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ACTIONS AND RECOMMENDATIONS FROM THE SSG-14

(1) Preparation of a review paper highlighting achievements of GEWEX Phase 1.

(2) GEWEX has been since its beginning a major user of remotely sensed data and has provided guidance through the Director of WCRP to the space agencies on the needs for improved observations from space. GEWEX requirements have indeed served as a basis for the development of several key space missions in Earth Observation. GEWEX SSG has recommended reassessing the situation in view of space projects recently decided and under development.

(3) Improving the observation, understanding, and representation of processes that produce precipitation in all phases, with the objective to improve precipitation forecasts and their applications for the management of water resources. Among other things, this requires a joint reflection across GEWEX projects on the critical aspects of observation strategies, data processing and modelling with respect to both precipitation prediction and applications, and the development of methods for assessing precipitation observation and prediction at an appropriate scale, compatible with satellite and model data. This would also include the participation in a WCRP action to assess the skill of current models on simulating and forecasting precipitation at various space and time-scales. A working group cutting across GRP/GHP/GMPP to collectively address these issues has been proposed.

(4) Improving the simulation of global precipitation statistics and addressing the problem of the prediction of changes in precipitation statistics associated with climate variability and climate change. This issue, raised at SSG by Prof. P. Morel, implies a significant improvement of the simulation of the water cycle in climate models and is essential to predict practical consequences of climate variability and climate change. Research requirements include the development of a new generation of parameterisation schemes based among other things on cloud resolving models, the development of reliable methods to predict precipitation associated with weather events and the probability distribution of weather disturbances associated with various dynamical states of the global climate system.

(5) GEWEX SSG has endorsed a proposal from A. Hollingsworth to initiate the preparation by the WCRP community of the equivalent of a Second GARP Experiment (SGGE), but adapted to present WCRP priorities. A SGGE, which would take place roughly 30 years after F.G.G.E., would provide a valuable opportunity to take advantage of large progress in modelling of the Earth System and of the availability of a whole range of new environmental satellites in the period 2005-2010. Present initiatives covering the few coming years, such as CEOP, GODAE and THORPEX could be considered as preparatory for a co-ordinated weather-climate experiment which remains to be defined . The GEWEX community feels it has a key role to play in the initiation and preparation of such an undertaking.

(6) GRP is encouraged to continue on with its new approaches to addressing joint and integrated global data sets development, in order to respond to GEWEX phase II objectives. This should involve, among other things, a better integration of satellite and other sources of data into the analysis products, the exploitation of new satellite information, and the establishment of better working connections between the global satellite projects, the hydro-meteorology groups and the GMPP modelling groups. Plans for a reorganisation of global data projects are under discussion and will be submitted to 2003 SSG.

CEOP should serve as an example and a test bed within WCRP community on the issue of international exchange of data and scientific products between agencies and research organisations, and for the development of global data sets which can be used as a reference by scientists in a variety of disciplines.

GEWEX SSG welcomed the proposal for a WCRP workshop on the general issue of co-ordination of data management activities.

(7) GEWEX SSG has agreed to pursue the reflection on a specific action on climate research for arid and semi-arid regions, responding to the request of Arab States and building upon existing expertise.

(8) GEWEX SSG has expressed concern over the continued development by many projects (outside of GEWEX) of ground sites for in-situ and remote measurements at diverse locations without looking for a minimum of scientific and logistics co-ordination. Substantial benefits could be gained by promoting such a co-ordination.

(9) Participation of GEWEX in the Arctic HYCOS programme for the monitoring of arctic hydrological basins.

(10) Organisation of a joint workshop with WGCM on cloud-radiation feedback.

(11) Organisation in the first half of 2003 of a joint workshop with CLIVAR on modelling for monsoon environments.

(12) Approval of Murray-Darling as a new continental-scale experiment.

(13) Recommendation of an increased co-operation between CEOP and the NWP community.

(14) Pursuing the preparation of a Joint Water Project with the ESSP programmes and confirming Dennis Lettenmaier as the WCRP representative on the scoping team.

(15) Strengthening horizontal activities within GHP and support to the organisation of specific workshop by WEBS and WRAP projects.

(16) GEWEX SSG has endorsed a proposal to establish a more formal relationship with AMIP in order to take part in the planning and evaluation of experiments, assuming that the funding for this activity will be maintained;

(17) Participation of GEWEX to a ECMWF workshop to be taking place in July on the "assimilation of water variables" and organisation of a specific workshop at the beginning of 2003 on the assimilation of precipitation data.

1. INTRODUCTION

This report summarises the main items and recommendations from the fourteenth session of the GEWEX scientific committee kindly hosted by ECMWF in Reading, 28-31 January 2002.

2001 has been a year of transition for GEWEX between phase I leading to the GEWEX Conference in Paris in September and phase II based on a few revised principles and guidelines which have been appropriated by the GEWEX community. These principles which were proposed by SSG-13 and refined by JSC-22 now underlie the activity of the three main thrusts of the programme, radiation, hydrology and modelling, and the new initiative CEOP (co-ordinated enhanced observing period). This resulted in an increased co-ordination between the various activities within the programme and an effort to better take into account synergies and possible overlaps between GEWEX and the other WCRP programmes and modelling panels.

The positioning of GEWEX with respect to programmes or initiatives including partners outside WCRP was also considered as a major item. This presently includes WWRP, WCP Water, the WCRP-IGBP-IHDP joint projects on food, carbon and water and the IGOS Partners Water Cycle theme.

There is a continuing effort to keep close relationship with space agencies programmes, with the participation this time of ESA, NASA, NASDA and NOAA, and with main modelling centres, with the participation this time of ECMWF, NASA/DAO and NCEP.

Finally the start of GEWEX phase II was the occasion to have a debate on how to increase the scientific efficiency and visibility of the GEWEX effort and on the need to take a leading role in the organisation of a new global experiment by the end of the decade.

2. TRANSITION FROM GEWEX PHASE I TO PHASE II AND MAIN RECOMMENDATIONS FROM SSG

2.1 Overview

Main achievements of GEWEX phase I were highlighted in the Paris Conference which was held on 10-14 September at College de France with a participation of about 250 scientists from 20 countries. Many of GEWEX accomplishments were reported on the whole range of scientific areas covered by the programme. This includes the understanding of cloud processes, their representation in models and their role in the general circulation, ground hydrology and its interaction with the atmosphere, the interaction between the atmosphere and the biosphere, the global water cycle and its sensitivity to climate change, and the large input from research satellites. The Conference demonstrated the rapid advancement in our understanding of the global energy and water cycle and its role in climate. Main issues are summarised in GEWEX Newsletter dated November 2001 (see Appendix E).

In addition to key scientific results, it has been acknowledged that GEWEX has been particularly successful in bringing together scientists from various disciplines to work on the global energy and water cycle, in fostering co-operation between the scientific community and environmental space agencies, in transferring research results to operational centres, and in transferring knowledge to water resource managers. Achievements of GEWEX phase I will be presented in a summary paper in preparation.

Guiding goals for GEWEX phase II have been expressed by JSC-22 as follows:

- production of consistent descriptions of the Earth's energy budget and water cycle and their variability and trends, and data sets for the validation of models;
- enhancing the understanding of how energy and water cycle processes contribute to climate feedbacks;
- developing improved parameterisations encapsulating these processes and feed-backs for atmospheric circulation models;
- interacting with the wider WCRP community in determining the predictability of energy and water cycles;
- interacting with the water resource and applications communities to ensure the usefulness of GEWEX results.

These guidelines serve as a general orientation for the evolution or co-ordination of on-going projects and as a basis for the start of new initiatives, as can be seen throughout this report. To take a few examples: the first one is underlying the new orientations of global data sets and the planning of CEOP; the second and third one inspire the increasing modelling activity of GEWEX in close co-ordination with WGNE and WGCM; the fourth one is for example taken into account in the evolution of continental scale experiments and the fifth one serves as a guiding principle for hydro-meteorology activities.

2.2 Interaction between GEWEX and other programmes

(i) With other WCRP programmes:

The necessary interaction between GEWEX and other WCRP programmes proceeds from the above guidelines:

- The interaction with CLIC has been well defined at the start of this new programme and does not seem to pose any specific problem. To take a few examples: CLIC is involved in some of the Continental Scale Experiments and in CEOP; GEWEX co-sponsors with CLIC a workshop on cold region precipitation which is organised in Fairbanks in June 2002; GEWEX SSG has endorsed a participation of GEWEX in the Arctic HYCOS programme for the monitoring of arctic hydrological basins.

- The interaction with SPARC is significant in the domains of water vapor transport of troposphere-lower stratosphere interface and of the radiative effects of stratospheric aerosols.

GRP has kept informed about SPARC activities; two current members of the GRP have participated directly in radiative transfer and aerosol activities (Ramaswamy) and water vapor (Bates). GACP is planning a specific re-processing of its aerosol data to remove the stratospheric component; if that separation works, then ISCCP may re-process the cloud data to remove the effects of stratospheric aerosol.

- Interaction with CLIVAR has been clear since the start of this programme; two subjects deserve particular attention, the predictability and variability of monsoon systems and the cloud-climate feedback.

Quantification of the components of regional water cycles over land surfaces is one of the keys for understanding monsoon dynamics and reciprocally the forecast of monsoon systems is essential to forecast precipitation variability. Most Continental Scale Experiments are involved in studies which are directly relevant to CLIVAR projects and GEWEX/CLIVAR co-operation is underlying the second main objective of CEOP (Monsoon systems studies). If one considers the various regional experiments, GAPP is a partner in the North American Monsoon Experiment NAME; the Plata Basin experiment in preparation can be considered as a future joint GEWEX/CLIVAR experiment; a CEOP Asian-Australian Monsoon Project (CAMP) has been jointly established between GEWEX and CLIVAR communities; a joint CLIVAR-GEWEX West African Monsoon Experiment is in preparation with CATCH activity being one of its components. In addition GEWEX modelling community will be involved in the preparation for the first half of 2003 of a workshop on “modelling for monsoon environments” mainly organised by CLIVAR.

In order to address the key problem of cloud-climate feedback, the GEWEX Radiation Panel and GMPP are organising a workshop (tentatively planned for October 2002 in Boulder) with participation of WGCM.

(ii) As part of WCRP modelling activities and relations between WCRP and NWP centres:

Implication of GEWEX in WGNE activities is increasing as modelling is progressing within GEWEX radiation and hydro-meteorology communities and close co-ordination is kept between GMPP and WGNE, their steering committees being held together. Interaction with global modelling centres is encouraged. A few examples are given below:

- Each GEWEX modelling panel explicitly takes into consideration the development of improved parameterisations and their validation as one of their major objectives, this includes mainly the parameterisation of clouds, radiative fluxes, boundary layer and land-surface properties;
- GEWEX SSG has endorsed a proposal to establish a more formal relationship with AMIP in order to take part in the planning and evaluation of experiments, assuming that the funding for this activity will be maintained;

- Close interaction with NWP community is considered as part of CEOP objectives, including exchange of data and the validation of model forecasts, with emphasis on cloud and precipitation forecast;
- GEWEX will co-sponsor a workshop being planned by ECMWF in July 2002 on assimilation of atmospheric water variables.

(iii) Within WMO:

Interaction with two specific WMO programmes has been considered and welcome by GEWEX SSG-14, WCP Water and WWRP.

- WCP Water established to promote hydrological activities in the World Climate Programme is interested in the applications of GEWEX results to the management of water resources and particularly the development of WRAPS activities as described below.

- The World Weather Research Programme (WWRP) develops several projects relevant to GEWEX objectives, in particular THORPEX aimed at improving the predictability of temperate cyclones in the northern hemisphere, MEDEX to improve forecasts of severe weather in the Mediterranean basin, and a specific project on the improvement of precipitation forecasts over continents.

(iv) As part of joint projects:

- GEWEX is involved in the three joint IGBP/IHDP/WCRP projects on food, carbon and water, with a particular emphasis on the third one where the hydrometeorology community should have a leading role. This should be ensured by the participation of Denis Lettenmaier and Harry Lins as WCRP delegates in the scoping team for this action that will hold its first planning workshop in May 2002 in Paris.

- GEWEX is also active in the development of the IGOS Partners theme on “Integrated Global Water Cycle Observations” under WCRP leadership, with Rick Lawford as proposed Chair. This is seen as one way to respond to a clear need of co-ordination between space agencies and the “users” community, but this does not replace direct contacts as mentioned below.

(iv) Relationship with space agencies:

GEWEX has been since its beginning a major user of remotely sensed data and has provided guidance through the Director of WCRP to the space agencies on the needs for improved observations from space. GEWEX requirements have indeed served as a basis for the development of several key space missions in Earth Observation. GEWEX SSG has recommended reassessing the situation in view of space projects recently decided and under development.

2.3 General scientific orientation of GEWEX

The general orientation of GEWEX effort has been the object of extensive discussions at SSG with emphasis on two complementary aspects, which, at least for the second one, imply a dialogue with other WCRP components:

- Improving the observation, understanding, and representation of processes that produce precipitation in all phases, with the objective to improve precipitation forecasts and their applications for the management of water resources. Among other things, this requires a joint reflection across GEWEX projects on the critical aspects of observation strategies, data processing and modelling with respect to both precipitation prediction and applications, and the development of methods for assessing precipitation observation and prediction at an appropriate scale, compatible with satellite and model data. This would also include the participation in a WCRP action to assess the skill of current models on simulating and forecasting precipitation at various space and time-scales. A working group cutting across GRP/GHP/GMPP to collectively address these issues has been proposed.

- Improving the simulation of global precipitation statistics and addressing the problem of the prediction of changes in precipitation statistics associated with climate variability and climate change. This issue, raised at SSG by Prof. P.Morel, implies a significant improvement of the simulation of the water cycle in climate models and is essential to predict practical consequences of climate variability

and climate change. Research requirements include the development of a new generation of parameterisation schemes based among other things on cloud resolving models, the development of reliable methods to predict precipitation associated with weather events and the probability distribution of weather disturbances associated with various dynamical states of the global climate system.

Apart from this discussion on the general orientation of the programme, GEWEX SSG has endorsed a proposal from A. Hollingsworth to initiate the preparation by the WCRP community of the equivalent of a Second GARP Experiment (SGGE), but adapted to present WCRP priorities. A SGGE, which would take place roughly 30 years after F.G.G.E., would provide a valuable opportunity to take advantage of large progress in modelling of the Earth System and of the availability of a whole range of new environmental satellites in the period 2005-2010. Present initiatives covering the few coming years, such as CEOP, GODAE and THORPEX could be considered as preparatory for a co-ordinated weather-climate experiment which remains to be defined . The GEWEX community feels it has a key role to play in the initiation and preparation of such an undertaking.

2.4 Other recommendations of GEWEX SSG

Specific recommendations made by GEWEX SSG and not covered above are summarised here:

- CEOP, which is now under way, should serve as an example and a test bed within WCRP community on the issue of international exchange of data and scientific products between agencies and research organisations, and for the development of global data sets which can be used as a reference by scientists in a variety of disciplines. GEWEX SSG welcomed the proposal for a WCRP workshop on the general issue of co-ordination of data management activities.

- GEWEX SSG has agreed to pursue the reflection on a specific action on climate research for arid and semi-arid regions, responding to the request of Arab States and building upon existing expertise.

- GRP is encouraged to continue on with its new approaches to addressing joint and integrated global data sets development, in order to respond to GEWEX phase II objectives. This should involve, among other things, a better integration of satellite and other sources of data into the analysis products, the exploitation of new satellite information, and the establishment of better working connections between the global satellite projects, the hydro-meteorology groups and the GMPP modelling groups. Plans for a reorganisation of global data projects are under discussion and will be submitted to 2003 SSG.

- GEWEX SSG has expressed concern over the continued development by many projects (outside of GEWEX) of ground sites for in-situ and remote measurements at diverse locations without looking for a minimum of scientific and logistics co-ordination. Substantial benefits could be gained by promoting such a co-ordination.

- With respect to personal nominations, the only change to be mentioned this year is the appointment of Jan Polcher as Chair of GMPP, as of the beginning of 2003, in replacement of Dave Randall, recently nominated SSG member. Jan Polcher will remain Chair of GLASS until a successor is appointed at a later date.

- GEWEX SSG has endorsed a proposal to hold its next meeting in Bangkok 20-24 January 2003 and to hold the 5th GEWEX International Conference in Tucson in mid-June 2004.

3. HYDRO-METEOROLOGY

3.1 Overview

The hydrometeorology activity is co-ordinated by the GEWEX Hydrometeorology Panel (GHP) which held its 7th annual meeting in Paris in September 2001. Its mission, currently expressed as: "to improve the capability to predict variations in water resources and soil moisture on time scales of seasonal and annual as an element of WCRP's prediction goals for the climate system", is key to the goals of GEWEX phase II.

A crucial aspect of the overall strategy for GHP has been to carry out a number of regional research activities as a first step towards global application. In this regard, 5 continental-scale experiments (BALTEX, GAME, GCIP/GAPP, LBA and MAGS) as well as one affiliate experiment (CATCH) have been initiated. The first five

ones have made substantial progress and are now entering a more mature phase of their development following orientations of GEWEX Phase II and integrating their effort as part of CEOP. CATCH is progressing and should become soon part of a larger research programme dedicated to the African Monsoon, which should be formally submitted to the SSG next year. A new continental-scale experiment for the Murray-Darling basin has been proposed and accepted by SSG-14. Two efforts with strong ties to CLIVAR are also in the planning stages, NAME (part of GAPP), and the La Plata basin Study.

