GEWEX WCRP

Global Energy and Water Cycle Experiment

# NEWS

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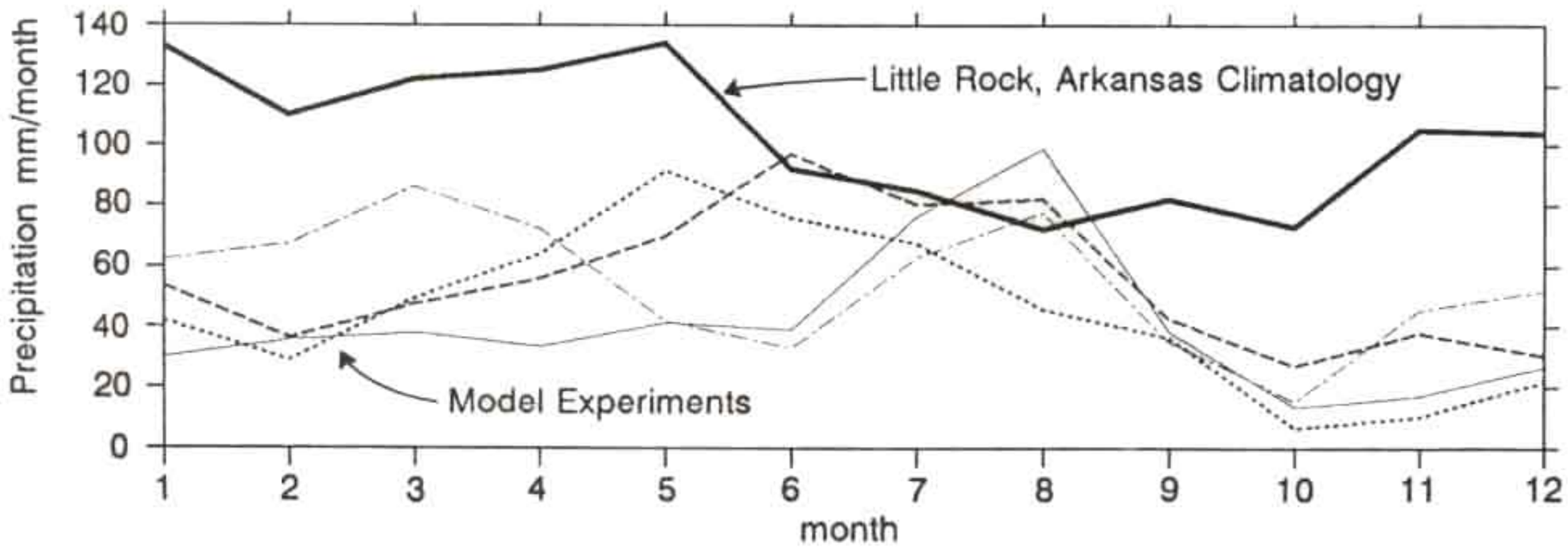
World Climate Research Programme–WCRP




***Systematic error in precipitation estimates from GCM results over the GCIP domain.***
***(See Page 2 for accompanying article.)***

## *GCIP/WGNE PROJECT FOR INTERCOMPARISON OF LAND-SURFACE PARAMETERIZATION SCHEMES (PILPS)*

## OFF TO A GREAT START

**A. Henderson–Sellers**
**Macquarie University, North Ryde, Australia**
***and***
**Michael Coughlan**
**NOAA Office of Global Programs,**
**Silver Spring, Maryland, USA**

One of the crucial tasks for climate and hydrological scientists over the next few years will be the validation of parameterizations used in climate models to represent land surface processes. With the many degrees of freedom and parameters to be considered, it is unlikely that any one single scheme will emerge as clearly superior. Further, different scientists may wish to capture processes differently. Consequently, while the need for validation remains, there is also a distinct need for comparisons between the way in which different schemes handle the various atmospheric and land surface processes, and the important interactions at the land-atmosphere interface.

*(Continued on Page 6)*

## WHAT'S NEW IN GEWEX

- GCIP Implementation Plan Volume I (final draft out)
- GCIP Science Plan (second printing now available)
- GCIP Hydrology Subpanel established
- GCSS Implementation Plan drafted
- GPCP Display Software available
- Canadian GEWEX Secretariat formed

**In This Issue**

*COMMENTARY*

## GEWEX IS INTERNATIONAL

**Dr. Moustafa T. Chahine, GEWEX SSG Chairman**

The Global Energy and Water Cycle Experiment (GEWEX) is rapidly becoming the primary focus of the international scientific strategy to understand and predict the impact of climate change. Both the science plan and implementation plan of GEWEX call for a significant worldwide effort to be mounted over the next two decades. The effort will address the crucial energy and hydrological processes of the earth-ocean-atmosphere system with emphasis on the fast components of the climate system. To support the GEWEX plans, a number of national and international activities have been established. In the past year the United Kingdom and Canada have developed national GEWEX plans. In 1992, National Aeronautics and Space Administration (NASA) undertook a major effort to rescope its Earth Observing System (EOS) in coordination with the European Space Agency and with Japan, while still maintaining a GEWEX focus for the two platforms, AM-1 and PM-1. In addition, several other nations have identified specific scientific activities that support the objectives of GEWEX. These activities include, but are not limited to:

| Country | Activity and Point of Contact |
|---|---|
| Australia | Murray-Darling Basin Experiment<br>Ann Henderson-Sellers<br>Macquarie University<br>North Ryde, New South Wales |
| Canada | Mackenzie GEWEX Study (MAGS)<br>Richard Lawford<br>Canadian Climate Centre<br>Saskatchewan |
| Germany | Baltic Sea Experiment (BALTEX)<br>Erhard Raschke<br>GKSS Research Center<br>Geesthacht |
| Japan | GEWEX-related Asian Monsoon Experiment (GAME)<br>Tetsuzo Yasunari<br>University of Tsukuba, Tsukuba City |
| United Kingdom | UK GEWEX Forum<br>Keith Browning<br>Meteorological Office<br>Bracknell, Berkshire |

Of particular interest this year, the Continental-Scale International Project (GCIP), having just completed its science and implementation plans, invites international participation, to include the development and validation of models, the conduct of process studies outside the Mississippi Basin, and the exploitation of GCIP data for the assessment of impacts on water resources. Additional national activities in support of GEWEX will be reported in future issues of *GEWEX NEWS*.

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## NEAR SURFACE SYSTEMATIC ERRORS IN GCMs—DYNAMICS VS. LAND SURFACE PROCESSES

**Lydia Dumenil**
**Max-Planck-Institut für Meteorologie, Germany**

State-of-the-art climate models (i.e., coupled general circulation models (GCM) of the atmosphere and ocean) are sophisticated and reliable tools that represent the present-day climate in a faithful way. Nevertheless, several points still require further research efforts, e.g., the representation of clouds and the hydrological cycle.

One systematic error common to several GCMs is the erroneously strong warming of the near-surface atmosphere in the Central United States in the summer. Also, in the Max-Planck-Institut (MPI) model simulation, too little precipitation occurs in this region and as there is plenty of energy available for evaporation, the soil dries out in the course of the integration and subsequently warms up excessively during the summer. This is not observed.

At MPI a series of experiments was begun in order to clarify if these errors are due to errors in the large-scale dynamics or if they are due directly to the representation of the flux of moisture from the land surface. Such experiments will have to assess the sensitivity of the annual cycle of precipitation to the specification of the properties of the soil moisture reservoir and the general information of the equations governing the evaporation from bare ground or through plants, respectively.

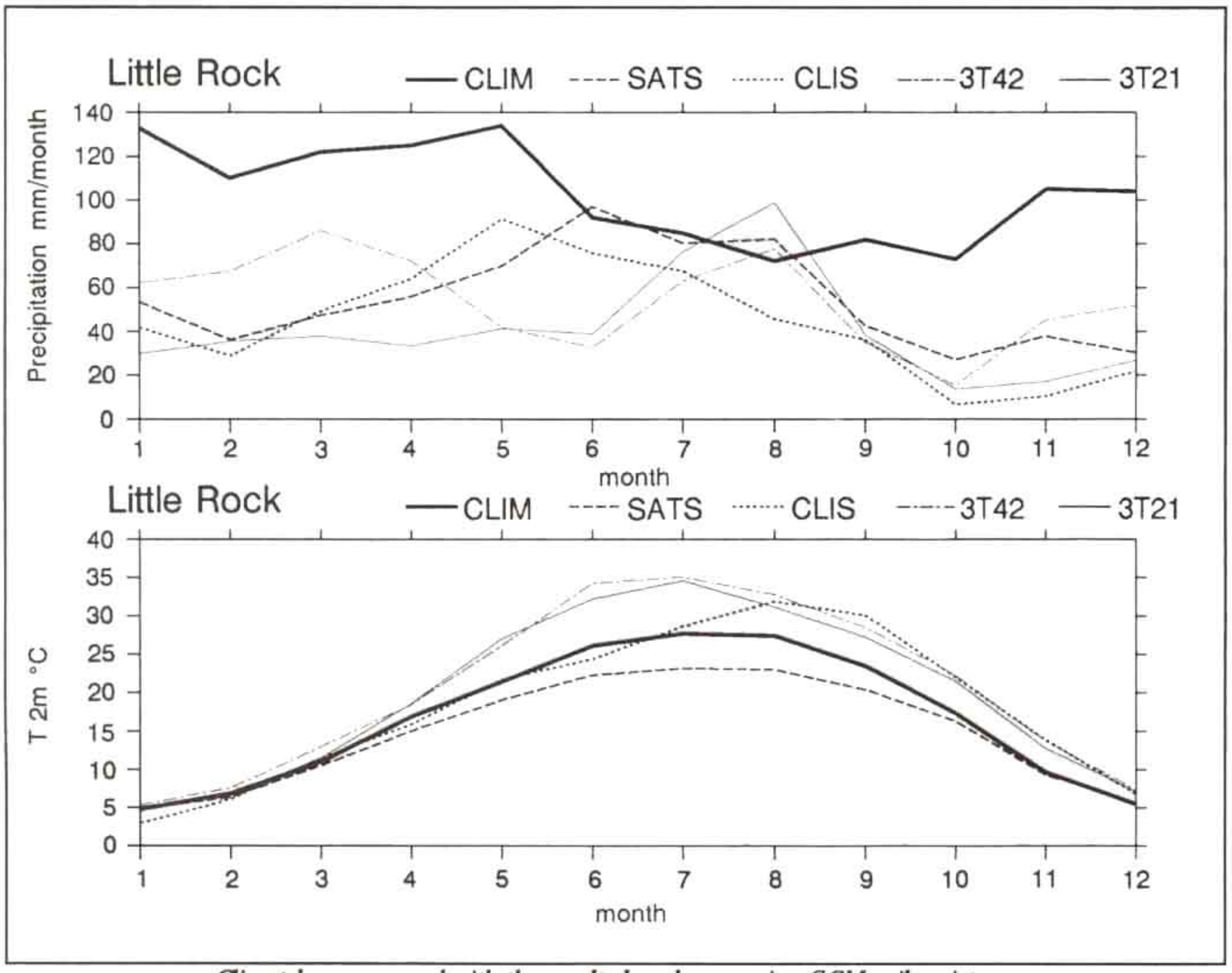
The climatology (solid heavy line) for Little Rock, Arkansas, is shown on page 1 and in the figure on the next page. The results are from a T21 control integration, two T21 experiments with modified boundary conditions, and a T42 control integration.

