacific Oceans, focusing on the dynamical effects of heating contrast between the Indo-Pacific warm pool and the Asian continent. The project will include a special observing period, tentatively planned for 2008 to 2009, that includes measurements of atmosphere and ocean from ships, buoys and moorings over the South China Sea, Eastern equatorial Indian Ocean and western equatorial Pacific Ocean.

(Lead/ Point of Contact (POC): Guoxiong Wu, LASG, Institute of Atmospheric Physics, CAS).

B2.4 South China Heavy Rainfall Experiment (SCHeREX)
SCHeREX is aimed at better understanding the mechanism of formation and development of meso-scale strong convective systems under Asian summer monsoon background and improving its prediction, as well as the study of advanced characteristics of the Asian summer monsoon and its relation with activities of meso-scale heavy rainfall systems. The period of SCHeREX is three years from 2007 to 2009. This project is focusing on establishing a meso-scale observing network including over 600 surface automatic stations, over 20 sounding stations, 9 Doppler radars with four movable Doppler radars comprised of four pairs of dual-Doppler radar nets, airborne dropsonde, 3 wind profiles and others in Southern China and a lot of operational observation stations and equipments in the areas of down and middle stream of Yangtze River. (Lead/ Point of Contact (POC): Renghe Zhang, CAMS, CMA, China).

China is also supporting several other projects that will be part of IMY including: 1) Drought trends in Northern China and human adaptation, 2) Environmental change over the Tibetan Plateau, its response to global change and the adaptation counter measures, and 3) Aerosols over China and their climatic impacts.

A2.5 Monsoon Research Program (India)
Particularly relevant to the AMY are two planned field campaigns: Severe Thunderstorms: Observations and Regional Modeling (STORM) 2006-09, and Continental Tropical Convergence Zone (CTCZ) 2007-2010. The science focus of STORM is in heavy rainfall, lightning, and severe weather. Mesonet (25 km resolution) observation networks will be set up in target regions to monitor, heavy rain, wind, lightning, aerosols, and other atmospheric parameters during various phases of the monsoon. In CTCZ, the scientific objective is to unravel the relative roles of internal dynamics and the boundary layer forcing of the intraseasonal oscillations in affecting the northward movement of the monsoon from northern India Ocean to the Indo-Gangetic Plain and the foothills of the Himalayas, and their possible relationship to interannual and decadal scale climate variability and change. The possible impacts of aerosol forcings during the pre-monsoon period, as well as during the monsoon breaks, aerosol-cloud rainfall interaction over the Indo-Gangetic Plain and elsewhere there are additional factors that may affect monsoon predictability. (Lead/POC: D.R. Sikka/ Rao, Science and Technology Agency, India)

A2.6 Japan EOS Promotion Program (JEPP) (Japan)
As a contribution of Japan to GEOSS, five research projects have been selected that relate to the establishment of hydrometeorological observations in the Asian monsoon region. These include: Observation network in the Indian Ocean (Lead: Mizuno, JAMSTEC/IORGC) and Maritime Continent (Lead: M.D. Yamanaka, JAMSTEC/IORGC), over the Tibetan Plateau (Lead: H. Ishikawa, Kyoto Univ., Japan); in Southeast Asia (Lead: J. Matsumoto, Tokyo Metrop. U., Japan) and in Thailand (Lead: T. Oki, Univ. Tokyo, Japan).

A2.7 *Monsoon Asia Integrated Regional Study (MAIRS)*
MAIRS is an Earth System Science Partnership (ESSP) initiative sponsored by the World Climate Research Programme (WCRP), the International Geosphere Biosphere Programme (IGBP) and being implemented by START. MAIRS has the objective of better understanding the role of human activities in affecting and interacting with the changing atmospheric, terrestrial, and marine environments in the Asian monsoon regions, and to develop institutional capacity to improve forecasts and to mitigate adverse impacts. Monitoring stations for aerosol, agriculture, biodiversity will be set up in coastal zones, high mountains, semi-arid regions, and urban areas in the Southeast and East Asian regions. (Lead/POC: C. B. Fu, Institute of Atmospheric Physics, CAS, China).

A2.8 Joint Aerosol-Monsoon Experiment (JAMEX)

The objective of the Joint Aerosol-Monsoon Experiment (JAMEX) is to unravel the physical mechanisms and multi-scale interactions associated with aerosol-monsoon water cycle in the Asian Indo-Pacific region towards improved prediction of rainfall in land regions of the Asian monsoon. JAMEX will be planned as a five-year (2007-2011) multi-national aerosol-monsoon research project, aimed at promoting collaboration, partnership and alignment of ongoing and planned national and international programs. Two coordinated special observing periods (SOP), covering the pre-monsoon (April-May) and the monsoon (June-August) periods is tentatively targeted for 2008 and 2009. One of the unique aspects of JAMEX is that it stems from grass-root scientific and societal imperatives, and it bridges a gap between aerosol and monsoon dynamics research in existing national and international programs. Currently we have identified 10 major national and international projects/programs separately for aerosols and monsoon research planned in the next five years in China, India, Japan, Italy, and the US, that could be potential contributors or partners with JAMEX. These include the AIPO, MAHASRI, CTCS/STORM, SHARE-Asia ABC, PACDEX, East-AIRE, MAIRS and others. (Lead/POC, W. Lau, V. Ramanathan).

WORLD CLIMATE RESEARCH PROGRAMME

JOINT SCIENTIFIC COMMITTEE

TWENTY-EIGHTH SESSION

ZANZIBAR, TANZANIA, 26-30 MARCH 2007

JSC-XXVIII/Doc. 2.4
(13.II.2007)

Item 2

Cross-Cutting Topic: Decadal Prediction

1. Introduction

i. Natural and Anthropogenically-Forced Decadal Variations

There are many examples of extreme climate variations on decadal timescales, many of which are associated with human death and misery. Perhaps the most striking in recent decades is the decadal timescale drought in the Sahel (leading, for example, to the remarkable Band-Aid Concerts). Other decadal-timescale droughts, such as the "dust-bowl" drought in the Southern US in the 1930s, are infamous in history (inspiring classics of literature such "The Grapes of Wrath").

More generally, decadal-timescale variability can be seen in most climate records. For example, in Africa there is a bi-decadal signal in precipitation over many parts of southern Africa and parts of East Africa have a strong decadal signal in the "short rains" season (CLIVAR VACS, 2007). Changes in the Atlantic Multidecadal Oscillation (AMO) are linked with decadal Atlantic hurricane variability and have impacts in the Sahel, India, Brazil, Central America and the Arctic. Changes in AMO are dynamically linked with the variations in the Meridional Overturning Circulation (MOC) of the Atlantic, in turn linked with the thermohaline circulation (THC). In the paleoclimate record, "abrupt" climate changes are believed to be linked directly with decadal variations in the MOC/THC. In the Pacific/Indian Ocean basins, there are strong signals of decadal variability associated with the Pacific Decadal Oscillation (PDO) with statistical links to the climate of surrounding regions. For example, during the 20th century, El Niño-like phases of the PDO coincided with decades in which ENSOs impact on Australia was weak, whereas La Niña-like phases of the PDO coincided with decades in which ENSOs impact on Australia was strong (Power et al, 1999).

In addition to natural climate variability, anthropogenic emissions of greenhouse gases (GHGs) will change the statistics of weather patterns in the coming decades. Hence the decadal climate prediction problem must take into account, not only the potential role of initial conditions (especially ocean, land and sea-ice) , but also future concentrations of GHGs (including other forcings such as aerosols). A prediction which depends entirely on forecast initial conditions is often referred to as a "prediction of the first kind" (following nomenclature introduced by Lorenz). A prediction which depends entirely on some specified forcing (eg specified SST anomalies, or a specified concentration of GHGs) is referred to as "a prediction of the second kind." Decadal prediction is both of the first and second kind. Indeed, this combination of prediction type poses interesting scientific questions: for example, does the impact of GHG forcing on decadal timescales depend on initial conditions; conversely, do estimates of initial-condition predictability depend on GHG forcing?

ii The scientific basis for decadal prediction

Many of the decadal variations mentioned above, are associated with remote sea surface temperature anomalies. For example, Folland et al (1986) showed that the persistent drought in the Sahel in the second half of the 20th Century was affected by decadal timescale anomalies in SSTs associated with the MOC, further exacerbated by local land surface interactions. Similarly, Schubert et al (2004) showed that the US "Dust Bowl" drought was dynamically associated with anomalously cold SSTs in the tropical Pacific and warmer than normal SSTs in the tropical Atlantic. There is evidence that decadal rainfall signals in East Africa are linked with the PDO (CLIVAR VACS 2007).

Whilst there are no clear spectral peaks in SSTs on decadal timescales eg associated with the MOC and PDO, it is nevertheless possible that these spatially-coherent patterns of variability may have some predictability on decadal timescales, ie there is some potential for predicting these climate anomalies, given sufficiently accurate knowledge of initial conditions of land and ocean. However, the existence of such predictability needs to be proven - the null hypothesis is that decadal fluctuations arise from low-pass filtering of unpredictable atmospheric noise by the slow components of the climate system such as the oceans.

There is evidence for the existence of decadal predictability. For example, PREDICATE, an EU-funded project on the mechanisms and predictability of decadal fluctuations in Atlantic-European climate, concluded that potential decadal predictability exists for both the tropical and extratropical parts of the North Atlantic European region - up to 60% of the variance is potentially predictable. The project showed that the ocean exerts an important influence on multi-decadal timescales. For example, multidecadal variations in Atlantic SST associated with the MOC/THC modulates European climate.

An important workshop on Atlantic Decadal Predictability was held at GFDL in June 2006. A working hypothesis of the workshop was that if the state of the Atlantic MOC can be determined from data assimilative ocean models, then, when coupled to atmospheric models, the state of the MOC and perhaps the AMO can be projected into the future. Results from the workshop showed evidence from coupled GCM experimentation that the MOC was partially predictable on timescales of a decade or two.

In any case, even if initial-value predictability is limited, there is little doubt that the statistics of modes such as the MOC, AMO, PDO and so on will be affected by ACC.

2. A Cross-Cutting Proposal to Advance the Science of Decadal Prediction

The last decade has seen substantial developments in the development of coupled ocean-atmosphere models in global data assimilation systems for the ocean and the atmosphere, and in ocean observing systems. With these data assimilation systems, retrospective global analyses of the ocean and atmosphere state have been made over the past 40 years. In addition, impact and application models eg for health, agronomy and hydrological applications, have been developed and coupled to climate models. These developments suggest that the time is ripe to assess decadal predictability using state-of-the-art coupled model, initialised using realistic ocean-atmosphere analyses, and to assess the utility of these assessments on practical applications.

Some studies of decadal predictability using observed estimates of atmosphere-ocean initial conditions are already underway (eg Smith et al, 2007; ENSEMBLES, 2007). However, given the importance of this problem, it is timely to propose these types of study to the international community. The organisation of internationally-coordinated multi-model experimentation has been one of WCRP's strengths, and below is a proposal for a first step to explore decadal predictability from realistic ocean-atmosphere initial states, at coordinated international level. It is important at this stage not to propose too extensive a set of integrations. Firstly, institutes may not have sufficient resources to undertake an extensive programme of experimentation. Secondly, this preliminary study will raise as many issues, scientific and technical, as it will solve. Hence this study should be seen as a precursor to a second, more definitive study in a few years time.

The proposal would be to take two suggested initial dates from distinct decades, here suggested 1965 and 1994 (cf ENSEMBLES, 2007; Troccoli and Palmer, 2007). ECMWF can provide atmospheric and oceanic initial conditions from their atmosphere and ocean reanalysis effort. Modelling groups would then be asked to run four 20-year 3-member ensembles:

A 1965 initial conditions, observed GHGs (including aerosols) from 1965
B 1994 initial conditions, observed GHGs from 1994
C 1965 initial conditions, observed GHGs from 1994
D 1994 initial conditions, observed GHGs from 1965

By comparing A with B we can gauge the overall level of predictability arising from both having different initial conditions and different GHG forcings. By comparing A with D, and B with C, we have two estimates of decadal predictability (arising from having different initial conditions and the same GHG forcing). By comparing A with C, and B with D, we have two estimates of the impact of GHG forcings (since initial conditions would be the same).

These experiments allow yet more subtle types of analysis to investigate the dependence of initial conditions on GHG impact, and GHG impact on initial-condition predictability. Hence by comparing (A-C) with (B-D) we can study how the impact of the greenhouse forcing depends on the initial condition. Similarly, by comparing (A-D) with (B-C) we can study how the influence of initial conditions depends on the underlying GHG forcing.

There are technical issue which need to be discussed before finalising this proposal. For example, what is the best way to initialise the ocean from a set of analyses. For example, adding analysed anomalies (analysis - climatology) to some pre-existing state spun-up with climatological (eg Levitus) forcing might be best to try to reduce initial imbalances.

This type of experimentation is reminiscent of that proposed under the TOGA Monsoon Numerical Experimentation Group (MONEG 1992). There, seasonal AGCM integrations were made from initial conditions on 1 June 1987 and 1 June 1988 and run with observed SSTs from 1987 and 1988 (cf A and B). With additional hybrid experiments (cf C and D) running 1 June 1987 atmosphere/land initial conditions and 1988 SSTs (and vice versa) the impact of the atmosphere/land surface initial conditions could be distinguished from the impact of the SSTs.

It can be envisaged that, following successful execution of this initial phase, a full scale decadal-prediction study, organised under the auspices of WCRP, could be devised.

3. Relevance to WCRP

i Scientific impact, balance and relevance of WCRP overall

The two overarching objectives of WCRP are:

1. to determine the predictability of climate, and:
2. to determine the effect of human activities on climate

A study of decadal prediction addresses both of WCRP's objectives - the intrinsic predictability of climate, ie the role of initial conditions, and the anthropogenic forcing of climate.

The WCRP strategic framework (WCRP, 2005) aims to facilitate analysis and prediction of Earth System variability and change for use in an increasing range of practical applications of direct relevance, benefit and value to society. Clearly an expansion of work in the area of decadal prediction fits well this aim. More specifically, however, a key focus of the WCRP strategic framework is towards seamless prediction, and there are many theoretical and practical reasons for the weather and climate community to adopt a seamless prediction methodology (Hurrell et al, 2007). Decadal prediction is a "meeting ground" for the weather and climate modelling communities. The climate-change community is typically focussed on the problem of estimating anthropogenically-induced climate change on centennial timescales. For this community, the provision of accurate initial conditions is not a major concern, since the level of predictability of the first kind is believed to be small on century timecales. By contrast, the numerical weather prediction and seasonal forecast community have well-developed data assimilation schemes to determine initial conditions, however the models do not incorporate many of the cryospheric and biogeochemical processes believed to be important on timescales of centuries. A focus on decadal prediction by the two groups may help expedite the development of data assimilation schemes in Earth-System models, and the use of Earth-System Models for shorter-range, eg seasonal prediction. For example, as has been discussed elsewhere (Palmer et al 2007), seasonal predictions can be used to calibrate probabilistic climate-change projections, in a seamless prediction system. Hence there is common ground over which to base a cooperation of the two communities in order to develop seamless prediction systems.

ii Policy relevance for WCRP

The proposal in Section 2 is extremely policy-relevant for WCRP. Firstly, reliable decadal predictions have application in many sectors: health, agriculture, water management, tourism, forestry, fisheries, hurricane predictions, arctic navigation, permafrost and methane gas emission, electrical power generation, shipping and offshore construction (Crawford et al, 2006) to name a few.

These applications would all be relevant without the additional complication of anthropogenic climate change (ACC). However, in the light of ACC, many public and private sectors are now facing the problem of assessing what infrastructure investment is needed to adapt to climate change. Whilst mitigation policy is relevant for controlling carbon concentrations a hundred or more years ahead, infrastructure investment decisions in climate-sensitive areas are most relevant on the decadal timescale. Hence developing a reliable decadal prediction system will be a key contribution WCRP can make to the problem of climate adaptation.

Because of the importance of short-range climate prediction for climate adaptation decisions, it is conceivable that multi-decadal climate prediction from observed initial states will play a prominent role in the next IPCC assessment report.

iii Organisation and governance of WCRP

This paper proposes activities which will draw on the expertise of scientists across the whole range of WCRP and build on overarching issues which lie under the scope of both WMP and WOAP. In particular it requires attention to both state of the art analysis and assimilation systems for initialization of coupled models and carefully designed numerical experimentation. Both of these are key issues for CLIVAR which can bring considerable wider expertise to this activity (decadal variability is a cross-cutting science topic within CLIVAR which also has the lead within WCRP on the role of the oceans in climate. Further, GEWEX can supply important expertise on the role of land surface processes and in particular experimentation on how initialization of the land surface may influence decadal predictions. In addition, expertise on the the role of ice for decadal prediction through involvement of CliC scientists and of the potential influence of stratospheric processes on decadal prediction via SPARC will also be crucial.

It is proposed that scoping of the proposed activity be carried out by a short period pan-WCRP Task Force led by CLIVAR and involving experts from CliC, GEWEX and SPARC, reporting on progress to the WMP and WOAP and aiming of the development of a comprehensive plan for the initial experiment in time for JSC XXIX. Such a plan would build on, and benefit from the planning for the upcoming TFSP Seasonal Prediction experiment. The activity would therefore be built on existing WCRP governance structures and forms of working set out in the WCRP Stategic Framework 2005-2015.

iv Visibility and communication by WCRP

Development of the basis for decadal timescale prediction will be a key activity with potential for high visibility for WCRP, in particular providing a legacy similar to that which emerged from TOGA and ongoing efforts under CLIVAR for seasonal prediction. WCRP will need to communicate our understanding of and the potential for decadal prediction to its stakeholders at an early stage and to then build on this as key science achievements and capabilities emerge. The role of decadal prediction as a meeting ground for the weather and climate modelling communities and a vehicle for seamless prediction will also need to be widely communicated to ensure the buy-in from a wide range of the community and from a broad spectrum of agencies world-wide. It will also be essential to involve and communicate with those involved with the potential applications of decadal prediction both through publicity, but more importantly through their involvement in activities to assess the utility of the predictions themselves and advertisement of emerging capability.

v. Interaction with other bodies

There are potentially considerable opportunities to develop interactions with other bodies, including e.g. the WMO World Climate and Applications Services Programme (and in particular its Climate Information and Prediction Services (CLIPS) project) as well as a wide range of potential user communities, especially agencies seeking predictions for long-term planning. Decadal timescale predictions will also provide an interface with a range of other programmes and in particular with IGBP in terms of the impact of variability on biogeochemical systems, with IHDP in terms of impacts on society and its ability to plan and input to any future IPCC assessments (eg on short-range projections for climate adaptation), providing the perspective of the influence of long timescale climate variability.

vi. Capacity building in/by WCRP

As a cross cutting topic of WCRP, decadal prediction will provide a focus for development of capacity in terms of seamless prediction and to help direct the activities and requirements (e.g. for observations and assimilation and prediction systems within WCRP overall as well as more widely. Decadal prediction has potential for a wide range of prediction services, building capacilty for planning across both the developed and developing world. It will also impact on capacity building at intraseasonal-seasonal-interannual prediction timescales through increased understanding of the role of decadal timescale variability on seasonal predictions themselves

References

CLIVAR VACS, 2007: Decadal variability issues in Africa.

Crawford, W., Martinez, R. and Suga, T., 2006: List of possible applications for decadal prediction. CLIVAR Pacific Panel Document.

ENSEMBLES, 2007. http://www.ensembles-eu.org/

Folland et al, 1986: Sahel rainfall and worldwide sea temperatures 1901-85: Observational, modelling and simulation studies. Nature, 320, 602-607.

Hurrell, J., Bader D., Delworth, T., Kirtman, B., Meehl, J., H.L.Pan, B. Wielicki: 2007. White Paper on Seamless Prediction. In preparation for BAMS.

Leetmaa, A. and J. Marshall, 2006: Workshop report: Atlantic Decadal Predictability and Plan for Next Steps.

MONEG, 1992. Simulation of interannual and intraseasonal monsoon variability. WMO/TD-No 470, 185pp

Palmer et al, 2007: Calibration of probabilistic climate-change projections of precipitation using seasonal reforecasts. Nature. Submitted.

Power, S., Folland, C., Colman, A. and V. Mehta, 1999: Inter-decadal modulation of the impact of ENSO on Australia. Climate Dynamics, 15, 319-324.

PREDICATE, 2006: http://ugamp.nerc.ac.uk/predicate/

Schubert et al, 2004: On the cause of the 1930s dust bowl. Science, 303(5665), 1855-1859.

Smith et al, Improved surface temperature prediction for the coming decade from a global climate model. 2007. Science. Submitted.

Troccoli A. and Palmer, T.N., 2007: Climate prediction as an initial-value problem. Phil. Trans. Roy. Soc., submitted.

WCRP, 2005: http://wcrp.wmo.int/About_Strategy.html

WORLD CLIMATE RESEARCH PROGRAMME

JSC-XXVIII/Doc. 2.5
(15.II.2007)

JOINT SCIENTIFIC COMMITTEE

Item 2

TWENTY-EIGHTH SESSION

ZANZIBAR, TANZANIA, 26-30 MARCH 2007

Climate Extremes – what should WCRP be doing?

1. Introduction

"You'd better learn to make money from climate change or you'll be eaten for lunch," warned Paul Dickinson of the Carbon Disclosure Project (1) at the recent World Economic Forum in Davos. The Carbon Disclosure Project is a London-based group that monitors the readiness of companies to tackle global warming for investors managing assets worth about $31 trillion.

For some companies this is only about reducing carbon emissions, but for others it means careful planning and risk assessment that takes into account the best possible information about what a changing climate might look like. Swiss Re, when contacted as part of the Era WCRP Networking Survey, expressed a keen interest in information exchange with WCRP on topics of mutual interest, in particular forecasting of climate extremes. Similarly, the Willis Research Network is a major, long term partnership between leading international scientific institutions and Willis Reinsurance to address industry specific questions concerning extreme events. For example, one question of interest is how much do extreme events cluster and how is this likely to change in the future.

Now that global warming is "unequivocal", attention is on how to deal with the consequences. Governments will be expected to take into account estimates of sea level rise and changes in tropical storm intensity when planning coastal city development. Construction, transportation and energy companies will factor in a new range of climate extremes and farmers around the world will want to plan their crops based on the best estimates of regional changes in extreme temperatures and precipitation. Another indication of the timeliness of this topic is that the Association of British Insurers has teamed with the Engineering and Physical Sciences Research Council (EPSRC) in the UK to sponsor a series of workshops to look for innovative ways to address the problem of coping with extreme weather events against the backdrop of climate change. The EPSRC is looking to allocate 1.5M£ of research funds in areas that may include:

- Analysis of the impact of extreme weather events on infrastructure and human health.
- Requirements for infrastructure tolerance to extreme weather events.
- Prediction methods and impact modelling with a focus on multidisciplinary research; early warning systems.
- New building/structure design systems to cope with extreme weather demands.
- Analysis of existing public buildings/structures to assess weather risk.
- River flood alleviation and coastal flooding analysis; urban flooding prevention planning.

- Impact of extreme weather events on the energy infrastructure.
- Issues surrounding uptake - how can engineering offer solutions that will be acted on?
- Emerging challenges in the area of adaptation to extreme weather events.

2. Background

In 1990 and 1992 the Intergovernmental Panel on Climate Change (IPCC), in its first assessment of climate change did not consider whether extreme weather events had increased in frequency and/or intensity globally, because data were too sparse to make this a worthwhile exercise. In 1995 the IPCC, in its second assessment, did examine this question, but concluded that data and analyses of changes in extreme events were 'not comprehensive' and thus the question could still not be answered. Since then, concerted multinational efforts have been undertaken to collate, quality control, and analyze data on weather and climate extremes. In particular the CLIVAR/CCI ETCCDMI organized the development of user-friendly analysis software, organized 5 capacity building workshops contributing to a global extremes indices paper as well as other peer reviewed papers which contributed to IPCC AR4. Thus whilst the Third IPCC Assessment (2001) made some statements about both (i) observed changes in extremes and (ii) projected changes in extremes, now, in 2007, the Fourth Assessment Report of the IPCC contains quite strong statements regarding already observed and expected changes in climate extremes, the latter based on analyses of the outputs of the WCRP AR4 model archive. As a result of this assessment process it has, however, become very clear that there is no adequate DEFINITION of what constitutes a climate extreme and, worse, there is no overarching FRAMEWORK under which either observations or projections of such climate extremes can be assessed.

The WCRP has a role as the international coordinator of world climate research to provide GUIDANCE on what constitutes a climate extreme and also a FRAMEWORK under which observations and projections of climate extremes can be assessed. Given the range of climate extremes and their impacts, it is not likely that the WCRP can arrive at one single definition of qualitative or quantitative climate extremes. However, the WCRP should take the initiative to provide an inventory of agreed to definitions and take the lead in arriving at community consensus about the most useful definitions.

3. Proposed WCRP Activities

3.1 Objectives

- To summarize, compare and assess definition(s) of climate extremes and develop a common language amongst researchers and end users.
- To design an intercomparison framework through which both observations, climate model representations of extremes and projections of climate can be assessed and by which changes in climate extremes can be better evaluated.
- To accelerate progress on the prediction of climate extremes with a focus on developing capabilities and products which facilitate practical applications for stakeholders and regions around the world.
- To assess the observational and dataset framework for study of global extremes

- To determine how extremes are changing and varying and why (including their relationship to mean variables, physical factors, shape of pdf etc).

3.2 Scope

Besides the ongoing activities related to climate extremes within WCRP projects and groups (see the paper presented at JSC 27 by Cattle (JSCXXVII/Doc. 9)), two new activities are proposed:

- Organization of a WCRP-led group to summarize and assess definitions and language about climate extremes
- Design of a 'comparison framework' using observations and model projections to evaluate changes in climate extremes

In so doing, the WCRP could provide a central focus for worldwide extremes work, and serve as a clearing house linking scientists working on different aspects of extreme events while providing access to long observational data sets and projections of climate extremes in developing nations. Swiss Re mentioned specifically the need for higher resolution regional products. WCRP has many projects at the regional level which, combined with existing national and regional efforts, could deliver regional assessments of climate extremes and their predictability.

Topics which have been suggested as part of a WCRP-led framework for evaluation of climate extremes are:

- *Observational requirements*

  There is a need to improve historical data sets (reanalysis and reprocessing) and to define adequate monitoring systems for extremes to provide the basis for the assessment of the likely causes of any trends in extremes. The CEOP data set could be a valuable resource in this respect. A challenge for a WCRP- led activity on extremes is to implement the requirements and obtain the requisite data.

  Data available for analyzing trends in extreme temperatures has greatly improved through extensive work and international cooperation over the past 15 years, but needs to be further improved especially with hourly data. For most other extremes (e.g. tropical cyclones, storm surges, droughts, heavy rainfall events, etc) analyses are inconclusive because of concerns about the quality, comprehensiveness, and comparability of data over decades. Observational requirements for extremes are discussed and laid out in detail by the Second Adequacy report from GCOS and the subsequent implementation plan. While for surface temperature there have been improvements in data, much more is needed especially in acquiring hourly data. GCOS has emphasized the need for hourly data on precipitation, in particular.

- *Data analysis and assimilation, including assessment of analysis products as to how well they depict extremes. [Reanalyses have typically had weaker intense cyclones than in high quality analyses]*

- *Modelling and assessment of global model outputs, Regional modelling, and Predictability*

  This would include an assessment of how well present climate models are at representing and predicting extreme events, what new observations are needed to initialize such predictions, what processes/parameterizations need improvement in support of predicting extreme events, and the characterization of extremes among ensemble predictions.

- *How extremes are changing*

  Assessment of the nonstationary behavior of extreme events

- *Capacity building/ transition to operations*

For example, what would be the necessary components for an early warning system(s) for extreme events?

The input received to date makes many important points and identifies various areas of emphasis. JSC might wish to form a group to take forward the actions above and, building on existing WCRP efforts, to further refine the WCRP role. For instance, there is agreement that research is needed to improve the understanding of the causes of long term droughts and changes in tropical cyclone activity (including frequency, intensity, size, duration, tracks), as well as any long term changes to monsoons. In all cases, natural variability and the relationship to global warming should be assessed. WCRP activity on extremes, may also need to cover extended wet spells, extreme changes in extratropical cyclone patterns, and long duration heat waves. Operational prediction of short-lived extreme climate/weather events, eg , temperature extremes, cold waves, fog, floods, tornadoes, severe thunderstorms, hail storms – are being dealt with by operational agencies and are studied under THORPEX and with cooperation from WGNE. In addition to weather extremes, systematic patterns of changes in weather extremes are of interest to WCRP. WCRP's role in this context will be to address our past knowledge of the statistics of such events and how these may change in a changing climate. In that context it may need to link with the THORPEX/WGNE activity in this area.

CLIVAR: As described in the JSC 26 Extremes document, the primary CLIVAR effort on extreme events comes, from a monitoring perspective, through the work of the joint CLIVAR/Commission for Climatology (CCI) Expert Team for Climate Change Detection, Monitoring and Indices (ETCCMDI). In addition, the CLIVAR regional panels maintain oversight of relevant extreme events (for example: extreme monsoon events, e.g. the 2002 Asian monsoon) and all CLIVAR ocean basin panels have been tasked with development of relevant ocean indices for feed-in to OOPC and the ETCCDMI. Future changes in extremes from an ACC perspective aspects can and have been addressed through analysis of the JSC/CLIVAR WGCM IPCC scenario simulations. Aspects of the work of the CLIVAR/PAGES (IGBP Past Global Changes) Panel also contribute in terms of our understanding of climate variability over past millennia and rapid climate change and drought events

GEWEX: One of the most critical and visible aspects of the water and energy cycle is the occurrence of extremes such as droughts and extended wet periods. They lead to enormous societal impacts when and where they occur but they are also fundamental aspects of the climate system. One of the most critical concerns of a changing climate is whether the occurrence and severity of extremes will change in the future. Extremes have consequently always been a concern of GEWEX. In particular, GEWEX is studying possible feedback mechanisms to see what gives rise to wet and dry periods.

CliC: Some effects of extreme climate, but which are of considerable interest to stakeholders:

- Permafrost thaw and methane release; impact of permafrost on the global carbon cycle
- Reduced water resources or hydropower due to snow deficit
- Increased number of icebergs – danger to shipping
- Ice sheet melting - effect on sea level
- Sea ice extent – effect on global climate, fauna, shipping

SPARC: Stratosphere-troposphere dynamical coupling and its role in dynamical variability and predictability from days to decades

Several lines of evidence suggest that the stratospheric state exerts a significant influence on the tropospheric circulation. As global climate models, which typically represent the stratosphere poorly, become increasingly comprehensive,important questions arise: How does a poor representation of the stratosphere degrade the simulation of tropospheric circulation in climate models? Furthermore, how does stratospheric representation affect the simulated circulation response to climate change? To address these questions SPARC has initiated a project on Dynamical Variability, which will set up a model intercomparison to explore the dynamical coupling between the stratosphere and the troposphere. The project aims to compare in detail the climatology and variabilty of standard "low-top" climate models and stratosphere-resolving "high-top" climate models. Among the plans is a comparison of simulations performed according to the specifications of the CLIVAR Climate of the 20th Century (C20C) project with high-top and low-top models. While not specifically focussing on extreme events, topics such as the link between the polar vortex and cyclogenesis are certainly within the purview of this SPARC activity and the SPARC CCMVal activity (where chemistry is involved).

A number of the WCRP stakeholders mentioned the importance of high-impact regional manifestations of climate variability and change. Possible regional foci for the study of extreme events include:

- North American drought (US initiative)
- Sahel droughts (CLIVAR VACS interest)
- Mediterranean drought (MedCLIVAR and others)
- AA monsoon changes (CLIVAR AAMP/GEWEX MAHASRI)
- African monsoon (AMMA)
- La Plata Basin flooding (CLIVAR VAMOS/GEWEX)

Examples of research results that provide insights about extremes also come from projects such as AMMA where during the summer of 2006, a wide range of data sets was collected over western Africa. These data will be critical to understanding the effects of sea surface temperature and soil moisture on the development of monsoons and precipitation extremes in these monsoons. They will also provide a basis for assessing the role of easterly waves over Africa and the Saharan dust storms on the development of tropical storms (and hurricanes) over the Atlantic Ocean.

Ongoing WCRP efforts of general importance to the study of extremes include:

- analysis of the WCRP CMIP3 multi-model dataset remains the most visible and fruitful activity with regards to extremes that exists in the WGCM sphere, and this should and will continue.
- Model development/ parameterizations
- Reanalyses
- Reprocessing of climate data
- ETCCDI – development of indices, capacity building workshops
- GEWEX WISE – case studies on hydrological extremes
- GEWEX has been coordinating its activities internally with the Extremes group within CEOP

For each of the ongoing activities, communication with stakeholders and end users could be enhanced to determine whether the research outcomes from the projects are known to, and/or of use to, potential stakeholders and end users, and what could be done to make them better known and more useful. This can build on ongoing assessments such as those being carried out by the US CCSP and the Australian government.

Other efforts of direct relevance

THORPEX/WGNE on predicting weather extremes

The observational aspects of the Extremes cross-cut are being addressed through GEO which has specific tasks addressing floods and droughts and the IGOS-P Global Water Cycle Observations theme (IGWCO).

Milestones, timeline

It is recommended that WCRP develop a framework for the study of climate extremes, building on its existing activities, the IPCC fourth assessment report and various ongoing national assessments. A first step could be to form a small team to further scope the focus of WCRP activities and to develop plans for a WCRP-sponsored workshop on this topic. The workshop would be designed to formulate a coordinated international strategy for the study of climate extremes. Research priorities and requirements would be addressed, as well as means to accelerate the transition of research results to operations and practical applications.

Timeline:

March 2007- JSC discussion and recommendations
April 2007 – formulation of initial network team
Sept 2007 – workshop first announcement, call for papers, begin formal fund raising (does this fit with the EU schedule?)
Dec 2007 – workshop agenda finalized, second announcement
Feb 2008 - WCRP workshop on strategic framework for climate extremes (note that US CLIVAR is planning a workshop on droughts in 2008, date tbd; some international participation likely, so the WCRP shouldn't schedule ours too close to theirs).

2009?? Major ESSP conference on droughts/extremes funded through EU 7th framework.

Resources needs

Resources will be needed for meetings of a task team and for an eventual oversight body. Depending on the activities which will evolve from the task team recommendations, funding will have to be sought for research activities such as model/observation intercomparisons, capacity building, and workshops involving scientists and stakeholders.

There seems to be a general interest in an initial workshop. Given the wide scientific interest and large number of stakeholders, such a meeting could be very large, but would then stray from a workshop format and be more of a conference. Perhaps, a small planning workshop is called for followed by a more encompassing conference. Would seed money from the EU be a possibility, by billing this workshop as the lead in to a larger EU/ESSP one? The task team will have to consider how to proceed and whether a series of workshops, each targeted at a specific audience/ climate extreme is what is needed.

Risks, feasibility

The question at hand is what can the WCRP deliver and within what time frame. Here we have identified many questions to be answered. Another 15 years of improvement as rapid as have been the past 15 will surely provide definitive answers to the search for trends in all the various extremes. In the near-term however, based on DEMETER studies, the current resolution of climate models is not sufficient for drought/ flood prediction, at least in Europe and SE Asia. Consistent with recent JSC discussions, we need to better integrate weather and climate models together (WCRP seamless prediction goal). Thus the resolution of climate models could begin to approach that of NWP and the diagnostics used in NWP (eg short-range budget tendency calculations) can be applied to the climate problem. The question is, how can a WCRP extremes initiative/framework help to make this happen? Is model resolution/computational horsepower the major limiting factor? Similarly,
for detection and attribution of extreme events, do we need better/bigger models.? The WCRP via this extreme activity, has the responsibility to determine what is possible, practical, and meaningful to do with today's present set of climate prediction and projections. In short, how predictable are climate extremes (certainly some more than others)?. There are several ongoing studies that seem to be addressing this. What added value would the WCRP bring? Is there a need for a more directed, better coordinated, international effort on this? Could WCRP initiate an "assessment" here, similar to what TFSP is supposed to be doing for seasonal prediction? As part of this process the WCRP needs to survey stakeholders to find out what type/level of information is useful to them.

3. Relevance to WCRP

i Scientific impact, balance and relevance of WCRP overall

The two overarching objectives of WCRP are:

1. to determine the predictability of climate, and:
2. to determine the effect of human activities on climate

A study of climate extremes addresses both of these objectives - the intrinsic predictability of extremes and the identification of changes due to anthropogenic forcing.

The network survey has shown that within scientific circles and amongst stakeholders who know us, WCRP is seen as the one organization that can offer the most up to date, unbiased and high quality information about climate variability and predictability. However, outside our immediate circle of "friends", WCRP is virtually unknown. JSC in March 2006 recognized the opportunities presented by the growing interest in climate extremes and recommended that WCRP "set up a framework for studying extreme events to address data, modelling, simulation and predictability needs of extremes."

One of the aims of creating a climate extremes focus in WCRP is to bring our expertise and "stamp of quality" to a wider audience and hence gain recognition and build a network of partners who value WCRP input and leadership. This would be a step towards meeting the WCRP strategic framework goal, "To facilitate analysis and prediction of Earth system variability and change for use in an increasing range of practical applications of direct relevance, benefit and value to society". In the immediate, identifying and building a network can be viewed as a means to raise resources and profile and deliver visibility and benefits for our community of researchers.

ii Policy relevance for WCRP

Because of the importance of improved knowledge of climate extremes for climate adaptation decisions, it is likely that extremes will be an important subject in the next IPCC assessment report and in UNFCCC activities related to climate adaptation.

At a national level, climate extremes are becoming a major focus and national assessments are underway in the USA and Australia that could form part of the basis for the WCRP- led effort. The EU funded ENSEMBLES project has activities directly related to climate extremes and the EU 7th Framework also includes activities on extremes

iii Organisation and governance of WCRP

A WCRP-led extremes activity will draw on the expertise of scientists across the whole range of WCRP projects and working groups, but must also closely involve a certain number of stakeholders in order to define the activity objectives in a way that most effectively will meet stakeholder needs. These stakeholders, or "network partners" should also be involved in the setting of milestones and in the on-going assessment process, and presumably in fund-raising as well.

Both CLIVAR and GEWEX have indicated a willingness to lead this effort for WCRP. In terms of project office staff, a member of the ICPO has shown a keen interest in pursuing this, especially in developing links to stakeholders such as risk management companies.

The issue of governance of an eventual WCRP-led "climate extremes network" should be discussed by the JSC in the context of the overall management of WCRP. It is recommended that CLIVAR and GEWEX take the lead with good support from the JPS. In any case, an initial task team, involving scientist from within and outside the projects and representatives from some key stakeholders, will need to be formed to further scope this activity. Whether this group will constitute an eventual oversight body, or whether one of the SSGs or JSC will perform this role, will have to be discussed.

iv Visibility and communication by WCRP

In order to successfully build a comprehensive extremes activity led by WCRP and involving a wider network, we will have to poll stakeholders as to what their needs are. Many sectors are in need of improved knowledge about climate extremes: health, agriculture, water management, tourism, forestry, fisheries, hurricane predictions, arctic navigation, permafrost and methane gas emission, electrical power generation, shipping and offshore construction to name a few, but it is unlikely that WCRP scientists will have direct contact with many of the players in these areas. Instead, it has been recommended that we focus on groups that provide the risk assessments to these industries, taking into account climate information, or that develop industry standards. These include:

1. Insurance Markets (eg Lloyds, ABI)
2. Regulatory bodies (DNV, BSI, International bodies etc)
3. Risk Assessment/Management companies
4. Capital Markets (dealing with weather derivatives)

Taking the lead in the study of extremes has the potential for increasing WCRP visibility in these and related end users. Additionally, there is great media interest in climate extremes. The WMO Secretary General has said that the questions he is asked most frequently by the media are about climate extremes. If WCRP helps to more clearly define the terminology involved, this could potentially increase our visibility.

v. Interaction with other bodies

Organizing a framework for the study of climate extremes presents many opportunities to develop interactions with other bodies, such as those mentioned above, but also including related efforts by our three major sponsors (e.g. the WMO World Climate and Applications Services Programme, the WMO Disaster Mitigation Programe, the new ICSU effort on natural disasters, and IOC projects related to climate impact on fisheries, coral reefs and coastal zone management. GCOS would be a major partner in aspects related to observations, as well as GEO, which has task on climate extremes.

vi. Capacity building in/by WCRP

Climate extremes are already the focus of capacity building activities which have been organized under the CLIVAR/WMO/JCOMM Expert Team on Climate Change Detection and Indices. The ETCCDI has organized workshops world wide to build capacity in data handling and analysis related to climate indices. Other WCRP groups such as CLIVAR VACS and GEWEX have been involved in capacity building activities that could be further developed to include a focus on extremes.

References

(1) as quoted in the International Herald Tribune, 24 january 2007, p7.

WORLD CLIMATE RESEARCH PROGRAMME

JOINT SCIENTIFIC COMMITTEE

TWENTY-EIGHTH SESSION

ZANZIBAR, TANZANIA, 26-30 MARCH 2007

JSC-XXVIII/Doc. 2.6
(16.II.2007)

Item 2

WCRP AND THE INTERNATIONAL POLAR YEAR (IPY) 2007-2008

(Submitted by CliC SSG Chair, the CliC Intl. Project Office, and JPS for WCRP)

Background

The WMO and ICSU lead the IPY, which is envisioned as an intensive burst of internationally coordinated, interdisciplinary, scientific research and observations focused on the Earth's polar regions. Intensive field investigations from March 1st, 2007 to March 1st, 2009 will enable nations to make major advances in knowledge and understanding of the high latitudes. This report discusses only WCRP's role, activities and interests in IPY. Regularly updated description of the various aspects of IPY is available at the IPY web site http://www.ipy.org.

Scientific goals, relevance of and for WCRP

The main goal of WCRP in IPY is to close or significantly reduce the existing gaps in polar processes knowledge and ability to predict the poles and their influence on the rest of the globe at a variety of important time scales.

Specific objectives:
- expand the polar research community contributing to the WCRP goals and cooperating with WCRP,
- produce, for the first time in history, a comprehensive snapshot of both polar regions,
- focus the science on addressing the climate feedbacks in which the poles are significant,
- leave the legacy of IPY in terms of a coordinated climate change – relevant polar observing system.

Major scientific and operational issues with regard to the polar regions are:
- strong impact on weather and seasonal anomalies and insufficient understanding of predictability associated with polar processes,
- extremely poor observational coverage of the polar regions,
- need to quantify and strongly reduce uncertainty in description of how the poles affect the rest of the globe by changing freshwater balance (impact on ocean baroclinic circulation), dynamics of atmosphere (from the surface to mesosphere), atmospheric chemistry (aerosols, ozone, carbon balance), poor representation of all cryospheric elements in climate studies as "frozen" part of the global hydrological cycle,
- knowledge of global teleconnections with participation of poles and polar modes of climate variability.

The following major specific WCRP scientific achievements can be expected during the IPY:
- establishment of a basis for an innovative Arctic Ocean Observing System,
- first in the history coordinated observation period of major satellites, especially for the Synthetic Aperture Radar,
- breakthrough in the establishment of an Arctic hydrological cycle observing system and advances in polar hydrology,
- strong step forward in permafrost monitoring,
- record-long ice-core based climate history (Chinese contribution),
- future-oriented interoperable data legacy,
- unprecedented survey of the Southern Ocean,

- massive snapshot of the polar cryosphere and polar atmosphere, stratosphere and mesosphere as a benchmark for future studies.

These results will require future processing and use in modeling, analysis and reanalysis in order to gain benefits for predictability studies and progress in understanding of human effect on climate.

Policy relevance of WCRP

The expected results and the process through which they will be produced will contribute to several high-level plans. They directly contribute to several strategies of the WMO Sixth Long-Term Plan. Establishment of the Arctic Ocean Observing System will fulfill a key task in the GCOS Implementation Plan, which was assigned to the WCRP. The results will lead to a better ability to predict climate in the polar regions, especially in the Arctic, i.e. where it is expected to change the fastest, and this will be another contribution of WCRP to UNFCCC and IPCC.

Following preliminary analysis of the IGOS-Cryosphere Theme, the Group on Earth Observations (GEO) assigned WCRP/CliC to lead the implementation of its IPY legacy task, CL-0605. The assignment reads: "Coordinate with the IPY to enhance the utilization of Earth Observations in all appropriate realms (including, but not limited to, sea and land ice, permafrost, coastal erosion, physical and chemical polar ocean changes, marine and terrestrial ecosystems changes, biodiversity monitoring and impacts of increased resource exploitation and marine transport)."

There is an increasing use of traditional knowledge for arctic research in Canada, the Nordic countries and the US (Alaska). This is reflected in the research planning through International Conference of Arctic Research Planning (ICARP), the structure of IPY and the funding in several of these countries.

Organization and governance of WCRP IPY activities

At its 25th session in Moscow, March 2004, the JSC gave an assignment to CliC to stimulate and coordinate the preparations for IPY on behalf of the WCRP.

WCRP representatives were instrumental in building links between the WMO and ICSU in their approaches to the IPY, participated in the discussions of IPY ideas and plans, and solicited substantial input to the IPY planning from the WCRP community. Members of the CliC SSG and WCRP JPS were a lead in developing the IPY Scientific Framework and the initial data policy and data management process.

In November 2004, a Joint Committee (JC) for IPY was established by WMO and ICSU. This is the lead coordinating body of IPY. To facilitate IPY implementation, the JC has established three Sub-Committees: Observations (SCOBS) with its Space Task Group (STG), Data Policy and Management (SCDPM), and Education, Outreach and Communications (SCEOC). In 2004 the WMO also established an Intercommission Task Group (ITG) on IPY, which reviewed IPY plans and WMO contribution to them. WCRP nominees are on JC, SCOBS and its STG, SCDPM and ITG. This means that almost all aspects of IPY planning involve coordination with the WCRP.

ICSU and WMO have issued call for Expressions of Intent in November 2004. 1200 responses were obtained and clustered. In March 2005, the JC issued a call for preparation of full proposals with final deadline January 31, 2006. The JC evaluated 452 received proposals and endorsed 172 scientific proposals, 1 project for data and information management and 56 proposals on education and outreach.

Internal calls to all WCRP projects were made in 2004 to propose ideas for IPY and in 2005 to propose clustered projects. The WCRP community has been very responsive to these calls. WCRP and its projects are a leading international agency of 22 major projects. Overwhelming majority of the WCRP- and project-related proposals were endorsed by the IPY JC. The WCRP projects are concerned with the Land, Ocean, Ice, Atmosphere, Space and Data sections of the

IPY-chart (see the last page of this document). There are no WCRP projects in Education, Outreach, Earth or People categories, although some projects will cross-cut these topics.

Main WCRP projects in IPY are shown in the following Table.

No.	Domain or Name	Affiliation	IPY No.
1	Synoptic Antarctic Shelf-Slope Interactions Study (SASSI)	CliC	8
2	Sea level and tidal science in the polar oceans	CLIVAR	13
3	Integrated Arctic Ocean Observing System (iAOOS)	WCRP, CliC, AOSB	14
4	Bipolar Atlantic Thermohaline Circulation (BIAC)	WCRP	23
5	POLar study using Aircraft, Remote sensing, surface measurements and modelling of Climate, chemistry, Aerosols and Transport (POLARCAT)	SPARC	32
6	Ocean-Atmosphere-Sea Ice-Snowpack Interactions affecting Atmospheric Biogeochemistry and Ecosystems in the Arctic (OASIS-IPY)	SOLAS	38
7	Data and Information Service (IPYDIS)	WCRP, CliC, NSIDC	49
8	Permafrost Observatory Project: Thermal State of Permafrost (TSP)	WCRP, CliC, IPA	50
9	Monitoring of the upper ocean circulation, transport and water masses between Africa and Antarctica (UCAA)	CLIVAR	70
10	Arctic Circum-Polar Coastal Observatory Network (ACCO-Net)	through MoU with IPA	90
11	Global Inter-agency IPY Polar Snapshot Year (GIIPSY)	WCRP, CliC, IGOS-Cryo	91
12	The Arctic Hydrological Cycle Monitoring, Modelling and Assessment Program (Arctic-HYDRA)	WCRP, CliC	104
13	The State and Fate of the Cryosphere	WCRP, CliC	105
14	Sea Ice from Space for the IPY (iAOOS – SISI)	WCRP, CliC	108
15	Climate of Antarctica and the Southern Ocean – Ocean Circulation Cluster (CASO)	WCRP, CliC	132
16	Cold Land Processes in the Northern Hemisphere (CLPNH)	WCRP, CliC, GEWEX	138
17	Hydrological Impact of Arctic Aerosols (HIAA)	GEWEX	140
18	Antarctic Sea Ice in IPY	WCRP, CliC	141
19	Antarctic Climate and Atmospheric Circulation	WCRP, CliC	180
20	Impacts of Surface Fluxes on Arctic Climate: Severe Storms, Effects on Coastal Processes and Relationships to Changing Climate	SOLAS	205
21	The Structure and Evolution of the Polar Stratosphere and Mesosphere and Links to the Troposphere during IPY (SPARC-IPY)	WCRP, SPARC	217
22	Comprehensive Meteorological dataset of active IPY Antarctic measurement phase (COMPASS)	WCRP	267
23	Program of Antarctic Nova Disciplines Aspects (PANDA)	CliC	313

There are many other projects, which focus on the climate change science but are not formally affiliated to the WCRP and its projects. It is possible to say that climate research dominates the IPY agenda.

Strong collaboration exists between WCRP affiliated projects within the IPY. For example, the CASO project (# 132) is being coordinated by the CLIVAR/CliC/SCAR Southern Ocean Region Implementation Panel. The CLPNH project (# 138), developed within the Northern Eurasia Earth Science Partnership Initiative (NEESPI), has strong interactions with the CliC community for its terrestrial cryosphere components, as well as with the GEWEX community, for the development of a synergistic observing system.

Interaction with other bodies

WCRP has used the opportunity of IPY to engage several partners in joint proposals for ideas and projects. In some cases WCRP and its projects were recognized as logical and legitimate umbrellas for cooperative proposals without a prompt. Some cooperation links were actively pursued, and some formed naturally. Strong cooperation of WCRP-led or affiliated projects can be noted with WMO, SCAR, IPA, and AOSB.

Operational links with IASC, AMAP, IOC, IHDP and GEO are weaker and require attention. Cooperation with IASC is developing because WCRP/CliC was accepted as the coordinator of research on terrestrial cryosphere. Joint work with AMAP is unrolling in the process of developing a Sustained Arctic Observatory Network (SAON) project. CliC's initiatives on the establishment of the Artic Ocean Observing System contributed to the inauguration of an Arctic GOOS Regional Alliance. It is essential to ensure that WCRP polar oceanographic activities form a part of a coherent IOC ocean climate science program. Links with GEO will strengthen because CliC is assigned by this organization to coordinator the development of IPY legacy in terms of data and observing systems.

The IPY has strongly influenced activities and coordination between research groups and the WCRP projects. GEWEX scientists interact with several international bodies (e g. IPA) and national bodies (e.g. the Russian Academy of Science). CliC community has been further developed in Australia, Canada, China, Japan, and the USA. An 'Asia-CliC' Regional Group was established in 2006. This regional group has attracted support from the funding agencies and fostered unprecedented cooperation between countries and agencies in the cryosphere / climate science.

WCRP core projects lead several of the IPY endorsed proposals and these international proposals have provided the context for national research proposals. Just as an example: the project *Variability and Change in the Canadian Cryosphere* is designed to contribute to CliC's *State and Fate of the Cryosphere* (IPY # 105). Some regional projects, such as *Antarctic and sub-Antarctic Permafrost, Periglacial and Soil Environments* project (# 33) contribute to larger scale CliC-affiliated projects such as the *Permafrost Observatory Project: Thermal State of Permafrost* (# 50).

IPY projects by are definition expected to promote international interactions, e.g. for HIAA (# 140), through the GEWEX GCSS Working Group on Polar Clouds, NEESPI, and the Coordinated Energy and water cycle Observing Project (CEOP). The IPY is going to intensify the WCRP networking in terms of co-sponsoring of meetings, like it is already the case for CliC with SCAR (e.g. co-sponsorship of the International Workshop on Antarctic Sea-Ice Thickness, Hobart, Tasmania, July 2006) and with the IPA (e.g. co-sponsorship of a Young Permafrost Researcher Presentation Award at the Asian Conference on Permafrost, Lanzhou, China, August 2006).

Visibility and communication by WCRP

Several large-scale initiatives were launched by WCRP and partners. One recent example is the ESA announcement of opportunity to work with IPY satellite data, which explicitly indicates that it is made to meet CliC objectives. Several forthcoming meetings organized by WCRP projects will enhance the visibility of projects by their link to IPY (e.g. a large SPARC-IPY workshop is currently being planned to be held in conjunction with the next SPARC Data Assimilation Workshop in September 2007). If the GEWEX IPY project HIAA is funded, it will provide additional visibility to WCRP through an extensive effort in outreach and education (website, a special segment on the Weather Channel, press releases, involvement of U.S. high school teachers, town meetings in Arctic communities, etc.). In addition, training of young scientists from all participating countries but especially Russia could be an important contribution of GEWEX IPY activities to capacity building.

Another recent opportunity needs to be seized. There is an arrangement with Google to have an IPY layer as one of the default layers in Google Earth. Any time one of the 100 million users of this application opens the application, an IPY layer will appear in the lower left option box. It is an easy and effective outreach pipeline and needs to be used as widely as possible.

Despite many of the IPY leaders and participants are members of WCRP projects and groups, the role of WCRP in IPY planning is not always acknowledged. Our experts need to be encouraged to more strongly promote WCRP in principle and its role in IPY in particular.

Capacity Building in / by WCRP

Model shortcomings in the polar regions are a well-known impediment to better understanding and prediction of polar climate. Important progress has been made through various WCRP IPY initiatives in the last year, but the modeling and the insufficient or lacking representation of satellite data and products in IPY endorsed projects remain severe concerns for future knowledge and network building within the discipline. The IPY integrated modeling strategy by the Southern Ocean Basin Implementation Panel of CLIVAR constitutes an important effort for high latitudes.

An IPY Data and Information Service (IPYDIS) will build on ICSU and WMO strategies for future data systems. Planning and implementation of IPYDIS will be carried out in partnership with the concurrent Electronic Geophysical Year. The technical solutions necessary to implement IPYDIS will comply with advanced international standards for interoperability and for metadata. IPYDIS and the long-term IPY data legacy will involve many innovative solutions. CliC wishes to collaborate with the IPYDIS in the long-term legacy of data, taking a coordinating role for cryospheric data and information. The Data and Information Service for CliC (DISC) is the prototype of a central metadata portal with web-based search engines providing a comprehensive overview of cryospheric data based on discovery-level metadata, and with efficient linkages between all data and metadata centers worldwide. However, due to funding limitations, CliC has not been able to extend the DISC tool past the prototype. New directions have been explored in order to help the development of DISC, in particular with data management services at the Norwegian Polar Institute. A solution has not yet been found.

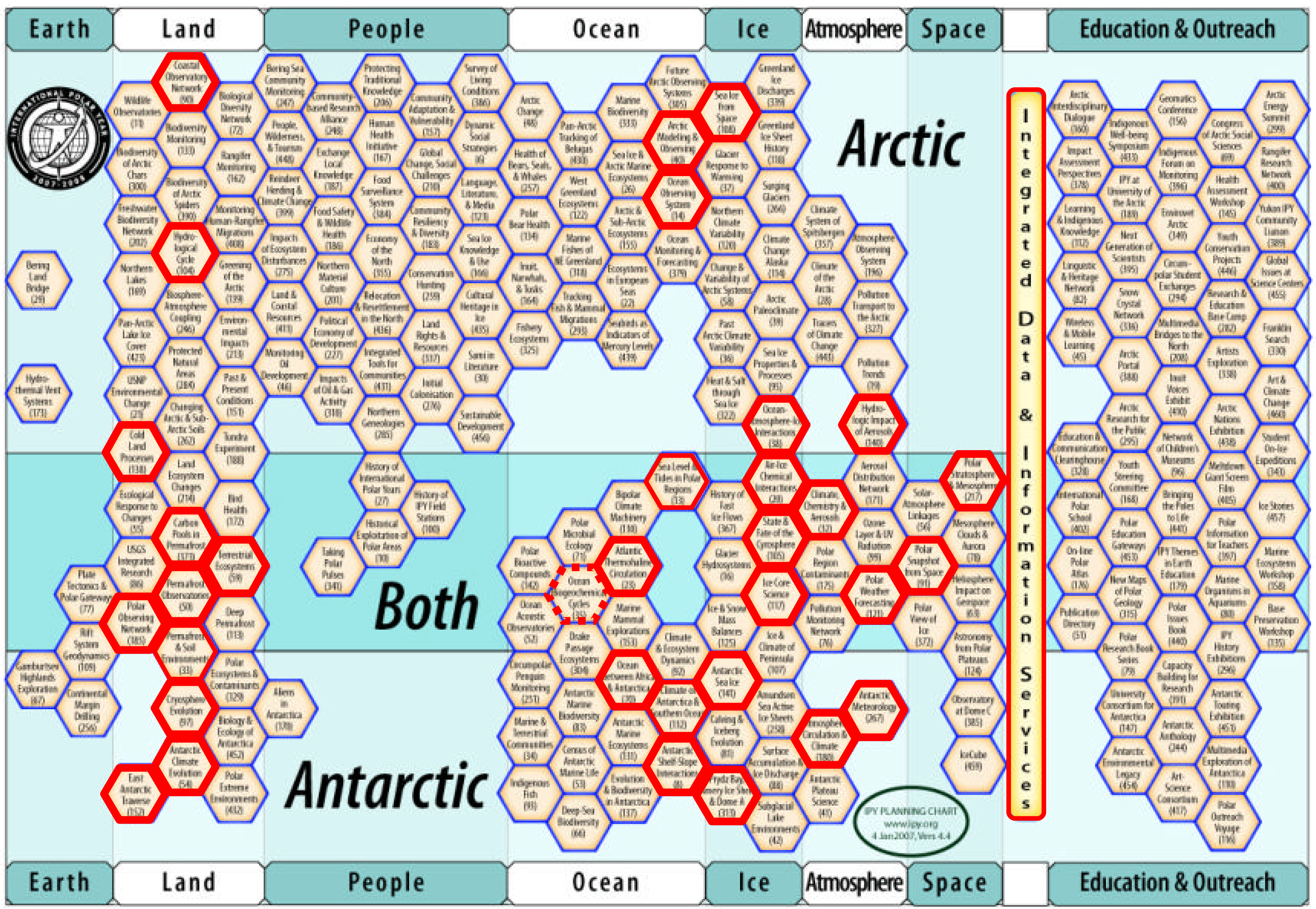
The total amount of funding available to IPY research and observations is estimated to be very significant, of order of one billion US$ (equivalent). Approximately one quarter of this funding will come as new (additional) investment, which would not be possible without IPY. More than 50,000 individuals from 63 countries (current estimate) are expected to participate in IPY.

IPY activities may be very helpful in building the capacity of WCRP polar research. There are indications that many of the projects proposed by WCRP or relevant projects will receive some funding. Contributions to WCRP interests may also come unsolicited. For example, a major relevant project that has funding in the U.S.A. is International Arctic Systems for Observing the Atmosphere. It is funded by NOAA and is deploying cloud radars and other instruments to augment observations at observing sites in the Arctic. Even in the case there is no additional fresh funding, some existing resources available to individual investigators can be redirected towards IPY activities. For example, in the case of GEWEX project HIAA resources of several PIs may be redirected for polar modeling and satellite remote sensing.

Challenges and questions to JSC

1. The IPY science program is a result of top-down solicitation by the initiators and bottom-up response from scientific community. The endorsed IPY projects were selected because of their relevance for the themes and international character. Some of the endorsed projects failed to obtain funding. This all means that with certain exception the IPY agenda is a collection of useful projects but it does not envision achievement of specific overarching goals. The role of the WCRP could be to try to help the IPY JC to obtain a program, which helps to study predictability of the polar regions. This requires contribution of all WCRP projects and certain resources. WCRP should define observing strategies and provide the coordination of analysis activities for the IPY.
2. The IPY will produce an unprecedented data set of polar observations. IPYDIS with participation of CliC works on preserving it and making available to science. WCRP should plan in advance how this data can advance modeling, reanalysis and prediction on a range of essential time scales. GEWEX stresses that the long-term global data sets produced from satellite data are inadequate over polar regions and that it has been very difficult to maintain homogeneous data sets (as reported in the latest IPCC report). Efforts are needed at the WCRP level to ensure that appropriate data are collected for product development and evaluation and that reprocessing occurs

3. Should CliC, given shortage of its resources, embark on an effort-intensive coordination of the legacy of IPY in terms of data and observing systems as a contribution to the GEO Work Plan for 2007-2009?


Earth
Land
People
Ocean
Ice
Atmosphere
Space
Education & Outreach
Arctic
Both
Antarctic
Integrated Data & Information Services
IPY PLANNING CHART
www.ipy.org
4 Jan 2007, Vers 4.4

WORLD CLIMATE RESEARCH PROGRAMME

JOINT SCIENTIFIC COMMITTEE

TWENTY-EIGHTH SESSION

ZANZIBAR, TANZANIA, 26-30 MARCH 2007

JSC-XXVIII/Doc. 2.7
(13.II.2007)

Item 2

Report of the Task Force on
Understanding Sea-level Rise and Variability

A World Climate Research Programme Workshop
and a WCRP contribution to the
Global Earth Observation System of Systems (GEOSS)

The WCRP Sea-level Workshop:

A very successful Workshop was held at the UNESCO Headquarters in Paris from June 6-9, 2006. 163 scientists from 29 countries, including representatives of funding agencies and associated programs like GEO attended. A summary statement of the workshop can be found at http://wcrp.wmo.int/AP_SeaLevel.html and a summary meeting report has been published in EOS (**88**(4), 43-44). The workshop statement was distributed widely and has been well received. There have generally been very positive comments about the workshop (including from funding agencies and from GEO).

The workshop, co-sponsored by 35 organizations from around the world, was able to cover the costs of many attendees, including a number of people from developing nations.

A full report of the workshop in the form of a book titled “Sea-level Rise and Variability” will be published later this year. There remain some funds from the workshop to cover the cost of publication but WCRP may wish to consider being part of a bulk purchase (at significant discount) for distributing to developing nations and for publicity purposes.

IOC was pleased with the workshop and has suggested that similar types of workshops (perhaps of more limited scope) or covering different topics be carried out every two years. WCRP should also consider how future workshops may contribute to further IPCC Assessments and whether holding a focused workshop in preparation for the next IPCC Assessment is appropriate.

The Workshop, recent publications and the IPCC AR4 have all clearly identified the need for improved observations, understanding and associated modelling of changes in the mass balance of ice sheets as one of a number of high priority needs.

Issues:

The JSC and WCRP Projects, Working Groups and Panels are requested to:

a. Note the success of the workshop and the recommendations from the Workshop,

b. Consider whether future workshops or other activities should be undertaken,

c. Consider participation in a bulk purchase of books from the Workshop, and

d. Raise any other issues of relevance.

WORLD CLIMATE RESEARCH PROGRAMME

JOINT SCIENTIFIC COMMITTEE

TWENTY-EIGHTH SESSION

ZANZIBAR, TANZANIA, 26-30 MARCH 2007

JSC-XXVIII/Doc. 2.8
(14.II.2007)

Item 2

Seasonal Prediction Activities within WCRP

Ben Kirtman (Co-Chair WGSIP, Chair TFSP)

1. Scientific impact, balance and relevance for WCRP overall

The WCRP has a long-standing commitment to coordinating international seasonal prediction activities. The success of the international Tropical Ocean Global Atmosphere (TOGA) program is a shining example of how WCRP activities have enabled scientific progress. The TOGA program demonstrated the potential predictability and societal benefit of seasonal prediction. While the scientific progress since has not been as rapid as during the early days of TOGA, there are several key areas where WCRP leadership and coordination, primarily through CLIVAR, have lead to measurable progress in the field seasonal prediction, as outlined in Section 1.1.

More recently, WCRP in recognition of the importance of all the interactions among all the elements of the climate system (i.e., atmosphere, ocean, biosphere, cryosphere) has launched a major international numerical seasonal prediction experiment designed to exploit these interactions for improved seasonal predictions, as described in Section 1.2.

WCRP coordination has been instrumental in two recent breakthroughs in seasonal prediction:

(i) the recognition that seasonal forecasts must include quantitative information regarding uncertainty (i.e., probabilistic prediction) and that verification must include probabilistic measures of skill; and (ii) that a multi-model ensemble strategy may be the best current approach for adequately resolving forecast uncertainty.

<u>1.1 WCRP-CLIVAR WGSIP Seasonal Prediction Activities</u>
The Working Group for Seasonal-to-Interannual Prediction (WGSIP) has specific responsibility for coordinating seasonal prediction activities worldwide. It also links with other seasonal prediction activities in WCRP, including those of CLIVAR's regional panels. WGSIP's research on seasonal prediction is to develop a programme of numerical experimentation for seasonal-to-interannual variability and predictability, paying special attention to assessing and improving predictions. Further research aims are to develop appropriate data assimilation, model initialization and forecasting procedures for seasonal-to-interannual predictions, and to consider such factors as observing system evaluation, use of ensemble and probabilistic methods and statistical and empirical enhancements, and measures of forecast skill.

WGSIP has successfully conducted a number of projects that are described by the following references.

