WCRP REPORT

World Climate Research Programme

Meeting Report

WCRP Observation and Assimilation Panel (WOAP)

Report from the Third WOAP Meeting (WOAP-3)
Boulder, CO, USA 29 Sep.-1 Oct. 2008

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SUMMARY OF MAJOR ISSUES

A major concern of WOAP is the development and improvement of climate data records (CDRs) which can be used for studies and assessments of climate variability and change, such as for IPCC. Particular concerns for which there are activities underway include:

- Continuity and homogeneity of observations, especially from space.
- The need for reprocessing of records
  - But not in a piecemeal fashion; requires coordination among groups
  - Agreement on algorithms
  - Includes evaluation and assessment of results
- The need for reanalysis to produce global gridded fields.
  - Promotion of reanalysis has been successful, leading to a problem of proliferation of reanalyses without the ability to adequately vet them.
  - However, all reanalyses have been or are directed at producing the best series of analyses given the observations.
  - None are directed at fully addressing spurious effects of the changing observing system on the record.
  - Dataset development and stewardship, archival and data management of records are needed in ways to facilitate reanalysis and access.

WCRP is developing an implementation plan based on the Coordinated Observation and Prediction of the Earth System (COPES) strategic plan. WOAP believes that WCRP should play a major role in supporting the development of new climate information systems. Because global warming is "unequivocal" to quote IPCC, and some warming is guaranteed, adaptation to climate change is essential. This requires information to assess vulnerability, devise coping strategies, determine possible impacts, and plan for future changes. Research is required and the role of WOAP is as follows:

- Advocate improved observations and analysis suitable for climate (satisfying the GCOS Climate Monitoring Principles that are designed to ensure continuity of record). This especially includes those from space.
- Data set development: evaluating observations and promoting their reprocessing and reanalysis into global fields. Develop new products and datasets.
- Develop analytical and diagnostic techniques to process observations and model data. Develop new products and datasets, often high level derived products, for use in understanding and analyzing climate variability and change, and for evaluating models.
- Continue to carry out studies on mechanisms and modes of variability that have contributed to observed climate anomalies. Further develop capabilities that contribute to an operational attribution activity by pioneering studies and numerical experimentation that might be used in near real time to allow reliable statements to be made not only about what the state of the climate is, but also why it is the way it is and the mechanisms involved. Studies involve the atmosphere and the fully coupled system.
- Improve initializing of coupled models for prediction.
- Satisfy modelers' needs on observations to improve predictions
- Make data available e.g., through the internet.

SUMMARY of RECOMMENDATIONS

2.3 The JSC and the GSC (GCOS-SC) should promote the need for the IPCC AR5 to address future directions for research and observations to support future assessments.

2.4 The GSC should invite IPCC to participate fully in the review of the GIP and help identify observation needs for the AR5 and beyond.

3.1 The WGCM and WGNE should liaise to determine whether some model results used in CMIP5 of WGCM could also contribute to the AMIP-transpose project of WGNE.

3.2 The WGNE and WGCM should decide whether it is timely to review indices for model evaluation across all time scales, and to report on the adequacy of current observations to support these evaluations.

3.4 The CLIVAR SSG should liaise with all relevant groups across WCRP and GCOS to ensure that the observation projects on salinity are adequate and coordinated to ensure that the scientific objectives will be met effectively and efficiently

3.6 The CliC SSG and the GCOS Panels should examine the list of cryosphere essential climate variables (ECVs) for completeness, bearing in mind the IGOS Cryosphere observational requirements for snow and ice. This action should be done as part of the current revision of the GCOS Implementation Plan. In the longer term, the WMO Global Cryosphere Watch (GCW) is expected to play a role in this process and in the implementation of the appropriate observing systems.

3.8 The CLIC SSG should liaise with TOPC in the framework of the GCW to develop a project to develop a global climatology of snow water equivalent

3.9 The JSC should encourage all SSGs to promote the support of international projects to analyze variability and trends in relevant climate variables.

4.1 WCRP groups should contribute as required through expert meetings and written contributions to the review of the GIP.

4.2 The WOAP endorses the initiatives of AOPC to promote the development of the GRUAN and encourages the Panel to maintain close scientific oversight of the project, in particular to ensure a representative distribution of stations beyond the initial phase.

4.3 The JSC and the GSC should continue to promote the vital importance of continuing support of sustained observing systems for climate research and applications

4.5 As part of its continuing dialogue with CEOS, WOAP should draw attention to the possible intermediate-term gap in the monitoring of profiles of ozone and related species.

4.6 The TOPC should consider the organization of some workshops and related activities to promote the development of land-domain data sets that meet the GCOS Monitoring Principles.

4.7 The JSC and GSC should jointly request GEO to provide vital enhancement of global monitoring by (i) promoting data sharing across all nations, (ii) developing international standards and regulations for the consistent monitoring of ECVs and related variables, and (iii) encouraging all nations to support environmental monitoring systems.

5.1 In the continuing dialogue with CEOS, the JSC and GSC should continue to promote the importance of restoring the climate instruments on NPOESS or other platforms. WOAP expressed its support for the re-manifestation of the climate instruments on NPOESS

5.2 In the continuing dialogue with CEOS, the JSC and GSC should develop a mechanism to enable CEOS to draw on the experience of WCRP programs in the development of CDRs based on satellite data.

8.2 WOAP recommends the development of a mechanism to ensure adequate consideration of climate data requirements for operational data collection and archival activities. This mechanism could be the formalizing of a direct link between WCRP/WOAP (via AOPC) and the WMO Observation Department.

9.3 Support for continued data archival by NCAR EOL (reference stations) and MPI (MOLTS) is needed.

9.4 After the upgrade of ISCCP to climate data record quality, it is desirable to continue the record in an operational mode into the future. WOAP recognized the desirability of the transfer of the ISCCP processing system from NASA to NOAA in 2010 as a demonstration of the value and maturity of the ISCCP products, which were developed under the auspices of WCRP. The transfer of this system from research to operations is appropriate and could be a model for other data sets in the future. WOAP encourages the relevant agencies to ensure that the research community maintains a role in the scientific oversight and evaluation of ISCCP products after the transfer in 2010.

9.5 WOAP is encouraged by the increasing number of global climate data sets and products being generated around the world. It is important for WCRP and GCOS to contribute to the continuing assessment and evaluation of these data and products in cooperation with the producers. WOAP encourages agencies to support the organization of workshops and working groups to support these activities.

10.5 WOAP should write a letter to the Working Group on Reanalysis Data Sets for distribution to the sponsors of the members supporting importance of data activities on reanalysis [R. Vose to provide list], with a copy to R. Dole in his CCSP capacity representing reanalysis activities. It should support the optional incorporation of homogenization updates such as those of Haimberger to new sonde records in ways that retain the original records. It should emphasize the need for improved access and data availability, and catalogs. The activity needs committed and sustained resourcing,

preferably at a level above that available today, which might be garnered by proposals that exploit the WG connections. Some of this activity could be more formalized as a sustained commitment. Reanalysis centres should in turn be encouraged to write to the same organizations to express (i) their commitment to the activities of the Working Group, and (ii) the reliance they would place on use of the Group's integrated and managed data sets in planning their future activities.

11.2 WOAP recommends that sponsors of the creation of ECV datasets should consider the creation of working groups, or mandating of existing working groups, to provide a continuing process to assure the quality and usefulness of data sets created by different groups. It noted that for satellite data records, the satellite supplement of the GIP had identified several existing groups that were well placed to participate in this process.

14 Recommendation: presentations will be put on WOAP website.

REPORT FROM THE MEETING

K. Trenberth opened the session and presented the apologies of Eric Barron, Director of NCAR, who could not attend. On behalf of WOAP, he thanked NCAR for hosting the meeting and providing support for the logistics of the meeting (especially Lisa Butler) and local travel. He also noted the considerable amount of material that had been posted on the WOAP-III web site (see Appendix 3 and http://www.wmo.ch/pages/prog/wcrp/AP_WOAP3.html) as background for the meeting and thanked Stefanie Lorenz and Stephan Bojinski for their help in setting this all up. The agenda is given in Appendix 1 and the participants list in Appendix 2.

Note was made that participants represented other panels or working groups of WCRP or GCOS. Task groups for this meeting were set up to focus on action items on subtopics (see agenda). M. Manton was appointed rapporteur for the meeting. G. Asrar, Director of the WCRP Joint Planning Staff, made opening remarks on behalf of the WCRP.

The main topics addressed at the meeting included the following:

- Progress achieved during the last two years in relation to observations, especially space agencies and CEOS, reprocessing and reanalysis, interactions between GCOS and WCRP activities, and participation in GEOSS.
- Transition of WCRP projects and datasets beyond 2013.
- Assessment of the activities and results of Task Group on Data Management and the Joint Working Group on Observational Data Sets for Reanalysis.
- Develop report to the GCOS SC meeting in 2 weeks.
- Explore the role of WOAP in World Climate Conference III, 31 Aug to 4 Sept 2009, and OceanObs09 from 21-25 September 2009.
- Develop contributions to the WCRP implementation plan

Session 2: Review of past actions and status of the panel

The chair briefly reviewed the goals and accomplishments of WOAP, related activities over the past two years, and outstanding issues for this meeting and longer term; see the presentations made at the meeting for details (available on the WOAP-III web site).

The chair summarized events related to WOAP arising from the WOAP-II meeting and subsequently. Many of these are detailed in the written WOAP presentation to JSC (which he was not able to attend) (appendix 3). The Task Group on Data Management and Working Group on reanalysis data were successfully set up following the last WOAP meeting, and they reported later in this meeting. Many topics, covered in more detail later, include the joint GCOS, WCRP, IGBP 2007 Sydney workshop and the *WMO Bulletin* article which arose from that; a brief IPCC update; CEOS interactions; the Tokyo reanalysis conference; the World Modeling Summit for Climate Prediction; and outreach.

A report from WCRP JSC and the role of WOAP within WCRP was given by G. Asrar and T. Busalacchi (Chair of the JSC). They noted that while COPES provides the strategic framework, there is a need for a WCRP implementation plan. They raised questions about the relationship of WOAP activities to IGBP, such as with observations of carbon cycle variables

and their assimilation. A key question is what WOAP brings beyond what is already available from the projects? They also noted the importance of interfacing with constituencies and facilitating information flow. The chair noted the previous lack of feedback to WOAP from the JSC and the need to be able to plan ahead for future meetings. Task groups do most of their work by e-mail, but a regular meeting of the panel is necessary for coordination or WOAP will languish. WOAP had proposed that JSC should adopt at least a two and preferably three year planning horizon and that WOAP meetings should occur preferably annually and at least every two years. A budget appropriate to support this is required. Asrar assured WOAP that it should plan for another meeting. A continuing issue is WOAP membership, which is complicated by the assignments of members to projects.