This endeavour collectively brings together an international group of about 500 researchers to address water and energy fluxes and reservoirs over various land areas. In each regional experiment, efforts have been mounted to acquire the necessary observations to characterise water and energy fluxes and reservoirs and to simulate these with appropriate atmospheric, land surface and hydrological models, as described below.

Carrying out the overall strategy for GHP has also led to the establishment of specific overarching projects and the development of several critical activities currently being carried out in a more ad-hoc manner, as described below.

In addition GHP was a driving force in the initiation and preparation of CEOP, described below, now endorsed by JSC and other international bodies as a key activity of GEWEX phase II.

Future directions for the hydrometeorology community can be expressed as follows:

- Existing regional projects, known as continental-scale experiments will pursue their development marked by a co-ordinated approach by hydrologists, land surface scientists and atmospheric scientists and the development of coupled models. Simultaneously, interaction between the various groups will be favoured through joint initiatives such as CEOP.
- A small number of new projects will be integrated in the GEWEX continental scale approach, this is the case for the already approved Murray-Darling Basin Water Balance Project, and may be the case in the near future for the proposed African monsoon experiment and a project on the Mediterranean basin
- The hydro-meteorology community will play a central role in the foreseen interaction between GEWEX and other programmes dealing with water related issues, as mentioned earlier in this report.

3.2 Continental scale experiments

1) The Baltic Sea Experiment (BALTEX)

The Baltic Sea Experiment (BALTEX) was established in 1992 to measure and model the energy and water cycles over the Baltic Sea and its catchment. Its purpose is to provide an improved understanding of the processes controlling the fluxes of water and energy into and out of the entire basin and to use such knowledge for establishing and improving coupled atmospheric, hydrological and ocean models for better weather forecasting, climate studies and climate prediction.

The scientific exploitation of phase I, initiated in 1992 and marked by a 3-month pilot observing period in1995 (PIDCAP), can now be considered as completed. It has served as a basis for an extensive model inter-comparison exercise and for the validation of new remote sensing applications. An overview of BALTEX achievements has been published in November 2001 (BAMS). A central observing period, known as BRIDGE, comprises a continuous series of additional observations at various sites over the period 2000-2002, including new types of data such as GPS water vapour column measurements, radar network and satellite cloud climatology products. Water budget studies for the entire Baltic region are available for limited periods and in progress for a full annual cycle. Several advanced modelling activities are presently conducted over the BALTEX area with in view a fully coupled atmosphere/land-surface/hydrology/sea/sea-ice regional model. A BALTEX phase II with enlarged objectives has now been initiated for the period 2002-2005, fully integrated in CEOP, including in addition research on seasonal predictability and regional climate change scenarios.

2) GEWEX Asian Monsoon Experiment (GAME)

The first phase of GAME has allowed the establishment of a precious observational network covering the main regions of interest for understanding the role of the Asian monsoon in the global energy and water cycle, namely a tropical monsoon region around the Bay of Bengal, the Tibetan Plateau, a large river basin in China, and a part of Siberia. It has also allowed to assemble co-ordinated data sets and analysed products and initiated a series of model studies. The proposed second phase, organised as part of

CEOP, has been prepared in co-operation with the CLIVAR monsoon panel under the acronym CAMP (CEOP Asia-Australia Monsoon Project). An implementation plan for CAMP has been established.

3) GEWEX Continental-scale Experiment (GCIP)/ GEWEX Americas Prediction Project (GAPP)

GCIP which, initiated in 1995, was the first of its kind, is now completed and its achievements will be presented in May 2002 in New Orleans. The GCIP data set comprises a unique ensemble of high resolution precipitation data, including gage and radar rain observations, high resolution hydrological data, as well as soil moisture and radiation data at selected sites. Significant accomplishments have been realised in three main areas: the closure of water and energy budget over the Mississippi basin, the identification of land surface processes that are important in forcing the atmosphere on short and medium terms (leading to improvements in surface parameterisation schemes and in the establishment of a 1 km resolution land surface data set), and the demonstration of the utility of meteorological forecasts in the management of water resources.

GCIP has now officially given way to GAPP which extends the GCIP approach to the western part of the USA, with two main objectives:

- Develop and demonstrate a capability to make reliable monthly to seasonal predictions of precipitation and land-surface hydrologic variables through improved understanding and representation of land surface and related hydro-meteorological and boundary layer processes in climate prediction models;

- Interpret and transfer the results of improved seasonal predictions for the optimal management of water resources.

The implementation plan for GAPP is under completion. It will serve as a key component of CEOP, with the contribution of four reference sites, the development of an operational land surface assimilation scheme, and studies of transferability of regional coupled atmospheric-hydrology models. GAPP will also contribute to the study of the monsoonal circulation and the carbon cycle.

4) Large-scale Biosphere-Atmosphere Experiment in Amazonia (LBA)

After a phase of implementation of field activities and the initiation of research and training activities, new developments include the implementation of several levels of climate and hydrological modelling, making use of the CPTEC Global model at 70 km resolution and the Eta/CPTEC regional model at 20 km. resolution. Future activities on this subject include the downscaling of climate change scenarios from IPCC, with the prospect of also running climate scenarios at a later stage. On the observational side, the involvement of LBA in CEOP, and the implementation and planning of field experiments in Amazonia from 2002 to 2005 guarantee the availability of high resolution time-space data. The closure of the water budget over the Amazon basin remains a priority. With respect to new developments, one should note the field experiment on the South American Low Level Jet planned jointly with CLIVAR for summer 2003, which will allow a better knowledge of the moisture transport between Amazonia and the La Plata river basin. Currently, there are 102 projects going on in LBA, funded either by Brazilian or international founding institutions. A special issue of JGR with the major findings of the first LBA conference will be published during the first semester of 2002 and the second international LBA Conference is scheduled for July 2002 in Manaus.

5) The Mackenzie River GEWEX study (MAGS)

The goals of MAGS are stated as:

- To better understand and model the high latitude water and energy cycles that play a major role in the global climate system;

- To improve our ability to assess the changes in Canada's water resources that arise from climate variability and human-induced climate change

MAGS has successfully completed the transition to a second 5-year phase covering 2001-2005. The scientific achievements of phase1 have been published in a synthesis article, they demonstrate the value of the comprehensive data set which has been compiled and significant progress in the description, understanding and modelling of the energy and water cycle, as well as in the closure of the water budget, in an arctic continental basin.

The objectives of phase 2, which are refined during a scientific planning meeting in march 2002, focus on the response of the energy and water cycle to climate variability and change, on the impact of related changes, on the applications of predictive capabilities to climatic, water resource and environmental issues in the Mackenzie basin and other high latitude regions.

6. The Murray-Darling Basin Water Balance Project (MDBWP)

The objectives of the MDBWP are:

- to enhance the capability of the operational systems of the Bureau of Meteorology to provide accurate and reliable estimates of the real-time surface water budget across the MDB;
- to measure the spatial and temporal variability of soil moisture and temperature across one part of the basin (the Murrumbidgee River basin);
- to identify and reduce key limitations in the representation of soil moisture and temperature in BMRC atmospheric model;
- to develop products for water authorities in the MDB.

These objectives are being achieved through a programme of combined observation and modelling studies, based on the hydrology and spatial modelling expertise at The University of Melbourne and the meteorological modelling expertise in BMRC. Detailed observations of soil moisture and temperature are being collected at 18 sites across the Murrumbidgee River basin, and they will provide a unique data set for the evaluation and development of numerical models.

7. Coupling of the Tropical Atmosphere and Hydrological Cycle (CATCH)

The CATCH observational programme is being reinforced with the equipment of an additional small river basin and the adjunction of a precipitation radar scheduled for 2003. A multi-scale African Monsoon Experiment is planned using CATCH as one of its components but involving a much larger community. The planning document for this experiment, provisionally baptised AMMA (Analyse Multidisciplinaire de la Mousson Africaine) is under preparation. Two of its features are of prime interest to GEWEX, a reinforcement of the rawindsond network during 2004 and 2005 and of the hydrometeorology network in the CATCH area for the whole decade up to 2010.

3.3 Specific projects and activities

- **International Satellite Land Surface Climatology Project (ISLSCP):** The ISLSCP Initiative I data collection contained 159 parameters of global data for the base years of 1987-1988. Most of the data sets were provided at a monthly temporal resolution and at a common 1-degree spatial resolution. In 1999, NASA's Hydrology Program provided funding to initiate the production and publication of the ISLSCP Initiative II data collection. Following recommendations from ISLSCP members and the general scientific community, a set of 382 key data parameters was compiled. The data sets that are being produced for Initiative II cover over the 10-year period from 1985 to 1995 and should be available by the end of 2002.

- **Water and Energy Balance Study:** WEBS aims to quantify and characterise the water and energy fluxes and reservoirs over the GHP continental-scale experiments as well as other regions. Progress has been made to assess our capability to "close" the water and energy balance with global and regional models. Two workshops have been held so far, an article using NCEP re-analysis data over all of the CSE regions has been completed, WEBS-related efforts are ongoing within the individual CSEs, and other workshops will be held at AGU/EGS/EGU 2003 and IUGG 2003.

- **Water Resources Applications Project:** WRAP is designed to structure the dialogue between the users of hydro-meteorological information, forecasts, and the researchers within GHP who are involved in the development of data-sets and models on a global basis. A successful initial workshop has been held and appropriate linkages have been started to better apply the ongoing GHP and GEWEX progress. Two additional meetings (at the Dresden ICWRER in July 2002 and at IUGG 2003) are being planned to facilitate this dialogue. This effort is duly appreciated by the hydrology and climatology community, as expressed for example by the WCP-Water programme.

- **Data Management Working Group:** This group is concerned with improving the access to and distribution of various data sets. For example, each of the continental-scale experiments has produced a variety of special data sets. To help improve the use of these, this working group has

summarised the various data listings and access guidelines of participating groups within GHP, and it is currently concerned with pulling together its first collective data set on precipitation. This group is also playing a major role in the preparation for CEOP and in the launching of a concerted initiative in this domain within WCRP.

- **Large scale hydrological modelling:** These studies are being carried out in the continental-scale experiments. In some cases, these are using fully coupled atmosphere/land-surface models. As well, and in co-operation with GMPP and ACSYS, an inter-comparison activity has been carried out within the BALTEX region.
- **Transferability and validation:** The transferability of regional models between regions and/or the validation of global models over continental-scale experimental regions and other regions is being addressed on a case by case basis. To move this effort along, BALTEX has volunteered that the 1995 PIDCAP period can act as the basis for an inter-comparison of regional (and global) models. Under CEOP, specific tests of transferability and evaluation are being planned.

- **Prediction and Predictability:** Prediction and predictability studies are underway within each of the continental-scale experiments. These are generally aimed at establishing our capabilities and weaknesses to predict water-related parameters over these regions on time scales ranging up to interannual.

3.4 Co-ordinated Enhanced Observing Period (CEOP)

The overall goal of the Co-ordinated Enhanced Observing Period (CEOP) is to understand and model the influence of continental hydro-climate processes on the predictability of global atmospheric circulation and changes in water resources, with a particular focus on the heat source and sink regions that drive and modify the climate system and anomalies. To this end, a co-ordinated effort has been undertaken to put together the observations being taken by the CSEs, data sets derived from environmental satellites including the newer ones and data sets from global models. The primary objectives of CEOP are to:

- Document, better understand and improve the simulation and prediction of water and energy fluxes and reservoirs over land for water resource applications
- Document the seasonal march of the monsoon systems and better understand their physical driving mechanisms and their possible connection.

A CEOP Implementation plan has been published following the workshop held in Greenbelt in February 2001. An international implementation planning meeting is taking place in Tokyo, 6-8 March 2002, in order to refine operations, data management and scientific planning.

CEOP will create a database of common measurements from both *in situ* and remote sensing observing platforms and a number of carefully selected reference stations will be linked closely with the existing network of observing sites involved in the CSEs. The initial purpose of CEOP is to develop a pilot global hydro-climatological data set that can be used to help evaluate, develop and eventually predict water and energy cycle processes in global and regional models. *In situ* and satellite observations, model output, and four-dimensional data analyses (4DDA, including global and regional reanalyses) will be developed and co-ordinated during this period. Enhanced observations, which began in October 2001, are scheduled to build up and focus on 2 annual cycles in 2003 and 2004.

CEOP, which has been initially proposed by GEWEX hydrology community requires a close co-ordination with CLIVAR for monsoon related studies. It requires close co-ordination with WGNE and the various NWP and modelling centres for optimising the general data strategy, with a combination of observational and model data. This strategy is being discussed in Tokyo in order to allow the best use of CEOP data by modelling centres for parameterisation, assimilation and forecast validation studies and an optimal contribution of model data as a complement to observations.

The endorsement of CEOP as the first element of the new Integrated Global Water Cycle Theme defined by IGOS partners favours a direct participation of environmental satellite operators in the CEOP programme.

3.5 Proposed cross-cutting activity on precipitation

GEWEX SSG recognizes the clear cross cutting nature of the prediction of precipitation and the observation, understanding, and representation of the processes that produce precipitation in all phases. The output and form of the precipitation products are particularly relevant to the potential applications for

water resource use and must be more thoroughly addressed. Therefore, **the following several related activities are being suggested.**

- Development of methods for assessing precipitation observation and prediction on a basin average approach (vs gauge/point method). This was suggested by ECMWF. GMPP/WGNE, GHP and GPCP all would have a role to play. Basin averaging would also have a positive direct impact on verifying satellite based products where pixel size and aggregating methods may not validate well against point/gauge data. The GPCP 1DD and PERSIANN data sets are examples where this process might help significantly.

- **Develop a cross cutting working group to address improving the critical aspects of the precipitation process affecting both prediction and application**. Since observational products, model parameterizations, prediction and applications are all aspects to be addressed, members would be expected to be at least from GRP, GPCP, GHP, WRAP, GMPP, WGNE, and GCSS (WG4) with potential interactions with TRMM and GPM science teams as well. An early task might be to develop specific areas to target for investigation that (from a sensitivity point of view) would have the most impact on prediction of precipitation, both onset and amount. Applications feedback would be critical since past experience has shown that users can benefit from model prediction output not normally provided (e.g., percent of convective vs stratoform precipitation).

- As mentioned elsewhere, the GRP should consider how this focus on precipitation observations and processes may **affect the current organization of DMWGs and projects within GRP.**

4. RADIATION PANEL AND GOBAL DATA SETS

4.1 Overview

The GEWEX Radiation Panel (GRP) leads studies on atmospheric radiative exchange processes, particularly with regard to cloud and aerosol effects, and on water exchange processes, particularly precipitation, and the development of global data sets, derived largely from satellites, to characterize the variations of the global energy and water cycles.

One of the primary goals of the set of global satellite data analysis projects has been to create or foster the systematic collection of the global, long-term, atmospheric and surface property data-sets needed to diagnose the joint variability of the global energy and water budgets and to improve understanding of the climate processes that determine its natural variability and sensitivity to changes.

Several of these data sets already cover a fairly long period, of the order of 10 years or more. The first objective is to complete them up to a 20-year coverage. As part of GEWEX phase II, emphasis will be put on the development of advanced diagnostics, on the exploitation of new satellite products and on the identification of signatures of climate variability.

Plans for the coming year highlight three activities:

- An effort will be made to define a "standard" set of statistical and diagnostic analyses to be applied to all of the GEWEX global data products and possibly a few others. The purpose of this exercise is to characterise the variability of all the measured quantities in some common way as a prelude to a joint analysis.

- To prepare for a joint analysis of energy and water cycle variability, common resolutions will be defined for merging all the GEWEX global data-sets (and possibly a few others) into a single data products.

- A complete review of progress in understanding atmospheric radiation, particularly the effects on it of variations in clouds, water vapour and aerosols, will be conducted to highlights the contributions of WCRP/GRP projects and activities.

The activity of the radiation panel is central to the continued interaction between the GEWEX community and satellite operators. It has recommended that GEWEX SSG and WCRP emphasise the importance of the continuity of measurements from operational and polar orbiting satellites, to endorse NOAA plans, to increase interaction with Eumetsat, and to increase communication with all space agencies or institutes involved in GEWEX related research.

An increasing interaction with the hydrometeorology community has been recommended and is taking place as part of CEOP. Interaction with other communities becomes necessary as the scope of global data sets evolves to meet some of climate scientific challenges. A major one concerns radiative feedbacks in the climate system which should be the topic of a workshop proposed for the end of 2002. The model component is obviously essential in this area, as already taken into account by a strong tie with GCSS, and the importance of an increased interaction between the GEWEX radiation community and WGCM has been underlined by GEWEX SSG.

As GEWEX enters Phase II, the integration of data analyses and model studies needs to be enhanced to address the more complex interactions of climate sub-systems that produce the feedbacks controlling the natural variability of the climate and its response to forcing. First, to analyze the joint variability of the global energy and water cycles, the analysis of the satellite observations needs to be better integrated than currently; this may include integration of satellite and other sources of data. Second, to exploit the large array of new satellite observations, where direct processing by GEWEX may be beyond available resources, the emphasis needs to shift more towards integration of multi-instrument data streams, which is not the direct concern of the specific spacecraft missions. Third, to verify and extend the satellite-based analyses, a much better working connection needs to be established between the global satellite projects and the GHP (CSEs/CEOP) data groups. Fourth, to complete process-model investigations, a much better working connection needs to be established between these data groups and the supporting data groups in the GMPP modeling studies (GCSS/DIME and GLASS/ALMA).

It is felt that all of these enhancements can be better effected and supported by GRP If the separate satellite projects were organized into a single, integrated data management group. This change also seems to make sense because there appears to be some overlap, that may not be necessary if the datasets were being handled by these different groups.