The atmosphere is combined with an ideal boundary condition of soil moisture (from a climatology by Mintz and Serafini, 1981) in experiment CLIS, and a saturated soil (which should satisfy the atmospheric demand at all times) in experiment SATS.

In the T21 model, soil wetness during the year varies between 20 and 40 percent, while in the climatology it is 80 percent during the winter and spring and 20 percent in the summer. The model produces rainfall of the order of magnitude that is observed in the summer, but much less than observed during the winter and spring. Therefore, the soil moisture reservoir in the model cannot be refilled which in turn is likely to suppress the precipitation process further. The error in the winter precipitation is both influenced by the surface boundary condition and the large-scale dynamics of the model. Precipitation increases if a climatology boundary condition is applied and is still not sufficient if the soil is saturated, indicating that even with an ideal boundary condition the moisture transfer is not strong enough to support the total precipitation by local processes. The formulation of the parameterization needs to be further examined. At the same time the precipitation is increased with higher resolution, which points to problems in the large-scale dynamics. Experimentation will be continued.

**Reference:**

Y. Mintz and Y.V. Serafini, October 1989: *Global Monthly Climatology of Soil Moisture and Water Balance*. Note Interne, Laboratoire de Météorologie Dynamique (LMD), No. 148.




***Climatology compared with the results based on varying GCM soil moisture.***

*INTERNATIONAL SYMPOSIUM ON ACTIVE SENSORS AND NON-SYNCHRONOUS MISSIONS DEDICATED TO GEWEX*

# FINDINGS AND RECOMMENDATIONS TO THE SPACE AGENCIES

**Alain Ratier, CNES, France**

The International Symposium on Active Sensors and Non-Synchronous Missions Dedicated to GEWEX was held in Jouy-en-Josas, France on 15-19 June 1992. The symposium was organized by the Centre National d'Etudes Spatiales (CNES), the National Space Development Agency of Japan (NASDA), the National Aeronautics and Space Administration (NASA), the European Space Agency (ESA), and the World Climate Research Programme (WCRP). The conference agenda and the venue provided an opportunity for consultations among research scientists, space engineers, and managers of scientific and space programs relevant to the GEWEX, on scientific requirements, state of the technology, and current and planned space programs.

The participants agreed that the scope of the sun-synchronous and other satellite missions being planned in the USA, Europe, and Japan, and the fast pace of instrument development for these missions, are evidence of the interest of space agencies in earth observation from space and an indication of the strong support given by space agencies to earth system and global climate sciences.

It was also noted at the conference that, in addition to its obvious scientific interest, the problem of climate change has considerable political implications for the long-term welfare and economic development of human societies, as stated by the United Nations Conference on Environment and Development in Rio de Janeiro, June 1992.

Participants made presentations on behalf of the GEWEX science community, expressing the scientific strategy and requirements for global climate research.

The two most significant scientific issues in this context, namely, the overall sensitivity of global climate to increase in greenhouse gases and the response of the hydrological cycle and water resources to climatic changes, are the focus of the GEWEX program of WCRP. Scientific research for solving both issues would be greatly facilitated by, or in some instances requires, specific satellite sensor developments as currently planned in the U.S. Earth Observing System program, and comparable programs in Europe and Japan.

Recognizing that the role of clouds in the climate system represents the primary source of uncertainty in predictions of the equilibrium warming, a first order issue is that of establishing with sufficient accuracy, the relationship between the radiative properties of cloud systems and radiation fluxes at the top of the atmosphere (TOA) on the one hand, and large-scale weather patterns and the vertical structure of the atmosphere which generate the clouds, on the other. Enhanced measurements of TOA radiation fluxes and cloud-top properties will help but will not be sufficient to meet this objective. Simultaneous or concurrent enhanced measurements of vertical profiles of atmospheric temperature, moisture, and wind will be essential for this purpose. Further delay in the much awaited upgrading of basic observations of atmospheric temperature, moisture and wind from space will retard the refinement of climate models and the ability to provide a quantitative prediction of climate change associated with specific scenarios for the increase of carbon dioxide and other greenhouse gases.