Session 2 Issues

2.1: WCRP review. ICSU is currently reviewing WCRP and its links to other parts of the global environmental change program. The JSC is reviewing the implementation of WCRP on intermediate time scales for current programs and beyond 2013 for the longer term, and it is promoting the links between modeling and observations.
Conclusion: The ICSU review of WCRP is likely to lead to a strengthening of WOAP-related issues across WCRP. WOAP will contribute to an implementation plan related to cross-cutting observation issues for WCRP. The longer term aspects of the plan should account for the broadening scope of WCRP as more and stronger links with IGBP are developed. This breadth of scope is also required for the GCOS observation program.

2.2: WCRP relevance. There is increasing pressure on all climate-related programs to ensure that their outputs can have impacts on a broad user community.
Conclusion: The new structure of WMO should facilitate the capacity of WCRP and GCOS to provide useful products to a broad community through the WMO and related organizations. This partnership approach should allow WCRP and GCOS to focus on the core research and observation issues.

2.3: IPCC and WCRP. The IPCC AR4 did not include a section on future directions of research and monitoring to support future IPCC assessments. The structure of the IPCC AR5 is being developed through international scoping meetings over the next year.
Conclusion: Currently there is no well-recognized authoritative statement on future needs for IPCC assessments. The joint WCRP-GCOS-IGBP meeting in Sydney in 2007 provided a forum to develop some of those needs, and the results are being well publicized. However, the IPCC itself provides the most recognized mechanism for developing a consensus in the climate community and for promoting the results in influential forums.
Recommendation: The JSC and the GSC (GCOS-SC) should promote the need for the IPCC AR5 to address future directions for research and observations to support future assessments.

2.4: IPCC and GIP update. As IPCC develops the scope of the AR5, it will be important that observation needs are considered and included appropriately.
Conclusion: The joint GCOS-IPCC scoping workshop held in 2002 to help identify observation needs for the AR4 was found to be mutually beneficial, in ensuring GCOS recognized the needs of IPCC and IPCC recognized the limitations of current systems and resources for observations.
Recommendation: The GSC should invite IPCC to participate fully in the review of the GIP and help identify observation needs for the AR5 and beyond.

2.5: WCRP and IGBP. The effectiveness of WOAP in promoting cooperation across WCRP and GCOS on all data matters
Conclusion: As the scope of WCRP activities is extended, particularly through collaborative projects with IGBP, it is expected that WOAP will be required to extend its scope accordingly. This may have resource implications (people and funds).

Session 3: Reports from WCRP groups

J. Meehl reported on WGCM activities and especially the next phase of CMIP (CMIP5), joint with AIMES, which involves 18 modeling groups. Two classes of runs and models are designed to address two time scales: (i) decadal predictability to 2035; and (ii) long term (to 2100 and beyond). The runs to 2035 do not need a carbon cycle or different emissions scenarios, while the longer runs do. Initializing the climate state using observations is also required for the shorter runs. In CMIP5, general principles are given as a framework for the runs but there is no dictate on, for instance, how to initialize models for the shorter suite of model runs to 2035. Can WOAP provide guidance? A metrics panel for evaluating model output is being set up.

P. Gauthier summarized WGNE activities and noted the importance of transpose AMIP runs in evaluating climate models, and which require initialization. There is a THORPEX WG on data assimilation and observing systems. TIGGE helps link WCRP and THORPEX and WWRP activities through the ensemble prediction as part of the seamless prediction of climate.

J. Shukla provided a summary of WMP's activities and the World Modeling Summit for Climate Prediction (see appendix 3 for the statement from this meeting), and subsequent developments. These include articles proposed for the *Bull. Amer. Meteor. Soc*. WMP and THORPEX are developing a joint plan for advanced global modeling and forecasting for weather and climate.

It was suggested by WOAP that modeling groups should be more proactive in making their observational needs known.

Brief presentations were given by 1) CLIVAR (D. Stammer) who featured decadal predictions and noted that the biggest problems were on salinity: models disagree and observations are few. 2) CliC (J. Key) who noted the formation of a sea ice working group and development of the Global Cryosphere Watch (GCW). 3) SPARC (C. Savigny) who gave updates on various studies with latest datasets on temperature, water vapor, and ozone. He noted the threat to limb measurements related to determination of ozone and other chemical species vertical profiles. 4) CEOP (T. Koike) The former CEOP "Coordinated Enhanced Observing Period" has merged with the GEWEX Hydrological Program (GHP) into a new entity and has thus changed its name to the Coordinated Energy and water cycle Observations Project (CEOP). 5) GEWEX (W. Rossow) features 3 parts: the Radiation Panel (GRP), GHP=CEOP, and the Modeling Panel (GMPP). There is a 2011 goal for complete energy and water cycle CDRs. The issue of disconnects between datasets from different groups and projects was raised.

Session 3 Issues

3.1 Modeling and CMIP5. Past pressures of time and resources led to some separation between the activities of WCRP and IGBP and the preparation and evaluation of future climate projections used in past IPCC assessments.
Conclusion: The recent initiative of WGCM and AIMES (CMIP5) to develop a succinct set of coupled model inter-comparison projects should ensure that a feasible and defensible set of model runs will be available to support the AR5 assessment of future climate projections. As CMIP5 results will be a major investment, there should be a coordinated effort to optimize the application of the results.
Recommendation: The WGCM and WGNE should liaise to determine whether some model results used in CMIP5 of WGCM could also contribute to the AMIP-transpose project of WGNE.

3.2: Model evaluation. WGNE with THORPEX are reviewing the scope of indices used to evaluate high-resolution model output applied to socio-economic issues and to extreme weather events.
Conclusion: The WGNE activity is expected to lead to a comprehensive set of indices for evaluating the performance of models for weather purposes. Given the WCRP promotion of seamless prediction and the development of CMIP5, it may be worthwhile for WGNE and WGCM to review the full range of indices used for model evaluation across time scales.

Recommendation: The WGNE and WGCM should decide whether it is timely to review indices for model evaluation across all time scales, and to report on the adequacy of current observations to support these evaluations.

3.3: World Climate Conference. WMO has created a working group on climate prediction to develop a proposal for the World Climate Conference.
Conclusion: WOAP supports modeling group representatives encouraging their groups to be responsive and recognize this opportunity.

3.4: Fresh water budgets. Improving fresh water budgets requires ocean salinity and surface freshwater fluxes including runoff.
Recommendation: The CLIVAR SSG should liaise with all relevant groups across WCRP and GCOS to ensure that the observation projects on salinity are adequate and coordinated to ensure that the scientific objectives will be met effectively and efficiently

3.5: Cryosphere Watch. The WMO is creating the Global Cryosphere Watch (GCW) to coordinate the monitoring of the global cryosphere
Conclusion: The CliC SSG will work closely with the new GCW to ensure that each relevant ECV is monitored efficiently and effectively, and that the associated research needs of WCRP are met in the future

3.6: Cryosphere ECVs. Some questions have been raised in the research community about the handling of ECVs in the cryosphere in the GCOS Implementation Plan.
Conclusion: It would be appropriate for the GCOS Panels to liaise with the CliC community to review the handling of ECVs in the cryosphere in the GIP.
Recommendation: The CliC SSG and the GCOS Panels should examine the list of cryosphere essential climate variables (ECVs) for completeness, bearing in mind the IGOS Cryosphere observational requirements for snow and ice. This action should be done as part of the current revision of the GCOS Implementation Plan. In the longer term, the WMO Global Cryosphere Watch (GCW) is expected to play a role in this process and in the implementation of the appropriate observing systems.

3.7: Sea ice. The CliC SSG is planning to establish a working group on sea ice
Recommendation: The CLIC SSG should liaise with OOPC and AOPC and the JCOMM expert team, and others to determine how the new group will complement and work with the existing GCOS working group on SST and sea ice

3.8: Snow water equivalent. A global climatology of snow water equivalent is needed to support WCRP research and the GCOS ECV
Recommendation: The CLIC SSG should liaise with TOPC in the framework of the GCW to develop a project to develop a global climatology of snow water equivalent

3.9: Trend analysis. SPARC has been very effective in identifying user needs for trend analyses in UTS domain
Recommendation: The JSC should encourage all SSGs to promote the support of international projects to analyze variability and trends in relevant climate variables.

3.10: CEOP. The former CEOP "Coordinated Enhanced Observing Period" has merged with GHP into a new entity and has thus changed its name to the Coordinated Energy and water cycle Observations Project (CEOP).
Conclusion: Through international cooperation, CEOP has developed an effective data archive and access system for *in situ* and satellite data as well as model output.

Session 4: Coordination with GCOS and GEO

The position of Director of GCOS is currently vacant and A. Simmons presented an update on the overall GCOS activities as provided by the secretariat. The 2007 Sydney workshop provided recommendations pertinent to GCOS. Reporting to UNFCCC remains a major GCOS activity, and GCOS has planned for February 2009 an "Expert Meeting on Updating the GCOS Implementation Plan". Development of the new GRUAN network of reference upper air stations is now underway.

Brief outlines of activities and issues were also provided by the GCOS Panels. A. Simmons, Chair AOPC, presented a summary of AOPC activities and their 4 working groups. E. Harrison, chair of OOPC, presented a summary of OOPC and GOOS activities and noted the often disconnect between observations and products. Many ocean observations are in the research domain; and several new developments are occurring that are promising. J. Famiglietti, representing TOPC, presented a summary of TOPC activities and highlighted the role of the GCOS IP (GIP) in focusing efforts on a relatively small number of essential variables (14). He noted that data sharing is declining, and that data must be integrated using models to get a robust picture.

J. Key led a discussion on cryosphere observations and possible update on ECVs, per GCOS SC request (Action 37), and noted that it was cross cutting issue for AOPC, OOPC and TOPC. It was suggested that the cryosphere is really already in the GIP, but they are just not collected under the cryosphere banner. The Global Cryosphere Watch may be a way forward.

WOAP was briefed on WMO Integrated Global Observing Systems (WIGOS) activities by M. Menne. WIGOS follows from the WMO reorganization and applies for four years through 2011. It is advisable to recognize this structure and use it as a way to deliver services and information. It has a major observations department. It is setup to play a key role in GEO tasks.

Progress on GEO tasks were reviewed by M. Tanner, and several climate tasks involve WOAP in some way. These include those on reprocessing and reanalysis. A key issue is how to engage others? It was noted that solving data sharing would be a major advance and this is especially the case for hydrological data.

Session 4 Issues:

4.1: GCOS Implementation Plan update. GCOS is preparing a 5-year progress report on the GIP for SBSTA in April 2009
Recommendation: WCRP groups should contribute as required through expert meetings and written contributions to the review of the GIP.