Therefore, the GEWEX SSG recommends that the GRP formulate plans with the leaders and participants of all the current projects and representatives of GHP/CEOP and GMPP (DIME/ALMA), that can be reviewed at its next session that MAY lead to the formation of a single data management group including the participants of all the current projects and representatives of GHP/CEOP and GMPP (DIME/ALMA).

The goals of this new group are to:

(1) continue the collection and analysis of operational weather satellite data in support of the current data projects,
(2) work towards production of new integrated data products for the analysis of the global energy and water cycles,
(3) examine methods for integration of the new data products coming from the new satellite missions, and
(4) collaborate with the CSE and CEOP data groups and the DIME/ALMA data support groups for GCSS/GLASS to cross-connect data holdings and to exchange datasets where necessary.

It is anticipated that the formation of this group will initially be undertaken on an interim basis so that the SSG can remain advised of its progress in meeting the stated goals in an acceptable international framework. The review of this action at the 15th session of the SSG should, however, include plans for an initial meeting of the joint group in 2003.

4.2 Global data sets and satellite projects

- **International Satellite Cloud Climatology Project (ISCCP):** There is now a 16-yr cloud data record, which will shortly be extended to an 18-yr record (various products with resolutions from 30 km, 3 hr to 300 km, monthly). Recent theoretical research, together with a special analysis of the ISCCP data-set, has provided a method for parameterising the radiative effects of small-scale cloud variability in GCMs. Currently, work is underway to explain a slow variation in global monthly-mean cloud cover, observed in the tropics.

- **GEWEX Global Aerosol Climatology Project (GACP):** There is now an 11-yr, monthly-mean aerosol data record over oceans only (300-km resolution). The recent work concluded with the development of the best (least sensitive to assumptions) 2-channel retrieval approach. Radiance calibration uncertainty cannot be resolved with the current data. Time variations in global aerosol thickness and average size are consistent with evolution of the stratospheric aerosols between volcanic events.

- **Surface Radiation Budget (SRB):** Production has started to produce a 12-yr radiative flux data record (resolution is 100 km, 3 hr). The data set will include surface, as well as top-of-atmosphere, up-welling and down-welling, short wave and long-wave fluxes.

- **Earth Radiation Budget (ERB):** A combined NIMBUS-7 ERB, ERBE, ScaRab and CERES data-set gives a 21-yr data record of top-of-atmosphere radiative fluxes. A long-term variation in tropical OLR appears to be consistent with observed changes in cloud cover and upper tropospheric water vapor.

- **Global Precipitation Climatology Project (GPCP):** There is now a 22-yr precipitation data record (pentad and monthly mean, 300 km) and a 4-yr record (daily, 100 km resolution); the development of a 50 km. hourly product is being considered. A global diagnosis of the water budget was attempted using GPCP, NVAP and NCEP winds. TRMM data have provided a very useful input for the validation and improvement of algorithms. New developments are expected in microwave algorithms and procedures for using simultaneous data from several satellites; the elaboration of a “snowfall” product has been recommended. The issue of inter-annual variability and global change of precipitation will be further examined. A workshop on the “ objective analysis of precipitation “ is being proposed.

- **GEWEX Water Vapour Project (GVAP):** The NVAP pilot study produced a 10-yr water vapour record (daily, monthly at 300-km resolution). For now, GVAP will continue as study project to carry out comparisons of existing water vapour data sets, together with newer methods/data to come.

- **Evaluation activities:** The global satellite analyses are supported by studies to help evaluate their accuracy. In many cases, these activities are intrinsic to the global project itself. ISCCP organised algorithm comparisons in its early stages but was additionally supported by several nationally organised field studies (FIRE, ICE, EUCREX, JACCS). GPCP directly organised algorithm comparisons, including special collections of verification data, but this effort largely became incorporated in the larger TRMM activity. Also, early activities in GVAP have focused on evaluation campaigns. The major extrinsic evaluation activity organised under GRP is the BSRN to support the SRB project. Currently, BSRN consists of 30 functioning sites in 19 countries. After a recent hiatus, the central archival has begun to make available many surface flux (and ancillary) data records from these stations with lengths varying up to 7 years. Significant clarification and, in some cases, reduction of the sources of measurement error have been achieved.

4.3 Specific study projects and working groups

GRP has organised several specific study projects to examine particular problems and to foster work towards their solutions. Some GVAP-sponsored activities fall under this heading, where there has been significant clarification of the nature of the errors in water vapour measurements. GRP also sponsored some workshops that initiated planning for the CloudSat, Calipso, and EarthCARE spacecraft mission proposals. The most notable study projects are ICRCCM, I3RC and SeaFlux.

- **ICRCCM-SW:** A study comparing available presentations and parameterisations for treating cloud variability effects on short wave scattering to full 3-D calculations is nearing completion. Results show that treatments that represent small-scale variability as an "independent column approximation" and calculate fluxes for horizontally varying layers provide fairly accurate results. A test kit containing specifications of inputs and outputs from 3-D and other radiative transfer models is being prepared for publication.

- **ICRCCM-LW:** After completing its first phase, amore extensive set of test cases is now being documented to prepare a new test kit, paralleling the effort for short-wave radiation, that emphasises cloudy scenes with the full range of variability.

- **I3RC:** This study, which is nearly done, has shown that all of the various methods used to calculate 3-D radiation agree (now). This verifies these tools to be used to examine further issues concerning how radiation couples to the atmosphere and surface at the scales where it is 3-D.

- **SeaFlux:** This project is well underway. A major resource was created, a Web site with the largest collection of in situ validating and corresponding satellite data-sets for calculating various aspects of sea surface fluxes. After two workshops, several comparison activities are underway: retrievals of skin SST and air temperature/humidity, turbulent surface flux formulations and global flux products.

This group is also interacting with others to compare retrievals of sea surface winds, especially from scatterometers, and precipitation over oceans.

A new formal working group, the Column Profiling WG, has been established to encourage co-operation among the several sites now producing long-term, if not continuous, atmospheric profile data-sets. The primary emphasis is on cloud profiling by radar and lidar, but efforts will be made to include and/or combine this with profiling of water vapour and winds where possible. The objectives are to discuss common issues, particularly regarding analysis methods, and to establish some common practices and data formats so that the rest of the research community can more easily use these data sets.

An informal working group is being organised to conduct a review of atmospheric radiation-related progress and achievements over the past two decades, with an emphasis on the contributions of WCRP/GRP projects and activities. The maturity of the clouds, aerosols and radiative flux activities suggests that such a review would be useful.

5. MODELLING AND PREDICTION

5.1 Overview

The GEWEX Modelling and Prediction Panel (GMPP) has the objective of developing and evaluating improved interactive model formulations of atmospheric and land-surface processes that regulate the global hydrological and energy cycle. This Panel, which includes specifically the GEWEX Cloud System Study (GCSS), and the Global Land-Atmosphere System Study (GLASS), has formulated plans for a new GEWEX Atmospheric Boundary Layer Study (GABLS). Because of the close connections between activities of GMPP and the CAS/JSC Working Group on Numerical Experimentation (WGNE), the two groups meet jointly.

GMPP has also been active in promoting inter-panel activities within GEWEX and is taking specific steps toward co-operation in the establishment of requirements for commonality of collection and production of GEWEX data sets and products, leading to preparation of common global data sets (same grid and time resolution, i.e. monthly mean and daily) with supportive ancillary information that can facilitate joint diagnostic studies dealing with variability of global energy and water cycles.

GMPP would take a major role in the land-flux activity associating the expertise of the various components of GEWEX, and recommended by its SSG: The experience acquired in three-dimensional cloud and boundary layer simulation will serve to develop a strategy for advancing knowledge of cloud/boundary layer/land surface radiative and turbulent coupling. GMPP also advocates some involvement in the planning of AMIP activities. It should finally be noted that the forthcoming joint WGNE/GMPP meeting scheduled in Toulouse in November is a good opportunity for increased collaboration within the WCRP modelling community.

5.2 GEWEX Cloud System Study (GCSS)

The primary objective of GCSS is the development of refined parameterisations of cloud systems within atmospheric models used for numerical weather prediction and climate simulations through a better understanding of the coupled physical processes in different types of cloud systems. Five different cloud types are being specifically studied: boundary layer; cirrus; extra-tropical layer clouds; precipitating convectively driven cloud systems; polar clouds. In each area, a series of case studies drawing on observations from various field programmes is conducted to evaluate the simulations of cloud resolving or cloud-system models and the treatment of the relevant processes. Single-column models are also valuable tools particularly in making connections between general circulation models and data collected in the field, thereby facilitating observationally based evaluations of new parameterisations in isolation from the large-scale dynamics. Ultimately, cloud parameterisations must, of course, be tested in full climate simulations or in numerical weather prediction models and the organisation of such activity was being considered. Attention is now turning increasingly to parameterisation development, especially by reviewing specific new treatments of clouds and their representation and their performance in single-column or cloud system models. Full details of the scientific issues being addressed in GCSS and the studies carried out or underway are described in the GCSS Science and Implementation Plan. A general GCSS meeting is being organised jointly with an ARM workshop in Canada in May 2002. It will bring together all the scientists working on the various different cloud types and experts from the (large-scale) atmospheric modelling communities.

5.3 GEWEX Global Land-Atmosphere Study (GLASS)

The implementation of the GLASS project is continuing through the various actions which were defined in the implementation plan. During 2001 new experiments were conducted in the local and global off-line actions.

In this category one should mention one set of simulations of surface hydrology at high latitude (in Sweden), one set of simulations including carbon fluxes over a forested land (in the Netherlands), and one set of regional simulations over the Rhône basin.

The launch of the new local and global coupled actions is progressing well. Evidence has been mounting that the sensitivity of land-surface models in the coupled mode is different from the one obtained in off-line mode. A method needs to be developed to force these models in a way which is much closer to their coupled application, i.e. some of the feedback provided by the planetary boundary layer needs to be included. Another need for such a method will be data assimilation, which is under development for land-surface models.

For the global-coupled action, a simplified experiment has been designed to evaluate the feedbacks between the atmosphere and the land-surface in a number of coupled models. This set-up has been tested with 4 different GCMs and needs now to be generalised and expanded to a larger ensemble of models.

The infrastructure project is continuing its support activity and has helped with all the projects that were conducted in 2001.

It should finally be noted that IGBP has expressed its interest to collaborate with GEWEX/GLASS for its modelling activities. The possible topics of collaboration will be identified during the year 2002.

5.4 GEWEX Atmospheric Boundary Layer Study (GABLS)

GABLS was initiated in 2000 and endorsed as a new GEWEX activity by JSC-22. The main goal of GABLS is to improve the representation of the Atmospheric Boundary Layer in atmospheric models on the basis of a proper understanding of the relevant processes. As such GABLS will provide a platform in which scientists working on boundary layers at different scales will interact. Such activity is important in itself and also very relevant for other activities in GEWEX and for activities within WCRP and IGBP.

The kick-off meeting of GABLS was held in Utrecht, August 2001 and proposed that the first focus of GABLS should be on "Stable Boundary Layers over Land". Much of the warming predicted by climate model occurs indeed during stable conditions over land, either in winter or at night, while at the same time the understanding and parameterisation of the Stable Boundary Layer is still very poor!

A first scientific workshop for GABLS is being organised in March 2002 at ECMWF, with the main intention to bring together "process" and "large-scale" modellers.

The important topic of boundary layers over the ocean, which is already covered in part by GCSS has not been considered yet by GABLS.

APPENDIX A

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APPENDIX B

AGENDA AND EXPLANATORY MEMORANDUM
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SCIENTIFIC STEERING GROUP
FOR THE GLOBAL ENERGY AND WATER CYCLE EXPERIMENT (GEWEX-SSG)
FOURTEENTH SESSION

ECMWF, READING, UK, 28 JANUARY - 1 FEBRUARY 2002
(REV-2.3a, 28 JANUARY 2002)

Monday, 28 January 2002:

8.30-9.00 **REGISTRATION**

9.00 **1. OPENING OF SESSION, OVERVIEW AND STRATEGIC PLANS**
(Remarks in this section should be held to 20 minutes with discussion)

1.1: Welcome from the Hosting Organization (A. Hollingsworth)

1.2: Assessment/Perspective of GEWEX as part of WCRP (D. Carson)

1.3: Remarks by the Chairman (S. Sorooshian)

The focus of the Chairman's comments will be on the importance of:

(a) maintaining collaborations with sponsoring agencies, other WCRP programmes and related international activities, including a possible GEWEX role in a WCRP arid regions/desertification initiative,
(b) establishing connections with the water resources community and
(c) setting the approach for the remainder of the meeting in which specific science topics of importance to GEWEX will be presented, in particular the establishment of an overall goal for GEWEX in precipitation prediction and further discussions of the strategy for the next phase of GEWEX.

1.4: International GEWEX Project Office view (P. Try), including:

Summary of Results from the Fourth GEWEX International Science Conference and Plans for a Fifth Conference

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10.30 **BREAK**

11.00 1.5: GEWEX contributions to joint WCRP-IGBP-IHDP themes and other joint initiatives
(Presentations in this section should be 20 minutes with discussion)

Status and Issue Reports to be followed by SSG discussion on GEWEX role, contributions, plans and progress.

Carbon Theme (R. Dickinson)
Water Theme (P. Kabat)
IGOS Water Initiative (D. Carson)

Monday, 28 January 2002 - Continued

12.00 **2. GEWEX RELATIONSHIPS TO AGENCIES AND OTHER GROUPS (PARTICULARLY IN THE AREA OF PRECIPITATION PREDICTION AND WATER RESOURCES)**
(Presentations in this section should be 20-30 minutes with discussion)

Representatives of agencies will brief the group on the latest developments in plans for Earth observation from space and other relevant GEWEX initiatives. The focus will be on:

(a) ways to improve collaboration between WCRP/GEWEX and the agencies and
(b) expanding support of GEWEX efforts on issues related to processes involved in improved prediction of precipitation and enhanced management of water resources.

2.1: ESA - GEWEX Relationships and Plans (E.-A. Herland)

12.30 **LUNCH**

13.30 **2. GEWEX RELATIONSHIPS TO AGENCIES AND OTHER (Continued)**

2.2: NASDA - GEWEX Relationships and Plans (T. Koike)
2.3: NASA - GEWEX Relationships and Plans (P. Houser)
2.4: WWRP (K. Browning), CLIVAR (A. Busalacchi)

15.00 2.5: Special report/discussion on issues in prediction of precipitation and the processes involved

Professor P. Morel will lead a discussion designed to advise the SSG on matters related to the need for well defined objectives in GEWEX Phase 2, particularly related to broad issues associated with research into wet process that require special attention of the international science community and that deal mainly with a scientific focus on improved prediction of precipitation. (P. Morel)

Other speakers will address the fact that GEWEX has continued to focus on issues in climate research related to **wet processes** and has contributed to improved knowledge about the role of the global atmosphere and its interactions with land and oceans in the climate system. The science foci of the GHP, GRP and GMPP have emphasized these interactions and have been integrated to provide knowledge of component processes that has resulted in new global data products and been applied to improve weather forecasting, prediction of precipitation, and management of related hydrological assets. The report and discussion will include issues related to new observing concepts (e.g. GPM) and related EOP/validation initiatives, (e.g. GHP/CSEs/CEOP); new assimilation techniques (e.g. assimilation of precipitation in the NCEP Eta model); new approaches for the treatment of precipitation in land-surface and hydrological models (e.g. GMPP/GLASS/GLDAS studies); new methods for the parameterization of processes involved in precipitation in large-scale atmospheric models; and new retrieval aspects and recycling studies (e.g. GRP/GPCP methodologies). (P. Houser, E. Smith, R. Adler, R. Stewart, W. Rossow)

15.30 **BREAK**

Monday, 28 January 2002 - Continued

16.00 2.5: Discussion on issues in prediction of precipitation - Continued

Reports and discussion on issues in prediction of precipitation will continue as required

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18.00 **ADJOURN**

A RECEPTION HOSTED BY ECMWF WILL TAKE PLACE IMMEDIATELY AFTER THE CLOSE OF THE SESSION ON 28 JANUARY 2002. THE LOCATION OF THE RECEPTION WILL BE WITHIN THE ECMWF FACILITY.

Tuesday, 29 January 2002:

8.30 **3.** **GEWEX RADIATION PANEL (GRP)**
(Presentations in this section should be 20-25 minutes with discussion)

The GRP Chair will organize the discussion around conclusions/ recommendations/ actions from the Panel's November 2001 session. A special focus should be on an assessment of the GRP Research Scientific Foci and on strategies for addressing the influence of cloud/radiation feedbacks in the climate system, including precipitation. Results from GEWEX radiation projects that relate to understanding these feedbacks should also be provided, along with plans for further interactions between GRP and WGCM activities. (SRB, BSRN, ERB, ISCCP, GPCP, GVaP, GACP) (W. Rossow)

The presentation should highlight significant accomplishments that respond/apply to important scientific questions and areas where action is required by the SSG.