- Intercomparison of Nino3.4 Prediction: Kirtman et al., 2001, http://www.clivar.org/publications/wg_reports/wgsip/nino3/report.htm

- ENSIP – Intercomparison of ENSO simulations in coupled models: Latif et al (2001), Climate Dynamics, 18, 255-276

- STOIC – Study of tropical oceans in climate models: Davey et al (2002), Climate Dynamics, 18, 403-420

More recently, the WGSIP has set up the Seasonal prediction Model Intercomparison Project (SIMP). Under SMIP, two experimental protocols using atmospheric general circulation models were set up up to investigate: (1) potential seasonal predictability (SMIP-2) using observed SST, and (2) actual predictability using forecast SST (SMIP-2/HFP). These projects include international contributions from DEMETER, PROVOST, DSP and APCC. These coordinated numerical experiments clearly demonstrate that successful seasonal prediction is a multi-model and multi-institutional problem.

Diagnostic Subprojects have been submitted by various authors to exploit the results of the SIMP experiments.

1.2 Task Force on Seasonal Prediction (TFSP) activities

Recognizing the importance of seasonal prediction as a specific objective under the new strategic framework, the JSC recommended that a limited term Task Force on Seasonal Prediction (TFSP) be established. This Task Force draws on expertise in all WCRP core projects (i.e. CLIVAR, GEWEX, CliC and SPARC), WGNE, and WGCM. The overarching goal of the TFSP is to determine the extent to which seasonal prediction is possible and useful in all regions of the globe with currently available models and data.

In order to provide direct and immediate support and input to the TFSP, the International CLIVAR Project Office (ICPO) and the CLIVAR Scientific Steering Group (SSG) asked the Working Group on Seasonal-to-Interannual Prediction (WGSIP) to provide the core leadership for the TFSP. This close collaboration between the WGSIP and the TFSP is an excellent example of how WCRP can leverage a specific core project to reach across several programs.

The overarching TFSP objectives include designing a comprehensive set of WCRP-wide coordinated prediction and predictability experiments (the pan-WCRP Seasonal Prediction Experiment – see Appendix) with ocean-land-atmosphere models that will ultimately lead to seamless weekly-seasonal-interannual-decadal forecasts. While it is clear that the TFSP will depend significantly on input and guidance from the WGSIP, it is also evident that the Task Force will continue to require considerable collaboration and coordination across the WCRP. In collaboration with the core WCRP programs, the TFSP has two major ongoing activities: (i) organising the first WCRP Seasonal Prediction Workshop (see Section 4) and (ii) the co-ordination of the pan-WCRP Seasonal Prediction Experiment itself. Both of these activities are necessarily pan-WCRP, and their success depends on interactions among the core programs.

1.3 Issues for JSC

- *The TFSP is due to turn over its activities to WGSIP in June 2007. How will WGSIP continue to access beyond CLIVAR for scientific guidance in the implementation of the TFSP seasonal prediction experiment?*

- *Seasonal prediction activities cut across all core programs of the WCRP. These activities will continue to increase over time. How will WGSIP continue to coordinate these activities?*

- *The TFSP/WGSIP numerical experiments generate large data sets that need to be shared throughout the community, and more importantly across all WCRP communities. Indeed, it is the sharing of high resolution (in both space and time) seasonal prediction data from both retrospective forecasts and near real-time forecasts that is the key point of collaboration between the various programs. This necessity for data sharing requires the support of some infrastructure. In particular, a limited number of data host centres need to be identified and they will need to support the archival of the data and the capacity to share the data throughout scientific and user communities.*

2. Policy relevance of Seasonal Prediction in WCRP

The WCRP community has the obligation to help the development of relevant scientific knowledge and a science infrastructure to provide policy- and decision-makers:

- More accurate and, from a socio-economic prospective, more useful prediction of high-impact weather and environmental events.

- Information needed for the reduction of emerging and existing global and regional social, economic and environmental vulnerabilities caused by the combined effects of a changing environment and increasing economic development.

Our ability to predict the seasonal variations of the Earth's tropical climate dramatically improved from the early 1980s to the late 1990s. This period was bracketed by two of the largest El Niño events on record: the 1982-83 event, whose occurrence was unknown until after it was over; and the 1997-98 event, which was fairly well predicted up to six months in advance. This improvement was due to the convergence of many factors including a concerted international effort to observe, understand and predict tropical climate variability, the application of theoretical understanding of coupled ocean-atmosphere dynamics, and the development and application of models that accurately simulated the observed variability.

After the late 1990s, our ability to predict tropical climate fluctuations reached a plateau with little subsequent improvement in skill. Is the predictability of the climate system undergoing fundamental change, due to either natural or anthropogenic forcing? Is our inability to substantially improve the model forecasts indicative of critical failings in the models used to make predictions? Have we accounted for all the critical interactions among all the elements of the climate system (ocean-atmosphere-biosphere-cryosphere)? Are the observations adequately blended with the models to make the best possible forecasts?

About a third of the world population live in countries influenced significantly by El Nino and the associated climate anomalies. Many of these countries are developing countries whose economies are largely dependent upon their agricultural and fishery sectors. The successes of the 1980s and 1990s brought great promise for societal benefit in the use and application of seasonal forecast information. However this promise of societal benefit has not been fully realized, in part, because there have not been adequate interactions between the physical scientists involved in seasonal prediction research and production, the applications scientists and the operational seasonal prediction providers. The issues and problems go beyond merely improving forecast skill and making forecasts readily available. The physical scientists need to actively facilitate and understand how forecasts can be used in order to make useful improvements to forecast products.

As the appreciation of the complexity of the underlying science issues grows, investigations will become more and more multidisciplinary in nature, necessitating a more holistic and team approach to the Earth System. Climate, air quality, water, environmental and weather modeling and prediction systems will become more integrated, move to increasingly finer space-time scales, and rely on complex systems for blending information from observations and models. There will be a tremendous increase in the variety and quality of environmental data, and in the variety and scope of weather and environmental predictions on scales from minutes to decades and beyond, as well as a broadening in prediction paradigms (deterministic as well as probabilistic). These changes will greatly enhance the capacity to meet a range of prediction challenges to increase the safety and security, regionally and globally, and to provide information in support of the development of policies and services by better adapting to the constantly changing environment.

3. Organization and governance of Seasonal Prediction within WCRP

The organization and governance of seasonal prediction activities largely lies within CLIVAR WGSIP and relevant activities of its regional panels. However, the other WCRP core programs also have seasonal prediction activities; hence the continuing need for a pan-WCRP TFSP perspective. WGSIP has had noted success collaborating and coordinating with the CLIVAR Atlantic Panel (under which the Tropical Atlantic Climate Experiment (TACE), which has a primary focus on the role of ther ocean circulation for seasonal SST predictions, has just been initiated), the Variability of the American Monsoon Systems (VAMOS) panel, and the Asian-Australian Monsoon (AAM) panel. WGSIP has also developed numerical experiments in collaboration with GEWEX (the Global Land-Atmosphere Coupling Experiment (GLACE) being a prime example). Individuals pursuing their own scientific interest largely drive these collaborations. *The JSC may want to consider new strategies for sustaining and facilitating these collaborations that are more substantive than mere cross panel membership.*

The TFSP, by design, has extensive pan-WCRP interactions. Significant coordination between GEWEX, CliC, SPARC and CLIVAR is well established. However, the TFSP is due to end its term. *The JSC may need to consider how these collaborations and interactions will continue beyond the lifetime of the TFSP.*

4. Visibility and Communication:

WGSIP has provided the scientific expertise for a number of successful international workshops. Previous workshops include the “Ensemble Methods Workshop,” the “Atlantic Predictability Workshop,” the “Systematic Errors Workshop,” the “TFSP Experimental Design Workshop”.

The first WCRP Seasonal Prediction Workshop will be held in Barcelona Spain June 4-7 2007 (http://www.clivar.org/organization/wgsip/spw/main.html). The Workshop will focus on addressing two basic overarching questions:

(i) What factors are limiting our ability to improve seasonal predictions for societal benefit?
(ii) What factors are limiting our ability to use seasonal predictions for societal benefit?

In addition to addressing these questions, the workshop will include recommendations spanning both the physical and application sciences for how to overcome these limiting factors. The Workshop aims to produce a roadmap for improving skill and setting priorities on development and application of dynamical models for seasonal prediction recognizing that this process necessarily requires robust interactions among the physical science and applications communities and the delicate balance between scientific feasibility and application requirements. Part of this roadmap will include a process by which progress in seasonal prediction can be uniformly assessed.

The Workshop will draw together the diverse seasonal prediction community. This includes researchers of the physical climate system and forecast methodology, operational forecast providers and forecast application experts. The Workshop participants will be making presentations on (and critically evaluating) the following key issues:

(i) Validating and assessing the state-of-the-art and skill in seasonal forecasts by bringing together high quality retrospective forecast data issued from international research projects (i.e., SMIP2/HFP DEMETER, ENSEMBLES, and APCC) as well as data available from operational centres. Assessments will be made in terms of scientific quality and factors limiting improvement as well as in terms of the value for applications and society.

(ii) Highlighting issues important for interfacing seasonal forecasts with applications including calibration, downscaling and validation, determining whether there is an emerging consensus on approach and methodology.

(iii) Addressing seasonal prediction from a wide-ranging multi-disciplinary perspective looking at the role of cryospheric processes, stratospheric processes and air-land interactions on seasonal prediction, as well as the role of ocean initialization, aiming to explore additional source of potential seasonal predictability.

The workshop organizers, in collaboration with the core programs, have already developed special sessions to address how the core programs and regional panels contribute to seasonal prediction and what are the issues impeding progress.

5. Interaction with Other Bodies:

The challenge of seamless prediction from days to decades, particularly in terms of bridging the gap between forecasting high impact weather events and seasonal variations naturally brings together the activities of the WCRP Task Force for Seasonal Prediction and the THORPEX Interactive Grand Global Ensemble (TIGGE). The TFSP and THORPEX communities have emerging coordination and collaboration. In particular, both communities are discussing strategies for sharing seasonal prediction data, and are developing a "white paper" that highlights key scientific and programmatic issues for the future.

6. Capacity Building in/by WCRP:

WGSIP continues to actively participate in a few focused applications projects, and works to provide a robust access to retrospective seasonal prediction data. This data access issue is of critical importance to the applications community and is a potential key focal point for future international coordination.

The WCRP Workshop is expected to attract a considerable number of international participants, with an estimated attendance of 200 people. Its importance for the seasonal forecast field fundamentally lies in its aim to bring together the key proponents of the field, encouraging strong attendance from young, emerging scientists and attendees from developing countries, thus stimulating the innovation of the field and bridging the gap between highly sophisticated seasonal forecast products and applications users.

Appendix

Pan-WCRP Seasonal Prediction Experiment

One of the overarching goals of the WCRP is determine the predictability of the complete climate system on time scales of weeks to decades. By complete climate system, we mean contributions from the atmosphere, oceans, land surface, cryosphere and atmospheric composition in producing regional and seasonal climate anomalies. Advances in climate research during the past decade has lead to the understanding that modeling and predicting a given seasonal climate anomaly over any region is incomplete without a proper treatment of the effects of SST, sea ice, snow, soil wetness, vegetation, stratospheric processes, and chemical composition (carbon dioxide, ozone, etc.). The observed current climate changes are a combination of anthropogenic influences and the natural variability. In addition to possible anthropogenic influence on climate due to changing the atmospheric composition, it is quite likely that land use in the tropics will undergo extensive changes, which will lead to significant changes in the biophysical properties of the land surface, which in turn will impact atmospheric variability on seasonal time scales. It is therefore essential that the past research by two somewhat non-interacting communities (i.e., climate change and seasonal prediction) be merged into a focused effort to understand the predictability of the complete climate system.

This problem of prediction and predictability of seasonal climate variability is necessarily multi-model and multi-institutional. We argue that the multi-model approach is necessary because there is compelling evidence that, with imperfect models, perturbing the physics of the models is superior to perturbing initial conditions of one model in terms of resolving the probability density function or quantifying the uncertainty. A multi-model approach is essentially a simple and consistent way of perturbing the physics. Moreover, by testing our hypotheses with multiple models it is possible to determine which results are model independent, and hence likely to be robust. This problem is also necessarily multi-institutional simply because the level of effort and computational resources required is just too large for any one institution. This multi-model multi-institutional aspect of the problem requires WCRP coordination.

The primary role of TFSP is to insure that these experiments are coordinated across all relevant WCRP activities, and that the seasonal prediction data is made readily available to both the applications and physical science communities. The various components of the WCRP will continue to lead assessment of the forecasts, developing strategies and experiments for improving the forecasts and component model, and observing system evaluations and process study and field campaign integration. Indeed, the planned First WCRP Seasonal Prediction Workshop will produce a roadmap for how to improve seasonal prediction and how to assess our progress in improving forecasts and their utilization for societal benefit.

The TFSP proposes a comprehensive seasonal prediction experiment that is designed to test the following hypothesis:

There is currently untapped coupled predictability due to interactions and memory associated with all the elements of the climate system (Atmosphere-Ocean-Land-Ice).

The results of these experiments provide a framework for future experiments, specifically these prediction results will:

- Provide a baseline assessment of our seasonal prediction capabilities using the best available models of the climate system and data for initialisation.
- Provide a framework for assessing of current and planned observing systems, and a test bed for integrating process studies and field campaigns into model improvements.

- Provide an experimental framework for focused research on how various components of the climate system interact and affect one another.
- Provide a test bed for evaluating IPCC class models in seasonal prediction mode.

The TFSP recognizes that certain elements of the proposed experiment are already part of various WCRP activities. The intent here is to leverage these ongoing activities and to coordinate and synthesize these activities into a focused seasonal prediction experiment that incorporates all elements of the climate system. These experiments are the first necessary steps in developing seamless weekly-to-decadal prediction of the complete climate system.

WORLD CLIMATE RESEARCH PROGRAMME

JSC-XXVIII/Doc. 3.1
(19.II.2007)

JOINT SCIENTIFIC COMMITTEE

Item 3

TWENTY-EIGHTH SESSION

ZANZIBAR, TANZANIA, 26-30 MARCH 2007

AGENDA FOR AFRICAN NETWORKING

‘’ Africa Climate Research Networking Workshop for Young Scientists’’

28 March 2007

in conjunction with the 28th session of the Joint Scientific Committee for the WCRP, 26-30 March 2007, in Zanzibar, Tanzania

Tentative Agenda

Morning Session

0830-0900: Welcome, introductions and preliminaries

1. J. Church, Chair, JSC-WCRP

2. M. Mhita, Director General, Tanzania Meteorological Agency

0900-1030: Review presentations [by senior/established scientists and researchers, each 20 minutes, including discussion]

1**. IPCC 4th Assessment WG 1 findings for Africa** (B. Hewitson/UCT, South Africa)

2**. CLIVAR-VACS: Current status and challenges for the future** (C. Reason/UCT, South Africa)

3. **AMMA: Current Status and challenges for the future** (A. Gaye, University of Dakar, Senegal)

4. **WMO CLIPS: Current status on Application of climate information and products in the Africa** (B. Nyenzi, WMO/WCP, Geneva)

1030-1100: Coffe/Chai break

1100- 1230:

1. **Climate change related vulnerability, resilience and adaptation in Africa** (A. Nyong/IDRC, Kenya)

2. **Past Global Changes in Africa** (M. Umer/Addis Ababa Univ. Ethiopia)

3. Advancing African Climate Predictions: A proposal for near- and longer-term strategy (F. Semazzi/U. North Carolina, USA)

4. **Climate change related vulnerability; resilience and adaptation in Tanzania**(Ms Juliana Adosi, TMA, Tanzania)

1230-1400: **Lunch Break**

Afternoon Session:

1400-1500: Invited lecture

Mainstreaming Climate Information in National Development Plans and Strategies (by Hon. Minister M. Mwandosya, Tanzania)

1530-1600 Coffee/Chai break

1600- 1700: Panel discussion: On Challenges of coordinating existing and emerging initiatives in Africa (AFRICANESS, ICSU ROA, ACCESS, etc.) to enhance WCRP-related research in Africa.

Chair: S. Toure /A. Alusa (UNEP Regional Office for Africa, Nairobi)
Discussion (20 minutes)
Panelists: (10 minute each for comments)
S. Wandiga/U. Nairobi, Kenya
S. Muhongo/ICSU ROA, Pretoria, South Africa
L. Ogallo/ICPAC, Nairobi
K. Anaman, U. Ghana, Ghana
M. Mhita, Dar-es-Salaam, Tanzania

1700-1800:

A wine and cheese/samosas-type walk around session where a number of young scientists will be invited to showcase their work on posters.

18.30-20.00

Proposed Dinner for all participants of JSC and African Day – co-hosted by WMO/START/WCRP
Welcome to be given by Dr Nyenzi, WMO/WCP

WORLD CLIMATE RESEARCH PROGRAMME

JOINT SCIENTIFIC COMMITTEE

TWENTY-EIGHTH SESSION

ZANZIBAR, TANZANIA, 26-30 MARCH 2007

JSC-XXVIII/Doc. 3.2
(28.II.2007)

Item 3

GLOBAL CHANGE SYSTEM FOR ANALYSIS, RESEARCH AND TRAINING

Annual Progress Report as of 31 December 2006

GLOBAL CHANGE SYSTEM FOR ANALYSIS, RESEARCH AND TRAINING

Annual Progress Report

As of December 31, 2006

Scientific Steering Committee (SSC)

The START SSC provides direction and oversight for START. The START-SSC also serves to provide an informal forum for discussions between governmental and non-governmental representatives.

The START SSC meets annually, and consists of two categories of membership:

Members-at-large, who are appointed in their own individual capacities (10 members in 2006)

Ex-officio members who are representatives of START's Program Sponsors (IGBP, IHDP and WCRP) and START's regional committees, centers or secretariats (13 members in 2006; in addition representatives of APN, IAI, ICSU, and core/joint projects of the ESSP are invited as guests.

For CY 2006 membership of the START SSC, please see START Annual Report or website. More information, including members' bios, is also available at <http://www.start.org>. Nominations of potential new members to replace members rotating off at the end of 2006 are invited.

In various regions, START operates through regional coordinating committees. Currently, there are 5 START regional coordinating committees. Composition of each regional committee is unique to the region. Members of these committees are drawn from scientific, policy and other relevant communities within the region (typical meetings of these committees include guest members, e.g., some representatives of core/joint projects of ESSP). In Southeast Asia, a regional council comprising members drawn from high level scientific and policy organizations in the region meets biannually in conjunction with the region's coordinating committee. A complete list of members of all START regional coordinating committees is available at http://www.start.org

International Project Office (IPO)

International START Secretariat
2000 Florida Avenue NW, #200
Washington DC, 20009, USA
Tel: +1 202 462 2213; Fax: +1 202 457 5859; Email: start@agu.org
Website : http://www.start.org

START regional project offices (4 centers and 2 secretariats) are located in Africa, Asia, Oceania, South America, and the Mediterranean. START's Regional Centers are based at:

- East Asia- the Institute of Atmospheric Physics of the Chinese Academy of Sciences in Beijing, China;
- Southeast Asia Regional Center- Chulalongkorn University in Bangkok, Thailand;
- Southeast Asia Secretariat- the National Central University, Chung-Li, Taiwan;
- South Asia- the National Physical Laboratory in New Delhi, India;
- Oceania- the University of the South Pacific, Fiji; and
- Africa- the University of Nairobi, Kenya.

Besides regional research and capacity building, each center/secretariat serves as a regional information node and as a secretariat for the regional coordinating committee. MEDIAS-France in Toulouse, France, serves as a coordination node for START activities in the Mediterranean region.

In addition, following approval by the Pan-Africa Regional Committee for START, the following 3 regional thematic nodes have been established in Africa:

- Regional node for Climate Modeling and applications based at the University of Cape Town, South Africa;
- Regional node for coastal and wetland issues based at the University of Ghana's Center for Wetlands in Legon-Accra Ghana; and
- Regional node for Paleoclimate based at the Geology Department of the University of Nairobi, Kenya

For more information, see the START Annual Report and http://www.start.org

SCIENTIFIC HIGHLIGHTS

MAJOR ACTIVITIES AND ACHIEVEMENTS

1. Research:

1.1 During 2006, START supported around 70 regional research projects on the following themes (many of the projects directly contribute to ESSP's core and joint projects):

- Land Use Change and its Impacts on Terrestrial Ecosystems;
- Regional Climate Variability and Change;
- Regional Changes in Atmosphere;
- Coastal Zones;
- Global Change and Water Resources; and
- Assessments of Impacts of and Adaptations to Climate Change.

Highlights:

1.2 The project on **Assessment of Impacts and Adaptations to Climate Change (AIACC)** is now complete and final reports are under preparation. Activities during 2006 focused on producing scientific and technical papers and reports from the 24 regional projects. In addition to reports and working papers already published, AIACC has already yielded 60 peer-reviewed publications. Two major synthesis volumes: one dealing with vulnerability and another with adaptations to climate variability and change are in final review and will be published by Earthscan Books during mid-2007. The regional projects have also contributed to capacity building within their regions through support of students (to-date 17 training courses), and by interaction with the policy community, including special sessions for participants at meetings of the Conference of Parties of the UNFCCC. It is an impressive record of accomplishments and efforts are underway to implement successive activities. Consultations are ongoing with UNEP to seek funding support from GEF for follow-on activities targeted at actual implementation of adaptation practices in selected developing countries. In addition, a related project titled "**Advancing Capacity for Climate Change Adaptation (ACCCA)**" has been funded by the EU and DEFRA/UK and was launched during 2006 in collaboration with UNITAR and SEI/Sweden.

1.3 START, at the request of the ESSP, completed its initial; task to establish the **Monsoon Asia Integrated Regional Studies (MAIRS) project**. The MAIRS SSC and IPO have been established and significant funding support from CAS-China has been secured for the MAIRS IPO. The MAIRS initial Science Plan was approved by the MAIRS SSC and endorsed by the ESSP at the OSC (Beijing, November 2006). The MAIRS project will include intensive field and observational as well as numerical modeling activities. In addition to conducting research in selected regions in Asia and providing a venue for collaboration between many core projects of START's sponsors, this project will contribute information to the Global Earth Observing System. START provided initial funding support for MAIRS-related Workshop to define a set of research topics on Mountain Zones of Asia.

1.4 In addition, START has supported or jointly conducted the following joint activities with the Core and Joint projects of the ESSP family:

1.4.1 WCRP: START provided funding support to several AMMA-related projects of African scientists; a CLIVAR-Africa-related workshop (held during 2006 in Daressalaam, Tanzania); and an ARGOS free-drifting profiling floats-workshop for West Africa (also to be held during late 2006 in Ghana). In addition a number of other small grant and PhD fellowship awards have been made to African scientists. Details are available on the START website www.start.org.

1.4.2 IGBP: In the context of the global LAND project and the Joint Carbon Cycle project, START supported regional GOFC/GOLD networks in African and Asia.

1.4.3 IHDP: With funding from NEDO/Japan, START organized and conducted a workshop on the Industrial Transformation in Asia at the UNU in Beijing during January 2006. Two studies related to the steel, paper/pulp and electronic industries were completed. Moreover, a synthesis session of the Advanced institute on Vulnerability and Risk Management was conducted in Delhi in conjunction with the 2nd WSSD session.

1.4.4 DIVERSITAS: Two African Doctoral Fellows have completed their PhD degree requirements on topics pertaining DIVERSITAS. In addition, START has made small grant awards to several African scientists working on issues pertinent to DIVERSITAS Core Themes.

1.4.5 ESSP JOINT PROJECTS:

(A) AFRICANESS: During November 2006, START's Pan-African Secretariat organized a workshop on behalf of the IGBP to develop a science plan for AFRICANESS.

(B) MAIRS (Monsoon Asia Integrated Regional Studies): See above under 1.3. Also, in collaboration with IPRC and START's East Asia Regional Center, a proposal for an advanced institute: Advances in Monsoon Science was prepared and submitted to APN

(C) CARBON: South China Sea Carbon Cycle Project is funded through SARCS/START; 7 individual projects were completed under the supervision of Prof. A. Chen (JCP SSC member). A training session for young scientists, held during November 2005 in Taiwan, on water and carbon cycles in Southeast Asia focused on issues of fluvial transport and the carbon cycle in the context of the impacts on primary productivity in the South China Sea.

(D) WATER: In collaboration with GWSP, GECHS/IHDP and the International Foundation for Science, a curriculum was designed for an Advanced Institute on *OREDO(QYLURQPHQWDO&KDQJH and the Vulnerability of water resources in the context of the Millennium Development Goals

2. Capacity Building:

2.1 During 2006, some 1,000 scholars from developing countries were involved in various START activities, including regional science planning and research workshops, collaborative research networks, short term fellowships, visiting scientists and lecturer awards, African dissertation/PhD fellowships program, small grants program, and young scientists awards. Full details are available on the START website (www.start.org).

2.2 **A highlight this past year** was the 2nd International Young Scientists' Global Change Conference organized together with CMA and ESSP and supported by many donors (see

START website for more information). Major funding donors for this event included USCCSP, US NSF, APN, IAI and DGIS/The Netherlands. This conference took place November 5-8, 2006 at the Science and Technology building on the China Meteorological Administration campus in Beijing, China. The conference offered a prestigious platform for young scientists from 35 countries around the world to present their research findings to one another and leading scientists in the field. It was intended, and succeeded to stimulate competition, encourage excellence, reward outstanding performance, and foster the development of personal and institutional networks. All YSC participants also took part in the Earth System Science Partnership's Open Science Conference, "Global Environmental Change: Regional Challenges" (November 9-12, 2006, Beijing International Conference Center). Distinguished invited keynote speakers for this young scientists conference were Prof. Congbin Fu and Nobel Laureate Paul Crutzen; and sessions were chaired by leading members of the global change research community. Awards were granted for the most outstanding contributions in three categories, best paper, best poster, and best CMA young scientist poster

PUBLICATIONS AND OTHER PRODUCTS

List all publications in the peer review literature (science journals, special issues, books/ book chapter, etc), reports, datasets/databases, model(s), etc.

Note: numerous papers in peer reviewed journals have been published by various START grantees. Here we note only major recent publications:

1. A special issue of *Climate Research*: *Advances in Applying climate prediction to agriculture (CR Special 16, Vol 33, No. 1, December 21, 2006)*
2. See AIACC project description above and the website http://www.aiaccproject.org for complete listing.

OUTREACH

The international START Secretariat broadly disseminates an electronic news bulletin and publishes an annual report (2006 issue under preparation). In addition, START's regional centers/secretariats and nodes disseminate their own e-bulletins/newsletters. Staff of START often provides pro bono community/outreach services, including participation in sessions of IPCC WGs and Task Groups,, UNFCCC COP and SUBSTA sessions, meetings of UNU, IGFA and APN as well as global change-related sessions of US NAS Boards/Committees. A listing can be provided upon request.

CHALLENGES / CONSTRAINTS

While significant support for the International START Secretariat has been obtained from the USCCSP agencies, it is at a lower level than required to maintain full Secretariat operations. Discussions are ongoing with IGFA agencies in this regard. Renewed funding for a number of programmatic activities, including follow-up to AIACC and various capacity building activities, must be obtained for CY 2007 onward. Proposals are being submitted to various development assistance agencies. For 2007 and beyond, the funding outlook is uncertain for START's capacity building program for basic global change science/research (including fellowships, young scientists awards, support for participation in international conferences, support for regional nodes, centers and secretariats, and annual sessions of the START SSC and START Regional Committees).

GOALS AND PLANS FOR MAJOR ACTIVITIES IN 2007 AND 2008

The START SSC considers and approves work plans for the overall START program. The START SSC meeting during November 2006 approved the work plan for 2007. Information on the 2007 work plan is available from the International START Secretariat.

Among the major actions for 2007 are:

1. Needs Assessment workshops in Southeast Asia and Sub-Saharan Africa related to climate risk management
2. Initiation of 14 ACCCA regional projects
3. Implementation of an MS-level curriculum on climate change and biodiversity conservation

in Africa
4. Supporting further development of the MAIRS program
5. Conducting a three week Advanced Institute on *OREDO (QYLURQPHQWDO &KDQJH DQG WKH Vulnerability of water resources in the context of the Millennium Development Goals in collaboration with IHE-UNESCO, IVM/The Netherlands, GWSP, GECHS and IFS and initiating follow-on research projects
7. Continuing START's African Doctoral Fellowships program and small grants programs in Africa (and in Asia in collaboration with APN)
6. Securing continued funding for START's research driven capacity building portfolio

06-February-2007	***Compiled by: Roland Fuchs and Hassan Virji***

WORLD CLIMATE RESEARCH PROGRAMME

JOINT SCIENTIFIC COMMITTEE

TWENTY-EIGHTH SESSION

ZANZIBAR, TANZANIA, 26-30 MARCH 2007

JSC-XXVIII/Doc. 3.3
(19.II.2007)

Item 3

Africa: World Climate Research Partnering (A-WCRP)

Motivation: WCRP and Stakeholders

There are a number of African institutions conducting research on various aspects of African climate variability and change. These range from individuals or small groups at some universities to several large quasi-government institutions that in many cases receive international donor funding. Most of the latter tend to focus on specific aspects such as drought monitoring, climate variability impacts and long range forecasting (e.g., Drought Monitoring Centre – Harare, ICPAC – Nairobi, ACMAD – Niamey). Some National Meteorological Services (NMS's) in the region also have a significant climate research component to their activities.

A large component of the work done by these bodies tends to be in-house, operational rather than research-oriented (and, thus, is not always published in international refereed journals) and regionally focused with a reduced need to collaborate with others outside the particular organisation concerned. Recently however, certain bodies have begun to develop research proposals that are multi-disciplinary and multi-institutional and, to some extent, Africa-wide or at least involving several countries in the same region. Examples include the ICSU Regional Office for Africa Global Change document, the ACCESS Earth Stewardship Science proposal led by Prof. George Philander and CSIR (South Africa) and the AFRICANESS project (PASS, Nairobi).

These efforts are laudable and need to be encouraged although there seems to be a certain amount of overlap and potential duplication of effort. In many cases, the proposal would benefit from a refinement of the various ideas in order to create synergies and an economy of effort. For wider recognition of these bodies, there remains the need to disseminate the proposals more broadly throughout Africa and to entrain the upcoming generation of younger scientists in the continent (some of who may be completing higher degrees or postdocs overseas). It will be this cohort of younger scientists who, if sufficiently excited and enthused by the research ideas, will be able to refine them, conduct the necessary research and implement the recommendations. To some extent, initiatives attached to AMMA have addressed these concerns, although again, the effort is mainly regional rather than continent-wide.

To this end, better communication and information dissemination throughout African academia and research institutions is needed. One way which may help the community to advance towards this goal is to create a WCRP-sponsored virtual network of young African scientists involved in climate research.

Climate Research Network for Africa

An outcome of the recent CLIVAR VACS training workshop on Climate Prediction for southern and East Africa was to establish a network of long range forecasters from the various NMS's and ocean agencies in the region. A web site using the Google Writely facility has been established and is able to be expanded by the various users. The goal of this network is to encourage the workshop attendees to discuss the issues and challenges faced in implementing the Climate Prediction Tool (CPT) at their home institutions and to work towards posting their seasonal forecasts on the site in advance of the forthcoming rainy season for community feedback and input.

The same facility can be implemented more broadly and generally for the climate community working in Africa with the goals of refining the research ideas outlined in the ICSU ROA, ACCESS (see http://a-c-c-e-s-s.blogspot.com for an early draft) and AFRICANESS and related proposals, obtaining feedback from a wider group of workers than has been involved so far, and entraining and enthusing the upcoming generation of recent PhD graduates.

To begin with, the group of Young Scientists attending the WCRP JSC Zanzibar meeting should be encouraged to join the proposed network, introduce the idea to their colleagues in their home institutions and countries and to begin to adapt it as necessary for their particular needs.

A dedicated web server and IT technician are required in order to achieve the goal of a well-functioning and adaptable climate network. It is desirable that the facility be located in an African country with relatively good infrastructure and linkages to other African countries, a relatively robust and stable economy and which has had less opportunity than other countries to benefit from initiatives sponsored by the WMO or similar bodies. An example of such a country could be Botswana or Tanzania.

WORLD CLIMATE RESEARCH PROGRAMME

JOINT SCIENTIFIC COMMITTEE

TWENTY-EIGHTH SESSION

ZANZIBAR, TANZANIA, 26-30 MARCH 2007

JSC-XXVIII/Doc. 4.1
(15.II.2007)

Item 4

Report on the Core GEWEX Project
Prepared for the JSC-28 meeting in Zanzibar
February 14, 2007

1. Science:

For more than 15 years, the climate community has known that the most uncertain component of global climate models is their treatment of atmospheric hydrology, particularly clouds, precipitation and surface hydrology. GEWEX, a critical and mature component of the WCRP provides unique expertise that contributes to characterizing, understanding and modeling these components of the climate system. It blends observations and modeling studies to provide an integrated approach to understanding atmospheric properties and surface-atmosphere interactions. According to IPCC reports, the spread in model responses to doubled CO_2 concentrations has remained relatively unchanged for almost two decades suggesting that limited progress is being made in solving this problem. However, GEWEX is making progress through its coordinated research strategy that is built upon improved long-term global data sets and high resolution time series of energy and water properties; parameterization evaluation and development, constrained by the data sets, and modeling supported by process studies across a wide range of scales.

The GEWEX Modeling and Prediction Panel (GMPP) has established itself as the prime model parameterization development and evaluation body in WCRP. The GMPP strategy consists of identifying important regimes in the climate system; evaluating model performance generally and in the critical regimes using long-term data sets; developing new parameterization approaches through process studies targeting those regimes that are not well represented in current models, and supporting the implementation of the newly developed parameterizations in climate and NWP models. Among recent examples of GMPP contributions to climate modeling is the GLACE project, which revolutionized land-feedback studies by elucidating areas of strong land-atmosphere coupling; and GCSS, whose approach to model development contributed in a major way to the first climate models using a cloud-resolving model approach to parameterization.

GEWEX process studies have benefited from the emergence of a number of new CSEs (now referred to as Regional Hydroclimate Projects (RHPs)). These large scale projects have multiyear implementation plans that often include shorter duration field projects and intensive observation periods. For example, during the summer of 2006, a wide range of data sets was collected over western Africa. These data will be critical to understanding the role of sea surface temperature and soil moisture in the development of monsoons and for assessing the role of easterly waves and Saharan dust storms in the development of tropical storms (and hurricanes) over the Atlantic Ocean. In addition to increasing the number of RHPs from five to eight over the past decade, cross-cutting global scale projects were launched and CEOP, the largest of these cross-cuts, grew to include 35 reference sites, product generation by more than 10 Numerical Weather Prediction (NWP) centers and a large archive of satellite data with contributions from five major space agencies. Significant improvements to prediction models have been realized by comparing model output with observations using these archives. With CEOP data, model skill is being evaluated at individual NWP centers and the process of model development, particularly at the smaller NWP centers, has been accelerated.

During the past year GEWEX has streamlined its regional projects to bring more focus and economy of scale to these activities. This consolidation has included the development of the Hydrology Applications Project (HAP) to succeed the Water Resources Application Project (WRAP) and to build stronger ties to the Global Water System Project (GWSP), GMPP and CLIVAR. Other projects have come to an honorable end such as the PILPS semi-arid experiment which has shown that semi-arid environments require a more complex land cover classification than those generally used in models for more humid regions. Most significantly, GEWEX has merged CEOP and GHP into a single panel activity known as the Coordinated Energy and water cycle Observations Project (CEOP). This approach has consolidated the RHPs and CEOP science within a global data and science framework so that they broaden their applications and link more effectively to GMPP and GRP.

Through GRP, GEWEX has supported the development and maintenance of surface-based long-term networks such as BSRN and the development of satellite data products such as the Global Precipitation Climatology Project (GPCP) products to monitor quantities that are key for identifying natural variability and trends; for validating satellite observations and developing retrieval algorithms; for developing parameterization schemes to more accurately represent the atmospheric behavior, and for evaluating the fidelity of model simulations of the hydrological and energy cycles. The foundation of any climate research program is a comprehensive set of observations of the behavior of the climate over the whole range of space-time scales from process-level to decadal (or longer) variability with sufficient detail to diagnose the causes of this variability. This requires an observation strategy for systematic measurements of a large number of quantities with sufficiently high space-time resolution over the whole globe for decades. The strategy would include an observing system composed of both a network of reference surface sites and a constellation of satellites: the former should collect a comprehensive set of co-located measurements and the latter should provide global coverage with sub-diurnal time resolution.

To develop predictive capability and determine the causes of climate variability in the various WCRP cross-cutting activities, the contributions of specific processes to variations of the global energy and water cycle must be diagnosed. This diagnosis requires systematic, long-term, global observations to allow for study of the coupling of numerous processes at many different space-time scales. Observations of variations and forcing changes need to be combined to separate forced and unforced variations. To obtain the needed high (relative) accuracy requires cycles of reprocessing of the datasets as understanding advances. GRP projects provide the foundation for the GCOS/GEO climate data collections. Furthermore, GRP projects have pioneered development of multi-satellite analysis capabilities and have formulated the rationale for and developed the approaches to systematic and coordinated data product reprocessing. With the emergence of WCRP cross-cutting activities, additional data analysis are needed to support them by helping to determine the processes that must be represented in prediction models and providing the basis for evaluating the representation of long-term variations of the climate.

In view of the data needs of the new WCRP cross-cuts, GEWEX recommends that WCRP take the lead in defining the observing system requirements and support re-processing and analysis activities by tasking an appropriate group (e.g., WOAP) to provide for their coordination across the core projects and the cross-cuts.

2. Value Added:

GEWEX has added value through its research results, its coordination function and its outreach, and has stimulated many new research results and programs that would not exist without its involvement. In terms of climate science the unique contributions of GEWEX rest upon: 1) *Improved long-term global data sets and high resolution time series of energy and water properties:* GEWEX has developed homogeneous long-term data sets from satellite data for energy and water cycle variables including global top-of-atmosphere radiation, surface radiation, and precipitation datasets that are used by nearly every reputable climate modeling group to evaluate their models. As noted earlier, GEWEX contributions to sensor conceptualization and design led to new space-borne instruments, most notably CloudSat and CALIPSO that are now providing unprecedented views of global cloud cover. 2) *Parameterization evaluation and development constrained by the data sets:* These tools developed to bring GEWEX data sets and field campaign results to model developers include the CIRC website for the evaluation of radiation codes and the ISCCP simulator, which allows direct comparison of model results with observations using joint probability distributions of cloud vertical location and optical properties. 3) *Modeling across a wide range of scales enabled by a large increase in computer power:* GEWEX has brought the hydrologic and atmospheric science communities together to collaboratively develop fully coupled land-atmosphere models that are now considered to be the benchmark for updated climate models. In a project pioneered in collaboration with GCSS, a cloud resolving model has been embedded in each grid cell of a global climate model, thus improving parameterizations and preparing the way for high resolution climate models.

GEWEX uniquely extends WCRP interactions to a large network of satellite programs and the hydrology community. In addition to GEWEX's strong linkages with CLIVAR, WGNE, WOAP, CliC and SPARC, it makes distinct and meaningful contributions to each of the WCRP cross-cuts. Within the larger ESSP community GEWEX has many links with IGBP mainly through iLEAPS and more recently through IGAC. Also, GEWEX has maturing interactions with GWSP and has interacted with the other ESSP cross-cuts (food, health and carbon). GEWEX also has programmatic links to the UNESCO International Hydrology Programme (IHP), the International Association of Hydrological Sciences (IAHS) and GCOS. In addition GEWEX has established links at the national level with many national funding agencies, programs, data services, research groups and environmental organizations. For example, the RHPs have connections with national and even international funding agencies (e.g., Global Environmental Facility) and programs. The money invested by WCRP to foster these activities through travel support to meetings has been multiplied hundreds of times over in regional studies that support WCRP objectives and in WCRP linkages into dozens of countries where they would otherwise be absent.

GEWEX also provides value through its outreach activities developed in many areas because of WCRP coordination. WCRP has fostered a number of GEWEX links with the space community by asking the Committee on Earth Observation Satellites (CEOS) to support CEOP and by asking GEWEX to take the lead in developing the IGOS Global Water Cycle Observations (IGWCO) theme and by nominating GEWEX members to GEO working groups and tasks. GEWEX has benefited from these linkages and has created opportunities to advance WCRP science in fora such as the World Water Forum and side meetings of the Commission for Sustainable Development.

It is recommended that the JSC reaffirm the WCRP commitment to support the development of GEOSS and encourage its projects and personnel to play an more active role in this process.

3. Impacts:

With support from WCRP, GEWEX contributes in a variety of ways to the actions, priorities and policies of international and national programs. In the observations field the value of GEWEX to WCRP is seen through the utility of the data sets and the quality of advice that GEWEX provides through its research. GEWEX has played a major role in bringing climate and water issues and the needs of climate research to a number of space agencies and national environmental programs. CEOP has stimulated a strong financial commitment to water cycle research in Japan and has been the primary motivator for the emerging Asian Water Cycle Initiative. In the USA, NASA has launched the multimillion dollar, multi-year NASA Energy and Water Cycle Study (NEWS) research program. The NEWS Implementation Plan drew heavily from the plans and research activities of GEWEX in defining its goals and its roadmap. Another example arose when the demonstrated benefits of TRMM data products, produced in part through GEWEX research, led to the reversal of a NASA plan to phase out the TRMM satellite in 2005. GEWEX has made a major contribution to the planning of the Integrated Global Water Cycle Observations theme of IGOS and more recently the GEO 10-year Implementation plan where some GRP products are mentioned by name (e.g., GPCP). In addition, CEOP has had extensive collaboration with CEOS giving GEWEX and WCRP more opportunities to influence and benefit from the Earth Observation community.

GEWEX has supported the policy of free and open exchange of data promoted by WMO and GEO. Through CEOP, GEWEX has demonstrated a strategy for achieving this goal by developing standards, procedures and policies for data formatting, collection, processing, archiving, release, and dissemination for stations in its reference site network. CEOP data providers, even those from countries with restrictive data policies, are participating in CEOP and freely exchanging data on a routine basis.

4. Responsiveness:

In addition to the examples of responsiveness outlined above, GEWEX has been responsive to the research agenda of the US Climate Change Science Program (CCSP) and has collaborated with its water cycle program. GEWEX was the principal architect and advocate of the water cycle science component of CCSP when it was initiated. Through CEOP and GAME/MAHASRI, GEWEX has been an important contributor to the ascendancy of the water cycle as a priority in the Japanese Government's Science priorities. Based on recommendations from WCRP and others, the European Community has made more funding available for the support of water cycle research. GEWEX Extremes research on drought in Canada is now contributing to a Canadian drought response strategy.

There is a major thrust by many international bodies both inside and outside the United Nations to support capacity building. GEWEX has collaborated with GEO and IGWCO in launching capacity building activities in Latin America and Asia. In Asia these activities are linked with CEOP through the Asian Water Cycle Initiative. Within the Americas a new program for capacity building is being developed with strong GEWEX input. Both programs will serve WCRP interests. Many of the GEWEX RHPs, (CPPA, LBA, BALTEX, LPB, AMMA, MAHASRI and NEESPI) include scientists from underdeveloped countries. This GEWEX regional focus has been useful for giving them new scientific opportunities. Some regional projects (e.g., BALTEX) have held training programs to enable young scientists to better use GEWEX data sets and services. Recently, the European Union has provided funding to a number of African nations and organizations to enable them to play a larger role in AMMA and strengthening the ability of their hydrometeorological services to provide more useful information to their national agencies.

5. New Directions:

Climate change and the broad range of anthropogenic activities that contribute to it are seen as areas which need increased policy attention in the next 5 to 10 years. Although the Kyoto Protocol will make a significant impact, it is not structured to resolve all of the climate issues arising form human activities. To build the case for further action, better climate models and more understanding of the effects of aerosols, land use change and global water system changes on the climate will be needed. GEWEX process and modeling studies help address these issues by looking at the potential impacts of land use change and urbanization on the climate; by producing long-term global water and energy data sets that can be used in evaluating trends; by developing models and tools that will useful in assessing the hydrologic impacts of climate change scenarios; and by improving the representation of two of the most poorly performing parts of the climate models: cloud and land surface feedbacks. Through GMPP, GEWEX will provide the fundamental international coordination and support for climate model evaluation and parameterization development. GEWEX will continue to lead or support these efforts because the parameterization of physical processes must be improved to narrow the range of climate sensitivity in models. Furthermore, there is a need to develop global cloud-resolving models. All of these modeling activities will require global observation sets and an understanding of physical processes at the cloud resolving scale.

GEWEX provides data sets are essential for WCRP assessments of imminent environmental crises. In addition to the climate change crisis, GEWEX is accumulating data sets and prediction capabilities that will help to address both the water crisis and the energy crisis: issues that are expected to become more critical in the next few decades. Energy is a major geopolitical issue and many nations are becoming aware of their need to assess the potential for wind and solar energy. Furthermore, the over-allocation of water in some parts of the world and the additional stress of biofuel production on water resources are expected to exacerbate the stress on the world's water resources. Through the application of its radiation data sets, GEWEX already is contributing to the development of plans by the solar energy industry to find alternative energy sources. GEWEX also provides global observations and model output of global runoff and global water resource monitoring.

It is recommended that the JSC establish a task force to explore the implications of the potential water and energy crises in terms of the needs and opportunities for climate research and data.

6. Challenges:

Communications

WCRP can assist GEWEX in a timely way in the areas of communications and commitment. WCRP has provided new ways for GEWEX to become more visible through its EZine Newsletter, the Annual WCRP Report and the promotion of GEWEX activities on its web site. WCRP can continue to help by articulating the overarching strategic plan for achieving climate research goals to the funding agencies and the public and by providing a united voice of the research community to the international organizations. However, this will require better internal communications. WCRP should exercise leadership in facilitating communication between GEWEX and the JSC, and among the other components of WCRP. This communication could be improved–for example at the most recent GEWEX SSG meeting the Chair indicated that he did not have a clear understanding of the current WCRP priorities, nor was a WCRP JPS representative present to explain them.

It is recommended that JSC and the WCRP JPS reaffirm their commitment to ensuring clear, full and transparent communications with GEWEX and other WCRP projects.

Commitment:

GEWEX remains committed to the goals and objectives of WCRP. GEWEX brings more than 1500 scientists from over 50 countries to address critical aspects of the climate prediction issues. Since these scientists are volunteers, good will, trust and commitment are the essential attributes that must be present to advance the GEWEX research agenda. GEWEX believes it is essential to provide its scientists with a science framework and a stable programmatic platform as they seek funding and collaborators for their research. GEWEX has recently consulted with its community and developed a roadmap for the 2007 to 2012 period that clarifies the roles and expectations from each GEWEX panel and project. Although GEWEX planning has made significant advances, recent signals from the JSC have created some uncertainties about the consequences of fully committing to this plan.

It is recommended that the JSC reaffirm to GEWEX that it fully supports the intention of GEWEX to stay the course and to continue pursuing its research agenda through 2012 so that the deliverables outlined in the GEWEX Roadmap can be fully realized and the science that underpins the WCRP climate advisory efforts can be more fully developed and exploited.

WORLD CLIMATE RESEARCH PROGRAMME

JOINT SCIENTIFIC COMMITTEE

TWENTY-EIGHTH SESSION

ZANZIBAR, TANZANIA, 26-30 MARCH 2007

JSC-XXVIII/Doc. 4.2
(14.II.2007)

Item 4

CLIMATE VARIABILITY AND PREDICTABILITY (CLIVAR)

(Submitted by the Chairs of the CLIVAR Scientific Steering Group and the Director, International CLIVAR Project Office)

1. Introduction

Highlights of recent outputs from the activities of CLIVAR[1] panels and working groups[2] are provided below in the requested format. These should not be taken as a comprehensive summary of CLIVAR networking activity but are illustrative of its breadth.

2. Science

- Many CLIVAR scientists have taken part in the IPCC AR4 assessment, contributing as Convening Lead Authors and Lead Authors and in media outreach activities. Some of these testified before the US Senate and the House; a number also played a leading role in the formulation of the IPCC WG1 summary for Policymakers.

- A paper on global observed changes in daily climate extremes of temperature and precipitation incorporating the outputs of the earlier ETCCDI capacity building workshops has been published. (Alexander et al. JGR, 2006). The outputs from this and two other papers by Christidis (GRL, 2005) and Tebaldi (Climatic Change, 2006) which draw on a previous ETCCDI-related paper by Frich (Clim. Res., 2002) enabled ETCCDI to have a substantial influence of the IPCC AR4 Report.

[1] CLIVAR's mission is "*to observe, simulate and predict changes in the Earth's climate system with a focus on ocean-atmosphere interactions, enabling better understanding of climate variability, predictability and change, to the benefit of society and the environment in which we live*". In line with the WCRP overarching objectives and strategic plan, CLIVAR acts to encourage and facilitate national and international activities that contribute to our understanding of climate variability and our ability to provide improved climate predictions on seasonal, interannual, decadal and centennial timescales. It seeks to encourage the development and implementation of sustained observations of the climate system, field and modelling studies that help our understanding of climate processes and how they can be represented in models, analytical studies to assist our understanding of climate variability and coordinated effort in climate prediction. CLIVAR has a number of cross cutting science topics aligned with those currently providing the focus for WCRP: ENSO and other tropical modes of variability; monsoons; decadal variability; anthropogenic climate change (ACC); the role of the oceans in climate and climate prediction. CLIVAR's focus is on the physical climate system on both regional and global scales, linking with other programmes on the wider biogeochemical, ecological and human dimension aspects of the Earth system.

[2] To aid CLIVAR implementation, the CLIVAR SSG has established a number of global and regional panels and working groups. These comprise the JSC/CLIVAR Working Group on Coupled Modelling (WGCM); Working Group on Seasonal to Interannual Prediction (WGSIP); the Working Group on Ocean Model Development (WGOMD). CCl/CLIVAR/JCOMM Expert Team on Climate Change Detection and Indices (ETCCDI); Global Synthesis and Observations Panel (GSOP); CLIVAR/PAGES Panel; Variability of the American Monsoon System (VAMOS) Panel; Variability of the African Climate System Panel (VACS); Asian Australian Monsoon Panel (AAMP); Atlantic Panel; Pacific Panel CLIVAR//GOOS Indian Ocean Panel (IOP); CLIVAR/CliC/SCAR Southern Ocean Panel and the CliC/CLIVAR Arctic Climate Panel. The International CLIVAR Project Office (ICPO) is responsible for the coordination of the scientific and administrative aspects of CLIVAR, acting as the executive arm of the SSG under its general direction.

- Community access to and analysis of the WCRP CMIP archive of model datasets for IPCC AR4 continues unabated. At 15 September 2006 there were 553 diagnostic sub projects registered with PCMDI and soon the milestone of the 1000th user of the archive will be reached. A large number of the diagnostic sub-projects cover science directly relevant to CLIVAR objectives. The CLIVAR SSG continues to encourage analysis of this dataset through its regional panels and working groups and this is reflected in a number of associated projects. Amongst other things, VACS has noted that the dataset has stimulated a new generation of Sahel research.

- Results from the joint WCRP(WGCM)/IGBP Coupled Climate Carbon Cycle Model Intercomparison Project (C4MIP) have shown unanimous agreement among the models that future climate change will reduce the efficiency of the earth system to absorb the anthropogenic carbon perturbation (Friedlingstein et al., J Climate, 2006).

- A CLIVAR/PAGES Workshop (Wengen, Switzerland, June 2006) on “Past Millennia Climate Variability: Proxy based reconstructions, Modeling and Methodology - Synthesis and Outlook” has stimulated ideas for a community-wide “paleoclimate reconstrution challenge” building on the theme of model intercomparison using synthetically-derived “pseudoproxy test datasets” from climate models as a test of methods used in paleoclimate reconstruction.

- Analyses of the outputs from the international Seasonal Model Intercomparison Project organized by WGSIP to estimate seasonal predictability using existing models are providing a focus for input to the WCRP Workshop on Seasonal Prediction, Barcelona, June 2007 (see the separate JSC paper on “Seasonal Prediction”).

- A paper is being drafted summarizing the results of early contributions from six international modelling efforts to the WGOMD Coordinated Ocean and sea ice model Reference Experiments (COREs). The paper demonstrates, in particular, that missing feedbacks at the ocean-sea ice edge can lead to either unrealistic mixed boundary condition oscillations, and/or to a very weak Atlantic meridional overturning circulation in model simulations.

- Under AAMP, coordinated analysis of results from several intercomparison projects has demonstrated that monsoon-warm pool interaction is one of the essential causes of Asian-Australian monsoon variability and a source of monsoon seasonal predictability and that air-sea interaction is one of the factors influencing monsoon intra-seasonal oscillations and prediction of their evolution.

- Various modelling and data assimilation activities have leveraged off the outputs from the VAMOS North American Monsoon Experiment (NAME) 2004 Field Experiment. A special issue of the J Climate on NAME with some 22 papers is due out in early 2007. The Monsoon Experiment South America (MESA) also has produced a BAMS paper on the South American Low Level Jet Experiment in 2006, as well as participated at the J. Climate paper on the unified vision of the American Monsoons in 2006. Future MESA modeling and assimilation activities are reflected in a new MESA Science and Implementation Plan that will be ready in March 2007. It will include modeling and field activities for 2 field experiments planned for 2008-2009 (PLATEX and ALTIPLANEX).

- The VACS panel, with funding support from various organizations, ran a training workshop at the Tanzania Meteorological Agency (TMA) in Dar es Salaam, Tanzania during 10-13 July 2006. The workshop was entitled *Predictability and Prediction of southern and eastern African climate variability and impacts of the neighbouring oceans.* The workshop ran for four days and was aimed at senior operational staff responsible for long range forecasting at national meteorological services and operational staff from related agencies (hydrology, water resources, oceans). In all there were around fifty participants from over twenty countries. An interactive CD was put together for the participants which included the agenda (with links to all the talks and practicals) as well as all the background documents, useful links, participant lists etc. A workshop website is also available at:

http://www.clivar.org/organization/vacs/VACS_workshop.php and an interactive discussion forum hosted by TMA will shortly be available.

- The electronic African Climate Atlas, developed at the University of Oxford, UK, through VACS is being extended to include a fifth outreach section devoted to answering FAQs about African Climate for e.g. journalists, educationalists etc. The other has four interactive parts covering Climatology, Anomalies, Aerosol Index, Pressure level climatologies and composites from the ECMWF 40 –year reanalysis. (http://www.geog.ox.ac.uk/%7eclivar/ClimateAtlas/)

- 2006 saw the successful completion of the Special Observing Periods for the African Monsoon Multidisciplinary Analysis (AMMA) field programme.

- A pilot assessment of some 20 ocean re-analyses has been carried out through a GSOP/GODAE Ocean Synthesis Evaluation Workshop held in August 2006 at ECMWF. The assessment was carried out against a coordinated set of metrics developed by GSOP in coordination with CLIVAR's ocean basin panels. The meeting provided a quantitative statement of the skill of available global synthesis products; identified common strengths and weakness of present systems and produced recommendations with regard to future synthesis resource planning, data processing and management.

- The Tropical Atlantic Climate Experiment (TACE), promoted by the Atlantic Panel, is underway. A Tropical Atlantic Climate Variability Experiment in the south-western Atlantic is now being formulated jointly between the VAMOS and Atlantic Panels.

- The Pacific Panel ran a WCRP-sponsored workshop on Multidecadal to Centennial Global Climate Variability (Hawaii, USA, November 2006). One of the outcomes (the result of analysis of CMIP water hosing experiments) was the emerging awareness that the North Atlantic significantly influences the Pacific climate system on long timescales. It does so via the atmosphere, global ocean wave adjustment and changes to Bering Strait throughflow, cooling the North Pacific and impacting the equatorial eastern Pacific in spring, reducing the annual cycle and intensifying ENSO substantially.

- FRCGC/University of Tokyo reported at IOP-3 (March 2006) that their seasonal forecasting group predicted a positive Indian Ocean Dipole in the latter half of 2006. Predictability was discussed at the meeting, and analysis of dynamics suggesting that skill is possible, but others debated the 2006 prediction. A strong IOD event occurred. The apparent success of this prediction will be the subject of further research to see if it was just good luck or a good prediction for dynamically valid reasons.

- A paper on the Southern Ocean Region (SO) Panel's Climate of Antarctica and the Southern Ocean (CASO) umbrella project for IPY entitled "The Role of the Southern Ocean in Past, Present and Future Climate: A Strategy for the International Polar Year" has been submitted to the International Polar Year special issue of the Indian Journal of Marine Sciences. The panel has also been active in producing an integrated modelling strategy for the Southern Ocean region linked to IPY.

- At the ICPO, the second volume of the WOCE Atlases, which focuses on the Pacific is currently being finalised and will likely be published in late March or early April. The atlas will consist of a high quality printed volume of around 300 pages as well as an electronic version available on DVD and the internet (a draft of the electronic version is already available from http://www-pord.ucsd.edu/whp_atlas/). A volume focusing on the Indian Ocean will likely be completed towards the end of the year with the final, Atlantic, volume hopefully being available in early 2008.

- A selection of papers from the 1st International CLIVAR Science Conference (Baltimore, USA, June 2004), organized by US CLIVAR, have recently been published as a special issue of J Climate (Volume 19, Issue 20 October 2006); a second special issue of the J Climate containing papers from the Atlantic Panel's Workshop on Atlantic Climate Predictability (Reading, UK, April 2004) has also been published recently (Volume 19, Issue 23, December 2006).

3. Value added *(outcomes that would not have been possible without CLIVAR coordination)*

The science items outlined above have arisen directly from the activities of CLIVAR's panels and working groups. They are illustrative of wide range of CLIVAR activities that have been funded from national resources. Recent other examples are:

- Under US CLIVAR development of model improvements through its funded Climate Process Teams; funding for US CLIVAR Working Groups relating to the MJO (with focus on key metrics and the issue of prediction across scales), western boundary currents and drought; announcement of a new activity (DRICOMP) to provide support for research into the physical and dynamical mechanisms leading to drought and the mechanisms through which drought may change as climate changes.

- A recent NOAA award of $12M for applications-focussed research on African Weather and climate systems. This is related to the VACS East African initiative led by Dr F Semazzi.

- Announcement of funding for the VAMOS Ocean Cloud Atmosphere Land (VOCALS) study involving field studies and modelling over the South East Pacific region.

- Funding by the European Science Foundation of MedCLIVAR to integrate CLIVAR-relevant activities in observations, paleoclimatic studies, prediction and synthesis in the Mediterranean region over the next 5 years.

- In collaboration with the Tropical Buoy Implementation Panel (TIP), initial deployments contributing towards a basin-scale array of fixed moorings spanning the Indian Ocean in response to the IOP's plan for a sustained Indian Ocean observing network. It has recently been reported that China (SOA) will join Japan (JAMSTEC), India (NIO) and the US (NOAA) in maintaining elements of the array. The TIP continues to provide coordination of national contributions to the TAO and PIRATA buoy arrays.

- Funding support in several countries for the Tropical Atlantic Climate Experiment (TACE), developed through CLIVAR's Atlantic Panel. TACE will advance understanding of coupled ocean-atmosphere processes, seek to improve SST based climate prediction for the eastern tropical Atlantic region and provide coordinated observational, modelling and synthesis studies of the region in the 2006-2011 timeframe. A key component of TACE is extension of the observational network in the region, including the PIRATA array.

- An activity that has greatly benefited the coordination provided by the Pacific Panel is the emerging South Pacific Circulation and Climate Experiment (SPICE) programme. CLIVAR has provided an umbrella for scientists from 5 countries to share ideas and expertise, resulting in a comprehensive Science Document and a preliminary Implementation Plan.

4. Impact *(impacts that CLIVAR has had recently on international or national policies or decision making as a result of its activity)*

Many CLIVAR scientists and a number of its activities (see above) feed into international and national policies through the inputs the programme makes to the IPCC process. A related recent activity with potential feed into policy was the organization by WGCM, in coordination with SPARC, IGBP AIMES and IGAC and the IPCC Task Group on Emission Scenarios, of a summer session at the Aspen Global Change Institute (AGCI) in August, 2006, to discuss the near term prospects for what will be included in the next generation global coupled climate models for ACC, and what the future emission scenario requirements would be for a future IPCC assessment. Emerging emphases for any future IPCC assessment included "decadal prediction", thus demanding better initial conditions (major need for ocean analyses); "prediction across scales" (MJO, links to THORPEX, NWP methods and community, etc.); better representation of land surface change and processes (links to GEWEX; IGBP); chemistry (IGBP, megacities, etc.); much in response to societal needs (how to adapt to climate change over next 20 years). Many of these match to JSC cross cutting topics.

CLIVAR scientists also make specific inputs to national policy advice as needed. For example VACS research priorities have been placed on UK NERC strategy 2007-2012. More explicitly in Africa, AMMA seeks to ensure that the multidisciplinary research is effectively integrated with prediction and decision-making activity. Recently an African Centre for Earth Stewardship Science proposal focussed on southern Africa benefited from a VACS science steer whilst ongoing work with UK DFID on climate risk management includes a VACS related bid for major research programme. VACS has also led an application to the Royal Society for networking of Southern African climate science.

In the past, in the context of the La Plata Basin (LPB) Project as a Continental Scale Experiment with joint involvement of GEWEX & CLIVAR, leverage of CLIVAR research in S America through VAMOS was a key component in the successful bid in 2003 to the Global Environmental Facility (GEF) for funds for LPB planning and for implementation of strategic actions to be taken by governments in countries in LPB for the environmentally and socially sustainable economic development of the region.

More widely, CLIVAR has stimulated national and international funding for a wide variety of activities as outlined in “Value added” above, emphasizing the impact of CLIVAR on national and international programmes.

5. Responsiveness *(new developments in national or international research agendas either contributed to or influenced by the CLIVAR research agenda)*

An extensive Initial Implementation Plan was developed for CLIVAR and published in 1998 and this provides a guide for the programme overall. However specific development of activities within the programme is carried out interactively by the scientists involved in CLIVAR’s Panels and Working Groups under the overall guidance of the CLIVAR SSG. This process offers the opportunity for national or international research interests to be brought to the table by individual scientists and aired in an international context. (examples include IPY, developments in ocean observing systems and of ocean and atmosphere process studies, model intercomparison and other studies, needs for climate information etc). CLIVAR has also sponsored/organized a variety of research workshops providing a forum within which national research efforts can influence CLIVAR’s research agenda. CLIVAR’s influence on national research agendas and funding is exemplified in the responses to “Values added” and “Impact” above.

CLIVAR is also seeking to respond to the needs of IGBP GLOBEC for climate information and to respond to a set of questions and issues relating to the role of climate variability and change on marine ecosystems posed through CLIVAR’s Atlantic Panel. In response to these, CLIVAR hosted a session at the SCOR Summit of International Marine Projects (Royal Society, London, December 2006) to plan a joint CLIVAR/IMBER/GLOBEC conference provisionally entitled "Climate driving of ecosystem changes - making the connections". Through Jim Hurrell’s membership of the GLOBEC SSG, CLIVAR is seeking to more widely engage GLOBEC in planning that will link their marine ecosystem modeling with global change modeling. Links to IMBER are also strengthened by membership of the IMBER SSG by Wilco Hazelegler (Atalntic Panel Chair).

6. New Directions

Anticipated developments include:

- Future contributions to any future IPCC assessment and to WCRP activities in this area (see JSC paper on ACC) including further ETCCDI-led capacity building workshops.

- Continued focus on seasonal prediction, including implementation and management through WGSIP of the TFSP Seasonal Prediction Experiments and links to applications (see JSC paper on Seasonal Prediction).

- Development of decadal timescale prediction and exploration of its use in planning and implementing measures for adaptation to climate change (see JSC paper on Decadal Prediction.

- Contribution to the new WCRP-led initiative on Climate Extremes on defining and assessing extremes in modeling and observational studies and on the predictability of extremes, including assessing whether extremes are changing in a changing climate (see JSC paper on Extremes).

- Continued development (with GEWEX, WGNE, THORPEX and others) of global and regional aspects of monsoon prediction and of our understanding of the role of monsoons in the global climate system (see JSC paper on "Monsoons and YOTC").

- Continued emphasis by GSOP of data synthesis activities, including further development of ocean reanalysis leading to coupled reanalyses of the total ocean-ice-atmosphere-land system.

- Through CLIVAR's ocean basin panels and GSOP, continued development of the sustained climate observing system including use of new technology and integration of in-situ and remotely-sensed data; in collaboration with OOPC assessment, through a workshop/conference, of the current status of the global ocean observing system. Encouragement of key field programmes to enhance understanding of ocean processes and their representation in models.

- Transition of CLIVAR science from research to operations, in particular developments in seasonal to interannual prediction and applications of CLIVAR science for societal benefit including capacity-building efforts.

- Greater integration of physical and biogeochemical aspects of climate research (with IGBP, in particular through IMBER and GLOBEC)

- Assembly of the overall "CLIVAR legacy".

7. Challenges

Key issues include:

- The reduction in the sustained in situ observing system (especially for the atmosphere and the African continent).
- The still relatively sparse ocean observing system (Argo has done a lot to help).
- The lack of clear pathways for the transition from research to operational (and sustained) mode for much of the ocean observing system.
- The need for greater access to high speed computing facilities for climate research.
- The need for greater efforts in data analysis integration and synthesis activities (involving both in situ and remotely-sensed data).

WORLD CLIMATE RESEARCH PROGRAMME

JSC-XXVIII/Doc. 4.3
(14.II.2007)

JOINT SCIENTIFIC COMMITTEE

Item 4

TWENTY-EIGHTH SESSION

ZANZIBAR, TANZANIA, 26-30 MARCH 2007

STRATOSPHERIC PROCESSES AND THEIR ROLE IN CLIMATE (SPARC)
(Submitted by the Co-chairs of the SPARC Scientific Steering Group)

SCIENCE

SPARC Project objectives and approach

Since its inception in 1992, SPARC has addressed key issues related to the stratosphere and its role in climate, both from scientific and policy information perspectives. Further, as the science and science-policy needs have evolved, SPARC has refocused its activities to provide the most useful research and information. The current SPARC programme focuses on three key themes of modern climate science:

1) Climate-Chemistry Interactions

- How do stratospheric ozone and other constituents evolve as climate changes?
- How do changes in stratospheric composition affect climate?
- What are the links between changes in stratospheric ozone, UV radiation and tropospheric chemistry?