4.2: GRUAN. The GRUAN was identified in the GIP as a high-priority addition to the global climate observing system
Recommendation: The WOAP endorses the initiatives of AOPC to promote the development of the GRUAN and encourages the Panel to maintain close scientific oversight of the project, in particular to ensure a representative distribution of stations beyond the initial phase.

4.3: Continuity of observations. Continuity needs to be further promoted in agencies that fund sustained observation networks for climate in all domains
Recommendation: The JSC and the GSC should continue to promote the vital importance of continuing support of sustained observing systems for climate research and applications

4.4: GEWEX datasets. GEWEX is planning to develop global data sets on components of the energy and water cycle
Conclusion: The development of a global data set on many components of the energy and water cycle will be a valuable legacy of GEWEX. It will be vital for the research community to remain engaged with the continuing evaluation and reprocessing of such data sets. It will also be important to continue this into the future.

4.5: Ozone profile observations. Continuity of satellite capability for limb atmospheric profiling for some important species beyond 2013 is under threat. Currently, several satellite instruments provide global measurements of stratospheric ozone profiles with good vertical resolution (ACE-FTS/SCISAT-1, GOMOS/Envisat, MAESTRO/SCISAT-1, MIPAS/Envisat, MLS/AURA, OSIRIS/Odin, SCIAMACHY/Envisat, SABER/TIMED, SMR/Odin). However, the number of vertical profiling sensors will decrease significantly over the next several years, and the continuity of the satellite record of ozone (and other stratospheric key species) profiles, especially in limb viewing mode, is jeopardized.

Conclusion: The capability to perform vertically resolved global observations of stratospheric ozone and other relevant species is important to monitor the evolution and recovery of the stratospheric ozone layer. The only secured future ozone profile sensor is the OMPS (Ozone Mapping and Profiling Suite) to fly on NPP (NPOESS Preparatory Project). There will likely be another OMPS-Limb sensor on one of the NPOESS satellites, but other future missions have not yet been confirmed.
Recommendation: As part of its continuing dialogue with CEOS, WOAP should draw attention to the possible intermediate-term gap in the monitoring of profiles of ozone and related species.

4.6: Terrestrial ECVs. The difficulty in meeting the GCOS Climate Monitoring Principles for the land domain ECVs.
Recommendation: The TOPC should consider the organization of some workshops and related activities to promote the development of land-domain data sets that meet the GCOS Climate Monitoring Principles.

4.7: GEO interactions. The role of GEO in supporting global environmental observation systems. A critical example is the need to allow open access to hydrological data across the world; access to these data will be vital for the world to manage water availability in the coming decades. A further example is the need for sub-daily climate data to support the analysis of extreme events which have substantial impacts on human activities and natural ecosystems.
Recommendation: The JSC and GSC should jointly request GEO to provide vital enhancement of global monitoring by (i) promoting data sharing across all nations, (ii) developing international standards and regulations for the consistent monitoring of ECVs and related variables, and (iii) encouraging all nations to support environmental monitoring systems.

Session 5: Space matters and relation with space agencies

From WOAP-II a letter was sent by WCRP/GCOS to CEOS highlighting climate needs from space-based observations, as well as the needs for reprocessing and reanalysis of past data. Key points made to emphasize the climate needs and priorities included: 1) We are not inventing new requirements, but are reinforcing aspects of the GIP; 2) We are, however, trying to help establish priorities and sharpen those to emphasize:

- Continuity, continuity, continuity;
- The need for reprocessing and reanalysis of past data;
- The need for multiple ECVs, for land, ocean, atmosphere domains;
- Importance of calibration, accuracy, benchmarks, and in situ observations;
- Concerns over risk to continuity with NPOESS cuts in longer term;
- That climate variables need to have higher priority.

In late 2007, WOAP was asked by GCOS SC to draft a further letter to CEOS intra-sessionally. In that letter, sent again under the joint signatures from the Chairs of JSC and the GCOS-SC, we noted the climate needs and especially need for quality and continuity. We applauded the CEOS plan but expressed concern that it may not be implemented and we sought reassurance that climate concerns would be a priority. We sought an update on funding and progress. We also expressed concern over the de-manifesting of climate instruments from NPOESS and we offered to help.

CEOS actions in response to GCOS and WCRP needs were addressed by I. Petiteville with contributions from M. Goldberg. The GIP and related reports provide a good target for agencies in setting priorities. This highlights the importance of the forthcoming update. CEOS reports annually and is making considerable progress that is not always well communicated to WCRP and GCOS. Concern was expressed over disconnects between what is happening in some space agencies that does not recognize developments and projects in WCRP. For instance, although space agencies are carrying out reprocessing of satellite data, scientific coordination does not appear to be great, for example no process is in place to agree on a single or even group of algorithms, so that disconnects are inevitable among products.

A representative from the U.S. Climate Change Science Program (CCSP) (C. Tucker) provided an update on progress to restore the climate instruments that had been de-manifested from

NPOESS. The situation has improved a lot from what it was two years ago. Nonetheless, there is no long-term strategy for climate observations from space.

Developments in Regional/Specialized Satellite Centres for Climate Monitoring (R/SSC-CM) and GSICS were addressed by A. Simmons. The inter-calibration of satellites via GSICS is an important and useful development and includes LEO-to-LEO and GEO-to-LEO. Inconsistencies among the GEO should be apparent on overlaps in domains. This is not done in real time and thus mandates reprocessing. The R/SSC-CM comes from the meteorological agencies via CGMS and has several projects involving AVHRR, SSM/I, motion vectors, UT humidity, surface albedo, and clouds and aerosols. It was apparent that with the 5 pilot projects being independent, the products could be inconsistent. The ESA Climate Initiative, described by S. Briggs, is seeking funding for science projects and looks very promising; it enables ESA to do some of its tasks under CEOS.

In general discussion, WOAP noted the very promising developments, but again emphasized the concern over the extent to which people doing these projects are engaging the wider community and the coordination. An example is the CEOS workshop planned by M. Goldberg in November 2008 (see session 11). In particular there has been inadequate contact between these activities and WCRP (although this is now being addressed).

Session 5 Issues

5.1: Demanifested climate instruments on NPOESS. The continuing possibility exists for a substantially reduced observing capability for climate purposes on NPOESS.
Recommendation: In the continuing dialogue with CEOS, the JSC and GSC should continue to promote the importance of restoring the climate instruments on NPOESS or other platforms. WOAP expressed its support for the re-manifestation of the climate instruments on NPOESS

5.2: Climate Data Records. International collaboration on the development of climate data records is desirable.
Recommendation: In the continuing dialogue with CEOS, the JSC and GSC should develop a mechanism to enable CEOS to draw on the experience of WCRP programs in the development of CDRs based on satellite data.

5.3: GSICS. Development of global climate products through GSICS process should occur.
Conclusion: It will be important for the process through which satellite-based global climate products are produced to include explicit activities on the inter-comparison and evaluation of those products. The programs of WCRP, such as GEWEX, have extensive experience in these activities and this experience should be used.

5.4: SST microwave observations. Continuity of the microwave SST data record is at risk.
Conclusion: The GCOS Implementation Plan notes the value of microwave instruments in monitoring SSTs in all weather, and so the satellite agencies are encouraged to ensure the continuity of these measurements.

5.5: Ocean color. Potential lack of continuity in the climate record for high quality ocean color exists.
Conclusion: As ocean color instruments evolve there is a tendency for the specific bands to change and for quality to be compromised. There is a need to ensure the high quality of the MODIS and other records continues into the future

5.6: Climate observations from space. Climate concerns should be considered in national reviews of satellite missions.
Conclusion: WOAP encourages nations, as they regularly review their national requirements for satellite missions, to ensure that climate needs are assessed on a scientific basis. The WCRP and GCOS communities would be willing to assist in such assessments if requested.

Session 7: Host country activities

Priorities of global observation and products of the CCSP were outlined by C. Tucker. The NRC follow-up to the Decadal Survey is one means of vetting the assigned priorities. WOAP

stressed the need to have ways for scientists to have input into the process. An overview of current U.S. activities related to reanalyses (minimally, CFSRR, MERRA, and the historical 20th Century reanalysis project), and future CCSP/U.S. priorities was given by Randy Dole. The framework is the Integrated Earth System Analysis which is an admirable goal. The latter includes chemistry and biology. CFSRR is coupled but driven by operational needs and climate is a secondary consideration. NCEP lacks expertise on Earth Systems aspects. The 20th Century reanalysis project is breaking new ground and shows lots of promise. A. Macdonald gave a brief outline of the development of climate services in NOAA.

WOAP has been successful in promoting the need for reanalysis, but now we face a problem of proliferation and having four new global reanalyses: JRA, ERA-Interim, MERRA, CFSRR. There is also the Arctic regional reanalysis to 40ºN in the same time frame and the 20th Century reanalysis. It is potentially overwhelming for the climate community to deal with and vet all of these.

WOAP expressed considerable interest in the reprocessing and reanalysis activities within the US but also concern about how well they are coordinated both within the US and internationally, so that they lead to systematic advancement of the basic dataset and lessons learned are appropriately taken into account. This aspect is continued in session 10.

Session 8: In situ issues

E. Kent provided a briefing on issues arising from the WG on Surface Fluxes (WGSF). This has mainly focused on ocean atmosphere exchanges but now has a land component and is also exploring (with SOLAS) CO_2 and other fluxes. Of particular concern are the threats to VOS. NWP relies on VOS less and less, and decisions are made for weather priorities that have climate implications. Masking of ship signs in synoptic weather reports removes the ability to QC the data and make adjustments to correct for biases. WOAP expressed concern over these developments and this concern should be communicated to the GCOS-SC, WMO, and JCOMM. Other key datasets for the WGSF include the meteorological stations from the OceanSITES project and meteorological and flux measurements from Research Vessels. Research Vessel meteorological and underway oceanographic measurements are presently not well coordinated internationally, the US Shipboard Automated and Oceanographic Systems (SAMOS) initiative is a potential model for improving quality, availability and stewardship of these data.

E. Harrison and D. Stammer are playing lead roles in the major Ocean Obs. 09 conference, to be held in September 2009, and their briefing led to a discussion on the role of WOAP.

Session 8 issues

8.1: VOS. The continuing decline in number of multivariate meteorological observations from VOS and loss of unique platform identifiers is a major concern.
Conclusion: Owing to a range of resource and priority issues, support for the collection of VOS data has been declining. Platform identifiers are vital for quality control and bias correction. Insofar as these data provide valuable contributions to the global climate record, WOAP strongly encourages the relevant national meteorological agencies and commercial operators to support this activity.

8.2: Operational Data Collection. The increasing use of operational observations in climate research and product development
Recommendation: WOAP recommends the development of a mechanism to ensure adequate consideration of climate data requirements for operational data collection and archival activities. This mechanism could be the formalizing of a direct link between WCRP/WOAP (probably via AOPC) and the WMO Observation Department.