10.30 **BREAK**

11.00 **3.** **STATUS OF GRP ACTIVITIES (Continued)**

12.30 **LUNCH**

14.00 **3.** **STATUS OF GEWEX RADIATION PANEL (GRP) (Continued)**

GRP wrap-up/open discussion: the GRP Chair will lead a discussion on any open issues and questions related to precipitation prediction and other topics from the presentations. (W. Rossow, All)

Tuesday, 29 January 2002 - Continued

14.30 **4. GEWEX HYDROMETEOROLOGY PANEL (GHP)**

The GHP Chair, will organize the session to provide an overview/summary of key results/actions/ recommendations from the seventh GHP session in September 2001. The main items are: the GHP Scientific Focus/Strategy for prediction of precipitation and related Global Applications associated with plans for implementing steps related to GHP learning more about various climatically-distinct regions; milestones related to the GEWEX Continental-Scale Experiments (CSEs); Contributions of GHP CSE's to the GEWEX/GHP Co-ordinated Enhanced Observing Period (CEOP) and other plans including, a possible Murray-Darling basin CSE, advancement on the Water Resources Application Project (WRAP), the Water and Energy Budget Study (WEBS) and connections to groups such as the WMO Hydrology and Water Resources (HWR) and ACSYS/CliC (ARCTIC-HYCOS).
(R. Stewart, M. Manton, J. Marengo, P. Kabat, S. Williams, H.-J. Isemer, J. Huang, T. Yasunari, H. Cattle)

Only significant accomplishments should be noted such as those which respond/apply to important scientific questions and areas where action is required by the SSG.

15.30 **BREAK**

16.00 **4. STATUS OF GEWEX HYDROMETEOROLOGY PANEL (GHP) (Continued)**

18.00 **ADJOURN**

Wednesday, 30 January 2002:

8.30 **4. STATUS OF GEWEX HYDROMETEOROLOGY PANEL (GHP) (Continued)**

GHP wrap-up/open discussion: the GHP Chair will lead a discussion on any open issues and questions related to precipitation prediction and other topics from the presentations.
(R. Stewart, All)

9.30 **5. GEWEX MODELLING AND PREDICTION PANEL (GMPP)**
(Presentations in this section should be 20-25 minutes with discussion)

The GMPP Chair will organize the discussion to provide a report on conclusions and recommendations from the second meeting of the Panel. Topics covered will include: An assessment of the GMPP Research focus, the status of the GEWEX Cloud Systems Study (GCSS), progress on the GMPP Cloud/Radiation Parameterizations work, the status of activities underway, including precipitation prediction, in association with the JSC/CAS Working Group on Numerical Experimentation (WGNE), an update on progress of the GEWEX Global Land/Atmosphere System Study (GLASS) including the outcome of the third GLASS Science Panel meeting and a presentation of the status of the implementation of the GEWEX Atmospheric Boundary Layer Study (GABLS) will be presented.
(D. Randall, J. Polcher, A. Beljaars)

The presentation(s) should highlight significant accomplishments which particularly respond/apply to important scientific questions and where action is required by the SSG.

Wednesday, 30 January 2002 - Continued

10.30 **BREAK**

11.00 **5. STATUS OF GEWEX MODELING/PREDICTION PANEL (GMPP) (Continued)**

12.30 **LUNCH**

14.00 **5. STATUS OF GEWEX MODELING/PREDICTION PANEL (GMPP) (Continued)**

GMPP wrap-up/open discussion: the GMPP Chair will lead a discussion on any GHP open issues/questions (D. Randall, All).

15.30 **BREAK**

16.00 **6. GEWEX CONTRIBUTIONS TO THE ENHANCEMENT OF GLOBAL MODELLING AND PRECIPITATION PREDICTION**

(Presentations in this section should be 20-25 minutes with discussion)

The modelling and prediction thrust of GEWEX has the objective of developing and evaluating improved interactive model formulations of atmospheric and land-surface processes that regulate the global hydrological and energy cycle. Advances in meeting this objective have contributed directly to the broad WCRP goal to develop models capable of simulating the climate system and predicting climate variations on a wide range of space/time-scales. GEWEX has fostered relationships with NWP/large-scale climate modelling/prediction centres to further assist production/demonstration of improved extended predictions as an element of seasonal-to-interannual climate predictability. GEWEX is also contributing to the validation and accurate computation of the radiation budget and fluxes, as part of decadal-to-centennial climate variability and response to changes in external parameters.

Special reports will be provided on topics of relevance to the global modelling and prediction thrust of GEWEX from representatives of Modelling Centres.

(A. Hollingsworth-ECMWF, R. Atlas-DAO, S. Lord-NCEP, K. Puri-BMRC/WGNE, Others)

18.00 **ADJOURN – A BUFFET DINNER WILL BE HOSTED BY ECMWF IN THE ECMWF RESTAURANT IMMEDIATELY FOLLOWING THE SESSION ON 30 JANUARY 2002.**

Thursday, 31 February 2002:

8.30 **7. CEOP SPECIAL IMPLEMENTATION STATUS AND DISCUSSION SESSION**

A special report/discussion on CEOP will be organized for the SSG and others directly involved in the planning and implementation of CEOP. (T. Koike, Others)

Thursday, 31 February 2002 - Continued

8.30 7.1: CEOP Introduction/Overview (T. Koike)

CEOP is seeking to achieve a database of common measurements from both in situ and satellite remote sensing measurements, as well as matching model output that includes Model Output Location Time Series (MOLTS) data along with four-dimensional data analyses (4DDA; including global and regional reanalyses) for a each specified period. In this context, a number of carefully selected reference stations are linked closely with the existing network of observing sites involved in the GEWEX Continental Scale Experiments, which are distributed around the world. It is being developed and implemented within the WCRP. It has also been endorsed by the Integrated Global Observing Strategy Partnership (IGOS-P) as the first element of the IGOS Water Cycle Theme.

8.50 7.2: Implementation Plan/Executive Summary Main Topics (P. Try)

A key aspect of CEOP is to coordinate the regional observations by the different GEWEX Continental Scale Experiments (CSEs) that have been established within the framework of the GEWEX Hydrometeorology Panel (GHP) to facilitate global and transferability studies. The enhanced observations of sub-surface (soil), surface (radiation and precipitation), near surface (flux tower), atmospheric soundings (raob and profiler), and 3D (radar and aircraft) made at the CSE CEOP reference sites will provide CEOP with the basic resources necessary to achieve its main scientific objectives. The CEOP science objectives take into account the requirements of GEWEX, CLIVAR, and other WCRP core projects as well as the climate research community at large and the CEOP coordinated database will also serve numerical modeling and analysis needs.

9.10 7.3: CEOP Satellite Data Strategy (T. Koike/M. Bosilovich)

Progress is being made on the satellite data integration activity under development by NASDA and University of Tokyo (UT). Koike reconfirmed that a 500 tera-byte data archival system at UT will be available for the CEOP satellite data integration work. NASDA has also proposed that a CEOP CEOS/WGISS Test Facility (CEOP-WTF) be developed to assist with the derivation of CEOP special products from each satellite sensor. (T. Koike)

9.30 7.3: CEOP Satellite Data Strategy (Continued)

NASA and other groups are undertaking Land Data Assimilation System (LDAS) projects that are developing an LDAS at both the North American (NLDAS) and global (GLDAS) scales. Both projects will lead to more accurate reanalysis and forecast simulations by numerical weather prediction (NWP) models. Specifically, the system will reduce the errors in the stores of soil moisture and energy which are often present in NWP models and which degrade the accuracy of forecasts. (M. Bosilovich)

9.50 7.4: CEOP Model Data Strategy (M. Bosilovich)

CEOP should provide a wealth of data to enable extensive testing of atmospheric model parametrizations, and have urged NWP and Climate modeling centers to consider how to take advantage of the opportunities provided. At the same time a request has been made by WCRP of these Centers for their help and participation in CEOP through the provision to the international research community of some of their global and regional analyses and model predictions (if possible) of water and energy cycle processes over the proposed CEOP period. In particular, CEOP would welcome:

Thursday, 31 February 2002 - Continued

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(1) high temporal resolution time-series output referred to as Model Output Location Time Series or MOLTS at specified individual sites;

(2) gridded output in both three- and two-dimensional forms processed as synoptic snapshots at a minimum of six-hourly intervals.

10.10 7.5: Data Management Strategy Update (S. Williams)

A great deal of information has recently been made available concerning the characteristics of the CEOP reference sites. This information has been placed in the CEOP Reference Site Table at: http://www.joss.ucar.edu/ghp/ceopdm/rsite.html. Sufficient information has also now been obtained to allow a first draft version of a CEOP data access policy to accommodate the particular CEOP circumstances for collection, formatting, quality checking, and timely distribution of specific coordinated data products. Work is also underway to take all the available information associated with the current Reference Site database and to describe the characteristics of a CEOP data set for the period July through September 2001. This exercise should provide CEOP with the nature and quality of a strawman data set that might be able to be assembled from data that is available or which is expected to become available from, at least a subset of, the current set of reference sites, and that could be released, in due course, within the guidelines of a CEOP data accessibility policy.

10.30 **BREAK**

10.50 7.6: Selected CSE/CEOP Sites Introduced (H.-J. Isemer, R. Stewart, J. Huang, J. Marengo, T. Koike)

A critical facet of CEOP is its data collection and organization to support advanced climate research. Of the three types of data (in situ, satellite and model output) that are the basis of CEOP, the In situ data gathered from the reference sites and reference hydrological basins from the CSE regions around the world is the most fundamental component of the CEOP strategy. The CEOP reference sites located in the six most comprehensive GEWEX CSEs namely, GAPP (Mississippi River Basin), BALTEX (Baltic Sea region), MAGS (Canadian Mackenzie River Basin), LBA (Amazon region), CAMP (Asian monsoon region) and CATCH (Western African Monsoon Region), are being provided, through Multi-National commitments, to improve the collective contribution of the CSEs to the global requirements of CEOP.

11.10 7.7: Scientific Foci and Strategy (T. Koike)

CEOP aims to use enhanced observations to better document and simulate water and energy fluxes and reservoirs over land on diurnal to annual temporal scales and to better predict these on temporal scales up to seasonal for water resource applications. Its other main objective is to document the seasonal march of the monsoon systems, assess their driving mechanisms, and investigate their possible physical connections. Specific issues related to both these objectives are being defined and incorporated into the CEOP scientific strategy.

11.30 **8. SPECIAL SSG SESSION**

The remainder of the day will be set aside for a closed session of the GEWEX SSG Chair and members. The other participants at the meeting will undertake/review special ad hoc study actions as may have been assigned.

12.30 **LUNCH**

Thursday, 31 February 2002 - Continued

14.00 **FOLLOW-UP OF SPECIAL SSG SESSION AND SPECIFIC WORKING GROUP WORK**

Friday, 1 February 2002:

8.30 **9. FINAL PLENARY**

The SSG Chairman will lead an open discussion and wrap-up session with all participants, which will aim to end at lunchtime.

APPENDIX C

LIST OF SCHEDULED MEETINGS

Date	Meeting	Location	Attendance
2002			
13-17 Jan	82nd American Meteorological Society	Orlando, FL, USA	Open
28 Jan - 1 Feb	14th Session of the GEWEX SSG	ECMWF, UK	Invitation
6-8 March	CEOP Kick-Off Meeting	EORC/NASDA, Tokyo, Japan	Invitation
11-13 March	WCRP Southern Ocean CLIVAR/CLIC Panel	Hobart, Australia	Invitation
12-15 March	ISLSCP Initiative II Workshop	NASA/GSFC, Greenbelt, MD, USA	Invitation
18-23 March	WCRP Joint Scientific Committee Meeting	Hobart, Australia	Invitation
25-27 March	GABLS Workshop at ECMWF: Focus on Stratified Boundary Layers Over Land	ECMWF, UK	Open
19-20 April	Workshop on Land-Atmosphere Coupling Aspects in Land Data Assimilation and SVAT Parameter Estimation	De Bilt, The Netherlands	Open
21-26 April	European Geophysical Society XXVII General Assembly	Nice, France	Open
13-17 May	16th GPCP-WGDM Meeting	Tokyo, Japan	Invitation
13-17 May	Mississippi River Climate and Hydrology Conference	New Orleans, LA, USA	Open
20-24 May	GCSS-ARM Workshop on the Representation of Cloud Systems in Large-Scale Models	Kananaskis Village, Alberta, Canada	Open
22-25 May	The Northern Environment, CMOS - 36th Congress	Rimouski, Quebec, Quebec, Canada	Open
23-25 May	11th LBA Science Steering Committee Meeting	Piracicaba, SP Brazil	Invitation
27-28 May	WEBS Workshop	Toronto, Canada	Invitation
28-31 May	7th BSRN Scientific and Review Workshop	Regina, Canada	Open
28-31 May	AGU Spring Meeting (Special Session on the Global Water Cycle)	Washington, DC, USA	Open
17-19 June	BALTEX Science Steering Group Meeting #13 Estonian Business School	Tallinn, Estonia	Invitation
7-10 July	2nd LBA Science Conference	Manaus, Brazil	Open
9-12 July	Western Pacific Geophysics Meeting (Special Session on Space-based Observations of Ocean-Atmosphere-Land-Ice Interaction in the Southern Pacific and Surrounding Regions)	Wellington, New Zealand	Open
15-19 July	15th AMS Symposium on Boundary Layers and Turbulence	Wageningen, The Netherlands	Open
22-26 July	International TRMM Science Conference	Honolulu, Hawaii, USA	Open
28 July-1 Aug	Second Federal Interagency Hydrologic Modeling Conference	Las Vegas, NV, USA	Open
31 July - 2 Aug	13th Session of the WCRP/GEWEX Radiation	Zurich, Switzerland	Invitation

Date	Meeting	Location	Attendance
2002 (Continued)			
2-6 Sept	WMO/WWRP International Conference on Quantitative Precipitation Forecasting	Reading, UK	Open
4-5 Sept	MAGS Modelling Training Course	Toronto, Canada	Invitation
9-13 Sept	GHP-8	Palisades, NY, USA	Invitation
3-5 Oct	5th International Study Conference on GEWEX	Nagoya, Japan	Open
10-19 Oct	34th COSPAR Scientific Assembly (Special Session on Properties of the Earth-Atmosphere-Ocean System as Inferred from the New Generation of Earth Science Satellites)	Houston, TX, USA	Open
6-10 Nov	8th Annual MAGS Meeting and Science Committee Meeting	Jasper, Canada	Invitation
12-15 Nov	Second International Atmospheric Model Intercomparison Project (AMIP) Conference	Météo-France, Toulouse, France	Open
6-10 Dec	AGU Fall Meeting	San Francisco, CA, USA	Open
2003			
20-24 Jan	15th Session of the GEWEX SSG	Bangkok, Thailand	Invitation
9-13 Feb	83rd American Meteorological Society Annual Meeting	Long Beach, CA, USA	Open
7-10 April	International Conference on Hydrology of the Mediterranean and Semi-Arid Regions	Montpellier, France	Open
2004			
June 2004	5th International Scientific Conference on the Global Energy and Water Cycle	Tucson, AZ, USA	Open

APPENDIX D

PUBLICATIONS AND REPORTS 2001-2002

2001

Informal Reports

5/2001 Draft) Report of the sixth session of the GEWEX Hydrometeorology Panel (GHP) (Angra dos Reis, Brazil, 11-15 September 2000)

17/2001 Report of the 6th BSRN Science and Review workshop (Melbourne, Australia, 1-5 May 2000)

18/2001 Report of the 13th session of the GEWEX Scientific Steering Group (Barcelona, Spain, 29 January-2 February 2001)

19/2001 Report of the 9th session of the GEWEX Cloud System Study (GCSS) (Tokyo, Japan, 29 November-1 December 2000)

24/2001 Report of the 15th session of the GPCP WGDM, Bologna, Italy, 14-17 May 2001

IGPO Document

No. 36 May 2001

Cordinated Enhanced Observing Period (CEOP) Implementation Plan -- Executive Summary

2002

3/2002 Report of the 12th session of the GEWEX Radiation Panel (GRP) (Fort Collins, CO, USA, 12-14 November 2001)

APPENDIX E

SPECIAL REPORTS

- Report of the 4th GEWEX International Science Conference
- Proposal for the Murray-Darling Basin Water Project
- GACP
- GPCP
- SRB
- GCSS

REPORT ON THE 4TH INTERNATIONAL SCIENTIFIC CONFERENCE ON THE GLOBAL ENERGY AND WATER CYCLE (from the November 2001 issue of the GEWEX News)

Two hundred and fifty scientists from 20 countries attended the Conference, which was held 10-14 September 2001, in Paris at the Collège de France.

Opening Session

Dr. David Carson, Director of the World Climate Research Programme, welcomed the participants and acknowledged the work of the local organizers, led by Dr. Jan Polcher, Laboratoire de Météorologie Dynamique du CNRS, and the host, Collège de France, in particular, Professor Xavier Le Pichon. Dr. Jean-Louis Fellous, Centre National d'Etudes Spatiales (CNES), continued the welcome, noting the key role of satellites in the advancing knowledge of the global energy and water cycle.

During the introductory remarks, the relation to carbon in the atmosphere and vegetation to the energy and water cycle was discussed by Professor Gérard Mégie, President du Conseil d'Administration du Centre National de La Recherche Scientifique (CNRS), Co-Chairman of the Conference. Professor Mégie was followed by Professor Soroosh Sorooshian, Chairman of the GEWEX Scientific Steering Group and Co-chairman of the Conference. Professor Sorooshian presented an overview of GEWEX water resources application activities. Water management requires accurate regional forecasts of precipitation and intense rain events, including monsoon/tropical storms. As an example of the complexity of water cycle science and management, he noted that there are 30 agencies involved in managing the Columbia River Basin.

In the keynote address, Dr. Andràs Szollogy-Nagy, Director, Division of Water Sciences, UNESCO, cited GEWEX progress in bringing together scientists from around the world, in various scientific disciplines to investigate the Earth's water balance. However, with the knowledge gained, he noted, there remains a challenge to transfer this new knowledge to water resource managers, particularly, since the use of water has increased in the past 30 years at a rate twice that of population growth. He also commented that for water resources, the word "sustainability" is not defined, and to be defined, there is a need for more measurements and experiments.