Furthermore, acquiring a global description of the multiple-layer structure of clouds in the atmosphere is also an important, perhaps indispensable, requirement for developing adequate models of the crucial cloud-climate feedback processes.

Developing a quantitatively meaningful representation of the global hydrological cycle, the central objective of GEWEX, has obvious scientific and practical importance. This calls for high-priority development of rain and water vapor measurements from space, as could be achieved by the Tropical Rainfall Measuring Mission (TRMM) and meteorological radars, passive (optical and microwave) radiometers, and possibly lidars on follow-on missions.

Attention was drawn to the fact that cloud, radiation, and rain processes exhibit distinct diurnal variability. For climate science and prediction purposes, a "climate-dedicated" satellite mission on a 55° to 60° inclined orbit (which could sample a full diurnal-cycle in the course of 1-2 months) is an essential requirement to complement existing and planned sun-synchronous and geostationary systems. Alternatively, non-sun-

synchronous measurements could be undertaken with a series of dedicated satellites on appropriate inclined low earth orbits.

Taking into consideration these scientific requirements and the announced plans of space agencies in the USA, Europe, and Japan, the conference highlighted several deficiencies or gaps in satellite observations that are expected to be available for climate science and predictions at the beginning of the 21st Century. These deficiencies are:

- the delay in the provision of more accurate, high vertical resolution temperature-moisture soundings receiving the detailed structure of the troposphere, to be acquired simultaneously with multi-spectral imagery and ERB measurements;

- the lack of rainrate profile information outside the tropical zone;

- the lack of information on the global 3-dimensional distribution of clouds;

- the lack of global wind data.

This situation primarily reflects:

- the delay in the provision for high spectral resolution atmospheric sounder instruments;

- the lack of a program perspective for maintaining and extending the essential capability for non-sun-synchronous monitoring of diurnally variable properties (cloud, radiation and rain), including rain and cloud radar measurements, from an inclined earth orbit;

- the slow pace of development of lidar sounding systems.

Based on these findings, specific technical recommendations regarding future earth observing satellite missions include the following:

**(1) Non-sun-synchronous mission after TRMM.**

To extend the results of TRMM beyond the tropics and to realize the global objectives of GEWEX, the space agencies are encouraged to

- define the scope and specifications of TRMM follow-on missions and sensors, through appropriate interactions with the scientific community;

- coordinate and conduct the corresponding feasibility studies and development, with a view to creating the conditions for a program decision;

- study and tradeoff several options for the rain radar (dual beam, two-frequency, dual polarization).

**(2) Dedicated wind lidar mission**

Among the lidar missions, the development of a Doppler lidar mission has the highest priority as the most promising technique to achieve a significant enhancement of basic meteorological observations on the global scale. In this respect, the following findings were highlighted during the conference:

- System studies and technological developments already accomplished by NASA, CNES, and ESA have demonstrated the maturity of $CO_2$ laser technologies for the flight of the first Doppler lidar mission.

- Recent developments in solid state lasers offer promise for follow-on missions, but system studies are required to demonstrate overall instrument feasibility.

- A conical scan concept is preferable over a fixed telescope configuration, for its capability to document a wider range of scales.

*(Continued on page 7)*

**GCIP/WGNE PILPS Great Start**
*(Continued from page 1)*

The GEWEX Continental-Scale International Project (GCIP) Science Panel and the World Meteorological Organization/Committee for Atmospheric Sciences (WMO/CAS) Working Group on Numerical Experimentation (WGNE) have launched a joint Project for Intercomparison of Land-Surface Parameterization Schemes (PILPS). The principal goal of the project is

> *To achieve greater understanding of the capabilities and potential applications of existing, and new, land-surface schemes in atmospheric models.*

To accomplish this goal, PILPS will focus initially on the simulations of energy and water exchanges at the atmosphere-land surface interface, and later on carbon uptake and release processes. The PILPS Science Plan lays out three phases for the project:

**Phase 1**

Documentation of current schemes

**Phase 2**

(a) Stand-alone intercomparisons in which the schemes are not coupled to an existing climate model and are driven by pseudo-data or constrained "real" data sets

(b) Feasibility Studies

(i) Acquisition and dissemination of suitable data sets to be used in subsequent intercomparisons

(ii) Coupled intercomparisons using one or several well-documented climate models

**Phase 3**

(a) Stand-alone intercomparisons using high quality "real" data sets

(b) Coupled intercomparisons in 1- and 2-dimensional modes

(c) Fully coupled 3-dimensional intercomparisons

(d) Evaluation over extended data areas and periods

Work has already begun on Phases 1 and 2(a), and on identifying a few suitable existing data sets to be used in later intercomparisons. The first meeting of interested scientists was held in June 1992 in Columbia, Maryland, and over thirty schemes have been submitted by scientists around the world for inclusion in the intercomparison. The first phase of the stand-alone intercomparisons was initiated in September 1992. Four experiments for each of three locations (tropical forest, prairies, grassland and tundra) are being conducted by all participating groups:

(1) A control simulation forced by repeating a single year's meteorological information many times

(2) A hydrology "spin-up" in which all soil and canopy moisture stores were initialized at zero and the meteorological forcing prescribed until the scheme equilibrated

(3) A hydrology "spin-down" in which all the moisture stores were set to capacity and the schemes again run to equilibrium

(4) A "dry-down" in which the precipitation was zeroed in the meteorological forcing and the simulation continued from the end of (2) until all moisture stores dry out

One question is "did each scheme achieve the same equilibrium for experiments (2) and (3)?"

By January 1993, participants had submitted results from fourteen schemes to the PILPS database, and others are still completing their simulations. All participants (and the PILPS science team) have learned a great deal about their schemes from these experiments and the intercomparison of results promises to be very interesting.

Future opportunities for discussion on the project have been scheduled at the Fourth International Conference on Southern Hemisphere Meteorology and

Oceanography in Hobart, Tasmania in late March and early April 1993, and at the Joint IAMAP/IAHS Assemblies in Yokohama, Japan in July 1993. The project is being steered by a science team chaired by Professor Ann Henderson-Sellers. For a copy of the First PILPS Meeting and Science Plan report, contact the International GEWEX Project Office (IGPO), and for more information on the project contact: Professor Henderson-Sellers at the Climatic Impacts Centre, Macquarie University, North Ryde, NSW 2109, Australia, FAX: +61 2 805 8428; E-MAIL: Internet/ pilps@mqclimat.cic.mq.edu.au.

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**International GEWEX Symposium Results**
*(Continued from page 5)*

- A sun-synchronous orbit is preferable to minimize technical constraints and cost, in view of the impact of the large sensor power requirement on satellite design.

A recommendation is made to NASA and CNES to cooperate with a definition of a wind sounding dedicated mission based on a Doppler wind lidar, also taking into account developments by ESA, with the objective to propose for decision a cooperative, affordable, and scientifically attractive wind-dedicated mission.

**(3) Backscatter and dial lidar missions**

High vertical resolution atmospheric profiles will eventually be needed on a global basis as input to and validation of general circulation models. In this respect, the backscatter and dial lidar systems would also provide important scientific information for GEWEX, given their original capabilities to document cloud and aerosol properties, the structure and height of the planetary boundary layer and water vapor profiles (in the boundary layer and free troposphere). Proof-of-concept space experiments of sufficient duration and global significance are recommended for technical and mission impact demonstration.

**(4) Millimeter-wave cloud radar**

Acquiring a global description of the multiple-layer structure of clouds is required for cloud feedback studies. This objective might be met, at least to first order, by a simple, non-scanning, near nadir viewing, millimeter-wave radar in low earth orbit, the study and development of which are recommended.

**(5) International cooperation and coordination**

Overall, the conference participants recognized that international cooperation and coordination among the space agencies is essential to overcome the challenging problems posed by the development of the next generation of satellite instruments and emissions for climate change studies. For example, further international cooperation in the development of a Doppler wind-lidar mission and the follow-on precipitation mission are strongly recommended.

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**EDITOR'S NOTE**

GEWEX investigators are encouraged to submit short articles on their findings for publication consideration in the newsletter. Concise illustrations summarizing results are encouraged.

## CANADIAN GEWEX SECRETARIAT APPOINTED

On October 1, 1992, Dr. Terry Krauss was appointed as Head of the Canadian GEWEX Secretariat. Located at the National Hydrology Research Centre in Saskatoon, Dr. Krauss reports jointly to the Chiefs of the Hydrometeorological Processes Division of the Climate Research Branch, and the Hydrological Sciences Division of the National Hydrology Research Institute of Environment Canada.

Dr. Krauss, a native of Medicine Hat, Alberta, has an M.Sc in meteorology from the University of Alberta, a Ph.D. in the atmospheric sciences from the University of Wyoming, and more than 15 years of experience in conducting both domestic and international atmospheric research and field programs. Before joining Environment Canada, he worked with the Alberta Research Council, the South African Weather Bureau, and INTERA Technologies, Ltd.

In his secretariat role, Dr. Krauss will coordinate the implementation of Canada's contribution to the International GEWEX Programme including organizing scientific and planning meetings, informing the national and international science communities on the status of Canadian GEWEX activities, and coordinating the collection and dissemination of data from Canadian and relevant international GEWEX projects. For more information about GEWEX, Terry can be reached at PHONE: (306) 975-5776; or FAX: (306) 975-5143.