2) Detection, Attribution, and Prediction of Stratospheric Change

- What are the past changes and variations in the stratosphere?
- How well can we explain past changes in terms of natural and anthropogenic effects?
- How do we expect the stratosphere to evolve in the future, and what confidence do we have in those predictions?

3) Stratosphere-Troposphere Dynamical Coupling

- What is the role of dynamical and radiative coupling with the stratosphere in extended-range tropospheric weather forecasting and in determining long-term trends in tropospheric climate?
- By what mechanisms do the stratosphere and troposphere act as a coupled system?

These main themes are complemented by a number of cross-cutting activities with specific foci. Current prominent SPARC activities include the Chemistry-Climate Model Validation project (CCMVal), work by the Data Assimilation Working Group (SPARC-

DAWG), the activity on Solar Influence (SOLARIS), and the recently initiated Dynamical Variability activity.

VALUE ADDED

SPARC Publications.

(a) SPARC Newsletters. The widely read and cited SPARC Newsletters, published twice-yearly, feature brief thought-provoking scientific contributions, topical mini-reviews and rapporteur summaries of science meetings. Newsletter No. 28 was published and distributed in January, 2007 and is now available on-line from the SPARC web site (http://www.atmosp.physics.utoronto.ca/SPARC/).

(b) SPARC Assessment Reports. SPARC also issues comprehensive scientific reports on key aspects of the stratosphere and its role in the climate system. These address essential scientific gaps in the knowledge of the stratosphere and its representation in models. Without the corporate work of SPARC their completion would be impossible. SPARC Assessment Reports are peer-reviewed and are fully acknowledged by and have served as bases for the international WMO/UNEP Reports. The Assessment of Stratospheric Aerosol Properties (ASAP) Report was published in February, 2006 and distributed shortly thereafter. This report is also available on-line from the SPARC web site. An assessment report on Polar Stratospheric Clouds (PSCs) is in preparation and one on Chemistry-Climate Modelling is in the planning stages. Previous assessment reports are all available on-line from the SPARC web site.

SPARC Co-Sponsored Workshops. Several well attended workshops were sponsored or co-sponsored by WCRP/SPARC in 2006. Within the reporting period these include (i) the joint SPARC/GEWEX/IGAC workshop on Modelling of Deep Convection and of Chemistry and their Roles in the Tropical Tropopause Layer (TTL) (Victoria, Canada), (ii) the Third International LIMB workshop (Montreal, Canada), (iii) the SPARC Data Assimilation Workshop (Noordwijk, Netherlands), (iv) the First SOLARIS workshop (Boulder, USA), and (v,vi) the Atmospheric Chemistry and Climate (AC&C) Workshops (Boulder, USA, and Geneva, Switzerland). Other meetings facilitated ongoing work on the updating of temperature trends, preparation of the forthcoming SPARC Assessment Report on polar stratospheric clouds (SPA), and planning for IPY activities. The TTL and AC&C workshops are associated with cross-cutting activities with other WCRP projects and ESSP partners and are discussed further in that context below.

Atmospheric Chemistry and Climate (AC&C) Initiative. The AC&C Initiative has been approved as a major joint effort of WCRP and IGBP, with the SPARC and IGAC projects leading its implementation. A plan and time line for this activity was set out at the twenty-seventh session of the JSC in Pune in 2006. The first phase of this activity involves a modelling effort, which will utilize and build upon the SPARC CCMVal activity, so as to move toward a broader based activity that will utilize modelling and observational activities in a synergistic way to define gaps in understanding, quantifying, and modelling chemistry-climate interactions. The AC&C initiative is progressing well, with the next CCMVal workshop coming up in Leeds (UK) in June 2007. AC&C is discussed in greater detail in the companion report on this activity for the current session of the JSC.

Joint SPARC-GEWEX-IGAC activity. The role of deep convection in the Upper Troposphere/Lower Stratosphere (UT/LS) was initiated with a workshop on Modelling of

Deep Convection and of Chemistry and its role in the Tropical Tropopause Layer (TTL) held in Victoria, BC, Canada in June 2006. This workshop was very successful in bringing together researchers from the three scientific communities with a common interest in the role of deep convection in the upper troposphere-lower stratosphere (UT/LS) region (see the report in SPARC newsletter # 28). The workshop generated considerable enthusiasm and a number of suggestions for future collaborative activities emerged from the meeting. A small working group has been assembled to develop a framework for further collaborative research and plan future activities to facilitate it.

Adding value to the IPY science program. SPARC initiated the IPY activity entitled "The Structure and Evolution of the Polar Stratosphere and Mesosphere and Links to the Troposphere during IPY". The central goal of the SPARC-IPY activity is to produce a comprehensive picture of the dynamics, chemistry and microphysical processes within the polar vortices during the IPY, supported by a well organized data set of measurements and analyses of the polar stratosphere. The activity is being coordinated through the SPARC IPO and carried out with the oversight of the SPARC Scientific Steering Group (SSG). National funding for several of the specific sub-projects within this activity has been awarded and coordination work on the data acquisition and assimilation components has begun within the SPARC-DAWG. SPARC-IPY adds value to and has common interests with a number of other IPY activities including POLARCAT, ORACLE-O3, PANSY, and IASOA. A small initial planning workshop was held jointly with the IASOA group in Toronto in June 2006 and a larger SPARC-IPY workshop is currently being planned to be held in conjunction with the next SPARC-DAWG workshop (September 2007). (http://www.ipy.org/development/eoi/proposal-details.php?id=217).

IMPACT

SPARC plays a vital role in advancing research on the middle atmosphere and upper troposphere. This is reflected by the 143 references to SPARC Newsletters and 45 references to SPARC Assessment Reports cited in the Web of Science (as of 10 February 2007), revealing the high reputation of these products in the peer-reviewed journal literature. The IPCC TAR cites SPARC Assessment Reports 18 times, the 2002 WMO/UNEP Scientific Assessment of Ozone Depletion 22 times.

SPARC had significant impact on the development of the 2006 WMO/UNEP Scientific Assessment of Ozone Depletion. Scientists within the SPARC community served as members of the Assessment Steering Committee, lead and contributing authors, and reviewers ("This report builds upon the previous assessments, research over the last 4 years, reports from SPARC committees, and observations from various field campaigns and new satellite instrumentation", Chpt. 4). The CCMVal project organized the key element of the assessment process, the Chemistry Climate Model simulations. These simulations were of critical importance in assessing the evolution of ozone, temperature, and trace species in the stratosphere in the recent past as well as in making projections of ozone recovery in the twenty first century. (More information and a list of recent publications is available from the CCMVal web site:
http://www.pa.op.dlr.de/CCMVal/List_CCMValCollaborators.html.)

RESPONSIVENESS

The role of SPARC in the national context

SPARC relies on nationally funded research activities to produce the science outcomes of its programme. SPARC delivers its programme by engendering cohesion and collaboration between these nationally funded research programmes. The synergy which SPARC is able to achieve in this critical role stimulates and provides international context for national programmes on the role of the stratosphere in the climate system. This important stimulus of SPARC is evident in a number of current national programmes. In the UK, the stratospheric research programme of the Natural Environment Research Council has been given a clear international stimulus by SPARC in the areas of atmospheric dynamics, transport, stratospheric chemistry, solar impacts, and coupled chemistry-climate modelling. It is not coincidental that the scientific agenda in these areas matches perfectly with the priorities set by SPARC some years ago. Similar correspondences between national programmes and SPARC themes and activities can be found in research programmes in France, the USA and Japan. A recent example is the Canadian SPARC network which has been funded for an initial 4-year period at a level of approximately C$ 1M/year, includes international collaborators, and has the SPARC themes and major activities as its main elements.

Responding to the needs of International Assessments

The major contributions of SPARC to the WMU/UNEP Ozone Assessment Process are currently the most visible examples of the SPARC's responsiveness to the needs of international assessments. There have been other less visible instances where SPARC has been able to provide requested assistance in a timely manner. A recent example is the study of the global warming potential of a substitute for an ozone depleting substance. This was initiated as a fast track activity in response to an IPCC request.

NEW DIRECTIONS

Three of the key issues that continue to be of central importance in regard to the role of the stratosphere in the climate system are (a) stratospheric ozone depletion and recovery and its relationship to climate change, (b) the effect of the stratosphere on tropospheric variability and change, and (c) the effect of solar variability on climate and climate change. A central objective of the SPARC programme is to achieve, in a timely manner, the level of understanding of these issues that is needed to enable quantitative predictions for the climate system as a whole, on a wide range of time scales. These issues are multifaceted and of necessity require an understanding of the wide range of phenomena that are addressed in the current SPARC programme. Some of the new and emerging initiatives that are expected to be central to the SPARC programme in the next one to three years have been alluded to above. These include the following:

(1) Ozone recovery and its relationship to climate change. SPARC will continue to play a key role in the WMO/UNEP Ozone Assessment process, and CCMVal is already engaged in planning to ensure an even stronger contribution to the expected 2010 Ozone Assessment. It is now clear that ozone recovery and climate change are so closely linked that future efforts to improve predictions of long term variability and change, for both stratosphere and troposphere, will require taking the role of stratospheric ozone fully into account. It is anticipated that SPARC will, in collaboration with the Working Group on Coupled Modelling (WGCM), become involved in planning and executing modelling activities for future climate change assessments (AR5 and beyond).

(2) Chemistry-climate interactions and their role in climate change. Whilst understanding and modelling stratospheric chemistry and its role in climate has always been a central component of SPARC, the need to go beyond this perspective to deal with the role of chemistry-climate interactions throughout the whole atmosphere will receive increased attention within SPARC in the future. This is not only consistent with the leading role of SPARC within AC&C but also a natural evolution from the knowledge and experience that has developed within SPARC over the past decade. In fact this accumulated SPARC experience, and its ongoing development, remains a major motivation for the leadership role of SPARC within AC&C. Examples of processes that involve both stratosphere-troposphere coupling and chemistry-climate interaction are the effects of downward transport from the stratosphere of chemically and radiatively active species such as ozone and possible impacts on surface climate, the level and importance of stratospheric ozone radiative forcing, and the importance of the stratosphere in reconciling observed temperature trends in the troposphere.

(3) Stratosphere-troposphere dynamical coupling and its role in dynamical variability and predictability from days to decades. Several lines of evidence suggest that the stratospheric state exerts a significant influence on the tropospheric circulation. As global climate models, which typically represent the stratosphere poorly, become increasingly comprehensive, important questions arise: How does a poor representation of the stratosphere degrade the simulation of tropospheric circulation in climate models? Furthermore, how does stratospheric representation affect the simulated circulation response to climate change? To address these questions SPARC has initiated a project on Dynamical Variability, which will set up a model intercomparison to explore the dynamical coupling between the stratosphere and the troposphere. The project aims to compare in detail the climatology and variability of standard "low-top" climate models and stratosphere-resolving "high-top" climate models. Among the plans is a comparison of simulations performed according to the specifications of the CLIVAR Climate of the 20th Century (C20C) project with high-top and low-top models.

(4) The role of large-scale transport, convection, and chemistry on water vapour and chemical composition in the UT/LS region. The UT/LS is of continued interest for the SPARC community because of its importance for processes associated with stratosphere-troposphere interaction, where dynamics, radiation (including cloud feedbacks) and microphysics couple. Among the many processes operating within the Tropical Tropopause Layer (TTL) are those that control the amount of water vapour and trace gases entering the stratosphere, important in determining greenhouse gas forcing, stratospheric chemistry and temperatures, PSCs, and enhanced radiative cooling. In addition, convection in the tropics plays a key role in redistributing trace gases and aerosols in UT/LS region. Conversely, at middle and high latitudes the intrusion of stratospheric ozone into the troposphere and its effect on the not understood tropospheric background ozone concentrations is of ongoing interest. The global scale models used to study climate typically employ physical and numerical formulations and associated spatial and temporal resolutions that limit their ability to represent key details and components of these processes, yet a solid understanding of their effects is necessary for climate prediction. Cloud Resolving Models (CRMs) can bridge this gap using high-resolution observations and modelling to discriminate between different mechanisms. Among the issues of current concern is understanding the processes that determine the tropical cold point temperature, and understanding of key ice cloud microphysical and chemical processes such as those controlling supersaturation.

(5) The Fourth SPARC General Assembly (GA). The SPARC GAs are held on a four-year basis. They have become major international science conferences and played a key role in assessing the state and development of SPARC science as well as in pointing to fruitful new directions for the SPARC programme. The Third SPARC GA, held in Victoria, Canada in 2004, attracted 340 registered participants and a total of 378 papers were presented. The Fourth GA will be held in Bologna, Italy, on 1-5 September 2008. Dr. Elisa Manzini has agreed to serve as chair of the Local Organizing Committee, and Drs. Peter Haynes and Thomas Peter will be co-chairs of the Scientific Organizing Committee.

(6) The SPARC International Project Office. We are pleased to be able to report that additional funding has now been secured, which will support the operation of the SPARC IPO in Toronto, Canada, through 2010.

CHALLENGES

The future of AC&C

The WCRP/IGBP activity on Atmospheric Chemistry and Climate is fully coordinated with the SPARC themes and activities on atmospheric chemistry and climate. This close linkage with the SPARC programme is fundamental to the planned development of AC&C as noted above and was envisaged when AC&C was initially conceived as a joint WCRP/IGBP activity, with SPARC and IGAC taking the lead roles, to address critical gaps in knowledge concerning chemistry and climate. The joint leadership of AC&C by SPARC and IGAC utilizes the programmatic elements, expertise and experience that have been established through previous and ongoing collaborations between SPARC and IGAC over a period of years. However, because of its overarching nature, separate project status for AC&C may be warranted in the future. If AC&C is to be a separate activity, there will be broader implications for the evolution of WCRP/IGBP interactions, the role of SPARC in them, and the future of the SPARC programme. The SPARC SSG requests that the JSC consider the following issues and questions:

1. Given the current stage of development of AC&C and in light of the possible future evolution of the WCRP what is the view of the JSC as to the nature, extent and duration of the role of SPARC in AC&C?

2. Given the scientific challenge, importance and scope of AC&C, does the JSC believe that AC&C should eventually became a fully fledged project in its own right, run jointly by WCRP and IGBP?

3. If so, what is the appropriate time scale for this development and how should the other key elements of SPARC's work be carried forward in the event of such a development? Would these decisions be developed jointly with IGAC and IGBP?

4. Is the putative AC&C joint project viewed as the first manifestation of a longer term intent to merge WCRP and IGBP into a single international programme that embraces the physical climate, chemical and biological systems?

WORLD CLIMATE RESEARCH PROGRAMME

JSC-XXVIII/Doc. 4.4
(15.II.2007)

JOINT SCIENTIFIC COMMITTEE

Item 4

TWENTY-EIGHTH SESSION

ZANZIBAR, TANZANIA, 26-30 MARCH 2007

THE WCRP CLIMATE AND CRYOSPHERE (CliC) PROJECT

(Submitted by CliC SSG Chair)

"Warming of the climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice, and rising global mean sea level." (Summary for Policymakers, 4th Assessment report, IPCC WG I, February 2007)

The cryosphere has received marked attention in the Policymakers' Summary of WG I report of the recent IPCC Fourth Assessment. CliC, WCRP's core project on Climate and Cryosphere, has not only contributed to, but is well positioned to follow-on from, the results presented in this assessment. **CliC,** a global scale project, **evolved** from the regional project ACSYS (Arctic Climate System Study), which sunset at the end of 2003. **This was a JSC decision** based on the recommendations on future priorities and challenges for research activities made by the delegates of the Conference on the WCRP Programme: Achievements, Benefits and Challenges (WMO TC #904, 1998). They specifically identified the need to investigate the role in climate of the global cryosphere. This foresight was done when snow and ice was by no means an almost daily item in the global media or of immediate concern in decision making, as it is today. Following this direction, expert teams prepared a Science and Co-ordination Plan for CliC and an Implementation Strategy, both of which have set the basis for scientific initiatives contributing to this core project and for the development of a global community of scientists focussed on the cryosphere in the climate system.

The **goal of CliC** is *"To assess and quantify the impacts that climatic variability and change have on components of the cryosphere and the consequences of these impacts for the climate system"***.** In addressing this aim, CliC also seeks to determine the stability of the global cryosphere. At its recent SSG meeting, **CliC** focussed its activities through the following **themes**:

- Terrestrial cryosphere and hydro-climatology of cold regions
- Ice Masses and Sea Level
- Marine Cryosphere and Climate
- Global Prediction of the Cryosphere

This report summarizes the highlights the activities of CliC in the context of key scientific results, value added through its co-ordination and partnering, CliC's impact on national and international research agendas and in turn its ability to respond to national/regional research needs, and finally future priorities and challenges. Currently, many CliC initiatives are related to the International Polar Year (March 2007-2009) and these are discussed in Doc. 2.6 on IPY.

1. Key Scientific Advancements 2006:

CliC has directly contributed to several important scientific advances through recent initiatives that could only best be accomplished by the international co-ordination that CliC now provides.

- For the first time, there was a chapter in **IPCC AR4** WG 1 on the cryosphere (Observations: Changes in Snow, Ice and Frozen ground), in which scientists involved in CliC contributed scientific results as authors and/or reviewers. Conclusions from the AR4 report highlighted past, present and future changes in the cryosphere, including Arctic sea ice declines, melting ice sheets and glaciers and rising sea level, decreasing spring snow cover, decreasing area of frozen ground and the shortening of the ice cover season for lakes and rivers. CliC is using the output from the 23 AR4 models and has highlighted the difficulty the models had in reproducing observed variability of the cryosphere over the last two decades.
- Questions of **sea level** rise are of vast importance to the countries of the world and their people. The scientific issues involved are cross-disciplinary and complex. The current and future contribution of melt water from the world's glaciers, ice caps and ice sheets to sea level rise has a wide range of uncertainty. To bring these widely ranging disciplines together, CliC was an active partner in developing the WCRP sponsored Sea Level Workshop 'Understanding Sea Level Rise and Variability' held in June 2006. The workshop reviewed current knowledge, determined uncertainties in knowledge of the contributing factors, and generated recommendations to reduce uncertainties. The outcomes of this initiative with all the white papers will be published in a book in 2007, including an executive summary on sea level rise as recommendations for policy makers.
- **Ice sheets**, their observation and modelling, are important CliC topics. CliC sponsors the Ice Sheet Model Intercomparison project (ISMIP) which has led to the development and discussion of ice sheet models and the development of protocols for intercomparison of ice sheets models. Recently, they have started to investigate higher order models, including the ability to model ice age cycles, which are very important politically.
- **Sea ice thickness** is a fundamental parameter to climate studies, yet there are presently no systematic observations. The Antarctic Sea Ice and Climate panel (ASPeCt), co-sponsored by CliC and SCAR, has produced the first ever climatology of sea ice thickness for the Antarctic sea ice zone. This unique database was created by merging the results of many field experiments, satellite data, and analyses by the National Ice Center (NIC).

2. CliC Co-ordination adds Value:

CliC has established a **cryosphere 'specialist' list** to enhance our co-ordination capability and to identify and engage experts for CliC activities. This has increased the involvement of scientists in cryospheric initiatives and has provided contacts for improved coordination in the future. For example, CliC was quickly able to identify several candidates from the Himalayan region to assist Grid-Arendal in their GEO4 snow and ice assessment. Some examples where CliC's involvement enhanced the outcomes of climate-cryosphere initiatives and contributed to improved knowledge of the cryosphere in the global climate system follow.

- CliC was on the Scientific Steering Committee of the **2nd International Conference on Arctic Research Planning** (November 2005). CliC organized the development of two science plans on *Terrestrial Cryospheric and Hydrologic Processes and Systems,* and on *Modelling and Predicting Arctic Weather and Climate*, as well as a special session on global observations and the impact on Arctic programs. CliC is now part of the group for follow-on research planning and implementation and leads implementation of the activities on *Terrestrial cryospheric and hydrologic systems* and co-ordination of Arctic weather and climate modelling activities with other Arctic organizations. Following the conference, the European Polar Board decided to initiate a trans-national programme in polar science. It was also acknowledged that co-ordination by funding agencies to support diverse Arctic science programs was essential. The complete conference publication is available for use by scientists to guide future research proposals, by national and international organizations for research planning, and by policy makers. A further outcome is that CliC is a co-sponsor with IASC, AMAP and NSF of a co-ordinated plan to develop a *Sustained Arctic Observing Network,* engaging research and operational entities. This will be a legacy of IPY.

- CliC produced and distributed a **DVD** with the proceedings of the **First CliC Science Conference** "*Cryosphere, the "Frozen" Frontier of Climate Science: Theory, Observations, and Practical Applications*" held in April 2005 in China. The DVD contains the book of abstracts and the 137 presentations given by 245 participants from 22 countries.
- The **Symposium on Cryospheric Indicators of Global Climate Change,** the largest ever IGS meeting held (, Cambridge, UK, August 2006) was co-sponsored by WCRP/CliC, the International Glaciological Society (IGS) and the IUGG Commission on Cryospheric Sciences (ICCS). CliC initiated this symposium, and associated collaboration, as one of its first activities. Over 250 papers were presented and a selection will be published in peer reviewed "Annals of Glaciology". The results of **young scientists** were highlighted.
- **Reanalysis** is of interest throughout the climate community. CliC co-sponsored (with SCAR, ICPM) a Workshop on High Latitude Re-analyses (Cambridge, UK, April 2006). It assessed outputs from re-analyses for the high latitudes, identified issues in polar regions and made suggestions for future re-analyses. It was noted that re-analyses are not set up for data sparse areas, a characteristic of high latitude regions. ECMWF identified the need for better lake ice and snow cover data for future re-analysis exercises. A future workshop is planned to discuss and implement some of these suggestions.

Other workshops/meetings in 2006 where CliC played a pivotal co-ordinating role included: 1st Asia CliC Symposium 'The state and fate of Asian Cryosphere' (April); the International Workshop on Antarctic Sea-Ice Thickness (July), the Asian Conference on Permafrost (August); the IGS Nordic Branch Meeting (October), ICARPII Follow-on Planning Workshop (November).

3. Impact of CliC's Activities:

Impacts of one's activities are not always immediate. The full impact may be realized several months or even years later. Some key impacts follow.

- CliC has significantly raised the visibility of cryosphere and climate as a discipline, such that the **IPCC Working Group 1** had a specific chapter on cryosphere - the first time ever.
- The Asian region responded to CliC, its science and coordination plan and implementation plan, by establishing an **'Asia-CliC' Regional Group**. An Asian CliC meeting held in Japan (April 2006) engaged researchers from over a dozen countries to define collaborative initiatives in Asia that address regional priorities and contribute to CliC goals and objectives. This has attracted support from the funding agencies, and a CliC support office is being established in Japan. This fostered cooperation between countries and agencies on common issues that has not occurred previously in the field of cryosphere/climate science.
- The satellite **Cryosat** was designed to help answer many fundamental questions about climate and cryosphere, notably to help estimate sea ice thickness and ice sheet mass balance. Cryosat was lost during launch in 2005, but within several months, approval and funding were obtained for Cryosat 2. This is a credit to the organized response of the cryosphere community, which was in part coordinated by CliC, WCRP and the IGOS Theme on cryosphere. CliC continues its effort to get a follow-on mission of ICESat.
- As a consequence of the WCRP **Sea Level Workshop**, the US science advisor to the president called for a briefing of abrupt climate change; the US congress committee had a hearing on the International Polar Year and another hearing on climate change.
- CliC is involved in several initiatives for **IPY**, which will be a major focus for CliC and many other international research groups. WCRP/CliC and members of the CliC SSG were a lead in developing the IPY Scientific Framework, in particular the initial data policy and data management process. CliC members are on IPY Joint Committee.
- One of the near term goals of CliC is to help ensure that IPY is not just a 'blip', but there is a legacy of infrastructure, observational systems and data management which remains after IPY. One of the initiatives to help insure this legacy is the ***Integrated Global Observing Strategy Theme on Cryosphere (IGOS-Cryo)***. The principal objectives of IGOS are to address how well user requirements are being met by the existing mix of observations,

including those of the global observing systems, and how they could be met in the future through better integration and optimization of remote sensing (especially space-based) and in-situ systems. This CliC-led initiative was developed by engaging scientists and agencies in North America, Asia and Europe through CliC sponsored workshops. This is the first document to treat observations of the cryosphere in a comprehensive manner to be used by decision makers for prioritizing needs and for use by scientists for developing research proposals. This document will be used by space agencies (CEOS), international programs such as GCOS and GEOSS in defining capabilities and needs and defining new space missions.

- Within this observing system, the IPY proposal iAOOS (Integrated Arctic Ocean Observing System), led by Norway and prepared in cooperation with the Arctic Ocean Sciences Board, is expected to play a large role in the Arctic portion of the observing system. GIIPSY, a CliC-led IPY project, in conjunction with IGOS-cryo are coordinating data acquisition requests for several space agencies. A recent success is the offer by the Canadian Space Agency to process a large amount of data from their archives.
- CliC, working through national delegates at the recent CIMO meeting, succeeded in initiating, in co-operation with other commissions, a study on automation of precipitation measurements in cold climate regions.

4. Responsiveness:

CliC has been able to respond to new research needs at the national and international level. Needless to say the development of **IPY** strongly influenced CliC in preparing its near-term research agenda to be responsive to the IPY and to CliC goals and objectives.

- IPY influenced activities and coordination between the research groups and CliC, for example in Australia, Canada, China, Japan, and USA. CliC initiated several of the IPY endorsed proposals, bringing cross-cutting topics to IPY which is still very discipline centred. These international proposals then provided the context for national research proposals; e.g. Variability and Change in the Canadian Cryosphere is specifically designed to contribute to CliC's *State and Fate of the Cryosphere*. Collectively, through CliC, the national efforts are brought together for a circumpolar and/or global perspective.
- There is a renewed focus on **Polar Regions**, and especially the circumpolar Arctic. The Arctic Climate Impact Assessment, ICARPII and IPY combined with today's rapidly changing climate conditions which are impacting society, economy, and the physical environment are influencing policy decisions in high latitudes. CliC has responded through its partnering with other Arctic organizations to take a leading role in defining and implementing research activities on climate and cryosphere, including cold climate hydrology, and regional modelling.
- IPY and ICARPII also have strengthened the use of traditional knowledge for arctic research in Canada, the Nordic countries and the US (Alaska). This is reflected in the research planning for ICARPII and IPY and the associated funding in several of these countries. CliC included the use and assessment of the value of traditional knowledge for climate studies as part of its IPY activities.

5. New Directions:

The role of the cryosphere in the climate system, and in Earth System Science, will remain a high priority topic of research over the next decade. At the recent ESSP conference every ESSP partner identified components of the cryosphere which were important to their investigations. Yet the **only cryospheric focus in ESSP is through WCRP/CliC**. IPY and the renewed focus on cold climates and high latitudes and the associated impacts of a changing climate provide a framework to address priorities within the dimate-cryosphere system. It is expected that regional climate modelling, seasonal forecasting, sustained observing systems as well as the ongoing issue of prediction and predictability, will shape our priorities.

- Predictions of **sea level rise** will require improvements in ice sheet, glacier and ice shelf **models**. For example, the ice mass wasting of the Greenland ice sheet will have significant effects on sea level rise in the coming years if the ice sheet continues to lose mass as in previous years. We need to understand the mechanism that leads to the large ice wasting. Surface melt cannot explain the recent loss of 175 km^3 per year for southern Greenland. Similarly, the response of Antarctica to a changing climate is not well understood and could have significant impact on sea level.
- **High latitude observation and modelling,** often over remote sparse regions, will have added emphasis, as part of IPY and its legacy. The **reanalysis** is a comprehensive means of obtaining consistent, global data sets to answer questions about climatic change, extreme events and sea level rise. The polar regions however have unique issues which are often overlooked in a re-analysis, as noted above. The southern Hemisphere sea ice is particularly poorly represented in global models. An initiative led by CliC is being organized to compare and improve the sea ice models in the Southern Ocean, and to investigate the representation if ice shelves and glacier melt in these models. The CliC-sponsored Ice Thickness workshop has identified these issues and suggested ways these can be addressed in any future reanalysis. Associated priorities include improved parameterization of cold climate processes in climate and forecast models, determination of high latitude precipitation, and verification of model outputs on a regional and global scale.
- **Permafrost** and its response to a changing climate and the potential release of methane and the influence on the **global carbon cycle** will be a key issue. Modelling of the global carbon cycle is expected to be a future focus. CliC is co-organizing a workshop on carbon fluxes in the Arctic with Arctic Monitoring and Assessment Program of the Arctic Council.
- Snow and glaciers impact **water supply** for irrigation, consumptive use and hydropower production, floods, and tourism. The changing cryosphere (especially snow and glaciers) in alpine regions of the globe need to be quantified. Particularly **in developing countries**, large numbers of people rely on these water supplies. Asia-CliC now provides expertise for the Himalaya region and is developing a regional group in Latin America, which will engage more scientists working/living in these regions to improve management of these resources.
- **Decreasing Arctic Sea ice** has been widely reported. Understanding the implications of this for climate and ecosystems is receiving increasing attention. There is also increasing interest in forecasting Arctic sea ice conditions, for operational use.

6. Challenges:

Climate is not just of scientific interest, it is now a very political issue that can be affected by governments and organizations changing priorities. Research is longer term in nature and is put under added stress when priorities are constantly changing to “respond to the issues of the day”. With changes in priorities by national and international bodies comes change in available funding. But an adequate base level of funding is essential for CliC to deliver its program and to be able to leverage other resources. Research funds are accessed nationally and regionally, but funding for co-ordination (the glue) is essential for CliC, and hence WCRP, to be recognized as a credible research partner.

No matter the number of times it is written that long term **monitoring and observation** is essential to support research, operations and decision making, research and operational observing networks are under constant pressure. This is especially true for the cryosphere. Such declines hinder long term monitoring needed to quantify climate changes needed for decision making and policy setting and sustained model development.

IPY has brought to the forefront again that free and open access to data is crucial. Some funding agencies encourage or require it, but do not adequately fund data activities. Others do not even have a data access policy which often defaults to no access. Reconciling this issue between different agencies and developing a universal approach is important to provide the best global and comprehensive data sets for climate change research. The polar regions are one of the most data sparse, and it is particularly important to use all the available data.

Access to polar regions and the oceans that surround them is essential for our program's scientific progress, and especially for IPY. In particular, access for scientific purposes to territorial waters can be difficult and expensive; any steps to remove this barrier would make a large difference in the science outcomes. CliC supports the IPY in addressing this issue.

Finally, scientific human capacity will be a challenge for CliC. Cryosphere and climate is a small community, yet the expectations, needs, opportunities are large. The training of observationalists, field scientists, modellers with cryospheric understanding and expertise will be an ongoing challenge.

WORLD CLIMATE RESEARCH PROGRAMME

JSC-XXVIII/Doc. 5.1
(13.II.2007)

JOINT SCIENTIFIC COMMITTEE

Item 5

TWENTY-EIGHTH SESSION

ZANZIBAR, TANZANIA, 26-30 MARCH 2007

Report to JSC XXVIII, March 2007.

WCRP Observations and Assimilation Panel (WOAP)

(submitted by the Chair of WOAP)

1. INTRODUCTORY REMARKS:

This is the second report of the **WCRP Observations and Assimilation Panel (WOAP)** set up by JSC XXV (March 2004) as part of the WCRP strategic framework. Its first meeting was held at GISS, New York in June 2005. This initiated the activities of the panel and lead to a first report to JSC XXVII in March 2006. The terms of reference of the panel had been finalized, along with a clarification of the domains covered, what was and was not within WOAP purview, how matters were to be handled, and on what timetable. The main issues dealt during the first year were the definition of the interface between GCOS and WOAP, the clarification of WCRP's input to GEO and preparation of its involvement in GEO 2006 work-plan, the preparation of a rationale for global reanalyses, a review of CEOP objectives and data management aspects, the preparation of a data assimilation strategy document for WCRP, and an exchange of letters with CEOS on WCRP's priorities in Earth Observation. A WOAP website was also set up with the help of the WCRP strategic support unit based in Paris (Mrs C.Michaut). It contains all relevant documents, including powerpoint presentations at the panel meetings: http://wcrp.ipsl.jussieu.fr/Organization/COPESStructure/WGOA.html

The initial membership included representatives from all WCRP projects and main working groups (WGCM, WGNE and WGSF), the chair of WMP, as well as the chairs of the three GCOS panels, AOPC (Atmospheric Observations Panel for Climate), OOPC (Ocean Observations Panel for Climate), and TOPC (Terrestrial Observations Panel for Climate), the first two being jointly sponsored by WCRP, and a representative from GEO. CEOP was also represented by its Principal scientist. Since then, a representative from IGBP joined the panel, as well as a representative from CEOS, and Dr. M.Manton, ex-chair of AOPC, is now appointed as expert.

The Second meeting was held at ISPRA, Italy, 28-30 August 2006, at the invitation of Alan Belward. Topics covered included a summary of accomplishments up to the date, as well in-depth discussions on WOAP role within WCRP and with respect to GCOS, WCRP participation in the GCOS Implementation Plan, the relationship between WCRP and space agencies, its involvement in GEO and IGOS-P, WCRP reanalysis and reprocessing activities, data management activities and a prospective reflection on WCRP observation strategy. A number of task-groups were formed during the meeting to help streamline the panel's work on the main issues, and two specific working groups were initiated on the development of improved observational data sets for reanalyses and on data management. The above items as well as the detailed meeting recommendations are presented in the meeting's report distributed in November 2006, and the present report summarizes the main results and focuses on issues most directly relevant to JSC. It also takes into account actions carried out since the meeting as a result of its recommendations.

2. MAIN ACTIONS CARRIED OUT DURING THE YEAR

- Status of WOAP and relationship with GCOS: a major item concerned the status of WOAP, which had been the subject of discussions between GCOS and JSC Chairs, following the JSC recommendation to review the respective roles of the joint WCRP-GCOS panels and to develop a formal link between WOAP and GCOS SC. There was a strong support by members of the role of WOAP as a coordination panel within WCRP, as a forum to discuss observation and data assimilation questions across projects, and to deal with issues of common interest, including promoting new observational techniques and systems, finding the best balance between in situ and space observations, developing common data management activities, ensure availability of data for assimilation, developing new assimilation techniques … There was also general agreement that co-sponsorship of WOAP by GCOS would be a positive step, and would help harmonize the work of WCRP with GCOS and the currently co-sponsored panels AOPC and OOPC. This would confirm the role of WOAP as the preferred channel for the interaction between the two programmes and for the dialogue between GCOS panels and WCRP projects. WOAP would still primarily be a WCRP Panel with GCOS co-sponsorship, similar to what is done for AOPC which is cosponsored by WCRP but has primary support from GCOS.

In addition, the meeting heard reports from the three GCOS panels and discussed some items requiring specific coordination. It provided its support to GCOS and WCRP Secretariat to ensure the maintenance of BSRN archives after Prof. Ohmura's retirement, and its support for a formal confirmation of the joint sponsorship of TOPC by WCRP. It also supported the Upper Air Network strategy presented by GCOS, urging a first stage in the implementation, by defining some priority early steps, with the addition of new sensors in a second stage.

- Relationship between WCRP and space agencies: the exchange of letters which took place between WCRP (initiated by WOAP) and CEOS in 2005 led to a response by CEOS which raised the issues of specific WCRP priorities with respect to GCOS, and of the scientific and societal benefits expected from the additional space observations advocated by the research community (it is worth noting that this correspondence was cited in his annual report by Dr Colin Hicks, CEOS Chair, as one of the highlights of his 2005 term). The first issue is to a large extent clarified by the GCOS IP satellite supplement to which WCRP has been closely associated. The second issue is partly dealt with in a further letter to CEOS Chair dated 30 October 2006, initiated again by WOAP, and co-signed by GCOS and WCRP Chairs. The 2006 letter emphasizes once more the need for sustained, well calibrated and validated space observations, for research as well as operational purposes. It makes a strong plea for international coordination in maintaining continuity of climate records, seriously endangered by the de-scoping of NPOESS but, since then, notably reinforced by recent efforts of both CEOS and the Coordination Group on Meteorological Satellites (CGMS). It also highlights the need for reprocessing of past data and for a sustained effort in global re-analyses, with adequate support from space agencies. This second letter was timely and welcomed in the United States, where NPOESS cutbacks had been announced, and it was part of the submissions to the Office of Management and Budget by NOAA.

- WCRP participation in GEO: as part of its purview, WOAP coordinates WCRP inputs to GEO and a task group set up during the 2006 meeting prepared a joint position paper with GCOS stressing a common approach to the 2007-09 GEO work-plan, including an update on participation of both programmes to GEO tasks. This was followed by a GCOS-WCRP message to GEO Plenary in November 2006. The strategy outlined for the climate "societal benefit area" of GEO stresses the need to use the GCOS Implementation Plan and follow-on satellite supplement as the main guideline for climate tasks, with a three-fold approach including a sustained reprocessing and reanalysis effort, a coordinated reinforcement of both in situ and space-based systems and the development of a "seamless" weather and climate prediction capability. Further coordination of GCOS and WCRP inputs to GEO are ensured by the participation of Dr. M.Manton and Dr. G. Sommeria to the Scientific and Technical Committee of GEO.

- WCRP reanalysis and reprocessing activities: both types of activities are key elements in the involvement of WCRP in linking climate observations to relevant high quality global climate information, and are central to WOAP's objectives. Their need is highlighted in the GCOS implementation plan, and in GEO workplans, as they form one of the GEO climate tasks. Several presentations on reanalysis activities dealt with the recommendations from the Maryland workshop (Sept 2005) on *"The development of improved observational data sets for reanalysis: lessons learned and future directions"*, and a joint GCOS-WCRP working group is being set up at the beginning of 2007 to ensure progress in this domain. A. Simmons reported on the WOAP-initiated ECMWF workshop held in June 2006 on Atmospheric Reanalysis, under the auspices of WCRP and GCOS, and with financial participation from GEO. It led to an article by A.Simmons and K.Trenberth in *EOS*, in December2006, publicizing benefits and importance of reanalyses for climate research as well as outstanding issues. The JMA reanalysis (JRA-25) is now completed and publicized by an article in the journal of the Japan Meteorological Society, and WOAP has endorsed the plan for a Third International Reanalysis Conference co-sponsored by GCOS and GEO, to be hosted in January 2008 by several Japanese organisations in Tokyo. The panel initiated the conference and the nomination of an International Programme Committee chaired by Prof. T.Koike, which is presently finalizing the agenda. A special topic, not covered in 2006, was also recommended for next panel meeting under the leadership of Dr. A.Lorenc, focusing on the coupled assimilation of atmosphere, ocean, sea-ice, and land surface data, as well as issues related to biogeochemistry.

With respect to reprocessing activities of global data sets, a survey within WCRP projects has been conducted with the help of Dr. G. Duchossois and its results were discussed at the meeting. This was recognized as one of the priority areas where support is required from space agencies, as highlighted in the letter to CEOS mentioned above, and subsequently endorsed by CEOS in its recent strategic document "*Satellite observation of the Earth System*" presented in November 2006 at COP12 in Nairobi. As IPCC work is very much dependent on the quality of climate data sets, WOAP initiated the organisation of a joint IPCC-GCOS-WCRP workshop, which would take advantage of lessons learnt from AR4 in advancing the quality of global data sets. Since then, the scope of this workshop has been widened to encompass more generally GCOS and WCRP activities and is tentatively scheduled to take place in October 2007 in Australia.

- WCRP data activities: The panel meeting further discussed the coordination of WCRP data activities. The discussion on data management in projects was initiated by a comprehensive matrix prepared by Prof. T.Koike. It highlighted the fact that all efforts were developed independently, which also meant solving problems separately without taking advantage of other efforts, and also coming up with answers that may not be compatible across WCRP. A key task is to ensure that projects can take advantage of developments and solutions to problems from other projects. WCRP cannot do data management but can facilitate and coordinate it, and work to minimize duplication of effort. Following the panel recommendation, a task group initially chaired by N. Mc Farlane has been set up in December 2006, to review the status and management of observational data and model output archives, including web sites within WCRP, and to make recommendations for a WCRP-wide overarching structure, website contents and data policy. In addition to the general discussion on data management and as requested by JSC, the panel reviewed the prototype data management system of CEOP which could serve as an example for other WCRP projects. It was also informed of advances in the WMO Information System, and recommended it to be publicized and be considered as a general framework to archive and exchange data within WCRP community.

3. ANSWER TO JSC PRIORITIES

Most of items mentioned above respond to priorities expressed as part of WCRP strategic framework or to specific requests from JSC. It is appropriate to particularly mention JSC XXVII's support to the coordination of global reanalyses and reprocessing, to the organization of the Third International Reanalysis Conference, to the assessment of CEOP, and to the interaction with CEOS, which in our view, have progressed as expected. The recommendations made on improved presence of project information on the internet and on the development of a research strategy for data assimilation, have not been fulfilled yet, but are the object of on-going activity. WOAP has also responded positively and actively to the recommendation of increased coordination with GCOS, specifically with respect to interfaces with space agencies and with GEO.

The assessment of WOAP progress up to now should be judged on its ability to coordinate activities previously spread out within the various WCRP projects, and on its ability to prepare joint WCRP positions in its domains of competence. A number of specific actions have also been initiated, some with already tangible results, some with expected results in coming years. As an attempt to respond to general criteria set up by JSC for this session, we consider the following:
- **Scientific results**: the role of WCRP in promoting and supporting global reanalyses is well recognized and several workshops have resulted, and WOAP has played an important leadership and coordination role in this domain, by its direct support and by promoting its recognition and support by GEO.
- **Value added**: WOAP has contributed to coordinate the development of research data sets and assimilation techniques within WCRP projects, and has allowed the preparation of WCRP-wide positions with respect to partner programmes, such as GCOS, and within the wider Earth Observation community, particularly GEO and CEOS.
- **Impact**: the WOAP-drafted joint GCOS-WCRP letter to CEOS on Earth Observation has had a direct impact on the definition of its Earth Observation policy by CEOS, and on Earth Observation policy in some countries. A recent example is the detailed citation of this letter in a US senate hearing on 7 Feb 2007.
- **Responsiveness**: WOAP has responded to specific events, such as the de-scoping of NPOESS, with a concerted and well documented reaction, and some tangible results. The possibility, through WOAP, to be able to rapidly prepare a "position" of the climate research community on Earth Observation matters is certainly valuable, as demonstrated by the quick reaction of WCRP to decisions by space agencies, concerning for example the TRMM, SMOS and HYDROS programmes. Another example of responsiveness is the WOAP proposal to organize a joint GCOS-WCRP meeting with IPCC, in order to rapidly take advantage of momentum gained around AR4 to promote new research activities. Many WOAP presentations have been made in different workshops and conferences.
-**New directions**: in the medium term (1-3 years), WOAP represents WCRP in the coordination of global reanalyses and development of new reanalysis efforts, including those of the oceans WOAP also coordinates WCRP efforts to obtain high quality climate data sets in order to assess new aspects of climate variability and change, such as extremes, and to make climate research data sets better known and more accessible to users. As a longer term effort, WOAP intends to facilitate WCRP research in data assimilation with breakthroughs expected in coupled models with progressive introduction of the various components of the Earth System, and to support the international coordination in the improvement of climate observing techniques by in situ networks and space missions.
- **Challenges**: WOAP has had to function with minimal support from WCRP funds, certainly less than was expected, and a prolongation of this situation will undermine its capacity for action and its credibility in the scientific arena. Unless this is turned around, the viability of WOAP is uncertain.

4. CONCLUDING REMARKS AND ISSUES FOR JSC:

WOAP was formed to facilitate cross cutting activities related to observations and data assimilation under the new WCRP strategic framework. It has markedly increased the visibility of WCRP in this area and become part of the international dialog on new observations and priorities for observations and related activities in the climate domain (including reprocessing and reanalysis). Exciting new observations are in place from the COSMIC suite of GPS Radio Occultation observations and CloudSat and Calypso research satellites, among others. WCRP through WOAP has had an impact on the priority setting following the NPOESS cut backs in the U.S. and has been responsive to those developments. It has helped establish climate observation priorities, promoted reprocessing and reanalysis activities, with several workshops resulting and a major international conference forthcoming. Several reports have resulted, published in Eos, online or in other forms. Many WOAP presentations have been made in different workshops and conferences. WOAP has offered many constructive comments on GEO work plans.

Those activities were undertaken with the understanding that WOAP was an essential coordination component of the COPES scientific strategy defined by WCRP in 2004 for the coming years. The panel has initiated its activities with minimal cost and a lot of personal involvement of its members. However, it cannot function without a minimum annual funding. Task groups do most of their work by e-mail, but a yearly meeting of the panel is necessary for coordination or WOAP will languish. So far all travel to represent WOAP at meetings has come from outside of WCRP.

Other Issues for JSC

1) ***Consider the changes in sponsorship of WOAP by GCOS and also endorse sponsorship of TOPC by WCRP.***
2) ***Recognize the two new Task Groups that have been set up, the members and their tasks, and participate and help as required.***
3) ***Recognize the ongoing discussion with space agencies and the demands from WCRP for higher priority to be given to climate concerns in priority setting. Note the need to promote these priorities within nations.***
4) ***JSC is invited to take note of and comment on the activities of WOAP by visiting the web site and going over the many background papers related to observational issues.***
5) ***Consider when and whether WOAP should meet again. A default of no action could result in all of the activities of WOAP being shut down and phased out.***
6) ***A specific endorsement of WOAP is requested.***

APPENDIX: TASK GROUPS AT WOAP MEETING AND PROPOSED WORKING GROUPS

Task groups for WOAP meeting

1/ Satellite Task Group to deal with space matters and relation with space agencies.
M. Manton, *A.Belward, N. Mc Farlane, J.Key (e-mail exchanges with W.Rossow)*
2/ Reanalyses: recommendations for follow-on actions and joint WG with AOPC on data for reanalysis:
A. Simmons, *D. Stammer, G. Flato, J. Shukla*
3/ Data management: ***N.Mac Farlane***, *T.Koike, E.Harrison, M.Tjernström,*
4/ Reprocessing: ***R. Lawford***, *J.L.Fellous, A.Lorenc, (W.Rossow by e-mail)*
5/ GEO items: ***G. Sommeria***, *M. Manton, T.Koike, M.Rast, R.J du Vachat*

New Task force on data management in the WCRP, Members (as of 12 January 2007):
Chair (initially): **Norm McFarlane** (Norm McFarlane@ec.gc.ca)
SPARC: Bill Randel (NCAR; randel@ucar.edu)
CLIVAR: Howard Cattle (CLIVAR Project Office), Nico Caltabiano (caetano@noc.soton.ac.uk)
GEWEX: Bill Rossow (wbrossow@ccny.cuny.edu)
CLiC: Jim Moore (NCAR; jmoore@ucar.edu), Taco D'Bruin (bruin@nioz.nl Netherlands)
CEOP: Steve Williams (NCAR; sfw@ucar.edu)
OOPC: Bob Keeley (Ottawa, Canada, MEDS, keeleyr@dfo-mpo.gc.ca)

WMP: Jim Kinter (COLA; kinter@cola.iges.org)
WCRP: Hans W. Jacobi (hans-werner.jacobi@awi.de); Catherine Michaut (Catherine.Michaut@ipsl.jussieu.fr)

New Working Group on Reanalysis Observational Data Sets (WGRODS), joint WOAP-AOPC, with members nominated by institutions (names are tentative at this stage)
Russell Vose (NCDC) Chair (confirmed) (expert for *in-situ* data)
NCAR: S.Worley, J.Comeaux; NCDC: J.Bates for satellite data ; NASA/GMAO: S.Schubert
NCEP: one person to be nominated by L Uccelini; ECMWF: S. Uppala or D. Dee
JMA : K. Onogi ; EUMETSAT :L. van de Berg; BMRC: P. Steinle
One expert in snow/ice datasets; CRU: P. Jones; UKMO: Peter Thorne; NOAA: G.Compo
Chinese Meteorological Agency: one person to be nominated

WCRP Modeling Panel (WMP)

1. Background:

The WCRP and its component programs (ACSYS, TOGA, WOCE, CLIVAR, GEWEX, SPARC, CliC) have made major advances in the past, and are continuing to make tremendous progress in describing, understanding and modeling of the physical climate system. Based on these advances, the World Climate Research Programme (WCRP) has introduced a new strategic framework to integrate and synthesize the activities of all its components and to obtain a holistic and predictive understanding of the total climate system.

This strategic framework,

Coordinated Observation and Prediction of the Earth System (COPES)

has as its aim:

To facilitate analysis and prediction of Earth system variability and change for use in an increasing range of practical application of direct relevance, benefit and value to society.

To implement this new strategic vision of COPES, WCRP has created two panels: WCRP Observations and Assimilations Panel (WOAP) and WCRP Modeling Panel (WMP).

WCRP has the dual responsibility of promoting and encouraging climate research among the nations of the world, as well as facilitating the utilization of climate research for the benefit of society. The primary focus of COPES and these two newly created panels of WCRP is to ensure that WCRP-wide expertise in specific areas are brought to bear to address the high priority areas of climate prediction and societal applications. The two panels will work closely on the requirements for and uses of observations in models (e.g. issues of data analysis, reanalysis, assimilation, model initialization, identifying observational gaps and deficiencies in relation to predictive skill, and to understanding and parametrizing physical processes). If the existing or the planned observing systems are not adequate for weekly-seasonal- decadal predictions, WOAP will identify and make recommendations to improve the observing systems. Likewise if the existing models, data assimilation systems and computing facilities are not adequate to harvest the weekly -seasonal- decadal predictability, WMP will identify the problems and suggest possible strategies to improve the models and data assimilation systems.

The current list of WCRP modeling groups, grouped according to the dominant time scale are given below:

List of WCRP Modeling Groups (arranged according to time scale).

1. Weather Prediction (1-10 days):	**WGNE**
2. Intra-Seasonal Prediction (1-30 days):	**WGNE, GMPP, TFSP**
3. Seasonal Prediction (1-100 days):	**WGSIP, TFSP, GMPP, CliC, SPARC, WGOMD**
4. Interannual Prediction (1-1,000 days):	**WGOMD, WGSIP, TFSP, WGCM**
5. Decadal Prediction (1-10,000 days):	**WGCM, WGOMD**
6. Climate Change (1-100,000 days):	**WGCM**

The terms of reference and members of WMP can be found at the WCRP website. The membership consists of chairs of WGNE, WGCM, WOAP, chairs of modeling panels of CLIVAR, GEWEX, CliC, SPARC, two members of JSC and Executive Director of THORPEX.

The primary aim of WMP is to "coordinate" WCRP modeling activities. WMP is the only forum where all modeling groups of WCRP (weather prediction to climate change) meet and review the abilities and limitations of current NWP and climate models. These discussions are quite candid. For example, at the WMP-II, it was pointed out that the resolution of some climate models is inadequate, and their ability to simulate the weather statistics is poor.

WMP had its first meeting (WMP-I) at Exeter, UK, 6-7 October 2005, and its second meeting (WMP-II) at Boulder, USA, 23-24 October, 2006.

Summary of Discussions at WMP-II:

1. There is insufficient comprehensive model development effort globally. The effort is often under-funded, does not have sustained support, is considered unglamorous by some and scientists engaged in model development do not necessarily have a clear career path.

2. Presentation by the chair of WGNE pointed out serious limitations of low resolution climate models in simulating the current climate, especially the statistics of mid-latitude storms and blocking. It is therefore unlikely that such models can give sufficiently reliable estimates of changes in the statistics of regional climate to facilitate adaptation at the regional and local scale to climate change. It is essential and urgent that climate models are evaluated with respect to a comprehensive set of model metrics.

3. Use of high resolution regional models to downscale regional climate change is questionable if the global models from which lateral boundary conditions for regional models are prescribed do not have reliable simulation of planetary waves and statistics of storms and blocking.

4. While there is a general acceptance that the traditional boundaries between weather and climate are somewhat artificial, there is as yet no world-wide organized and coordinated effort to implement the framework for seamless prediction of weather and climate variations, which is one of the central themes of WCRP-COPES. This framework requires that the decadal and multi-decadal predictions

using IPCC-class models should move towards consideration of climate change as an initial value problem. This will ultimately require the state of the ocean-land-atmosphere-cryosphere system should be correctly initialized. Recent results suggest that decadal changes in meridional overturning circulation are sensitive to initial conditions of the ocean-atmosphere system. It is recommended that the IPCC-class models should be subjected to data assimilation and prediction of short-term weather and ENSO-type variations. Just as 1 day forecast errors are critical in determining the 10 day forecast errors in NWP, some elements of one season or one year predictions may be critical for decadal predictions.

5. The weather and climate modeling community does not have sufficient computing power to build and develop the next generation of cloud system resolving models. A significant fraction of computing power during the past 30 years has been used for running a large number of low resolution (cyclone scale resolving) model ensembles for long periods of time. It is essential that computing power be increased substantially (by a factor of 1000), and scientific and technical capacity be increased (by at least a factor of 10) to produce weather and climate information of sufficient skill to facilitate regional adaptations to climate variability and change (WCRP and THORPEX are jointly preparing a white paper to highlight this need). Presentations (by Dr. Sato (Japan) and Dr. Randall (USA)) using cloud-system revolving models were highly encouraging.

6. While there has been considerable progress, physical climate system models continue to have serious limitation in simulating the space-time structure of the current climate (rainfall in the tropical forests, ITCZ, monsoons, dryness over deserts etc). Additional complexity (complex chemical and biological processes) must be being introduced in these models to address some issues. Careful studies are needed to quantify the best ways of improving models (e.g. realism versus complexity).

7. Lack of sufficient computing power and dedicated scientific staff to develop data assimilation systems for ultra-high resolution models has made it difficult to realize the maximum possible value from space measurements which are made at a significant cost.

8. There was a remarkable initial success in dynamical seasonal prediction of ENSO about 10-20 years ago. There is an apparent lack of further progress because of large errors in coupled ocean-atmosphere models, both in the initial conditions and in the evolution of the coupled system. Recent results suggest that if a coupled model does not have realistic “weather noise,“ its ability to predict ENSO will be severely limited.

9. WCRP projects worldwide will be producing enormous amounts of data, both from observations and models. WCRP should begin to develop a common data management strategy for all WCRP activities.

10. WCRP, in collaboration with WMO/THORPEX and IGBP, and working with current centres, should initiate a major international effort in developing the next-generation Earth System models and establishing appropriate computing and data facilities.

Renaming WGCM as WGCM-ACC(Working Group on Coupled Modelling- Anthropogeninc Climate Change)

A proposal from Co-Chairs, J.F.Mitchell and G.Meehl

WCRP has recognized it needs to raise its profile if we are to attract the funding to enable us to build the collaboration we believe is necessary to tackle the weather and climate issues. The work of WCRP is organized around disciplines rather than outputs which are of use to society. In the case of anthropogeninc climate change, there is no one stop shop in WCRP where the outsider can see what we are doing- or who to contact. The core work on ACC is done in WGCM, but the "The Working Group on Coupled Modelling(WGCM)" is not a name that conveys this to the outsider. We believe strongly that until WCRP concentrates on outcomes-improving seasonal to centennial predictions through international collaboration, it will contiue to struggle to raise its profile. This is not to undermine the importance or status of the programs- the improvement of the underlying science is the cornerstone of the task. However, the world at large is more concerned with the "So what" than the "How" so if WCRP is to maintain/ increase its profile, it needs to show what the benefits of its work are if it is to justify the work on underlying science. Note that as anthropogenic climate change becomes more widely accepted, competition in this area is going to become more intense. Hence we believe we need a group/program in WCRP which explicitly addresses ACC. Hence, we propose to change the name of WGCM to WGCM-ACC to more fully reflect what it actually does.

This may raise the separate issue of seamless prediction. We should be working much harder to get the synergy across NWP to climate timescales - it is the same system and the same underlying science. However, from a practical point of view, operational concerns are not going to use the exactly the same model (including resolution) to produce guidance from NWP to long term climate timescales because of limitations in resources. To remain competitive, centres are going to chose the highest resolution they can for the problem they are tackling. At the climate timescales, increased resolution alone is unlikely to reduce uncertainty- model ensembles (as opposed to initial condition ensembles) with a diversity of models will remain essential- an issue which becomes less important as one goes to shorter timescales.

Much of the workplan for WGCM was set out in the ACC part of the CLIVAR implementation plan (mainly by Neville Nicholls and John Mitchell some time ago). Since then, guidance from CLIVAR has been predominately about concerns,probably quite justified, that not enough attention has been paid to long term climate variability. On the other hand, WGCM has led the way in collaborating with the relevant parts of IGBP to further earth system modelling through joint meetings, the last being in Victoria in September 2006 where we discussed joint activities which would contribute to the next IPCC assessment. This collaboration with outside organizations needs to be supervised by JSC. Although the links with CLIVAR are welcomed and should be maintained, by far the strongest direction, both scientific and strategic, has come from JSC. Hence, we ask that the supervision of what was WGCM revert to JSC, with one co chair retaining responsibility for liaising with CLIVAR.

WORLD CLIMATE RESEARCH PROGRAMME

JOINT SCIENTIFIC COMMITTEE

TWENTY-EIGHTH SESSION

ZANZIBAR, TANZANIA, 26-30 MARCH 2007

JSC-XXVIII/Doc. 5.4
(13.II.2007)

Item 5

ATMOSPHERIC MODELLING ACTIVITIES IN SUPPORT OF WCRP

(Submitted by the Chairman of the JSC/CAS Working Group on Numerical Experimentation)

The following text briefly reviews the main activities of WGNE in support of WCRP objectives, emphasizing items arising at its twenty second session which was kindly hosted by the National Centre for Atmospheric Research, Boulder, Colorado USA, 24 -27 October 2006. On this occasion the 24 October was a joint session with the WMP.
Emphasis has been given to activities where international coordination is paramount and facilitated by the working group's existence, or where new scientific initiatives are involved.

1. Role of WGNE in support of WCRP and CAS

WGNE, as a joint working group of the JSC and CAS, has the basic responsibility of fostering the development of atmospheric models for use in weather prediction and climate studies on all space and timescales. In the WCRP, WGNE is at the core of the global modelling effort and co-ordination between WGNE, WGCM and WGSIP is maintained primarily through ex officio meeting attendances. WGNE also works in close conjunction with the WCRP Global Energy and Water Cycle Experiment (GEWEX) particularly in the development of atmospheric model parametrizations, with WGNE sessions held jointly with the GMPP (but not in 2006). The WGNE Chair is a member of WMP, with WGNE represented on WOAP also.
WGNE also has specific THORPEX sessions at its meetings. The close relationship that exists between WGNE and operational (NWP) centres underpins many of the activities of WGNE, and it is the work of these centres that provides much of the impetus for the development and refinement of the physics and dynamics of atmospheric models.

2. Studies and comparisons of atmospheric model simulations

Model inter-comparison exercises are a key element in meeting a basic WGNE objective of identifying errors in atmospheric models, appreciating their causes and reducing or eliminating these errors.

<u>PCMDI, CMIP and a Workshop on Model systematic errors</u>
WGNE congratulated PCMDI for continuing to maintain and enhance a valuable infrastructure for processing model outputs at PCMDI and establishing efficient data formats etc for such exchanges of model simulations. The recent outstanding achievements in the context of the IPCC/AR4 are of particular note. PCMDI has offered to receive high resolution NWP AMIP-type runs to complement their ongoing CMIP activities. PCMDI is the local host for a pan-WCRP/CAS workshop on Model

systematic errors in February 2007. This is being organized by PCMDI and WGNE with input from WGCM and GMPP, and the programme is structured by timescales to emphasis the 'seamlessness' of many model errors.

"Transpose" AMIP

The goal of the WGNE-Transpose AMIP is to obtain the benefits for climate model development and evaluation that have been invaluable for weather prediction model development, by applying climate models to weather forecasting. The method allows direct comparison of parametrized variables such as clouds and precipitation with synoptic observations, satellite and field programmes. In general, development of a complete analysis system is not needed with initial conditions obtained from NWP (re-)analyses. The method allows direct comparison of parametrized variables such as clouds and precipitation with observations including field programmes (such as ARM), early in the forecast while the model state is still near that of the real atmosphere. This WGNE initiative was prototyped jointly by PCMDI and NCAR and known as CAPT. The intention is to encourage climate modelling groups to implement this forecast strategy into their development process. The formal proposal for Transpose AMIP has been sent to climate modelling groups.

Aqua-Planet Experiments (APE)

WGNE recognizes the value of applying atmospheric models to simplified surface conditions for examining the behaviour of physical parametrizations and the interactions of parametrizations with the dynamical cores. In particular, "aqua-planet" experiments with a basic sea surface temperature distribution offer a useful vehicle in this regard. The details of the experiment and schedule are available at http://www.met.reading.ac.uk/~mike/APE.

The experiment is designed to provide a benchmark of current model behaviour and to stimulate research to understand differences arising from: (1) different subgrid-scale parametrization suites, (2) different dynamical cores, and (3) different methods of coupling model dynamics and parametrizations. Using the APE database, analysis of the APE experiments is continuing for another year. Following the workshop held in April 2005, a second workshop is planned to discuss the more complete analyses in late 2007 at the University of Tokyo.

The basic experiments are deliberately done at "climate model" resolutions but a few groups are examining convergence with resolution and the results and interpretation of resolution studies will be an important outcome of this work.

Regional Climate Modelling

Following the WMO/WCRP sponsored RCM Workshop in Lund, Sweden in 2004, the Transferability Working Group (TWG) was created. The aims of this group are to assess the global applicability of RCMs in regions remote from their home domain of development. Particular emphasis is being placed on the simulation of regional scale water and energy cycles in a wide variety of climatic regimes and the Inter Continental Scale Experiment Transferability Study (ICTS) focussing on GEWEX Continental Scale Experiment sites is in progress. A second RCM workshop is planned for 2008, probably in Trieste (ICTP). WGNE also discussed results from SGMIP (Stretched Grid Model Inter-comparison Project). It will continue to monitor the developments in this area in its future sessions.

3. Climate Model Metrics

WGNE has been involved in developing standard climate model diagnostics and metrics for some years. The goal of such metrics is to objectively measure model quality or skill and suitable metrics depend on the intended applications. The

application for climate models includes the prediction of future climates for which no verification data will be available within the lifetime of the model. WGNE discussed the issue of climate model metrics at some length with many questions and issues resulting. A sub group with a member from each of PCMDI, WGCM, WGNE, GMPP and the JWGV (Joint Working Group on Verification) will define the climate model metrics and standard verification data sets with the intention of asking WCRP to encourage usage of these metrics for climate models. It was decided to ensure some emphasis on climate model metrics at the February 2007 model systematic errors workshop.
The need for good metrics for climate-type models is under discussion. WGNE will discuss this further also in the context of the new 'unified' prediction systems.

4. Physical parametrizations in models

WGNE's close working relationship with GMPP (the GEWEX modelling and prediction panel), provides the focus for the development, refinement and evaluation of atmospheric model parametrizations, notably those of cloud and radiation, land surface processes and soil moisture, and the atmospheric boundary layer. WGNE reiterated the value of the interaction with GMPP for parametrization work, particularly with GCSS. A joint WGNE/GCSS model intercomparison study of a Pacific cross section (GPCI) to evaluate physical parametrizations along the atmospheric cross section following the trade winds is in progress, with excellent support from both NWP and climate modeling groups. The need for an expert group on parametrization to advise both WCRP and WWRP (and their Working Groups) was discussed, and further consideration will be given to this in consultation with the GMPP.

5. Numerical weather prediction

Reanalysis projects and data assimilation
The ERA-40 reanalysis at ECMWF is complete and an "interim reanalysis" has begun. This is running from 1989 onwards. It contains improvements that greatly alleviate deficiencies identified in ERA-40. A comprehensive atlas of the atmospheric general circulation as depicted by ERA-40 has been produced in collaboration with the Meteorology Department of the University of Reading.
The Japanese 25-year Reanalysis Project (JRA-25, 1979-2004) has been completed. WGNE reiterated its strong support for the reanalysis work, the desirability of maintaining a core of experts without excessive duplication of effort and ensuring efficient phasing of these efforts.

Earth System assimilation
The new developments in the assimilation of parameters pertinent to the Earth System but not routinely analysed by current data assimilation systems are being monitored by WGNE. These include analyses of greenhouse gases, aerosols and reactive gases. Earth system science such as the GEMS (Global and regional Earth-system Monitoring using Satellite and in-situ data) project will increasingly demand cross-project liaison within WCRP and CAS.

Model developments
WGNE noted the substantial improvements in the resolution of global and deep convection permitting forecast models in progress or planned in the next few years. There exists a dichotomy of opinion regarding the use and interpretation of grid-lengths of several kms for forecasting. These resolutions will become affordable for GCM use in the coming years, and the prospect of climate simulations with grids of order one kilometre is an issue of international activity and debate, and WGNE will

continue to monitor such developments.
Recent results showing the need for model resolutions of 100 kms or better to properly define the statistics of extra-tropical storm tracks were noted. This contrasts with typical climate model resolutions substantially poorer than this, a matter of serious concern to the group.
WGNE noted that plans for unified (coupled) forecast systems that will provide forecasts from days out to seasons, typically by progressively degrading the resolution with forecast range, will provide new opportunities for ensemble techniques, including initial perturbations, stochastic parametrizations and metrics, and bring even closer collaboration between the NWP and climate communities.
WGNE will contribute to the TFSP meeting in Barcelona, June, 2007 including a report on the Systematic Errors workshop.

Performance of the main global operational forecasting models

WGNE routinely reviews the skill of daily forecasts from a number of the main operational centres in terms of verification scores (such as anomaly correlation and root mean square error) for various fields at different lead times. For most centres, a distinct increase in skill continues.