Professor Pierre Morel, University of Maryland, continued the opening session with an invited presentation on how dynamically driven wet processes effectively govern energy and water fluxes. He listed a series of questions that need to be addressed if global temperature increases. What will be the resulting changes in:

- atmospheric general circulation?
- wet processes?
- amount and distribution of precipitation?
- P-E for oceans?
- soil conditions?

To answer these and similar questions will require new global measurements of wet processes from spaceborne lidar and microwave instruments, such as NASA's CloudSat and ESA's Soil Moisture and Ocean Salinity satellite.

Technical Sessions

During the week of this successful conference, many GEWEX accomplishments were reported. Some are mentioned in the following paragraphs; however, there were several major accomplishments evident, but not necessarily stated. They include:

- bringing together diverse disciplines to work on the global water and energy cycle,
- transition of research results to operational prediction centers,
- applying global satellite measurements to processes studied, and
- new initiatives to transfer knowledge to water resource managers.

Murray-Darling Basin Water Balance Project (MDBWBP): A Contribution to the GEWEX Continental Scale Experiment

Participants

Bureau of Meteorology Research Centre (BMRC)

G. Mills
H. Richter
E. Ebert
M. Manton

The University of Melbourne

F. Chiew
A. Western
R. Young
T. McMahon
R. Grayson
J. Walker

1. INTRODUCTION

1.1 Background

Under the Cooperative Research Centre (CRC) program of the Australian Commonwealth Government, a group of Universities and Commonwealth and State agencies support the CRC for Catchment Hydrology (CRCCH) which has a particular focus on the Murray-Darling Basin. In 1999 the CRCCH established a project on "Modelling and forecasting hydroclimate variables in space and time". A component of that project is the Murray-Darling Water Balance Project (MDBWBP), which aims to enhance the capability of numerical weather prediction models to provide a real-time surface water budget over the Murray-Darling for application by water authorities. The project involves both modelling and field studies, and is being carried out through collaboration between the Bureau of Meteorology Research Centre (BMRC) and The University of Melbourne's Department of Civil and Environmental Engineering.

1.2 International significance

The Murray-Darling Basin (MDB) covers a catchment area of $1x10^6$ km^2 or about 14% of Australia Both the Murray and Darling Rivers have lengths greater than 2500 km, and so the MDB is one of the world's major river systems. A key feature of the MDB is that it represents a semi-arid zone, and so its ratio of discharge to precipitation is extremely low (less than 0.05) due to the potential evaporation rate being more than twice the precipitation rate. The climatology of the MDB is complicated not only by the high evaporation rate, but also by the large interannual variability of the rainfall, mainly due to the impact of the El Niño - Southern Oscillation (ENSO) on the climate of south-eastern Australia. This variability in rainfall is amplified in the annual runoff figures, which are more variable than runoff elsewhere in the world (except for parts of Southern Africa that experience a similar climate).

The MDB includes the three longest rivers in Australia. The Darling is 2740 km long from its source in the north to its confluence with the Murray at Wentworth, the Murray is 2530 km long from its source in the Australian Alps to its mouth on Encounter Bay in South Australia, and the Murrumbidgee is 1690 km long. The Basin also includes many rivers and creeks, but many of these are dry most of the time and they carry water only during flood times.

Most of the Basin consists of extensive plains and low undulating areas, with an elevation less than 200 m above sea level. The Basin is limited to the south and east by the Great Dividing Range, which includes Mt Kosciuszko at an elevation of 2228 m. The nature of the Basin means that its rivers tend to meander slowly over plains, so that for example the course of the Darling River is about three times the direct distance between its ends.

There is a range of climatic conditions across the Basin, with cool humid conditions on the eastern uplands supporting areas of rain-forest, and sub-tropical conditions in the north-east. The climate to the south-east is temperate, while the large western plains are semi-arid and arid areas.

1.3 National significance

The Murray-Darling Basin (MDB) is the food bowl of Australia with rich irrigation, farming and grazing land. The Basin accounts for 40% of Australia's agricultural production, utilising about 70% of all water used for agriculture across the nation. The 1,500,000 hectares under irrigation for crops and pastures represents 70% of the total area under irrigation in Australia. More than 80% of the divertible surface water resource is consumed in the Basin. The Basin holds a population of 2 million people, which is about 10% of the national population. In addition to agriculture, there are manufacturing industries that have an annual turnover of more than $10 billion.

There are more than 30,000 wetlands in the Basin, and at the time of European settlement the species in the Basin included 85 mammals, 367 birds, 151 reptiles, 24 frogs and 20 freshwater fish. At present there are at least 35 endangered birds and 16 endangered mammals. There are 11 introduced species of fish and 20 mammals are known to be extinct.

The management of natural resources of the MDB is shared by four State Governments (Queensland, New South Wales, Victoria, and South Australia), the Government of the Australian Capital Territory, and the Commonwealth Government. The Murray-Darling Basin Commission, involving all six Governments, manages the Basin and sets policy for water quality, water allocation, riverine ecosystem health, and terrestrial biodiversity. A Basin Salinity Management Strategy has been developed to manage salinity at basin, catchment and sub-catchment levels to provide a balance between production and environmental needs.

2. GEWEX CONTINENTAL SCALE EXPERIMENTS (CSEs)

2.1 Background

The Global Energy and Water Cycle Experiment (GEWEX) was established in 1988 as a major program of the World Climate Research Programme, with a focus on studies to observe, understand and predict the global hydrologic cycle. A component of GEWEX is the Continental Scale Experiments (CSEs) which involve intensive studies of specific hydrological regions, with the aim of improving the capability to model the coupled land-atmosphere system. Current CSEs are located in USA (GCIP), the Baltic (BALTEX), Brazil (LBA), Asia (GAME), and Canada (MAGS), with an associated experiment in Africa (CATCH).

A set of five criteria have been developed for GEWEX in order to ensure that each CSE has the appropriate level of modelling and observational resources to promote the required improvements in the representation of hydrologic processes in models. These criteria must be satisfied by a project in order for it to be recognised as a GEWEX CSE.

2.2 CSE Criteria for MDBWBP

Criterion (i) The co-operation of a NWP centre which has implemented a state-of-the-art atmospheric and surface data assimilation procedure, and will deliver estimates of hydro-meteorological properties in a form directly comparable to observables.

The BMRC is the research division of the Australian Bureau of Meteorology, and so the project is supported by the numerical weather prediction (NWP) suite of the Bureau run by the National Meteorological Operations Centre (NMOC). The systems used in NMOC are developed and maintained by BMRC. The core operational suite is run twice each day, and it consists of

- a global assimilation and prediction system (GASP) with a horizontal resolution of 75 km
- a limited-area assimilation and prediction system (LAPS) with a horizontal resolution of 37.5 km, nested in GASP to cover the full Australian region
- a limited-area prediction system (mesoLAPS) with a horizontal resolution of 12.5 km, nested in LAPS to cover the Australian continent

The global system (GASP) is integrated to 7 days ahead (Seaman et al., 1995), while LAPS provides forecasts to 48 hrs ahead (Puri et al., 1998). The mesoLAPS system is integrated to 36 hrs ahead.

To support an air-quality prediction system over Sydney and Melbourne, the mesoLAPS system is further nested at a resolution of 5 km over NSW and Victoria. A version of LAPS (TLAPS) is run over the Australian tropics (extending from 45N to 45S), and a special 15-km version (TC-LAPS) is run whenever there is a tropical cyclone in the Australian region.

The assimilation systems in GASP and LAPS use a Generalised Multi-Variate Statistical Interpolation technique to incorporate in situ and satellite data through a 6-hr data insertion cycle. Satellite sounding data are assimilated through a 1D-VAR variational method, which is currently being extended to 3D-VAR.

The MDBWBP uses the mesoLAPS model (with a resolution of 12.5 km) for the analysis and prediction of the water budget over the MDB. This model is used extensively for case studies of special weather events (e.g. Mills, 2001) that lead to the continuing improvement of the operational system.

Verification of the various NWP models is enhanced by a system focused on rainfall. Each day a 25-km resolution analysis of daily rainfall is carried out over the Australian continent, using a Barnes analysis to interpolate raingauge data from about 1500 sites. (The system is currently being upgraded to use a Kriging technique to incorporate satellite data.) The density of raingauge sites varies markedly across the country, such that a finer resolution analysis can be supported in some regions. In particular, a daily analysis is carried out at a resolution of 12.5 km over the south-east of Australia.

Using the daily rainfall analyses, a rainfall verification system (RainVal) has been developed (Ebert and McBride, 1997) to provide detailed statistics on the performance of the various models available to NMOC.

It is clear that the operational NWP suite from the Bureau used to support the MDBWBP provides appropriate estimates of hydro-meteorological properties that can be compared with real-time observations.

Criterion (ii) A commitment of resources and personnel to pursue the development of suitable atmospheric-hydrological models, develop an atmospheric-hydrological data management and assimilation system, and to conduct an appropriate programme of numerical experimentation and climate change studies.

The numerical modelling for the MDBWBP is being carried out in BMRC within its overall modelling research program, which extends from the modelling of mesoscale systems to global coupled modelling for climate variations on time scales from seasons to decades. The atmospheric modelling is carried out within the framework of the unified BMRC Atmospheric Model (BAM).

The modelling research in BMRC is incorporated in the operation of its six research groups, which are listed in Table 2. The modelling systems developed in BMRC are transferred to the operational units of the Bureau to support routine analysis and forecasting. The specific research for the MDBWBP is being carried out in the Weather Forecasting Group, which also has continuing activity on the analysis and model verification of rainfall. Because of the focus on the unified model, the continuing development of the unified system throughout BMRC will directly benefit the MDBWBP.

Research Group	**Group Leader**
Model Development	Kamal Puri
Data Assimilation	William Bourke
Model Evaluation	Bryant McAvaney
Weather Forecasting	Thomas Keenan
Climate Forecasting	Neville Nicholls
Ocean and Marine Forecasting	Neville Smith

Table 2. Research Groups and Group Leaders in BMRC.

Criterion (iii) A regional scientific cooperation mechanism for collecting and managing hydrometeorological data sets, including satellite observations, for supporting and validating the above model developments.

Core data for the MDBWBP are collected and managed through the Bureau's real-time systems, where satellite *in situ* data are processed through the National Meteorological and Operations Centre. The Bureau's observation program involves the collection of data from both surface-based and space-based instruments. There are 50 sites at which upper-air data are taken and 452 sites where cooperative observers take surface synoptic and climate measurements. These surface data are complemented by data from 59 Bureau-staffed stations and from 456 automatic weather stations around the country.

The measurement of rainfall is enhanced through an additional 1690 real-time sites and 3745 climatological raingauge sites operated by volunteers. Other surface data are obtained from remote-sensing instruments, such as weather watch radars, wind profilers and lightning-detection systems.

The Bureau also makes use of satellite-based data in its operations. In cooperation with Japan and China, turn-around and ranging stations are maintained near Melbourne for geostationary satellites in the Australian region, and there is local processing of imagery and sounding data from operational geostationary and polar-orbiting satellites. Satellite-based products from the local processing system include NDVI and surface solar irradiance.

For the MDBWBP, the routine data from the Bureau are being complemented by specialised land-surface data collected by The University of Melbourne. Eighteen sites in the Murrumbidgee River Basin are being instrumented for rainfall, soil temperature, soil moisture and soil suction. There are two groups of five sites along Kyeamba and Adelong Creeks in the eastern sector of the basin, and the other eight are sited within existing Bureau of Meteorology surface stations across the whole basin.

There are several reasons for the soil measurement project to be focused on the Murrumbidgee River. First it is a large catchment with an area of 100,000 km^2 or about 600 grid cells of mesoLAPS. Secondly there is significant spatial variability in climate (alpine to semi-arid), soils, vegetation and land use, and these variations are well documented. Hydrological monitoring in the basin is sufficient to allow the overall water balance to be well estimated. The area is therefore an ideal location for the development and testing of the land surface components of mesoLAPS.

The region is also the centre of a number of other government and research activities, so that the basic infrastructure is sound and there is great interest by local agencies in the use of mesoLAPS output for operational hydrological and water allocation management in the Basin. Finally the region is within a day's drive of Melbourne, and so the monitoring sites can be readily maintained.

The routine measurements will be complemented by intensive field campaigns, aimed especially at describing the spatial variability of soil properties and hence the representativeness of the measurements at each monitoring site. The University of Melbourne's "Green Machine" (Western and Grayson, 1998; Woods et al., 2001) will be used to measure soil moisture in the 0-30 cm layer along 10-km transects around each of the 8 Bureau sites. A north-south and an east-west transect will be made with measurements taken every 500 m.

Criterion (iv) A commitment to participate in the international exchange of scientific information and data in conformity with the general practice of WCRP.

The routine data collected by the Bureau of Meteorology is exchanged nationally and internationally under Resolution 40 of the World Meteorological Organisation, and so there is a clear commitment to the international exchange of data.

To promote the exchange of data and information on the MDBWBP, a web page will be developed on the BMRC web site at http://www.bom.gov.au/bmrc. Data from the soil moisture project in the Murrumbidgee River area will be provided on that site. The data will be quality controlled before it is placed on the web page, and they will include relevant synoptic observations from the Bureau sites in the area.

Criterion (v) Collaboration with water resource agencies or related client/user groups to better utilize improved continental-scale information with the objectives of addressing the problem of assessment of impacts on regional water resources.

The MDBWBP is being carried out under the auspices of the CRC for Catchment Hydrology, which comprises Universities and Government agencies. The key stakeholders in the project are the relevant water authorities for the Murray-Darling Basin, and a planned outcome of the project is to enhance the application of Bureau products by water authorities. A component of the MDBWBP is the development of joint activities with these authorities. The initial activity is a workshop in late 2001 between the research team and water authorities in Victoria and NSW.

3. STATUS OF MDBWBP

3.1 Objectives and strategy

The objectives of the MDBWBP are:

- to enhance the capability of the operational systems of the Bureau of Meteorology to provide accurate and reliable estimates of the real-time surface water budget across the MDB
- to measure the spatial and temporal variability of soil moisture and temperature across one part of the basin (the Murrumbidgee River basin)
- to identify and reduce key limitations in the representation of soil moisture and temperature in BMRC atmospheric model
- to develop products for water authorities in the MDB.

These objectives are being achieved through a program of combined observation and modelling studies, based on the hydrology and spatial modelling expertise at The University of Melbourne and the meteorological modelling expertise in BMRC. Detailed observations of soil moisture and temperature are being collected at 18 sites across the Murrumbidgee River basin, and they will be compared with the results of the BMRC numerical models. These observations will provide a unique data set for the evaluation and development of numerical models.

3.2 Status statement

The project has formally commenced with new science positions in BMRC and The University of Melbourne to support the modelling and observation activities. The modelling is based on the mesoLAPS model of BMRC which is run operationally each day to provide predictions 36 hrs ahead at a horizontal resolution of 12.5 km. Routine verification of the system includes daily evaluation of the rainfall predictions against an analysis of raingauge and satellite data.

The focus of the modelling research for the MDBWBP is on the initialisation and subsequent simulation of soil moisture, using the Viterbo and Beljaars scheme in the mesoLAPS model. The work includes an analysis of the effects of spatial variability at both regional and sub-grid scales. The modelling research is complemented by continuing model development and data assimilation research for the unified BMRC Atmospheric Model.

The field program has commenced, with the 18 sites in the Murrumbidgee River area being selected. The instruments will be deployed in September 2001.

3.3 Scientific issues and results

The basic model for the project (mesoLAPS) is run twice each day over the Australian continent, and its performance is routinely monitored. As shown in Figure 4, the rainfall predictions from the system provide a sound basis for future enhancements under the project.

3.4 Timeline of activities

The plans for the MDBWBP have been established under the planning process of the sponsoring CRC for Catchment Hydrology. At this stage, the project has a three-year duration. However, it could be extended if results from the first phase are sufficiently useful.

The basic timelines for the three components of the project are outlined below:

Modelling
New science position in BMRC - January 2001
Review initialisation procedure for soil moisture - December 2001
Commence evaluation of model simulations against observations - December 2002

Observations
New science position in Melbourne University - January 2001
Site selection for soil moisture observations - July 2001
Installation of soil instrumentation - September 2001

Applications
Workshop with water agencies - October 2001

GLOBAL AEROSOL CLIMATOLOGY PROJECT:
Aerosol Climatology Based on Channel 1 and 2 AVHRR Data

PROGRESS REPORT (1998–2001)

Michael Mishchenko

Since the operational AVHRR algorithm (Stowe et al., 1997) utilizes only one datum per pixel (channel 1 reflectance at a single observation geometry), it can retrieve only one model parameter (optical thickness), whereas all remaining parameters must be fixed *a priori*. It has been suggested that the use of channel 2 as well as channel 1 reflectance measurements can provide additional information on the aerosol model and also improve the accuracy of the optical thickness retrieval (Durkee et al., 1991; Nakajima and Higurashi, 1998). The papers by Mishchenko et al. (1999) and Geogdzhayev et al. (2002) outlined the methodology of inverting channel 1 and 2 AVHRR radiance data over the oceans, described a detailed analysis of the sensitivity of monthly averages of retrieved aerosol parameters to the assumptions made in different retrieval algorithms, and presented a preliminary global aerosol climatology for the period of NOAA-7, -9, and -11 observations. The sensitivity analysis was based on using real AVHRR data and exploiting accurate numerical techniques for computing single and multiple scattering and spectral absorption of light in the vertically inhomogeneous atmosphere-ocean system. It was assumed initially that aerosol particles were homogeneous spheres so that their scattering and absorption properties could be computed using the standard Lorenz-Mie theory. Theoretical channel 1 and 2 reflectances were calculated using a radiative transfer code based on the scalar version of the adding/doubling method. The numerical procedure incorporated the rough ocean surface reflection via the modified Kirchhoff approximation, the water vapor, oxygen, and CO_2 absorption via the k-distribution technique, and gaseous scattering. The upwelling radiances from the ocean body and foam scattering were either ignored or modeled by adding a small Lambertian component to the surface bidirectional reflection function. The atmospheric temperature and humidity profiles were taken from the ISCCP version of the TOVS data, while the vertical distribution of ozone and water vapor was based on a standard atmospheric profile. The vertical profile of aerosol was taken to be the same as the normalized profile of water vapor. The radiative transfer code was used to compute a look-up table in which multidimensional arrays of theoretical channel 1 and 2 reflectance values for all viewing geometries and aerosol and atmospheric parameters were stored. The look-up table was then used to retrieve the aerosol optical thickness and size using cloud-screened channel 1 and 2 radiance data. Each pixel was mapped on a 1˚ by 1˚ global grid. The retrieved values of the aerosol parameters for all pixels within one grid cell were averaged to produce a map for a specified period of time.