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## PROPOSED LATEX-GEWEX COOPERATION ALONG THE GULF COAST

**Dr. Murray Brown**

The Minerals Management Service (MMS) Gulf of Mexico Region has been planning the "Texas-Louisiana Shelf Physical Oceanography Program" (LATEX PROGRAM) since May 1988. It has been recognized that LATEX and GEWEX may be complementary since the ocean region to be studied is the source of much continental moisture. LATEX, which should span the period April 1992 to April 1995, overlaps the GEWEX Continental-Scale International Project (GCIP) in time, and may be able to provide useful southern-boundary data. LATEX is primarily a physical oceanography study of the Louisiana and Texas Continental Shelves; however, ancillary meteorological data are being obtained from offshore buoys and oil platforms. These data will be available to GCIP investigators and, at the Third Science Panel Meeting, GCIP scientists were invited to consider the use of specific facilities available to LATEX.

For further information on LATEX, contact: Dr. Murray Brown (MS-5430), Minerals Management Service, Gulf of Mexico (OCS) Region, 1201 Elmwood Park Boulevard, New Orleans, Louisiana 70123-2394, USA. PHONE: (504) 736-2901; FAX: (504) 736-2610; E-MAIL: OMNET/M.Brown.MMS.

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## PRECIPITATION DISPLAY SOFTWARE

The Global Precipitation Climatology Centre (GPCC) has global data sets available on diskettes for 1987 through August 1988. The global data sets on a 2.5° grid are analyses of monthly precipitation based on approximately 6600 conventional gauge measurements each month which can be easily displayed in map form. For further information contact: GPCC, B. Rudolf (or U. Schneider), Deutscher Wetterdienst, Frankfurter Str. 135, D-W 6050, Offenbach Main, Germany, PHONE: 49 69 80 62 2815

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To announce a GEWEX meeting or submit a meeting summary, send details to IGPO via Mail, E-Mail(OMNET): INTL.GEWEX, or Fax (202) 488-5364.

## SUMMARIES OF MEETINGS

**GEWEX Cloud System Study (GCSS)**
**Science Panel Meeting**
**14-15 December 1992**
**Reading, England**

GCSS Science Panel members met on 14-15 December 1992 at the Meteorological Office College in Reading, England. The purpose of the meeting, chaired by Dr. Keith Browning, was to define the basic science issues intrinsic to GCSS and develop the GCSS Implementation Plan. Various types of cloud systems were discussed and four working groups selected to address the following.

- Boundary Layer Clouds
- Cirrus and middle layer clouds
- Precipitating layered clouds
- Precipitating convectively driven systems

Also discussed were linkages of GCSS to other GEWEX activities and to projects with complementing science objectives being pursued or planned but not necessarily part of GEWEX.

## International Symposium on Spectral Sensing Research
## Maui, Hawaii, USA
## 15-20 November 1992

The International Space Year event, International Symposium on Spectral Sensing Research (ISSSR), was held 15-20 November 1992 in Maui, Hawaii, USA. Approximately 300 attended this highly successful meeting, addressing the application of new high resolution sensing science and technology to the measuring of environmental phenomena.

The symposium began Sunday morning with tutorials and ended Friday with workshops. All technical sessions, tutorials, poster sessions, and workshops were fully attended and for some sessions the attendance exceeded the planned capacity. Technical topics included: Hyperspectral Sensing Systems, Image Processing and Analysis, Data Base Management, Atmospheric and Ionospheric Remote Sensing, Hyperspectral Imaging of the Environment, Applications of Hyperspectral Imaging and Technological Advances. The majority of the presentations (oral and poster) addressed hyperspectral sensing of the Earth's surface.

One of the workshops on the applications of hyperspectral sensor data focused on international science programs concerning the environment. Dr. Paul D. Try, Director IGPO, chaired the International Programs part of this workshop. The recommendations developed by the participants of the workshop on application of hyperspectral data will enhance global climate change studies and specifically programs such as GEWEX.

There are plans to publish proceedings of this first ISSSR meeting and to schedule a second ISSSR as early as late 1993.

## Third Meeting of the GCIP Science Panel
## Vicksburg, Mississippi, USA
## 10-12 November 1992

The site of the Third Meeting of the GCIP Science Panel was the U.S. Army Corps of Engineers Waterways Experiment Station, Vicksburg, Mississippi. The meeting opened with informative briefings on the mission of the facility and management of the lower Mississippi Valley water resources. During the meeting participants had opportunities to visit the research activities on the 600 acre main facility and the Mississippi River Basin Model constructed on an 800 acre site in Jackson, Mississippi. This large hydraulic model was constructed in the 1940s (before the computer simulation era) for the purpose of studying flood control problems of the entire Mississippi basin, a river basin containing parts of 31 states and 2 Canadian provinces.

The theme of the 3rd GCIP Science Panel meeting was to refine the GCIP Implementation Plan. On the first and into the second day the 40 participants were briefed on GCIP related atmosphere, hydrology, land surface, and data management activities including progress science efforts. During the meeting there was also a session on implementation interfaces and potential cooperative activities. In that session there were presentations on the U.S. Weather Research Program, Atmospheric Radiation Measurements Program, Mackenzie GEWEX Study, Baltic Sea Experiment, Louisiana-Texas Experiment, Global Precipitation Climatology Project, and GEWEX Cloud System Study.