8.3: OceanObs09 conference. OOPC and CLIVAR are jointly coordinating the organization of OceanObs09 conference in September 2009 in Venice.
Conclusion: WOAP endorses the approach to OceanObs09 being taken by the organizing committee such that broad community involvement is being encouraged and that future

requirements will be identified and promoted. WOAP encourages WCRP scientists to provide helpful comments and be engaged.

Session 9: Data activities

Issues of data management within WCRP and the future of observations and datasets after the sunset of WCRP projects in 2013 was a major topic for this session. It was led off by a report from the Task Group on Data Management now chaired by H. Cattle. This group was set up following the last WOAP meeting where the discussion on data management in WCRP projects 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. There was discussion of the need for a WCRP data policy, and the conclusion was that it should be driven by the sponsors of the projects. The policies as they stand, are not very different and is not a major issue.

CEOP perspectives were outlined by T. Koike. CEOP has developed quite a large data management system with 300 TB of data. Some is distributed; for instance NCAR deals with data from the 53 reference sites (funded by NOAA), while MPI handles the model data (MOLTS) (funded by EU). CEOP data management is a five year key project to GEO funded by the Japanese Government (JMA, JAXA), and is regarded as a legacy project with funding 5 years at a time, but with good prospects into the future.

A review of the WMO Information System (WIS) was given by D. Middleton. WIS has its foundation in the GTS and has developed a system for seamless discovery, access and retrieval of data; it is a system of systems. A catalog of metadata is one key while the data are at distributed sites. WIS is a means for WMO to participate in GEOSS and it involves operational and research data. It seems desirable for WCRP to adopt the WIS when fully functional (2011).

WOAP legacy issues arising from the transition of WCRP Projects beyond 2013 were discussed by the projects. CLIVAR data (D. Stammer) is more robust than WOCE data but the volumes unique to CLIVAR are small. The GEWEX (W. Rossow) web site directs users to project web sites for GEWEX specific datasets. Some have “permanent” archives (e.g., at NCDC and also NASA DAACs). Analysis migration from research to operations is occurring, led by ISCCP, where new processing code is to go to NOAA in 2010. There remain some reprocessing issues and GRP is doing some assessments but has inadequate funding. The continuity of SPARC (C. Savigny) constituents’ datasets is in jeopardy, especially limb sounding for ozone profiling; where there is a risk of gaps between 2010 and 2017 as ozone recovers from the ozone hole. Most CliC (J. Key) data sets are not owned by CliC but reside at NSIDC or elsewhere. The WGSF (E. Kent) does not collect datasets and collection and aggregation of observations should continue. Modeling groups (J. Meehl) have utilized the centralized PCMDI archive but will use more distributed archives for the next CMIP. A small task team is working on that.

More generally, many datasets are not owned by the projects but are relevant. Hence many have a haven in World Data Centers or long-term stable archive centers. However, there remain QC issues and need to coordinate data streams. Many DACS are under funded. Some datasets need evaluations, and improved assessments of existing data are desirable. It appears that most activities are likely to continue under different banners.

Session 9 Issues

9.1: WCRP data management. Review and assessment of data management across WCRP. *Conclusion:* WOAP thanked Norman MacFarlane and Howard Cattle for their work in leading the WOAP Task Group on Data Management (TGDM). The TGDM found that there are no clear redundancies in data sets across WCRP but there are a range of approaches to data management. WOAP decided to extend the term of the TGDM by one year and to ask them to consider the long-term aspects of data management of WCRP data especially in relation to data discovery, data access and data archive. The TGDM should also update the list of WCRP

data sets and consider the potential for rationalizing the naming convention of WCRP data sets to simplify data discovery. In particular the TGDM should prepare a report for the next JSC meeting on these issues.

9.2: WIS. Developing awareness, use and capability of the WIS.
Conclusion: WOAP was encouraged by the vision and scope of the WIS, and noted the potential for the WIS to be considered in the long term as the portal for global environmental data and information. Accordingly WOAP requested the TGDM to consider the potential for the WIS to become the mechanism for discovery and access of WCRP data sets in the long term.
Recommendation: WOAP should alert WCRP projects to the potential of the WIS for their use.

9.3: CEOP data management. The CEOP data system includes the production of metrics on data access.
Conclusion: Metrics show that access is international and WOAP encouraged the research community to make use of the system. WOAP also noted that long term support for the data system in Japan is linked to the recognition of it as a national contribution to GEOSS.
Recommendation: Support for continued data archival by NCAR EOL (reference stations) and MPI (MOLTS) is needed.

9.4: ISCCP. Upgrade and transfer of ISCCP processing system from research to operations.
Recommendation: After the upgrade of ISCCP to climate data record quality, it is desirable to continue the record in an operational mode into the future. WOAP recognized the desirability of the transfer of the ISCCP processing system from NASA to NOAA in 2010 as a demonstration of the value and maturity of the ISCCP products, which were developed under the auspices of WCRP. The transfer of this system from research to operations is appropriate and could be a model for other data sets in the future. WOAP encourages the relevant agencies to ensure that the research community maintains a role in the scientific oversight and evaluation of ISCCP products after the transfer in 2010.

9.5: Dataset and product evaluation.
Recommendation: WOAP is encouraged by the increasing number of global climate data sets and products being generated around the world. It is important for WCRP and GCOS to contribute to the continuing assessment and evaluation of these data and products in cooperation with the producers. WOAP encourages agencies to support the organization of workshops and working groups to support these activities.

9.6: ICOADS. Development and continuation of ICOADS
Conclusion: ICOADS is an essential part of the climate data record, and a model for open data access. WOAP encourages the continual update of ICOADS and enhancement of its archive. This will require additional resources.

Session 10: Reanalysis in support of climate research

Following WOAP-II, an action item was for A. Simmons and K. Trenberth to write an article on reanalysis for EOS, publicizing the need. This was successfully done (along with S. Uppala from ECMWF).

K. Trenberth reported on the very successful Third International Reanalysis Conference held at the University of Tokyo in 28 Jan 2007 to 1 Feb 2008. From the conference, a statement on reanalysis was issued, and this formed the basis for a further article in EOS “Problems and prospects for reanalysis” by K. Trenberth, T. Koike, and K. Onogi. In turn, this was used as the basis of a letter sent to all agencies involved in reanalysis activities, including those focused only on data set development. In spite of limited feedback, it is believed that this has helped with priorities in some countries.

From the conference, it was apparent that much work remains to be done to address outstanding issues in reanalyses, especially those related to the changing observational data base. These problems adversely affect decadal and longer variability and limit applications of reanalyses at present. Concern was also expressed over proliferation of reanalyses and whether there was adequate ability of the community to screen and evaluate all the efforts

going on (quality not quantity). Ocean reanalyses were also discussed, and problems highlighted related to under-sampling of the ocean.

R. Dole reported on U.S. reanalysis efforts earlier in session 7, and A. Simmons reported on new ECMWF and JMA efforts. D. Stammer presented the plans for ocean reanalyses, and J. Key discussed those on Arctic and cryospheric related reanalyses. P. Gauthier reported on progress in coupled reanalysis. Summary conclusions follow:

Single-domain reanalysis

- Atmosphere-only reanalysis and ocean-only reanalysis have reached levels of maturity that call for sustained production activity.
- Significant progress is being made in addressing the scientific problems highlighted in previous statements from WOAP and from the workshops and conference that WOAP has played a part in organising, but much more remains to be done, both in addressing issues in data assimilation and in addressing issues of observational data recovery, data quality and data management.
- WOAP's advocacy of reanalysis and the earlier identification of needs for reanalysis in the GCOS Implementation Plan have helped in the establishment of new initiatives.
- Notwithstanding these new initiatives, insufficient sustained funding of existing reanalysis groups is inhibiting formal coordination among the groups, preventing staggered production of major reanalyses, or adoption of a managed distribution of approaches among reanalysis centres [e.g., use of full observation set or use of reduced, more homogeneous observation set]. There is nevertheless good international cooperation at the working level.
- Lack of a coordinated, staggered production has resulted in the recent or near-future availability of several additional reanalyses for the satellite era.
- This is leading to needs for central user guidance as to the qualities of the various analyses and for the availability and access to reanalysis products to be provided in a uniform way that promotes intercomparison. Development of an information system for reanalyses, including their input data, is becoming a priority. Adoption of the WIS could provide a technical basis for this and should be explored.

Coupled reanalysis

- WOAP was pleased to learn of a variety of first steps towards the long-term goal of fully coupled earth-system analysis, and of the participation from several different domains in the 3rd WCRP Reanalysis Conference in Tokyo in January.
- There are several examples of coupled systems that are implemented or under development, such as atmosphere/ocean, ocean/ice, atmosphere/land and meteorology/chemistry.
- In most instances, the data assimilation is not fully coupled in the sense that observations of one domain do not directly influence the other domain within the analysis process; coupling instead occurs during the subsequent cycling of the data assimilation system.
- The current exercises are part of a dynamic learning process, and are viewed as an appropriate way forward.
- They do not, however, obviate the need for research into meeting the scientific challenges of developing fully coupled systems that aim to make optimal use of the information content of the observational database and to lead to optimal balance between the coupled domains.
- WOAP thus welcomes the diversity of effort currently being devoted in this area and encourages full dialogue among the individuals and communities involved.

Linking reanalysis with climate model assessment and development

- WOAP notes the critical requirement for reliable decadal prediction and the role reanalysis can play in helping ensure that prediction systems become capable of exploiting such predictability as exists for these timescales.
- Coupled analysis and reanalysis is necessary for provision of initial conditions for such predictions and for assessing the realism of the models employed and the accuracy of their hindcasts for past decades.

• In this regard the "transpose AMIP" initiative of WGNE is fully supported. The ideal of actually employing the climate model within the data assimilation process itself, confronting it with observations in the most direct way, was recognised as a technical challenge for many climate modelling centres, although this is indeed an initiative being undertaken within SPARC.

Observational datasets for reanalysis
Following WOAP-II a working group was set up jointly by WCRP (WOAP) and GCOS (AOPC) on the issue of "development of improved observational data sets for reanalyses". R. Vose (Chair Joint/Working Group on Observational Data Sets for Reanalysis) reported on activities in his WG on observations, and discussion of follow-up actions.

The WG has several projects working on in situ data. Some new data, but not all, are being used in the latest reanalyses, e.g., by NCEP, NASA. It is important also to include and integrate Haimberger and other corrections in the updated sonde dataset. The WG should be used as a way for members to garner resources (WOAP can support these, for instance). The reanalysis dataset will also be exceedingly useful for multiple other purposes, such as IPCC and data for analysis of extremes.