The main results of this sensitivity study of the expected performance of two-channel aerosol retrieval algorithms can be summarized as follows.

- Two-channel algorithms can be expected to provide significantly more accurate and less biased retrievals of the aerosol optical thickness than one-channel algorithms.
- Imperfect cloud screening is a major source of errors in the retrieved optical thickness. This problem is difficult to solve definitively and should be addressed by means of extensive ground-based observations, careful statistical analyses of the radiance data, and, potentially, comparisons with future results from more advanced satellite instruments.
- Two different ways of computing the average aerosol size (direct versus optical-thickness-weighted) can be expected to produce similar results because of weak correlation between the aerosol optical thickness and size.

- Both underestimating and overestimating aerosol absorption as well as the potentially strong variability of the real part of the aerosol refractive index may lead to regional and/or seasonal biases in the retrieved aerosol optical thickness.
- Neglecting the diffuse component of the ocean reflection function can affect the retrieved optical thickness in the cases of low aerosol loads.
- Simple monthly average of the Ångström exponent appears to be the most invariant aerosol size characteristic and should be retrieved along with optical thickness as the second aerosol parameter.
- For some pixels the best retrieval in terms of yielding the minimal difference between the measured and modeled radiances is obtained for Ångström exponents corresponding to either the maximal (1.75) or the minimal (0.0) A value allowed by our look-up tables. This creates a problem of how the pixels yielding either A = 0 or A = 1.75 should be treated. For example, very small retrieved Ångström exponents correspond to large particles and may be interpreted as a sign of undetected cloud contamination. Alternatively, the cases of out-of-range Ångström exponent values may be caused by imperfect radiance calibration or result from using fixed global values of certain model parameters that are significantly different from their actual values for specific pixels at the time of the measurement. Given this uncertainty, it has been decided to modify the final aerosol product by creating two separate Ångström exponent data sets which may be called “constrained” and “unconstrained” versions. In the unconstrained version, all pixels are taken into account in computing the average A value, whereas the constrained version excludes pixels with A = 0 or A = 1.75. In both cases all pixels contribute to the optical thickness average.
- Radiance calibration uncertainties may be among the main factors hampering the retrieval accuracy. Specifically, the addition/subtraction of one digital count to/from the AVHRR radiances can cause changes in the retrieved aerosol optical thickness exceeding 40% in open ocean areas. Given the significant spread in the published calibration constants, it is unlikely that a significant breakthrough in the retrieval accuracy may be achieved based on the AVHRR data alone. Instead, the way to solve the calibration problem may be to use advanced global satellite retrievals (Kahn et al. 1998, 2001; Tanré et al. 1997; Deuzé et al. 2000) as a benchmark.
- The two-channel algorithm shows a significant degree of insensitivity to a specific choice of the aerosol particle size distribution function. One should expect only small (.10%) changes in the retrieved aerosol optical thickness and changes less than 0.3 in the Ångström exponent when switching from one size distribution function to another [Figs. 2(a) and 2(b)]. This conclusion appears to be independent of other model and calibration assumptions.
- The CCN column number density cannot be reliably retrieved from the 2-channel AVHRR data. A change in the assumed analytical representation of the aerosol particle size distribution can lead to changes in the retrieved CCN concentration exceeding 300% [Figs. 2(c) and 2(d)].
- The assumption of a fixed global value of the wind speed leads to errors less than 10% in the retrieved aerosol optical thickness and less than 0.125 in the Ångström exponent relative to the results obtained using real-time wind speed data. Taking real-time wind speed data into account may improve the accuracy of regional retrievals in the areas where strong wind patterns exist, although on the global scale the accuracy gain may be masked by other uncertainties.

- Global monthly mean values of the aerosol optical thickness show no significant trend over the lifetime of the NOAA-9 satellite (February 1985 through November 1988). The derived average global values are 0.15 for the optical thickness and 0.85 for the constrained Ångström exponent. However, these values depend on the assumed calibration and aerosol optical model, the main source of errors being the uncertainty in the deep space count.
- There is a discontinuity in the retrieved Ångström exponents at the time of NOAA-9 to NOAA-11 transition and a significant trend in the Ångström exponent not consistent with the Mt. Pinatubo eruption (Figs. 3 and 4). This is likely to be an indication of a serious calibration problem.
- The NOAA-9 record reveals a seasonal cycle with maxima occurring around January-February and minima in June-July in the globally averaged aerosol optical thickness. The Northern hemisphere mean optical thickness systematically exceeds that averaged over the Southern hemisphere. Zonal means of the optical thickness exhibit an increase in the tropical regions of the Northern hemisphere associated with annual desert dust outbursts and a spring time increase at middle latitudes of the Northern hemisphere. Increased aerosol loads observed at middle latitudes of the Southern hemisphere are probably associated with higher sea salt particle concentrations. Reliable extension of the retrieval record beyond the NOAA-9 lifetime will help to corroborate these findings.

Although the initial processing of the entire ISCCP data set is essentially completed, several important issues still need to be addressed. These include an improved calibration of AVHRR channel 1 and 2 radiances, the inclusion of stratospheric aerosols for the periods of volcano eruptions, and the effect of nonsphericity of dust-like aerosols on the optical thickness and Angstrom exponent retrievals. The expected final result will be a flexible and compact algorithm that could be combined with the ISCCP cloud retrieval algorithm and used for simultaneous operational retrievals of cloud and aerosol properties. Further research will focus on validation and fine-tuning of the aerosol algorithm based on various kinds of in situ, ground-based, and aircraft data and calibration of the global aerosol product using more advanced results from the MODIS and MISR instruments.

Global Precipitation Climatology Project (GPCP)
Report for SSG

January 28, 2002

1.1 **Arnold Gruber, Director**

Current Status

The GPCP is currently producing several global and quasi-global precipitation products. The primary data sets are the blended or merged satellite and gauge products. These include monthly mean precipitation estimates at 2.5 x 2.5 degree grids for the globe from 1979 and continuing; daily 1 x 1 degree estimates beginning in 1997 and continuing and pentad, 2.5 x 2.5 degree precipitation estimates also beginning in 1979. The first product listed will replace an earlier version identified as Version 1 that began in July 1987 and was not globally complete. Also, the data sets as well as Version 1 are available online from World Data Center A at http://lwf.ncdc.noaa.gov/oa/wmo/wdcamet-ncdc.html. An example of the three data sets are shown in **Figure 1 and 2** for a limited target area during July 1999.

The precipitation components of the merged analysis are also available. These include the geostationary precipitation index (GPI) based on infrared observations and an infrared polar orbiting version, microwave emission and scattering estimates from the Special Sensor Microwave Imager (SSM/I), and a gridded gauge analysis prepared by the Global Precipitation Climatology Centre (GPCC), at Deutcher Wetterdienst, Offenbach, Germany. In 2001 the GPCC completed an analysis of the expanded gauge network (30,000 stations) for the period 1986-1995. A 0.5 degree analysis has been performed and made available to the ISCCP II data High density surface reference data sets are available for comparisons and validation from the Surface Reference Data Center (SRDC), at the Environmental Verification and Analysis Center at the University of Oklahoma.

Geostationary satellite data collection is done at 1 x1 degree 3 hourly and is globally complete since Meteosat 5 is over the Indian Ocean Sector. Additionally, we have been obtaining INSAT geostationary data since 1999.

In order to accomplish these tasks; data collection, precipitation estimates, merging satellite and gauge data and validation activities has organized itself into several components as shown in Figure 1. Geostationary data collection is done by the satellite operators designated Geostationary Satellite Data Processing Centres (GSDPC) and those data are merged by the Geostationary Satellite Precipitation Data Centre (GSPDC) . The microwave emission and scattering estimates are accomplished by Centres located at NASA and NOAA, the gauge data collected and analyzed at the Global precipitation Climatology Centre (GPCC) and the merging of satellites and gauges is done at the GPCP Merge Development Center (GMDC) at NASA. **Figure 3** shows the organizational structure of GPCP.

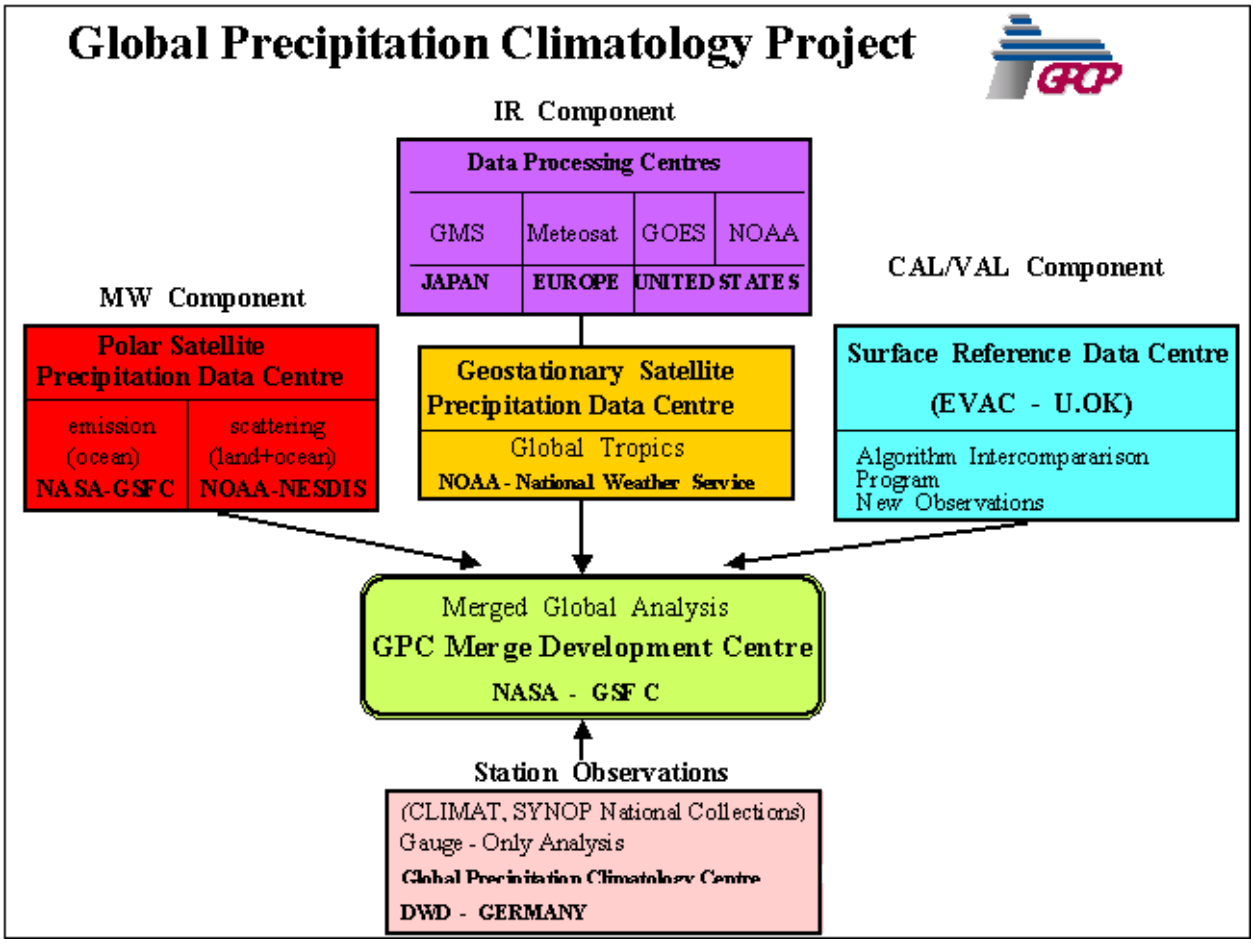


Figure 3. Organizational Structure of GPCP

Summary of Significant Accomplishments Since Project Inception

1986- GPCP project initiated. Dr. P. Arkin is GPCP Manager. Initial satellite rainfall algorithms were based on geostationary infrared and microwave emission models. Basic structure established for satellite data collection gauge analysis, and validation. Three algorithm intercomparison projects (AIP) planned.

> 1989 - AIP -1 conducted over Japan and the surrounding waters during June-August. Included "BAIU" frontal precipitation as well as tropical convective rainfall.

> 1991 - AIP-2 was conducted over a large region of western Europe during February-April. Included rain and snowfall over land and ocean.

> 1992-93 - AIP - 3 evaluated satellite estimates of rainfall associated with tropical convection. It utilized data from the intensive Observing Period of the TOGA-COARE experiment November 1992-February 1993.

>1994 - Microwave scattering algorithm for use over land was selected.

>1995- Arnold Gruber takes over as Manager of the GPCP.

> 1995- GPCC provides gridded analysis for 1987-88 for ISLSCP CD ROM

> 1995- Automated quality control of GTS gauge data implemented by the Global precipitation Climatology Centre. Gauge analysis can now be produced with a 1-2 month turn around.

> 1995 - A blended analysis procedure is developed that blends satellite and gauge data. This is the final step in producing a satellite data set.

> 1995 - International Workshop on Research Issues on the Identification and Partitioning of Precipitation Type and Rates in Global Data Sets.

> 1996 - Version 1a merged analysis produced July 1987 - 1996. It is a monthly mean, 2.5 x 2.5 degree latitude/longitude quasi global data set (60N-60S) available on line from NCDC. Also, it includes individual components (IR and MW satellite estimates and gauges) and error estimates.

> 1996 - 1 x 1 degree, 3-hourly geostationary IR data collection initiated - November. This is experimental and the normal 2.5-degree 3hourly pentad data was collected as well

> 1997 - The GPCP established the GPCP Merged Development Centre at the NASA GSFC. GMDC is responsible for continued development and production of merged precipitation data sets.

> 1998 - Publication of the Version 1a data set on CD-ROM. It contains data from July 1987 - December 1987. It includes 43 Surface Reference Data Centre high gauge density grids, the Pacific Atoll rain gauge data and all rain component fields and associated error estimates.

> 1998 - 2.5 x 2.5 degree pentad collection ceased (December)

> 1998 - The SRDC moved to the Environmental Verification and Analysis Centre at the University of Oklahoma. There are 45 reference sites at locations around the world.

> 1998 - Indian Ocean area from Meteosat 5 data now being received

> 1999 - Receiving INSAT data since December 1999. These data come via the Indian/US Cooperative Agreement in satellite activities.

> 1999 - A workshop “Use of Precipitation in the Study of Global and Regional Climate Variability, Modeling, Surface Hydrology and Water Resources” in Silver Spring, Maryland from May 10-12, 1999.

> 2000 - Three new data sets were approved by the GPCP WGDM: they are a globally complete monthly mean 2.5 x 2.5 degree latitude/longitude beginning in 1979 and continuing, a daily 1 x 1 degree data set beginning in 1997 and continuing, and a 2.5 x 2.5 degree pentad data set, beginning in 1979.

>2000 - Participation in the ISLSCP II data set production; provision of 1 x 1 degree gauge analyses, and pentad data set provided. Temporal desegregation of monthly means will be performed from ISCCP DX data.

> 2001 - 0.5 x 0.5 degree analysis of expanded gauge data set (30,000 gauges) completed and made available to ISLSCP II.

> 2001 - TRMM data is helping GPCP products. Analysis of TMI and SSM/I retrievals of rain over the ocean shows that on average TMI is equal to the average value of SSM/I F13 and F14 satellites. However, TMI error is larger indicating the importance of sampling on the non systematic error structure. Over land the TRMM data has helped improve the SSM/I scattering algorithm, removing a high bias.

> 2001 - Water balance over the oceans studied with mix of observations (GPCP precipitation, GVaP water vapor) and model data (NCEP re-analysis winds). Preliminary results suggest that mix of observed and model dependent data make it extremely difficult if not impossible to close water balance.

- 2001 - Comparisons between Meteosat 5 and INSAT for July 2000 show a systematic difference - Meteosat higher than INSAT near the diurnal peak 09-12 GMT and minimum (near zero difference) near 21 GMT.