With the fortification of information from the presentations, open discussion, and having a "strawman" draft implementation plan, the participants (Science Panel members and invited contributors) divided into three working groups which were Atmospheric, Hydrology, and Data Collection and Management. The final formal session of the meeting provided a forum for the spokesperson for each of the working groups to report on their recommendations for the GCIP Implementation Plan. The results have been incorporated in the GCIP Implementation Plan for which Volume I is now available.

*GCIP Science Panel Meeting Participants*

## Canadian GEWEX Planning Meeting and University Workshop
## Toronto, Canada
## 14-15 October 1992

A joint Canadian GEWEX Management and Science Committee meeting took place at the Atmospheric Environment Service's (AES) Headquarters in Toronto on 14-15 October, followed by a two-day workshop to discuss the implementation plan of the Canadian GEWEX Programme with the University Community.

The objectives of the Canadian GEWEX Programme are to (1) contribute to the international GEWEX Programme in areas of special Canadian interest and expertise, and (2) contribute towards the better understanding and prediction of changes to Canada's water resources arising from climatic change.

A central goal of the Canadian GEWEX Programme is to develop the ability to model the water and energy balances of the Canadian Arctic Basin on spatial scales of 100 km and temporal scales of one month.

Activities within Canada are within the purview of the Canadian Climate Programme and the Canadian Global Change Programme.

Approximately 40 people, including more than 20 university researchers from 11 universities in 5 provinces attended the Workshop. Three working groups covering atmospheric processes, hydrologic processes, and hydrologic modelling were formed. The three groups discussed and presented plans to be incorporated into the Canadian GEWEX Implementation Plan.

## Second International Conference on Modelling of Global Climate Change and Variability
## Hamburg, Germany
## 7-11 September 1992

The Second International Conference on Modelling of Global Climate Change and Variability was held 7-11 September 1992 in Hamburg, Germany. In order to broadly cover the currently most important research areas in climate research, the conference was organized to address the following topics: development of comprehensive climate models, climate sensitivity and response experiments, modelling and prediction of the natural climate variability, simulation and detection of climate change.

Progress in these fields since the first conference of this series in 1989 was reviewed. Models of the climate system now include fully coupled ocean atmosphere models. Some models have also been extended to include atmospheric chemistry, better representation of the land surface processes and the global carbon cycle. Considerable progress was reported on the quality of present day climate simulations.

In several papers the performance of these models with respect to oceanic and atmospheric variability ranging from the short term to interannual variability was shown to be validated against observations.

Several papers addressed the representation of the hydrological cycle in the model simulation. The role of horizontal resolution, various physical parameterizations and the specification of initial conditions and boundary conditions were discussed in some detail. The general aspects of land surface heterogeneity were also discussed.

Continued efforts are being made in the assessment of model sensitivity, e.g., to resolution, the specification of boundary conditions, and the formulation of physical processes. The influence of sea surface temperatures is being studied with a view to exploring the predictability of the climate system.

It was noted that the output from relatively coarse global climate models needs to be down-scaled in order to estimate regional and local effects of climate change. Both statistical methods and regional models are being developed for this purpose.

## Sixth Session of the Working Group on Data Management for GPCP
## Asheville, North Carolina, USA
## 3-5 August 1992

The Working Group on Data Management for the Global Precipitation Climatology Project (GCIP) met 3-5 August 1992 in Asheville, North Carolina, USA. At the meeting a synopsis of the GPCP's six years of activity was presented and plans were reviewed for extending the collection and processing of all the precipitation data and products. Presentations addressed the promotion and coordination of validation efforts, including the Algorithm Intercomparison Project and the Surface Reference Data Center activities, that relate to WCRP's overall scientific objectives and key projects concerning the fluxes of water and energy between atmosphere and land surface. In the discussions concerning external interactions and regional research efforts the Working Group was advised of other components of GEWEX and specific attention given to the GEWEX Continental-Scale International Project. By the end of 1993 a three year (1987-1989) integrated "all observation" global product that combines estimates of rain gauge and satellite data will be available. This processing will be done with currently accepted algorithms, calibration values and other processing coefficients to finalize the 3-year precipitation climatology. Latter improved data products will provide by mid-1994 a new 5-year GPCP database.

## WCRP/GEWEX MEETINGS CALENDAR

**1-5 February 1993**—THE FIFTH SESSION OF THE GEWEX SCIENTIFIC STEERING GROUP will be held in San Diego, California, by invitation only. Contact S. Benedict, WMO (WCRP) 41, Avenue Giuseppe Motta, 1211 Geneva 2, Switzerland. PHONE: 41-22-730-8247; FAX: 41-22-734-0357; E-MAIL: OMNET/S.Benedict.

**8-12 February 1993**—THE FIFTH SESSION OF THE IRC/JSC/GEWEX WORKING GROUP ON RADIATION FLUXES will be held in San Diego, California, by invitation only. Contact T. Vonder Haar, Colorado State University. PHONE: (303) 491-8566; FAX: (303) 491-8241; E-MAIL: OMNET/T.VonderHaar.

**18-19 February 1992**—The ISLSCP SCIENTIFIC STEERING COMMITTEE will meet with invited members of the ISLSCP community at NASA Goddard Space Flight Center in Greenbelt, Maryland. Discussions will further define specific tasks and review the status of ongoing projects. An ISLSCP report from the June 1992 workshop is forthcoming. Contact IGPO for further information.