Session 10 Issues

10.1: The third reanalysis conference.
Conclusion: WOAP congratulated and thanked Japan for hosting the third reanalysis conference, which was very successful in highlighting the significant progress that has been made in the science and identifying the need for continuing research.

10.2: Proliferation and coordination of reanalyses. There are an expanding number of atmospheric reanalysis efforts around the world and the associated cost of each activity is substantial.
Conclusion: WOAP again notes the desirability for staggered reanalyses and is concerned about the evaluation of the resulting datasets. It is desirable to optimize the benefit of successive activities as they build on the lessons of previous activities.

10.3: Reanalyses of the Earth system. The scope of reanalysis continues to expand.
Conclusion: The societal needs for reanalysis products across all climate variables means that reanalysis and associated data assimilation research is expanding to include the entire earth system. This research effort is a major initiative and will require close international cooperation to ensure that progress is based on the best science. The WCRP and GCOS communities will work closely with the relevant agencies to support these activities.

10.4: Progress in reanalysis. WOAP was pleased to note the continuing progress in extending the scope of reanalysis across all domains.
Conclusion: The scientific challenges associated with these developments will require major commitments of expertise and infrastructure in the future.

10.5: Dataset development for reanalysis. There is a need for common data sets for reanalysis and climate diagnostics.
Conclusion: The Working Group on Reanalysis Data Sets has made excellent progress in achieving its terms of reference. The Group has created an inventory of relevant data sets around the world, and there has been some progress in augmenting some data sets by building on existing data sets. It will be appropriate to get a commitment from groups preparing future global reanalysis to make use of the common data sets being coordinated by the Working Group.
Recommendation: WOAP should write a letter to the Working Group for distribution to the sponsors of the members supporting importance of data activities on reanalysis [R. Vose to provide list], with a copy to R. Dole in his CCSP capacity representing reanalysis activities. It should support the optional incorporation of homogenization updates such as those of Haimberger to new sonde records in ways that retain the original records. It should emphasize the need for improved access and data availability, and catalogs. The activity needs committed and sustained resourcing, preferably at a level above that available today,

which might be garnered by proposals that exploit the WG connections. Some of this activity could be more formalized as a sustained commitment. Reanalysis centres should in turn be encouraged to write to the same organizations to express (i) their commitment to the activities of the Working Group, and (ii) the reliance they would place on use of the Group's integrated and managed data sets in planning their future activities.

Session 11: Reprocessing

WOAP received notification indirectly of CEOS plans for a reprocessing workshop to be held in Washington Nov 17-19, 2008, led by Mitch Goldberg. Unfortunately there had been no consultation with WOAP or GEWEX, and no acknowledgment that many reprocessing efforts were already underway. Consequently, the Chair of WOAP sent a letter (Appendix 4) expressing these concerns to Mary Kicza of NOAA, now the chair of CEOS, and seeking more information.

W. Rossow reported on reprocessing activities led by the GRP (Chaired by C. Kummerow), including variables suitable for reprocessing (need, readiness), activities definitely planned, and funding and commitments already obtained and required. GEWEX has developed a number of very useful datasets but they were not designed to produce reliable time series for tracking climate change. New efforts are now underway to try to fix artifacts and make data more homogeneous. One goal is to make datasets with a common space and time component such as 1 deg and every 3 hr. This allows joint pdfs to be formed and expands prospects for understanding. 2010 to 2011 dates are targets for the new datasets. These projects go to 2013 and ISCCP has plans beyond then. GRP covers a small set of variables and there are also many other variables, such as SST, ocean variables, sea ice, ozone, other constituents, chemistry, sea level, land surface variables, and so on.

I. Petiteville reported on CEOS reprocessing activities with material provided by M. Goldberg. CEOS is responding to GEO task CL-06-02 and working with WMO under R/SSC-CM. CEOS coordinates tasks but the extent of coordination appears limited and different Centres do their own thing so that there is no unified view on algorithms to be used, and some may not be adequately vetted. Work is proceeding on many variables. However, it appears that others take care of evaluations and assessment and this is not a core part of the reprocessing. While 1200 PIs in and outside of ESA are working with ENVISAT data, space agencies do not fund much research on assessments of the data. Connections to what is ongoing in WCRP are apparently not considered.

WOAP expressed concern over the lack of adequate coordination and recognition of other efforts. If agreement can not be reached on a single algorithm, why not employ several and thus compare results? WOAP offered to participate and help resolve possible inconsistencies. Discussion occurred on the need for a working group to improve these aspects, although existing expert teams can help. WOAP believes that all eligible groups should participate. Hence it requires commitments from groups to come together and ongoing exchange of information that could be enforced by funding agencies. WOAP should communicate these aspects to CEOS and the GCOS-SC, GEO and WCRP, accomplished in part via the WOAP meeting representatives and the meeting report.

Session 11 Issues

11.1: GEWEX dataset continuation. There is a need for continuation of GRP data sets beyond 2013.
Conclusion: The GRP data sets have proved to be useful for a range of diagnostic and modeling studies. The update and evaluation of the data sets will continue to 2013, when GEWEX will formally end. Given the demonstrated value of these data sets, it is desirable to identify institutional arrangements to maintain them beyond 2013.

11.2: Dataset evaluation. Need for evaluation of climate data sets.
Conclusion: Datasets of many ECVs have to be derived by processing measurements from satellites or by combining measurements from various instruments. The algorithms for these purposes are not unique, and it is generally desirable to have more than one group deriving

global data sets for each ECV. A critical aspect of this strategy is to have a formal process for comparing and evaluating the products. WOAP noted that under the auspices of CEOS a number of climate variables related to ECVs are being derived from satellite data. The value of such global datasets is enhanced by the incorporation of a formal evaluation and comparison process, as recommended in the GCOS Implementation Plan. The most effective process is the establishment of working groups, such as the AOPC Working Group on SST and Sea Ice, to bring together the community of product developers and users to compare and evaluate the different data sets.
Recommendation: WOAP recommends that sponsors of the creation of ECV datasets should consider the creation of working groups, or mandating of existing working groups, to provide a continuing process to assure the quality and usefulness of data sets created by different groups. It noted that for satellite data records, the satellite supplement of the GIP had identified several existing groups that were well placed to participate in this process.

Sessions 12 and 13: Climate information and reflection on WCRP observation strategy

The need to frame WCRP activities in new ways arose from JSC 29 which reviewed WCRP progress to date and decided that in order for WCRP to remain relevant and well-funded, there would need to be an evolution, or "transition" in its activities that would reflect changing science priorities and societal needs. This programme development was seen to take place on two time horizons – to 2013 and beyond. For the intermediate term perspective the general consensus was that the strategy outlined in the so-called COPES (Coordinated Observation and Prediction of the Earth System) document is the desirable way forward. Consequently the JSC recommended that in the near term, crosscuts should be fully integrated in the projects' work and all aspects of WCRP work should be measured against the COPES strategy.

To focus the way forward in terms of the implementation of the COPES strategy for the intermediate term and to lead the way for planning post COPES, the JSC requested that the projects and modeling groups develop an implementation plan for the intermediate term. In this context, all of the core projects are asked to assess and identify what activities need to be further emphasized and which can be de-emphasized in the intermediate term. JSC also decided to prepare a document summarizing achievements of WCRP to date in implementing the COPES strategy. The aim is to have first draft of the Implementation plan and accomplishments document prepared in time for the next JSC meeting in first quarter of 2009.

In response to this, the draft document in Appendix 5 was prepared for consideration by members, and discussion occurred after K. Trenberth presented the framework of building a climate information system and the implications for WCRP and WOAP in terms of research. There was good discussion and seemed to be general acceptance on this conceptual framework, but it was recognized that the framework must come from the JSC.

Session 12 and 13 Issues

12.1: WCRP implementation plan. Need for WOAP to prepare contribution to the WCRP implementation plan.
Conclusion: The JSC has requested each steering group and panel to prepare an implementation plan, covering the short term and medium term (i.e. beyond 2013). As a background to such preparation, WOAP considered a future model for WCRP in which research components are associated with the elements needed to support climate information services. Care would need to be applied to ensure that the core global climate processes continue to be addressed adequately under an operationally-based structure for WCRP, in particular, that internationally-coordinated field studies continue to be organized as needed.

Session 14: Wrap up

T. Koike presented a monsoon cross cut across activities of WCRP and the time line, that would lead to comprehensive global datasets.

The main issues and recommendations developed throughout the meeting were reviewed.

14 *Recommendation*: presentations will be put on WOAP website.

The chair thanked everyone for attending and their participation, and WOAP members thanked Lisa Butler for local support, and K. Trenberth for hosting the meeting.

Appendix 1: Agenda of WOAP III meeting

Third WCRP Observations and Assimilation Panel (WOAP) Meeting

NCAR, Boulder, CO, 29 September – 1 October 2008
Mesa Lab., Damon Room

Final Agenda (29 September 2008)

Session held under the auspices of the World Climate Research Programme (WCRP) and the Global Climate Observing System (GCOS).

Meeting Chair: Kevin Trenberth

Meeting objectives:
- Progress achieved during the last two years in relation to observations, especially space agencies, CEOS, interactions between GCOS and WCRP activities, and participation in GEOSS.
- Transition of WCRP projects and datasets beyond 2013
- Assess the activities and results of Task Group on Data Management and the Joint Working Group on Observational Data Sets for Reanalysis

Documents posted on the following web site:
http://www.wmo.ch/pages/prog/wcrp/AP_WOAP3.html

are indicated by *

Note times are for guidance only.