Model Verification

With global models attaining much higher resolutions, and mesoscale models being routinely run at most operational centres, consideration is being given to additional skill scores to the conventional ones that are more appropriate for such resolutions. Furthermore there is an increasing requirement to provide measures of model performance for predicting weather elements and severe weather events. The joint WGNE/WWRP working group on verification (JWGC) is now considering this important subject.
There are a number of WGNE projects involved with the validation of forecasts. New developments were discussed including the development of methods to verify high resolution spatial forecasts; verification methods for rare events; incorporation of scaling methods into verification processes; approaches to account for observational uncertainty in verification measures and analyses; development of methods that are customer dependent and appropriate for studies of forecast value; and verification of probability distribution functions.

Inter-comparison of typhoon track forecasts

The inter-comparison of forecasts of typhoon tracks has been an ongoing project that has been conducted by the Japan Meteorological Agency on behalf of WGNE for a number of years. This now includes all ocean basins, and data from operational forecasts is now available from eight Centres. The overall gradually improving performance of these models in predicting cyclone tracks over the past few years has been maintained. In future statistics will be gathered to assess the skill in intensity forecasts and forecasts of cyclone genesis. Many results related to typhoon track forecast including a multi-model ensemble are presented on the web site (http://nwp-verif.kishou.go.jp/wgne_tc/index.html (user id and password are required)).

Verification and inter-comparison of precipitation forecasts

This WGNE initiative is being conducted at the DWD, NCEP, BMRC, CMA, JMA, CMC, the Met Office and Meteo-France. Quantitative global precipitation forecasts from the above are being verified against surface stations in these relatively data rich areas (some Centres also include their limited area model forecasts in the verification). A series of scores such as bias, Heike skill score, equitable threat score are used. It was noted that there is clear evidence from several Centres that the skill of precipitation forecasts in mid-latitudes was increasing.

Model-derived estimates of ocean-atmosphere fluxes (SURFA)
SURFA will evaluate and inter-compare global surface flux products (over ocean and land) from the operational products of a number of the main NWP centres and this will provide a good opportunity for estimating and determining the quality of model surface fluxes, of considerable relevance to atmospheric and coupled modelling communities and oceanographers. Following a joint session at WGNE-22 with the WCRP Working Group on Surface Fluxes (WGSF) it has been agreed to revitalize SURFA, and an agreed set of NWP fields etc will be routinely archived at the National Climate Data Centre from a number of NWP Centres (after a preliminary pilot study currently in progress).

The WGNE 'Blue book'
A key WGNE publication for many years has been the WGNE "blue cover" numerical experimentation report series, which continues to be popular with the modelling community and is prepared on behalf of WGNE by Recherche en Prevision Numerique (RPN), Montreal since its inception, and the latest annual summary of research activities in atmospheric and oceanic modelling (No. 36) has been released. This publication is facilitated by use of e-mail contact and the website at RPN, (http://www.cmc.ec.gc.ca/rpn/wgne)

6. THORPEX

At the 22nd WGNE meeting there was a session, which reviewed the status and plans of THORPEX and the wide-ranging opportunities for collaboration and synergy with WCRP and other bodies. The plans for T-PARC were of particular note, and this 'campaign' promises to make a major contribution to our understanding of meteorology in the Pacific basin.
The use of ensemble methods now forms a cornerstone of forecasting on all timescales, and WGNE hoped that the rapidly progressing TIGGE project will help accelerate the effective use of ensemble forecasting information.

7. A Year of Tropical Convection

WGNE discussed the proposal for 'A Year of Tropical Convection' (YOTC) which as currently envisaged, is aiming to assemble a dataset that will enable focussed research on many aspects of tropical convection, which in turn should lead to significant/important advances in our NWP abilities on all timescales currently labelled under 'seamless' prediction. The discussions strongly supported the idea but felt that it was less clear how the aims of the YOTC would be achieved. Some concern was also expressed that the proposed timescales were somewhat too tight.
As this YOTC dataset will be a judicious combination of many existing datasets in a variety of forms and repositories, questions were asked as to whether this is an opportunity to harness the powers of the new WMO Information System (WIS), and what was the YOTC relationship to other planned 'global' activities such as IPY and a possible Monsoon' focus. It was suggested that WWRP and WCRP should consider these questions and the efficacy of having a working group and/or a workshop in 2007.
Recognizing that convection is central to many problems in WCRP modelling research on almost all space and time scales, WGNE/GMPP were already jointly considering a high resolution modelling experiment specifically directed towards aiding and accelerating parametrization development. This could be part of a coordinated effort to benefit the entire WCRP community.

WORLD CLIMATE RESEARCH PROGRAMME

JSC-XXVIII/Doc. 5.5
(15.II.2007)

JOINT SCIENTIFIC COMMITTEE

TWENTY-EIGHTH SESSION

ZANZIBAR, TANZANIA, 26-30 MARCH 2007

Item 5

THE WCRP WORKING GROUP ON SURFACE FLUXES (WGSF)

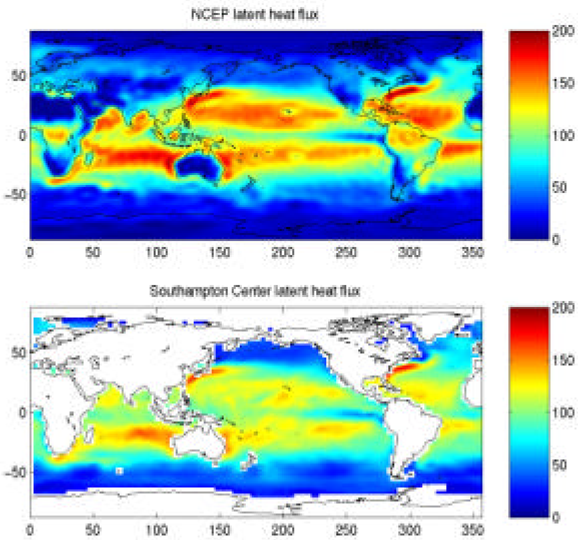
(Submitted by WGSF Chair)

1. Introduction

This report focuses on the **science** enabled by WGSF through **networking** and also presents WGSF's direct work and the **value** for and **impact** of its activities on WCRP research. An attempt is made to demonstrate WGSF **relevance** and **responsiveness** to WCRP requirements. JSC is requested to recommend the way forward based on the WGSF analysis of **new directions** and **challenges**.

2. Scientific Challenge

Climate predictability on time scales longer than one or two months is closely linked with the influence of the oceans on the atmosphere. Recent advances in ocean observations and data assimilation open prospects for better understanding and exploiting this predictability, but to do so, an accurate representation of surface fluxes is needed in predictive models. At present, this accuracy is far from being achieved. For example, an obvious requirement for reducing biases in coupled models should be their ability to reproduce the flux climatology. However, the current differences in flux climatologies produced by leading research groups are very significant (see figure, **"challenge"**).



latent heat flux (Wm^{-2}) climatologies.

Accurate representation of surface fluxes is crucial for forcing ocean general circulation models and producing reliable ocean reanalyses (**"relevance"**). Surface fluxes represent an important factor in the sea level variability and change. By providing energy inputs for atmospheric synoptic systems in mid-latitudes and tropics (mid-latitude and tropical cyclones), surface fluxes are crucially important for further effective analysis and prediction of extreme events (**"relevance"**). Exchange of gases and biogeochemistry compounds at the sea-air interface has strong influence on atmospheric chemistry balances and affects the understanding of the mechanisms of climate change (**"challenge"**). The existing flux computation techniques are insufficiently accurate at high wind speeds over the ocean, over land, and especially at high latitudes (**"challenge"**). Moreover, methods to account for sampling inhomogeneity are still uncertain. The science of gas and particle exchange between the ocean and atmosphere is only emerging (**"new directions"**).

Progress in computing surface fluxes and developing new high quality surface flux products is a key in moving ahead predictions of the seasonal, interannual, decadal and longer time scale climate (**"value", "relevance", "new directions"**); and that was the JSC's motivation for establishing the WGSF in 2003-2004.

3. Charge to WGSF

The WGSF is charged with reviewing and coordinating requirements of the various WCRP projects and activities for air-sea fluxes, promoting research in air-sea fluxes, and facilitating communication of research advances. It was anticipated that the group would start to address global fluxes (i.e., including land surface-atmosphere fluxes) after the initial 2-3- year-long period of its work on air-sea fluxes only. Specific objectives include developing flux data sets available from different sources (in-situ, remotely sensed, NWP-based); improving measurement technologies, parameterizations and flux field production algorithms; and assessing the sensitivity of climate models and limits of predictability associated with uncertainties in surface fluxes. The WGSF also serves as a bridge between WCRP and the Surface Ocean-Lower Atmosphere Study (SOLAS) of the International Geosphere-Biosphere Programme (IGBP), Scientific Committee on Oceanic Research (SCOR), Commission on Atmospheric Chemistry and Global Pollution (CACGP) of the IUGG International Association of Meteorological Sciences, WMO/IOC JCOMM and the operational oceanography community dealing with ocean forecasting and surface wind-wave hindcasting. With all its broad scientific tasks, real multidisciplinarity, and contributing to practically all WCRP cross-cutting issues and core projects, the WGSF stands as an effective component of the implementation of the WCRP Strategic Framework and WCRP networking (**"value adding, enabling"**).

4. Meetings

Despite limited financial support the WGSF has been able to meet several times.

Full meetings of WGSF	Kick-off: 11-12 October 2004, Halifax, Canada Second meeting: 4-5 September 2006, Heidelberg, Germany
Recent meetings of opportunity	SEAFLUX Workshop, 2-3 March 2006, Tallahassee, USA, GOSUD/SAMOS Workshop, 2-4 May 2006 Boulder, USA WGNE, 24-26 October 2006, Boulder, USA

5. Networking Activities, Partnering and Outreach

From the outset, the group members and affiliates established contacts and liaisons with several essential partners. Below is the list of their **networking** assignments:

B. Barnier	TF on Seasonal Predictability, ocean models
R. Phillipona	BSRN
R. Weller	CLIVAR, SURFA, OOPC
F. Bradley	GEWEX precipitation
E. Kent	WOAP; SAMOS/GOSUD
Ed Andreas	CliC
P. Taylor	OOPC
P. Braconnot (not a WGSF member)	WGCM
P. Gleckler (not a WGSF member)	WGNE
S. Gulev	Wave hindcasting community and NWP
S. Smith	SAMOS/GOSUD; SURFA

Several WGSF members are active participants in the GEWEX SeaFlux activity.

A key WGSF partner is SOLAS. S. Gulev started in 2006 to serve as SOLAS SSC member. A joint WGSF/SOLAS workshop was held in Heidelberg in September of 2006 to discuss activities, future collaborations, data intercomparisons, and data management. Details can be found at ftp://ftp.etl.noaa.gov/user/cfairall/wcrp_wgsf/meetings/Heidelberg_06/.

To facilitate engaging the flux research community in a network, the WGSF has started a newsletter entitled "FluxNews" (available at http://www.sail.msk.ru/newsletter/index.htm). The third issue features articles on forcing of ocean circulation models.

The WGSF website resides at http://www.esrl.noaa.gov/psd/psd3/wgsf/. Apart from background information, minutes of meetings and reports, the website includes guidance on measuring and parameterizing fluxes, datasets, and links to other relevant flux sites. The flux section includes the handbook on ship-based flux estimation, computer codes, research publications, the Flux Newsletter, and selected *in situ* datasets.

The idea of a flux summer school is being explored. If a WGSF own summer school proves difficult or not feasible to organize, then WGSF members could participate in and lecture at a SOLAS summer school. Currently S. Gulev is exploring the idea of organizing short courses onboard research vessel for young scientists interested in air-sea fluxes.

6. SURFA

SURFA was conceived as a WGNE project to improve NWP and GCM representation of surface fluxes by archiving operationally generated NWP fluxes and high-quality *in situ* observations for subsequent intercomparison and analysis. For the WCRP, systematic comparison of NWP-generated fluxes is a critical area for developing future predictive models. Therefore, one of the WGSF key tasks became to re-invigorate SURFA in cooperation with WGNE. Significant effort went into formulating new SURFA content (**"responsiveness"**) and requirements that would ensure that the project was the project meaningful even at a significantly reduced level of funding. Efforts of R. Weller, P. Gleckler, M. Miller (WGNE chair), and WGSF Chair resulted in SURFA finding a new "home" at NOAA NCDC (**"impact"**). At the WGNE meeting in 2006, a joint WGSF/WGNE session on SURFA was held, and the following outcomes were achieved:

- A list of NWP variables to be archived was composed and made available for comment.
- A strategy was developed to initially begin archiving NWP flux products from NCEP and ECMWF as a pilot study of about one year duration to evaluate and streamline the process. After the initial problems are worked out, NCDC will begin accepting data from other NWP centers.
- D. Majeweski was appointed WGNE point of contact to arrange for archiving with the NWP centers.
- S. Smith of the WGSF will coordinate archiving the *in situ* data.
- Huai-Min Zhang of NCDC began to investigate arrangements to set up the archive.

Following the SURFA meeting with WGNE, the BSRN coordinator (E. Dutton) met with the WGSF members to discuss coordination and participation in SURFA (for both land and ocean radiative fluxes).

While there are still many steps remaining before the new SURFA becomes a reality, it appears that the first step has been taken. The work will be done in partnership. WGNE is coordinating the NWP center archiving effort. Further organizational action is required in WGSF to coordinate the archiving of the data. The WGSF talks at the WGNE meeting are available at ftp://ftp.etl.noaa.gov/user/cfairall/wcrp_wgsf/surfa/WGNE_06_Boulder.

7. SeaFlux

The GEWEX SeaFlux project (http://gfdi.fsu.edu/SEAFLUX/) is an important complement to SURFA. SeaFlux has new funds from NASA. Drs. J. Curry and C. A. Clayson are participating in the NASA Energy and Water Cycle Study (NEWS, http://www.nasa-news.org/), blending NWP and satellite data to improve forcing of coupled air-sea models. The WGSF chair contacted the SEAFLUX PIs (J. Curry, W. Rossow, and C. A. Clayson) for an update and discussion of joint interests and three representatives (S. Smith, A. Bentamy, and W. Drennan) participated in the SEAFLUX workshop on 2-3 March 2006 near Tallahassee. In the future, a joint program of work is required for WGSF, SeaFlux and SURFA.

8. Observing systems

WGSF actively contributed to the development and efficiency of the Global Ocean Observing System and Global Climate Observing System. Close synergy of WGSF with OOPC, AOPC, as well as with WMO/IOC JCOMM contributed to the launch of the ambitious VOS-Clim project targeted on the qualitative improvement of the VOS observational system (**"impact", "relevance"**). WGSF is also connecting directly with the marine observing network through GOSUD (Global Ocean Surface Underway Data: http://www.ifremer.fr/gosud/) project and the SAMOS (Shipboard Automated Meteorological and Oceanographic System: http://samos.coaps.fsu.edu/html/) initiative. Moreover, the inventory of different flux data sets (see Section 10) now constitutes the background for developing and validating ocean reanalyses, in particular, the MERCATOR reanalysis. E. Kent will expand the Marine Climatology community Wiki Page at NOCS to include pages for the WGSF and fluxes more generally (**"value added"**). It will be possible to add information about relevant projects, deployments and datasets with links to the project websites, data and papers.

Due to the relentless efforts of the group, the momentum has been gaining in obtaining time series observations of surface meteorology and air-sea fluxes in challenging, high priority locations (**"science"**). M. Cronin (NOAA PMEL, USA) has support for continuing her surface mooring in the Kuroshio Extension; R. Weller (WHOI, USA) has deployed a surface mooring in the location of high winter heat losses in the core of the Gulf Stream; and E. Schulz (Bureau of Meteorology, Australia) with colleagues are planning a surface mooring at 47°S, 140°E. W. Drennan (U. Miami, USA) reports an extreme Air-Sea Interaction" (EASI) buoy will be deployed next month to make direct flux measurements in "hurricane alley" off Florida. M. Yelland (NOCS) and colleagues are routinely obtaining direct flux measurements from the weather ship Polarfront at station Mike (66°N, 2°E). Since Nov 2005 TNO (G. De Leeuw) & LDEO (C. J. Zappa) in cooperation with the US Army Corps of Engineers have started long-term monitoring of air sea fluxes at several locations (momentum, heat, water vapor, CO_2), with focus on wind-wave interaction in high wind speeds.

9. Other important results

Air-sea flux science and IPCC Fourth Assessment Report (**"impact, value added"**). Long-term air-sea flux products and the climate changes in air-sea interaction characteristics were reviewed for IPCC AR4 in two chapters. S. Gulev, in the capacity of the IPCC leading author for Chapter 5 and contributing author for Chapter 3 and S. Josey as the contributing author for both Chapters 3 and 5, were responsible for these results.

Reviews of gas and particle transfer parameterizations. Two major reviews of emerging science have been planned by WGSF as its key output. The articles will evaluate the state-of-the-art in surface flux parameterizations to provide guidance for SOLAS modeling efforts. W. McGillis is the lead author of the gas transfer article, and G. De Leeuw is the lead author of the particle transfer article. Both articles are expected to be finished in 2007. They are intended to open avenues for developing more sophisticated gas and particle transfer parameterizations in Earth system models (**"science, new directions"**).

Handbook on best practices of ship/buoy flux measurements. The aim of the Handbook is to meet the expressed needs (**"responsiveness"**) of flux researchers of different experience, including students, with a standardized, comprehensive description of observational practices. After two years of work (authors F. Bradley and C. Fairall with contributions from many members of WGSF), the Handbook was printed in September 2006 and unveiled at the International Marine Technicians Symposium, Woods Hole, 17–19 October 2006, (ftp://ftp.etl.noaa.gov/user/cfairall/wcrp_wgsf/flux_handbook/).

Global estimation of VOS sampling uncertainties. Using the latest updates of ICOADS, IORAS, ECMWF, and IFM-GEOMAR, a new comprehensive analysis of sampling effects in VOS fluxes was produced (**"science", "impact"**). These uncertainties may regionally amount to tens of W/m^2. Results were published in a two-part article in *Journal of Climate* in 2007. A surface flux dataset from in situ observations, which includes estimates of uncertainty, is under development at the National Oceanography Centre, Southampton (E. Kent and D. Berry) and will be made available in 2007 (**"value added"**).

Radiative flux results. A motion-stabilized platform for infra-red and solar radiative flux sensors is being developed at NOAA (C. Fairall). It will be field tested in 2007. (**"science"**)

Ocean reanalysis. About 15 different ocean reanalysis projects are being carried out and evaluated (B. Barnier) under the coordination of CLIVAR GSOP (**"science", "value added",** see http://www.clivar.org/organization/gsop/synthesis/synthesis.php). Comparisons of fluxes produced by various ocean reanalyses show that the surface flux estimation depends on the models ability to resolve frontal dynamics, and that the sensitivity to the initial guess needs to be known (this later point calling for improved observed flux data and flux error estimates). Ocean reanalysis has real potential to help improve the surface flux estimation, especially because it may reconcile the global balance problem. Surface fluxes are therefore recognized as important metrics in the evaluation procedure of ocean reanalyses, and need to be evaluated against observed fluxes. (**"impact"**)

Fluxes in high winds. Two papers detailing the first direct measurements of humidity and momentum fluxes in winds of 30 m/s will appear shortly in *J. Atmos. Sci.* (W. Drennan, **"Science"**).

New near real time 6-hourly surface wind analysis for the global oceans with 0.25 degree resolution is now complete for the period from April 1, 2004 to Present. The product integrates satellite observations and atmospheric model analyzes surface meteorology, and is developed by IFREMER under the European Integrated project MERSEA. The data and reference information can be found at http://www.ifremer.fr/cersat/facilities/mwf-blended-nrt/ or at http://www.mersea.eu.org/forcing-F/1-forcingfield-blended.html (**"value added"**).

10. Flux products ("science", "value", "impact", "responsiveness", "new directions", "challenge")

WCRP requires a calibrated, validated and complete set of surface flux products with an estimate of error. It needs to unify efforts of several research groups and projects working in this area and to have a complete inventory of existing products as well as developing products. Currently, there are several new generation sea-air flux products. Of recent products, we note the 20-year WHOI daily blended surface fluxes; NOAA blended satellite winds at ¼ degree resolution, covering about 18 years; and IORAS surface roughness (wind waves) products. Coordination of this type of work by the many groups and projects is absolutely essential. The full scope should include fluxes over land, sea-ice covered ocean, and estimates of precipitation and evaporation. The groups with interest in this area include (but are not limited to) WGSF, GEWEX, SOLAS, SeaFlux and iLEAPS. The JSC is invited to recommend the way forward for these activities, which would efficiently use available resources, exclude duplication, and possibly serve users both within and outside WCRP. It may require a working group with a wider range of responsibilities than the WGSF or a completely different arrangement.

At the same time, recent progress achieved by WGSF in reinvigorating the SURFA project should be preserved. The JSC may wish to recommend conducting a one-year-long pilot study and forming a SURFA research group, and it would be also desirable to express WCRP's gratitude to the NOAA NCDC for their agreeing to host the SURFA archive.

WORLD CLIMATE RESEARCH PROGRAMME

JSC-XXVIII/Doc. 5.6
(14.II.2007)

Item 5

JOINT SCIENTIFIC COMMITTEE

TWENTY-EIGHTH SESSION

ZANZIBAR, TANZANIA, 26-30 MARCH 2007

SURFACE OCEAN-LOWER ATMOSPHERE STUDY

ANNUAL PROGRESS REPORT 2006

SURFACE OCEAN-LOWER ATMOSPHERE STUDY

ANNUAL PROGRESS REPORT 2006

Website: http://www.solas-int-org

Scientific Steering Committee (SSC) membership in 2006

Name, Country	Expertise
Peter Liss, UK (Chair)	Microlayer / Air-Sea Overview
Isabel Cacho Lascorz, Spain	Palaeoceanography
*** Ken Denman, Canada ***	Biogeochemical Modelling
Guang-Yu Shi, China	Coastal Processes
Barry Huebert, USA	Atmospheric Aerosols / Processes
Tim Jickells, UK	Air-Sea Exchange of Nutrients
Truls Johannessen, Norway	Ocean Carbon
Christiane Lancelot, Belgium	Biological Oceanography / Nutrients
Gerrit de Leeuw, Netherlands	Atmos Boundary Layer Physics
Patricia Matrai, USA (Vice-chair)	Sulfur Compounds and Processes
Wade McGillis, USA	Oceanic Boundary Layer Processes
William Miller, USA	Marine/Atmospheric Photochemistry
Ulrich Platt, Germany	Halogen Compounds and Processes
*** Sergey Gulev, Russia ***	Air-Sea Exchange
Shigenobu Takeda, Japan	Marine Biogeochemistry
Mitsuo Uematsu, Japan	Atmospheric Aerosols / Deposition
Osvaldo Ulloa, Chile	Biological Oceanography / N2O
Doug Wallace, Germany	Air-Sea Chemical Exchange / CRCs

*** denotes WCRP delegate to the SSC

SOLAS International Project Office (IPO)

School of Environmental Sciences
University of East Anglia
Norwich, Norfolk NR4 7TJ, UK
Executive Officer: Jeff Hare. E-mail: jeff.hare@uea.ac.uk
Project Officer: Emily Breviere. E-mail: e.brévière@uea.ac.uk

a. Scientific Highlights

One of the most significant and discrete scientific developments for SOLAS within the past twelve months is the publication of a synthesis of over a dozen open ocean iron enrichment experiments that have been conducted over the course of the past decade. During the 2004 SOLAS Open Science Meeting in Halifax, it was recognized that there was a critical need to establish in one document the totality of the response results from the various controlled experiments to add iron to the ocean surface. In October 2005, SOLAS was the primary sponsor of a workshop of the world's experts on the science in the city of Wellington, New Zealand. Twenty-one scientists from 9 nations met for a week to discuss the various responses to iron enrichment and to synthesize this information into a single publication. The result is the publication of the Science article by Boyd et al., 2007 (see below).

In November 2006, 30 scientists from a dozen nations met at the University of East Anglia for a workshop on the "Anthropogenic Nitrogen Impacts on the Open Ocean". Nitrogen is deposited to the ocean via atmospheric and riverine inputs, but the impact of increased nitrogen loading has not yet been discussed coherently within the scientific community. These concerns led SOLAS, NOAA, the International Nitrogen Initiative (INI), and the European Science Foundation (ESF) to sponsor a four-day workshop in Norwich, UK. The output of the workshop is expected to be at least one seminal review paper on the topic, suitable for publication in Science or Nature.

SOLAS has also led the development of the Asian Dust and Ocean EcoSystem (ADOES) consortium of scientists who are interested in the response of the ocean surface biogeochemical system on inputs of masses of dust from the Asian plateau. Two ADOES workshops were held in 2005 and 2006, and plans are underway to consolidate the participants into a research initiative.

In December 2006, SOLAS sponsored a workshop for the Comparison of Oceanic Dimethylsulfide Models (CODiM) in Brussels. This workshop is a continuation of discussions held during the 2004 SOLAS Open Science Meeting in Halifax, and seeks to conduct a systematic comparison of DMS ecosystem models against common data sets to spur improvements and indicate future observations to better constrain the dynamics of DMS systems. The CODiM exercise consists of two complementary initiatives: a comparison of different 1D DMS-ecosystem models with data sets from 3 different identified ocean sites and a task to compare global mechanistically-based 3-D DMS models against a database of DMS(P) measurements. A review paper is in process, entitled "A first appraisal of ocean DMS models and prospects for their use in climate models", and two detailed articles will be produced on 1D and 3D model inter-comparisons.

b. Value Added

WCRP is a sponsor of SOLAS, providing financial support to bring two additional scientists to the SOLAS SSC (Ken Denman and Sergey Gulev in 2006; Wade McGillis and Sergey Gulev in 2007).

SOLAS maintains a strong relationship with the WCRP's Working Group for Surface Fluxes (WGSF), with SOLAS Focus 2 being a compliment to the work of the WGSF. Of specific importance to the synergistic relationship between these two groups is the continuing development of improved parameterizations of air-sea fluxes of gas and particles. In September 2006, SOLAS Implementation Group 2 (IMP-2) and the WGSF met for a two-day workshop at the University of Heidelberg. IMP-2 and WGSF have jointly developed two review papers on the current state of gas flux parameterizations and aerosols, and these journal articles will appear sometime in 2007. These two groups have also developed a calendar of opportunities to meet and exchange ideas and collaboration.

SOLAS is a direct contributor to the CLIVAR VAMOS Ocean Clouds Atmosphere Land Studies Program (VAMOS is the Variability of American Monsoon Systems and is a CLIVAR project) which will hold its intensive field campaign in the fall of 2008. SOLAS has been a partner in the development of the science plan for the experiment, and SOLAS scientists will be included in the cruise and aircraft personnel.

SOLAS does have experimental activities in operation for the International Polar Year (IPY) and has been involved in the planning for joint CLIVAR/CliC/SCAR activities. Although SOLAS does not play a leading role in IPY activities, the other WCRP projects have included our input in their planning and coordinating workshops and meetings.

c. Impact

See sections **d.** and **e.**

d. Responsiveness

SOLAS-Japan has gained greater significance with the award of $9 million over a five year term for research into the ocean biogeochemical responses to changes in atmospheric composition and to evaluate the contribution of marine biogenic gases to climate change.

SOLAS-Germany was recently awarded $6.5 million for research over the next three years under the acronym SOPRAN (Surface Ocean Processes in the Anthropocene). Among the goals of this research effort are investigation into how changing atmospheric composition affects the surface ocean ecosystem, study of how climate-related changes in surface ocean processes alter oceanic emissions to the atmosphere, and process studies of the mechanisms and rates of air-sea exchange of gases and particles. In addition, the Germans have invested significantly into the development of the oceanic observatory off the Cape Verde Islands. The UK and USA have partnered to develop the atmospheric observatory on one of the islands.

SOLAS-USA recently published a national science plan, and the US community has solidified plans for a March 2008 gas transfer investigation cruise in the Southern Ocean.

The first five years of research funding for the SOLAS-Canada network has completed, and an incredible 140 (and counting) peer-reviewed publications have been generated from this program. There are plans to re-establish funding for the group after the national funding agencies have made readjustments to their finances.

SOLAS-UK has entered the field campaign stage. At least 3 cruises are planned for the next 12 months, and funding levels remain strong for participating scientists.

e. New Directions

SOLAS has secured leadership of a European Cooperation in the Fields of Science and Technology (COST) Action. COST is an EU-Framework funded mechanism to provide networking of European scientists to collaborate and coordinate research efforts. The COST Action 735 is largely SOLAS-based, with an emphasis on the development of air-sea flux fields of compounds of importance to climate and pollution. This network currently has three Working Groups, closely aligned with the three SOLAS Foci, and membership stands at about 60 scientists. It is anticipated that two meetings per year will be scheduled over the course of the five-year term of the project.

In parallel with the COST Action, the SOLAS IPO has also secured funding for the position of a "SOLAS Project Integrator". A young research scientist at the University of East Anglia (Dr. Tom Bell) has recently begun work in this position, which seeks to develop and maintain the global-scale databases of air-sea gas and particle fluxes.

f. Challenges

The largest challenge and constraint facing the SOLAS project is securing resources for support for synergistic activities. There are multiple interactions between WCRP projects and SOLAS (some of which are indicated above), but finding resources to make these activities a reality continues to be problematic. WCRP support for the WGSF is of great importance to SOLAS, as SOLAS has mentioned on a number of occasions.

SOLAS has two major activities planned for 2007: The Open Science Meeting (6-9 March) in the city of Xiamen, Fujian Province, China, and the International Summer School (20 October – 3 November) on the island of Corsica, France. These activities require an immense effort by the SOLAS IPO, the SOLAS SSC, and associated Organizing Committees. Significant IPO time and resources have been expended to develop support mechanisms for each of these activities.

14-02-2006	Compiled by Jeff Hare

WORLD CLIMATE RESEARCH PROGRAMME

JOINT SCIENTIFIC COMMITTEE

TWENTY-EIGHTH SESSION

ZANZIBAR, TANZANIA, 26-30 MARCH 2007

JSC-XXVIII/Doc. 5.7.1
(15.II.2007)

Item 5

Terms of Reference

International Council for Science (ICSU) – International Group of Funding Agencies for Global Change Research (IGFA) Review of the Earth System Science Partnership (ESSP)

Preamble

ICSU is a sponsor of the four global environmental change programmes: the World Climate Research Programme (WCRP; together with WMO and IOC), the International Geosphere-Biosphere Programme (IGBP), the International Human Dimensions Programme on Global Environmental Change (IHDP; together with ISSC) and DIVERSITAS – An International Programme on Biodiversity Science (together with UNESCO, SCOPE and IUBS).

In 2001 at the first Global Change Open Science Conference in Amsterdam the 1400 participants (from more than 100 countries) signed the Amsterdam Declaration on Global Change. The declaration called for strengthening the cooperation amongst the global environmental research programmes, for greater integration across disciplines, environment and development issues and the natural and social science. It also called for greater collaboration across national boundaries and for intensified efforts to enable the full involvement of scientists from developing countries.

In response to the declaration, DIVERSITAS, IGBP, IHDP, and WCRP joined together to form the Earth System Science Partnership (ESSP). The ESSP brings together researchers from diverse fields, and from across the globe, to undertake an integrated study of the Earth System:

- its structure and functioning;
- the changes occurring to the System;
- the implications of those changes for global sustainability.

The interactions and feedbacks between the component parts of the Earth System exhibit multi-scale temporal and spatial variability. Understanding of the System's natural dynamics has advanced greatly in recent years, and now provides a sound basis for evaluating the effects and consequences of human-driven change.

General reviews of the ICSU Global Environmental Change Research Programmes, as well as the global observing systems and all other relevant ICSU Interdisciplinary Bodies and Joint Initiatives, were conducted in 2002-2003 within the Priority Area Assessment on "Environment in Relation to Sustainable Development" as a component of the development of an ICSU Strategic Plan 2006-2011.

A specific review of the Global Environmental Change Research Programmes is specifically called for in the Strategic Plan 2006-2011: "ICSU will conduct individual reviews of its global environmental change research programmes. Special attention will be given to the development of the Earth System Science Partnership, which brings together the four programmes to address issues that are integral to sustainable development. The links between this Partnership and other ICSU Interdisciplinary Bodies and Members will be considered as part of these reviews."

Review of the Global Environmental Change Research Programmes in 2007-2009

The four Global Environmental Change Research Programmes have been reviewed in the past:
DIVERSITAS; management review by IGFA in 2003;
IGBP in 1987, 1991 and 1996;
IHDP in 2005; and
WCRP in 1995.

ICSU will review DIVERSITAS, IGBP, WCRP and ESSP in the period 2007-2009 through the appointment of individual Review Panels. ICSU has suggested to the International Group of Funding Agencies for Global Change Research (IGFA) that reviews be conducted by the two organizations jointly. In addition, other co-sponsors must also be involved in the reviews for DIVERSITAS (IUBS, SCOPE and UNESCO) and WCRP (IOC/UNESCO and WMO).

The reviews should be both reflective and forward-looking. They should evaluate past performance of the Programmes, review operational structures and assess future plans. The reviews will thus help guide the scientific research, which is vital for advancing our understanding of the functioning of Planet Earth. Such understanding is essential if we are to predict future trends in the development of the Earth as a system.

Research findings underpin many international Assessments such as the Intergovernmental Panel on Climate Change (IPCC), the Millennium Ecosystem Assessment (MA) and the planned biodiversity assessment (IMoSEB). Through such assessments, scientific research is supporting several global conventions such as the UN Convention on Climate Change (FCCC), the UN Convention on Biodiversity (CBD) and the UN Convention to Combat Desertification (CCD). Thus, global change research provides excellent examples of policy relevant science.

The WCRP has existed since 1980, IGBP since 1987, DIVERSITAS in its current form since 2002, and IHDP in its current form since 1996. During this period, the world has changed and political interest is today primarily on other issues than reducing the scientific uncertainties in relation to global change processes. The interest within the policy community has, for example, shifted to the Millennium Development Goals and the outcomes of the World Summit on Sustainable Development. The discussion currently centres on how research could help to alleviate poverty.

The Earth System Science Partnership (ESSP) has taken on the challenge of truly integrating natural and social sciences around common research questions and educating a new generation of scientists to address complex issues outside of disciplinary research structures. In doing so, it is hoped that a new generation of scientists can be trained to tackle complex, multidisciplinary issues.

The International Group of Funding Agencies for Global Change Research (IGFA) and ICSU have identified the need to more effectively bring the global change community together with the development community. Thus, a conference was organized in 2005 that brought the two communities together to discuss common interest and possibilities for increased collaboration. Reference is made to the presentation by Sara Farley at the IGFA Annual Meeting 2005 on "Rethinking Global Change & Development Research" and sessions during the ESSP Open Science Conference (November 2006). A major challenge for ESSP will be to try to build bridges between the global change and development communities.

Terms of Reference

ICSU and IGFA will conduct a review of the Earth System Science Partnership (ESSP), through the appointment of a Review Panel, to address issues that are integral to sustainable development and to build the science structure necessary to investigate coupled human-environmental systems. The components of ESSP are Joint Projects (currently addressing food, water, health and carbon), Integrated Regional Studies (currently MAIRS) and the Global Change System for Analysis, Research and Training (START).

The review will focus on both internal and external interactions. The major questions to be considered by the review are given below. The overriding objective should be to evaluate the extent to which the character of ESSP adds value to its priority areas of research and the national programmes that contribute to them.

The primary question that the review should answer is: "What do scientists, sponsors and the end-users get out of participating in and supporting the ESSP that they could not get from participation in the individual Programmes (DIVERSITAS, IGBP, IHDP, WCRP)?".

Additional questions to be considered are listed below. In addressing the questions, the review should go beyond providing simple "yes" or "no" answers and give the reasons for conclusions reached and, where appropriate, recommendations for improvement.

1. Scientific aspects

1.1 Is the scientific mandate of ESSP clearly stated, is it distinct from the mandates of the four sponsoring Programmes, and, if so, how?

1.2 Has the existence of ESSP added significant new approaches and components that could not have been part of the four Programmes?

1.3 How were the topics for Joint Projects developed and what strategic considerations were used to set priorities?

1.4 Do the scientific and implementation plans developed by the ESSP components (Joint Projects, Integrated Regional Studies and START) address key issues perceived as priorities by the scientific community?

1.5 Does the ESSP seek to achieve balance between natural and social sciences and, if so, what is the nature of this balance and is it appropriate?

1.6 Do the Joint Projects seek to achieve balance between global and regional approaches and, if so, what is the nature of this balance and is it appropriate?

1.7 The need to link global change and development research has been discussed. Has ESSP, or its components, developed in such a way that it could provide a platform for involving both the global change and development communities?

1.8 Do the ESSP Joint Projects, Integrated Regional Study and START receive input and benefit from the four Programmes?

1.9 Does the ESSP plan for syntheses and integration of results from its components, both within ESSP and with the four Programmes?

2. Policy relevance

2.1 Do the ESSP Joint Projects, Integrated Regional Study (MAIRS) and START address issues perceived as priorities by the policy communities? How have they interacted with the assessment and policy communities? Is it necessary to strengthen the policy relevance of the research and, if so, how?

2.2 Has ESSP developed a strategy for ensuring that its components are relevant to the Millennium Development Goals and Science for Sustainable Development? Has such relevance been clearly demonstrated to the user communities? Have the policy and other stakeholder communities made attempts to engage ESSP?

2.4 Is a specific forum necessary to enable ESSP and policy, as well as other stakeholder, communities to have a closer ongoing dialog and, if so, what might such a forum be?

3. Organization and Governance

3.1 The four Programmes are currently discussing substantive changes in the governance of ESSP. Does the proposed governance structure ensure appropriate mechanisms for priority setting and efficient coordination?

3.2 Has the ESSP made efforts to ensure long-term financial stability of its planning and coordination activities and, if so, have these efforts been effective? Has ESSP been important in fund-raising for the components?

4. Visibility and communication

4.1 Do the ESSP's visibility and communication efforts stimulate the international science, development and donor communities to contribute to the ESSP and are the various stakeholders cognizant of its activities?

4.2 Does ESSP involve the scientific communities in all parts of the world and, if so, to what extent??

5. Capacity Building

5.1 Have ESSP components been able to attract the interest of young scientists and to foster a new generation of scientists working in a more interdisciplinary research environment?

5.2 To what degree has START been instrumental in developing capacity for scientists in developing countries to participate in ESSP? Has this effort been successful and, if so, are there any lessons to be drawn from this? Should the Joint Projects and Integrated Regional Studies capacity-building activities be done in cooperation with START or independently, or both? If both, what activities are appropriate for START and what can the Joint Projects and Integrated Regional Studies better do themselves?

6. Resources

6.1 Recent information received from national and international funding agencies indicate that they are facing constraints on their budgets for global change research and for its planning and cooperation. Have planning, cooperation, and implementation of the ESSP been impacted by limited funding and, if so, what has the impact of such limitations been and what might such impacts be in the future?

6.2 Are the transaction costs of planning and coordination of ESSP reasonable?

6.3 Has the funding community been receptive to the transaction costs of increased coordination and multidisciplinarity in the ESSP activities that are in addition to the transaction costs of the four Programmes and its Core Projects?

The review process

During the first meeting, the Panel will agree on the conduct of the review, the information necessary to perform the review and the division of work. The Panel should also decide on the balance between review of ESSP relative to its component parts. It may be necessary to design an interview/questionnaire process for collection of views of ESSP leadership, Joint Projects, Regional Studies and START as well as individual participating scientists. The policy relevance should be assessed through interviews/questionnaires with representatives of various international assessments, UN framework conventions, relevant UN organizations and others (e.g., ICSU bodies) with an interest in the results from ESSP.

At its second meeting the Panel would review the collected material and prepare a first draft of its report. This draft would then be circulated to ESSP and its components and the four Programmes with the opportunity for them to provide factual corrections and comments. During a teleconference the Panel would review the comments received, and decide how the report should be amended before circulating the second version of the report to a wider audience (i.e., including ICSU bodies and IGFA members).

The final assessment report would be finalized at the Panel's third and last meeting and shortly thereafter submitted to ICSU and IGFA.

The Review Panel will be assisted by Dr. Leah Goldfarb, ICSU Science Officer, Environment and Sustainable Development.

Time Table

2006

October-November	Final approval of ToR and Membership. Members of Review Panel invited to serve.

2007

18-19 January	Preparatory meeting
26-27 April	First meeting of Review Panel
May-Sept.	Collection of information and interviews
23-25 October	Second meeting of Review Panel and half-day meeting with the ESSP Scientific Committee
~early Nov.	Preliminary report to ESSP for review
~mid Nov	Conference call to consider ESSP initial comments
~late Nov.	Draft report to ICSU, IGFA, and other relevant bodies for review.
17-19 Dec (or 7-8 Jan 2008)	Final Meeting of ESSP Review Panel and submission of report to CSPR and IGFA

2008

February	ESSP Review for consideration at CSPR meeting
April	Report to the ICSU Executive Board

Membership of the Earth System Science Partnership (ESSP) Review Panel

Lidia Brito
Department of Forestry
Universidade Eduardo Mondlane
Praça 25 de Junho, P.O. Box 257
Maputo
Mozambique
Email. lidia.brito@uem.mz

Adrian Fernandez Bremauntz
President, National Institute of Ecology
Secretariat of Environment
Periferico Sur 5000 / Col. Insurgentes
Cuicuilco, Mexico City
Mexico 04530
Tel. (52 55) 5424 6418
Email. afernand@ine.gob.mx

Louise Fresco (Chair)
University of Amsterdam
Spui 21
1012 WX Amsterdam
The Netherlands
Tel. (31 20) 525 6171
Email. l.o.fresco@uva.nl

Nicolas Gruber
Professor of Environmental Physics
Institute of Biogeochemistry & Pollutant
Dynamics, Dept.of Environmental Sciences
ETH Zürich, CHN E21.1, 8092 Zürich
Switzerland
Tel. (41 44) 632 1691
Fax. (41 44) 632 1691
Email. nicolas.gruber@env.ethz.ch

Göran Hydén
Department of Political Science
University of Florida
303 Anderson Hall
Gainesville FL 32611-7325
USA
Tel. (1 352) 392 0262 ext.295
Email: ghyden@polisci.ufl.edu

Walter Reid
Conservation and Science Program
The David and Lucile Packard Foundation
300 Second Street
Los Altos, CA 94022
USA
Tel. (1 650) 917 7239
Email. wreid@packard.org

Johan Rockström
Stockholm Environment Institute
Lilla Nygatan, 1
Box 2142
SE-103 14 Stockholm
Sweden
Tel. (46 8) 412 14 03
Email. johan.rockstrom@sei.se

Meryl Williams
Australian Centre for International
Agricultural Research (ACIAR)
GPO Box 1571
Canberra, ACT 2601
Australia
Tel. (61 2) 62 17 05 00
Email. scylla@myjaring.net

Hans Joachim Schellnhuber
(CSPR, *Ex Officio)*
Potsdam Institute for Climate Impact
Research (PIK)
P.O. Box 60 12 03
D 14412 Potsdam
Germany
Tel: (49 331) 288 2500
Fax (49 331) 288 2510
Email.: schellnhuber@pik-potsdam.de

IGFA *Ex Officio* (to be named)

WORLD CLIMATE RESEARCH PROGRAMME

JOINT SCIENTIFIC COMMITTEE

TWENTY-EIGHTH SESSION

ZANZIBAR, TANZANIA, 26-30 MARCH 2007

JSC-XXVIII/Doc. 5.7.2
(19.II.2007)

Item 5

Earth System Science Partnership Open Science Conference

9-12 November 2006, Beijing, China

Background

The first Global Change Open Science Conference in Amsterdam in July 2001 brought together scientists and other interested parties from 105 countries to describe, discuss and debate the latest scientific understanding of natural and human-driven changes to our planet. They examined the effects of these changes on our societies and our lives, and explored what the future might hold. A proceedings volume entitled "Challenges of a Changing Earth" has been published by Springer. Participants at the Conference signed "The Amsterdam Declaration on Global Change" which, amongst other things, stated that "A new system of global environmental science is required." It called for strengthening of current cooperation amongst the global environmental change research programmes and for greater integration across disciplines, environment and development issues and the natural and social sciences. It also called for greater collaboration across national boundaries and for intensified efforts to enable the full involvement of scientists from developing countries.

In response to the Declaration, the four international global environmental change research Programmes: DIVERSITAS, IGBP, IHDP, and WCRP created the Earth System Science Partnership (ESSP) devoted to the study of the integrated Earth System.

The ESSP decided that, five years after the first Global Change Open Science Conference, it was time to once again bring together the worldwide global environmental change research community to assess progress since the Amsterdam meeting and to lay plans for the future.

Objectives

The ESSP OSC (hosted by the China Meteorological Administration (CMA) in Beijing) had the following goals:

1) To present the results of the last five years of global environmental change research, emphasising the Earth System Science approach, in particular as it relates to carbon, food, health and water.

2) To highlight the rich variety of research conducted by the global environmental change community, particularly the GEC programmes' core and joint projects (including that of the WCRP), and how that research contributes to and supports the objectives of the ESSP.

3) To point the way for the next decade of Earth System Science.

Audience and outreach

The Conference attracted scientists and others interested in the Earth System Science approach to global environmental change research. This included the ESSP community and members of the broader global environmental change science and development communities, policy makers, practitioners, and journalists. Immediately prior to the main Conference, the 2nd International Young Scientists (YSC) Global Change Conference (organised by START and the CMA) provided an opportunity for selected young scientists to present and discuss their work and to participate in the ESSP Open Science Conference. A special effort was made to attract and support scientists from developing countries and post-doctoral researchers and graduate students to participate in the OSC. The OSC International Organizing Committee and START worked together to ensure that capacity building was an important element of both events. Indeed, the YSC offered a prestigious platform for young scientists from 35 countries around the world to present their research findings to one another and leading scientists in the field. It was intended, and succeeded to stimulate competition, encourage excellence, reward outstanding performance, and foster the development of personal and institutional networks. All YSC participants also took part in the ESSP OSC and awards were granted for the most outstanding contributions in three categories, best paper, best poster, and best CMA young scientist poster during the closing session of the OSC.

Added Value of the ESSP OSC

The ESSP Open Science Conference in Beijing was different from the OSCs of the Programmes in that it focused on the integrative and multidisciplinary aspects of the whole of the ESSP. The Conference marked the launch of the new ESSP Joint Project on GEC and Human Health, as well as the initial Science Plan of the Monsoon Asia Integrated Regional Study (MAIRS). Research networks were also created or strengthened and new projects are under development. The ESSP OSC generated a lot of media attention, thus raising the profile of the ESSP and attracting the public's attention to major GEC issues. There was also a special evening event to celebrate over 25 years of WCRP research.

Conference Impact

The ESSP OSC attracted over 900 scientists, policy-makers, and journalists. The next generation of Earth System Science researchers were also in attendance following the successful Young Scientists' Conference. Highlights of the ESSP OSC included an impressive variety of keynote presentations on advances in Global Environmental Change to Earth System Science and the way forward (presented by John Church). There were 44 parallel sessions ranging from Monsoon Asia to the future of Earth System Modelling to the governance of water, food, and carbon and over 500 poster presentations. Major outcomes of the Conference included the launch of the new ESSP Joint Project on GEC and Human Health as well as the launch of the Monsoon Asia Integrated Regional Study (MAIRS) initial Science Plan. The ESSP Open Science Conference delivered a message of urgency to governments to take action on issues of global environmental change and sustainable development. The Conference also received wide media attention, ranging from Chinese and German national TV, the Economist and the Financial Times, Nature, the BBC website and The Independent and Guardian Newspapers. For a complete list of media coverage, access: www.essp.org/en/media/media-coverage.html.

An ESSP OSC questionnaire will shortly be distributed to Conference participants to gauge the success of the ESSP OSC. Results of this survey will be used, for example, to assist with planning future events and to maintain participants interest in ESSP activities.

Celebration of WCRP Achievements

WCRP celebrated its 25th anniversary at the ESSP Open Science Conference in Beijing, China. The WCRP Director, Ann Henderson-Sellers, welcomed all conference participants and the organizing committee to join the celebration. Speeches given by Qin Dahe, Director of the China Meteorological Administration (CMA), the deputy Secretary General of the World Meteorological Organization (WMO), Yan Hong, on behalf of the WMO Secretary General, Mr Michel Jarraud, and Thomas Rosswall, Executive Director of the International Council for Science (ICSU), underscored the great progress that the WCRP has made in its long history in climate research and climate predictability. In his closing speech, John Church, WCRP JSC Chair, highlighted the many opportunities that evolve from building on the WCRP success story and the ESSP partnership.

Sponsorship

The ESSP is extremely grateful for WMO and WCRP sponsorship of the Open Science Conference.

Acknowledgements

The ESSP OSC would not have taken place without the leadership and dedication of the WCRP and its staff. Special thanks go to John Church, Ann Henderson-Sellers, Valery Detemmerman, Carolin Arndt, Mareile Wolff, Margaret Lennon-Smith, and Catherine Michaut. Strong JSC member and WCRP project participation at the ESSP OSC was also extremely encouraging. Thank you very much!

APPENDIX Lessons Learned – notes from ESSP Secretariat Review of OSC

1. **Programme development**
   a. Call for sessions/papers

   Allow for at least 3 months for the announcement to be circulated and the proponents to develop proposals. Make it clear that it's an ESSP integrative Earth System Science session and not a flag bearing programme/project (disciplinary) activity. Be careful that the session doesn't develop into a friends re-united. This, however, shouldn't be the case with a competitive and thorough review process.

   b. Review process

   Safety in numbers, have at least 3 reviewers per abstract and give at least one month to review the proposals – not 10 days over Christmas as was the case with this OSC.
   For the call and the review process, it is imperative to have a computer/IT system that you can trust and is easy to use.
   It would be good to set up a more refined review process with grades – as was done for other OSCs - rather than yes or no. This would have been very useful to allocate grants on the basis of scientific excellence. This can be done automatically and does not take much more time for the reviewer.

2. **Fund raising/ budget**

   Plan at least 3 years in advance, proposal development takes a serious amount of time and effort. Let IGFA know well in advance so that their member countries can set aside money. Venture out into new funding sources, i.e. foundations and private sector, but this takes times and you need contacts – something that we didn't have either of.

3. Participant support

a. Funding

i. Selection of candidates

A grading process would have helped to select the best candidates (see above).

ii. Distribution of funds

Need a serious amount of time and staff resources for this important task. Cannot be left to one or two people to handle.

b. Communications

Setting up some interviews before the conference starts is key to attract attention on the conference.

c. Visas

Make sure you have a competent local host to take care of visa matters. Instructions on the website should also be clear and concise. Check wording with local hosts.

4. Local logistics

a. Site Selection

Be realistic with the numbers you expect to attend and make sure that the Conference centre does not have a monopoly over the facilities, i.e. hotels, restaurants, printing services, or you will end up being charged ridiculous rates with poor service – as was the case with the Beijing International Convention Centre. The place completely lacked charm. The selection of the conference center, the surroundings, overall style of the conference are, in addition to the scientific content of course, what makes a conference a real success, something that people will remember and want to do again.

b. Housing (hotel, apartments, reservations)

The main organizer(s) should stay at the accommodation well in advance of the conference and check out the facilities (part of planning meeting). Make sure the staff speaks English and that the reservation system is simple and easy to use with competent sales staff.

c. Conference Centre Facilities

Booths

Get in there well in advance at least one day before to set up the booths. Nothing was ready on the booths on the part of the local organisers (the communications team was ready but not able to work properly). Get reimbursed if the convention staff does not open the floor to you on time. The ESSP OSC, however, had a nice balance of scientific organisations, ESSP and programme booths and academic publishers.

Main Hall

Make sure projection screens are clearly visible and that audio equipment is up-to-date.

Parallel Session Rooms

Check that the rooms are sound proof and that you can't hear sessions going on in other rooms.

Offices and Meeting Rooms

Check internet connections and phone lines are working properly. Have more than one key (if possible). Have informal meeting schedules posted on the office board so that people do not double book the office space, which can be used as a meeting room to save costs. It's all very well having a photo copier, but make sure that you have enough paper.

Support Staff

It was difficult to find venue staff whenever necessary to help set up or carry things. It was not clear that there were people who had been instructed to help us.

Social events

The banquets were very nice. However, having it hosted in a place different from the plenary would have been a big plus, but this is not something that we always have control over.

5. Presentations

Attract dynamic presenters; save the presentations and then post them on a website.

a. Plenary

Logistics: The screens were too small. The addition of an extra screen (centre stage) was very helpful.

Content: The final segment of the plenary lacked vision and dynamism. Participants must leave this kind of conference filled with excitement, and vision. By starting invitations earlier, we could improve the content of the final plenary.

b. Parallel sessions oral

The sessions were generally well attended, and interesting. It is important to keep the idea of keeping at least one slot, if not two open for discussions. The best sessions were those that had kept much time for discussion. Some people complained that there were too many sessions in unison.

c. Posters

Have poster sessions at the end of the afternoon with cheese and wine in a more relaxed environment – and keep the poster areas near where all the action is and make sure that the poster session numbers and themes are clearly highlighted and sectioned accordingly. This was probably the biggest failure of the ESSP OSC, it simply was not organised properly. This led to confusion, which was a shame because we had many (564), and that they were very interesting.

d. Other:

Arrange for key staff to have mobile phones; have a smaller, yet, leaner organizing committee; share the workload and don't over-burden one co-chair; we started the process very late, and had to rush a number of steps. More time would have allowed us to have a more successful call (and to capture a wider part of our respective communities), and perhaps to raise more funds.

6. Communications

a. Announcements and Circulars: Keep them short, sweet and eye catching
b. Web site: The importance of this tool cannot be stressed enough.
c. Programme Book: Have several people work on this, too much to expect one person to work on this. Excellent layout, and overall work.
d. Abstract book: As with the programme book.
e. Conference statement: Make sure there are no political sensitivities with the local host country well in advance. This is where we could make a difference by starting much before the drafting process. In Amsterdam, there were exchanges and discussions at least 3 months before the conference, and a draft statement was ready for participants to read and comment upon, at the opening. Participants provided comments, and were very involved in the process. Similarly for the DIVERSITAS OSC. A huge basket was placed in front of the plenary, and many comments were collected. These comments were examined, and taken into account. There was not enough time in Beijing to do this.

7. Media relations

The media campaign, overall, was successful with comprehensive media coverage ranging from Chinese and German national TV, the Economist and the Financial Times, Nature, the BBC website and The Independent and Guardian Newspapers.
a. Press releases: Press releases should in future target a set of specific scientific issues, rather than present the whole conference. Themes should be selected ahead of time by the scientific organising committee.
b. Press briefings
c. Interviews
d. Coverage in the media: Journalists seemed to be aware only of the climate change portion of the conference. The global environmental change message did not come through as clearly as it could have.

8. Additional Comments

In terms of scientific content, it was felt that the conference brought together initiatives of the 4 programmes next to each other, but not together. This was a very important first step (Amsterdam was an IGBP conference, not an ESSP, so Beijing was truly the first ESSP OSC). Next time, we have to make an effort to have better integration across the programmes, in addition to the activities of the joint projects, which are integrative in nature. 3 examples

include:
1) Monitoring. There was a separate session on biodiversity monitoring, and other sessions on monitoring related to other parts of GEOSS. It would have been more interesting to have a longer integrated session on the ESSP contribution to GEOSS.
2) Scientific expertise and policy making. There was a session on IMoSEB, the new IPCC like mechanism under exploration, for biodiversity. It would have been more interesting, to make it a session dedicated to science expertise and decision making in the context of the ESSP as a whole, with lessons learnt from the IPCC, the MA and other assessments.
3) Climate change and biodiversity. This could also be more integrated, and taken in a broader context.

WORLD CLIMATE RESEARCH PROGRAMME

JSC-XXVIII/Doc. 5.7.3
(2.III.2007)

JOINT SCIENTIFIC COMMITTEE

Item 5

TWENTY-EIGHTH SESSION

ZANZIBAR, TANZANIA, 26-30 MARCH 2007

GLOBAL CARBON PROJECT
Annual Progress Report
As of December 31, 2006

SCIENTIFIC STEERING COMMITTEE (SSC)

Michael Raupach, *Co-Chair,* CSIRO Atmospheric Research, Canberra, AU
Annan Partwardhan, *Co-chair,* Indian Institute of Technology-Bombay, IN
Philippe Ciais, Commissariat a L'Energie Atomique, Laboratorie des Sciences du Climat et de l'Environnement, Gif sur Yvette, FR
Christopher Field, Carnegie Institution of Washington, Stanford, USA
Patricia Romero Lankao, Universidad Nacional Autónoma de México (UNAM), México
Corinne Lequere, Max-Planck-Institute for Biogeochemistry, Jena, DE
Nebojsa Nakicenovic, International Institute for Applied Systems Analysis, Laxenburg, AT
Yoshiki Yamagata, National Institute for Environmental Studies, Tsukuba, JP
Yi Qe, Tsinghua University, Beijing, CN
Antonio Nobre, Escrtorio Regional do INPA, INPE-Sigma, Sau Palo, BR
Guy Midgley, South African National Biodiversity Institute, Cape Town, South Africa
Thomas Johansson, Lund University, SE
Pierre Friedlingstein, Centre National de la Recherche Scientifique, FR
Cheng-Tung Arthur Chen, National Sun Yat-Sen University, Taiwan

PROJECT OFFICES

Global Carbon Project International Project Office Australia
Pep Canadell, Executive Director
Rowena Foster, Centre Manager
CSIRO Earth Observation Centre
GPO Box 3023, Canberra, ACT 2601, Australia
Tel.: 61-26246-5631; Fax: 61-2-6246-5988
Email: pep.canadell@csiro.au; Rowena.Foster@csiro.au
Website: www.globalcarbonproject.org

Global Carbon Project International Project Office Japan
Shobhakar Dhakal, Executive Director
Yukako Ojima, Secretary
Centre for Global Environment Research
National Institute of Environmental Studies (NIES)
16-2 Onogawa; Tsukuba, Ibaraki 305-8506 Japan
Tel: 81-298-50-2672; Fax: 81-298-50-2960
Email: shobhakar.dhakal@nies.go.jp; ojima.yukako@nies.go.jp
Website: www.globalcarbonproject.org

There are also four Affiliated Offices with the GCP:

CarboEurope European Office
Annette Freibauer, Executive Officer
Max-Planck-Institute for Biogeochemistry
PO Box 100164, 07701 Jena, Germany
T: 49-3641-686726; F: 49-3641-686710
Email: afreib@bgc-jena.mpg.de

SCOR-IOC Advisory Panel on Ocean CO2
Maria Hood
Intergovernmental Oceanographic Commission
UNESCO; 1, rue Miollis
75732 Paris Cedex 15, France
T: 33-1-4568-4028; F: 33-1-4568-5812
Email : mhood@unesco.org

Affiliated Office in Beijing
Mingkui Cao, Executive Director (deceased in February 2006)
Shaoqiang Wang, Deputy Director
Bo Tao, Research Fellow
Institute of Geographical Sciences and Natural Resources
Datun Road, No.A11, Anwai; Beijing 100101; PR China
Tel: 86-10 6488 9808; Fax: 86-10 6488 9399
Email: caomk@igsnrr.ac.cn
Website : http://www.cern.ac.cn/12lj/caomingkui/gcpindex.htm

Roger Hanson
Carbon Cycle Science Program Office
US Global Change
1717 Pennsylvania Ave. NW, Suite 250
Washington, D.C.
U.S.A.
Email: rhanson@usgcrp.gov

ACTIVITIES IN 2006

VULNERABILITY OF CARBON IN TROPICAL PEATLANDS
23-26 January 2006, Sumatra, Indonesia

NETWORKS OF COMMUNITY ACTION FOR DECARBONIZING JAPAN
9 February 2006, Tokyo, Japan

ASIA-PACIFIC TERRESTRIAL CARBON SINK DYNAMICS IN A GLOBAL CONTEXT
13-15 March 2006, Beijing, China

VULNERABILITY OF FROZEN CARBON – first workshop
28-30 March 2006, Santa Barbara, California, USA

CLIMATE VARIABILITY AND THE CARBON CYCLE (Past, Present and Future)
CL044-EuroCLIMATE open session in European Geosciences Union (EGU)

CARBON FUSION: DATA ASSIMILATION IN TERRESTRIAL CARBON CYCLE SCIENCE
9-11 May 2006, United Kingdom

REDUCING EMISSIONS FROM DEFORESTATION IN DEVELOPING COUNTRIES
10-12 May 2006, Bad Blumau / Austria

VULNERABILITY OF THE CARBON CYCLE TO DROUGHT AND FIRE
5-9 June 2006, Canberra, Australia

GLOBAL CARBON BUDGET UPDATE
July-October 2006

MODEL-DATA FUSION: APPLICAT IONS TO CARBON-CLIMATE-HUMAN SYSTEMS
9-12 July, Vermont, USA

INTERNATIONAL CONFERENCE ON REGIONAL CARBON BUDGETS
16-18 August 2006, Beijing, China

6th SSC MEETING OF THE GLOBAL CARBON PROJECT
31 August – 2 September 2006, Mexico City

URBAN AND REGIONAL CARBON MANAGEMENT AT LOCAL AND REGIONAL LEVELS
Connecting Development Decisions to Global Issues. Open Science Conference
4-8 September 2006, Mexico City, Mexico

2nd EARTH SYSTEM SCIENCE PARTNERSHIP (ESSP) OPEN SCIENCE CONFERENCE:
Global Environmental Change: Regional Challenges
9-12 November, Beijing, China

HOW DO CITIES DRIVE THE GLOBAL CARBON CYCLE?
A session at ESSP Open Science Conference
10 November, Beijing, China

INTERNATIONAL OCEAN CARBON COORDINATION PROJECT (IOCCP)

SIDE-EVENT ON CO-BENEFIT OF AIR POLLUTION AND CARBON MANAGEMENT

COP-12 meeting of UNFCCC, Organized by ECN-Netherlands in collaboration with GCP and others, 15th November, Kenya, Nairobi

VULNERABILITY OF FROZEN CARBON – second workshop
28-30 March 2006, Santa Barbara, California, USA

GCP- IHDP IDGEC- NIES JOINT WORKSHOP ON INSTITUTIONAL DIMENSIONS OF URBAN AND REGIONAL CARBON MANAGEMENT
5th December 2006, Bali, Indonesia

GCP SEMINAR SERIES ON CARBON MANAGEMENT

PUBLICATIONS AND OTHER PRODUCTS

Global Carbon Project (2006c) The Global Carbon Cycle. Policy Briefing. GCP report no. 5.

Global Carbon Project (2006b) GCP Overview 2005-06. GCP report no. 4

Global Carbon Project (2006a). What can be learned from champions of ozone layer for urban and regional carbon management? GCP report no. 3, Tsukuba.

Plummer S, Arino O, Simon M, Steffen W (2006) Establishing an Earth observation product service for the terrestrial carbon community: the GLOBCARBON initiative. Mitigation and Adaptation Strategies for Global Change (2006) 11: 97–111.

Global Carbon Project (2005) Proceedings of the first International Workshop on Social Networks and Methodology: Applications to urban and regional carbon management. GCP report no. 2, Tsukuba.

Canadell JG, Raupach MR (2005): The challenge of stabilization CO2 atmospheric concerntrations. IGBP Newsletter 61: 19-20; IHDP Update 2/2005: 18-19

Romero P, Lopez H, Rosas A, Gunther G, Correa Z (2005): Can cities reduce global warming? Urban development and the Carbon cycle in Latin America. IAI Final Report

Raupach M, Rayner P, Barrett D, Defries R, Heimann M, Jima D, Quegan S, Schmullius C (2005): Model–Data Synthesis in Terrestrial Carbon Observation. Global Change Biology (2005) 11, 378–397

Canadell J, Ciais P, Cox P, Heimann M (2004) Quantifying terrestrial carbon sinks. Special issue in Climatic Change (in preparation)

Field C, Raupach M, (eds.) (2004) Towards CO2 Stabilization: Issues, Strategies, and Consequences, Island Press (in press).

Global Carbon Project (2003). The GCP Science framework and Implementation. Canadell JG, Dickson R, Raupach M, Young O (eds). Earth Science System, Partnership (ESS) Report Series No.1, GCP Report Series No 1, Canberra, pp. 69.

Sabine C, Hood M (2003) Ocean carbon scientists organize to achieve better coordination, cooperation. EOS 84: 218-220.

Canadell J, Zhou G, Noble I, (eds.) (2002) Land use/cover change effects on terrestrial carbon cycle in the Asian Pacific region. Science in China. Special Issue 45 Supp.: 1-141.

Hibbard K, Steffen W, Benedict S, Busalachi T, Canadell J, Dickinson R, Raupach M, Smith B, Tilbrook B, Velling P, Young O (2001) The carbon challenge. An IGBP-IHDP-WCRP project. Stockholm.

OUTLOOK 2007

GCP-IIASA-NIES WORKSHOP ON URBANIZATION, DEVELOPMENT PATHWAYS AND CARBON IMPLICATIONS
28-30 March 2007, Tsukuba
Contact: Shobhakar Dhakal

BIO-ENERGY AND THE CARBON CYCLE
TBA

VULNERABILITY OF METHANE HYDRATES
IIASA, Austria, March 2007
Contact: Nebojsa Nakicenovic and Pep Canadell

CARBON IN PEATLANDS: STATE OF THE ART AND FUTURE RESEARCH
15-18 April 2007, Wageningen, Netherlands
Contact: Juul Limpens
Meeting website: http://www.peatnet.siu.edu/CC07MainPage.html

WORKING GROUP MEETING ON "DEVELOPING CASE STUDY PROTOCOL FOR URBAN AND REGIONAL CARBON MANAGEMENT"
Colorado, date TDB
Contact: Shobhakar Dhakal

GCP SEMINAR SERIES ON CARBON MANAGEMENT
Contact: Shobhakar Dhakal

ACHIEVEMENTS/CHALLENGES/CONSTRAINTS

Achievements
The project is in full swing with a range of scientific activities, both initiated by the GCP and its partner organizations and materializing in output of individuals or parts of the SSC. Two most successful activities of GCP are on vulnerability of carbon pools and the Urban and Regional Carbon Management (URCM). GCP is in the process to start a new initiative on bio-energy and land use in carbon context.