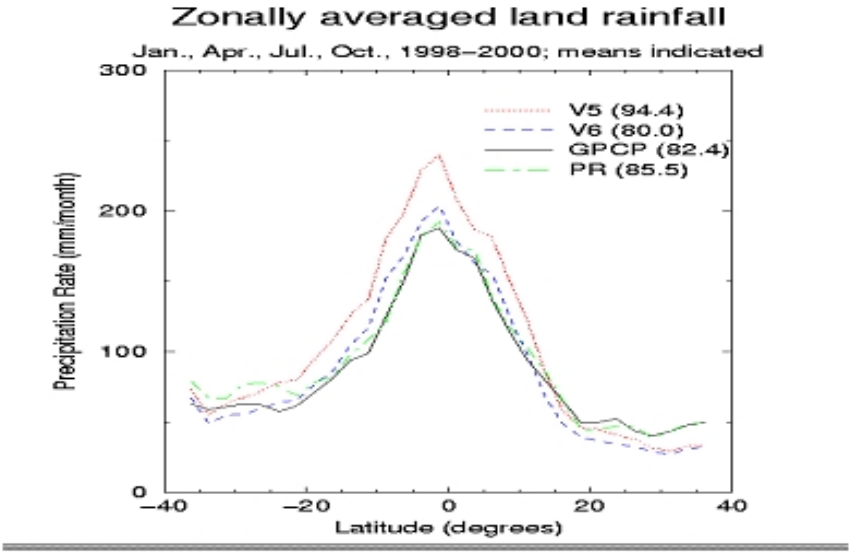


Figure 4. A comparison of a new SSM/I over land retrieval algorithm (V6), with the one used in GPCP (V5). The new algorithm was developed for AMSR and will be used in TRMM. Zonal averages over land are shown. Also included are the TRMM PR and the GPCP estimates over land.

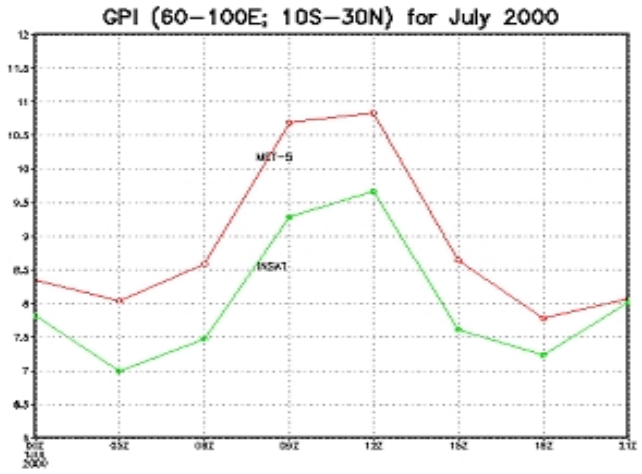


Figure 5. A comparison of rain estimates using GPI (mm/day) from Meteosat 5 and INSAT. Note the good phase relationship but systematic difference between the two estimates.

GPCP Plans for 2002

Continue with the production and enhancements of data sets. This would include the incorporation of improved microwave retrieval algorithms as described above and , and development of procedures for the use of multiple satellites, e.g., TRMM, SSM/I and AMSU. Analysis of data in attempts to answer global climate change questions, such as trends, global water balance and spatial and temporal variability of precipitation on scales ranging from daily to interannual.

Continue to seek funding for development of regional climate data sets at 50Km, hourly resolution. A major part of this effort is the assessment of new algorithms, that could also be incorporated into the existing global data set.

Continue to seek GEWEX support for a proposed workshop on the Objective Analysis of Precipitation. This was initiated because there are two different large scale precipitation analyses that exist which, while similar in many respects, exhibit some differences which are related to how the satellite and gauge data are merged. This Workshop, proposed by myself and Dr. M. Kanamitsu, will examine the many issues associated with merging spatially and temporally discontinuous data from different sources i.e., gauges and various satellites. It became obvious that there are other GEWEX elements that involve blending in situ and remotely sensed data and/or analyses of discontinuous fields such as clouds and radiation, and so the proposed workshop may be broader than to examine objective techniques for analyzing precipitation data.

ISSUES FOR SSG

Objective Analysis Workshop (See 2002 Plans above)

Regional Precipitation Estimates - this is an effort that we have had difficulty getting funded. We have tried to do this by proposing, without success, to GAPP and NASA GWEC. Perhaps it would be better if both GRP and GHP joined together for such an effort. This may or may not be something that the SSG wants to endorse at this time - however, it would represent an intersection between the regional efforts and the global scale.

GEWEX Surface Radiative Budget Project:

Status Report for December 2000 – December 2001

Paul W. Stackhouse, Jr.
NASA Langley Research Center

S. K. Gupta, S. J. Cox, M. Chiacchio, J. C. Mikovitz
Analytical Services and Materials, Inc.

Paula T. Detweiler and John O. Olson
Scientific Applications International, Inc.

Hampton, VA
December 2001

The following report summarizes the status of the WCRP/GEWEX Surface (SRB) Climatology Project since December 2000. During 2001, work has continued under the the NASA Modeling Data Analysis Research (MDAR) Earth Observing System Interdisciplinary Science Program (EOS/IDS). GEWEX SRB continues to work toward the release and validation of a 12 year SRB data set spanning July 1983 – October 1995. The proposal calls for data processing, validation and analysis activities as illustrated in Figure 1. During the past year, all of the algorithms have been changed to correct or improve codes as necessitated by validation efforts on the test months. Additionally, the codes were updated to include new data quality information to assist in the validation efforts. All the changes are noted below. As of the date of this writing, 2 full years (1986 and 1992) of data have been processed through the GEWEX shortwave (SW; 0.28 – 5.0 μm), SW Quality Check (QC) and longwave (LW; 4.0 - ∞ μm) QC flux algorithms. These two full years are being made available to the SRB users (Table 1) and other interested researchers via ftp. The current status, recent and past accomplishments are summarized blow.

Current Status:

During the past the SRB has delivered modified processing codes to the NASA Langley Atmospheric Sciences Center (ASDC – or formerly DAAC) for processing. ASDC has reprocessed the original 10 test months twice and now has processed twice two full years for all the SRB processing codes except the GEWEX LW code which is still being tested. Below is a review of the SRB project status.

1. Code Status (codes running at NASA Langley ASDC):
    a. International Satellite Cloud Climatology Project (ISCCP) DX processing operational; 26 months archived
    b. NASA DAO GEOS-1 processing operational; 26 months archived (DAO has supplied Dec. 1993 – Nov. 26, 1995; these data are not archived at the NASA Goddard DAAC)
    c. TOMS column ozone processing complete; July 1983 – Dec. 1994
    d. SW (Pinker/Laszlo) processing operational; 26 months archived
    e. LW (Stackhouse/Fu) running at 1^{o}, not operational at ASDC; testing and validation continuing for 4 months in 1992.
    f. SW Quality Check (QC; originally Staylor model, now updated and corrected and called Langley Parameterized Shortwave Algorithm, LPSA) processing operational; 26 months archived
    g. LW QC (Gupta) processing operational; 26 months archived

2. Data status:
    a. Processed and archived for internal use the years 1986 and 1992 plus two months from 1989.
    b. Two full years of data made available to SRB Users Group via ftp.
    c. Six months of data has been sent to International Satellite Land-Surface Climatology Project (ISLSCP) Initiative II CD group. The remainder of the two years will be sent as ISLSCP can accommodate the data flow.

3. Validation and Research Activities:
    a. Continuing comparisons between surface flux measurements and newly processed products.
    b. Concluding comparisons between the NASA GEOS version 1 reanalysis (GEOS1), the European Community Medium-Range Weather Forecast 15-year reanalysis (ERA-15), the NASA Water Vapor Project (NVAP) water vapor data set and ISCCP surface meteorological parameters. Analysis includes the diurnal cycles. Collaborating with NASA Goddard Institute of Space Studies (GISS) to compare other data sets.

4. Documentation:
    a. Processing System/Algorithm/validation documentation being drafted for reports and publications
    b. Web pages being upgraded to include processing status links
    c. Data files being prepared for inclusion into ASCD archive

Accomplishments for GEWEX SRB Project: 12/00 – 12/01

1. SRB Processing System/Algorithm Updates and Status

The new processing system was implemented and tested at the ASDC. Several of the codes were updated as a result of a need for standardization and after validation of data products identified problems. New quality control parameters were added to each of the codes. A brief overview is given in Table 2 below. The GEWEX SW, SW QC, and LW QC have been fully implemented to the new processing system and have been enhanced with new data quality information. These codes have been processed for 26 months including the full years of 1986 and 1992. Progress on getting the GEWEX LW code operation was delayed to accommodate the changes and upgrades to the upstream processing codes. However, the code is now running in test mode at 1^{o} resolution and will be operational at ASDC within 1-2 months.

Of the 26 months, 24 are being made available to SRB Users Group and interested researchers. A special ftp access site has been setup for this purpose at the ASDC and we expect all SRB user group members to have access by the end of December, 2001. In addition, SRB has delivered 1 year of data files to ISLSCP for evaluation and eventual inclusion on the ISLSCP Initiative II CD.

2. Validation Results

The output flux products from the GEWEX SW, SW QC, and the LW QC algorithms were compared to the daily and monthly averaged observations from the World Radiation Data Centre (WRDC) and the NOAA Climate Modeling Diagnostics Laboratory (CMDL) data sets, the Baseline Surface Radiation Network (BSRN) and the radiometric data from the Meteorological Service of Canada from 1983 through 1995.

The new estimates of surface fluxes were compared to BSRN measurements for both SW and LW estimates in 1992. Comparisons are all 1992 observations are giving mean difference and RMS for monthly averaged SW and LW of –2.0 and 20.4 W m^{-2}, 3.0 and 19.6 W m^{-2} respectively. The integrated monthly averaged diurnal cycles of SW agreed with BSRN measurements generally within about 10% with some exceptions that are being investigated. The LW monthly averaged fluxes have now also been compared to BSRN measurements with mixed results depending upon location and season. The sources of these differences are being explored in the work outlined below.

The WRDC data set includes a number of broadband hemispheric radiometric time series from as many as 1000 sites distributed globally. Comparisons of the SW algorithm results to these observations are now being analyzed in terms of latitudinal zones, surface types (including coastal vs. noncoastal) and by topography in an effort to better understand the results. In general, the bias errors have become systematically less in an absolute sense (i.e., some biases errors changed sign from positive to negative) and RMS differences remain very close to those obtained from the previous version using ISCCP C1 at the 280 km equal area grid.

3. Other Research

a. Meteorological analysis: We have concluded comparisons of the GEOS-1 surface properties to that of ERA-15. For additional contrast column water *Other Research* Meteorological analysis: We have concluded comparisons of the GEOS-1 surface properties to that of ERA-15. For additional contrast column water vapor from the NVAP project and skin temperatures from ISCCP were also compared. The LW and SW fluxes were computed using these reanalysis profiles and ISCCP clouds to get the sensitivity of the fluxes under all-sky conditions. The diurnal cycles of the skin-temperatures and resulting fluxing were also compared. Additional comparisons will be conducted in collaboration with GISS.

b. Calibration monitoring: Collaborating with Yongxiang Hu and Bruce Wielicki of CERES, we have applied an approach to compare albedos of optically high cold cirrus clouds. The approach includes only those pixels between 40^{o}N and 40^{o}S with brightness temperature less than 205 K. The pixels are binned according to angle. Albedos are computed using angular distribution models build using visible from the VIRS instrument on TRMM. Missing angles from VIRS are filled using least squares and theoretical cirrus radiative transfer properties. The June-July-August season for both 1986 and 1992 were compared. The albedos in 1992 are shown to be systematically higher. Whether this is due to the effects of the Mount Pinatubo aerosol is unknown. Despite the change, the albedos from each satellite and the combined pixels selected according to ISCCP hierarchy agree within the uncertainties cited by ISCCP.

c. Two-year intercomparison: The two full years of SRB that have been processed, 1986 and 1992, are being compared to find and explain the differences. We find global annual averages consistent within 1-2 W m^{-2} for surface fluxes which considering the uncertainties may mean that the fluxes are statistically indistinguishable. However, we note that the solar insolation decreased by 0.9 W m^{-2} despite the fact that cloud fraction and cloud average optical depth decreased. The TOA albedo increased from 31.5% to 31.8% and the global solar surface albedo increased from 11.7% to 11.9% consistent with an insolation reduction. These changes seem only to be explained by the presence of aerosol unaccounted for in ISCCP and SRB processing, but more investigation is required. Differences in the zonal annual average latitudinal ranged from 5-10 W m^{-2} with asymmetric differences between and northern and southern hemisphere tropics/subtropics. Monthly averaged global annual cycle showed a several month delay between maximum differences in SW and LW. Geographical differences were found to be large and consistent with classic El Niño patterns. This comparative analysis will continue and be extended.

Accomplishments since Project Inception

The SRB project at Langley has produced one past 4-year SW-only data set (Whitlock et al., 1995) which has been well used and cited by the research community. In the early years of the project much emphasis was given to the validation of the ISCCP calibration that included conducting field operations over desert targets. The algorithms selected for the first data set were competed as submitted by the research community. Early LW results produced erratic results due to calibration uncertainties in the measurements and to large uncertainties in atmospheric profile (especially in the boundary layer), cloud base and surface properties.

Within the last few years the emphasis has changed from strictly a processing and validation project to one where new algorithms are derived and tested as well. A new LW model is being developed and tested taking into account the physics of the surface. Additionally, all the algorithms were updated and adapted to run at a higher resolution of 1^{o}x1^{o} using cloud properties derived from the ISCCP DX pixel data set. This year, 2 full years of 1^{o}x1^{o} SRB parameters (1986 and 1992) from three algorithms were processed. These data have been made available via an anonymous ftp site for the SRB users and those requesting the data. Preparations are continuing to put these data into the NASA Langley ASDC (formerly, DAAC) for more public access. Processing is continuing.

Current Timeline Schedule

Figure 2 delineates the tasks and milestones planned through June 2002. The most important of these is complete the processing of this GEWEX SRB Release 2 and provide for its distribution to at least the SRB user group. At our current rate of processing, including the implementation and processing of the GEWEX LW code, we expect a 118 month data set (Jan. 1986 – Oct. 1995) near March 2002. Since the LW is not yet fully operational and requires a longer runtime, the other algorithms may be processed and archived ahead of the fluxes from this algorithm. These data will be made available to the SRB user group as processed. Public distribution of the full July 1986 – Oct. 1995 data set via the ASDC web site is scheduled to begin in June 2002. Concurrent with this processing, we plan to submit a Bulletin of American Meteorological Society article in the Spring 2002 and release a NASA technical report documenting the data set. Additionally, validation and intercomparisons are planned between SRB and researchers with other surface radiation products as well as interaction with the SRB user group.

Table 1: GEWEX SRB evaluation user/team members, organizations and research applications for the new 1^o SRB data set.

Category	**Member**	**Organization**	**Application**
AGCM and Re-analysis projects	Dr. Peter Gleckler	WCRP/AMIP, Program for Climate Modeling Diagnosis and Intercomparison, Lawrence Livermore National Laboratory, USA	Evaluate 1^o GEWEX SRB/TOARB data sets for use as a diagnostic for ocean surface fluxes computed by state-of-the-art AGCM's.
	Dr. Jean-Jacques Morcrette	European Centre for Medium Range Weather Forecasts, United Kingdom	Validation of ECMWF 15 and new 40 year Re-Analysis (ERA-15,40); validation of 10 day forecasts
	Dr. Fred Prata, Dr. John Garratt	CSIRO Atmospheric Research, Australia	Validation of AGCMs particularly vegetation/albedo and SRB/clouds; to contribute surface measurements
	Dr. Brian Soden, Dr. V. Ramaswamy	Geophysical Fluid Dynamics Laboratory, NOAA/ERL, Princeton University, USA	Validation of GFDL AGCM; surface/atmosphere energy budgets from satellites and models
Biological	Dr. Scott Goetz	Laboratory for Remote Sensing Studies, Dept. of Geography, University of Md., USA	Global terrestrial net primary production efficiency modeling using PAR fluxes; global CO_2 dynamics
Cryospheric	Dr. Jeffrey Key	Cooperative Institute for Meteorological Satellite Studies, Space Science and Engineering Center, University of Wisconsin, Madison, USA	Comparison with: Polar Radiative Flux project for Arctic and Antarctic, surface and TOA observation, and surface albedo/emittance from ice/snow maps.
Hydrology	Prof. David Maidment	Center for Research in Water Resources, Department of Civil Engineering, University of Texas at Austin, USA	Regional water balance computations for evaporative fluxes; coastal surface energy budgets
	Dr. P. Chris D. Milly	US Geological Survey, Water Resources Division, Princeton, NJ, USA	Temporal variability in land water and energy balances
Atmospheric Science/Energy Budgets	Dr Ernesto Lopez-Baeza.	Dept. de Termodinamica Facultat de Fisica. Universitat de Valencia, Spain	Regional SRB of Mediterranean Basin; assess changes due to increase in resolution.
	Dr. Ilias Vardavas	Environment Research Laboratory, Foundation for Research and Tech. – Hellas (FORTH), Greece	Evaluate cloud data for use in own SRB/TOA fluxes, intercomparison; Mediterranean basin application

Figure 1: SRB logistical organization under the new proposal. The end users include a SRB Users Group that will assist with feedback on the data quality.