Day 1: Monday, 29 September 2008

0830: Assemble

0850

Session 1: **Opening of meeting**

1.1	Welcome and logistics *(Trenberth, Butler)*	*(5 mins)*
	(Organize group dinner; Tuesday)	
1.2	Opening remarks by Eric Barron (Director, NCAR)	*(15 mins)*
1.3	Introduction: "Everyone represents a group"	
1.4	Purpose of the Meeting and Adoption of the agenda *(Trenberth)*	*(15 mins)*
1.5	Conduct of meeting: Formation of Task groups (see Appendix)	*(5 mins)*
1.6	Report from WCRP Director (*Asrar)*	*(15 mins)*

0945

Session 2: **WOAP updates**

2.0	Report from the WOAP Chair (*Trenberth)*	*(10 mins)*
2.1	Review of activities since WOAP-II *(Trenberth)*	*(15 mins)*

IPCC update, Sydney meeting, Reanalysis conference, World Modeling Summit for Climate Prediction

2.2	Report from WCRP JSC: role of WOAP within WCRP (*Asrar, Busalacchi)*	*(15 mins)*
2.3	Discussion	*(5 mins)*

Reference documents: WOAP report to JSC, Reanalysis Conference statement*, Letter to CEOS*, World Modeling Summit for Climate Prediction*, EOS Conference Summary**
3/4 hour

1030- 1100 Break

1100

Session 3: **Reports from WCRP Groups**

3.1 Reports from WGCM and WGNE *(Meehl, Gauthier)* *(10 mins each)*
3.2 WMP, World Modeling Summit, issues for WOAP *(Shukla)* *(20 mins)*
3.3 Future perspectives from WCRP Projects *(10 mins each)*
(development of written position papers is encouraged):
CLIVAR *(Stammer)*
CliC *(Key)*
SPARC (*Savigny)*
CEOP *(Koike)*
GEWEX *(Rossow)*
3.4 Discussion on future directions *(10 mins)*

Reference papers: WGCM report to JSC, WGNE report to JSC*, World Modelling Summit for Climate Prediction*, CLIVAR report to JSC*, GEWEX report to JSC*, CliC report to JSC*, SPARC report to JSC**

1240- 1400 Lunch

1400

Session 4: **Coordination with GCOS and GEO**

(about 10-15 mins each)

4.1 Update on GCOS Activities *(GCOS provides slides, presented by Simmons)*
4.2 AOPC *(Simmons)*
4.3 OOPC *(Harrison)*
4.4 TOPC *(Famiglietti)*
4.5 Discussion on cryosphere observations and possible update on ECVs, per GCOS SC request (Action 37) *(Key)*
4.6 WMO Integrated Global Observing Systems (WIGOS) (*Menne*)
4.7 Report from GEO; GEO tasks *(Tanner)*

Reference papers: GCOS and Panels report to JSC, GCOS Implementation Plan in support of the UNFCCC*, Fourteenth Session of AOPC: Conclusions and Recommendations**
1.5 hours

1530- 1600 Break

1600

4.8 Discussion *(Manton) to be continued after session 9.* *(1 min)*

Session 5: **Space matters and relation with space agencies**

5.1 Letter to CEOS *(Trenberth)* *(10 mins)*
5.2 Responses, GCOS reactions *(Simmons, Harrison, Famiglietti)* *(10 mins)*
5.3 Regional / Specialized Satellite Centres for Climate Monitoring (R/SSC-CM) and GSICS *(A. Simmons)* *(15 mins)*
5.4 CEOS actions in response to GCOS and WCRP needs *(Petiteville)* *(10 mins)*
5.5 NPOESS follow-up and re-manifestation of climate instruments *(Tucker, Rossow)* *(15 mins)*
5.6 ESA Climate Initiative (Briggs*)* *(15 mins)*
5.7 Discussion *(15 mins)*

Reference papers: Letter to CEOS, Draft NRC – NPOESS Report**
1.7 hour

Session 6: **Review of action items**

Possible actions for WOAP on items and recommendations to WCRP and GCOS: discussion lead by *K. Trenberth*
Home Work (based on day's events)
20 mins

1800 END of DAY 1 *Reception*

Day 2: Tuesday, 30 September 2008

0830

Session 7: **Host Country (US) Activities**

(25 mins each)

7.1 Priorities of Global Observation and Products of the Climate Change Science Program *(Tucker)*
7.2 Other developments in CCSP related to WOAP (prioritizing observations, analysis, reanalysis, etc; *(Dole, MacDonald)*
7.3 US Perspective on WOAP *(Tucker)*
7.4 Discussion *(15 mins)*
Documents: CCSP Revised Research Plan, Scientific Assessment of the Effects of Global Change on the United States**
1.5 hour

1000

Session 8: **In situ issues**

(about 10 mins each)

8.1 Report of the Working Group on Surface Fluxes (WGSF) (*Liz Kent)*
8.2 WOAP contributions to the upcoming Ocean Obs '09 (Sept 2009)(*Harrison, Busalacchi*)
8.3 Other issues *(5- 10 mins)*
Reference papers: WGSF project reports, Voluntary Observing Ships (Kent et al)*, AOPC-XIII recommendations on VOS**
½ hour

1030- 1100 Break

Session 9: **Data activities**

9.1 Report from Task Group on Data Management *(H. Cattle)* *(30 mins)*
9.2 CEOP perspectives (Koike) *(15 mins)*
9.3 WMO Information System *(Don Middleton)* *(15 mins)*
9.4 Transition of WCRP Projects beyond 2013: legacy, issues arising *(10 mins each)*
9.4.1 CLIVAR *(Stammer)*
9.4.2 GEWEX *(Rossow)*
9.4.3 SPARC *(Savigny)*

1230-1400 LUNCH

9.4.4 CliC *(Key)*
9.4.5 WGSF *(Kent)*
9.4.6 Modeling groups *(Meehl)*
9.5 Web sites *(15 mins)*
9.6 Recommendations, actions *(15 mins)*
2.5 hours

Session 4 **continued*:*** **Coordination with GCOS and GEO**
4.8 Discussion *(Manton)* *(20 mins)*

Focus on participation of WCRP to GCOS IP, Joint GCOS-WOAP actions under way or required.

1520
Session 10: **Reanalyses**

10.1 Report from the 3rd WCRP International Conference on Reanalysis, 28 Jan – 1 Feb 2008, Tokyo, Japan *(Trenberth)* *(15 mins)*

1535- 1600 BREAK

10.2 Atmospheric reanalyses: an update *(Simmons)* *(15 mins)*
10.3 Ocean, cryosphere reanalyses *(J. Key)* *(20 mins)*
10.4 Coupled reanalyses/ assimilation of atmosphere, ocean, sea-ice, and land surface data, "seamless" predictions *(P. Gauthier)* *(15 mins)*
10.5 Report from Reanalyses WG and discussion of follow-up actions *(Vose)* *(25 mins)*
10.6 Discussion *(10 mins)*
Reference papers: Third international reanalysis conference statement, letter to reanalyses agencies*, EOS article**

1725: Discussion / Meeting of Task Groups

18.00 END of DAY 2

Group Dinner at Laudisio's restaurant, 29th Street Mall (within walking distance of hotel) **http://www.laudisio.com/**

Day 3: Wednesday, 1 October 2008

0830

Session 11: Reprocessing

11. 1 Report from GEWEX on progress summarizing the status with regard to activities related to reprocessing, including variables suitable for reprocessing (need, readiness), activities definitely planned, and funding and commitments already obtained and required.
(W. Rossow; expect input from Kummerow) *(30 mins)*
11.2 CEOS reprocessing activities (*Petiteville)* *(30 mins)*
11.3 Additional comments by project reps *(40 mins)*
11.4 Actions and recommendations to advance this activity *(20 mins)*
2 hours

1030- 11.00 BREAK

Session 12: **Climate Information**

12.1 Developing climate information and services *(lead by K. Trenberth)* *(15 mins)*
12.2 Discussion *(15 mins)*
*Reference paper: Observational needs for climate prediction and adaptation by Trenberth in WMO Bulletin**
½ hour

1130

Session 13: **Reflection on WCRP observation strategy**

13.1 Main issues: introduction by *Trenberth*
(Priorities: in situ networks, longer-term space observations, analysis, products)
13.2 Items carried over

1 hour

1230-1400 LUNCH Tasks groups lunch together

Session 14: Reports by task groups formed during meeting

Other Business

- Next meeting
- Intra-sessional activities
- JSC meeting
- Third World Climate Conference

Close of the meeting: around 3 P.M.

Appendix: PROPOSAL FOR TASK GROUPS for this meeting

1/ Data matters: datasets, data management, legacy, reprocessing (session 9)
Manton (chair), Vose, Cattle, Koike, Rossow, Savigny

2/ Current and future data: space observations, CEOS interactions, in situ (session 5)
Key (chair), Kent, Petiteville, Famiglietti

3/ Reanalyses and attribution: recommendations for follow-on actions, joint WG with GCOS on data for reanalysis (session 10)
Simmons (chair), Shukla, Stammer, Gauthier, Vose

4/ GEO/GCOS items (session 4)
Tanner, Meehl, Harrison

Appendix 2: List of participants

Chair:	**Kevin Trenberth** National Center for Atmospheric Research (NCAR) trenbert@ucar.edu
Rapporteur:	**Mike Manton** Monash University Michael.Manton@sci.monash.edu.au
WMP:	**Jagadish Shukla** (Chair modeling panel) George Mason University shukla@cola.iges.org
CliC:	**Jeffrey Key** NOAA/NESDIS jkey@ssec.wisc.edu
CLIVAR:	**Detlef Stammer** University of Hamburg stammer@ifm.zmaw.de
GEWEX:	**William Rossow** City University of New York wbrossow@gmail.com
SPARC:	**Christian von Savigny** University of Bremen csavigny@iup.physik.uni-bremen.de
WGCM:	**Jerry Meehl** NCAR meehl@ucar.edu
WGNE:	**Pierre Gauthier** L'Université du Québec à Montréal pierre.gauthier@ec.gc.ca
WGSF:	**Elizabeth Kent** Southampton Oceanography Centre eck@soc.soton.ac.uk)
CEOP	**Toshio Koike** University of Tokyo tkoike@hydra.t.u-tokyo.ac.jp
AOPC:	**Adrian Simmons** ECMWF adrian.simmons@ecmwf.int
OOPC:	**Ed Harrison** NOAA D.E.Harrison@noaa.gov
TOPC:	**James Famiglietti** University of California, Irvine jfamigli@uci.edu
IGBP:	**Michael Tjernström (not present)** Stockholm University michaelt@misu.su.se
CEOS-SIT:	**Ivan Petiteville** CEOS Ivan.Petiteville@esa.int

Ghassem Asrar (D/WCRP, GAsrar@wmo.int**)**
Antonio Busalacchi (ESSIC, Chair JSC, tonyb@essic.umd.edu)
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Don Middleton (NCAR, WIS, don@ucar.edu)
Stephen Briggs (ESA**,** stephen.briggs@esa.int)
Howard Cattle (CLIVAR, coChair TGDM, hyc@noc.soton.ac.uk)
Russell Vose (NCDC, Chair WGODR, Russell.Vose@noaa.gov)
Matthew Menne (NCDC, WIGOS, Matthew.Menne@noaa.gov)
Michael Tanner (GEOSEC, MTanner@geosec.org)
Eric Barron (D/NCAR, barron@ucar.edu)

Appendix 3: All Documents of the meeting are available for downloading at http://wcrp.wmo.int/AP_WOAP3_docs.htm

Session-1 Documents:

- Agenda (word)

Session-2 Documents:

- GCOS WCRPLetter to CEOS 2008
- Third WCRP Reanalysis Conference Statement
- WOAP Report to JSC
- World Modelling Summit
- EOS Conference Summary: progress and Prospects for Reanalysis for Weather and Climate

Session-3 Documents:

- CLIVAR
- CliC
- GEWEX
- SPARC
- WGCM
- WGNE
- World Modelling Summit

Session-4 Documents:

- GCOS Implementation Plan
- GCOS report to JSC
- AOPC - XIV Conclusions and Recommendations (GCOS-122)

Session-5 Documents:

- GCOS WCRP Letter to CEOS 2008
- Draft NRC-NPOESS Report

Session-7 Documents:

- US Scientific Assessment
- CCSP Revised Research Plan for US

Session-8 Documents:

- AOPC Recommendation VOS
- Voluntary Observating Ships report to AOPC
- WGSF

Session-9 Documents:

- Membership of the TGDM
- Task Group on Data Management - First Report
- Comments by Bob Keeley

Session-10 Documents:

- EOS Article on Reanalysis
- Third WCRP Reanalysis Conference Statement
- WCRP Reanalyses Letter

Session-12 and Session-13 Documents:

- Article by K. Trenberth in January 2008 WMO Bulletin
- WCRP Implementation Plan
- WOAP information system document

Appendix 4: Letter to Chair of CEOS

9 September 2008

Dear Ms Mary E. Kicza

I am writing to you in your capacity as chairperson of CEOS and in my capacity as Chair of the WCRP Observations and Assimilation Panel (WOAP). We are having a WOAP meeting here in Boulder in late September (a draft agenda is attached). A major concern of WOAP has been the generation of climate quality data records, both in terms of the future observations and by reprocessing past data. A letter prepared earlier this year by WOAP and sent out to CEOS under the signatures of the Chairs of the Joint Scientific Committee overseeing WCRP and the Steering Committee of GCOS (also attached) highlights the ongoing concerns.