**22-25 February 1993**—COLLOQUIUM AND WORKSHOP ON COUPLED MODELLING will be held near NASA Goddard Space Flight Center, in Washington, D.C. Scientists at this meeting will be addressing the use of mesoscale and coupled mesoscale-cloudscale-hydrology models for the study of scale interactive processes. Many topics to be discussed at this meeting are relevant to GEWEX components including GCIP, GCSS, GVaP and to the proposed Cooperative Multiscale Experiment planned for 1995 in the central United States. This experiment involves several GEWEX components, the Atmospheric Radiation Measurements, and U.S. Weather Research Programs. For further information contact: Dr. Steven Koch, Code 912, NASA/GSFC, Greenbelt, MD 20771, USA, PHONE: (301) 286-7188; FAX: (301) 286-4661, E-MAIL: Koch@elena.gsfc.nasa.gov.

**15-19 March 1993**—SIXTH SESSION JOINT SCIENTIFIC COMMITTEE (JSC) for GEWEX, Hamilton, Bermuda, by invitation only. Contact S. Benedict, WMO (WCRP) 41, Avenue Giuseppe Motta, 1211 Geneva 2, Switzerland. PHONE: 41-22-730-8247; FAX: 41-22-734-0357; E-MAIL: OMNET/S.Benedict.

**11-23 July 1993**—IAMAP/IAHS SCIENTIFIC ASSEMBLIES, Yokohama, Japan. This is a joint international program of the International Association of Meteorology and Atmospheric Physics, and the International Association of Hydrological Sciences. Several GEWEX components are included in the agenda (see 5 January 1993 issue of EOS). For second circular, contact: IAMAP-IAHS, c/o Sankei Convention, Sankei Building, 10F, 1-7-2 Otemachi, Chiyoda-ku, Japan; PHONE: +81 3 3273 2083; FAX: +81 3 3273 2439 or +81 3 3273 6287; TELEX: 222 8342 SKBJPN.

**29 June - 2 July 1993**—GEWEX SPACE-BASED CLOUD RADAR WORKSHOP, will be held at JPL, Pasadena, California. For further information contact IGPO.

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## GEWEX REPORTS/DOCUMENTS
### (Available from IGPO)

GEWEX CONTINENTAL-SCALE INTERNATIONAL PROJECT (GCIP) DATA WORKSHOP: Summary report on GCIP Data Workshop, Saskatoon, Saskatchewan, Canada, 5-8 May 1992. IGPO Publication Series No. 4.

GEWEX CONTINENTAL-SCALE INTERNATIONAL PROJECT (GCIP)—(ATMOSPHERIC SCIENCE COMPONENT): Report on Atmospheric Subpanel Workshop, Silver Spring, Maryland, USA, 18-19 March 1992. IGPO Publication Series No. 3.

IMPLEMENTATION PLAN FOR THE PILOT PHASE OF THE GEWEX WATER VAPOR PROJECT (GVaP). March 1992; IGPO Publication Series No. 2.

SCIENTIFIC PLAN FOR THE GEWEX CONTINENTAL-SCALE INTERNATIONAL PROJECT (GCIP). February 1992; WCRP-67 (WMO/TD/No. 461). (Second Printing now available.)

THE ROLE OF WATER VAPOR IN CLIMATE, A STRATEGIC RESEARCH PLAN FOR THE PROPOSED GEWEX WATER VAPOR PROJECT (GVaP): Report Of Workshop, Easton, MD, USA, 30 October - 1 November 1991. NASA Conf. Pub. 3210.

REPORT OF THE THIRD SESSION OF THE JSC SCIENTIFIC STEERING GROUP FOR THE GLOBAL ENERGY AND WATER CYCLE EXPERIMENT (GEWEX), HAMILTON, BERMUDA, 21-25 January 1991. WCRP-57 (WMO/TD-No. 413).

GLOBAL ENERGY AND WATER CYCLE EXPERIMENT (GEWEX): Report of the First GEWEX Temperature/Humidity Retrieval Workshop, Greenbelt, MD, USA, 23-26 October 1990. WCRP-66 (WMO/TD-No. 460).

GEWEX CONTINENTAL-SCALE INTERNATIONAL PROJECT (GCIP): Report of the First GCIP Planning Workshop, Reston, Virginia, USA, 8-10 October 1990. IGPO Publication Series No. 1.

SCIENTIFIC PLAN FOR THE GLOBAL ENERGY AND WATER CYCLE EXPERIMENT. August 1990; WCRP-40 (WMO/TD - No. 376).

GLOBAL CLIMATE CHANGE—A SCIENTIFIC REVIEW PRESENTED BY THE WORLD CLIMATE RESEARCH PROGRAMME (WCRP), January 1990. The WCRP is the international scientific program chartered jointly by the International Council of Scientific Unions and the World Meteorological Organization to provide a quantitative understanding of climate and predictions of global and regional climate changes on all time scales. This document is a review of global climate change as of 1990.

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