Challenges
The main operational challenge will be the transition from the current team of co-chairs to a new leadership in addition to a major rotation of SSC members. Five members of the SSC were already replaced in 2006 and 5 more will need to be replaced by the end of 2007. GCP will try to become more relevant both in South American and Africa despite the initial difficulties to develop a relevant agenda for these regions. Both Antonio Nobre from Brazil and Guy Midgley from South African will be key new SSC members to support a larger engagement. An initial conference is planned next year in South Africa attached to the 7th SSC meeting.

Constraints
After the tragic death of Prof. Mingkui Cao, director of the GCP affiliated office in Beijing, we have a new director. This transition has slowed down the activity of the office which was playing both a regional role in Asia Pacific and a leading role in regional carbon budgets.

As always the IPO's are working with very limited funding and support.

MORE INFORMATION

You can find more information on the activities or download the publications from the GCP website at: www.globalcarbonproject.org.
We keep the most recent GCP ppt presentation at:
http://www.globalcarbonproject.org/about_the_gcp.htm.

14-February-2007	***Compiled by: Pep Canadell and Shobhakar Dhakal***

WORLD CLIMATE RESEARCH PROGRAMME

JSC-XXVIII/Doc. 5.7.4
(6.III.2007)

JOINT SCIENTIFIC COMMITTEE

Item 5

TWENTY-EIGHTH SESSION

ZANZIBAR, TANZANIA, 26-30 MARCH 2007

GLOBAL WATER SYSTEM PROJECT

GLOBAL WATER SYSTEM PROJECT

Report to WCRP JSC-XVIII, March 2007

The Global Water System Project is a Joint Project of the Earth System Science Partnership

The central tenet of the ***Global Water System Project*** is that, although human-induced changes to the water system are now global in extent, we lack an adequate understanding of how the global water system works and responds to disturbances, and how society can best adapt to rapidly-evolving new system states. The overarching question of the Global Water System Project (GWSP) is how human actions are changing the global water system and what are the environmental and socio-economic feedbacks arising from the anthropogenic changes in the global water system. Three core questions follow from this overarching question, and these questions make up the three major research themes of the GWSP.

The first question is *'What are the magnitudes of anthropogenic and environmental changes in the global water system and what are the key mechanisms by which they are induced?*' The activities related to this theme aim at the documentation and attribution of the global water system and will include examinations of the relationships between the global water system and water governance, land cover changes, climate change, water diversions, and nutrient and sediment transport.

The second question is *'What are the main linkages and feedbacks within the Earth system, arising from changes in the global water system?'* Related activities include studies of the linkages at different spatial scales in the global water system, arising for example through the international trade in virtual water, and studies of the legacy of human and natural interactions in the global water system. The goal of this theme is to gain a holistic understanding of the global water system.

The third question is *'How resilient and adaptable is the global water system to change, and what are sustainable management strategies?'* Related studies will deal with water requirements for nature and humans, the nature of the adaptive capacity of the global water system and approaches to enhance the capacity and the provision of ecosystem goods and services by the global water system. The aim of this theme is to understand implications for the future and to inform policy and decision makers.

Scientific Steering Committee (SSC)

Executive Committee of the SSC:

Joseph Alcamo (Co-Chair), Professor, Director of the Center for Environmental Systems Research, University of Kassel, Germany

Charles Vörösmarty (Co-Chair), Professor, Director of the Water Systems Analysis Group, University of New Hampshire, USA

Dennis Lettenmaier, Professor, Water Resource Engineering & Hydrology, Department of Civil and Environmental Engineering, University of Washington, USA

Robert Naiman, Professor, Aquatic & Fishery Sciences, College of Ocean & Fishery Sciences, University of Washington, USA

Claudia Pahl-Wostl, Professor for Resource Flow Management, Institute for Environmental Systems Research, University of Osnabrück, Germany

GLOBAL WATER SYSTEM PROJECT

Report to WCRP JSC-XVIII, March 2007

SSC Members:

Stuart Bunn, Professor, Director of the Australian Rivers Institute, Griffith University, Australia

Joyeeta Gupta, Professor of Policy and Law in Water Resources and the Environment, Free University of Amsterdam and UNESCO-IHE, The Netherlands

Felino Lansigan, Professor, School of Environmental Science & Management, University of the Philippines, Los Banos College, Philippines

Changming Liu, Academician of the Chinese Academy of Sciences, Institute of Geographical Sciences and Natural Resources, China

José Marengo, Professor, CPTEC / INPE (Center for Weather Forecasts and Climate Studies / National Institute for Space Research), Brazil

Christer Nilsson, Professor in Landscape Ecology, Leader of Landscape Ecology Group, Dept. of Ecology and Environmental Science, Umeå University, Sweden

Jay O'Keeffe, Professor, WWF Chair of Freshwater Ecosystems, Department of Environmental Resources, UNESCO-IHE, The Netherlands

Taikan Oki, Professor, Institute of Industrial Science, Hydrology and Water Resources Engineering, University of Tokyo, Japan

Hong Yang, Senior Research Scientist, EAWAG (Swiss Federal Institute for Aquatic Science and Technology), Switzerland

Eric Odada retired from the SSC in November 2006

WCRP QUESTIONS

VALUE ADDED: outcomes that would not have been possible without your /WCRP coordination

The GWSP is a Joint Project in the Earth System Science Partnership. Water is an international concern that goes beyond the interests and scientific resources of nations. As a Project true to the demands of the Amsterdam Declaration (2001), GWSP offers a high level of international coordination mainly aimed at bringing together social scientists and researchers from the geosciences and water management communities to address global environmental change issues. In its first two years, a team with global coverage of active research groups has made many important contributions to science, capacity building and education. Continuing to promote the relevant science, the Project has begun its second phase in 2007 with a special emphasis on product delivery.

GWSP defines its goals following a systems approach and addresses select scientific questions in an integrative way. The novel thrust of this Joint Project follows from the Scientific Framework that was only defined a few years ago. The GWSP research agenda involves specialists and generalist who promote the integrative aspects of global water system science in highly multi-disciplinary teams. Both the integrative approach and the high level of multi-disciplinarity require increased efforts of coordination.

The global water system is of universal interest. The community that is interested in and affected by global change issues related to the water system is dispersed over the globe. The needs and opportunities for international coordination are pressing and urgent. A multitude of stakeholders needs to be involved to make the science responsive and policy-informing. Without the leadership of ESSP via their Joint Projects, science that is relevant to assessments would only be undertaken in a limited fashion.

As the community that addresses the new paradigms is still in its infancy and limited in numbers, human and financial resources need to be pooled together in a worldwide effort to provide the support for research that faces the challenges of the Amsterdam Declaration. In doing so, GWSP provides mid-career and young scientists alike a forum to develop new skills.

GLOBAL WATER SYSTEM PROJECT

Report to WCRP JSC-XVIII, March 2007

SCIENCE: new and exciting scientific results that you can identify as a result of your recent activities and that have benefited from the international coordination that your/WCRP activity provides

The following GWSP scientific results are novel and promote the integrative approach that is unique to the Project.

Digital Water Atlas

The idea of the atlas is to map present, historical and possible future states of the global water system (GWS), and anticipated changes as well as those that have already occurred. The atlas will focus on basic elements and indicators and important links and feedbacks of the GWS. Data sets will be collected from research groups worldwide. Many ESSP products will be referred to. The IPO coordinates this activity and is responsible for the collection of data and metadata and the technical set-up of the atlas at a central site. The datasets will be provided for use in other programmes and modelling exercises. The Atlas will be launched on the GWSP website in spring 2007.

GWSP Water Indicators

The key objectives of this work are to: 1) Develop a new class of Indicators depicting the global water system, built on geospatial data beyond administrative units including the integrated GWSP database (Atlas); 2) Build liaison activities with interested partners; 3) Quantify system and subsystem states; 4) Engage the policy community with understandable "distillates" of more complex bio-geophysical information. In 2005 the SSC started a workshop series. The first workshop, hosted at the Centre for Ecology and Hydrology (CEH) in Wallingford, UK, in May 2005, focussed on indicators of water, poverty and food security. The report on this workshop was published in August 2006 as the first issue in the newly established GWSP publication series '*Issues in Global Water System Research*'.

Workshop on Global Water Governance

The IPO, in cooperation with GWSP SSC members C. Pahl-Wostl and J. Gupta, organised and convened the workshop "Governance and the Global Water System: Institutions, Actors, Scales of Water Governance Facing the Challenges of Global Change", 20-23 June 2006, Bonn. The workshop addressed the central questions at which scale water governance and water management regimes should operate and how they influence the adaptive capacity and vulnerability of the global water system. Forty researchers and policy-makers with expertise in the field of global water governance from around the world defined a research agenda for further collaboration. Follow-up research proposals are currently being developed and two journal special issues are being prepared.

GWSP - LOICZ Collaboration

Initial meetings were held and the following areas of collaboration identified:

- Comparing governance of freshwater and coastal systems
- Improving scientific understanding of saltwater intrusion to coastal aquifers
- Assessing the impact of river diversions and climate change on coastal processes
- Analysing the impact of land-use change, in particular mega-city growth, on coastal processes
- Identifying and comparing environmental flows of freshwater and estuarine systems
- Characterizing large-scale nutrient cycles

A meeting of GWSP and LOICZ researchers at Yale University in October 2006 defined three initiatives on these themes: (1) Deltas at Risk, (2) Coastal Zones at Risk, and (3) Constituent Transport Modelling Task Force. Further collaboration on these topics is underway, such as a joint GWSP-LOICZ session that was held at the ESSP Open Science Conference on "Global Environmental Change - Regional Challenges" in Beijing in November 2006.

Advanced Institute on Global Environmental Change and Water in the Context of the Millennium Development Goals

The objective of the Advanced Institute is to provide training and research opportunities for young researchers from Africa. This activity is a joint initiative of START, GWSP, GECHS, Free University of Amsterdam, UNESCO-IHE, and CPWC. The first Advanced Institute in the academic year

2007/08 was announced at the end of December 2006; deadline for applications is 10 March 2007; the Institute starts with a 3-week training course at UNESCO-IHE in September/October 2007 followed by a 12-month research period financially supported by the International Foundation for Science (IFS). Training provided by GWSP will address topics such as 'Unfolding the Changes in the Global Water System', 'Human Exploitation of the Global Water System', 'Resilience and Adaptation' and 'Ecological Implications of Changes to the Global Water System'.

Global Water System Lexicon (Glossary)

The overall aim of this glossary is to provide a coherent description of the elements of the Global Water System and a platform for interdisciplinary communication. A first version of the lexicon has been implemented by IPO staff. The lexicon, which is based on the wiki technology that facilitates online editing of terms and interactive lexicon entry discussions, was made available at a password-protected website (wiki.gwsp.org) for all SSC members. A first public version will be launched at the GWSP website in mid-2007 for worldwide interaction.

Workshop Series on Dam and Reservoir Data Bases

The IPO facilitates and co-organises a workshop series on dams and reservoirs. The workshop series is a joint initiative of the GWSP and The Nature Conservancy (TNC) to bring together the world's leading experts working on dams and reservoirs and their impacts on river basins and coastal zone areas. A first task is the harmonisation and optimisation of existing data sets from different disciplines. A first workshop has centered on the harmonisation and optimisation of existing data sets. It was co-organised by the IPO and held in April 2006 at TNC's headquarter near Washington, DC. A follow-up meeting of the network's Technical Group was organised by the IPO and held 12-13 October 2006 in Montreal, and planning is underway for a third workshop (May 2007 in Durham, New Hampshire, USA) to entrain a broader user community.

2nd GWSP Asia Network Workshop "Global water system hotspots in Asia region: mega cities and dams"

On June 8-11 2006 the second meeting of the GWSP Asia Network took place in Guangzhou, China. The main goals of the workshop were to summarize the existing state of knowledge on current cumulative impacts of mega cities and dams in Asia and to set and launch a research agenda with regard to mega cities and dams in Asia in the context of the global water system.

Curriculum Development

In its efforts to develop a curriculum on global water system research, the GWSP IPO has established a collaboration with NeWater, a European Union 6th Framework Integrated Project on the development of methods and tools for adaptive water resources management with a specific focus on vulnerability and adaptive capacity towards global environmental change. The GWSP IPO receives funding from NeWater for providing technical support and thematic input to the curriculum development and a summer school for junior researchers. As a first result, the GWSP IPO was able to fund the participation of 6 young researchers from Africa, Asia, Australia, and Europe in the 2006 NeWater Autumn School on Adaptive Water Management in Peyresq, France. Currently, the GWSP IPO co-organizes the NeWater summer school for 2007.

New GWSP publication series

Creation of a new GWSP publication series titled, "Issues in Global Water System Research". The first issue was published in August 2006: Sullivan, C. et al.: Mapping the Links between Water, Poverty and Food Security. Report on the Indicators workshop held at the Centre for Ecology and Hydrology, Wallingford, UK, 16-19 May 2005. GWSP *Issues in Global Water System Research*, No. 1. GWSP IPO, Bonn.
Available online at: http://www.gwsp.org/downloads/gwsp_issues_no1_lowres.pdf

GLOBAL WATER SYSTEM PROJECT

Report to WCRP JSC-XVIII, March 2007

IMPACT: impacts that your/WCRP activity has had recently on international or national policies or decision-making as a result of your/WCRP activity, associated international coordination, and others

Cooperation with Important International Water Organisations

The motivation behind this activity is that a systematic mechanism for providing advice from an independent science and technology community to policy-makers on the state of the world's water resources and water-related development interventions has yet to be established. The long-term goal of this effort is therefore to create an independent science and technology advisory for water and sustainable development. The envisioned advisory would resemble the "Subsidiary Body for Scientific and Technological Advice" (SBSTA) of the UNFCCC, which acts as a liaison and filter between the Convention users and the scientific community.
After some of its SSC members contributed prominently to the Millennium Assessment (Alcamo et al. 2005, Vörösmarty et al. 2005) the GWSP volunteered to participate in the reviewing process of the World Water Development Report; this initiative is still under negotiation. In the meantime the SSC started an effort to get involved in the 'UN Water' initiative, which resulted in a contribution to the Scoping Workshop for the UN Water Decade Office on Capacity Development, which will be established in spring 2007 at the UN University campus in Bonn, Germany.
In addition, a cooperation with the International Water Association (IWA) has been initiated through a number of meetings in 2006. A follow-up meeting for the definition of common GWSP-IWA agenda will take place in conjunction with a workshop jointly organized by The Integrated Assessment Society (TIAS) to be held in May 2007 in Washington, DC. at the venue of the 7th International Symposium on Systems Analysis and Integrated Assessment in Water Management of the International Water Association.

RESPONSIVENESS: new developments in national or international research agendas either contributed to or influenced by your/WCRP research agenda and delivered outcomes

As the GWSP is now transitioning from the initialization phase to the production phase, results of GWSP research will become more relevant. In 2006, GWSP has assisted in the development of a research plan for AFRICANESS, a regional cooperation on global environmental change research in Africa.

NEW DIRECTIONS: new scientific issues on the 5-10 year horizon (thematic or process) that you/WCRP are expecting to become high priorities in your/WCRP activities

In order to ensure product delivery during Phase 2 of the Project (2007-2010), the Executive Committee at its meeting in February 2007 identified three Integrative Study Areas (ISA) within which the implementation of the tasks of the Scientific Framework will be coordinated and the delivery of truly integrated and interdisciplinary research results will be secured. ISAs are targeted towards the production of scientifically outstanding and highly policy-relevant results. For the delivery of these results an integration of activities across themes and sub-themes of the Scientific Framework as well as across disciplines is a prerequisite. In this way, the ISAs are a strategic tool for the overall integration and synthesis of project results.

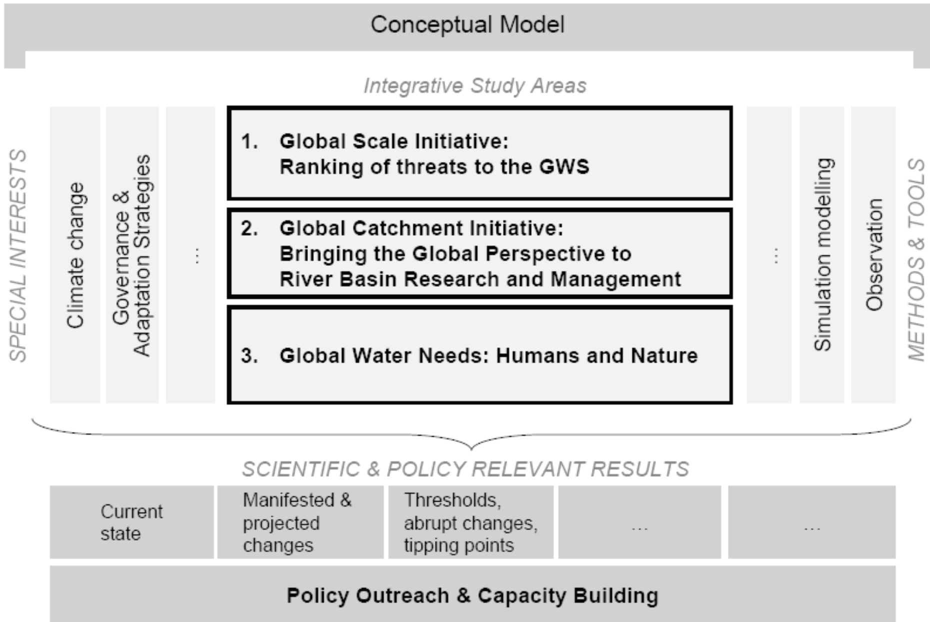
The three Integrative Study Areas are:

1. Global Scale Initiative: Ranking of Threats to the Global Water System
2. Global Catchment Initiative: Bringing the Global Perspective to River Basin Research and Management
3. Global Water Needs: Humans and Nature

This implementation structure will be developed further over the next few months. For each ISA a GWSP Expert Group will be established in order to promote, plan and coordinate the integrative research required to achieve the overall goals and objectives. Membership in GWSP Expert Groups will be open to the broader scientific community related to global water system research.

GLOBAL WATER SYSTEM PROJECT

Report to WCRP JSC-XVIII, March 2007



Expert Group 1 – *Global Scale Initiative*: Ranking of Changes to the GWS
Goals and Objectives:
a) Construct a global map of the major agents of change acting in the GWS.
b) Develop methods and tools for identifying hot spots of change.
c) Translate research findings about the global water system into priorities for policy.

Expert Group 2 - *Global Catchment Initiative*: Bringing the global perspective to river basin research and management
Goals and Objectives:
a) Bring the global perspective to river basin research and management. Encourage researchers working on a catchment level to address questions associated with the GWS not normally addressed in catchment studies
b) Identify regional feedbacks between the hydrologic system, the terrestrial environment, the climate system, and governance regimes
c) Analyse the impact of international institutions on the condition, management, and development of particular river basins
d) Compare water governance systems between different catchments and develop an international water governance typology

Expert Group 3 - *Global Water Needs*: Humans and Nature
Goals and Objectives:
a) Develop a global consensus on approaches for the assessment of environmental flow needs.
b) Consolidate the state of knowledge about human water consumption patterns and quantify the implications of future human water allocations on the sustainability of river ecosystems
c) Valuate freshwater ecosystem goods and services
d) Devise strategies for harmonising human and nature water requirements

CHALLENGES: Other than funding, have your/WCRP activities encountered any new significant challenges/obstructions that you feel have constrained scientific progress? Are there any ways in which JSC might assist in resolving these?

The major challenge that GWSP faces is that currently the number of scientists who are involved in integrative or systems approaches is limited and that many scientists have no or limited experience of working in a multi-disciplinary way. A new generation of scientists will have to be educated in a novel way. Of course, this is again related to the question of funding, because there are very few specific funding programmes that open an avenue to multi-disciplinary and/or integrative research. This was recently recognized by IGFA, but WCRP may wish to reiterate these programmatic infra-structure aspects as opposed to question of amounts of funding in future discussions.

For more detailed information about GWSP (SSC members, IPO, publications and activities) please consult *www.gwsp.org*

WORLD CLIMATE RESEARCH PROGRAMME

JSC-XXVIII/Doc. 5.7.5
(2.III.2007)

JOINT SCIENTIFIC COMMITTEE

Item 5

TWENTY-EIGHTH SESSION

ZANZIBAR, TANZANIA, 26-30 MARCH 2007

Earth System Science Partnership

GLOBAL ENVIRONMENTAL CHANGE AND FOOD SYSTEMS

Annual Progress Report 2006

GECAFS Global Environmental Change and Food Systems

SCIENTIFIC STEERING COMMITTEE (SSC)

As of December 31, 2006

SCIENTIFIC ADVISORY COMMITTEE

The Scientific Advisory Committee (SAC) provides overall guidance, and in particular, oversees the development of an active science programme; receives reports from GECAFS conceptual and regional projects; and prioritises activities of the science programme. It comprises representatives of a range of science communities (invited in their personal capacities, with approval of the IGBP, IHDP and WCRP Chairs and Directors) and nominees from GECAFS' strategic research partners.

Members
- Diana Liverman (Chair), University of Oxford, UK
- Anne-Marie Izac (Vice-Chair), CGIAR, Rome
- John Ingram (Secretary), NERC-CEH, UK
- Ahsan Ahmed, Bangladesh Unnayan Parishad, Bangladesh
- Hans-Georg Bohle, University of Bonn, Germany
- Angela Cropper, Cropper Foundation, Trinidad & Tobago
- Barbara Huddleston, FAO (retired), Italy
- Jim Jones, University of Florida, USA
- Richard Mkandawire, NEPAD, South Africa
- Mahendra Shah, IIASA, Austria
- Luis Viera, EMBRAPA, Brazil

Strategic Research Partner Nominees
- FAO: Prabhu Pingali, Agriculture and Economic Development Division
- CGIAR: Mark Rosegrant, International Food Policy Research Institute
- WMO: currently vacant

The SAC design also provides for up to four individuals representing different types of funding agencies interested in GECAFS research (i.e. foundations, bi-lateral development agencies, regional development banks and research councils). They are invited in their personal capacities to contribute to the general scientific discussion, but also with the objective of providing a liaison role with the different types of agencies. Oran Hesterman (WK Kellogg Foundation) and TBD (USAID) currently represent foundations and bi-laterals, respectively.

GECAFS EXECUTIVE COMMITTEE

The small Executive Committee is charged with ensuring the implementation of plans approved by the Scientific Advisory Committee; and reports to the Chairs and Directors of the sponsoring Programmes at their Annual Meeting. Representatives from IGBP-SC, IHDP-SC and WCRP-JSC sit on the Executive Committee to ensure good links with the Sponsoring Programmes. Representatives from IGBP and IHDP Secretariats act as Observers to help with implementation aspects. All members of the Executive participate in SAC meetings.

Members:
- Diana Liverman (Chair), University of Oxford, UK
- Anne-Marie Izac (Vice-Chair), CGIAR, Rome
- John Ingram (Secretary), NERC-CEH, UK
- IGBP-SC Representative (Mark Stafford-Smith)
- IHDP-SC Representative (Kate Brown)
- WCRP-JSC Representative (Pilar Cornejo)

Observers:
- IHDP Secretariat Representative (Maarit Thiem)
- IGBP Secretariat Representative (João Morais)

INTERNATIONAL PROJECT OFFICE (IPO)

As of December 31, 2006

The GECAFS IPO has re-located to the Environmental Change Institute at the Oxford University Centre for the Environment.

- **John Ingram,** Executive Officer, john.ingram@eci.ox.ac.uk *(NERC-funded)*
- **Polly Ericksen** Science Officer for "Vulnerability & Adaptation of Food Systems" polly.ericksen@eci.ox.ac.uk *(ESRC-funded)*
- **Sophie Paterson** IPO Manager, sophie.paterson@eci.ox.ac.uk *(NERC-funded)*

Funds are being sought for a DS / Scenarios Science Officer, to be based in the IPO.

SCIENTIFIC HIGHLIGHTS

Describe the major research findings the project has achieved during 2006 and include text references (if any), e,g, Watson et al (in press). Full references to be included in the section "Publications" (below).

- Food System conceptualisation for GEC research completed (Ericksen, 2006. submitted)
- Notions of vulnerability of food systems to GEC developed (Ericksen, 2006. submitted)
- Analysis of Case Study food systems in the IGP completed (Ericksen, in prep)
- Initial analysis of IGP vulnerability to GEC undertaken (Dixit at al; APN project – ongoing)
- Food system concept used to identify major uncertainties for European food systems over next 2-3 decades (ESF/COST Forward Look – ongoing)

MAJOR ACTIVITIES AND ACHIEVEMENTS

Describe the major activities of the Joint Project, e.g. research projects, special events (conferences, workshops, etc).

- **9 Jan,** IFPRI, Washington DC: GECAFS Introductory Seminar

- **6-9 Feb,** Wallingford, GECAFS Science Officer Meeting
- **21-23 Mar,** Barbados, Caribbean Science Plan drafting workshop.
- **16 May**, Oxford, Vulnerability of Food Systems Core-Committee meeting
- **17-18 May,** Oxford, Vulnerability of Food Systems Research Network meeting
- **19 May**, Oxford, GECAFS 5th Scientific Advisory Committee Meeting
- **20 May**, Oxford, GECAFS 10th Executive Committee Meeting
- **15-16 Jun**, Munich, C&Ds meeting
- **22-23 Jun**, Paris, ESF/COST Forward Look on European Food Systems in a Changing World
- **27-28 Jun**, Kathmandu, GECAFS IGP CPW&F Synthesis Workshop
- **29-30 Jun**, Kathmandu, GECAFS APN Launch Workshop
- **4 Jul**, Wallingford, GECAFS Seminar to CEH Staff
- **21-25 Jul**, Johannesburg, GECAFS SAF discussions at FANRPAN, NEPAD and DFID
- **12-14 Sep**, Dhaka, GECAFS IGP Science Plan drafting ws
- **19 Sep,** Stockton, UK, Café Scientifique
- **20 Sep**, Nantes, GECAFS presentation at IUFoST Congress
- **25-26 Sep**, Johannesburg, GECAFS SAF discussions at ICSU-Africa Forum
- **28-29 Sep**, Rome, Forward Look presentation at XXth Euragri Members Conference
- **16 Oct,** CEH Wallingford to University of Oxford - GECAFS IPO move
- **9-12 Nov**, Beijing, ESSP OSC
- **22 Nov**, Oxford, GECAFS Seminar at the Environmental Change Institute, University of Oxford
- **13 Dec**, Oxford, GECAFS 11th Executive Committee Meeting

Achievements:
- Preparatory food systems research in IGP completed (CGIAR-CPW&F funding)
- Follow-up research in IGP funded (APN funding)
- Prototype Caribbean Scenarios prepared and published (GECAFS Rpt 2) (ICSU/UNESCO funding)
- "Food Systems" concept established
- Advisory Cmmtt for Food Systems and Vulnerability established
- Scenarios cross-scaling methods discussed and applied
- GECAFS Southern African Science Plan published (GECAFS Rpt 3)
- GECAFS IGP and Caribbean Science Plans drafted

- 6 funding proposals prepared:
  - USAID/SANREM $768k for Caribbean research (unsuccessful)
  - APN $180k for IGP research (successful)
  - ESRC £200k for Vulnerability Science Officer (pending)
  - Defra £200k for DS Science Officer (unsuccessful)
  - DFID/Rockefeller £400k for Southern Africa research Phase I (pending)
  - Leverhulme pre-proposal for network activities (accepted; full proposal invited)
- New GECAFS Chair and Vice-Chair appointed wef 1 June 06
- Re-location of IPO to c/o ECI Oxford wef 1 Oct 2006
- Full re-design and publication of www.gecafs.org
- Convened GECAFS-related sessions at the ESSP OSC, Beijing
- Web-based GECAFS Forum designed and launched (ca. 100 subscribers by end Jan 2007)

Challenges:
- Securing funds for regional projects and maintaining momentum
- Securing funds for DS Science Officer post in the IPO
- Establishing collaboration with other Joint Projects and Core Projects of IGBP, IHDP & WCRP

Constraints:
- Lack of regional research funds
- Lack of DS Science Officer position

PUBLICATIONS AND OTHER PRODUCTS

List all publications in the peer review literature (science journals, special issues, books/ book chapter, etc), reports, datasets/databases, model(s), etc.

Published:
- GECAFS. 2006. Prototype GECAFS Scenarios for the Caribbean. *GECAFS Rpt **2.***
- GECAFS. 2006 GECAFS Science Plan for southern Africa. *GECAFS Rpt **3.***
- Zurek, M. 2006. A Short Review of Global Scenarios for Food Systems Analysis. *GECAFS Working Paper **1.***
- Ericksen, P. 2006. Conceptualizing Food Systems for GEC Research. *GECAFS Working Paper **2**.*
- Ericksen, P. 2006. Assessing the vulnerability of food systems to global environmental change: a conceptual and methodological review. *GECAFS Working Paper **3***.
- Henrichs, T. 2006. On the Role of Scenarios in GECAFS Decision-Support. *GECAFS Working Paper **4***.
- Zurek, M and T Henrichs. Linking scenarios across scales in international environmental assessments. 2007. *Technological Forecasting & Social Change (accepted)*
- GECAFS poster for ESSP OSC, Beijing
- www.gecafs.org redesigned

Submitted:
- Ericksen, P. Appraising methods for assessing the vulnerability of food systems to GEC. (Submitted to *Ecology and Society*)
- Ericksen, P. A Conceptual Framework Describing Food Systems–GEC Interactions. (Submitted to *Global Environmental Change*)
- Mano R et al. Southern African food systems in the context of global environmental change. (Submitted to *Environmental Science and Policy*)
- Ingram JSI, PJ Gregory and A-M Izac. The role of agronomic research in climate change and food security policy in the developing world. (Submitted to *Agric, Ecosystems and Environment*.)

In prep:

- GECAFS Science Plan for the Caribbean. 2007. GECAFS Rpt XX.
- GECAFS Science Plan for the IGP. 2007. GECAFS Rpt XX.
- Gregory PJ and JSI Ingram. Climate Change and Food Security. *Inside Agriculture*.
- Ingram JSI et al., 2007. Envisioning Earth System Science for Societal Needs: The development of Joint Projects and the Earth System Science Partnership (ESSP)

OUTREACH AND CAPACITY BUILDING ACTIVITIES

Newsletters, web sites, lectures, training & education, etc

- GECAFS Forum designed and launched to provide a platform for dialogue, information exchange, learning and promoting funding opportunities (Ericksen & Paterson)
- GECAFS Website completely redesigned and published (IPO/Paterson)
- GECAFS Seminars given at Environmental Change Institute, Oxford (Ingram & Ericksen)
- Café Scientifique on "Food Security and Climate Change" (Ingram)
- Global Seminar course developed and delivered in Univ Copenhagen (Henrichs, Erickson, Ingram)
- Advising Oxford MSc students (Ericksen & Ingram)
- Articles in Oxford University newsletters / website (Ingram)
- Regional Science Plans (Regional groups/Ingram)
- Regional food systems outreach (Regional Groups/Ericksen)

PROJECT ADMINISTRATION AND MANAGEMENT

IPO, Node/foci offices, sponsors

GECAFS International Project Office
Environmental Change Institute, Oxford University Centre for the Environment
South Parks Road, Oxford OX1 3QY, UK
Tel: +44 1865 285 176; Fax: +44 1865 285 534
www.gecafs.org

NERC IPO Funding until end March 2008 (Ingram & Paterson positions)
ESRC Science Officer Funding until end-March 2007 – renewal proposal submitted

INTERACTIONS

Describe activities/cooperation/new initiatives with other ESSP projects, international programmes, National Committees, etc.

GECAFS is co-convening (on behalf of the ESSP Chairs and Directors) a major planning workshop with the 15 Centers supported by the Consultative Group on International Agriculture Research Oxford, 21-23 February 2007.

GECAFS is establishing a major activity with FAO to plan a 3-to-5-year plan of work for FAO on GIS database development, case study applications and preparation of policy support and related communications products in the field of environment, food insecurity and poverty links.

GOALS AND PLANS FOR MAJOR ACTIVITIES IN 2007 AND 2008

1. Conceptual and Methodological Projects

Food Systems Concepts

- Completion of case studies in IGP
- Start of case studies in southern Africa

Vulnerability

- Networking a GECAFS Advisory Cmmtt on “The Vulnerability of Food systems to GEC and Adaptation”
- Development of GECAFS vulnerability and adaptation research.
- Establishment of a interdisciplinary Seminar Series

Scenarios

- Development of prototype scenarios for the IGP and southern Africa
- Refinement of scenarios for European food systems research

Decision Support (DS)

- Development of DS research in Caribbean, IGP and Caribbean
- Establishment of GECAFS DS Science Officer post

2. Regional Projects

Indo-Gangetic-Plain (IGP)

- Follow-up research activities including initial analyses of water-related GEC impacts on IGP food systems (APN funding confirmed)
- Publication of GECAFS IGP Science Plan

***Caribbean*:**

- Publication of GECAFS Caribbean Science Plan
- Initial Project funding for research activities
- Publication of paper on Caribbean food systems and GEC

***Southern Africa*:**

- SAF Core Fund Project funding for research activities

3. Other Activities

- Establish a DS Science Officer in IPO
- Help implement ESF/COST Forward Look “European Food Systems in a Changing World”
- Establish and implement protocols for GECAFS Partner Projects
- Follow-up on CGIAR–ESSP Workshop as appropriate
- Contribute to the ESSP Review as appropriate
- Plan GECAFS Conference, Oxford, April 2008

COMMENTS/OTHER INPUT

29-01-2007	***Compiled by: GECAFS IPO***

WORLD CLIMATE RESEARCH PROGRAMME

JOINT SCIENTIFIC COMMITTEE

TWENTY-EIGHTH SESSION

ZANZIBAR, TANZANIA, 26-30 MARCH 2007

JSC-XXVIII/Doc. 5.7.6
(15.II.2007)

Item 5

ESSP Joint Project on GEC and Human Health

The Challenge

The scientific community recognizes the growing need to better understand the multi-faceted and complex linkages between global environmental change (including climate change, land and sea use change, global biodiversity loss and change, global socio-economic change) and human health. However, as yet, little systematic research has been undertaken on the many important aspects of this topic. Nor has there been any sustained attempt to establish an international research community.

ESSP's Response

A fourth ESSP Joint Project (endorsed by the WCRP) on "Global Environmental Change and Human Health" was launched at the ESSP Open Science Conference in Beijing, November 2006. This Project will provide a focus of convergence for the three ongoing ESSP Joint Projects on the Global Carbon Cycle (GCP), the Global Water System (GWSP), and Global Environmental Change and Food Systems (GECAFS), each of which systems directly influences human wellbeing and health. The GEC and Human Health Project Planning Team have identified a set of key types of global environmental change that are known or suspected to have significant consequences for human health. The evolving Science Plan explores priorities and settings for the future coordinated international study of these relationships, taking into account the complexities of concurrently acting environmental changes and the importance of socioeconomic and cultural contexts as modifiers of community vulnerability.

Added Value

As this ESSP Joint Project on GEC and Human Health has just been launched it is too early to report scientific results, its impacts and the responsiveness of the Project at setting research agendas. However, the added value of this Project is clear in that it seeks to identify and quantify current health impacts of GEC and to forecast the future health impacts. These scenarios of future health impacts will form a new, dynamic and integrative node in the developing domain of Earth System Science. They will help focus on policy options that ensure a healthier and more sustainable future.

This Joint Project is being developed in collaboration with the World Health Organization (WHO).

Science

The main research objectives of the Project are to:

1. Identify and quantify health risks posed by Global Environmental Change, now and in the reasonably foreseeable (scenario) future.

2. Describe spatial (geographic, inter-population) and temporal differences in health risks, to better understand vulnerabilities and, therefore, intervention priorities.

3. Develop adaptation strategies to reduce health risks, assess their cost-effectiveness, and communicate results.

4. Foster research training, to boost networked international research capacity in Global Environmental Change and Human Health.

These objectives will be achieved by articulating the implementation strategy for this Joint Project around the following integrated themes that examine the relationships between Global Environmental Change and Human Health:

1. Atmospheric composition changes and their health impacts
    i. Climate change and health
    ii. Stratospheric ozone depletion and health
2. Land Use/Land Cover changes and human health issues
3. Infectious disease and Global Environmental Changes
    i. Land use/land cover change and vector/rodent-borne infectious diseases
    ii. Changes in human-animal relationships and emergence/spread of zoonoses
    iii. Food-borne, water-borne and other infectious diseases
4. Food-producing systems and health
5. Urbanisation and health
6. Vulnerability and adaptability: formal assessment of the situational and constitutional susceptibility of the at-risk community or population, and of the social and institutional resources available for reducing that susceptibility and coping with adverse health impacts.

Implementation

After the Project's launch at the ESSP Open Science Conference (Beijing, Nov 2006) Project implementation is now a priority. Implementation tasks include:

- Establishing an administrative infrastructure

- Finding funding sources for the IPO and for scientific activities

- Dissemination of project work plan

- Establishing the scientific steering committee

- Identifying key stakeholders

- Strengthening links with other international projects and networks, including the WCRP, its core projects and research community

- Developing a significant number of component projects

- Defining long-term strategic objectives

- Linking existing research gaps with Global Environmental Change and Human Health and help form new groups

- Periodic reassessment of goals, core questions and methods

International Project Office
We are exploring the possibility of the International Institute for Applied Systems Analysis in Vienna, Austria hosting the International Project Office.

Co-Chairs of the GEC and Human Health Project Planning Team
1. Anthony McMichael (National Centre of Epidemiology and Population Health, Australian National University, Canberra, Australia) and
2. Ulisses Confalonieri (National School of Public Health, Rio de Janeiro, Brazil).

Science Plan and Implementation Strategy
Copies of the Science Plan and Implementation Strategy can be downloaded from the ESSP website, www.essp.org. JSC members are welcome to comment on this Science Plan. Please send comments to Martin Rice (ESSP Coordinator), mrice@essp.org.

WORLD CLIMATE RESEARCH PROGRAMME

JOINT SCIENTIFIC COMMITTEE

TWENTY-EIGHTH SESSION

ZANZIBAR, TANZANIA, 26-30 MARCH 2007

JSC-XXVIII/Doc. 5.7.7
(15.II.2007)

Item 5

MONSOON ASIA INTEGRATED REGIONAL STUDY

ANNUAL PROGRESS REPORT 2006

MONSOON ASIA INTEGRATED REGIONAL STUDY

Annual Progress Report 2006

SCIENTIFIC STEERING COMMITTEE (SSC)

As of December 31, 2006

Prof. ***Congbin Fu***, Director START TEA Regional Centre, Institute of Atmospheric Physics Chinese Academy of Sciences, China. Chairman.
Prof. Dr. ***Michael Manton***, School of Mathematical Sciences, Monash University, Australia. Vice-chairman.
Prof. Dr. ***Jun Matsumoto***, Department of Earth and Planetary Science, University of Tokyo, Japan. Vice-chairman.
Prof. Dr. ***A.P. Mitra***, Director START SA Regional Centre, India National Physical Laboratory, India. Vice-chairman.
Prof. Dr. ***Chen-Tung Arthur Chen***, Institute of Marine Geology and Chemistry of Taiwan, China-Taipei.
Prof. Dr. ***Pavel Kabat***, Climate Change and Biosphere Centre, Wageningen University and Research Centre, Netherlands.
Prof. Dr. ***Toishio Koike***, Department of Civil Engineering, School of Engineering, University of Tokyo, Japan.
Dr. ***Louis Lebel***, Unit for Social and Environmental Research, Chiang Mai University, Thailand.
Prof. ***Shaw Chen Liu***, Environmental Change Research Project, Institute of Earth Sciences, Academia Sinica, China-Taipei.
Prof. Dr. ***Frits Penning de Vries***, Executive Director MAIRS IPO, *ex officio* member.
Dr. ***Karen C. Seto***, Department of Geological & Environmental Sciences, Center for Environmental Science; Policy Institute for International Studies, Stanford University, USA.
Prof. ***Liqin Shao***, Ministry of Science and Technology, China.
Prof. Dr. ***Anond Snidvongs***, Director START SEA Regional Centre, Chulalongkorn University, Thailand.

INTERNATIONAL PROGRAM OFFICE (IPO)

As of December 31, 2006

Prof. Dr. ***Frits Penning de Vries***, Executive Director
Dr. ***Ailikun***, Deputy Director
Ms. ***Yang Ying***, Information Officer.
Prof. ***Liqin Shao***, Scientific Advisor

SCIENTIFIC HIGHLIGHTS

MAIRS began its activities in 2006. These scientific highlights are related to how MAIRS perceives key research issues in monsoon Asia and to the formulation of its Initial Science Plan (ISP). There are no research results to disseminate for the time being.

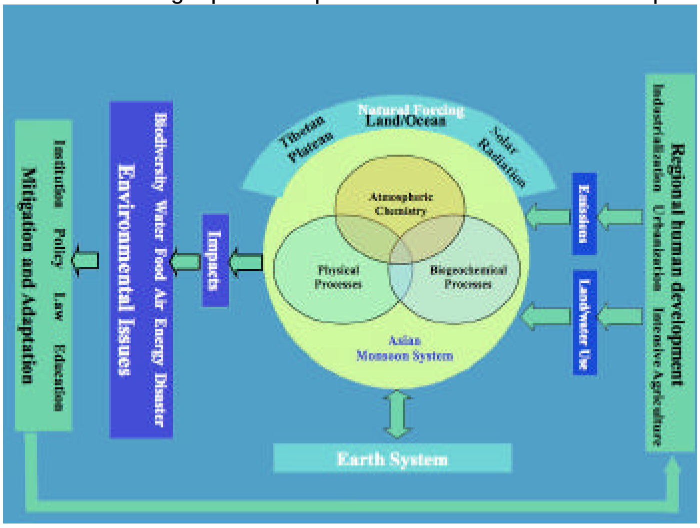
In the MAIRS context, we underscore the following principles:

1. MAIRS promotes research on coupled human–natural environmental systems in monsoon Asia and their dynamic linkages to the Earth System. This characterization defines our Niche in the ESS partnership. The task translates into three leading questions:
   - Is the Asian monsoon system resilient to human transformations of land, water and air?
   - Are societies in the region becoming more, or less, vulnerable to changes in the Asian monsoon?
   - What are likely consequences of change in monsoon Asia on the global climate system?
2. The System studied by MAIRS is "the environment and people in monsoon Asia" because the interactions between atmospheric, terrestrial and hydrological processes in parts of monsoon Asia are strong; intensive economic development and use of natural resources is a common feature across much of monsoon Asia — its ancient civilizations co-determined responses to environmental change. MAIRS will focus on issues that are important across monsoon Asia. Moreover, scientists from South, Southeast and temperate East Asia have complementary

knowledge and skills to address these issues.

3. The formulation of a Vision for MAIRS received ample attention; the statement had to be neither too broad nor too specific and needed to consider what the ultimate benefit of MAIRS research would be and for whom. We concluded that MAIRS *will significantly advance the understanding of the interactions between the human-natural components of the overall environment in the monsoon Asia region and implications for the global Earth System in order to support the strategies for sustainable development.* The Vision follows from pre-MAIRS meetings ("improved understanding"), but has been given a direction as well ("to support strategies for sustainable development"). The objectives of the MAIRS research program are a logical extension of the Vision (for details, see the Initial Science Plan, 2006).

The conceptual framework is a graphical representation of these three principles.



4. Themes for research were identified as "rapid transformation of land and marine resources in the coastal zones" (Coastal Zones); "multiple stresses on high mountain ecosystems and biophysical resources" (Mountain Zones); "degradation of land resources in semi-arid zones due to climate change and use" (Semi-arid Zones); and "changes in resource use and emissions as a result of rapid urbanization" (Urban Zones).

The key questions for these themes are:

- What are the effects of rapid transformation of land and marine resources in the Coastal Zones in the context of global change?
- What are the drivers and impacts of global environmental change on the ecologically fragile and human systems of the Mountain Zones of monsoon Asia?
- How will the Semi-arid Zone change over the next two to three decades in the context of changes in water availability, air quality, food production, provision of ecosystem goods and services as well as the occurrence of extreme natural events and hazards?
- Are Urban Zones changing, or altering, the vulnerability of societies to potential changes in the Asian monsoon?

Three of our zones are geographically well-demarcated: the Coastal Zones; the Semi-arid Zones (two large areas on the Pakistani-Indian border and in North China); and the Mountain Zones (not contiguous, but heavily dominated by the Himalayas and the Tibetan Plateau). The Urban Zones are not delineated so well. They correspond with a geographic area in the major urbanization centra and their surroundings, but crucial environmental issues are also present in cities that have not reached mega status yet.

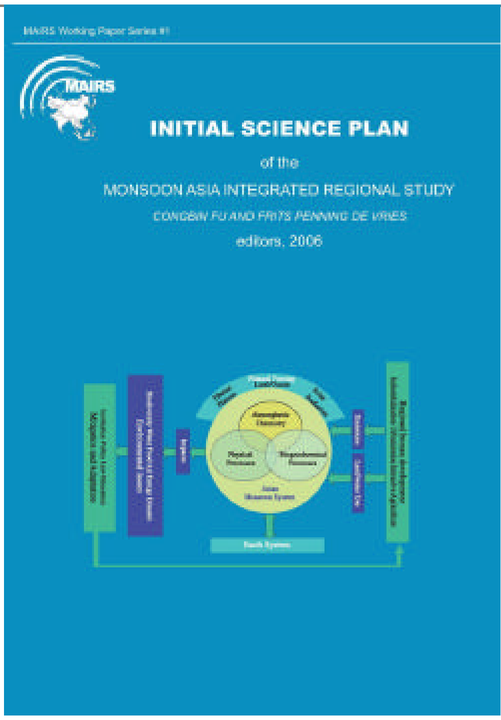
The Urban and Coastal zones overlap to a significant extent. For the time being, research questions for these zones have different angles so this is not perceived to be a handicap. It could be argued that other "zones" should have been included in the ISP, for example a lowland zone or further zonal integration. However there was neither time nor expertise to develop them for the ISP. Apropos biodiversity, there has been insufficient time to address issues at the platform level of other key anomalies.

5. Integration is both a concept and an approach. Despite very important resource management issues in monsoon Asia related to aspects of environmental change, including air quality and health, water degradation, natural disasters, threats to food security, energy and loss of biodiversity, we opted to focus on zones instead. The reason being that societies and people experience every aspect of environmental change simultaneously and everyone is affected by regional environmental change. Therefore, MAIRS themes are highly integrated. Identification of the themes was a benchmark step in 2006.

Integration distinguishes the Integrated Regional Study from the ESSP joint projects that focus on individual key aspects of environmental change (and at the global scale). MAIRS themes offer the opportunity to integrate research from joint projects as well as from other issue-driven projects into the complex reality of geographic zones.

6. MAIRS is a program to initiate and promote research. The program seeks to develop proposals for new research to answer questions framed in the ISP. These proposals will be outlined in planning workshops to which leaders from ongoing projects or relevant networks will be invited. One or more SSC members will lead such planning workshops. The workshops will also address possible funding mechanisms for the new activities, and identify additional research partners, in particular from monsoon Asian countries, who should be on board.

MAJOR ACTIVITIES AND ACHIEVEMENTS



A major activity was the development of the ISP. The foundation for the plan was laid out in the pre-MAIRS workshops, led by START, in 2003, 2004 and 2005. The outline of the plan was the outcome of an expert workshop held in Kunming, China, in April 2006, and it was approved at the first SSC meeting. A drafting team developed the outline further and reviewed drafts in July. From then onwards, emphasis was on production of the publication itself; the SSC had a clear preference for an ISP “with its own style”. The ISP was produced with the help of the RC-SEA and was presented formally at the Open Science Conference (OSC) in November 2006.

Another main activity was the establishment of the SSC. START identified candidates, in consultation with the GEC programs, invited them to join and provided terms of reference. The first SSC meeting was held in April, after the Kunming expert workshop, and the second was held during the OSC in November. “Implementation of MAIRS” by START refers to the establishment of the SSC, to its pre-MAIRS workshops to prepare a research program and to its contributions to the ISP.

MAIRS contributed to the organization of the OSC by organizing session 6 on monsoon Asia. The Beijing Statement of the Open Science Conference on Global Environmental Change mentions the initiation of MAIRS to examine the threats of environmental change on populations and the environment in monsoon Asia.

The SSC initiated a Workplan for 2007 and 2008. Working groups are being set up for the themes. ESSP-IPO’s will be informed of updates of the Workplan.

We held a short workshop in November 2006 to elaborate the ISP with research needed in the Mountain Zone. Several research proposals were drafted.

PUBLICATIONS AND OTHER PRODUCTS

Fu, C.B., F.W.T. Penning de Vries, Ailikun, C.T.A. Chen, L. Lebel, M. Manton, A. Snidvongs and H. Virji, 2006. The Initial Science Plan of the Monsoon Asia Integrated Regional Study. MAIRS-IPO, IAP-CAS, P.O. Box 9804, 100029 Beijing, China (80 pp), and http://www.mairs-essp.org/products.asp?c=2&cid=20.

OUTREACH AND CAPACITY BUILDING ACTIVITIES

We attracted attention to the new MAIRS program via:

- the website www.mairs-essp.org;
- introduction of MAIRS at the opening session of the OSC, as well as through a formal presentation of the ISP at this conference, and distribution of copies of the ISP;
- brochures (English, Chinese) that summarize the ISP;
- seminars (12) for RC-TEA and IAP staff and their students, at the IPO.

PROGRAM ADMINISTRATION AND MANAGEMENT

The IPO is located in the building of the Institute for Atmospheric Physics of the Chinese Academy of Sciences, in Beijing. It was opened formally in January 2006.

Program administration is carried out by the IPO under guidance by the SSC.

Internal procedures and inventories of resources have been initiated. After analysis, inventories will be made widely available.

MAIRS received a financial contribution from the Chinese Academy of Sciences that allowed for the creation of the IPO and SSC, as well as production of the ISP. START made a financial contribution to the Mountain Zone workshop.

INTERACTIONS

The focus of MAIRS in its first year was on consolidating basic thrusts. Interactions with ESSP colleagues beyond the SSC were rather limited.

The MAIRS program was presented at the following events: IGBP China meeting (January), the JRC meeting of the IGBP-WCRP (March), ESSP meetings in June and November, IHDP IT (January) and IDGEC workshops (December), the GWSP China meeting (June), the GCP China meeting (August), the AIMES SSC meeting (November), the RC-SA annual meeting (October), the NEESPI China meeting (November), as well as at the APN Annual Meeting (March). We organized the Mountain Zone workshop (November) with START and MRI.

Beyond the ESS partnership, MAIRS was presented to EAFES (East Asian Federation of Ecological Societies, March), Alterra China (March), INRA-SAD (Institute National de Recherche Agronomique, France, October) and the South China Agricultural University (November).

ACHIEVEMENTS/CHALLENGES/CONSTRAINTS

MAIRS has been put on the map for many Earth System scientists in Asia, including those related to the ESSP. It has also been accepted as the ESSP's first IRS. Moreover, the ISP provides contents and direction for the development of research proposals. In other words, MAIRS momentum has been created. Increasing awareness among Asian societies about global environmental change and potential impacts inspired by the Stern report and many national studies, has created a very receptive audience for MAIRS.

It will be a challenge in the years to come to use this momentum to produce results and generate impact. We should manifest several research projects based on the ISP so new research can commence. It is also necessary to collaboratively find practical ways to induce added value while linking with different ESSP projects in the region for the promotion of regional integration.

Research funding is a challenge for any new program. We aim to mobilize national program funding as well as international funding. The rate at which MAIRS will progress in 2007 and make use of the momentum created will depend, in part, on whether it has adequate funding for the workshops mentioned and for other activities.

The MAIRS working groups have considerable challenges. Involving younger scientists to support the busy senior members is urgently needed.

GOALS AND PLANS FOR MAJOR ACTIVITIES IN 2007 AND 2008

The Workplan for 2007 includes workshops on the following themes: Urban Zones (Thailand, April), Semi-arid Zones (Lanzhou, August), Mountain Zones (Kathmandu, autumn) and a cross-cutting meeting on Anthropogenic Impacts on the Asian Monsoon (autumn). Participation by members of the ESSP projects and GEC programs/projects will be important to initiate integration of findings and cooperation in research.

Plans for 2008 have not yet been expanded.

COMMENTS/OTHER INPUT

More exchange of practical information and procedures between IPOs of the ESSP projects and GEC programs/projects could enhance the efficiency and efficacy of their activities.

1 Feb 2007	***Compiled by: Frits Penning de Vries***

WORLD CLIMATE RESEARCH PROGRAMME

JSC-XXVIII/Doc. 6.1
(9.III.2007)

JOINT SCIENTIFIC COMMITTEE

Item 6

TWENTY-EIGHTH SESSION

ZANZIBAR, TANZANIA, 26-30 MARCH 2007

GCOS-GOOS-WCRP OCEAN OBSERVATIONS PANEL FOR CLIMATE (OOPC)

The GCOS-GOOS-WCRP Ocean Observations Panel for Climate (OOPC) is a scientific expert advisory group charged with making recommendations for a sustained global ocean observing system for climate in support of the goals of its sponsors. It also reports to JCOMM on requirements; the JCOMM Observations Programme Area coordinates many of the *in situ* networks of the global ocean climate observing system. The Panel aids in the development of strategies for evaluation and evolution of the system and of its recommendations, and supports global ocean observing activities by interested parties through liaison and advocacy (the list of meetings at which the Panel was represented[1] can be found on the OOPC website). The Panel works in close collaboration with CLIVAR, with representation from CLIVAR basin panels and the CLIVAR Global Synthesis and Observations Panel (GSOP) being critical to its way of working.

The sustained global ocean climate observing system is designed to provide data and information products for: climate monitoring and forecasting, climate assessment, and climate research. It is also the foundation for global operational oceanography, including global weather prediction and marine forecasting, and global and coastal ocean prediction.

The basic recommendations for the global ocean climate observing system (the global module of GOOS and the ocean module of GCOS) are written into the ocean chapters of two reports[2] to the UN Framework Convention on Climate Change (UNFCCC), published in 2003 and in late 2004.

This report will focus on the growing networks that make up the system and positive news emerging about them, as well as on challenges in moving to a fully functional and integrated observing system. A full report of the last OOPC meeting[3] (May 2006) is available. Specific input from JSC is sought on OOPC membership, on the development of a 2009 conference on successes and future challenges for the ocean observing system, and on continued advocacy for the ocean climate observing system and infrastructure (see Section 3).

[1] http://ioc3.unesco.org/oopc/calendar/

[2] The Second Adequacy Report and the GCOS Implementation Plan, both available at: http://ioc3.unesco.org/oopc/documents/background.php

[3] available on the meeting website http://ioc.unesco.org/oopc/oopc-11/

1. Plans and advocacy

Improved and more detailed recommendations for ocean satellite missions have been brought to the attention of the Committee on Earth Observation Satellites (CEOS) and the UNFCCC. After publication of the GCOS Implementation Plan (IP) at the end of 2004, the UNFCCC asked CEOS for a report on how they planned to respond to the GCOS IP. CEOS asked for more detail on the requirements for satellite missions, and the two reports, a GCOS IP supplement on systematic observation requirements for satellite-based products[4] and the CEOS response to the GCOS IP[5] were released in September 2006, recommending actions for satellite ocean observations of sea ice, sea level, SST, ocean colour, sea state, salinity, and in ocean reanalyses. The engagement from the satellite agencies has been promising, and will need continued follow-up.

The ongoing rolling review of the Integrated Global Observing Strategy (IGOS) Ocean Theme report provides an opportunity to look forward to emerging technologies and observing networks, both satellite-based and in situ, that will contribute to the future of the global ocean climate observing system.

The WCRP led an activity contributing to renewed recommendations for observations and research needed to improve understanding of sea level rise and variability, through a workshop held in June 2006. A summary statement of the findings and recommendations is available on the workshop web site[6]. These will inform future evolutions of the OOPC recommendations for the ocean observing system.

A number of regional enhancements to the ocean climate observing system will take place during the International Polar Year (IPY, 2007-2009). The OOPC remains engaged with the CLIVAR and CliC Southern Ocean and Arctic Climate Panels, and will work with them to learn lessons about the parts of the ocean observing system that can and should be sustained after the IPY.

The publication of the Intergovernmental Panel on Climate Change (IPCC) Working Group I report on the physical basis of climate change (2 February 2007) brought a lot of public attention to the issue of climate change, and noted contributions from global ocean observations, as well as some of the areas where observations and research were lacking (see story[7]). As societal vulnerability to climate is often felt through extremes, improved climate predictability on interannual to decadal timescales (in which ocean observations and coupled forecasting systems are critical) has large potential social benefit. The OOPC **invites the JSC** to consider how to best channel the growing societal awareness of climate change into advocacy for an improved global ocean climate observing system, as a part of an improved GCOS. Climate research, monitoring, and prediction remain the major user of the global ocean climate observing system, and continued advocacy by the WCRP is critical.

GODAE and the OOPC will be holding a workshop on Observing System Evaluations (OSE) and Observing System Simulation Experiments (OSSE) 5-7 November 2007 in Paris. The workshop will focus on reviewing OSE and OSSE work, on identifying robust features, and on developing preliminary recommendations for the observing system. Some specific topics will be low/high resolution altimetry, Argo, tropical moorings, high resolution SST, and new observing techniques (e.g., gliders, salinity).

---

[4] http://ioc3.unesco.org/oopc/documents/background/gcos-107.pdf

[5] http://ioc3.unesco.org/oopc/documents/background/CEOS%20Response%20to%20the%20GCOS%20IP.pdf

[6] http://wcrp.ipsl.jussieu.fr/Workshops/SeaLevel/

[7] http://www.ioc-goos.org/content/view/81

The development of these tools, along with expert judgment, will inform evolution of the recommendations for the global system.

The OOPC is participating, along with the International Ocean Carbon Coordination Project (IOCCP) and other interested groups, in organizing a symposium on multi-disciplinary sensors and systems for autonomous observations of the global oceans, targeted for 2008 ("OceanSensors08"). The development, testing, and proliferation of new sensors will advance our ability to observe a larger number of biogeochemical and ecosystems variables on a global scale. The objectives of the symposium would be to foster the exchange of information (including through a sensor database), assess the technology needed to meet observing system goals, and providing valuable input into a proposed general ocean observations symposium (see below).

Relations with the WCRP Climate Variability and Predictability project (CLIVAR) remain strong. CLIVAR ocean basin panel representatives are key to the functioning of the panel and their participation is supported by CLIVAR. The Panel cooperates closely with the CLIVAR Global Synthesis and Observations Panel (GSOP), which is largely focused on ocean reanalysis.

National reports on contributions and expected future commitments to both global and coastal modules of GOOS, including all aspects of the system (observations, data management, products and services, and coordination) have been requested for the upcoming June meeting of Intergovernmental Committee for GOOS (I-GOOS-VIII)[8]. The secretariat has worked to make sure that the reporting guidelines are consistent with the reporting requirements of nations under the UNFCCC, and requests for information from JCOMM.

2. State of the observing system

The global ocean climate observing system is making progress on many fronts, through the efforts and funding of national and international projects and programs. At the end of 2006 the *in situ* network elements of global ocean climate observing system were estimated to be 57% complete. The overall pace of progress has slowed (45% in 2003, 48% in 2004, 55% in 2005), although that masks remarkable progress made by Argo (2801 of a target 3000 floats in early March 2007); by the increasing real-time access to GLOSS tide gauge data, thanks to international support following the tsunami of December 2004; and with the surface drifting buoy network coordinated by DBCP, which now has a number of buoys reporting multiple times per day.

Progress with real-time metadata transmission is underway thanks to the JCOMM "Meta-T" pilot project. Awareness is growing within the ocean research community of the utility of real-time transmission of initial observations, as is the importance of improving metadata practices generally.

Ocean analysis and reanalysis activities are vigorous, through the AOPC/OOPC SST and sea ice and surface pressure working groups, GHRSST, GODAE, CLIVAR GSOP and national activities; interesting results and products have been obtained and comparison/evaluation metrics are being developed.

The OOPC web site on the state of the ocean climate[9] is gaining visibility and will be used to display new indices as they are developed. It was designed as a tool for basic evaluation of the capabilities of the observing system, by reporting key ocean climate indices and their uncertainty; and as a tool for advocacy about the capabilities of the global ocean climate observing system. The need for interesting

[8] http://www.ioc-goos.org/igoos8

[9] http://ioc.unesco.org/oopc/state_of_the_ocean/

indices based on subsurface ocean variability remains high, and is the subject of ongoing dialogue with CLIVAR groups.

Research programs continue to provide most of the support for global module activities; only limited progress has been reported of national actions for sustained observations and/or analysis activities.

3. Challenges and input requested of JSC

Seeking continued national support for sustained ocean observations, data systems, the generation of products, and coordination by JCOMM and other bodies is a continuing challenge for completion of the global ocean climate observing system. The WCRP represents the major user of the system, and the OOPC **invites the JSC** to continue advocacy for the need for climate observations to underpin climate research. The importance of understanding and predicting climate extremes was mentioned above. The OOPC **invites the JSC** to consider how to best foster improved climate predictability and forecasts on seasonal to decadal timescales.

The current composite *in situ* surface and subsurface networks described by the GCOS IP are in fact a collection of independent observing networks that coordinate through OOPC and JCOMM. Three of these networks (Argo profiling floats, DBCP surface drifters, and SOOP XBT lines) currently fund two technical coordinators at JCOMMOPS, and have found significant advantages in this cooperation. The Observations Programme Area of JCOMM hosted a roundtable in May 2006 on the possibilities for reinforcing and expanding this resource, and this will again be a major point on their agenda in April 2007, when the specifications for a call for proposals for an expanded Observing Program Support center will be discussed and finalized. The OOPC believes a reinforced center will be a critical element in strengthening global ocean observations, and **invites the JSC** to endorse this idea.

OOPC recommendations can be in many cases traced back to the science and technology presented at the OceanObs99 conference in San Rafael (1999). The OOPC has considered, and has been encouraged by the GCOS Steering Committee, to plan with other interested groups a new conference focused on global ocean observations and ocean products and services, in about 2009, ten years after San Rafael. The goals of this conference would be to take stock in progress and in major advances in scientific knowledge from the observing system, and to focus on challenges and opportunities, including new technologies, and new opportunities for global measurements of biogeochemical and ecosystem variables. This meeting would also address some of the evolutions necessary in the recommendations for the global ocean climate observing system focused on the physics of the ocean, including plans for deep ocean observations (sub-Argo), improved monitoring of critical transports, and sustained polar ocean observations. The OOPC **seeks input from JSC** on the rationale, objectives, scope, and development (including potential sponsors) of an Oceans09 conference.

The membership of OOPC[10] in 2006 can be seen on the OOPC web site, but note that the panel is augmented by CLIVAR basin panel representatives. Three panel members are rotating off (Dickey, Michida, Taylor). The OOPC **asks the JSC** to confirm two new panel members (CVs will be distributed at an executive session), and to nominate other panel member(s), particularly with expertise in global ocean biogeochemical or ecosystems measurements.

[10] http://ioc3.unesco.org/oopc/about/members.php

WORLD CLIMATE RESEARCH PROGRAMME

JOINT SCIENTIFIC COMMITTEE

TWENTY-EIGHTH SESSION

ZANZIBAR, TANZANIA, 26-30 MARCH 2007

JSC-XXVIII/Doc. 6.1
(13.II.2007)

Item 6

Global Climate Observing System
Report to World Climate Research Programme
Joint Scientific Committee-28
26-30 March 2007

1. General Considerations

As outlined in the GCOS Implementation Plan (item 3.2), observation of essential variables and the production of relevant climate products are often made in the context of research programmes or, in the case of space-based measurements, by Space Agencies whose primary mission is research and development. Once methods are sufficiently mature to guarantee a sustained set of observations to known and acceptable levels of accuracy to their users, they need to be maintained as part of a sustained observing system. Often the optimum arrangement is for the operation to be funded as part of a research laboratory's responsibility; in other cases it may involve the transfer of responsibility from one organization to another. This transfer of responsibility also implies sustained dialogue between the operational entities and the research community so that the operational arm may benefit from scientific advances. Although this transition into sustained observations has been difficult to implement in national and organizational planning, recent progress involving the establishment of "climate observatories" in some countries and decisions by Space Agencies has occurred, and further improvements are encouraged. GCOS will, with the agreement of the involved research entities and at the appropriate time, work with the relevant international programmes and their Members to ensure the sustained operation of essential research networks and systems for the "Essential Climate Variables" (ECVs). These basic ideas can serve as guidance in the definition and evolution of GCOS/WCRP relationships.

Cf. action C7 of GCOS IP:

Action: Ensure an orderly process for sustained operation of research-based networks and systems for ECVs. **Who:** System operators and research entities in cooperation with the GCOS Secretariat and the relevant international programmes (e.g., WCRP).