We have recently learned that Mitch Goldberg has called a meeting for Nov 17-19 in Washington to discuss making Climate Data Records (CDRs), and apparently the meeting is under the auspices of CEOS? Our concern is that we have only just heard about this and there seems to have been no consultation with other groups who are involved in this kind of activity, including perhaps other NOAA scientists in NCDC? A related concern is that the organizing committee for this "international" meeting is supposedly almost totally composed of NOAA employees that work for Mitch. I have only heard this second hand, but I wonder whether there is indeed adequate representation from other parts of NOAA or any other US agency, or any foreign participation? It is also important to recognize the previous processing of climate records and ongoing attempts to reprocess some of these, especially under the banner of the GEWEX Radiation Panel in WCRP and other WCRP projects, as well as GCOS.

You will see that we have the topic of reprocessing on the WOAP agenda on 1 October under session 11, and item 11.2 is supposed to be about both ESA and CEOS activities. It would help us, and maybe CEOS, if we could help coordinate activities related to this vital activity.

Thanks for any insights you can provide.

Kevin E Trenberth
Chair
WCRP Observations and Assimilation Panel.
For more information about WOAP, please see the WOAP web page:
http://www.wmo.ch/pages/prog/wcrp/AP_WOAP.html
and the principles we have developed for reprocessing as in the following
http://wcrp.ipsl.jussieu.fr/Documents/WOAP/ReprocessingPrinciples.pdf

Appendix 5: Climate information and the WCRP observation strategy

The need to frame WCRP activities in new ways arose from JSC 29 which reviewed WCRP progress to date and decided that in order for WCRP to remain relevant and well-funded, there would need to be an evolution, or "transition" in its activities that would reflect changing science priorities and societal needs. This programme development was seen to take place on two time horizons – to 2013 and beyond. For the intermediate term perspective the general consensus was that the strategy outlined in the so-called COPES (Coordinated Observation and Prediction of the Earth System) document is the desirable way forward. Consequently the JSC recommended that in the near term, crosscuts should be fully integrated in the projects' work; all aspects of WCRP work should be measured against the COPES strategy.

To focus the way forward in terms of the implementation of the COPES strategy for the intermediate term and to lead the way for planning post COPES, the JSC requested that the projects and modeling groups develop an **implementation plan** for the intermediate term. In this context, all the core projects are asked to assess and identify what activities need to be further emphasized and which can be de-emphasized in the intermediate term.

JSC also decided to prepare a document summarizing **achievements** of WCRP to date in implementing the COPES strategy. The aim is to have first draft of the Implementation plan and accomplishments document prepared in time for the next JSC meeting in first quarter of 2009. Material is due at the end of the year.

The following are the suggestions from WOAP:

To develop an actionable approach to understanding, questions may be posed as:

1) What and how are activities contributing to improvement of models and model development, such as through improved knowledge and understanding of processes?

2) What and how are activities contributing towards developing a climate information system, with optimization of observations, analysis, attribution, diagnostics and assessment?

Because global warming is "unequivocal", to quote IPCC, adaptation to climate change is essential and in fact an imperative. This means there must be ongoing activities to:

- Assess vulnerability
- Devise coping strategies
- Determine impacts of possible changes
- Plan for future changes

The key point is that this requires climate information. *WCRP should play a major role in building a new climate information system.* As such the following apply.

Future needs: Observations and Analysis

- Observations: in situ and from space (that satisfy the climate observing principles);
- A performance tracking system;
- Climate Data Records (CDRs)
- The ingest, archival, stewardship of data, data management;
- Access to data
- Data processing and analysis
- The analysis and reanalysis of the observations and derivation of products,
- Data assimilation and model initialization

Future needs: Models

- Data assimilation and model initialization
- Better, more complete models
- Assessment of what has happened and why (attribution) including likely impacts on human and eco-systems;
- Prediction of near-term climate change over several decades: ensembles
- Statistical models: applications
- Downscaling, regional information
- Responsiveness to decision makers and users.

An Imperative: A climate information system

- Observations: forcings, atmosphere, ocean, land
- Analysis: comprehensive, integrated, products
- Assimilation: model based, initialization
- Attribution: understanding, causes
- Assessment: global, regions, impacts, planning
- Predictions: multiple time scales
- Decision Making: impacts, adaptation

The details on how WCRP contributes to each of these overarching objectives are given in the Appendix and a schematic of the information system is given in Fig. 1.

Climate Information System: WOAP role

- Advocating improved observations and analysis suitable for climate (satisfying the climate principles that are designed to ensure continuity of record). This especially includes those from space.
- Data set development: evaluating observations and promoting their reprocessing and reanalysis into global fields. Developing new products and datasets.
- Developing analytical and diagnostic techniques to process observations and model data. Developing new products and datasets, often high level derived products, for use in understanding and analyzing climate variability and change, and for evaluating models.
- WCRP scientists have carried out many studies on mechanisms and modes of variability that have contributed to observed climate anomalies. This helps develop capabilities that contribute to an operational attribution activity by pioneering studies and numerical experimentation that might be used in near real time to allow reliable statements to be made not only about what the state of the climate is, but also why it is the way it is and the mechanisms involved. Studies involve the atmosphere and the fully coupled system.
- Improving initializing of coupled models for prediction
- Satisfying modeler's needs on observations to improve predictions
- Making data available through the internet.

Appendix

Observations

WCRP advocates improved observations and analysis suitable for climate (satisfying the climate principles that are designed to ensure continuity of record). This especially includes those from space.

WCRP evaluates observations and promotes their reprocessing and reanalysis into global fields.

Analysis

WCRP develops analytical and diagnostic techniques to process observations and model data, and facilitates their comparison and evaluation. Value-added derived products are developed and archived and new datasets are made available.

Assimilation

WCRP/WOAP advocates analysis of observations into forms suitable for use in models and to initialize models. Assimilation enables reanalysis and model diagnostics that can be compared with observations to evaluate and improve the models.

Attribution

WCRP has carried out many studies on mechanisms and modes of variability that have contributed to observed climate anomalies. WCRP helps develop capabilities that contribute to an operational attribution activity by pioneering studies and numerical experimentation that might be used in near real time to allow reliable statements to be made not only about what the state of the climate is, but also why it is the way it is. Studies involve the atmosphere and the fully coupled system.

Assessment

WCRP uses the information from the analyses and other products to assess the state of the climate.

Scientists participate in international (IPCC) assessments.

Prediction and predictability

Predictions are required on multiple time scales and it is evident from the inertia in the climate system and the forcings that there is some predictability associated with the initial state of the climate. Studies are carried out to assess the predictability associated with the initial state and thermal inertia, modes of variability, internal mechanisms and coupling among climate system components, and forcings. Evaluations of model strengths and weaknesses, possible improvements, comparisons among models and with observations and evaluations to score their results in multi-model ensembles are underway. Scientists are also involved in regional climate model studies using embedded models in order to adequately represent scales of motion thought to be important.

Decision making

WCRP contributes to how to reduce vulnerability and what the impacts will likely be associated with climate variability and change that in turn contribute to adaptation and risk assessment, such as to ecosystems, water resources, and communities.

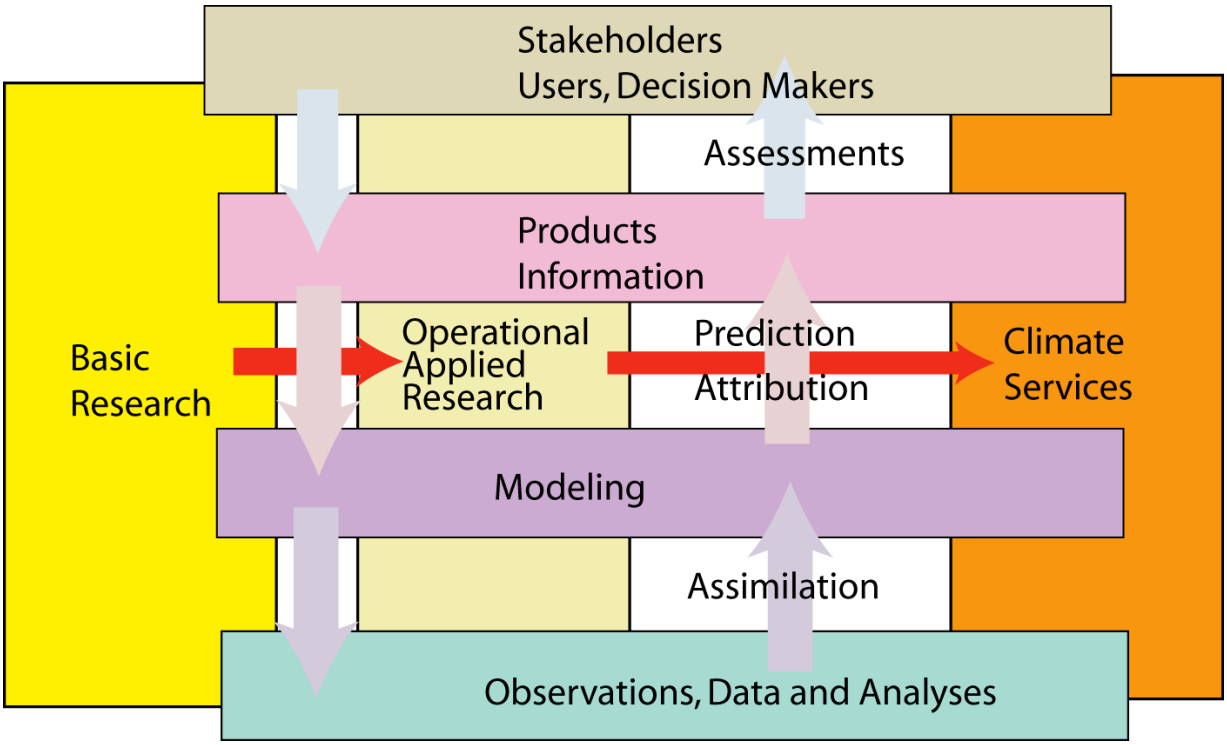

Fig. 1. The above constitutes schematically all of the Climate Information System, including the basic research, the transition of the research into operations, and the delivery of climate services. The vertical flows depict the essential basic activities starting from the observations and their use and development into products, attribution and prediction, assessments, and interactions with stakeholders and users to accommodate their needs as best possible. WCRP is engaged in all but the delivery of climate services.
From: Trenberth, K. E., 2008: Observational needs for climate prediction and adaptation. *WMO Bulletin*, **57** (1), 17-21.
http://www.cgd.ucar.edu/cas/Trenberth/trenberth.papers/WMO-BullJan08.pdf