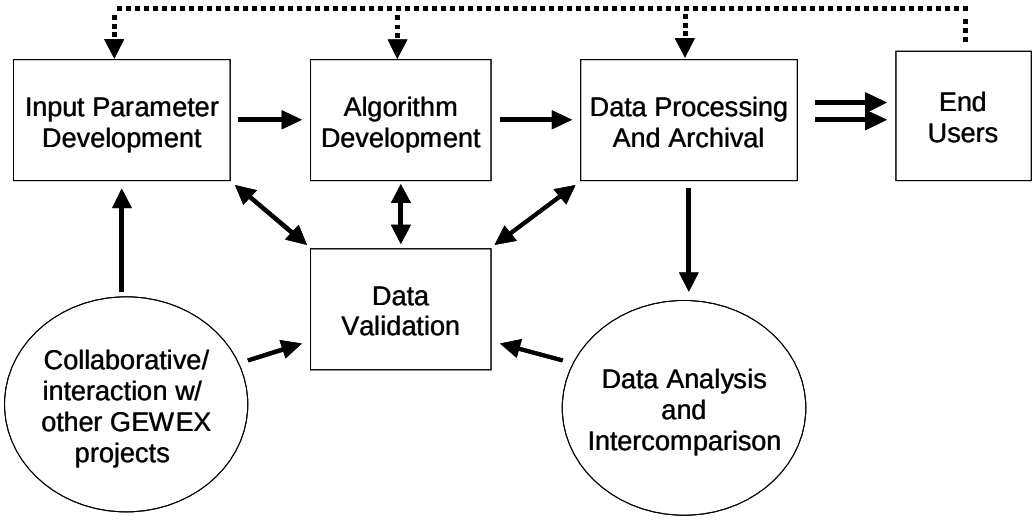
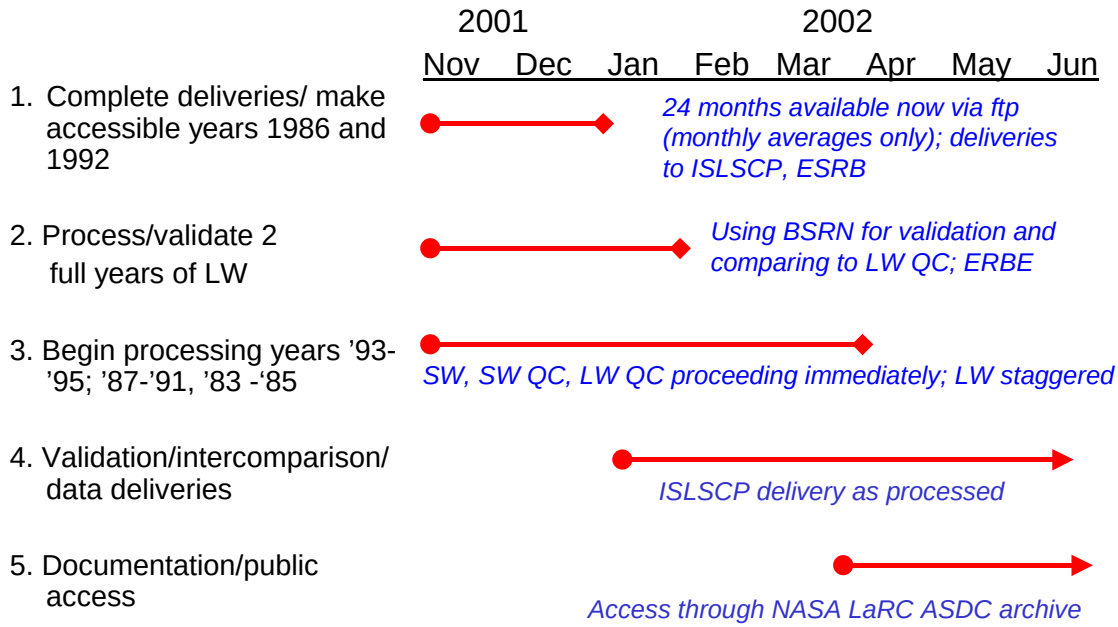


Table 2: Summary of codes changes during past year 2000 – 2001.

Nodes	Description
ISCCP merged DX	Code improvements required and delivered to ASDC
ISCCP gridded DX	Code improvements required, optical depth averaging corrected; delivered to ASDC
GEOS-1	Parameters updated; error checking upgraded for spatial-temporal interpolation; delivered to ASDC
TOMS Ozone	No substantial changes
SW	No substantial changes; GADS/GFDL background aerosols found to produce unpredictable results
SW QC	Upgraded to F90/95 w/ improvements to several parameterizations; coefficients code upgraded; delivered to ASDC
Cloud gap filling	Several parameters added for use in SW QC; delivered
LW	Running at 1^{o} resolution in testing state; ASDC delivery for implementation expected in 1-2 months.
LW QC	No substantial changes

Figure 2. Schematic of task plans and milestones for 2002.



STATUS and PLANS of GCSS WORKING GROUPS

WG1 (Boundary Layer Cloud Systems) Status and Plans

The Boundary Layer Cloud Working Group aims to improve physical parameterizations of Boundary Layer clouds, other boundary layer processes, and their interactions. The methodology is to conduct intercomparisons between observational or laboratory case studies, one-dimensional GCM column model results, and 2-dimensional (2D) and 3-dimensional (3D) eddy-resolving models of cloud-topped boundary layers. The main contributors to this effort include the leading boundary layer cloud modelling groups from around the globe, which continue to participate in the on-going series of WG1 workshops. The Boundary Layer Clouds working group is currently chaired by Prof. Peter Duynkerke P.G.Duynkerke@phys.uu.nl of the Institute for Marine and Atmospheric Research Utrecht (IMAU), The Netherlands. Updates on actions being taken by the Group are available by joining an email list. The email box identification is gcss-l@phys.uu.nl. To join, send a message containing the words "subscribe gcss-l" to server Majordomo@phys.uu.nl. The other source of information on the status of the Boundary Layer Clouds Working Group work is on the Internet at: http://www.atmos.washington.edu/~breth/GCSS/GCSS.html.

The two highest priority studies now under investigation by WG1 are, a continental shallow cumulus boundary layer diurnal cycle (ARM Oklahoma site) case that was presented at the January 2000 WG1 workshop held at Boulder, CO, USA and a diurnal cycle of stratocumulus case that uses data taken off of the coast of California, USA during the FIRE 1987 experiment. The case coordinator for the continental shallow cumulus case is Dr. A. Brown from the UKMO. Dr. Brown's email address is arbrown@meto.govt.uk. The case summary and specifications can be obtained by anonymous file transfer (ftp) from <email.meto.gov.uk> where it is necessary to first type the phrase "connect email.meto.gov.uk" and then the phrase "cd pub/apr/arm". The necessary files can then be obtained. The case coordinator for the FIRE '87, diurnal cycle of stratocumulus case, is Dr. Peter Duynkerke from IMAU. Dr. Duynkerke's email address is P.G.Duynkerke@phys.uu.nl. The case specifications for this case are still being developed.

The priority issues now under consideration by WG1 have followed earlier work on several test cases. For example, because no attempt had been undertaken previously to do a systematic intercomparison of non-precipitating (shallow) cumulus convective type boundary layer clouds, a test case with those characteristics was chosen from phase 3 of the Barbados Oceanographic and Meteorological Experiment (BOMEX) from 22 June to 30 June 1969. Since this was the first intercomparison study on shallow cumulus convection, a trade wind cumulus case with vertical profiles, which are typical for a large part of the trade wind region, was selected. More information on this case can be found at: http://www.knmi.nl/~siebesma/gcss/bomex.html.

In 1998 an intercomparison was undertaken that was based on an idealization of observations made during the Atlantic Tradewind Experiment (ATEX). This case was chosen for study because it was felt that it represented a more "typical" tradewind regime; one in which cloud fractions were nearer 50 percent.. More information about this case can be found at: http://www.asp.ucar.edu/~bstevens/atex/contents.html.

WG2 (Cirrus Cloud Systems) Status and Plans

WG2 is working to advance development of physically based parameterizations of cirrus cloud processes for implementation in large-scale models used for climate simulation and numerical weather prediction (NWP). State-of-the-art general circulation models (GCMs) now explicitly predict the occurrence and amount of cloud ice in the atmosphere. Models such as the ECMWF model produce cloud ice (cirrus) in a qualitatively

realistic fashion, both via large-scale ascent (dominant in winter hemisphere middle latitudes) and via detrainment from deep convective cloud systems (Jakob, 2000). However, there is little observational guidance in terms of the actual ice water budget of the atmosphere, especially at cold upper tropospheric levels where the radiative impact of clouds can be quite strong in the infrared spectral region. Thus, present GCM results show significant range, even for gross parameters such as the global mean ice water path (Rasch and Kristjansson, 1998). The fundamental approach of WG2 is to conduct systematic quantitative comparisons of cirrus cloud models, including CRMs and SCMs as well as the (parcel) models underlying the treatment of cloud microphysical development in CRMs. The intent is to identify key processes and parameters leading to significant inter-model differences such that the investigators and measurements can be focused on resolving those differences. The ultimate goal is to validate the CRMs versus observations and then to use these models for studies supporting parameterization development in GCMs.

The focus of the research has been on results of the first two WG2 projects. These projects are the Idealized Cirrus Model Comparison (ICMC) Project, developed and led by Dr. Starr (WG2 Chair at NASA GSFC), and the Cirrus Parcel Model Comparison (CPMC) Project, developed and led by Dr. Ruei-Fong Lin (USRA at NASA GSFC). Other members of WG2 contributed to the development of these test cases including Dr.. Phil Brown (UKMO) and Dr. Paul Demott (CSU). Consideration for possible future WG2 projects are being focused on existing well-observed cirrus cases at the Southern Great Plains (SGP) ARM site in Oklahoma, as well as future cloud IOPs planned there. Plans related to the FIRE CRYSTAL (Cirrus Regional Study of Tropical Anvils and Layers) experiments and other relevant field activities are also being followed carefully for possible future WG2 test cases. Most recently it was agreed that the Group should pursue an observed cirrus case study and that the SGP ARM data sets were the most appropriate available candidates. Drs Starr and Mace agreed to lead this effort to begin in 2000-2001 time period.

A copy of the paper with the preliminary results from the ICMC and CPMC activities may be found at the GCSS WG2 web page: http://eos913c.gsfc.nasa.gov/gcss_wg2/.

Specific test cases being developed include, the ARM-94 Cold Cirrus Case described in Sassen, K., G.G. Mace, J. Hallett, and M.R. Poellot, 1998: Corona-Producing Ice Clouds: A Case Study of a Cold Midlatitude Cirrus Layer. *Appl. Optics*, 37, 1477-1485; the EUCREX-93 Warm Cirrus Case; and Anvil Simulations case(s).

WG3 (Extra-Tropical Layer Cloud Systems) Status and Plans

Layer cloud systems are a major component of the extra-tropical region and they consequently play a fundamental role in the water and energy cycles of the mid-latitudes. The main scientific issue for this working group is to ensure that critical aspects of these systems are suitably represented in climate and weather general circulation models (GCMs). A common question that links many of the scientific issues being undertaken by this group is: Is there an optimal combination of GCM resolution and sub-grid scale parameterization of mesoscale cloud structure and cloud layering in extra-tropical cloud systems? Other scientific and technical questions of importance are related to what features of these cloud systems can be adequately handled with imposed GCM resolutions and what processes are not properly parameterized, and what are the specific threshold scales for critical features?

One of the main cases under analysis by WG3 is based on data from the FASTEX Intensive Observing Period number 16. Drs. Clark and Lean (UKMO) are leading this effort. The other most significant effort by the group is related to the development of large-scale survey techniques to identify model problems in generating midlatitude cloud structures being led by the incoming WG3 Chair Dr. Tselioudis, at the NASA GISS.

Significant new results arising from the Working Group 3 activities can be found at the WG3 home page: http://www.msc-smc.ec.gc.ca/GEWEX/GCSS/GCSS_wg3.html.

WG4 (Precipitating Convective Cloud Systems) Status and Plans

The goal of GCSS WG4 is to improve the parameterization of precipitating convective cloud systems in GCMs and numerical weather prediction models through an improved physical understanding of cloud system processes. The WG4 home page is at: http://www.met.utah.edu/skrueger/gcss/wg4.html.

Ongoing activities of WG4 during 2000 included the continuing valuable collaboration with DOE ARMs CPM (Cloud Parameterization and Modeling) and CP (Cloud Products) WGs. Several of the European WG4 modelers are funded under EUROCS (European Project On Cloud Systems In Climate Models). They will focus on the diurnal cycle of deep convective clouds based on a period during Case 3. ECMWF continues to provide valuable perspectives on parameterization issues as well as column output from its global forecast model for the ARM sites. NCEP's Environmental Modeling Center (EMC) is also involved with GCSS and ARM through its global forecast model, the column output from the global model for the ARM sites, and the SCM derived from the global model.

The Fifth WG4 meeting was held jointly with the ARM CPM WG from 6 to 8 November 2000 in Silver Spring, Maryland, USA. The meeting was hosted by NCEP's EMC. Further analysis of the results of Case 3 led to new findings. One such finding by Dr. John Petch showed that using a horizontal grid size smaller than 2 km improved the timing of convection initiation in the UKMO CRM. Dr. Marat Khairoutdinov made an extensive intercomparison of Case 3 simulations using the CSU 3D CRM in different configurations. He found that for two of the subcases the 2D and 3D versions of the model produced similar results. One outcome was that both 2D and 3D results showed no significant dependence on the domain size in the range of several hundred to a few thousand km except that the variances in the 2D simulations increased with domain size. Dr. Yali Luo compared the CSU-UCLA CRM Case 3 simulated cirrus cloud properties to observed properties. The simulated cirrus cloud occurrence frequency was greater than observed. In addition, the simulated cirrus clouds were thicker than observed, and had lower cloud bases.

Several new observational data sets for Case 3 were produced during 2000. These included a 25-mb-layer version of the Case 3 variational analysis (produced by Minghua Zhang), a cirrus properties dataset (Jay Mace), a boundary layer depth dataset (Cederwall, Coulter, Lazarus, and Krueger), a GCAPE analysis (Cripe and Randall), more extensive satellite cloud properties (Pat Minnis), and a compilation of the climatological diurnal cycle of precipitation at the SGP (Cederwall and Krueger). Dr. John Yio put the Case 3 model results online in netCDF format in both native and interpolated-to-analysis-level vertical coordinates. Contact Ric Cederwall (rcederwall@llnl.gov) for access to these data sets.

In 2000, WG4 agreed to accept as one of its priorities development of a test case associated with the diurnal cycle of deep convection over land. To move this action forward Dr. Wojciech W. Grabowski, incoming WG4 Chair, has asked that consideration be given to a proposal by Dr. Christian Jakob from ECMWF for a case that deals with convection over the Amazon basin. A database compiled during the TRMM/LBA campaign in this region and work already being undertaken with the data by members of the Working Group make this case an extremely viable one for further investigation.

Before the details of the LBA-based case can be finalized it was felt that the Working Group should benefit first from development and analysis of a deep convection case being undertaken in the context of a European Union cloud system study designated the EUROCS project (http://www.cnrm.meteo.fr/gcss/EUROCS/EUROCS.html). The WG1 of GCSS and the boundary layer working group of EUROCS have been cooperating on various test cases that are also of relevance to WG4.

A manuscript is in work that describes the results of an early WG4 case (Case 2: multi-day simulation of TOGA COARE convection). Finalizing this paper is important so that it can be referenced in other papers being submitted for publication by WG4 members. Dr Grabowski has agreed to work with Dr Krueger to have a draft of the manuscript finished by the end of 2001. Efforts are underway to arrange for WG4 to meet jointly with GCSS WG2 (cirrus clouds), chaired by Dr Starr. A joint meeting/workshop is being considered in conjunction with the next WG4 meeting the week of 22 October 2001. It is felt that such a meeting would be of mutual benefit and specifically that WG4 would be interested in evaluating existing microphysical schemes in WG2 test cases. The Working Group members are being encouraged to support two up-coming meetings a Second TRMM Latent Heating Algorithm Workshop on the topic of TRMM Heating Products: Requirements and Applications (10-12 October 2001 at NCAR, Boulder, CO, USA) and a Cumulus Parameterization Mini-Workshop (13-15 November 2001, NASA/Goddard Space Flight Center, Greenbelt, MD, USA). Please contact WG4 member Dr Wei-Kuo Tao (tao@agnes.gsfc.nasa.gov) for further information on either of these meetings.

WG5 (Polar Cloud Systems) Status and Plans

A GCSS focus on polar clouds was motivated by the fact that there is a poor understanding of the physical processes at work in the polar cloudy boundary layer and that current GCMs do well at simulating cloud, radiation, and boundary layer processes in the polar regions. The need to do better with these parameters is also motivated by the idea, associated with positive radiation feedbacks in the climate models, that there will be an amplification of the greenhouse warming in the Arctic. The effort is timely in light of a number of recent activities that have made a wealth of data on arctic clouds and radiation available. These include the Surface Heat Budget of the Arctic Ocean (SHEBA), a field experiment deployed in the Arctic Ocean during the period October 97 through October 98; the FIRE III Arctic Clouds Experiment deployed research aircraft during the period April through July 1998 over the SHEBA surface observations; and the ARM Program deployment of instrumentation at Barrow, Alaska for a period of up to 10 years, beginning in March 1998. These data have provided the basis for the initial case studies that WG5 is considering. Older datasets have also been under consideration and even newer data will also be actively pursued in conjunction with planned and future field programs, particularly in the Antarctic.

The main scientific issues for WG5 are reflected in the revision of the GCSS Science and Implementation Plan. The focus is on improved parameterizations associated with cloud microphysics (especially mixed phase clouds) cloud distribution, radiation fluxes, surface turbulent fluxes and stable atmospheric boundary layer. The priority test cases being developed and analyzed by the members of the working group are listed on the WG5 home page at: http://paos.colorado.edu/~curryja/wg5/home.html.
Dr. J. Curry, from the University of Colorado, at Boulder, CO, USA is the WG5 Chair.