2. Issues for In Situ Measurements:

One of GCOS' main missions is to ensure that data obtained by various types of in situ measurements meet a number of quality criteria, in order to ensure that they respond to the needs of users of climate information. Many ECVs and derived climate products rely on research developments, from the development of adequate sensors to the establishment of global networks, in atmospheric sciences, oceanography, land-surface research, hydrology…Those developments are in some cases carried out by Meteorological or Hydrological Services (this requires adequate "climate objectives" as part of the specification of the missions of those services), but in other cases by research institutions. For example, the National Centre for Scientific Research in France sponsors a number of "Environment Research Observatories" dedicated to atmospheric composition, radiative measurements, remote sensing from the ground, and oceanographic measurements. Once new observation techniques are validated, networks are developed at regional or global scale. A good example is the progressive development of the Global Atmospheric Watch network starting from a few isolated research stations. International Programmes have then the important role of ensuring quality standards, appropriate data exchange and archiving practices, and encouraging a real global extent and value of those networks, including raising resources for station development and maintenance in developing countries. It is expected that a research programme such as WCRP would encourage, in the climate domain, the development of new measurement techniques, the development of high quality reference sites, the development and maintenance of research networks, the initiation and validation of new climate products at global scale, and the development of treatment and assimilation techniques for use of those products in models. The role of GCOS is to ensure that relevant institutions are willing to support the long term functioning of the stations, to ensure that "GCOS Climate Monitoring Principles" (GCMP) are met by stations and networks, including to encourage the development and maintenance of stations where appropriate, and the maintenance of high quality archiving centres.

3. Issues for Space Observations

As outlined in GCOS IP (item 3.4), a detailed global climate record for the future critically depends upon a major satellite component. However, for satellite data to contribute fully and effectively to the determination of long-term records, the system must be implemented and operated in an appropriate manner to ensure that these data are climatically accurate and homogeneous. To assist the Space Agencies, the GCMPs have been extended specifically for satellite observations. Their implementation by the Space Agencies for operational spacecraft and systematic research spacecraft greatly enhances the utility of satellite information and benefit the climate record. For "one time" research spacecraft, the principles of continuity obviously do not fully apply, but as many of the other principles as possible should be followed. Space Agencies, under the coordination of the Committee for Earth Observations Satellites (CEOS) and the Coordination Group for Meteorological Satellites (CGMS), have recently made substantial progress towards meeting GCOS requirements in the planning and development of space missions, including support to data processing and access by climate users. Please refer on this subject to publication GCOS-107 (systematic observation requirements for satellite-based products for climate) and CEOS document entitled "Satellite Observation of the Climate System" in response to the GCOS IP.

4. Specific Issues for GCOS-WCRP Relationships:

A number of actions from GCOS IP refer to WCRP as "agent for implementation". Some are specific to observation domains or ECVs, and some are more general and cutting across the various climate domains. Among the cross-cutting actions relevant to the present subject, in addition to action C7 mentioned above, one should mention action C12: "establish sustainable systems for the routine and regular analysis of the ECVs, as appropriate and feasible, including measures of uncertainty" and action C13: "establish a sustained capacity for global climate reanalysis and ensure coordination and collaboration between reanalysis centres". Those various actions or recommendations have served as guidelines for recent developments of GCOS/WCRP relationships, particularly within the joint panels AOPC and OOPC, the recently established WOAP, and the joint development of GEO actions. They have lead to specific action items agreed at GCOS Steering Committee XIV in October 2006, which can serve here as input to JSC discussions.

Action Item 3 (proposed by AOPC): The SC welcomed the work towards establishing a reference network of high quality observing sites, including surface and upper-air measurements, a high-priority requirement identified in the GCOS IP. GCOS expects here WCRP's support for the development of high quality radiosondes and the design of the reference sites, building upon some already well developed research stations such as "ARM" in Oklahoma.

Action Item 4 (proposed by AOPC): The SC requested the Secretariat to take appropriate actions, jointly with WCRP, to ensure continuation of the archive of BSRN data. This follows steps taken recently to have the BSRN, designed as a WCRP project with research objectives, recognized as a GCOS observing system. BSRN remains a research project with well-defined scientific objectives (development of advanced radiation observing techniques, validation for satellite observations and atmospheric models). GCOS support can be proposed on the following Items: securing a proper archiving centre with the required specifications and long term funding, advocate and raising funds for the maintenance of endangered stations and proper development of the network, especially in developing countries.

Action Item 5 (proposed by AOPC and WOAP): The SC endorsed GCOS co-sponsorship of the Third International Reanalysis Conference. GCOS has agreed to provide a nominal financial support for a few participants, and to jointly seek with WCRP a financial support from GEO, which has been agreed in its principle.

Action Item 8 (proposed by OOPC): The SC, recognizing that the present ocean system activities depend heavily on short term research support, requested the Chairman and Secretariat to foster discussion at the highest accessible intergovernmental and governmental levels regarding the need for mechanisms (including 'agents of implementation') to sustain global ocean observations, analyses and reanalyses. This item, considered as an essential component of the climate observing system, is included in GEO as a specific task involving both WCRP and GCOS. A negociation strategy remains to be defined.

Action Item 10. The SC requested that TOPC establish contacts with WCRP/CEOP in order to pursue better coordination of relevant surface measurements. It furthermore requested that the Secretariat invite a CEOP presentation at next SC meeting. Contacts with CEOP have proceeded, particularly at GEWEX SSG. A CEOP presentation is scheduled at next GCOS SC. The need for a better coordination of surface networks, including BSRN and the CEOP reference sites has already been established, with the proposal of having the CEOP reference network associated with GCOS, similarly to BSRN.

Action Item 20. The SC agreed on the principle of GCOS co-sponsorship of WOAP and requested that the GCOS Secretariat prepare, in liaison with the WCRP Secretariat, a precise proposal of agreement between the two programmes, including the necessary amendments of the terms of reference and a precise definition of what "co-sponsorship" entails for GCOS. This proposal should be presented for approval to WCRP JSC and GCOS SC. The basic agreement there is a "symmetry" between AOPC, mostly supported by GCOS, and WOAP, mostly supported by WCRP, similarly as OOPC, mostly supported by GOOS, and potentially TOPC; mostly supported by GTOS. Draft Terms of Reference are included as Annex I.

Action Item 21. The SC recommended the organisation of a workshop in the second half of 2007 (possibly in August), including representation of the IPCC Bureau, key IPCC authors from Working Groups 1 and 2, and WCRP and GCOS scientists, to build on the results of and questions raised by AR4. Very good progress has been made to date, both in terms of identifying funding and key participants.

Action Item 23. The SC suggested that SBSTA might wish to encourage the Parties that support Earth Observation from Satellites to engage their national space agencies in progressing the actions proposed and report to SBSTA on the progress made. Both GCOS and WCRP should be involved in further consultations on this matter. CEOS has proceeded with its Earth Observation Strategy in response to GCOS IP (cf parag.3 above), and a precise modus operandi involving both WCRP and GCOS remains to be defined. A specific action concerning the maintenance (and reprocessing when needed) of global data sets is one of the recommendations from the CEOS plan, and deserves a concerted GCOS-WCRP action with respect to space agencies. This action is already recommended by WOAP and part of a GEO task. It is proposed here to test the efficiency of the GEO-CEOS mechanism, by ensuring the "operational recognition" of a small number of global data sets by space agencies, starting for example with ISCCP and GPCP.

5. Concluding Remarks

Both GCOS and WCRP are facing severely constrained budgets. It is in the nature of a research organization like WCRP to have priorities that change according to the progress of research. It is in the nature of GCOS to be more conservative, with the safeguarding of the climate record as a primary concern. Between these differing charters lies a potential gap. On larger stages, for example satellite issues, such a gap has produced what the US National Research Council[1] termed a "Valley of Death," where worthwhile research initiatives languish for lack of uptake by organizations responsible for sustained observations.

But both GCOS and WCRP share the work "climate" in their titles, which involves an innate concern for longer time scales. It is one of the roles of the JSC to make this concern manifest in setting priorities for WCRP. In setting these priorities, there cannot be a tacit assumption that GCOS will assume responsibility for activities deemed lower priority by WCRP. This must be in the nature of the dialogue to take place at JSC-28.

[1] National Research Council (2000): *From Research to Operations in Weather Satellites and NWP: Crossing the Valley of Death.*

Updated 12 February 2007

Annex I

WCRP Observation and Assimilation Panel (WOAP)

DRAFT UPDATED TERMS OF REFERENCE

The WCRP Observation and Assimilation Panel (WOAP), was established by JSC-XXV (March 2004) in recognition of the need to provide a focus on and coordination of the observational aspect of WCRP's activities. Close links with GCOS and complementarity with the GCOS co-sponsored panels, AOPC, OOPC and TOPC, was recognized as an essential element in the definition of WOAP's activities. JSC-XXV also approved that any further activities of the *ad hoc* WCRP Satellite Working Group should be part of the remit of the WOAP, including the need to maintain and develop further close and strong working relationships with space agencies. In its October 2006 session, the GCOS Steering Committee agreed on the principle of co-sponsorship of WOAP by GCOS, with updated terms of reference to be presented for approval to both WCRP JSC and GCOS SC, as follows:

The main objectives of WOAP are:

a. to identify observational requirements for climate system analysis and prediction and assist in optimization of observational strategies for sustained observation and to act as a focal point for WCRP interactions with GCOS and other groups and programmes on observational issues.
b. to promote and coordinate synthesis of global observations from the atmosphere, oceans, land and cryosphere, and for the fully-coupled system, through analysis, reanalysis and assimilation activities across WCRP, including the Modelling Panel.
c. to promote and coordinate WCRP information and data management activities, including development of web sites, in liaison with WCRP projects.

WOAP members will include specified JSC members, representatives of project observational activities, the Chair of the WCRP Modelling Panel, the Chairs of the three panels AOPC, OOPC and TOPC, representatives from CEOS, IGBP and major reanalysis centres, with the possible addition of other experts as necessary and appropriate.

The business would be carried out by electronic means to the greatest extent possible, but it is expected that the WOAP will meet, if required, about once per year, often co-located with another WCRP meeting. The WOAP will report to the JSC and GCOS SC. The organization and cost of WOAP meetings will be supported by WCRP, GCOS Secretariat covering the participation of AOPC Chair and of its own members.

WORLD CLIMATE RESEARCH PROGRAMME

JOINT SCIENTIFIC COMMITTEE

TWENTY-EIGHTH SESSION

ZANZIBAR, TANZANIA, 26-30 MARCH 2007

JSC-XXVIII/Doc. 6.2
(13.II.2007)

Item 6

THE ROLE OF THE WORLD CLIMATE RESEARCH PROGRAMME (WCRP)
IN THE IMPLEMENTATION OF THE
GLOBAL EARTH OBSERVATION SYSTEM OF SYSTEMS (GEOSS)

The Role of the World Climate Research Programme (WCRP) in the Implementation of the Global Earth Observation System of Systems (GEOSS)

José Achache, GEO Secretariat

February 2007

The Group on Earth Observations (GEO) is an intergovernmental group leading a worldwide effort to build a Global Earth Observation System of Systems (GEOSS) over the next 10 years. GEO involves 66 countries, the European Commission, and 46 international organizations. The GEOSS vision, articulated in a 10-Year Implementation Plan, represents the consolidation of a global scientific and political consensus: the prediction and assessment of the state of the Earth requires continuous and coordinated observation* of our planet at all scales.

The GEOSS approach considers the Earth as an integrated system facing major common challenges, an intentional departure from earlier approaches looking at individual components of the Earth's system. Ultimately the objective of GEOSS is to develop the use of Earth observations by a broad range of users - from both developed and developing countries and ranging from decision- and policy-makers to scientists, industry, international governmental, and non-governmental organizations.

1. GEOSS - Implemented by GEO Members for Society

Today, disparate and disconnected Earth observation systems are coordinated for limited purposes. Systems speak different languages, use different formats, produce different data accessible to different parties, and they have different reference frames. In one sense, the main idea about GEOSS is to make these observation systems interoperable and to bring them together into a single system to serve society across nine societal benefit areas:

- Disasters (Reducing loss of life and property from natural and human-induced disasters)
- Health (Understanding environmental factors affecting human health and well-being)
- Energy (Improving management of energy resources)
- Climate (Understanding, assessing, predicting, mitigating, and adapting to climate variability and change)
- Water (Improving water resource management through better understanding of the water cycle)
- Weather (Improving weather information, forecasting and warning)
- Ecosystems (Improving the management and protection of terrestrial, coastal and marine ecosystems)
- Agriculture (Supporting sustainable agriculture and combating desertification)
- Biodiversity (Understanding, monitoring and conserving biodiversity)

GEOSS will be implemented by GEO members and participating organizations which - while retaining existing mandates and governance arrangements - will benefit from the GEO high-level framework to (i) build inter-disciplinary partnerships, (ii) advocate observation priorities (e.g. the continuity and availability of data sets at Ministerial-level), and (iii) improve coordination, and reduce duplication, of planned or ongoing activities.

2. The Climate Challenge

GEOSS will not be successful if it does not establish a global observation system that helps "improve our understanding of the Earth's climate system and the ability to predict climate change, and to mitigate and adapt to climate change and variability" (GEOSS 10-Year Implementation Plan Reference Document, p.61). Moreover there is a series of Targets that GEO is set to reach in order to meet the "climate challenge", including (see Annex I):

* "*Observation*" refers to the collection, processing, modeling, and dissemination of data about the Earth system.

Climate

- Enhance collaboration between observation, research and user communities
- Support the development of observational capabilities for Essential Climate Variables
- Identify climate products and information required for societal applications
- Develop and implement approaches responding to these requirements
- Facilitate access to climate data and models, particularly for developing countries
- Facilitate exchange of data and information across societal benefit areas
- Combine climate data with socio-economic information to better anticipate manifestations of climate change in areas such as Disasters, Health, Water, Ecosystems and Agriculture
- Develop a long-term strategy to improve observation capability, data assimilation and modelling
- Advance the monitoring and predictability of climate on seasonal, interannual and decadal time scales

Capacity Building

- Support national and international efforts in education, training, research, and communication
- Develop capacity building for (i) using Earth observation data and products; (ii) contributing to, accessing, and retrieving data from global data systems and networks; (iii) analyzing and interpreting data; (iv) integrating Earth observation data and products (with others); (v) improving infrastructure development in areas of poor observational coverage.

3. The Role of the WCRP

The WCRP Strategic Framework - together with the GCOS Implementation Plan - represents a commonly agreed basis for GEO actions in the Climate area. Moreover considering the Targets above, the WCRP has an essential role to play in GEOSS implementation. Projects and activities such as GEWEX, CLIVAR, CLiC, SPARC and the Earth System Science Partnership (ESSP) represent key contributions to GEOSS implementation and to the GEO 2007-2009 Work Plan in particular.

WCRP Contribution - Main Areas

1. Understanding Earth System phenomena (e.g. organized tropical convection, sea-level rise)
2. Connecting disciplines and addressing crosscutting issues (through e.g. the ESSP "Global Environmental Change and Human Health initiative")
3. Developing Earth System modelling (e.g. from a seamless approach) and data assimilation schemes (integrating both space and in-situ data)
4. Fostering the development of user-driven socio-economic applications and related forecasting systems
5. Enhancing capacity for using data & products
6. Producing and disseminating information relevant to decision makers (at all levels)

WCRP Contribution - GEO 2007-2009 Work Plan

The WCRP currently contributes to seven GEO Work Plan Tasks and has expressed interest in two new 2007 Tasks (see Annex II for details). Six additional Tasks may be of interest to the WCRP (suggestions by the GEO Secretariat).

Work Plan Tasks to which the WCRP currently contributes:

CL-06-02: Key Climate Data from Satellite Systems
CL-06-05: GEOSS IPY Contribution
CL-07-01: Seamless Weather and Climate Prediction System
WA-06-02: Forecast Models for Drought and Water Resource Management
WA-06-05: In-situ Water Cycle Monitoring
WA-06-07: Capacity Building Program for Water Resource Management
US-07-02: Millennium Development Goals

Work Plan Tasks for which the WCRP has expressed an interest:

WA-07-02: Satellite Water Quantity Measurements and Integration with In-situ Data
DA-07-06: Data Integration and Analysis System

Additional Work Plan Tasks that could be considered:

DI-07-01: Risk Management for Floods
HE-06-03: Forecast Health Hazards
EN-07-02: Energy Environmental Impact Monitoring
EN-07-03: Energy Policy Planning
DA-06-03: Ensemble-Technique Forecasting Demonstrations
CB-07-01: Capacity Building Strategy Implementation

4. Final Remarks

The success of GEOSS - as a global environmental information system for society - will depend on engagement and cooperation throughout the global scientific community and throughout the WCRP community in particular. The present document was prepared to illustrate this fact and to highlight key aspects of WCRP contribution to GEOSS implementation. Further information on GEO activities and 2007-2009 Work Plan tasks can be found at http://www.earthobservations.org/index.html.

Annex I

GEOSS Targets relevant to the WCRP (non-exhaustive list; see GEOSS 10-Year Implementation Plan Reference Document for a full list).

GEOSS Two-Year Targets

- Establish a strong collaboration mechanism between observational organizations and research communities, and users of climate information, to further refine the observations, analyses and products required (*Climate Target 031*)
- Focus on research programmes to support the development of observational capabilities for Essential Climate Variables such as tropospheric ozone, cloud and aerosol properties and their vertical profiles, CO2 and other greenhouse gases, soil moisture and groundwater, above-ground biomass, permafrost, snow cover and glaciers, and ocean salinity, carbon and nutrients and their vertical profiles (*Climate Target 036*)
- Coordinate climate sectors and broad user groups to clarify and specify requirements for socio-economic benefit areas (disaster prevention, health, energy, water resources, ecosystem, agriculture, and biodiversity) for climate products and information (*Climate Target 037*)
- Facilitate, with existing international, regional and national efforts, the maintenance and strengthening of education, training, research, and communication so that each country reaches and sustains a level of capability that enables them to participate in GEOSS, receiving maximum benefits from it according to their needs *(Capacity Building Target 101)*
- Facilitate access to data and models, particularly for developing countries *(Capacity Building Target 105)*

GEOSS Six-Year Targets

- Enhance the collaboration mechanism between observation organizations and research communities with users of climate information to make maximum use of the observations, analyses and products (*Climate Target 134*)
- Develop data integration facilities for exchanging data, products and information between climate sectors and socio-economic benefit areas (*Climate Target 138*)
- Emphasize detection of current and historical climate changes and their impacts linked with other societal benefit areas such as disaster, health, water, ecosystem and agriculture by combining the natural scientific data and socio-economic information and enforcing palaeoclimate research approaches (*Climate Target 139*)

GEOSS Ten-Year Targets

- Provide support to the development of a long-term strategy that encompasses progress in observation, data assimilation and modelling (*Climate Target 206*)
- Contribute to major advances in the monitoring and predictability of climate on seasonal, interannual and decadal time scales, including the occurrence of extreme events (*Climate Target 209*)
- Establish an evaluation mechanism for climate product applicability to socioeconomic benefits (*Climate Target 210*)
- Support climate sectors to implement tailored approaches to respond to socioeconomic requirements (*Climate Target 211*)
- Within 10 years, GEO will seek to have in place a sustained capacity building strategy that will have significantly strengthened the capability of all countries, and particularly of developing countries, to:
  - Use Earth Observation data and products (e.g. process, integrate, model) following accepted standards.
  - Contribute to, access, and retrieve data from global data systems and networks.
  - Analyze and interpret data to enable development of decision-support tools.
  - Integrate Earth Observation data and products with other data and products, for a more complete view and understanding of problems and derived solutions.
  - Improve infrastructure development in areas of poor observational coverage.
  - Develop recommended priorities for new or augmented efforts in capacity building.

  (Capacity Building Target 240)

Annex II

Work Plan Tasks to which the WCRP currently contributes

CL-06-02: Key Climate Data from Satellite Systems
Establish actions securing the provision of key data for climate studies & forecasting from satellite systems.
WCRP Status: Contributor
WCRP Contact: Don Hinsman (WMO (Space Programme) in coordination with CGMS, GCOS, WCRP)

CL-06-05: GEOSS IPY Contribution
Coordinate with the International Polar Year (IPY) to enhance the utilization of Earth observations in all appropriate realms (including, but not limited to, sea and land ice, permafrost, coastal erosion, physical and chemical polar ocean changes, marine and terrestrial ecosystem change, biodiversity monitoring and impacts of increased resource exploitation and marine transport).
WCRP Status: Lead
WCRP Contact: Victoria Lytle (CLiC)

CL-07-01: Seamless Weather and Climate Prediction System
Support the development of a THORPEX/WCRP initiative on "International Weather, Climate and Earth-system Science", to better address uncertainties associated with climate variability and change, and related societal impacts. Related activities will include: Promote international multi-disciplinary (physics-biology-chemistry) collaboration on the development of a high-resolution seamless weather/climate global prediction system - including coupled atmosphere-ocean data assimilation. Support the development of an international framework for the design and implementation of a unified approach toward weather, climate, Earth system, and societal-economic research.
WCRP Status: Co-Lead
WCRP Contact: Venkataramaiah Satyan (WCRP Secretariat)

WA-06-02: Forecast Models for Drought and Water Resource Management
Enhanced prediction of the global water cycle variation is a key contribution to mitigation of water related disasters, drought and sustainable human development. Forecasting methods are to be improved for use by hydrological services throughout the world. The hydrological data and information system infrastructure should be determined, the data from hydrological and meteorological services should be pulled together first on a global level including moisture flux from the air-sea interface, on a national level including terrestrial systems and then on river basin level. The systems should also be made interoperable to facilitate global exchange of data and information. An international symposium is proposed to be held on approaches to Earth observations, drought predictive capabilities and management responses.
WCRP Status: Co-Lead
WCRP Contacts: John Schaake (NOAA), Richard Lawford (IGWCO)

WA-06-05: In-situ Water Cycle Monitoring
Initiate the creation of a coordination mechanism within GEO for global in-situ water observations, including ocean observations, and advocate synergy and sharing of infrastructure among observing systems. The current water cycle observation capability is inadequate for monitoring long-term changes in the global water system and their feedback into the climate system, and the lack of and inaccessibility of crucial data is also a major constraint for sustainable development of water resources and improvement of water management practices. In addition to filling gaps in measurement capability, interoperability of observing systems, and standardization of metadata for data sharing, progress in product development of the global near real-time river runoff network, advocate sharing of telecommunication infrastructure and joint know-how are important goals that need to be reached within the next few years.
WCRP Status: Contributor
WCRP Contact: Richard Lawford (IGWCO)

WA-06-07: Capacity Building Program for Water Resource Management
Initiate capacity building programs to develop tools for using remote sensing data in support of water management, and to show the value of Earth observations generally in water resource management. The program will be initiated in Latin America and will then be extended to Asia and Africa. Linkages with existing efforts of GEO Members and Participating Organisations will be made.
WCRP Status: Lead
WCRP Contact: Richard Lawford (IGWCO)

US-07-02: Millennium Development Goals
Facilitate inter-institutional coordination for common action towards the UN Millennium Development Goals, including poverty and hunger reduction, disease and disaster prevention, and environmental sustainability. Related activities will include: Improve coordination of existing environmental monitoring activities including actions by the space agencies, research centres, UN agencies and the public/private sectors. Promote the use of available environmental data at national and regional level and support the development of structured user communities at geographic scales from country to continent.
WCRP Status: Contributor
WCRP Contact: Ann Henderson-Sellers (WCRP Secretariat)

Work Plan Tasks for which the WCRP has expressed an interest

WA-07-02: Satellite Water Quantity Measurements and Integration with In-situ Data
Develop an operational mechanism to provide water level observations in rivers, lakes/reservoirs and estuaries from satellite observations to support the upgrade of deficient run-off water gauge networks. Combine different types of satellite data that are relevant for water quantity measurements (snow water equivalent, streamflow) with in-situ observations for better accuracy and global coverage. Produce an implementation plan for a broad and operational global water cycle data integration system that combines in-situ, satellite data and model outputs. An international symposium is proposed to be held to assess techniques and their maturity for transitions to operations. A workshop is planned in 2007.
WCRP Status: TBD
WCRP Contact: TBD

DA-07-06: Data Integration and Analysis System
It is expected that there will be a large increase in the volume of Earth Observation data. In addition to distributed data archives and integration system, data management facilities will be used for diverse and large-volume Earth Observation data from inhomogeneous information sources in cooperation with existing data centres. This Task is to coordinate data management approaches that encompass a broad perspective of the observation data life cycle, from input through processing, archiving, and dissemination, including reprocessing, analysis and visualization of large volumes and diverse type of data.
WCRP Status: TBD
WCRP Contact: Hans-Werner Jacobi (WCRP Task Force on Data Management)

Additional Work Plan Tasks that could be considered (non-exhaustive list suggested by the GEO Secretariat):

DI-07-01: Risk Management for Floods
(...) The Task will define best practices, here including decision support systems, with the goal to identify minimum required observations and associated networks (in-situ, remote sensing) and models to deal with flood management at different geographical scales. The Task will also include analysis and, where deemed applicable, further developments on weather and coastal ocean forecast and warning systems, as one of the main inputs, in particular to assess the risk during the monitoring/prevision/prevention phase. (...) With reference to and in coordination with the WMO APFM (Associated Programme on Flood Management) and with similar initiative conducted under national and regional projects, the core activity will be constituted by the definition and implementation of a pilot project, centred on the development and demonstration of a Flood risk management system for the South-Central American Regions. Coastal observations and associated warnings will be part of this activity.

HE-06-03: Forecast Health Hazards
Facilitate the formation of international consortia and coordinate, besides advocating funding for, the implementation of major demonstration pilot-projects integrating Earth observations, health and epidemiological as well as socio-economic data. As a priority, a project initiated by THORPEX will focus on the use of advanced weather and climate ensemble forecasting methods to develop and improve the predictability of major health hazards and impacts in developing countries (e.g., West Africa) (...)

EN-07-02: Energy Environmental Impact Monitoring
Promote the development of Earth observation systems for the monitoring and prediction of environmental impact from energy resource exploration, extraction, transportation and/or exploitation. Related activities will include: Promote and develop the use of Earth observation data for impact monitoring. Support the development of modelling systems helping to quantify and anticipate changes e.g. to freshwater, biodiversity, ecosystems, atmospheric and oceanic composition, and ground elevation. Make relevant synergies with carbon sequestration and greenhouse gas monitoring activities, and with Task US-07-01.

EN-07-03: Energy Policy Planning
Encourage the use of Earth observations for informed energy-policy planning in developing and developed countries. Related activities will include: Encourage the use of Earth science models to support energy scenario assessments. Enhance availability of data and products required to better assess countries' potential for energy production. Promote interactions of data providers and decision-support-system developers. Encourage training of decision-makers at all relevant levels for interpretation of relevant data and products.

DA-06-03: Ensemble-Technique Forecasting Demonstrations
Facilitate the development of demonstration projects promoting the wider use, in other disciplines, of ensemble-based techniques originally developed for weather forecasting.

CB-07-01: Capacity Building Strategy Implementation
- Engaging Donors
Organise a Capacity Building Symposium in early 2007 to initiate a dialogue and an exchange of views between GEO and the international donor community in support of Earth observation capacity building. (...)
- Identifying Best Practices, Gaps and Needs
Through the engagement of user and expert networks, build registries and databases of: current and planned capacity building activities; best practices; and identified gaps and needs; Best practice examples will include, but not will not be limited to, open-content courses; e- learning material; and downloadable data and products that support capacity building. (...) Enable access to the above through the GEO Web Portal and GEOSS Best Practices Registry. (...)
- Building National and Regional Capacity
Build national capacity in developing countries by enabling human, technical and institutional capacity for coordinating, accessing, using and sharing environmental data, information and services. Develop and implement a participatory model for environmental networking, observing/monitoring, and data and information sharing at the national level. The model will be based on existing national mechanisms. It will include key institutions (data providers and information disseminators), integrating regional and global tools and mechanisms for environmental data and observing systems. (...)

WORLD CLIMATE RESEARCH PROGRAMME

JOINT SCIENTIFIC COMMITTEE

TWENTY-EIGHTH SESSION

ZANZIBAR, TANZANIA, 26-30 MARCH 2007

JSC-XXVIII/Doc. 6.3.1
(26.II.2007)

Item 6

WWRP THORPEX

Over the last year the THORPEX programme has developed rapidly and, in the following paragraphs, developments that are of particular relevance to the WCRP are highlighted. In particular the attention of the JSC is drawn to:

The initiative to develop a WWRP/THORPEX Plan for Africa	**Section 1**
Collaboration between WWRP/THORPEX and the WCRP	**Section 4**
A proposal for developing the "Year of Tropical Convection" initiative (which includes a proposal for the WWRP/THORPEX and the WCRP to support/sponsor an Implementation Workshop)	**Sub-section 4.1**

1. International Planning

Southern Hemisphere

A WWRP/THORPEX Scientific Conference on "Improving the Global Predictability of High Impact Weather including a review of Southern Hemisphere plans" was held in Cape Town, South Africa (13-15 February 2006) prior to the fourteenth session of the CAS. The main outcome of the WWRP/THORPEX Scientific Conference was a final plan for the participation of Southern Hemisphere nations in THORPEX in order to:

- Extend the range of skilful weather forecasts of high-impact weather globally from one day to two weeks and beyond;
- Develop user-specific products ready for use in decision-making support tools;
- Assess the value of these forecasts and products when applied in societal, economic and environmental activities.

Africa

Following a workshop held in Burkina Faso in February 2007 (held prior to the quadrennial meeting of WMO RA I), Task Teams have been formed to develop a formal plan and to design the organisational structure required to implement an African THORPEX plan including the formation of a THORPEX Regional Committee for Africa.

2. TIGGE

TIGGE - the THORPEX Interactive Grand Global Ensemble

The TIGGE, the THORPEX Interactive Grand Global Ensemble, is a key component of the THORPEX plans to accelerate the improvements in the accuracy of 1-day to 2-week high-impact weather forecasts.

The key objectives of TIGGE are:

- An enhanced collaboration on development of ensemble prediction, internationally and between operational centres and universities
- New methods of combining ensembles from different sources and of correcting for systematic errors (biases, spread over-/under-estimation)
- A deeper understanding of the contribution of observation, initial and model uncertainties to forecast error
- Real-time support for demonstration projects and field experiments
- Societal applications leading to increased benefits to society

Over the last year the following milestones have been reached.

- A technical proposal for Phase 1 (global analyses and forecasts) has been developed by three archive centres (CMA, ECMWF and NCAR)
- Commitments have been received from eleven potential providers (BMRC, CMA, CPTEC, ECMWF, FNMOC, JMA, KMA, Meteo-France, Environment Canada, NCEP, UKMO)

It is now highly likely that routine access to the data base of global forecasts will be possible in spring 2007 and that a start will be made on a TIGGE LAM (Limited Area Model) Ensemble Prediction Systems approach later this year.

3. Regional Plans – future campaigns and experiments

THORPEX Pacific Asian Regional Campaign (TPARC) 2008

The concept of a THORPEX Pacific Asian Regional Campaign (TPARC) 2008 is being developed as a result of a workshop held in Seattle in June 2005 and the subsequent continuing dialogue between the NARC and the ARC. The proposed campaign is planned for the second half of 2008 and in this case would coincide with the IPY and with campaign to take additional measurements in support of the Beijing Summer Olympics (including Asian measurements in the vicinity of typhoons and perhaps over the Asian continent) and may continue into the November-December time-frame to study tropical cyclone tracks, extra-tropical transitions, tropical warm-pool physics and down-stream propagation.

European TReC (ETReC)

Several major research activities relating to summertime high impact weather are planned for the year 2007, most importantly the WWRP forecast demonstration project occurring as part of MAP, and the international field experiment COPS. The European Region Committee are proposing to initiate ETReC 2007, to support these programs, link them and leverage their efforts to contribute to THORPEX scientific goals.

4. Collaboration with the WCRP

A key element of the THORPEX strategy is to develop working partnerships with other programmes and considerable efforts have been made over the last 12 months to develop collaboration as follows.

4.1 Seamless Prediction

A joint project has been initiated to develop a unified approach to the development of ultra-high-resolution global systems for weather prediction and climate simulation and document 6.3.2 ("Toward A Seamless Process for the Prediction of Weather and Climate") and document 6.3.3 ("A Revolution in Climate & Weather Prediction") describe the proposals that have been developed so far.

4.2 Collaboration in tropical meteorology including tropical convection

4.2.1 Background

As a follow up to the THORPEX/WCRP/ICTP workshop held in Trieste, Moncrief, Shapiro, Slingo and Molteni have circulated a draft of a paper on "Organised Convection and Multi-scale Interaction with the Global Circulation: a THORPEX and WCRP Collaborative Research Opportunity".

Amongst other things, the authors review the abilities of forecast models, climate models and convection resolving/permitting models to simulate the various modes of tropical convection and stress the major failures of large-scale models that employ, out of necessity, parametrization schemes to describe convective processes.

Section 2 of their paper summarises the outcome of the THORPEX/WCRP/ICTP Workshop on convection that was held in Trieste in March 2006. The Workshop identified a number of areas for collaborative research activities and two strategic objectives that, if achieved, could advance the abilities of models to represent convection.

Objective 1. Develop an internationally coordinated 'virtual computational-observational laboratory to facilitate: i) access to observational, experimental and operational global weather/climate databases commensurate with the highest resolution achievable given the near-term computational constraints; ii) new diagnostic analysis packages and visualisation methods. This effort will provide the infrastructure to exploit the observations, operational prediction, and high-resolution simulations of tropical convection, its two-way interaction with extra-tropical weather and climate, and socio-economic impacts and their assessment.

Objective 2. Prepare a strategy for a coordinated observing, modelling and forecasting activity/ program with emphasis on organised tropical convection and its influence on predictive skill in the western Pacific and Indian Ocean locale, achieved through leveraging recent and near-term gains in modelling, observations, computer capabilities, and other programmatic activities.

4.2.2 The achievement of the first Trieste objective

Duane Waliser has been actively promoting objective 1 as the Year of Tropical Convection.

Operational Global Forecasting Centres are well placed to provide a substantial part of the data bases required for the first objective. A few them maintain archives of their analyses and forecasts at the highest resolution for the primary predicted variables and also for the parametrized fluxes which are computed for each sub-grid-scale physical process represented in their forecast model.

Operational centres also ingest large quantities of observational data, including satellite data, a large fraction of which is used in some way in the data assimilation process to produce initial conditions for forecasts. After assimilation this data is "flagged" to describe its use/non-use in the creation of initial values and is stored in structured archives.

In addition to this "NWP" observational data there is a vast quantity of other data, mainly satellite data, which can be used for verification, diagnostic studies and also reanalysis. The measurements of precipitation, condensate, optically thin clouds, and aerosols available from low-earth orbit profiling satellites (e.g., TRMM, CloudSat, and A-train) provide particularly useful "additional data" for validating cloud systems simulated by prediction models. Moreover, since the bulk of such data is not yet ingested into contemporary data assimilation systems, they provide a useful independent verification of NWP model performance in cloudy regions. It would be important for the research being considered to make this additional data generally available in structured archives.

Arguably, the output from the highest resolution global analysis and forecasting systems that are available are the best source of primary model data for Trieste Objective 1. Output from regional models, whilst useful for short-term prediction and case studies, will suffer from boundary problems particular for large-scale propagating modes that will seriously complicate diagnostic studies. And, the global TIGGE databases that will soon be available for research are too limited in resolution and content for the studies required.

Following informal discussions at ECMWF, it is suggested that the following approach is considered for Trieste Objective 1.

i) An approach is made to the ECMWF to obtain access to the full output from their T799 forecasting system and their observational archives for 12/18 months (ECMWF may require funding to do the necessary work). It would be useful if part of this period could overlap with the TPARC experiment planned for the second half of 2008.

ii) The NCAR data centre ingests these ECMWF databases and provide access to them by the international research community.

iii) A plan is developed and implemented to provide access to the additional observational data that is not included in the ECMWF observational archive - again at NCAR or possibly NASA.

4.2.3 Way forward

It is proposed that WWRP/THORPEX and the WCRP support/sponsor an Implementation Workshop to develop, quickly, a detailed technical plan for the achievement of the first Trieste objective and an outline of the requirements for the field experiment required for the second objective.

5. Collaboration with GEOSS – involvement in four main GEO tasks

WEATHER	Further develop TIGGE and societal applications
HEALTH	To improve predictability of major health hazards in W. Africa
AGRICULTURE	Help improve the predictability of food supplies in Africa
ENERGY	Demonstration project to improve energy management techniques

These tasks represent a very important and wide-ranging contribution from THORPEX to the GEO initiative and they will also mandate assistance and support from the GEOSEC to THORPEX for their successful completion.

6. IPY

A THORPEX cluster proposal to the IPY has been approved.

WORLD CLIMATE RESEARCH PROGRAMME

JSC-XXVIII/Doc. 6.3.2
(26.II.2007)

JOINT SCIENTIFIC COMMITTEE

Item 6

TWENTY-EIGHTH SESSION

ZANZIBAR, TANZANIA, 26-30 MARCH 2007

Toward A Seamless Process for the Prediction of Weather and Climate

A collaborative effort between the WMO Programs THORPEX and WCRP

Contributors to first draft: Gilbert Brunet (Environment Canada), Randall Dole (NOAA), Brian Hoskins (Reading U.), George Kiladis (NOAA), Ben Kirtman (GMU/COLA), Mitch Moncrieff (NCAR), Rebecca E. Morss (NCAR), Saroja Polaravapu (Environment Canada), Mel Shapiro (NOAA),Julia Slingo (Reading U.), Istvan Szunyogh (Maryland U.) and Duane Waliser (JPL)

Note: This document will be circulated to a wider international audience for comments and additional contributions between March-May 2007.

1 Introduction

THORPEX is a WMO weather research program to accelerate the improvement of forecasts for the 1- to 14-day forecast range. WCRP is a WMO program to determine the extent to which climate can be predicted, and to determine the extent of human influence on climate. The international THORPEX and WCRP communities both have the obligation to help the development of relevant scientific knowledge and a science infrastructure to provide policy- and decision-makers

- More accurate, and from a socio-economic prospective more useful, prediction of high-impact weather and environmental events.
- Information needed for the reduction of emerging and existing global and regional social, economic and environmental vulnerabilities caused by the combined effects of a changing environment and increasing economic development.

As the appreciation of the complexity of the underlying science issues grows, investigations not only must become more and more multidisciplinary in nature, necessitating a more holistic and team approach to modeling of the Earth System[1], but

[1] In this context the Earth-system is understood to mean the atmosphere and its chemical composition, the oceans, sea-ice and other cryosphere components, the land-surface, including surface hydrology and wetlands, lakes, and the simulation of short-time scale phenomena that result from the interaction between one or more components, such as ocean waves and storm surge. On longer (e.g., climate) time scales, the terrestrial and ocean ecosystems, including the carbon and nitrogen cycles, and slowly varying cryosphere components such as the large continental ice sheets and permafrost, would also be considered to be part of the Earth-system.

also will require a concerted international effort. Climate, air quality, water, environmental and weather modeling and prediction systems will become more integrated, move to increasingly finer space-time scales, and rely on complex systems for blending information from observations and models. There will be a tremendous increase in the variety and quality of environmental data, and in the variety and scope of weather and environmental predictions on scales from minutes to decades and beyond, as well as a broadening of prediction paradigms (deterministic as well as probabilistic). These changes will greatly enhance the capacity to meet a range of prediction challenges to increase safety and security, regionally and globally, and to provide information in support of the development of policies and services by better adapting to the constantly changing environment. As these weather and climate science issues become more global and complex, they cannot be addressed in isolation. An international and multi-disciplinary research program is essential.

This white paper proposes specific collaboration between THORPEX and WCRP to achieve the following main scientific objectives:

- Global climate simulations which much improved representation of the variability associated with transient weather events, particularly extreme events, such as tropical and extra-tropical cyclones.
- Extended range weather predictions that take advantage of the assumed predictability (e.g., MJO) in the intra-seasonal (10- to 90-days) forecast range.

We believe that the proposed research collaboration will accelerate:

- **Development of high-resolution models of the atmosphere, ocean and land** for data assimilation and seamless prediction of weather and climate and environmental parameters of the complex Earth system.

- **Development of high-resolution global and regional data-assimilation systems** which are capable of making effective use of the full spatial/ temporal resolution of all observations, both remotely sensed and in situ. This effort will contribute to the design and use of the Global Earth Observing System of Systems (GEOSS) that satisfies the observational and data-assimilation requirements spanning short-term weather warnings, numerical forecasts and the prediction and assessment of climate variability and change.

- **Execution of field campaigns** to advance knowledge of the modes of regional and global weather and climate variability, and to improve and evaluate the parameterizations and explicit representations of dynamical and physical processes in weather and climate prediction systems.

2 Context

The proposed collaboration is timely because of the unprecedented advances of the last few decades in High Performance Computing (HPC), high-speed telecommunication, ground-, space- and aircraft-based measurement technologies, systematic observations, remote sensing, field and laboratory process studies, data assimilation techniques, and in highly performing coupled numerical models of weather and climate prediction. Weather and climate research has produced numerical prediction and data assimilation systems that can efficiently exploit these technological improvements. The challenge today is to further improve the existing forecast and diagnostic products, to increase their economic and societal values and to broaden their suite of applications through the development of a seamless prediction process that eliminates the long existing separation of the weather and climate forecast processes.

3 Issues

This THORPEX/WCRP collaborative program is planned to address specific scientific issues in order to speed up new understanding of the past and present state of the environment (atmosphere, ocean, land surface, ice, coastal areas, ecosystems, species, etc.), and accelerate the capability to make scientifically sound predictions of the future state of the Earth-system from weeks to seasons. The following subsections introduce a series of high priority THORPEX/WCRP collaborative issues on numerical prediction and modeling, data assimilation and observational from weeks to seasons. More specifically, we propose to cover the following research topics:

1) Organisation and maintenance of organized tropical convection and interaction with the planetary circulation
2) Seamless prediction with multi-model ensemble (TFSP, TIGGE)
3) Data assimilation as a prediction and validation tool for the climate and weather research communities and a design tool for observation networks
4) High-impact weather in observations and models (including Regional Climate Models)
5) Societal and Economical Research Applications (SERA)

Each is defined and discussed in the following subsections under the headings "definition", "significance", "background", "science needed", "linkage" and "capacity needed".

3.1 Organisation and maintenance of organized tropical convection and interaction with the planetary circulation

Issue: Fundamental barriers to advancing weather and climate prediction on timescales from days to years are attributable to gaps in knowledge and very limited capability to simulate multi-scale organized convection in the tropics, like the Madden Julian Oscillation (MJO). The active phase of the MJO often provides the environment for high-impact weather events (e.g. tropical cyclones, excitation of mid-latitude Rossby wave train, monsoon precipitation anomalies). There is substantial observational evidence, combined with results from empirical prediction schemes that the MJO may provide the dominant source of predictability beyond 2 weeks in the tropics and mid-latitude.

The extratropical disturbances influence also low latitudes and the more slowly evolving tropical ocean-atmosphere interactions, such as the development of ENSO events and other large scale tropical sea surface temperature anomalies on the seasonal time scale.

Significance: It is now generally accepted that in order to predict the extratropical atmosphere with skill beyond the synoptic time scale, knowledge of the evolution of the tropical atmosphere, and in particular the distribution of tropical convection, is crucial. Conversely, evolution of the tropical atmosphere may be highly dependent upon disturbances impinging upon it from the extratropics, although the extent of this dependence varies substantially from one longitudinal sector to another. It is expected that improvement in the representation of tropical convective disturbances in operational numerical weather forecast systems, and especially the representation of behaviour of convection on the intraseasonal time scale of the MJO, would result in immediate improvements in extratropical forecasting skill. Likewise, better representation of the impact of extratropical circulations on tropical disturbances could potentially have a positive effect on high impact weather events such as forecasting the strength and tracks of tropical storms as they migrate out of the tropics. If realizable, this would transition into socio-economic applications for improving early warning systems for weather-climate induced hazards, e.g., agriculture, water management, and health. Recent studies in France, UK, Canada, USA and the UN have shown that approximately 30% of GNP of developed countries is weather sensitive.

Background: ropical convection contains variability on a variety of space and time-scales, ranging from the individual clouds, to cloud clusters associated with synoptic-scale disturbances, to super clusters or ensembles of clusters. Synoptic activity in the tropics is often associated with waves which can be related to the preferred equatorially-trapped modes of the atmospheric circulation based on shallow water theory, but it is only in the last few years that it has become increasingly clear that these modes account for much of the organisation of tropical convection and of the development of tropical weather systems.

The development and maintenance of equatorial waves is crucial for forecasting in the tropics, since these waves are the precursors for hurricanes and typhoons. The failure of present-day weather forecast and climate-prediction models to correctly capture the initiation of equatorial waves and their associated organised convection is largely due to inadequacies in the interaction of physics and dynamics, and is arguably one of the most fundamental errors in models used for weather and climate prediction. It compromises our ability to make skilful forecasts on timescales of days and weeks, as well as meaningful projections of climate change, including potential changes in the intensity of tropical weather systems.

Of the various modes of tropical organised convection, the MJO coupled ocean-atmosphere phenomena is one of the most critical. It dominates tropical variability on sub-seasonal timescales, it is intimately related to active/break cycles of the Australian and Asian Monsoons. Yet adequate knowledge of the processes involved in the initiation and maintenance of the MJO and realistic simulations and predictions of the MJO remain a major challenge to the weather-climate community.

It is well documented that there is substantial interaction between the tropical and extratropical atmosphere from synoptic to decadal time scales and beyond. At higher frequencies, Rossby wave energy originating at high latitudes readily propagates into the tropics, especially in regions of upper level westerly flow such as over the eastern equatorial Pacific and Atlantic during northern winter. These waves frequently trigger convection within the ITCZ, lofting moisture into the upper troposphere and then transporting it poleward ahead of troughs extending into high latitudes. It has been shown that the bulk of the moisture transport between the tropics and higher latitudes occurs during such synoptic scale events. Both Europe and the west coast of North America are impacted by such tropical moisture sources, which often result in heavy precipitation episodes. These events also strongly affect the radiation balance of the subtropics due to the presence of the highly reflective cloud bands associated with them. Over Africa, such interactions are often associated with Saharan dust storms, which may transport aerosols over long distances into the subtropical and tropical Atlantic.

Theory predicts and observations verify that Rossby wave propagation into lower latitudes is inhibited in regions where the upper level flow is characterized by a "critical line", or a transition from extratropical westerlies to tropical easterlies. However even these sectors of the tropics can experience substantial influence by extratropical events in the form of low level "pressure surges". Such interactions are frequent equatorward of eastern Asia and North America, especially during the cooler seasons, where continental anti-cyclones migrate equatorward, sometimes inducing heavy precipitation at low latitudes. In the Asian sector these surges have also been tied to the occurrence of low level "westerly wind bursts" along the equator, important for forcing Kelvin waves in the equatorial oceanic wave guide. In Central America surface pressure rises over the Caribbean result in strong flow into the Pacific through the Gulf of Tehuanapec, with substantial impacts on the Pacific Ocean.

Whatever the extent of extratropical influence on the tropics, the inverse impact is likely much more critical for global scale predictability. The most obvious example involves ENSO, where the reorganization of tropical convection by anomalous SST over the equatorial Pacific has profound impacts on the seasonal time scale. Linear Rossby wave theory indicates that the tropics will start to significantly affect the mid-latitudes within a few days. The extent of the impact of the tropics on the extratropics at intraseasonal time scales has been supported by so-called "relaxation experiments", where the state of the tropics in a forecast model is relaxed towards observed conditions, thus providing a "perfect tropics" forecast, and its effect on the extratropical forecast measured by objective means. These experiments suggest that substantial gains in extratropical forecast skill could be obtained if the state of the tropical atmosphere could be more reliably forecast from around three days on up to intraseasonal time scale.

Other important tropical-extratropical impacts include interactions between quasi-stationary fronts extending into low latitudes, such as the Mei-Yu and Bei-Yu fronts within the Asian monsoon system, and interactions between fronts and low latitude orography such as those occurring over Indonesia and Australia.

Science Needed: General circulation models are currently relatively successful at simulating and predicting the short term behavior of extratropical synoptic scale disturbances. However many aspects of lower frequency intraseasonal variability within the storm tracks, such as the initiation and maintenance of blocking, and wave-mean flow interactions leading to variability in well-known teleconnection patterns such as the North Atlantic Oscillation (NAO) and the Pacific-North American (PNA) pattern are still problematic within forecast and climate models. Nevertheless, it is thought that one major stumbling block to medium range and seasonal forecast improvement lies in the improvement of tropical convection tied to large scale wave dsturbances in the tropics. Improvements in the in situ and satellite observational network tied to the overall THORPEX goals geared to data assimilation will also enable better observational bases for diagnostic studies of tropical-extratropical interactions. Development of new parameterization schemes are seen by many recent studies as a necessary step in improving the modeling of convectively coupled tropical waves such as the MJO, as well as the development of cloud-system resolving modeling (CSRM) capabilities which to a large extent circumvent the necessity of convective parameterization. The type of coordinated efforts to conduct sensitivity and predictability assessments already planned under the auspices of THORPEX can be readily applied to the problem of tropical-extratropical interaction through case studies of high impact weather events and statistical studies of both recurring scenarios and tropical or extratropical relaxation experiments as outlined above, in order to determine the potential gain in predictability as targets for improvements in numerical modelling.

The following R&D action items were identified at the March 2006, THORPEX and WCRP international workshop at the ICTP, Trieste, Italy, for consideration as a first step toward engaging collaborative research activities (contact: M. Moncrieff):

i. Develop metrics/description of the daily, sub-seasonal, seasonal, and inter-annual characteristics of the MJO and organised convection that encapsulate our knowledge, enable model/forecast validation and guide future research.
ii. Promote collaboration on the use of NWP-type experiments for exploring error growth in simulations of organised convection and the MJO and two-way interactions between tropical and extratropical weather and climate systems.
iii. Integrate process studies of observed organised convection based on satellite and ground-based remote sensing (including 3D Doppler radar), with *in situ* measurements to provide improvements and validation of high-resolution models as it is proposed in the Year of Tropical Convection (YOTC) initiative.
iv. Consider the feasibility and strategy for the design and implementation of field campaigns on organised convection (e.g., over the Indian Ocean) guided by high-resolution modeling studies.
v. Develop a strategy for demonstration and assessment of socio-economic benefits and applications arising from advanced knowledge and predictive skill of multi-scale tropical weather/climate events on timescales of days to seasons.

Linkages: We need to:

- Promote collaboration on forecast demonstration experiments coupling statistically-based systems (e.g., Newman *et al*., 2003) and dynamically-based systems to assess the value of improved MJO/organised convection simulations for deterministic and ensemble prediction on timescales up to 4 weeks.
- Promote the transfer of advanced knowledge and predictive skill of organised convection into improvements for operational NWP and climate models through links with key groups within GEWEX/CLIVAR/THORPEX, and operational prediction centers.
- Promote international collaboration on high-resolution CSRM studies for exploring the upscale energy cascade associated with organised convection (e.g., NCAR, ESC), in order to optimize use of computing resources and to share the development of data analysis tools.

Capacity Needed: The capacity building discussed in the recent THORPEX/WCRP/ICTP Workshop on the MJO in Trieste during March 2006, and the Weather-Climate Workshop at NCEP during April 2006, and the Weather-Climate Retreat held in Boulder during July 2006, appear to be excellent starting points for discussions aimed at providing the necessary data sets and activities around which to design an effective effort to tackle the problems related to organised tropical convection and tropical-extratropical interactions.

Coordinated international efforts that could be facilitated by the THORPEX/WCRP collaboration will undoubtedly be crucial to the implementation of the necessary research to achieve these goals.

Scientific and observing infrastructures are also crucial for this problem and we need to:

- Endorse the need to maintain and enhance existing and planned satellite missions that measure tropical cloud and precipitation systems in order to provide a long-term capability for process studies, data assimilation and prediction.
- A High-Performance Computing Facility (HPCF) is at the heart of environmental prediction and is a crucial component for science development. One or many leadership HPCFs (e.g., NCAR, ESC) are needed for the success of the proposed numerical weather, climate and environmental science activities. Also collaboration in developing efficient numerical cores, designing experiments and in developing best practice for data handling and analysis will reap significant rewards, as will sharing experience in achieving computational efficiency.

3.2 Seamless Prediction with Multi-Model Ensemble (TFSP, TIGGE)

Issue: A fundamental guiding principle for WCRP activities is that the problem of prediction from days through decades is seamless. This guiding principle comes from the recognition that the global coupled atmosphere-ocean-land-cryosphere system exhibits a wide range of physical and dynamical phenomena with associated physical, biological and chemical feedbacks that collectively result in a continuum of temporal and spatial variability. The traditional boundaries between weather and climate are, therefore, artificial, as is any artificial boundary inhibiting the interactions among the components of the physical climate system. The large-scale climate, for instance, determines the environment for microscale and mesoscale processes that govern weather and local climate, and these small-scale processes likely have significant impacts on the evolution of the large-scale circulation and the interactions among the components of the climate system. The challenge for the weather and climate science communities is predicting the continuum in space and time, and the interactions among the components of the physical climate system.

The challenge of a unified approach to prediction from days to decades, particularly in terms of bridging the gap between forecasting high impact weather events and seasonal variations naturally brings together the activities of the WCRP Task Force for Seasonal Prediction (TFSP) and the THORPEX Interactive Grand Global Ensemble (TIGGE). This prediction problem is also necessarily multi-model and multi-institutional. The multi-model approach is necessary because there is compelling evidence that, with imperfect models, perturbing the physics of the models is superior to perturbing initial conditions of one model in terms of resolving the probability density function or quantifying the uncertainty. A multi-model approach is essentially a simple and consistent way of perturbing the physics. Moreover, by testing our hypotheses with multiple models it is possible to determine which results are model independent, and hence likely to be robust. This problem is also necessarily multi-institutional simply because the level of effort and computational resources required is just too large for any one institution.

Significance: Scale interactions, both spatial and temporal, are the dominant feature of all aspects weather and climate prediction. Global atmospheric, biospheric, cryospheric and oceanic models and their interactions are essential to both weather and climate predictions and the more scales that are explicitly resolved the greater the chance to improve the predictions. Modeling and predicting a given seasonal climate anomaly over any region is incomplete without a proper treatment of the effects of SST, sea ice, snow, soil wetness, vegetation, stratospheric processes, and chemical composition (carbon dioxide, ozone, etc.,). Moreover, it is well recognized that useful seasonal prediction must be made with models that include realistic representations of day-to-day weather fluctuations. Indeed, the most useful seasonal predictions will include forecasts of changes in the statistics of day-to-day weather fluctuations. The collaboration between the TFSP and TIGGE is our first opportunity to bring the weather and climate communities together to tackle the days to decades prediction problem with realistic physical climate system models that include interactions among the components of the climate system, but that also are able to predict high impact weather and accurately simulate day-to-day weather fluctuations.

Background: State-of-the-art weather forecasts are made with sophisticated atmospheric general circulation models that include our best understanding of synoptic (and meso) scale weather systems. However, these forecasts traditionally ignore, for example, the coupled interactions at the air-sea interface. We know this energetic inconsistency is problematic on time scales beyond two weeks, and it may well be an impediment to improving forecasts on shorter time scales, particularly for high impact weather phenomena. Seasonal climate predictions, on the other hand, typically use forecast systems that capture many aspects of the interactions among the physical components of the system yet fail to adequately resolve synoptic weather systems (in both the tropics and extra-tropics) and how they flux heat, momentum and moisture throughout the atmosphere.

There are, of course, good and well documented reasons for these different approaches. For a weather forecast on the scale of days, deterministic time evolution of individual synoptic systems must be forecast as an initial value problem. The success of a short-term weather forecast, moreover, is not dependent on the correct simulation of the meridional overturning circulation (MOC) in the ocean or other longer-term climate processes such as those involving changes in vegetation, sea ice or land ice. For climate time scales of seasonal to interannual and beyond, statistics of the collections of weather systems are of interest, not the individual time evolution of the systems themselves. For seasonal predictions, coupled interactions among the components of the climate system become especially important. In essence, the validity of the assumptions made in developing prediction systems must ultimately be evaluated in the context of the problem being studied. Yet, the seamless prediction paradigm explicitly recognizes the importance and potential benefit of greater convergence of methods used in weather and climate forecasting.

The prediction of the El Niño/Southern Oscillation (ENSO) phenomenon is a good case in point. While ENSO can now be predicted with some skill with an initialized state of the atmosphere and at least an upper ocean model in the tropical Pacific, profound gaps in our prediction abilities remain, in no small part because of the presence of large systematic errors in the coupled models. Of relevance is that: (i) the coupled model mean state does not agree with the observed mean state with sufficient fidelity; and (ii) the space-time evolution of the simulated climate anomalies is not sufficiently realistic.

Historically, these two problems have been addressed from semi-empirical perspectives. The first approach has been to try to improve the individual physical parameterizations in the component models, which would then hopefully lead to an improved coupled simulation and prediction. The second approach has centered on how best to use imperfect models to make predictions – e.g., a multi-model ensemble. The seamless prediction paradigm points to a third consideration: namely, that current climate models poorly represent the statistics of internal atmospheric (e.g., synoptic weather systems and tropical waves) and oceanic (e.g., poorly resolved tropical instability waves) dynamics and, thus, the interactions of these intrinsic motions with climate. Moreover, the specification of accurate initial conditions in the full climate system may be critical to accurately capture the high frequency phenomena of relevance (e.g., the dependence of the Madden-Julian Oscillation (MJO) on the upper ocean state). This third approach, then, postulates that the two errors noted above are at least due in part to the fact that the models do not accurately capture the weather-climate link. The issue then becomes what are the important missing elements of the statistics of internal dynamics and what is the best strategy for incorporating them in the coupled models.

In some sense the problem of improving the sub-grid scale physical parameterizations can be viewed as a procedure for including some aspects of the weather and climate link in the models. The typical assumption for sub-grid scale parameterization is to assume that the statistics of sub-grid scale processes can be parameterized in terms of the grid scale variables. However, it is noted here that in many cases this assumption may be seriously flawed and may be unable to capture the weather-climate connection. Hence an alternative strategy has been to reduce the grid size of the model and resolve more of the motions explicitly. While some improvements have resulted from this approach, it is inherently limited by the available computing power.

Science Needed: A basic requirement is that the operational prediction and prediction research communities need to gain considerable experience running models in climate mode with mesoscale processes resolved. This is essential to improve our understanding of the multiscale interactions in the coupled system, to identify those of greatest importance, and to document their effects on climate. Ultimately, such research will help us determine the best methods of including upscaling processes in climate models, and it will help us differentiate between those processes that can be better or newly parameterized versus those that cannot. Essentially, the TIGGE and TFSP communities need to work together to test weather forecast models in seasonal prediction mode.

There is a wide range of upscale interactions to be considered. One of the most critical is the manner in which moist convection and its associate mesoscale organization drives larger circulations. Current parameterization schemes do not adequately handle the mesoscale organization of convection, which is considered to be a critical missing link in the scale interaction process. The poor representation of cloud processes is likely a major factor in the inadequate simulation of tropical oscillations by today's climate models, from easterly waves to ENSO, and in the well known double ITCZ bias issue.

Such problems with the tropical modes directly affect the capacity to simulate important climatic features such as ENSO and tropical cyclones. They also effect simulations at higher latitudes, as the export of wave energy from the tropics is an important driver of mid-latitude circulations. As noted above, hurricanes likely play a key role in cooling and mixing the ocean, but as such processes are not represented in any way, how can the result be correct?

Other examples of regions or "hot spots" with significant upscaled effects include the monsoon regions of India and Tibet and Central and South America where steep topographical gradients and mesoscale processes such as low-level jet and mesoscale convective complexes play an important role in the water and energy budgets locally and remotely.

Linkages: Both the TIGGE and TFSP communities are planning large multi-model multi-institutional numerical experiments using state-of-the-art computer models and computing systems. These experiments generate large data sets that need to be shared within each community, and more importantly across both communities. Indeed, it is the sharing of high resolution (in both space and time) seasonal prediction data from both retrospective forecasts and near real-time forecasts that is the key point of collaboration between the TIGGE and TFSP communities, including the establishment of a common framework for comparison and diagnostics activities.

Capacity Needed: This necessity for data sharing requires the support of some infrastructure. In particular, a limited number of data host centers need to be identified and they will need to support the archival of the data and the capacity to share the data throughout scientific and user communities.

3.3 Data assimilation as a prediction and validation tool for the climate and weather research communities and a design tool for observation networks

Issue: Data assimilation is currently used to obtain initial conditions for weather forecasts, but has yet to be fully exploited as a design tool for observing systems, or as a validation tool for climate models. Reanalyses are provided by weather forecast centers for climate diagnostics, but are limited by climate biases in the forecast models and observations

Significance: Considerable R&D are done on measurements (satellite and ground based) for insertion into weather forecast models, and for monitoring the Earth's climate. To ensure maximum benefit from this investment it is essential to design the global observing system in an optimal manner for the various applications, which may have quite different requirements. In particular, it is essential to understand what is required to achieve climate-quality measurements. Confronting climate models with data assimilation provides a new tool for identifying climate model deficiencies, which should also help reduce climate biases in forecast models.

Background: Initial conditions for weather and environmental prediction with numerical models are obtained by combining the most recent measurements with short-term model forecasts. This procedure is essential when forecasts are dominated by initial state errors. Ensemble forecasting is an alternative approach which tries to take into account uncertainty in both initial conditions and in the forecast model. Since the forecast range for which model errors can be ignored is highly application dependent, both approaches to prediction will remain important in the future.

Some of the current limitations of medium range weather forecasts are being addressed by increasing model lid heights to the lower mesosphere. Improved stratospheric initial conditions are aided by model lids in the mesosphere since the observing network is increasingly relying upon satellite-based nadir sounders. Such instruments often sense atmospheric properties over very thick layers so that a measurement with peak sensitivity in the upper troposphere would also sense the upper stratosphere or even the lower mesosphere. In addition, forecasts with an increased vertical domain are also beneficial. Since stratospheric flow is dominated by large scales and has longer dynamical memory than the troposphere, predictability in the stratosphere is longer than in the troposphere. Studies have shown that improving a weather model's forecast of the stratosphere can impact tropospheric forecasts in the 10-day and longer range.

While data assimilation is primarily a tool for obtaining initial conditions for forecasts, it is also a tool for exposing model deficiencies because the process involves confronting a model with measurements. Weather forecast models are typically validated using short and medium range forecasts whereas climate models, which are run on timescales of months to centuries, are validated statistically. However, both types of validation are needed for both types of models. Short term validation of climate models using data assimilation can highlight different model weaknesses than statistical validation, specifically those associated with small scales and faster processes such as convection. At the same time, examination of the climate of weather forecast models will reveal systematic errors on seasonal and longer time scales. A third type of validation involves physically-oriented (rather than statistical) diagnostics. For example, assimilated winds are well-known to produce incorrect tracer distributions. This is because the Brewer-Dobson circulation is too fast with assimilated winds, when compared to GCM winds or to observations. The issue is connected both with erroneous mass transport which can be affected by incorrect assumptions of model and/or measurement biases, and with excessive mixing which is primarily due to improper mass-wind balances obtained during the assimilation process.

The typical experience at data assimilation centres is that it is very difficult to obtain significant impact from assimilating new measurement sources despite the underdeterminacy of the global assimilation problem. Furthermore, and ironically, data from new satellite instruments with thousands of channels are reduced in number by orders of magnitude prior to their assimilation. Part of the problem is insufficient computational resources. The other part is the fact that new measurements may sometimes provide information that is redundant, or irrelevant to a particular problem, or it may provide information about decaying (rather than growing) modes of forecast error. Thus, it is important to use data assimilation as a tool to choose the measurements which have the most impact for a given forecasting or analysis problem, whether short or extended range or climatic. Because of the expense of data assimilation with the current observing system, such design experiments are frequently done as theoretical exercises which employ "toy" models. While providing general guidance, it can be difficult to translate these results to implications for the real observing system.

Science needed: A better understanding of the impact of the stratosphere on the troposphere in terms of both assimilation and forecasting is needed. Stratospheric measurements are primarily satellite-based, so the optimal way of assimilating new measurements is needed. Such information can also feed back to designers of future satellite instruments.

A new and exciting area of research involves the use of data assimilation with climate models whose simulations are at least a season or longer. Here data assimilation would be used as a tool for identifying where climate models diverge from measurements. The methodology would highlight problems with parameterizations such as those for convection and precipitation. The difference from statistical evaluation of parameterizations is that the background state would be more realistic. The Transpose AMIP project has as its goal the application of data assimilation technology to climate models.

Assimilated fields are often used to understand physical processes which ultimately must be parameterized in climate models. Therefore such understanding is essential for improving the accuracy of climate models. However, assimilated fields are often validated statistically and on short time scales (less than two weeks). Thus physically-oriented validation of assimilation products can reveal weaknesses in the assimilation process. For example there is considerable discrepancy between analyses from different centres on the predicted extent of Polar Stratospheric Clouds, a k ey factor in ozone depletion. While reanalyses are extremely valuable products for understanding physical processes, they are severely compromised by climate biases in the assimilation model. Thus more effort is needed to further improve these products.

Design and optimization of observing systems is needed. The results of any study will depend on the current observing network, which is already large and comprehensive, so such studies will be extremely computationally expensive. Such work is currently encompassed within the THORPEX framework. However, when designing observing systems, it is important to bear in mind that measurements must serve the needs of both the weather forecasting and the climate communities.

Linkages: The recent vertical extensions of weather forecast models into the middle atmosphere reveal a need to link the weather and climate modeling communities, since the former has the tools and resources for data assimilation while the latter has the experience in middle atmosphere dynamics. Such a link has already been forged through the WCRP SPARC program. Similarly, SPARC has been encouraging physically-oriented evaluation of assimilation products through its Data Assimilation Working Group, which links the data assimilation and climate-model communities since many of the physically-oriented diagnostics are also applied to climate models (through the SPARC CCMVal activity). However, the processes of interest in this case are limited to the stratosphere and mesosphere. Expansion of this approach to the troposphere would require linkage between WCRP and WGNE. Furthermore, as climate models and forecast systems are beginning to include atmospheric constituents, this development should be coordinated so that the climate-model and data assimilation interaction is built in from the start. The WGNE will make a formal proposal to the international climate modeling community to participate in Transpose AMIP program (which will apply assimilation schemes to climate models). Finally, work carried out under the THORPEX banner is contributing towards the design and optimization of observing systems. However, extending the notion of optimal design to include climate-quality measurements requires links with WCRP.