Appendix 6: Acronyms

AIMES	ANALYSIS, INTEGRATION AND MODELING OF THE EARTH SYSTEM
AMIP	ATMOSPHERIC MODEL INTERCOMPARISON PROJECT
AOPC	ATMOSPHERIC OBSERVATION PANEL FOR CLIMATE
AR4	IPCC FOURTH ASSESSMENT REPORT
AR5	IPCC FIFTH ASSESSMENT REPORT (TO COME IN 2013)
AVHRR	ADVANCED VERY HIGH RESOLUTION RADIOMETER (NOAA)
BSRN	BASELINE SURFACE RADIATION NETWORK
CALIPSO	CLOUD-AEROSOL LIDAR AND INFRARED PATHFINDER SATELLITE OBSERVATIONS
CBS	COMMISSION FOR BASIC SYSTEMS (WMO)
CCSP	U.S. CILMATE CHANGE SCIENCE PROGRAM
CDR	CLIMATE DATA RECORD
CEOP	COORDINATED ENERGY AND WATER CYCLE OBSERVATIONS PROJECT
CEOS	COMMITTEE ON EARTH OBSERVATION SATELLITES
CFC	CHLOROFLUOROCARBON
CFSRR	CLIMATE FORECASTING SYSTEM REANALYSIS AND REFORECAST
CGMS	COORDINATION GROUP FOR METEOROLOGICAL SATELLITES
CliC	CLIMATE AND CRYOSPHERE PROJECT (WCRP)
CLIVAR	CLIMATE VARIABILITY AND PREDICTABILITY PROJECT (WCRP)
CMIP	COUPLED MODEL INTERCOMPARISON PROJECT
COP	CONFERENCE OF THE PARTIES (TO UNFCCC)
COPES	COORDINATED OBSERVATION AND PREDICTION OF THE EARTH SYSTEM (WCRP)
DAAC	DISTRIBUTED ACTIVE ARCHIVE CENTER (NASA)
DMSP	DEFENSE METEOROLOGICAL SATELLITE PROGRAM (USA)
ECMWF	EUROPEAN CENTRE FOR MEDIUM-RANGE WEATHER FORECASTS
ECV	ESSENTIAL CLIMATE VARIABLE (AS DEFINED BY GCOS-82)
ENVISAT	ENVIRONMENTAL SATELLITE (ESA)
EOL	NCAR'S EARTH OBSERVING LABORATORY
ERA	ECMWF RE-ANALYSIS PROJECT
ESA	EUROPEAN SPACE AGENCY
GCM	GENERAL CIRCULATION MODEL
GCOS	GLOBAL CLIMATE OBSERVING SYSTEM
GCW	GLOBAL CRYOSPHERE WATCH
GEO	GROUP ON EARTH OBSERVATIONS
GEOSS	GLOBAL EARTH OBSERVATION SYSTEM OF SYSTEMS
GEWEX	GLOBAL ENERGY AND WATER CYCLE EXPERIMENT (WCRP)
GHP	GEWEX HYDROLOGICAL PROGRAM
GIP	GCOS IMPLEMENTATION PLAN
GMPP	GEWEX MODELING PANEL
GODAE	GLOBAL OCEAN DATA ASSIMILATION EXPERIMENT
GOES	GEOSTATIONARY OPERATIONAL ENVIRONMENTAL SATELLITE (NOAA)
GOME	GLOBAL OZONE MONITORING EXPERIMENT
GOMOS/ENVISAT	GLOBAL OZONE MONITORING BY OCCULTATION OF STARS
GOOS	GLOBAL OCEAN OBSERVING SYSTEM
GPCP	GLOBAL PRECIPITATION CLIMATOLOGY PROJECT
GRACE	GRAVITY RECOVERY AND CLIMATE EXPERIMENT
GRP	GEWEX RADIATION PANEL
GRP	GEWEX Radiation Panel
GRUAN	GCOS REFERENCE UPPER-AIR NETWORK
GSC	GCOS STEERING COMMITTEE
GSICS	GLOBAL SPACE-BASED INTERCALIBRATION SYSTEM
GSOP	GLOBAL OBSERVATIONS AND SYNTHESIS PANEL (WCRP CLIVAR)
GTOS	GLOBAL TERRESTRIAL OBSERVING SYSTEM

ICSU	INTERNATIONAL COUNCIL FOR SCIENCE
IGBP	INTERNATIONAL GEOSPHERE-BIOSPHERE PROGRAMME
IGOS	INTEGRATED GLOBAL OBSERVING STRATEGY
IPCC	INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE
ISCCP	INTERNATIONAL SATELLITE CLOUD CLIMATOLOGY PROJECT
JAXA	JAPAN AEROSPACE EXPLORATION AGENCY
JCOMM	JOINT WMO-IOC TECHNICAL COMMISSION ON OCEANOGRAPHY AND MARINE METEOROLOGY.
JMA	JAPANESE METEOROLOGICAL AGENCY
JRA	JAPANESE RE-ANALYSIS PROJECT
JSC	JOINT SCIENTIFIC COMMITTEE (WCRP)
LEO	LOW EARTH ORBIT
MERRA	MODERN ERA RETROSPECTIVE-ANALYSIS FOR RESEARCH AND APPLICATIONS (NASA)
MIPAS/ENVISAT	MICHELSON INTERFEROMETER FOR PASSIVE ATMOSPHERIC SOUNDING/ ENVIRONMENTAL SATELLITE
MISR	MULTIANGLE IMAGING SPECTRORADIOMETER
MLS	MICROWAVE LIMB SOUNDER (NASA)
MLS/AURA	AURA MICROWAVE LIMB SOUNDER (MLS)
MODIS	MODERATE RESOLUTION IMAGING SPECTRORADIOMETER (NASA)
NASA	NATIONAL AERONAUTICS AND SPACE ADMINISTRATION (USA)
NCAR	NATIONAL CENTER FOR ATMOSPHERIC RESEARCH
NCDC	NATIONAL CLIMATIC DATA CENTER (NOAA)
NCEP	NATIONAL CENTERS FOR ENVIRONMENTAL PREDICTION (NOAA)
NESDIS	NATIONAL ENVIRONMENTAL SATELLITE, DATA, AND INFORMATION SERVICE (NOAA)
NOAA	NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION (USA)
NPOESS	NATIONAL POLAR-ORBITING OPERATIONAL ENVIRONMENTAL SATELLITE SYSTEM
NPP	NPOESS PREPARATORY PROJECT
NRC	NATIONAL RESEARCH COUNCIL (USA)
NSIDC	NATIONAL SNOW AND ICE DATA CENTER (USA)
NWP	NUMERICAL WEATHER PREDICTION
NWS	NATIONAL WEATHER SERVICE (NOAA)
OMPS	OZONE MAPPPING and PROFILING SUITE
OOPC	OCEAN OBSERVATIONS PANEL FOR CLIMATE
OSIRIS/Odin	OPTICAL SPECTROGRAPH and INFRARED IMAGING SYSTEM on the Odin SATELLITE
R/SSC-CM	REGIONAL / SPECIALIZED SATELLITE CENTRES FOR CLIMATE MONITORING
SABER/TIMED	SOUNDING OF THE ATMOSPHERE USING BROADBAND EMISSION RADIOMETRY on the TIMED SATELLITE
SBSTA	SUBSIDIARY BODY FOR SCIENTIFIC AND TECHNOLOGICAL ADVICE (UNFCCC/COP)
SCIAMACHY	SCANNING IMAGING ABSORPTION SPECTROMETER FOR ATMOSPHERIC CARTOGRAPHY
SPARC	STRATOSPHERIC PROCESSES AND THEIR ROLE IN CLIMATE CHANGE (WCRP)
SSG	SCIENTIFIC STEERING GROUP
SSM/I	SPECIAL SENSOR MICROWAVE/IMAGER
SST	SEA-SURFACE TEMPERATURE
SURFA	SURFACE FLUX ANALYSIS PROJECT
TGDM	TASK GROUP ON DATA MANGEMENT (WOAP)
THORPEX	THE OBSERVING SYSTEM RESEARCH AND PREDICTABILITY EXPERIMENT
TIGGE	THORPEX INTERACTIVE GRAND GLOBAL ENSEMBLE
TIMED	THERMOSPHERE, IONOSPHERE, MESOSPHERE ENERGETIC AND DYNAMICS MISSION
TOPC	TERRESTRIAL OBSERVATION PANEL FOR CLIMATE

UNFCCC	UNITED NATIONS FRAMEWORK CONVENTION ON CLIMATE CHANGE
VOS	VOLUNTARY OBSERVING SHIP
WCRP	WORLD CLIMATE RESEARCH PROGRAMME
WDC	WORLD DATA CENTRE
WG	WORKING GROUP
WGCM	WORKING GROUP ON COUPLED MODELING (WCRP)
WGNE	WORKING GROUP ON NUMERICAL EXPERIMENTATION
WGSF	WORKING GROUP ON SURGACE FLUXES (WCRP)
WIGOS	WMO INTEGRATED GLOBAL OBSERVING SYSTEMS
WIS	WMO INFORMATION SYSTEM
WMO	WORLD METEOROLOGICAL ORGANIZATION
WMP	WCRP MODELING PANEL
WOAP	WCRP OBSERVATION AND ASSIMILATION PANEL
WWRP	WORLD WEATHER RESEARCH PROGRAMME