Capacity Needed: There is a need for more research centres that can provide state-of-the-art climate models and data assimilation capabilities. Much of the current data assimilation capacity is tied up in “operational centers” which lack the mandate and capacity to do research in multiple subject areas. Multidisciplinary research centres would be better able to respond to requests for increased linkage between the data assimilation and the climate research communities. For example, in Canada, assimilation techniques are already being applied to climate models (as proposed in Transpose AMIP) because Environment Canada encompasses both climate and forecasting services and research.

There is a great need for much easier access to data, whether model output or measurements. The rationalization of data distribution access and procedures is becoming more urgent as chemical constituents become included in standard model output.

3.4 High-impact weather in observations and models

Issue: A question of fundamental societal interest is the relationship between climate variations and change and high impact weather events. There is abundant evidence that natural climate variations, such as ENSO and the North Atlantic Oscillation/Northern Annular Mode, can significantly alter the likelihood of extreme events, from floods and wintertime storms to hurricane activity in the Pacific and Atlantic basins. In some regions of the world, long-term trends have been observed toward more frequent intense rainfall events, consistent with climate model projections for future climate change, and increasing sea level over the next century is likely to put many coastal regions at increased risk from damage due to storm surges. At the same time, systematic forcings by short-term (minutes to days) “weather” fluctuations profoundly influence the evolution of climate variability and change on seasons to decades. Our incomplete understanding of the links between these more rapid “weather” phenomena and longer-term climate variations hinders our ability to provide society with increased lead times for forecasts of high-impact weather events. At the same time, uncertainties in modeling the effects and interactions of fast “weather” processes with longer-term variations present a fundamental challenge to improving short-term climate predictions and longer-term projections of future climate change.

Significance: High-impact weather disasters account for nearly three-quarters of all natural disasters, and are by far the leading cause of natural disaster-related property losses and deaths. Perhaps the most vital function of National Meteorological and Hydrological Services (NMHS) for the WMO member states is to provide forecasts and early warnings of high-impact weather events, in order to reduce adverse impacts on life and property. From the perspective of longer-term policy and decision-making, assessing how climate variations, whether natural or human-induced, may alter the frequencies, intensities, and locations of high-impact events is an issue of the highest priority. Of particular interest is how the behaviours of extreme weather events would be expected to change over the remainder of this century, and what would be the mechanisms that would produce such changes.

Background: A central objective of the WMO World Weather Research Programme (WWRP) for the next decade, as articulated in plans for “The Observing system Research and Predictability Experiment” (THORPEX), is to accelerate improvements in forecasts of high-impact weather on time scales from one day to two weeks. During this same period, the WMO World Climate Research Programme (WCRP) is proposing the “Coordinated Observation and Prediction of the Earth System” (COPES) effort to address the prediction problem on time scales from weeks to centuries in advances. Achieving the joint objectives of the WWRP and WCRP will require a more unified approach than in the past toward understanding the connections between weather and climate. Such an approach is entirely in keeping with the overall goal of developing a continuous suite of weather and climate forecasts that span time scales from very short-range weather forecasts and warnings to multi-decadal to centennial climate change projections.

Science Needed: It is useful to frame this issue in terms of three questions. The first question is how climate variations and change can affect high-impact weather phenomena. As a specific example, we may ask the question: How do climate variations influence hurricane behaviour? A central issue toward addressing such questions is to determine how the probability distribution functions (PDFs) of relevant variables (e.g., hurricane frequency or intensity) are altered by climate variations and change. A primary requirement toward meeting this objective will be to improve methods for modeling and downscaling predictions to the scales required to represent extreme weather events. Advances in ensemble modeling techniques, as well as improved representation of relevant processes, will also be vital in making progress in this area. A third key requirement will be to improve our understanding of the processes and mechanisms by which climate variations and change lead to systematic changes in high-impact weather events, and the regional and local implications of such connections. Achieving this objective will require substantially improved understanding of the mechanisms by which climate variations, whether natural or anthropogenic, influence high-impact weather phenomena (e.g., hurricanes), and determination of the full predictive implications of these relationships.

A second question that needs to be considered is how relatively fast "weather" phenomena affect climate variations and change. Important priorities for addressing this question are to improve the representations of processes associated with organized tropical convection, boundary layer processes, and ocean-atmosphere-land interactions within climate models. More subtle relationships include how phenomena like hurricanes may alter the upper ocean heat balance, and thereby potentially influence the thermohaline circulation and longer-term climate variations (e.g., Emanuel 2001, 2002). More generally, many important hydrological processes, including clouds, moist convection, and water vapor transports operate on weather time scales, yet are among the largest sources of uncertainties in future climate change projections.

A third question is: What are key phenomena and processes that bridge the time scales between synoptic-scale weather variability and climate variations of a season or longer? This intermediate time scale is one where collaboration between WWRP and WCRP is especially well suited. A major science requirement in this area is to improve the observations, analysis and modeling of links between tropical and midlatitude phenomena, especially intraseasonal phenomena like the Madden-Julian Oscillation. Variations in the hydrological cycle and ocean-atmosphere interactions at these intermediate time scales are also high near-term research needs.

Key data requirements to address all three questions include the development of improved climate-quality data and reference data sets and higher resolution model reanalyses that will enable improved interpretations of high-impact weather events and their trends. High-resolution observations together with focused process studies will be crucial for evaluating regional model simulations, especially in regions with rapid topographic variations, such as mountainous and coastal areas. Improving estimates of high-impact flooding events will require improved hydrological data sets and advances in coupled atmospheric-land surface-hydrology models.

Linkages: Fruitful linkages can be developed between WWRP and WCRP toward addressing the questions introduced above, with the linkage between weather and climate on sub-seasonal time scales having the potential for significant advances and opportunities for collaboration in the near-term. Results from both research in medium-range weather forecasts and climate forecasts and projections indicate that a key common issue is to improve the modeling of tropical convection. Several predictability studies suggest that, beyond about 10 days, tropical heating variations are likely to provide the dominant source of potential predictability. Weather and climate models, including those used in the latest IPCC assessment, still possess major deficiencies in the simulation of organized tropical convection, so this area appears ripe for advances that may improve both weather forecasts and climate predictions and projections. Beyond the tropics, there is emerging evidence of high-latitude and stratospheric links with some high impact weather events. This suggests that improved observations and simulations of polar and stratospheric processes may provide additional sources of extended-range predictability.

Capacity Needed: A central need is the development and use of ensemble based modeling methods in order to improve probabilistic estimates of the likelihood of high-impact events. Because of the relatively small scale of many events, there will be an ongoing need to improve model resolution and develop alternative downscaling techniques. The requirements for both ensemble prediction methods and greatly increased spatial resolution imply substantial future requirements for computational power and data storage capacity. Advances are also needed in the coupling of atmospheric components with other components of the Earth system, especially oceans, sea ice, and land surface processes. This requires substantially improved process understanding of the connections themselves, as well as the development of the capacity to perform model-based analyses of the coupled system.

3.5 Societal and economic research and applications

Issue: THORPEX/WCRP collaborations can generate new and improved weather and climate predictions that can benefit societies around the world. They can do so by providing useful information that helps individuals, governmental agencies, businesses, and other organizations at local, regional, national, and international levels make decisions that address important socioeconomic issues. In order for THORPEX/WCRP collaborations to reach their potential to benefit societies, investment will be required in societal and economic research and applications.

Significance: Weather and climate predictions are relevant to a broad range of important issues facing today's societies and our planet, including:

- Protection of life and property and reduction of human misery caused by high-impact weather and climate events (such as topical and extratropical storms, floods, droughts, cold spells, and heat waves)
- Agricultural and food production
- Water resource management

- Advancement of human health
- Air quality management
- Environmental protection and sustainability
- Promotion of economic and social well-being, safety, and security

Relevant weather and climate prediction information provided by THORPEX/WCRP collaborations can, if framed and communicated effectively, help policy- and decision-makers manage and mitigate these issues, generating substantial socioeconomic benefits. Because weather and climate predictions are inherently uncertain, communication of forecast uncertainty in ways that aid decision-making is of particular importance.

Background: The broad socioeconomic relevance of weather and climate predictions can be summarized into four general goals:

- Protecting life and property
- Enhancing socioeconomic well-being
- Ensuring and improving quality of life
- Facilitating natural resource and environmental sustainability

The last three goals, together, are closely linked with the broader objective of promoting sustainable development.

The physical science research to be performed through THORPEX/WCRP collaborations can generate new knowledge that may, eventually, facilitate the provision of useful information to help decision-makers address these issues. However, substantial previous experience at the science-society interface has demonstrated that much scientific research provides little, if any, direct benefit to society without focused interdisciplinary efforts dedicated to providing relevant, useable information that helps key decision-makers address specific societal issues. To be successful, such efforts in the weather and climate arena must generally:

- Be oriented around specific societal problems and relevant decision-makers' needs, with weather and climate information playing a key (but not necessarily central) role
- Involve long-term partnerships among physical scientists, social scientists, information providers, decision-makers, and other stakeholders

Thus, if THORPEX/WCRP collaborations are to fulfill their goal of developing relevant scientific knowledge and a science infrastructure to aid policy- and decision-making, physical science researchers will need to collaborate with hydrometeorological information providers, social scientists, and decision-makers to conduct decision-relevant scientific research and help provide usable weather and climate information. With the recent advances in methodologies to estimate weather and climate forecast uncertainty, an area of special interest is effective communication of forecast uncertainty for decision-making.

Science Needed: As discussed above, most successful efforts to provide useful weather and climate information for societal benefit are focused around specific socioeconomic problems. In addition, decision-making contexts and decision-makers' information needs vary with the country and region. Thus, much of the science needed is socioeconomic research and application development in collaboration with weather and climate scientists that focuses on addressing specific societal issues in specific regions. The focus of such efforts should be determined by the most pressing socioeconomic needs related to weather and climate information in different regions.

The specific type of research and development to be performed will depend on the socioeconomic issue, geographical area, and decision context, as will the most appropriate disciplinary expertise and methodologies. In general, however, such efforts will focus on one or more of the following:

- understanding the relevance of weather and climate information to the socioeconomic issue, the decision context, and the decision-maker's information needs in that context
- identifying new, improved, or modified weather- and climate-related information that is likely to help decision-makers address the socioeconomic issue
- exploring the most effective mechanisms for generating and communicating the decision-relevant weather and climate information
- developing and providing the decision-relevant weather and climate information, testing its use and value in decision-making, and refining the information and communication mechanisms as needed
- considering strategies for ensuring long-term, effective provision of valuable new weather- and climate-related information

Projects are needed in a range of developed and developing countries, focused on different socioeconomic sectors and different scales of decision-making. Where appropriate, such efforts may include an emphasis on generating and communicating of decision-relevant uncertainty information, in probabilistic and other forms.

More general socioeconomic research is also needed to provide a context for these specific projects, address key questions at the weather/climate/society interface, and help identify priority areas for THORPEX/WCRP collaborative research. Topics include:

- examining the socioeconomic use and value of information at the weather/climate interface in different socioeconomic sectors and different geographical regions
- investigating how weather and climate uncertainty information is incorporated into decision-making
- exploring effective means for communicating forecast uncertainty to different types of decision-makers in different contexts
- synthesizing best practices in connecting weather and climate information with socioeconomic issues and decision-making

Linkages: Linkages are needed with:

- National hydrometeorological services and other relevant hydrometeorological organizations (e.g. HEPEX, hydro-electricity industries …) and information providers
- International, national, and regional governmental and non-governmental organizations involved in addressing the socioeconomic issues discussed above
- Policy- and decision-makers involved in addressing the socioeconomic issues discussed above and other relevant stakeholders

- Social and interdisciplinary scientists with expertise in the socioeconomic issues discussed above
- Social and interdisciplinary scientists with expertise in connecting weather and climate information with decision-making

Capacity Needed: The specific capacity needed depends on the socioeconomic application area, the country or region, and the project. In general, capacity is needed in terms of developing social and interdisciplinary scientists around the globe who have expertise in

- Understanding how information at the weather/climate interface, including uncertainty, connects with decision-making
- Developing decision-relevant information from weather and climate predictions
- Bridging among weather and climate researchers, weather and climate information providers, and policy- and decision-makers

WORLD CLIMATE RESEARCH PROGRAMME

JOINT SCIENTIFIC COMMITTEE

TWENTY-EIGHTH SESSION

ZANZIBAR, TANZANIA, 26-30 MARCH 2007

JSC-XXVIII/Doc. 6.3.3
(26.II.2007)

Item 6

Draft White Paper for JSC March 2007

A Revolution in Climate & Weather Prediction

1. The revolution

The economic losses to society caused by weather-related disasters during the past two decades have been estimated to be more than one trillion dollars, and fatalities more than 500,000. However global societies now face a far more serious challenge of responding to global climate change and its regional manifestations of extreme weather and climate events.

This paper makes the argument that a revolution in climate and weather prediction is now both possible and necessary. Such a revolution is possible because of major scientific advances in the understanding and modelling of the climate system, and great technological advances in the power of computers. The revolution is necessary because adaptation strategies in response to climate change require more accurate and reliable regional predictions of extreme weather and climate events. Securing the future of life on Earth over the next 100 years demands the best possible information on its life-support system, in particular the availability of fresh water.

The scientific expertise to realize this revolution resides in no one nation or scientific discipline, and international collaboration is essential. It requires a step change in profile to one that is comparable with the big scientific endeavours of the past few decades, and an international programme involving a number of multi-peta-flop computers, coherent observational data collection, research and development. Very strong stakeholder interaction will be essential.

2. The basis for the revolution

Weather prediction has developed to the point that skilful global forecasts are routinely made in many operational centres for a week or more. The day 5 forecast is now comparable in skill to the day 2 forecast of 25 years ago. Shorter-term forecasts are being made with models representing the atmosphere over a limited region on scales of a few kilometres. They are starting to show capability in predicting the occurrence of high impact events such as severe rainstorms. In research mode, with even finer resolution, simulations of systems such as tropical cyclones showing individual cloud structures are possible.

Predictions of average weather properties for a season or more ahead are also now made routinely using models and initial data of the atmosphere, ocean and land built on weather forecast models and an observational system developed from that for weather. In the past decade seasonal climate prediction has achieved demonstrable and useful skill, particularly associated with periods of slowly changing patterns in tropical ocean temperatures, and most notably those associated with the El Nino-Southern Oscillation. These models are also being used, along with observations to investigate the aspects that may be predictable for a year to a decade ahead.

Further developments of these modelling and observational systems have given the basis for the detection of climate change and its attribution to human interference, primarily through activities that lead to the emission of greenhouse gases. This has enabled the 2007 Inter-Governmental Panel on Climate Change (IPCC) scientific assessment to state “most of the observed increase in globally averaged temperatures since the mid-20th century is very likely due to the observed increase in anthropogenic greenhouse gas concentrations”. It has also enabled the projections of future climate that are assessed in that and earlier IPCC reports and that have formed the basis for discussions by governments under the United Nations Framework Convention on Climate Change (UNFCCC) of possible actions to limit future emissions.

There can be some confidence in discussing long-term changes in global mean temperature using current climate models. However it is increasingly apparent that, with their averaged representation of detailed weather and other aspects of the system, they are in general unable to provide reliable regional information. Very importantly, it has also become apparent that they are much more likely to do so if they are run at the much higher resolution commensurate with that of current weather prediction models. In the ocean, very high-resolution models run in research mode are now able to capture the “weather systems” and tight Gulf Stream-like flows of the ocean. In the coarser models used at this time in seasonal and longer-term prediction these features are not captured or are smoothed considerably. The implications of this for the predictions by coupled ocean-atmosphere models are not yet known.

Until recently the composition of the atmosphere, whether for air quality forecasts or for greenhouse gases in climate calculations, has usually been determined using separate models. Increasingly the fully interactive nature of the meteorology and chemistry of the atmosphere is being represented in models. In the same manner, the two-way interactions of the land surface and its vegetation with weather and climate, and of the ocean biology with the dynamic ocean are also now starting to be incorporated. Fully interactive carbon cycle calculations are starting to capture the changing ability of the land and oceans to act as stores for carbon. The chemistry of this planet and the life on it are becoming represented in fully interactive components of climate models, turning them into truly Earth system models.

Uncertainty in forecasts is due to the uncertainty in construction of models, the uncertainty in observation of initial states, the uncertainty of specified fields (e.g. greenhouse gases) and the inherent uncertainty implied by the chaotic nature of the atmosphere-ocean system. In weather forecasting this is now being estimated using a large number of predictions, each of which is a possible outcome. At the moment individual operational centres diagnose their own ensemble of forecasts, but multi-model, multi-centre ensembles are being developed. Ensemble methods are also used in seasonal forecasting and a major advance in the 2007 IPCC has been their use in the production of probability distributions for globally averaged surface temperature increases at various times and for various emission scenarios.

Modern systems for using data to initialise weather forecast models and to provide statistically homogeneous data sets for diagnostic and process studies have been built on ideas developed in control engineering. The current and past observations of the atmosphere are combined together in the context of the model to provide an estimate of the atmospheric state. Both ends of the timescale are providing challenges for data assimilation research. On a day or less, the challenge is to assimilate data associated with rainfall. On months and longer it is the slower parts of the climate system, land surface, ocean and ice and the coupling between them that provide the challenge. For example, in all current models there is an initial imbalance between the atmosphere and ocean because of the lack of this coupling.

The natural variation of the Earth's climate on longer time-scales includes regional fluctuations in the past 20 thousand years with great impact on the development of human civilisation and the recurrent 100 thousand year glacial-interglacial cycle in the past million years. Simulating this natural variability provides an obvious challenge for climate understanding and test for climate models. There has been some success in simulating such long periods with much reduced climate models, and in simulating isolated time-slices of 50 years or so with the full models used for future climate prediction. The variety and length of periods simulated by the complex models are both increasing as computer power allows.

It is becoming recognized that there is an opportunity to develop a new philosophy in model development. Until now, model development has largely occurred from the 'bottom up', adding more complexity as is possible. With increasing computer power, processes and phenomena that in the past had to be represented in a bulk manner, based on often poorly observed systems, can now be explicitly modelled, offering the potential for computational 'field experiments'. Often these processes and phenomena are highly non-linear, and the current bulk representations of them fail to account adequately for this. In the developing 'top down' approach knowledge of processes and phenomena gained from explicit simulation of them will guide their representation in reduced resolution or complexity models.

Much increased computer power is at the heart of all these developments, enabling the use of much higher resolution to depict the necessary structures, the use of broader Earth system models with interactive chemistry and life, the use of large ensembles of runs to estimate uncertainty and risk, the use of advanced date assimilation systems, longer paleo-climate simulations and the performance of computational field experiments.

In 1955 John von Neumann wrote "*The approach is to try first short-range forecast, then long-range forecasts of those properties of the circulation that can perpetuate themselves over arbitrarily long periods of time....and only finally to attempt forecast for medium-long time periods which are too long to treat by simple hydrodynamic theory and too short to treat by the general principle of equilibrium theory*". Weather-climate-Earth system science has now reached the point at which the final stage envisaged by von Neumann is possible and the revolution proposed here would enable it to occur.

3. The societal drivers for the revolution

The fact that there is quite good confidence in climate models projections of, for example, globally averaged surface temperature change in the next has given the basis for discussions of the mitigation of that change in the UNFCCC, G8 and elsewhere. Due to the huge economic and social implications of any mitigation measures taken, there remains a strong need for this basis to be made ever firmer.

However, adapting to climate change places very different requirements on the ability to predict climate. Changes in weather and in modes of climate variability may constitute the most profound effects of climate change on human activity and well-being and on ecosystems at the regional and local level. Extreme weather and climate events lead to much of the high impact and the likelihood of them occurring over the next years and decades is vital information for planning in aspects of human activity such as water resources, agriculture, energy and health. Water is arguably the most essential component of earth's life support systems, and simulating and predicting the spatial and temporal heterogeneity of the water cycle remains a fundamental challenge. The focus of interest for society is increasingly from months to decades, between that traditionally associated with weather and climate.

These societal requirements accord with the growing scientific realisation that we should be considering the seamless weather-climate prediction problem, from days to months to decades and longer. The necessary regional information is not well captured by current models but the developments outlined above suggest that it could be captured in future, given the necessary computational resource.

As an example, extreme sea levels depend on a combination of overall sea level rise, changes in ocean currents and the occurrence of storms with particular characteristics. The difference in expenditure incurred to cater for different expectations of extreme sea levels, and the costs of flooding major cities through failure to combat just one extreme are both so vast that they dwarf the cost of obtaining the best possible information needed to predict future changes in flooding extremes.

The rainfall in Africa comes from a wide variety of systems organised on different scales, all of which must be represented well in models if their predictions are to be believed. These include the deep tropical convective systems of central Africa, the West African Monsoon with its weather systems and embedded convection and the winter middle latitude storms of Southern Africa. In contrast there are the desert areas in the north and south. In many regions the human population, particularly through its agriculture and the incidence of disease, is extremely susceptible to floods and droughts. Although there is currently poor agreement between the projected rainfall changes from climate models, it is clear that the impacts on human activity are likely to be very significant. However they could be mitigated if sufficiently reliable information became available. In the developing world, the use of even the currently available weather and seasonal climate information is not widespread. There will be a need to create the infra-structure which would enable the use of the range of predictions that can be available on all time-scales

If the extreme summer temperatures in Western Europe in 2003 were to occur more regularly and perhaps with even more intensity, this would have major implications for society and its organisation. In both developed and developing countries, economic and industrial activity also depends on the best possible information on time-scales of a decade and shorter to maximise the opportunities and minimise the risks.

Because of the evidence for the threat of human induced climate change a number of geo-engineering responses are being proposed to mitigate it. Many of these involve interfering with the incoming solar radiation or outgoing heat radiation from the Earth so as to counter the net impact of greenhouse gases. However there is currently no understanding of even the global climate implications of any of these proposals. It is clearly vital that models be developed and tested further so that confident predictions of global and region climate impacts can be made before any proposal could be seriously considered for implementation.

4. Requirements to realise the revolution

There are five essential elements to enable the revolution:

1. Governments, the computing industry and the science community should work together towards establishing a small number of dedicated ***supercomputing facilities*** with sustained calculation speeds of about 10 Petaflops. Each facility could be supported by a cluster of countries with some common interest in regional climate variations and change.
2. Funding of ***the development of the new prediction systems and of their operational use***, in collaboration with existing centres and with the community of research scientists. The proposed unified modelling framework for tackling the seamless weather-climate prediction problem will include global climate/Earth system models with atmosphere and ocean resolutions of 10km or smaller and corresponding data assimilation systems.

3. The ***observational system*** needs to be sustained to provide the necessary coherent initial data sets for prediction on the range of time-scales envisaged, to evaluate the predictions, to monitor the Earth system and to support process studies. An important aspect of the new modelling system will be the ability to obtain much more value from the observational system
4. Enhanced funding of ***weather-climate research***, including process studies, diagnosis of the behaviour of the observed system and the models of it, development of new climate-weather prediction systems.
5. An infra-structure that enables the continuous and comprehensive ***dialogue and interaction with the stakeholder community***, including policy makers and the user and application communities that is vital if the right products are to be produced and real use of them to be made around the world.

The revolution in climate prediction that the societal drivers demand is possible given the basis of proved progress in prediction and observational capability, the promise of current research results and the anticipated progress in supercomputing power. The scientific expertise to realise this revolution resides in no one nation or scientific discipline and international collaboration is essential for it. A step-function in profile and funding will be necessary to enable the revolution. It is proposed here that there should be international agreement on this step-change in profile and funding. The endeavour is comparable in scale to a Hubble telescope or a CERN particle physics laboratory. Given the benefits to society, the return on such an investment would be extremely high.

WORLD CLIMATE RESEARCH PROGRAMME

JSC-XXVIII/Doc. 7.1
(13.III.2007)

JOINT SCIENTIFIC COMMITTEE

Item 7

TWENTY-EIGHTH SESSION

ZANZIBAR, TANZANIA, 26-30 MARCH 2007

WCP-WCRP Partnership:
Improving existing and building new synergies

Background and Rationale

Strong and sustained collaboration between the WCP and WCRP has been a long-recognized need to ensure that the advances in climate research are effectively applied to improve the climate services at the global, regional and national levels. The Fourteenth World Meteorological Congress observed that one objective of the CLIPS Project, namely the fostering of an end-to-end approach to the development and delivery of climate services, would benefit from a focused research agenda. That research agenda should be broadly based, encompassing the development of operational forecasting, application techniques, communication and presentation methods, and verification. The research agenda should also include issues like impact analysis and the development of various tools for use in seasonal forecasting and applications. The agenda should therefore integrate and complement the existing research being conducted within the WCRP, related WMO Programmes, and other institutions. It should further be developed through broad consultation, and its implementation should be planned in consultation with WCRP (Abridged final report with resolutions, WMO-No. 960 paragraph 3.2.5.4). A close synergy between the activities of WCP and WCRP is therefore essential, the starting point for which would be to enhance the interaction between the Secretariat Staff of WCP and the Joint Planning Staff of WCRP. While a number of mechanisms have been in place for some years through joint membership in working groups and expert teams, and collegial participation in product development (e.g. the WCRP 2005-2015 Strategy, the El Niño/La Niña Updates, the World Climate News, etc.) it is only recently that the Director of the WCP formally started attending the WCRP-JSC sessions beginning with the 26th JSC in Guayaquil, Ecuador, in 2005. Dr Buruhani Nyenzi attended on invitation the 27th JSC session held in Pune, India, during 6-11 March 2006, and initiated discussions on how the WCRP research outcomes could be taken to the NMHSs and end-users and where WCRP “feeds” into WCP programmes. It is proposed that Dr Nyenzi present a paper to the forthcoming 28th WCRP-JSC session scheduled to be held in Zanzibar, Tanzania from 26 to 30 March 2007, outlining the existing and proposed potential areas of collaboration and making firm proposals to action the linkages. This paper may address not only the issues raised by the 27th JSC, but also provide a forward looking perspective of developing a sustained two-way interaction between the two pivotal bodies of the climate agenda.

In this context, the Directors of WCRP and WCP jointly convened a meeting on 27 February 2007 at WMO Secretariat to give all WCP and WCRP Secretariat staff members an opportunity to meet, identify and create new and better linkages, and improve the dialogue between the services, application sectors (WCP) and researchers (WCRP) .

In this meeting, the existing interactions and valuable synergies for further WCP-WCRP collaboration were identified and a mutually agreed plan of action over the next 12 months was proposed to enhance what is already in place and address the gaps.

WCRP provides the link to the science community and focuses on climate research including research needs and gaps, whereas the WCP provides the link to climate service providers and other end-users through the provision of climate applications to the benefit of society. The existing WCP-WCRP linkages and their potential improvement can be considered in the following key areas:

(I) Anthropogenic climate change;
(II) Research inputs to operational climate prediction services;
(III) Capacity building of climate service providers;
(IV) Climate applications;
(V) Climate data and monitoring.

Both the Programmes identified 'cross-cutting communication of (and participation at) events' and 'the organization of joint events' as key mechanisms to enhance the partnership. In practical terms, this means:

- meetings, events and activities of mutual interest and relevance should be well communicated between the Programmes;
- joint meetings/events should be organized;
- cross-cutting participation in meetings/sessions at various levels (management level, project/activity/panel level etc.)

It was also noted that, in preparation for the 28th session of the WCRP Joint Scientific Committee to be held in Zanzibar, Tanzania, 26-30 March 2007, all 'background' papers of WCRP projects and cross-cutting activities have been made available on the WCRP website (http://wcrp.wmo.int). These documents, in particular those on monsoons, seasonal and decadal prediction, can facilitate the development of WCRP-WCP synergies.

The existing WCP-WCRP linkages and plans of action for their further improvement are outlined below, for each of the key areas identified above.

(I) Anthropogenic Climate Change

Existing linkages:

- at SBSTA 24 (May 2006) WCP and WCRP organized a joint Side Event to address research needs and illustrate how science contributed to applications;
- at SBSTA 25 (December 2006) GCOS, WCP, UNECA and IRI organized a joint Side Event entitled 'Climate Information for Development Needs: A Focus on Africa'.
- WCP/WCRP jointly produced brochure on Nairobi Work Programme entitled 'Climate Change Adaptation and Development Needs' (to be published by May 2007);

Further action:

- at SBSTA 26 (May 2007), a proposed ESSP/WCRP/WCP Side Event on Research Needs for Earth System Science for Policy;
- Organize a joint WCRP/WCP/IPCC Workshop for NMHSs on science and adaptation (IPCC AR4 WG I and II) to brief on regional impacts;
- to meet NMHSs expectations and needs with respect to regional prediction tools/techniques, delegates from LDCs to be consulted during Congress (Cg-XV), specifically during the 'Side Event on Adaptation', and the 'African Day – Young Scientists' as part of the WCRP JSC in Zanzibar, Tanzania, March 2007;
- organize a special day at Pre-COF meetings on IPCC assessment outcomes and facilitate their dissemination it to regional levels.

(II) Research inputs to operational climate prediction services

Existing linkages:

- In response to the desire expressed by the 27th JSC for including WCRP (CLIVAR) in the ENSO activities of WCP, Dr Ben Kirtman, Chair, TFSP and WGSIP, was formally nominated to the CCl Expert Team on El Niño and La Niña;
- During Pre-COF training sessions CLIVAR scientists were involved;
- WCRP is consulted in the development of WMO El Niño/La Niña Update statements coordinated by the WCP

Further action:

- CCl ET3.1 on "Research Needs for Intra-seasonal, seasonal and interannual prediction, including the application of these predictions" has common interests with WGSIP and their interaction needs to be enhanced;
- Joint promotion of the application of ensemble-based seasonal prediction products in various sectors (e.g., health) through, for example, the activities of relevant CCl Expert Teams, interdisciplinary training and COFs;
- Joint activities in the development of downscaling strategies for climate predictions from global to regional national scales, including regional climate modelling;
- More active involvement of WCRP in the consensus processes of operational SIP being developed by WCP at global and regional scales, through participation in training and COFs;
- Joint activities to quantify uncertainties in real-time climate prediction and provide a practical tool for RCOFs;
- Development of verification tools;
- Potential WCRP involvement in the assessment of prediction tools developed by research institutes and NMHSs (e.g., IRI climate predictability tool), which can be considered as a desired outcome of the WCRP Workshop on Seasonal Prediction in Barcelona, Spain, June 2007;
- CCl Expert Teams may be encouraged to participate in the WCRP Workshop on Seasonal Prediction in Barcelona to enhance interaction between WCP, CCl and WCRP.

(III) Capacity building of climate service providers with NMHSs

Capacity building of climate experts of NMHSs (e.g., through professional development/training and opportunities to participate in workshops and conferences), particularly in the developing and least developed countries, is a major component of CLIPS, in which SIP is a core theme. Other aspects of capacity building to be considered for effective implementation of research results in developing countries are stable internet access, technology for satellite data feeds, processing equipment and computers, data storage devices, access to professional Journals etc.

Existing linkages:

- WCP supported and participated in the WCRP (CLIVAR) VACS Southern and Eastern African Climate Predictability Workshop held at Dar-es-Salaam, Tanzania, during 10-13 July 2006.
- A number of CCl ET and WCRP/CLIVAR panels contributed as resource persons in the recently held CLIPS Training Workshop for RAII (Eastern Part) at Bangkok, Thailand, in January 2007.
- WCRP-JSC meeting in Zanzibar will have a complete ‘African Day - Young Scientists’ organized by WCRP, START, WCP to stimulate NMHSs-researchers/WCRP dialogue.

Further action:

- WGSIP, in coordination with the WCRP (CLIVAR) regional panels (e.g., VACS, AAMP) to guide the regional climate outlook development process and assist in the operationalization of advanced seasonal prediction strategies within the RCOFs;
- WCP and WCRP join to promote the development of regional research capacities in SIP, particularly in the developing and least developed countries;
- WCRP, through its CLIVAR regional panels, to contribute to the development of CLIPS curriculum/training material, which can be integrated into regular training activities, and have WCRP actively involved in CLIPS training sessions; a formal set-up for WCRP involvement will have to be developed;
- WCRP panel meeting could be organized ‘in tandem’ with CLIPS sessions to enhance interactions and fruitful discussions;
- RCOF activities, end-user liaison and the requirements of climate related risk management may feed into agenda of WGSIP sessions to strengthen partnership between researchers, climate service providers and end-users;
- integrate regional climate services specialists (especially those with extensive experience in conducting COFs and in liaison with user communities around the world on an operational basis into the upcoming WCRP SIP workshop (June 2007, Barcelona);
- Jointly develop other mechanisms, in addition to CLIPS and START initiatives, to organize training programmes to operational climate providers at NMHSs (on seasonal prediction tools and others) similar to the VACS workshop in Dar es Salaam, Tanzania, July 2006.

(IV) Climate applications

CCl has focus on the sectors: (1) Health; (2) Energy; (3) Tourism; (4) Urban and Building Climatology; (5) Agriculture; and (6) Water Resources.

Existing linkages:

- International workshops on Climate Prediction and Agriculture (CLIMAG) were held on 27-29 September 1999 and 11-13 May 2005, both in Geneva, organized by WCRP/IGBP/START;
- a comprehensive publication on CLIMAG resulted from this cooperation: Advances in applying climate prediction to agriculture, Climate Research Special 16 (2006);
- Interaction through the WCP-Water programme activities

Further action:

- Experience and user-provided input to WMO from the Espoo Conference and the Madrid event should be shared with these communities, and factored into any discussions.
- The partnerships WCP has developed with international agencies (WHO, UNDP, UNEP, the International Society of Biometeorology and the International Association for Urban Climatology, etc.) could be fostered in this environment. THORPEX and GEOSS and their cross-cutting activities in support of societal benefits also need to be integrated into these partnerships.
- ESSP launched joint projects should be linked in with WCP activities; these projects are on: Global Environmental Change & Human Health (GEC&HH: http://www.essp.org/en/joint-projects/health.html); Global Water System (GWSP: http://www.essp.org/en/joint-projects/water.html), Global Environmental Change and Food Systems (GECAFS: http://www.essp.org/en/joint-projects/food.html) - a link to agricultural research, and Global Carbon (GCP: http://www.essp.org/en/joint-projects/carbon.html); synergies should be established to WCP contacts in the various sectors (GECAFS to the Agricultural Meteorology Programme; GEC to the CONASTAC (Contribution of Agriculture to the State of Climate) Network, established by the CAgM-Expert Group on the Contribution of Agriculture to the State of Climate;
- relevant WCP websites should link to the specific websites of the ESSP global environmental change projects; ESSP project representatives could be invited to relevant WCP meeting/events; WCP participation at SSG meetings of ESSP joint projects;
- joint activities of WCASP with CLIVAR and GEWEX may be planned to address the specific requirements of climate information within these sectors.

V Climate data and monitoring

Existing linkages:

- Joint CCl/CLIVAR/JCOMM ET on climate change detection and indices;
- WMO Seminar on Climate Data Homogenization and Climate Indices, Congo Brazzaville, 23-27 April 2006, with experts from CLIVAR and CCl

Further action:

- Collaboration on climate data exchange, data management and data rescue: The needs from WCRP and potential CCl/WCDMP involvement;
- CCl/CLIVAR/JCOMM joint effort: Seminars of climate change indices and climate extremes;
- A special issue of *WMO Annual Statement on Sea-Level (Rise)* should be produced.

Potential new overarching mechanisms for sustained WCP-WCRP linkages

- Cross-cutting participation in the sessions of CCl ETs and WCRP panels (e.g., WGSIP may invite the Leads of CCl ET3.1 on Research Needs/ET3.3 on El Niño/La Niña and vice versa);
- Coordinated START and WCRP involvement in CLIPS training activities, by way of joint training workshops with exchange of expertise and facilitation of user liaison;
- Coordination at the top level:

  - o President CCl may join JSC sessions and JSC Chair and D/WCRP may join CCl sessions, Management Group meetings, and other key meetings such as the Espoo meeting etc.
  - o CCl sessions are held once every four years: efforts may be made to collocate JSC session and CCl session with at least one day of joint session. The next CCl session will be in 2009;
- Joint WCP/WCRP involvement in the organization of the WCC3 in late 2009.

Acronyms

CAgM – Commission for Agricultural Meteorology
CCl – Commission for Climatology
CliC – Climate and Cryosphere
Cg – World Meteorological Congress
CLIPS – Climate Information and Prediction Services
CLIVAR – Climate Variability and Predictability project
ESSP – Earth System Science Partnership
ET – Expert Team
GCOS – Global Climate Observing System
GEWEX – Global Energy and Water Cycle Experiment
JCOMM – Joint WMO-IOC Technical Commission for Oceanography and Marine Meteorology
JSC – Joint Scientific Committee
NMHS – National Meteorological and Hydrological Service
RCOF – Regional Climate Outlook Forum
SIP – Seasonal to Interannual Prediction
START – Global Change System for Analysis, Research and Training
TFSP – Task Force on Seasonal Prediction
VACS – Variability of the African Climate System panel of the CLIVAR
WCASP – World Climate Applications and Services Programme
WCC3 – World Climate Conference Three
WCDMP – World Climate Data and Monitoring Programme
WCP – World Climate Programme
WCRP – World Climate Research Programme
WGSIP – CLIVAR Working Group on Seasonal to Interannual Prediction
WMO – World Meteorological Organization
WOCE – World Ocean Circulation Experiment

WORLD CLIMATE RESEARCH PROGRAMME

JSC-XXVIII/Doc.7.3
(9.III.2007)

JOINT SCIENTIFIC COMMITTEE

Item 7

TWENTY-EIGHTH SESSION

ZANZIBAR, TANZANIA, 26-30 MARCH 2007

IOC SPONSOR VIEW OF WCRP

The Intergovernmental Oceanographic Commission (IOC) of UNESCO serves its Member States with a mechanism for cooperation in the study of the oceans for the benefit of all, and is the UN focal point for ocean sciences and services. The IOC joined WMO and ICSU as sponsors of the WCRP in 1993.

This document summarizes input from IOC Member States and its Secretariat about climate research and the WCRP, for the consideration of the JSC in its discussions about the future of the WCRP.

1. IOC governing body decisions on the WCRP

The governing bodies of the IOC have provided specific instructions on the WCRP in the past two years. In June 2005, the IOC Assembly “reaffirmed its continued co-sponsorship and its support of the WCRP,” directing support at a proposed level of at least US$ 125,000 per year through Regular Programme funds. The IOC Executive Council in June 2006 “called on the WCRP to provide annual reports on research of interest to Member States, and on its planned biennial budget and the extra-budgetary resources sought.” Both urged IOC Member States to identify additional financial support for WCRP activities through the IOC Special Trust Fund for the WCRP. However since 2005 no additional support for the WCRP has been received from IOC Member States beyond the Regular Programme contribution.

2. Guidance for the WCRP

Advisory Group for the IOC Ocean Sciences Section

The IOC Assembly in 2005 directed the formation of an Advisory Group for the IOC Ocean Sciences Section, within which the WCRP belongs in the programmatic structure of the IOC. The conclusions of this Advisory Group will be considered by the IOC Assembly in June 2007 as it finalizes the IOC strategy for 2008-2013, and its programme and budget for 2008-2009.

The Advisory Group recommended strengthening the IOC’s involvement in the WCRP, noting its key role in achieving the objectives of the IOC Ocean Sciences programme and the objectives of IOC Member States. It identified the core WCRP strength in coordinating research on the predictability of the global climate system.

It also recommended that the IOC Ocean Sciences Section provide more attention to presenting work in its policy context, emphasizing its possible application and utility. It recommended that the Section improve communication with Member States, including on the impacts of climate variability and climate change on the marine environment and on its living resources and ecosystems.

from IOC Member States via input from regional subcommissions

Different regional subcommissions of the IOC have expressed varied priorities concerning climate research and the application of forecasts of climate change and variability, including interest in monsoons, in coastal impacts, in implications for marine resource management, and in building local capacity in ocean and climate research to address those priorities. A common thread is the desire to participate in and benefit from research to better understand the impacts of climate change and variability on both natural systems and human activities in their region.

For example, the IOC Regional Committee for the Western Indian Ocean (IOCWIO) reported at the last IOC governing body meeting on the need to enhance regional capacity to participate in and benefit from global climate research programs such as those in the WCRP, including the use of climate information in coastal zone management and the management of marine resources.

Responding to these priorities through climate research could include addressing improvements to the regional downscaling of global climate models and seasonal-to-interannual climate forecast systems, and addressing the impacts of climate change and variability on inputs into coastal and marine systems.

WCRP and sustained ocean climate observations in GOOS

A major programme of the IOC is the Global Ocean Observing System (GOOS), made up of global and coastal modules. The global module of GOOS is focused on climate monitoring, prediction, and research, and is the ocean component of the Global Climate Observing System (GCOS). The IOC invests in programs supporting coordination of observations, data management, the development of products and services, and central coordination for GOOS. Scientific oversight of the global module of GOOS through the OOPC relies on close cooperation with CLIVAR and growing cooperation with CliC.

The WCRP co-sponsored the June 2006 Workshop on Understanding Sea-level Rise and Variability hosted and co-sponsored by the IOC. The outcomes are reported in Document 2.7, and included expressions of research and observational needs in order to reduce the uncertainties in forecasts of sea level rise and variability. This provided valuable input for GOOS recommendations, and a useful tool in building support at the national level for improved ocean observations.

Similar workshops focused around a unifying scientific question, reviewing outstanding uncertainties and focused on providing recommendations for needed research and needed observations could be of mutual interest to the WCRP and to IOC programs. Some potential topics could be improving seasonal to decadal climate forecasting, understanding the potential for abrupt climate change, or improving the understanding of the link between tropical cyclone variability and larger climate variability and change.

3. Conclusions for the JSC

This report from the IOC has the following broad conclusions, which pose a final contradiction:

1. recognition by the IOC of WCRP core strengths and performance in coordinating research on mechanisms and predictability of climate change and variability, and as the authority in this research; and with a strong link to the global module of GOOS;

2. a desire by the IOC to see an extension to research on impacts of climate change and variability, through research on the effects of climate on different natural systems and human activities, including emphasis on a regional focus;

3. however, the IOC is itself faced with a reducing financial base in Regular Programme funds, with no possibility for increased funding to the WCRP. Level funding will require continued effort to demonstrate the utility of the WCRP to the IOC Member States.

The IOC will remain engaged with the leadership of the WCRP and the other sponsors as the WCRP reflects on its future directions.

World Meteorological Organization		**Cg-XV/PINK 3.2.7**
FIFTEENTH CONGRESS	Submitted by:	Dr A.M. Noorian, Chair, Committee A
	Date:	16.V.2007
GENEVA, 2007	Original Language:	English
	Agenda item:	3.2.7

WORLD CLIMATE RESEARCH PROGRAMME

Report to Plenary on item 3.2.7

REFERENCE:

Cg-XV/Doc. 3.2.7

APPENDIX:

Draft text for inclusion in the general summary on item 3.2.7

ACTION PROPOSED:

It is recommended that the draft text in the Appendix be included in the general summary of the work of the session.

DRAFT TEXT FOR INCLUSION IN THE GENERAL SUMMARY OF Cg-XV

3.2.7 WORLD CLIMATE RESEARCH PROGRAMME *(agenda item 3.2.7)*

3.2.7.1 Congress noted with satisfaction the achievements made by WCRP since the Fourteenth WMO Congress. Particular advances under WCRP's two objectives, improving climate prediction and enhancing understanding of human interactions with climate, included: enhancing seasonal prediction skill by robust ensemble techniques, quantitative skill assessments, and applications to outbreaks of tropical diseases, forest fires and floods; reanalysis improvement specifically the completion of the Japanese 25-year Reanalysis Project (JRA-25) in 2006, multiple improvements in European Re-Analysis (ERA-40), initiation of ocean reanalysis, and reprocessing to address precipitation coupling to other components of the climate system; climate change projections input to the Intergovernmental Panel on Climate Change (IPCC) AR4 including the creation of the Coupled Model Intercomparison Project (CMIP3, IPCC AR4) archive (at the Program for Climate Model Diagnosis and Intercomparison (PCMDI)) and user analyses (at the Max Planck Institute); assessment of skill in AR4 projections e.g. uncertainties in sea-level rise and carbon absorption; crucial contribution to the 2006 WMO/UNEP Scientific Assessment of Ozone Depletion especially through model skill evaluation and improvement; and contribution to formulating the IPY research tasks and establishing its legacy in terms of data and observing systems. Significant contribution to the understanding of the role of air sea interaction over the North Indian ocean in the sustenance of Indian summer monsoon has been achieved through various field campaigns at the national level under the aegis of the ICRP (Indian Climate Research Programme).

3.2.7.2 Congress noted the valuable work done in past years by the IAHS/WMO Working Group on WCRP GEWEX and encouraged the climate science community working under the WCRP and the hydrological science community of IAHS to cooperate so as to ensure an effective input from the hydrological sciences to the WCRP.

3.2.7.3 Congress was pleased to note that WCRP plans for implementation of its new Strategic Framework includes much closer involvement of WMO Members and specific goals designed to respond better to their needs. Congress noted that WCRP plans contribute to WMO Strategic Objectives 2 (increasingly beneficial climate services) and with THORPEX 5 (improving modelling of climate) through evaluating the skill of climate models in seasonal prediction in a focussed assessment involving major forecast centres to be held in Barcelona, Spain, in June 2007; with the WCP creating climate indices through the CLIVAR/CCl/JCOMM Expert Team on Climate Change Detection, Monitoring and Indices (ETCCDMI); establishing an Internet forum for users of the Climate Prediction Tool (CPT) and facilitating "train the trainer" activity to enable better use of the CPT; assisting nations in developing adaptation strategies to climate change through a LDC capacity building workshop hosted by the International Centre for Theoretical Physics (ICTP), Italy in November 2007 and participating in an international conference jointly with GCOS and IGBP on 'lessons learned from AR4'; facilitating the application of reanalysis data through the Third WCRP Reanalysis Conference to be held in Tokyo, Japan, in January 2008; and establishing a concrete climate focus on provision of the Early Warning of Climatic Extremes with the Natural Disaster Prevention and Mitigation (DPM) Programme and WCP; and many regional activities including the Indian Climate Research Programme's study of the hydrological cycle over the South Asian continent during the monsoon season; studies over oceans near Africa (especially the Indian Ocean) to improve our understanding of African climate variability for support in early warning and agriculture; and increased efforts to address lack of data and improving our understanding of equatorial climate processes. Congress welcomed the JSC's prioritization and supported these proposed climate research initiatives for 2008-2011.

3.2.7.4 Congress noted the brief WCRP report on the main outcomes of the WMO/ICSU/IOC Joint Scientific Committee (JSC) for the World Climate Research Programme, the 28th session of which took place in Zanzibar, Tanzania, on 26-30 March 2007. The JSC session focused its attention on ways of implementing the WCRP's Strategic Framework 2005-2015 and considered proposals on the actions needed to ensure the funding necessary for WCRP's future activities. The session confirmed the chief role of WCRP projects in the implementation of its programme. The JSC considered a proposal from the Scientific Committee of the International Geosphere Biosphere Programme (IGBP) to establish a joint JSC/IGBP Council working group to consider the common science issues and the best means of pursuing these into the future. Congress expressed its appreciation for the leadership of the WMO/ICSU/IOC Joint Scientific Committee (JSC) in formulating the overall scientific strategy for the programme. Congress also recognized that changing demands and the increasingly multi-disciplinary nature of climate research are likely to be considered in the upcoming review of the WCRP by ICSU, which will include WMO participation.

3.2.7.5 Congress was pleased to note the view expressed by the JSC at its 28th meeting in Zanzibar that WCRP should fully utilize the potential of WMO, WCRP's main sponsor, including its regional programmes with the World Climate Programme as well as START, in addressing the needs, interests and building capacity of developing countries in climate research and applications and that high priority would be given by WCRP to regional climate predictions and the ability to produce them by developing countries. It noted the high importance of the crosscutting activities prioritized by the JSC on the Anthropogenic Climate Change (ACC), Atmospheric Chemistry and Climate, Seasonal Prediction, Decadal Predictability, Monsoons, Climate and its Extremes, and the International Polar Year 2007-2008 (IPY). WCRP will work closely with IGBP to implement ACC as a major joint crosscutting activity while all other crosscutting activities will be led by various WCRP projects.

3.2.7.6 Congress was pleased with the WCRP's outward looking approach to WMO Members and acknowledged that integration of climate and Earth system science is essential for NMHSs to be able to deliver end-user benefits identified in WMO's Strategic Objectives 3 and 4. WCRP will work with NMHSs to improve climate predictions and their exploitation. WCRP will also deliver improved understanding of human effects on climate to assist Members, for example, in developing strategies related to adaptation to climate change.

3.2.7.7 The representative of the IOC of UNESCO recalled to the Congress that the IOC joined WMO and ICSU as a sponsor of the WCRP in 1993 and that in June 2005, the 23rd IOC Assembly "reaffirmed its continued co-sponsorship and its support of the WCRP" at a level of at least 125,000 US$ per year through Regular Programme funds. The IOC sees WCRP as a world-wide community of climate scientists, which represents the best collective knowledge about the physical climate system and its predictability. IOC Member States rely on the WCRP for leadership and coordination in climate science, for improved predictions of climate variability and change, and for the strong contributions of WCRP programmes to the Global Ocean Observing System. The inputs of the WCRP CLIVAR and CliC projects continue to be central for this. The IOC believes the WCRP should maintain its focus on coordinating and promoting the highest-quality research on the predictability of the climate system and the human effect on climate, as it has done so very well in the past. The IOC Member States have also expressed an interest in understanding climate science in its policy context and in understanding the impacts of climate variability and change. The IOC appreciates the initiatives WCRP has taken and will be taking in improving climate services, in exploring avenues for collaboration with the IGBP and other international climate research programmes through the ESSP, and in assisting developing countries in understanding regional climate projections in order to develop adaptation strategies. The IOC thanked the WMO for its continued major support of the WCRP secretariat and programme activities, and expressed willingness to continue dialogue on how to best support the activities of the WCRP.

Congress noted with appreciation that the Hydrographic Programme Atlas Series of the World Ocean Circulation Experiment (WOCE) has published Volume 1 with the Southern Ocean Atlas in 2005. New sections were added to the comprehensive African Climate Atlas. The WCRP Sea-level Rise Task Team organized the WCRP workshop 'Understanding Sea-level Rise and Variability' in June 2006 in Paris, France. The Workshop, which brought together 163 participants from 29 countries, made recommendations on research and observational requirements needed to address uncertainty in sea-level rise and its variability, which will be published in 2008. Dr John Church, the Chair of the WCRP, delivered the 2006 Lecture entitled "Global Sea Levels: Past, Present and Future" and received the Roger Revelle medal at the 39th Session of the IOC Executive Council (Paris, June 2006).

3.2.7.8 Congress recognized the importance of the work of the WCRP in pursuing implementation of WCRP's Strategic Framework 2005-2015 and appreciated WCRP's role in providing international coordination in facilitating climate research. Congress expressed serious concern about the lack of funding available for WCRP to continue its efforts to coordinate and facilitate fundamental climate research, and, particularly in light of WMO's role as a major sponsor of WCRP, strongly urged Members to find ways to increase support to WCRP.

3.2.7.9 Congress approved the continuation of the Agreement between WMO, ICSU and IOC for the conduct of WCRP following from Thirteenth Congress, Resolution 9 and urged WMO to continue its strong support for and guidance to the WCRP.

WORLD CLIMATE RESEARCH PROGRAMME

JSC-XXVIII/Doc. 7.5
(15.II.2007)

JOINT SCIENTIFIC COMMITTEE

Item 7

TWENTY-EIGHTH SESSION

ZANZIBAR, TANZANIA, 26-30 MARCH 2007

WCRP BRIEFING TO IOC 2007

WCRP World Climate Research Programme | WMO | IOC | ICSU International Council for Science

WCRP BRIEFING TO IOC 2007

IOC is a co-sponsor of the World Climate Research Programme (WCRP), together with the World Meteorological Organization (WMO) and International Council for Science (ICSU). These three major international organizations established WCRP to address two objectives: to determine the *predictability of climate* and to determine the *effects of human activities on climate*.

This report for IOC Member States and main partners of the IOC accompanies the WCRP Annual Report 2005-2006 (http://wcrp.wmo.int/pdf/WCRP_AnnualReport2005_06.pdf), entitled *New Futures: Building on Great Success*, and contains additional information about the ocean-related research of the WCRP. The goal of this report is to improve contact and communication between the WCRP and IOC Member States according to the recommendations of the 39th Executive Council of the IOC[1]. We would like to further develop the WCRP ocean-related activities so that they form an integral part of the IOC Ocean Sciences Section, including complementing activities that may develop through its proposed programme on climate impacts in the marine environment. The goal is a truly joint and cooperative programme of activities, in which IOC Member States express requirements, actively participate and achieve results tailored to their needs. We hope to mutually benefit the IOC Member States and the WCRP through this ongoing partnership.

This report includes background information, a summary of WCRP past accomplishments in ocean science, an account of current ocean research and proposals regarding possible future activities. We also invite feedback on its contents from all IOC Member States and partners.

I. WHY STUDY OCEAN CLIMATE?

The natural climate system and human systems interact in complex and increasingly numerous ways. Impacts on water supplies, ecosystems, agriculture, coastal areas and on human health from climate variability and change are expected to grow. The oceans play a key role in the climate system on both long and short time scales through their absorption and transport of heat and carbon. Understanding the ocean's role in the climate system is key to understanding and predicting sea level rise, ocean acidification, coupled modes of climate variability on interannual to decadal time scales such as El Niño and the North Atlantic Oscillation (NAO), the possibility of abrupt climate changes, and the strength and frequency of tropical cyclones. Climate variability and change also will have impacts on the oceans through interactions with ocean ecosystems, biodiversity and fisheries—a resource that currently provides food for 3.5 billion people. Addressing the threats human society faces requires international policy cooperation and a strong research effort to underpin policy directions.

The *IOC Medium-Term Strategy (2008-2013)* identifies the prediction of climate change and an assessment of its impact on the oceans as one of its four top priorities. The WCRP, in focusing on climate predictability and human impacts on climate, addresses this priority. Its Strategic Framework 2005-2015: *Coordinated Observation and Prediction of the Earth System* envisages direct input of WCRP science to practical applications of high relevance and benefit for society. It also has a potential to serve other IOC priorities, such as prediction and mitigation of natural disasters. http://wcrp.wmo.int/pdf/WCRP_strategImple_LowRes.pdf.

---

[1] Decision of IOC EC-39 (June 2006), section 4.2.3: "The Executive Council called on the WCRP to provide annual reports on research of interest to Member States, and on its planned biennial budget and the extra-budgetary resources sought. The Executive Council urged Member States to contribute to the IOC Special Trust Fund for the WCRP. Given the diversity of WCRP's activities and the diversity of Member State interests, the Executive Council also urged Member States to work with the WCRP Joint Planning Staff in order to identify specific ongoing activities or new activities consistent with the aims of the WCRP that could be supported by their contribution to the IOC Special Trust Fund."

II. ACCOMPLISHMENTS OF THE WCRP IN OCEAN SCIENCE

WCRP has been a leader in international oceanographic research since its founding 26 years ago. All three of the WCRP's completed research projects have included a strong oceanographic component:

1. **Tropical Ocean Global Atmosphere (TOGA,** 1985-1994) created the physical basis for explaining El Niño-Southern Oscillation (ENSO) in the ocean and atmosphere. It established the first elements of the observing system in the Pacific Ocean and parts of the Indian Ocean, and led the way to operational predictions of El Niño on seasonal time-scales. http://www.ncdc.noaa.gov/oa/coare/toga.html.
2. **World Ocean Circulation Experiment (WOCE,** 1990-2002) was the first comprehensive survey of the global oceans. This largest experiment in the history of oceanography greatly improved our ability to observe and model the world oceans and made important contributions to a large range of research and operational marine activities. The first comprehensive ocean atlas of WOCE data, covering the Southern Ocean, was released in 2006, and atlases for the Atlantic, Pacific and Indian Oceans will be released over the coming years. http://www.soc.soton.ac.uk/OTHERS/woceipo/.
3. During the decade of the **Arctic Climate System Study (ACSYS,** 1994-2003) the increased regional pace of climate change in the Arctic was predicted. Significant reductions of the Arctic Ocean multi-year sea-ice cover observed in recent years turn into action the ice-albedo climate feedback, which is one of the strongest in the climate system. A possibility of slowing down of the thermohaline circulation due to changes in the Arctic Ocean freshwater balance was also demonstrated. http://acsys.npolar.no/.

III. ONGOING OCEAN RESEARCH IN WCRP

The WCRP has several active research programmes with significant oceanographic components.

1. **Climate Variability and Predictability (CLIVAR)** studies physical mechanisms of climate variability and predictability on seasonal, interannual, decadal and longer time scales, and the role of the oceans in them. CLIVAR ocean basin panels develop pilot research-based observing systems focusing on the role of oceans in regional climate change and on important processes that affect the larger climate system. The CLIVAR basin panels have been a key partner for the Ocean Observations Panel for Climate (OOPC), a joint panel of the WCRP, the Global Climate Observing System (GCOS), and the Global Ocean Observing System (GOOS) in developing recommendations for the global module of the GOOS. http://www.clivar.org/.
2. **Climate and Cryosphere (CliC)** systematically addresses physical science questions related to sea-ice, glaciers, permafrost, snow and other components of the frozen water realm. These questions are integral to predicting future sea-level rise, water resources, changes in the ocean thermohaline circulation due to fresh water anomalies and the changes in the carbon cycle of the ocean. http://clic.npolar.no/.
3. **Global Energy and Water Cycle Experiment (GEWEX)** studies the hydrological cycle of the atmosphere. In cooperation with the WCRP Working Group on Surface Fluxes, it produces a new generation of land- and sea-surface flux data based on satellite observations, field studies and modeling. Better understanding and representation of ocean-atmosphere fluxes in coupled models is the key for longer-term climate prediction. http://www.gewex.org/.
4. **Surface Ocean–Lower Atmosphere Study (SOLAS)** is a joint project of WCRP with the International Geosphere–Biosphere Programme (IGBP), the Scientific Committee on Oceanic Research, and the Commission on Atmospheric Chemistry and Global Pollution. It is an innovative study aiming at quantitative understanding of the key biogeochemical-physical interactions and feedbacks between the ocean and atmosphere. SOLAS, as well as CLIVAR and CliC, contributes to the studies of the ocean carbon cycle, cooperating with the International Ocean Carbon Coordination Project (IOCCP). http://www.solas-int.org/.

5. **Monsoon Research and Seasonal Prediction:** One third of the world's population lives under the direct influence of monsoons, which occur due to the seasonal coupling of the atmosphere and ocean. Monsoon anomalies can mean deadly floods or insufficient rain for sustaining crops. WCRP monsoon initiatives are under way on all continents. Examples are the CLIVAR/GOOS Indian Ocean Panel, the African Monsoon Multidisciplinary Analysis (AMMA), and several South and North American projects. http://www.clivar.org/organization/indian/indian.php, http://amma.mediasfrance.org/, http://www.eol.ucar.edu/projects/vocals/, http://www.eol.ucar.edu/projects/epic/.

6. **Model Appraisal and Development:** The Working Group on Ocean Model Development addresses the specific needs and concerns of the oceanographic modeling community. http://www.clivar.org/organization/wgomd/wgomd.php/. More than 40 intercomparison projects have been undertaken by WCRP since its inception to develop weather prediction, ocean and climate models from their infancy. http://www-pcmdi.llnl.gov/.

7. **United Nations Framework Convention on Climate Change (UNFCCC) and WMO/UNEP Intergovernmental Panel on Climate Change (IPCC):** The WCRP coordinates scientific research and climate prediction experiments that form the foundation for IPCC reviews. For the 2007 IPCC Fourth Assessment Report, the WCRP established the world's first comprehensive collection of climate predictions and their analyses. To assist the UNFCCC, WCRP has recently conducted a study on gaps in climate change research and is currently seeking means to address them. http://unfccc.meta-fusion.com/kongresse/SB24/templ/ply_sideevent.php?id_kongresssession=168.

8. **Global Observations:** WCRP assists the GCOS in formulating requirements for climate observations. It cosponsors panels reviewing ocean (OOPC) and atmospheric observations for climate. By developing prototypes of observing techniques, data assimilation methods and deploying pilot observing systems, WCRP projects were instrumental in setting the stage for such successful activities as GOOS, Argo, and Global Ocean Data Assimilation Experiment (GODAE). http://www.wmo.ch/web/gcos/gcoshome.html, http://ioc.unesco.org/oopc/, http://www.ioc-goos.org/, http://www.argo.net, http://www.godae.org.

9. **International Polar Year 2007-2008 (IPY):** Input from the WCRP helped to shape the science programme of IPY, and climate research dominates its agenda. WCRP was instrumental in setting up the unprecedented two-year snapshot of the polar oceans. For the first time, many satellites will allow coordinated observations of the poles at multiple wavelengths, improving our understanding of the physics of the polar oceans. http://www.ipy.org (project number 91).

10. **Earth System Science Partnership (ESSP)** formed by WCRP, IGBP, Diversitas and the International Human Dimensions Programme on Global Environmental Change (IHDP), studies the complex Earth system. http://www.essp.org. Oceanographic projects of the IGBP include Land-Ocean Interactions in the Coastal Zone (LOICZ, cosponsored by IHDP), SOLAS, and Integrated Marine Biogeochemistry and Ecosystem Research (IMBER). The two latter projects are also cosponsored by the Scientific Committee on Oceanic Research (SCOR). http://www.scor-int.org. The joint ESSP Global Carbon Project (GCP), in its work on the global carbon cycle, cooperates with the IOCCP. http://www.globalcarbonproject.org/.

11. **Capacity Building:** The ESSP Global Change SysTem for Analysis, Research and Training (START) Programme sponsors scientists from the developing world and helps them to participate in international global change research. http://www.start.org.

IV. WCRP INITIATIVES IN OCEAN SCIENCE

The WCRP looks enthusiastically toward continuing success in many of the efforts currently under way. Retaining our focus on the predictability of climate and human effects on climate, we are developing the following new initiatives:

1. **Ocean Reanalysis:** Meteorological reanalyses assimilate and integrate past observations into a self-consistent data set. They have revolutionized atmospheric research and improved models and our understanding of physical processes, which resulted in an additional increase in the quality of numerical weather and climate prediction. Improved observations have made an ocean reanalysis and state estimation possible for the first time. The WCRP/CLIVAR ocean initiative on reanalysis will serve as the basis for studying climate dynamics of the oceans, assessing thermal expansion of the ocean in sea-level rise research, and providing an initial condition for climate predictions with coupled models. An ocean reanalysis is a necessary step toward a global climate system reanalysis. It will also contribute to ecosystem and fisheries research. http://www.clivar.ucar.edu/organization/gsop/implementation/ocean_reanalysis.html.

2. **Arctic and Southern Ocean Observing Systems:** The polar oceans are integral to the global circulation and climate, controlling the global fresh water balance and carbon uptake by the oceans. Melt-water from the cryosphere contributes significantly to the recent increase in the rate of sea-level rise. However, the polar regions are systematically under-observed. Pilot observing systems are being developed for these areas, including ice-based observing platforms (http://www.ipy.org/, project numbers 14 and 132). A comprehensive plan for cryosphere observations was recently developed by WCRP in cooperation with the Scientific Committee on Antarctic Research (SCAR) and will be implemented as a legacy of IPY. http://igos-cryosphere.org/. These research observing systems will inform future GOOS plans for ongoing observations in the polar oceans.

V. Climate Impacts Depending on Ocean Research

In order to formulate effective policies, governments need more reliable predictions of climate on a range of time-scales. The scale and nature of the expected changes are discussed in the IPCC 4th Assessment Report, which is coming out in 2007, http://www.ipcc.ch/. The "Stern Review on the Economics of Climate Change" emphasizes the multi-billion scale of the impact on the economy. http://www.hm-treasury.gov.uk/independent_reviews/stern_review_economics_climate_change/sternreview_index.cfm. A recent survey conducted for the European Space Agency (ESA) by PricewaterhouseCoopers (Executive Summary available on request from ESA) highlighted that by far the greatest return on investment in Earth observation is expected to be due to improved adaptation to and mitigation of global climate change. Oceans are critical in improving our predictive ability and we need better ocean assessments, observations and models, both for climate and coastal zone decision-making. In order to best serve society and the IOC Member States, as part of the IOC Ocean Sciences programme, the WCRP would like to explore, with IOC and its Member States, perceived needs and opportunities for major advances in ocean science in which WCRP could take a lead. Our emphasis will remain on climate predictability, risk reduction and risk management. We would like therefore to invite IOC Member States to consider the benefits of the following research areas:

1. **Sea-level rise:** In June 2006, the WCRP organized a major international workshop, hosted by the IOC at UNESCO, on sea-level rise and variability. It achieved consensus on the estimates of the current pace of sea-level rise and the requirements for observing systems and modeling to better constrain the estimates and predictions. The ocean level is currently rising at a rate of about 3 mm per year, 50% faster than the average in the 20th century. The population of some atolls in the Pacific has been already evacuated, but coastal areas are becoming more and more densely populated and developed. Already, a quarter of the world's population live within 100 km distance and 100 m elevation of the coast. Even those not in direct danger of flooding by the rising seas will be increasingly vulnerable to river flooding and storm surges. More research is needed to better understand the heat uptake and resulting expansion of the oceans, the stability of ice sheets, the amount of water stored on land, and to improve altimetric measurements of the ocean. http://ioc.unesco.org/iocweb/docs/WCRP-sealevelworkshop-2006-SumStat.pdf.

2. **Role of the ocean in seasonal and decadal forecasting and prediction of droughts and floods:** Long-term weather anomalies, heat waves and precipitation patterns are strongly influenced by the ocean. Today, science can predict these anomalies months in advance in regions strongly affected by ENSO in the Pacific. In other parts of the world, the predictability still needs to be discovered, for example through research on coupled ocean-atmosphere modes, such as the North Atlantic Oscillation (NAO). WCRP-led research on seasonal and decadal forecasting has already demonstrated its value for assessing water abundances and shortages, and hence the danger of droughts and floods, of outbreaks of tropical diseases, of forest fires and of many other hazards. Developing countries are most vulnerable to these seasonal climatic anomalies, and therefore stand to gain the most from improved predictions. For that reason, it is crucial to take full advantage of the potential predictability associated with the ocean in a range of seasonal and decadal prediction applications. http://wcrp.wmo.int/AP_SeasonalPrediction.html.

3. **Abrupt climate change:** In many past climate records, there are clear signs of abrupt changes in the regional or global climate, warming or cooling of more than 5°C in only a few decades. Some evidence suggests that these events may have been caused by large changes in the oceanic circulation. There may be thresholds or 'tipping points' in the oceanic circulation, so that changes to the climate may not be reversible. While the IPCC expects that the North Atlantic thermohaline circulation will slow and not change abruptly in the coming century, uncertainties remain, and the effects could be potentially catastrophic. Further investment in research on non-linear climate feedbacks and improvement of global ocean, coupled climate and Earth System models is necessary.

4. **Tropical cyclones, storms, surges and other climate-related hazards:** Floods and tropical cyclones are some of the deadliest and costliest natural hazards. The Bhola cyclone in 1970 killed 500,000 people in Bangladesh, and cyclone Katrina flooded the city of New Orleans in 2005. Tropical storms draw their energy from the heat of the ocean surface, so that ocean models and sea-surface flux data are required for predicting both the strength and path of an individual storm, and also the long-term changes in storm number, intensity and location.

5. **Systems outside the WCRP's scope that *benefit* from improved climate predictions** and where research on the intersection between climate predictions and impacts could be improved:

    a. *Fisheries and Marine Resources:* Robustness of fisheries depends critically on both climate variability and change. For example, El Niño suppresses nutrient upwelling on the west coast of South America, which then causes a dramatic fall of local catches. This dependence can only increase as fishing progresses down the food chain. Efforts to maintain sustainability of the ocean's life and health, and the resources humanity enjoys, require support by climate research.

    b. *Coastal Area Management:* In order to plan effectively, coastal area managers need assessments of long-term changes in storms and natural hazards, long-term weather anomalies, sea-level rise and ecosystem evolution. Since regional predictions depend upon global predictions, coastal area management benefits from research in oceanography and climate.

    c. *Ocean ecosystems change*: Climate change adversely affects coral reefs. As the ocean absorbs carbon from the atmosphere, it is becoming more acidic. Decalcification of several phytoplankton species is an example of expected consequences. The general picture of how changing ocean chemistry affects the ecosystems is complicated and difficult to predict, but it is required for more comprehensive climate modeling including biological feedbacks. This is an area where climate research not only benefits but is also enabled by the science of ocean biogeochemistry.

WCRP is participating in the preparation of the ICES-PICES-IOC 2008 Symposium on the Effects of Climate Change on the World Oceans (19-23 May 2008, Gijón, Spain), and this meeting may provide a platform for further enhancing the cooperation of WCRP and wider oceanographic community.

VI. Communication Improvement, Call for Input

In 2006, the World Climate Research Programme (WCRP) launched three major communications efforts: a new website at http://wcrp.wmo.int/ with a News section and a quarterly electronic eZine; and a concise and easy to read Annual Report, which you have received with this document. IOC Members are invited to use these resources and to offer items for the web news and input to the WCRP eZine. These may be sent at any time to wcrp@wmo.int.

The Chairman of the WCRP Joint Scientific Committee Dr. J. Church, WCRP Director Dr. A. Henderson-Sellers, and Dr. V. Ryabinin of the WCRP Secretariat (email: VRyabinin@wmo.int) would like to establish contact with IOC Member States. It will enable us to work closely both with the Member States and IOC Secretariat and contribute to the development of an improved and mutually beneficial programme of activities of the IOC Ocean Sciences Section that would unify the interests of developed and developing countries, enrich the current WCRP climate research with oceanographic content and ensure oceanography's continued relevance to society. Proposals of IOC Member States for new climate-related ocean initiatives are most welcome, as are financial contributions to the IOC Special Trust Fund for WCRP dedicated to these initiatives.

We cordially ask for your response to a short set of questions on the next page. Replies provided before 15 April 2007 would be most useful. A summary of your feedback will be presented to and discussed with delegations at the 24th Session of the IOC Assembly in June 2007.

CALL FOR INPUT BY IOC MEMBER STATES

Thank you for taking the time to provide to WCRP a feedback on your oceanographic research priorities and activities. The mandate of the WCRP is to coordinate and facilitate international climate research. Therefore, we are most interested to learn in what way your nation has contributed to or drawn information from ocean-related climate research. We ask you to attempt to respond from a *national* perspective including activities and interests of organizations outside your own. The more details you can provide, the better we will be able to understand your nation's needs.

1. Participation in ocean climate research in the past

a) Have organizations in your country (government, universities or others) *contributed* to ocean *climate* research within or outside of WCRP?

b) If yes, please briefly describe the nature of the research and the organization that guided it, including what type of contribution was made. Please indicate if it is ongoing.

2. Use of WCRP oceanographic information

a) Have organizations in your country ever *drawn information* from an ocean-related WCRP research project? If yes, which project?

b) If yes, what kind of information did you use and what did you use it for?

3. Assessment

Do you feel that contributing to these projects or drawing information from them was a good use of your country's resources? Why or why not?

4. Your interest in ocean climate research

Would your nation like to contribute to the following ongoing or potential areas of ocean climate research (please underline item(s) in a paper response or check the box in an online response):

<u>Ongoing research:</u>

1) Ocean climate variability and predictability
2) Air–sea fluxes, freshwater balance
3) Ocean biogeochemistry
4) Sea-level rise
5) Role of oceans in monsoons
6) Role of oceans in seasonal and decadal forecasting, prediction of long-term anomalies (draughts, floods etc.)
7) Ocean model development of different types and at a variety of scales (please specify)
8) Research needs of climate conventions and assessments (UNFCCC, IPCC, other)
9) Ocean field experiments, laboratories
10) Marine cryosphere: sea ice, icebergs, etc.
11) IPY, polar oceanography
12) Oceans as a part of the Earth system
13) Capacity building in ocean climate research

<u>Starting, developing and possible research themes:</u>

1) Ocean reanalysis
2) Pilot polar observing systems
3) Abrupt climate change
4) Ocean climate related hazards: storms, surges, tropical cyclones
5) Climate impact on
   a. Coasts
   b. Ecosystem change
   c. Activities: fisheries, transport, tourism, food production, resource exploration and exploitation, other.

<u>Other</u>

Please specify

5. General Communication

a) Is there any other information, advice, or feedback you would like to give to WCRP?

b) Would you like to subscribe to our quarterly eZine Newsletter? If yes, please provide your email.

c) May we approach you in the future? If yes, please provide contact details.

Thank you for your contribution. We prefer if you use the more ecologically friendly online form at http://wcrp.wmo.int, but are also glad to receive paper responses at the address below.

Dr. V. Ryabinin (Attn: IOC Feedback 2007), WCRP Joint Planning Staff,
c/o World Meteorological Organization, 7 bis, Avenue de la Paix, Case Postale 2300,
1211 Geneva 2, Switzerland

WORLD CLIMATE RESEARCH PROGRAMME

JSC-XXVIII/Doc. 7.6
(13.II.2007)

JOINT SCIENTIFIC COMMITTEE

Item 7

TWENTY-EIGHTH SESSION

ZANZIBAR, TANZANIA, 26-30 MARCH 2007

WORLD CLIMATE CONFERENCE THREE
(Geneva, Switzerland, October 2009 report Feb 2007)

WMO Discussion Paper

Moving Forward on Applications of Seasonal to Inter-annual Climate Predictions: A Strengthened Role for the World Meteorological Organization (WMO) and National Meteorological and Hydrological Services (NMHSs)

1. Background

1.1 The World Meteorological Organization (WMO), in cooperation with UNEP, FAO, UNESCO and its IOC, and ICSU organized the First World Climate Conference in 1979 and the Second World Climate Conference in 1990. The Conferences were important milestones in the development of climate as a 21st century issue of international importance.

- The First World Climate Conference influenced the establishment of a number of international scientific activities such as the Intergovernmental Panel on Climate Change (IPCC), the World Climate Programme (WCP) and the World Climate Research Programme (WCRP).

- The Second World Climate Conference (SWCC) called for the establishment of a climate convention, adding momentum to international efforts that resulted in the development of the UN Framework Convention on Climate Change (UNFCCC) in 1992. The SWCC also led to the establishment of the Global Climate Observing System (GCOS) and to recommendations on future WCP activities.

1.2 Over the last decade major advances have occurred in understanding and in predicting climate variability for time periods from a month to a season to a year in advance (and sometimes even longer). These scientific advances have been motivated by the ever-increasing demand for climate predictions in decision making and have led to increasing application of climate information to the needs of the world's nations for improving public health and safety, sustained economic development and stable societal infrastructures. Examples of sectors that have benefited from the application of climate knowledge and prediction include aviation and marine transport, agriculture and food security, health, water resource development, use and conservation, energy supply and allocation, and the management and conservation of biodiversity. Climate knowledge and applications have also been used in international, national, and local planning and response to the impacts of natural disasters associated with climate extremes. This includes reducing the impacts of floods, droughts, tropical and extratropical cyclones, and human, animal and plant disease outbreaks.

1.3 For example, improved observations and increased understanding of the El Niño-Southern Oscillation (ENSO) phenomena have led to useful predictions up to several months ahead[1]. These climate forecasts have improved (1) national and local emergency preparedness for natural disasters; (2) planning and managing water resources, especially in regions subject to drought; (3) actions to mitigate the impact on agricultural production and on losses from wild fires in drought-stricken regions. Developing useful products requires extensive interaction among scientists and users.

1.4 Adapting to climate variability and its potential impacts poses challenges and offers opportunities for the management of resources and for national and local infrastructures and economies. The pressures of high population densities and intensified land use, such as the extension of human settlements and activities into high risk zones accelerate the demand for effective early warning systems and for effective management of climate-sensitive resources. For example, information on short-term climate variability (i.e., weekly, monthly and seasonal forecasts) is relevant for the development of national, regional, and local plans to mitigate the impacts of drought and other climate related stresses, to manage agricultural operations and water resources, and to prevent or ameliorate climate-sensitive health effects. Strengthening response capabilities for climate variability will also benefit efforts to adapt to climate change. The World Bank in 2004 stated *'response to current climate variability and extremes is a necessary, if not sufficient, part of an effective adaptation strategy'.*

1.5 Many developing countries are highly susceptible to setbacks from climate extremes and thus are dependent, among other options, on improving their use of climate information for achieving their economic and societal goals. Rural food production and water resource development and management are highly dependent on good information on climate variability; yet the availability of and capacity to utilize climate information is limited in many countries, particularly the least developed countries. Human mortality rates from diseases such as malaria are also influenced by climate variability. In many regions, there is limited use of climate information for sustaining economic development. It is important to find ways for all countries to cope with climate variability through improved access to climate information and prediction products and the use of risk management techniques.

1.6 The time is ripe to apply these recent advances in climate understanding, observations, forecasts, data and products, and model results to extend and develop useful climate services and other societal applications. Attention will be paid to long-term climate changes over a 25 to 50 year period as a way to analyze the evolution of seasonal to inter-annual climate phenomena and impacts, e.g., how extreme events are affected by the evolution of climate over decades and by climate change. In addition, improvements in climate and earth observations from satellite, ground-based, and *in situ* platforms can be synthesized into useful data products and indicators for decision makers. Examples include integrated data products on precipitation, snow pack, stream flow, and potential for drought conditions and global and regional maps with high resolution that can be used to improve the management of crops and water resources and to assist in urban planning.

1.7 As a result of these developments and the recommendations from several bodies of Experts[2], the **World Meteorological Organisation (WMO) is proposing to organize a third in a series of World Climate Conferences,** in cooperation with other UN Agencies and relevant

[1] The application of this knowledge was particularly accelerated in many parts of the world by the large El Nino – La Nina event of 1997-98 which had truly global impacts.

[2] An Ad Hoc Exploratory Committee on World Climate Conference-3, established by WMO concluded that there are sufficient scientific issues to justify the holding of a WCC-3. The Committee considered that "scientific advances in seasonal to interannual and possibly decadal forecasting offered a great opportunity for the development of new services to a wide user community" and that to date it has not been the "subject of high-level focus by the world community".

international scientific organizations as well as national entities, including governments, private sector and NGOs. The theme of a World Climate Conference three (WCC-3) will be on advances in seasonal to inter-annual prediction and on the application of these predictions to societal needs and issues, such as crop and animal production, forestry, fisheries, water availability and quality, and health.

1.8 The benefits from a World Climate Conference-3 focused on seasonal to inter-annual prediction would be of direct interest and relevance to policy makers, the media and the public.

They have the potential to:

- Contribute to significant and immediate socio-economic benefits, including the prevention and mitigation of the impacts of natural disasters;
- Link very strongly into internationally agreed development goals, such as the UN Millennium Development Goals, poverty reduction strategies, and the Hyogo Framework of Action for Disaster Risk Reduction;

They would provide the opportunity to share available experience and products and extend existing capacity, especially to developing countries;

They could:

- Provide valuable input to the growing number of activities and programs focused on adapting to the risks posed by climate variability and change,
- Identify priorities for coordinated action at local, national, regional and global levels to meet user needs;
- Enhance support to climate related monitoring required for improved seasonal to inter-annual prediction in the global environmental observing systems (GCOS, GOOS, GTOS);
- Link observational requirements for seasonal to inter-annual prediction to the GEO process and into the Global Earth Observing System of Systems (GEOSS);
- Enhance attention to specific research needs on seasonal and inter-annual climate prediction in the context of climate change, as well as support to international scientific cooperation in this field, notably the WCRP;
- Provide an assessment of the scientific developments required to further develop seasonal, inter-annual and longer forecasts;
- Provide renewed support for developing effective capacity building activities among producers of climate information and users of information, especially those in least developed countries;
- Assist in communicating the benefits of the advances in the climate knowledge and prediction to developing and least developed countries, which are highly vulnerable to natural disasters and other climate related social and economic dislocations;
- Provide an opportunity for mainstreaming climate information and products into international, national and local decision-making in relevant sectors;
- Allow for enhanced co-ordination across WMO programmes and those in other UN and international scientific organizations in a way that would strengthen these activities;
- Enhance WMO's stature and world leadership by illustrating the essential services that it and its members provide; and

They would provide further benefits to WMO and its Members by:

- ✓ Helping to articulate the role of Regional Climate Centres;
- ✓ Strengthening the links between WMO, its members and the private sector;
- ✓ Enhancing the role and visibility of National Hydrometeorological Services (NMHSs) and the climate services they deliver.

2. Moving Forward toward a World Climate Conference - 3

2.1 WMO has established a Provisional Organizing Committee (POC) of climate experts to provide advice to its Executive Council on the direction and content of a WCC – 3. The Committee has recommended that the overarching theme for the Conference be **Climate Prediction for Decision Making: Focusing on Seasonal to Inter-annual Timescales,** with 4 scientific sub-themes:

(a) Advancing climate information and prediction science,
(b) Embedding climate into Hazard Early Warning Systems,
(c) Applications and socio-economic benefits of climate information and prediction,
(d) Mainstreaming Climate Information for Development.

2.2 The Committee also recommended that in light of the ever-increasing interest in the application of climate prediction to many societal issues, WMO should plan for a large conference with a 1000 or more participants but one that is completed within a 5-day workweek. The recommended structure for the conference is an:

(a) Opening session, including keynote addresses, on Monday AM,
(b) Science segment with sessions from Monday PM to Thursday AM, and
(c) High-level segment from Thursday PM to Friday PM.

3. Science Segment

The Science Segment would consist of parallel sessions organized around the 4 sub-themes.

(a) Advancing climate information and prediction science

Ranging from scientific research to observations to scientific assessments, which are three interdependent elements. The sessions would include discussions of observing systems (i.e., in situ networks and satellites), observational requirements for prediction; seasonal to inter-annual predictions (current and future); longer range climate predictions; predicting extreme events and regional climate variability and change; and seamless prediction from short range (e.g., extreme events) to seasonal to inter-annual to decadal or longer time scales.

(b) Embedding climate into hazard early warning systems

Including information needs for hazard early warning systems for climate; developing hazard early warning systems for climate; hazard early warning systems and emergency response systems for climate: The roles of International, regional, and national climate centers and response agencies; hazard early warning systems for specific climate modes of variability (El Nino, monsoons, droughts, etc); economic and social impacts of hazard early warning systems for climate.

(c) Application and socio-economic benefits of climate information and prediction

Including major application areas of energy and the built environment; agriculture and food security (including aquaculture); water resources, health; and vulnerable ecosystems, especially for small island developing states.

(d) Mainstreaming climate information for development

(including the Millennium Development Goals)

This will involve sharing experiences in how users act on climate information and prediction in decisions, planning, and policy and assessing the methodologies of translating climate information into social and economic benefits. There also would be discussions on evaluating climate coordination mechanisms, including the governance of the climate enterprise and in assessing future directions for providers of climate information and predictions and adapting (and optimizing) institutions to future needs for using climate information and predictions.

4. Conference Ministerial Declaration

The Provisional Organizing Committee for a WCC-3 has developed a set of expectations from the High Level (Ministerial Level) Segment for each of the sub-themes of the following Science Segment sub-themes. These are:

(a) Advancing climate information and prediction science

- Promoting the development of seasonal to inter-annual climate information and prediction science;
- Facilitating a global infrastructure for strengthening regional and national capacity for a seasonal to inter-annual prediction system.

(b) Embedding climate into hazard early warning systems

- Establishing the mechanisms and opportunities for sharing climate information and prediction products;
- Developing an effective hazard early warning system for climate, e.g., by recommending a menu of practical response actions to near-term climate risks, including the use of indigenous practices of early warning.

(c) Applications socio-economic benefits of climate prediction

- Developing seasonal to inter-annual climate information and prediction goals for WMO, its Members, and public and private sector entities;
- Defining strategies for the enhancement of application of climate information and prediction products for climate risk management.

(d) Mainstreaming Climate Information for Development

- Strengthening the regional and national response systems to climate variability, especially in the developing and least developed countries frequently affected by natural disasters caused by climate extremes;
- Extending available climate products to include annual prognostic analyses at the regional / global levels as well as to enhance the use of existing products by decision makers in key sectors throughout society;
- Optimising the global, regional national institutional mechanisms for using climate predictions in decision making.

5. High Level Segment

5.1 At the **High Level Segment,** the Ministers will consider a brief (1-2 page), pre-negotiated Declaration providing for basic recommendations to bolster the Plan of Action from the science conference. <u>This Declaration would include specific actionable items that would improve performance of an end-to-end climate services system and that the parties to the Declaration would commit to furthering to the extent possible</u>.

5.2 The outcomes from the conference should call generally for better implementation and coordination of the delivery of services, not for major new programmes.

- These action items should represent coordinated and possibly cooperative actions by countries, national and international organizations and where feasible, private and NGO groups;

- The nature of these actions would relate to specific objectives that would further the aims of the WMO Member States, the science and practice of climate prediction, especially on the seasonal to inter-annual time scales, and the application of seasonal to inter-annual climate predictions to socio-economic problems and issues at the international, regional, and national levels;

- One major focus for these action items will be to accelerate activities to integrate climate into hazard early warning systems and improve the scope and responsiveness of these systems that are currently part of the forecast, warning and dissemination activities of the NMHSs.

WORLD CLIMATE RESEARCH PROGRAMME

JOINT SCIENTIFIC COMMITTEE

TWENTY-EIGHTH SESSION

ZANZIBAR, TANZANIA, 26-30 MARCH 2007

JSC-XXVIII/Doc. 8.1
(15.II.2007)

Item 8

Draft Terms of Reference and Workplan Review of the International Geosphere-Biosphere Programme (IGBP) and the World Climate Research Programme (WCRP)

Preamble

The International Council for Science (ICSU) is a sponsor of the four global environmental change programmes: the World Climate Research Programme (WCRP; together with WMO and IOC), the International Geosphere-Biosphere Programme (IGBP), the International Human Dimensions Programme on Global Environmental Change (IHDP; together with ISSC) and DIVERSITAS – An International Programme on Biodiversity Science (together with UNESCO, SCOPE and IUBS).

The Global Change Research Programmes are central to ICSU's mission of strengthening international science for the benefit of society. ICSU with UN sponsors are also responsible for the Global Climate, Ocean and Terrestrial Monitoring Systems. The scientific research and the global monitoring efforts provide crucial information for assessments such as the Intergovernmental Panel on Climate Change (IPCC) and the Millennium Ecosystem Assessment (MA).

General reviews of the ICSU Global Environmental Change Research Programmes, as well as the global observing systems and all other relevant ICSU Interdisciplinary Bodies and Joint Initiatives, were conducted in 2002-2003 within the Priority Area Assessment on "Environment in Relation to Sustainable Development" as a component of the development of an ICSU Strategic Plan 2006-2011.

The ICSU General Assembly in October 2005 approved the ICSU Strategic Plan 2006-2011, which calls for a review of the Global Environmental Change Research Programmes. The reviews of IGBP and WCRP will follow the review of the Earth System Science Partnership (ESSP). All reviews are conducted jointly with the International Group of Funding Agencies for Global Change Research (IGFA) and, in the case of WCRP, with the World Meteorological Organization (WMO) and the Intergovernmental Oceanographic Commission (IOC) of UNESCO.

Review of the Global Environmental Change Research Programmes in 2007-2009

The four Global Environmental Change Research Programmes have been reviewed in the past:
DIVERSITAS; management review by IGFA in 2003;
IGBP in 1987, 1991 and 1996;
IHDP in 2005; and
WCRP in 1995.

ICSU will review DIVERSITAS, IGBP, WCRP and ESSP in the period 2007-2009 through the appointment of individual Review Panels. The reviews will be conducted jointly by ICSU and the International Group of Funding Agencies for Global Change Research (IGFA). In addition, other co-sponsors must also be involved in the reviews. In the case of DIVERSITAS, these are IUBS, SCOPE and UNESCO and for WCRP they are IOC/UNESCO and WMO.

The reviews should be both reflective and forward-looking. They should evaluate past performance of the Programmes, review operational structures and assess future plans. The reviews will thus help guide the scientific research, which is vital for advancing our understanding of the functioning of Planet Earth. Such understanding is essential if we are to predict future trends in the development of the Earth as a system.

Research findings underpin many international Assessments such as the Intergovernmental Panel on Climate Change (IPCC), the Millennium Ecosystem Assessment (MA) and the planned biodiversity assessment (IMoSEB). Through such assessments, scientific research is supporting several global conventions such as the UN Convention on Climate Change (FCCC), the UN Convention on Biodiversity (CBD) and the UN Convention to Combat Desertification (CCD). Thus, global change research provides excellent examples of policy relevant science.

The WCRP has existed since 1980, IGBP since 1987, DIVERSITAS in its current form since 2002, and IHDP in its current form since 1996. During this period, the world has changed and careful decision making now requires more than mere reductions in scientific uncertainties related to the functioning of global environmental systems. Through mechanisms and forums such as the Millennium Development Goals and the World Summit on Sustainable Development, science now also needs to enlighten and assist policy efforts to simultaneously enhance environmental sustainability, social and economic development and the alleviation of poverty.

The Earth System Science Partnership (ESSP) has taken on the challenge of truly integrating natural and social sciences around common research questions and educating a new generation of scientists to address complex issues outside of disciplinary research structures. In doing so, it is hoped that a new generation of scientists can be trained to tackle complex, multidisciplinary issues.

Terms of Reference

ICSU, in collaboration with the other sponsors and IGFA, will conduct individual reviews of the International Geosphere-Biosphere Programme (IGBP) and the World Climate Research Programme (WCRP). The links between the Programmes and other ICSU Interdisciplinary Bodies and Members will be considered as part of these reviews. For WCRP, special attention will be given to the interaction with other programmatic elements of WMO and IOC.

The review will focus on both internal and external interactions. The major questions to be considered by the Review Panel are given below. The overriding objective of these reviews is to evaluate the extent to which the international programmes adds value to their respective areas of research and to the national programmes that contribute to them.

The primary question that the review should answer is: "What do scientists, sponsors and the end-users get out of participating in and supporting these international programmes that they would not have gained if the international programmes did not exist?

The additional questions below are provided for guidance. In considering the questions, the review should go beyond providing simple "yes" or "no" answers and give the reasons for conclusions reached and, where appropriate, recommendations for improvement.

1. Scientific impact, balance and relevance

1.1 What are the indicators of success against which the Programme can be evaluated? What was accomplished as a result of the international Programme that would not have been achieved without its existence? What was achieved by the Programme in comparison with investment in a number of separate national efforts (i.e., the added value of international planning and coordination). Has the Programme helped build the scientific framework necessary to address global environmental change issues?

1.2 Has the Programme developed strategic scientific and implementations plans that address key issues perceived as priorities by the scientific community? Has the Programme augmented intrinsic scientific merit, including its effectiveness in integrating the best relevant disciplinary research?

1.3 Was the Programme a driving force in opening up new domains of science, providing opportunities for innovative research and enhancing inter/multidisciplinary research of high quality?

1.4 How well does the programme synthesize and integrate between its Core Projects and other Global Environmental Change Research Programmes and ESSP?

1.5 How well is the Programme integrated and 'mapped' with national climate and global environmental change programmes? Did the international Programme have an impact on national programmes, e.g., in terms of stimulation and supporting the creation of an international framework through which wide-ranging research goals and priorities could be set? For IGBP, is effective use made of input from the National Members?

1.6 Has the Programme fulfilled its original mandate and should a closing date be decided on? If not, should the Programme continue to focus on the original mandate or should this be changed? What should be the nature of any future Programme? If a change is proposed, suggest wording for a mission statement.

1.7 In view of the increasing collaboration between IGBP and WCRP, should they merge? If so, give the arguments for a merger and when it could take place.

2. Policy relevance

2.1 Has the Programme developed strategic plans that address key issues perceived as priorities by the policy communities? If so, how has the policy relevance been asserted?

2.2 Did the Programme, and its component parts, communicate and interact effectively with, and provide useful input to, international policy processes, e.g., international assessment activities (IPCC, MA, etc.) and the Multilateral Environmental Agreements (UNFCCC, CBD, CCD, etc.)?

2.3 Does the Programme have relevance for the Millennium Development Goals and Science for Sustainable Development? If so, has this potential been utilized?

3. Organization and governance

3.1 Has the governance structure been sufficient to ensure appropriate priority setting and efficient coordination for the overall Programme, Core Projects and cross cutting initiatives (as appropriate)? How effective was the scientific planning process and the guidance and coordination of its Core Projects?

3.2 Is the membership of the governing body of the Programme representative in terms of scientific expertise and geographical and gender balance?

3.3 Is the relative attention of the Programme between the Core Projects and the ESSP balanced?

3.4 Is the Secretariat organized in such a way as to optimize the use of personnel and financial resources? Are funds used in an optimal way in support of priority activities?

3.5 The ICSU Priority Area Assessment on Environment and its Relation to Sustainable Development recommended that "support for programme/core project planning and coordination should be increased from about 0.5% to 1% of the total research budget". Does the Review Panel support this recommendation and if so, how can it be achieved?

3.6 What impediments can be addressed to increase the efficiency of the Programme? Are there other models that could be applied that could make the Programme more effective?

3.7 Is the hybrid model on a non-governmental/governmental Programme (WCRP) appropriate and are there ways to make better use of the distinctive features of the sponsors? For IGBP, would there be any merit with a governmental co-sponsor, such as UNEP or UNESCO?

3.8 How strong and effective are the links to regional inter-governmental networks (e.g., IAI, APN)?

4. Visibility and communication

4.1 Are the Programme's visibility and communication efforts sufficient? Have target audiences been clearly identified?

5. Interaction with other bodies

5.1 Has the Programme developed appropriate links with other ICSU Interdisciplinary Bodies and how has the Programme benefited from the expertise within ICSU Scientific Unions and National Members? For, WCRP, how has it contributed to and benefited from other components of the World Climate Programme?

5.2 Are the links to the global observing systems (GCOS, GOOS, GTOS, IGOS-P, and the GEOSS process) adequate? How do these observing systems engage with and contribute to the research communities embodied in IGBP and WCRP?

6. Capacity Building

6.1 Has the Programme succeeded in involving the scientific communities in all parts of the world, including developing countries? Has it been able to attract the interest of young scientists and fostered a new generation of scientists collaborating in a truly interdisciplinary research environment?

6.2 Is START a valuable resource for the Programme in capacity building and have START activities substantially contributed to the advances of the Programme? How well did the Programme collaborate with other relevant global change research programmes that emphasize capacity building (e.g., IAI and APN)?

The review process

After appropriate consultations, the ICSU Committee on Scientific Planning and Review (CSPR) and IGFA appointed Review Panels (for WCRP, agreement was also reached with WMO and IOC). It is envisioned that there would be, three meetings for each review in addition to telephone conferences, as needed. CSPR and IGFA representatives, as well as IOC and WMO representatives for WCRP, would also be expected to attend the Panel meetings. The IGBP and WCRP Panels should have at least one member in common and a joint meeting should be convened between the two Panels before the reports are finalized.

During the first meeting, the Panels would agree on the conduct of the review, the information necessary to perform the review and the division of work. The Panels should also decide on the balance between review of the Programme relative to the Projects. It may be necessary to design an interview/questionnaire process for collection of views of Programme leadership, Joint Projects and individual participating scientists. The policy relevance should be assessed through interviews/questionnaires with representatives of various international assessments, UN framework conventions, relevant UN organizations and others (e.g., ICSU bodies) with an interest in the results from the Programmes.

At its second meeting the Panel would review the material collected and finish a first draft of the review. This draft would then be circulated to the relevant Programme(s). During a teleconference the Panel would review the comments, and decide how the report should be amended before circulating the second version of the report to a wider audience (i.e., including ICSU bodies and IGFA members plus relevant components of the IOC and WMO constituencies for WCRP).

The final assessment report would be edited at the Panel's third and last meeting and shortly thereafter submitted to ICSU and IGFA plus IOC and WMO for the WCRP review.

The Review Panels will be assisted by ICSU staff and persons identified from IGFA.

Draft Time Table

2006

December	Consultations with SC-IGBP, JSC WCRP, IOC, WMO and IGFA regarding Terms of Reference and membership of the two Review Panels

2007

February	CSPR approves Terms of Reference and Membership of the IGBP and WCRP Review Panels
June-July	First meetings of IGBP and WCRP Review Panels
August-October	Collection of information and interviews for IGBP and WCRP Reviews
October	Second Meetings of IGBP and WCRP Review Panels in conjunction with IGFA annual meeting
November-December	Draft report of IGBP and WCRP reviews to programmes for comments

2008

January	Teleconference to agree on draft report for review
February-April	Draft report to ICSU, IGFA, (WMO, IOC), and other relevant bodies for review.

May	Joint meeting of Review Panels with Sponsors and Chairs and Directors
March	Final reports delivered to the Sponsors and IGFA
September	IGBP and WCRP reviews considered by CSPR.
October	Report to ICSU Executive Board and ICSU General Assembly.

Draft Time Table (REVISED)

2006

December	Consultations with SC-IGBP, JSC WCRP, IOC, WMO and IGFA regarding Terms of Reference and membership of the two Review Panels

2007

February	CSPR approves Terms of Reference and Membership of the IGBP and WCRP Review Panels

2008

January	Preparatory meeting with the Chairs of the IGBP and WCRP reviews
May	First meetings of IGBP and WCRP Review Panels
June- September	Collection of information and interviews for IGBP and WCRP Reviews
Nov/Dec	Second Meetings of IGBP and WCRP Review Panels

2009

January/Feb.	Draft report of IGBP and WCRP reviews to programmes for comments
March	Teleconferences call to discuss comments
Late April	Draft reports to ICSU, IGFA, (WMO, IOC), and other relevant bodies for review
June/early July	Third meeting of the Panels to finalize the report
Early September	Final meeting with the Chairs of the reviews
Late September	IGBP and WCRP reviews considered by CSPR and IGFA
Early November	Report to ICSU Executive Board

WORLD CLIMATE RESEARCH PROGRAMME

JOINT SCIENTIFIC COMMITTEE

TWENTY-EIGHTH SESSION

ZANZIBAR, TANZANIA, 26-30 MARCH 2007

JSC-XXVIII/Doc. 9.1
(31.I.2007)

Item 9

PUBLICATIONS

(Submitted by the Director of the WCRP)

The following reports were produced under WCRP auspices in various series since the twenty-seventh session of the JSC:

WCRP Report Series

WCRP-127 **WCRP Annual Report 2005-2006**
New Futures: Building on Great Success
(WMO/TD-No. 1349)

DVD **Climate Change Research; Achievements and Challenges (WCRP Side Event at the 24th session of the UNFCC Subsidiary Body for Scientific an Technological Advice (SBSTA),** June 2006

Informal WCRP reports and documents

2006

WCRP Informal Report No	Title
2/2006	The 1st Pan-WCRP Workshop on Monsoon Climate Systems: Toward Better Prediction of the Monsoons (Irvine, CA, USA, 15-17 June 2005) (ICPO publications series No. 103)
3/2006	Joint GCOS-GOOS-WCRP Ocean Observations Panel for Climate, Tenth Session, Final Report (WMO, Geneva, Switzerland, 9-12 May 2005)
4/2006	Report of the 11th session of the GEWEX Hydrometeorology Panel (Melbourne, Australia, 26-29 September 2005)
5/2006	Understanding the role of the Indian Ocean in the Climate System - Implementation Plan for Sustained Observations (ICPO publication series No. 100) (with respect to place and dates, this is an implementation plan and was the result of a couple of meetings of the Indian Ocean Panel which is a joint panel with GOOS, there is still another meeting planned in regard to this).
6/2006	Report of the 6th meeting of the WGOMD (Hobart, Australia, 8-11 November 2005) (ICPO publication series No. 101)
7/2006	Report of the Southern Ocean Modelling Workshop

	(Hobart, Australia, 9-10 November 2005) (ICPO publication series No. 102)
8/2006	Report of the 9th Meeting of the Working Group on Seasonal to Interannual Prediction (Met Office, Exeter, UK, 14-16 October 2005) (ICPO publication series No. 104)
9/2006	Report of the 1st CLIVAR Workshop on Ocean Reanalysis (Boulder, CO, USA, 8-10 November 2004) (ICPO publication series No. 93)
10/2006	Report of the CLIVAR Workshop on North Atlantic Thermohaline Circulation Variability (Kiel, Germany, 13-16 September 2004)
11/2006	Report of the 13th session of the SPARC Scientific Steering Group (Oxford, UK, 26-29 September 2005)
12/2006	Report of the second session of the CliC Scientific Steering Group (SSG) (Copenhagen, Denmark, 6-9 November 2005)
13/2006	Report of the ninth session of the JSC/CLIVAR Working Group on Coupled Modelling (Met Office, Exeter, UK, 3-5 October 2005) (ICPO publication series No. 106)
14/2006	Report of the Third Meeting of the CLIVAR-GOOS Indian Ocean Panel (Honolulu, Hawaii, USA, 27 Feb-2 March 2006) (ICPO publication series No. 107)
15/2006	Report of the 18th session of the GEWEX Scientific Steering Group (Dakar, Senegal, 9-13 January 2006)
16/2006	Report of the 7th session of the Asian-Australian Monsoon panel (Irvine, CA, USA, 18-19 June 2005) (ICPO publication series No. 94)
17/2006	Report of the 4th Meeting of the CLIVAR Variability of the African Climate System (VACS) Panel (Dar es Salaam, Tanzania, 13-15 July 2006) (ICPO publication series no. 108)
18/2006	Report of the Third Session of the CLIVAR Pacific Panel (Honolulu, Hawaii, USA, 15-17 February 2006) ICPO publication series No. 95)
19/2006	Report of the CLIVAR VACS Southern and Eastern AFrica Climate Predictability Workshop (Dar es Salaam, Tanzania, 10-13 July 2006) (ICPO publication series No. 109)
20/2006	Understanding Sea-level Rise and Variability: Summary Statement from the WCRP Workshop (Paris, France, 6-9 June 2006)
21/2006	1st Asia Climate and Cryosphere (CliC) Symposium: The State and Fate of Asian Cryosphere, Yokohama Institute of Earth Science (JAMSTEC) (Yokohama, Japan, 20-22 April 2006)
22/2006	Report of the second session of the WCRP Observation and Assimilation Panel (WOAP) (Ispra, Italy, 28-30 August 2006)

2007

1/2007	Report of the ninth session of the Baseline Surface Radiation Network (Lindenberg, Germany, 29 May-2 June 2006)

Special WCRP Reports

Annual Review of the World Climate Research Programme and Report of the Twenty-seventh Session of the Joint Scientific Committee (Pune, India, 6-11 March 2006) (WMO/TD-No. 1353)

CAS/JSC Working Group on Numerical Experimentation Report Series

No. 21 Report of the twenty-first session of the CAS/JSC Working Group on Numerical Experimentation, St Petersburg, Russia, 7-11 November 2005) (WMO/TD-No. 1348)

WORLD CLIMATE RESEARCH PROGRAMME

JOINT SCIENTIFIC COMMITTEE

TWENTY-EIGHTH SESSION

ZANZIBAR, TANZANIA, 26-30 MARCH 2007

JSC-XXVIII/Doc. 9.2
(20.II.2007)

Item 9

WCRP Joint Scientific Committee
Twenty-seventh Session, Pune, India, 6-11 March 2006,
With Joint session with SC-IGBP, 6-7 March 2006.

SUMMARY OF THE MAIN DECISIONS, RECOMMENDATIONS, ACTIONS and STATUS

Agenda item(s)	Subject	Decision, recommendation or action	Responsibility	Status (20.02.2007)
3	**Matters relating to the WCRP sponsoring agencies, WMO, IOC and ICSU**	JSC welcomed the representatives of two of its sponsors (WMO and ICSU) and thanked them for their statements. JSC noted with interest that ICSU was currently considering co-sponsoring THORPEX in consultation with WMO. JSC welcomed this and pointed out that WGNE was already deeply involved with THORPEX and that WCRP's new Strategic Framework proposes close collaboration with THORPEX.	D/WCRP	
		JSC was informed of planning for World Climate Conference-3 in 2008(or 2009). JSC should define at an early opportunity what it might wish to see as an outcome of the World Climate Conference–3. JSC was informed of the UN Declaration of 2008 as the International Year of Planet Earth. WCRP agreed to pursue both of these opportunities.	D/WCRP	See Doc 7.6 (of JSC28). WCRP has contributed to development of WCC-3. The JSC input is awaited.
		JSC was pleased to note the strong supportive statement from IOC, and also its request to WCRP to engage with it more closely. JSC needs to be more active in consideration of climate of the ocean and its impacts. As a first step CLIVAR to liaise with IOC in planning the PICES / ICES / IOC symposium "Effects of Climate Change on the World's Oceans", to be held in Gijon Spain, in May 2008.	CLIVAR CoChairs	Letter sent to JSC Chair on 08/29/06 asking for advice as to who should be prompting this action; response awaited.

		JSC was briefed of the upcoming ICSU review of all of the global change programs including WCRP and ESSP. It was suggested that the ESSP should be reviewed first. JSC needs to form a small team to prepare for the review of WCRP in particular and ESSP more generally (including nomination of reviewers).	JSC Officers, D/WCRP	D/WCRP & Chair JSC actions. See Docs 5.7.1 and 8.1
4	**WCRP Strategic Framework 2005-2015: Coordinated Observation and Prediction of the Earth System**	In general, for all WCRP Task Forces, JSC recommended that all TFs should be charged before beginning to define plans towards a 2-year sunset or how a transition to mainstream WCRP activities will be effected. WMP should have oversight of modelling part of all TFs' activities and WOAP oversight of observational and analysis activities and both be empowered to recommend changes to JSC. WCRP should have a more visible web presence (including activities, meetings, reports, newsletters, access to data sets etc). WCRP should also engage in periodic announcements/ highlights about its activities and plans in prominent and high-visibility journals. JSC recognized the need for a more effective connection of WCRP activities to ESSP partners.	Chair WOAP Chair WMP D/WCRP and Project Directors	Letters to be sent to all TF Chairs,cc to others WCRP website completely overhauled (Aug06). WCRP annual report in new form (Nov06). e-Zine launched(March06).
4.1	**Sea-level Rise Task Force**	JSC was briefed about preparations for the upcoming Workshop on Sea-level Rise in Paris, 6-9 June 2006. JSC was informed that the possibility of getting the Workshop report published as a book was being considered.	TF Leader	The Workshop was conducted In June 2006, brought together 163 scientists from 29 countries (Doc 2.7). The Workshop was also conducted in support of the Global Earth Observation System (GEOSS) 10-year Implementation Plan and helped develop international and interdisciplinary scientific consensus for those

				observational requirements needed to address sea-level rise and its variability. The Extended Workshop Report, to be delivered in 2007, will address how the many uncertainties in understanding the causes of 20th century sea-level change and its recent acceleration could be reduced for input into future IPCC Assessment Reports.
4.2	**Report of the WCRP Panel on observations and Assimilation (WOAP)**	JSC noted with appreciation the initial steps taken by WOAP for the coordination of global reanalyses and of the preparatory activities for the reprocessing of global data sets. JSC was informed about the upcoming Workshop on Reanalysis at ECMWF in June 2006 and approved the plans to organize a major International Reanalysis Conference hosted by the Japanese Meteorological Agency in the fall of 2007. JSC endorsed the recommendations of WOAP to improve the presence of WCRP projects on internet, including easy access to and adequate information on available datasets. It supported WOAP's effort to define a research strategy for data assimilation in climate models. In order to ensure the efficiency of WOAP's coordination role, JSC reaffirmed the importance of the relay of WOAP's recommendations to projects and of a good follow up of actions in preparation for next meeting scheduled at JRC-Ispra, Italy, 28-30 August 2006. The JSC also commended the WOAP for taking the lead on recommending a way forward on CEOP with regard to the WCRP, and also for the letter stating the WCRP position on satellite observations to CEOS. The JSC noted that a response to the CEOS reply is being coordinated through GCOS. Projects to encourage the sharing of high frequency data for the analysis of extreme events and how they are changing.	Chair WOAP Chairs, CoChairs of all WCRP Projects and Working Groups	Preparations for the International Reanalysis Conference in full swing. JMA, CRIEPI and the University of Tokyo have agreed to host the Conference in Jan/Feb 2008.An Organizing Committee for the Workshop has been formed and Workshop agenda being developed.

4.3	**Report of the WCRP Modelling Panel (WMP)**	JSC was informed of the joint efforts of WMP and THORPEX to prepare a joint white paper on the grand challenge of establishing a multi-national coordinated research initiative to develop next-generation unified models for prediction of weather and climate. JSC encouraged the THORPEX and WMP leaders to develop an appropriate strategy to go forward including possible institutional arrangements for such an endeavour, the need for computing power and data management strategies. The JSC debated intensely on the central issue of seamless prediction. JSC encouraged working groups and projects to interact with WMP in order to unify our stand and move forward.	Chairs WCRP Projects	As a result of this collaboration, an assessment report was created and a 12-month effort entitled the "Year of Tropical Convection" will be managed in 2008 under the auspices of the new WMO Information System (WIS) (Doc 2.3).
4.4	**Report of the WCRP Task Force on Seasonal Prediction (TFSP)**	JSC was briefed by TFSP chairman about the ongoing efforts on the design and implementation of the seasonal prediction experiment and plans for a climate community wide seasonal prediction workshop for the middle of 2007. JSC Commended the Task force on progress to date and recommended the transition of the TFSP to CLIVAR's charge after the workshop. As requested by TFSP chairman, JSC agreed to send letters to: (i) all relevant panel chairs and operational centres regarding project announcement including numerical experiment, assessment process, and proposed workshop schedule and (ii) all JSC members to explore with their national funding agencies support to small seasonal assessment grants.	Chairs, CoChairs of all WCRP Projects and Working Groups Chair WMP Chair TFSP Co Chairs, CLIVAR Chair WMP	Letter from Chair, JSC sent to all relevant panel chairs and operational centres regarding project announcement including numerical experiment, assessment process, and proposed workshop schedule. Letters sent to S.Korea and Japan inviting them to act as data center host.

		The need for a consistent definition of ENSO was emphasised. The WCP has a group looking at this issue and WCRP (CLIVAR) needs to be more actively included in this activity.	D/WCRP (D/WCP) D/WCRP	Requested CLIVAR before the OCD meeting in 2006 to take action.
4.5	**Proposals received in response to invitation to participate in the WCRP.**	Two proposals received in response to call for proposals in the WCRP Strategic Plan (see Appendix F) were tabled for JSC's consideration: 1.A Moroccan proposal on '' Project Study on climate change impacts and adaptation in North Africa'' by Abdelkader Allali 2.An Indian proposal on "Monsoon Stability and Global Change" ,by G.B.Pant, G. Beig, M. Rajeevan, and C.Sharma The JSC was pleased to consider both proposals. To set a strategy in place to deal with such proposals, the JSC recommended that such proposals be delegated to relevant core and joint projects/programmes of the ESSP family for review. In the case of proposal # 1 it should be forwarded to CLIVAR-MED and START for a joint review. For proposal # 2, JSC expressed the view that it should be considered in the Monsoon cross-cutting activity and the ESSP MAIRS Project (see item 5.1). The JSC reiterated that WCRP should be proactive in soliciting proposals under the new strategic initiative. The JSC acknowledged with gratitude the contributions from the WCRP support unit in Paris with the prime functions to promote and help implement WCRP's new strategy, and to provide assistance to the new WCRP panels, WOAP and WMP.	CoChairs, CLIVAR, START Secretariat D/WCRP D/WCRP	Comments received from START for Proposal 1 forwarded to CLIVAR. No response from CLIVAR. Proposal 2: START said it is following it up with IITM, Pune. Director of the MAIRS IPO and MAIRS SSC Chair have welcomed IITM collaboration and have promised to follow up soon.

5	**Crosscuting topics for JSC consideration**			
5.1	**Monsoons: including consideration of the report and recommendations of the Monsoon Workshop, June**	The JSC expressed the view that the CLIVAR and GEWEX monsoon panels should work more closely together. CLIVAR and GEWEX (with SPARC and CLIC) should establish focal points (with a JSC Rep) to define how to bring the monsoon studies into a more coordinated program for discussion at next JSC. WMP should coordinate the modelling parts of the two projects together with SPARC and CEOP. JSC strongly supported WGNE and THORPEX participation in these activities, particularly in the focus on the diurnal cycle.	Chair GEWEX CoChairs, CLIVAR, Chair WMP CoChairs SPARC Chair WGNE T.Koike	Letters sent in August 06 to Chairs of CLIVAR,GEWEX,SPARC,CliC, WGNE, and B.Kirtman to nominate a representative for monsoons from their SSGs/WG by 10 sep. No response received.
5.2	**Anthropogenic Climate Change**	JSC noted that a great deal of effort is going on in various ACC activities of WCRP but that WCRP needs to raise its ACC visibility to a higher profile. An initial roadmap for ACC Activity to be developed by a JSC task team recognizing the existing work of the WGCM (with contributions by the projects, groups, task teams etc) which proposes how WCRP can deliver on its objective to determine the effect of human activities on climate. (JSC Task Team Members: V. Ramaswamy (Lead), J. Mitchell, H. Le Treut, J.Marotzke; Timeline- first draft available for the next OCD meeting). Terms of Reference (TOR) for this Task Team are: - With the aid of the Projects and Working Groups -To document current major activities being undertaken by WCRP that relate directly to ACC -To identify major gaps in WCRP activities that are required to narrow uncertainties regarding ACC	D/WCRP Co-Chairs WGCM	Task Team formed; work is in progress. The Task team has prepared Doc 2.1 on ACC for JSC 28.

		-To propose new activities that could fill thse gaps and thus reduce existing uncertainties (see also item 13). JSC also encouraged holding workshops on ACC involving all WCRP groups and other groups such as IPCC WGs and the ETCCDI.		
5.3	**Extreme Events**	JSC observed that WCRP needs to address this nascent and increasingly important area. It recommended that WCRP set up a framework for studying the extreme events to address data, modelling, simulation and predictability needs of extremes. An initial step is a session on extremes at the seasonal prediction workshop in 2007. JSC will continue to address the crosscut between Extremes and ACC in its future sessions. Through GCOS, WCRP must continue to stress the need for access to high frequency data for analysis of extreme events. As in Item 4.2, Projects to encourage the sharing of high frequency data for the analysis of extreme events and how they are changing. WCRP activities on extreme events should be brought together on a single WCRP web page.	D/WCRP, Chair TFSP Chairs WCRP Projects D/WCRP	Doc 2.5 on Extreme Events submitted for JSC28 session. A session on extremes planned at the seasonal prediction workshop in June 2007. No 'content' yet.
6	**CLIVAR**	JSC expressed appreciation of CLIVAR's visibility profile and its list of success measures. JSC was pleased with CLIVAR's engagement with African activity and that VACS is planning a workshop in Tanzania jointly with WMO and START, to address prediction and predictability of the climate of east and southern Africa. JSC requested inputs from this workshop be brought to the JSC prior to the next JSC meeting in east Africa next year. JSC thanked WGCM for the successful international Workshop on Analyses of Climate Model Simulations for the IPCC AR4 convened by US CLIVAR, hosted by IPRC (Univ. of Hawaii) March 1-4, 2005 and overseen by the WGCM Climate Simulation Panel. JSC was pleased to note that this was the largest, most comprehensive, highest profile and the most successful project ever organized by WGCM. JSC also expressed its grateful thanks to Program for Climate Model Diagnosis	CoChairs, CLIVAR, D/WCRP START Secretariat CoChairs,WGCM	Inputs from Tanzania workshop is made available to JSC by CLIVAR (Doc 4.2) for the JSC-28 session.

		and Intercomparison (PCMDI) for their invaluable contribution to the collection, archival and distribution effort for the IPCC multi-model analysis activity.		
7	**GEWEX - including CEOP**			
7.1	**GEWEX**	JSC would like GEWEX to accelerate progress on role of the land surface processes in predictability of intraseasonal, seasonal and longer time scales. JSC urged GEWEX to contribute to predictability and prediction studies. JSC recommended that a representative from the Global Land Atmospheric Coupling Experiment (GLACE2) (global coupled) be included on the WCRP Modelling Panel. JSC noted with appreciation the roadmap presented by GEWEX in response to WCRP's strategic framework and established a group for review of objectives , implementation, milestones, and timeline. This group includes Drs T.Yasunari (Lead), G.Wu, D.J.Griggs, J.Shukla and L Ogallo. JSC endorsed GEWEX plans for the coming year subject to review group's recommendations. TOR for the review group are: - To review the draft objectives and milestones of the GEWEX Roadmap - To identify major gaps in these objectives and milestones - To identify potential difficulties in achieving these milestones within the lifetime of GEWEX JSC encouraged GEWEX to increase its contribution to predictability and prediction studies.	D/WCRP JSC group Chair GEWEX, Chair WMP R.Koster Chair GEWEX	R.Koster(GLACE2) has been appointed member of WMP. The Task Team produced a document on '' Review on the GEWEX Phase II Strategy'' for the OCD, meeting, Beijing.
7.2	**CEOP**	JSC requested GEWEX to consider how to make progress on aerosol and cloud-related feedbacks, including linkages to climate models and sensitivity to human-induced climate change, to improve projections for the IPCC AR5. JSC considered the MAHASRI proposal and recommended that GEWEX	Chair GEWEX, Co	

		request CLIVAR to review it and that it meet the CSE criteria. JSC approved the plan for CEOP phase II, subject to a technical review of the science plan by experts from each WCRP project, in order to propose ways to maximize synergies and to prevent potential overlaps with existing WCRP activities. JSC reiterated the recommendation that the science issues be reviewed and reported by GEWEX and the data management aspects through WOAP. (See Agenda item 7, JSC26 Actions.). It recommended that GEWEX propose to next JSC a plan to reorganize its structure in order to better integrate CEOP agenda in its panels.	Chairs CLIVAR Chair GEWEX, Chair WOAP T.Koike	See Doc 4.1
8 **8.1**	**CliC - including WCRP participation in IPY 2007-08** **CliC**	JSC expressed satisfaction at the progress of activities in CliC. JSC urged CliC to take steps to provide inputs to modelling groups with a view to improving collaborations and the transfer of new modules to WGCM, WGNE, WGSIP, WMP and TFSP.	Chair CliC, CoChairs,WGCMC hair WGNE, CoChairs WGSIP Chair TFSP	
9	**SPARC**	JSC was pleased with the progress by SPARC, particularly progress in moving forward with the Chemistry and Climate initiative. JSC agreed to set up in consultation with SC-IGBP, a Task Force led by SPARC and IGAC as the core-organizers, determine its membership and TOR on "Chemistry and Climate" in a two phased manner: Phase 1: An initial modelling strategy to identify key tractable experiments designed to highlight the important processes concerning short-lived species. Phase 2: long term vision (involving climate models and	CoChairs SPARC Drs A.R. Ravishankara and P.Rasch and IOC to provide inputs on TOR Chair WMP D/WCRP	Joint WCRP-IGBP Task force established. It has submitted a background document to the JSC28 session on the crosscutting activity (Doc 2.2).

		observations) The time frame would be 3 years initially. JSC supported the new dynamic modelling initiative and expressed the view that there should be increased coordination of SPARC modelling with WMP. JSC encouraged linkage of this initiative with the new IOC effort on marine chemistry and climate.		
10 **10.1**	**Climate Modelling** **WGNE, including report on THORPEX**	JSC appreciated the continued progress by WGNE and reiterated its support to the Systematic Errors Workshop planned for February 2007 in San Francisco, USA. JSC encouraged WGNE to carry out predictions beyond 10 days up to a season to know its impact on intraseasonal and seasonal timescales. JSC strongly endorsed the WGNE/GCSS proposal on a coordinated effort on convection (and associated physics). JSC observed that convection is central to many problems in current modelling efforts on almost all space and time scales and that it cuts across most WCRP groups. Climate Process Teams (CPTs) would be interested. As a next step, JSC suggested that a small group consisting of Chair of WGNE, Co Chairs of WGCM and Dr.T.Palmer should discuss this proposal. JSC supported WGNE's proposal to strengthen membership in ensemble prediction and /or coupled modelling.	Chair WGNE, Chair GCSS, CoChairs,WGCMT .Palmer D/WCRM	WGNE's Systematic Errors Workshop, 12-16 Feb.2007, SanFransisco, attracted a large number of scientists and was very successful. WGNE discussed the proposal for 'A Year of Tropical Convection' (YOTC) at its 2006 session and strongly supported the idea. WGNE/GMPP were already jointly considering a high resolution modelling experiment specifically directed towards aiding and accelerating parametrization (including convection) development (Doc 5.4).

10.2	**WGCM**	JSC was pleased to note the great success of the WCRP/IPCC multi-model analysis activity. JSC expressed the view that synergy between WGCM and WGSIP will lead to fundamental advances in WCRP science and encouraged close collaboration. JSC would like to see more collaborative research efforts between the other projects and WGCM, particularly in connection with modelling of climate change. (See also item 6) JSC would like WGCM to lead a Pan-WCRP effort on decadal predictability as well as the development of a WCRP Task Team on ACC (See item 13).	CoChairs WGCM Co Chairs WGSIP Chair WMP	The WGCM and the IGBP/AIMES project convened a joint workshop is Aspen, Colorado, USA (July 2006) to construct a unified position of the modelling community with respect to the possible scenarios to be used in the future IPCC Fifth Assessment Report (AR5). This meeting represented a very significant breakthrough in the understanding of model forcings. The resulting joint report, approved by WCRP and IGBP in September 2006, has been communicated to the Chairman of the IPCC in response to his invitation for input in preparation for a future IPCC assessment. Work is in progress. See Doc 2.1.
11	**WG on Surface Fluxes**	JSC supported joint meeting of WGSF with WGNE on SURFA in Boulder (November 2006) and the joint meeting of WGSF representatives with SOLAS in Heidelberg (September 2006). JSC approved that WGSF start to negotiate with IGBP (iLEAPS), and other WCRP activities, regarding	Chair WGSF D/WCRM	D/WCRP attended iLEAPS SSC meeting in January 2007.

		potential cooperation on the WGSF transition to the sea/land mode and hoped that this discussion would lead to some synergies in the number of meetings and groups.		
12	**Climate monitoring and co-operation/liaison with global climate observing agencies and programmes**			
12.1	**GCOS, including AOPC and OOPC**	JSC thanked Drs J.Zillman, M.Manton and E.Harrison, Chairs, GCOS SC,AOPC and OOPC respectively, for their presentations. In response to request by GCOS to comment on the extent to which GCOS and its component systems meet the needs of climate research, JSC responded that availability and accessibility of routine data is currently seriously inadequate. There is a major unmet need for better data on extremes (e.g. hourly precipitation). JSC affirmed the importance of WCRP-GCOS co-ordination and mutual support in responding to the UNFCCC-COP's needs for information and support in respect of research (WCRP) and systematic observation (GCOS).		'Climate Extremes' topic discussed in Doc 2.5. GCOS-WCRP-IPCC to co host a Post AR4 Workshop in Oct. 2007.
		JSC agreed to review/reaffirm the roles, membership and work plans of jointly sponsored panels AOPC and OOPC. JSC also agreed that WOAP/WCRP should have formal links with GCOS SC.	D/WCRP Chair WOAP	
		JSC recognizes that global atmospheric data recovery, reprocessing and reanalysis require substantial investments, and that these activities rely also on the huge investments made in the global observing system and data assimilation for numerical weather prediction. Relevant programs and agencies are thus encouraged to collaborate to optimize the global returns from these investments.	Chair,AOPC	Action being taken. (Doc 9.3)
		JSC urged countries to make historical GSN data openly available to support analysis of climate extremes and impacts at global and regional levels.		
		JSC encouraged AOPC to work with relevant programs, agencies and		

		organisations to plan and implement a high-altitude high-quality upper-air reference network that helps consolidate the overall investment in and returns from global reference networks for ESS.		
		JSC noted with satisfaction the progress of the ocean research community and its national sponsors in advancing the implementation of the in situ component of the initial global ocean observing system defined in the GCOS Implementation Plan (GCOS-92), as developed by leading GOOS, GCOS and WCRP climate research scientists. It also noted the extent to which high level international acceptance has been obtained (e.g., UNFCCC, GEO, G-8 Gleneagles).	Chair,OOPC	
		JSC congratulated the international Argo community for its accomplishment in obtaining near-global coverage of temperature and salinity profiles over the ice-free ocean and noted that the upper 1-2km of the world ocean will be monitored systematically for the first time thanks to these efforts.		
		JSC congratulated the surface drifting buoy program for attaining its design deployment target of 1250 floats reporting SST and noted the importance of these data in producing climate quality global SST analyses. Recognizing the importance of SLP observations it encouraged an increase in the percentage of drifters measuring SLP in future years.	CoChairsCLIVAR Chair CliC	
		JSC noted the limited progress of nations to make commitments to sustain the agreed in situ, satellite and ocean analysis activities, and, recognizing that the ocean research community is the primary implementation agent for the global ocean observing system, recommended that CLIVAR and CliC make efforts to continue to sustain the recommended global ocean observing system via research efforts. JSC expressed the hope that national commitments to sustain the observing system would increase, via long-term non-research funding as national contributions to the global ocean module of GOOS and GCOS.		
		JSC noted the difficulty of determining ocean subsurface temperature trends (particularly the difficulty of obtaining statistically significant trends over most of the southern hemisphere), indicating the extent to which	D/WCRP	

		there is large spatial and temporal variability in oceanic temperatures. It notes that these results support a greater focus on decadal variability research and observations in coming years.		(See Doc 2.4)
12.3	**Satellite Matters Including Group on Earth Observations (GEO) and GEOSS**	JSC agreed to the suggestion by GCOS to emphasize the need for close WCRP-GCOS co-operation in input to satellite operators (especially with CEOS) and GEOSS bodies in respect of climate observations for research and suggested that WCRP should use GCOS and WMO Space Programme as prime communication routes to CEOS and GEO. JSC considered how to manage WCRP's interaction with GEOSS. The outcomes of GCOS presentations (and recommendations about linking better to WMO departments) suggest that this activity should be through WCRP/GCOS joint panels for observations and through the WMO Space Programme for research not otherwise covered.	D/WCRP	(See Doc 6.1) (See Doc 6.2)
13	**IPCC and UNFCC issues**	JSC discussed on how to deliver WCRP's capability to the UNFCCC. JSC recommended that a Task Team should come from WGCM and other activities and be established to develop and deliver WCRP's capability to the UNFCCC. It should have in its Terms of Reference: o To make input to the IPCC emissions scenarios issue (now and for future mutual benefits) o To initiate thoughtful interactions in ESSP on people/physics/bio-geochemical scenarios (ultimately perhaps the Task Team becomes an ESSP task team) o To propose and organize world climate research for the AR5 so that results can be collected, accessed, analyzed and distributed (e.g. for impacts) (the follow-on to the "Hawaii" meeting) o To prepare WCRP's strategy for the final publication of AR4 in 2007 so that WCRP plans are ready and can be publicized as soon as the AR4 is officially released o To work on the SBSTA submission (now), assist in preparations for the SBSTA-24 meeting, attend and offer a side event at Bonn and then to follow-up regularly so that each SBSTA and COP sees WCRP fully up-to-date and, if possible, endorsed by COP o To have and continue a clear dialogue with IPCC on (i) evolving research needs (COP/UNFCCC), (ii) scenario constancy/improvement (IPCC WGs /WCRP) (iii) radiative forcing (historical improvement and analysis & modelling)	D/WCRP Co-Chairs WGCM	WCRP prepared statement on research gaps for SBSTA24, May 06;participated in the "official" side event on research gaps (Bonn, May 2006);held an additional side event on WCRP research (Bonn, May 2006); submitted a document on research needs for SBSTA 25 with its partners in the ESSP (September 2006); and contributed significantly to the WMO paper on Adaptations presented at COP-

		(WCRP/GCOS) etc.		12. ESSP will convene a Side Event at SBSTA 26 in May 2007.
16	**Administrative matters**			
16.1	**WCRP Officers, Chairs and Directors (OCD) Meeting**	The next OCD Meeting will be held in Beijing, China, 7- 8 November 2006, along side the START Young Scientists' Meeting and just prior to the Second ESSP Open Science Conference.	Chair JSC D/WCRP	The OCD Meeting was held and a short report of the meeting was circulated to OCDs.
16.2	**Organization and membership of WCRP Committees**	JSC approved nominations of new members or renewals of terms of appointment of current members as appropriate. Dr J.Church was elected the new Chair, Prof. V. Ramaswamy, the new Vice-Chair, and Drs S. Gulev, Dr K. Trenberth, Prof. G. Wu, the new Officers of the JSC. JSC expressed some disquiet about the expanding number of groups. JSC encouraged reducing meetings and groups where synergies could be achieved. JSC also encouraged careful planning to allow back-to-back meetings whenever useful.	D/WCRM Chairs,Co-chairs of all projects, WGs	Letter from Chair, JSC sent to all Core Project and Working Group Chairs in 2006 regarding the desirability of increasing committees' geographical, gender and experience diversity. (Doc 9.3)
17	**Brainstorming session on WCRP Partnerships, Sponsorships, Visibility**	JSC discussed at length during the beginning of its session and throughout the week the important issue of demonstrated benefit delivery and, hence, increased visibility of WCRP. JSC expressed concern that despite WCRP's enormous contribution to the climate science its visibility has remained low. Throughout the week JSC endorsed and encouraged proactive co-operation with WCP, GCOS, AREP, WWW, the WMO Space Programme and Satellite Dept etc. JSC urged that WCRP take steps to attract young scientists and to reach out to and build bridges to the wider audience of stakeholders, programme managers and sponsors.	JSC members JPS members Chairs,Co-chairs of all projects, WGs Chair JSC D/WCRP	Implementing its 2005-2015 Strategic Framework, WCRP conducted two studies in 2006 to map future opportunities: the results were sent as a summary of possibilities for enhancing WCRP's

		JSC recommended that a roadmap, building on the COPES WCRP Strategic Framework, should be developed both by JSC and by WCRP projects, groups, task teams etc and then blended. The goals are: - To identify existing activities that contribute to WCRP achieving its two objectives; - To identify new activities that should be initiated or enhanced to allow WCRP to achieve these objectives and strategic goals; - To identify how these existing and new activities contribute to seamless prediction, Earth System Science and deliver benefit to users and stakeholders. Draft reports prepared by the JSC and WCRP groups to be made available in advance of the next OCD meeting.		effectiveness as well as to develop and improve its cooperation with key stakeholders. The second (commissioned)study included more than 100 interviews followed by four workshops with an additional 100 key stakeholders and helped WCRP plan (Doc 1.3) how it should move forward to implement its new strategy in light of its primary objectives and its aspirations. The Task Team's paper (Doc 1.1) presented at the JSC 28 session.
19	**Date and place of the next JSC session**	19-23 March 2007, Dar-es-Salaam or Zanzibar, Tanzania, Africa, by kind invitation of Dr L.A.Ogallo. The session will include a half-day poster session, half-day dialogue with local scientists and interaction with scientists from east Africa. START is invited to hold a Workshop alongside for young scientists. (See also agenda item 6).	Chairman, JSC D/WCRP L.A.Ogallo START Secretariat	A special one-day Work shop on WCRP networking in Africa is planned jointly with START during the JSC session in Zanzibar. A large number of young African scientists are expected to participate (see Docs 3.1, 3.3).