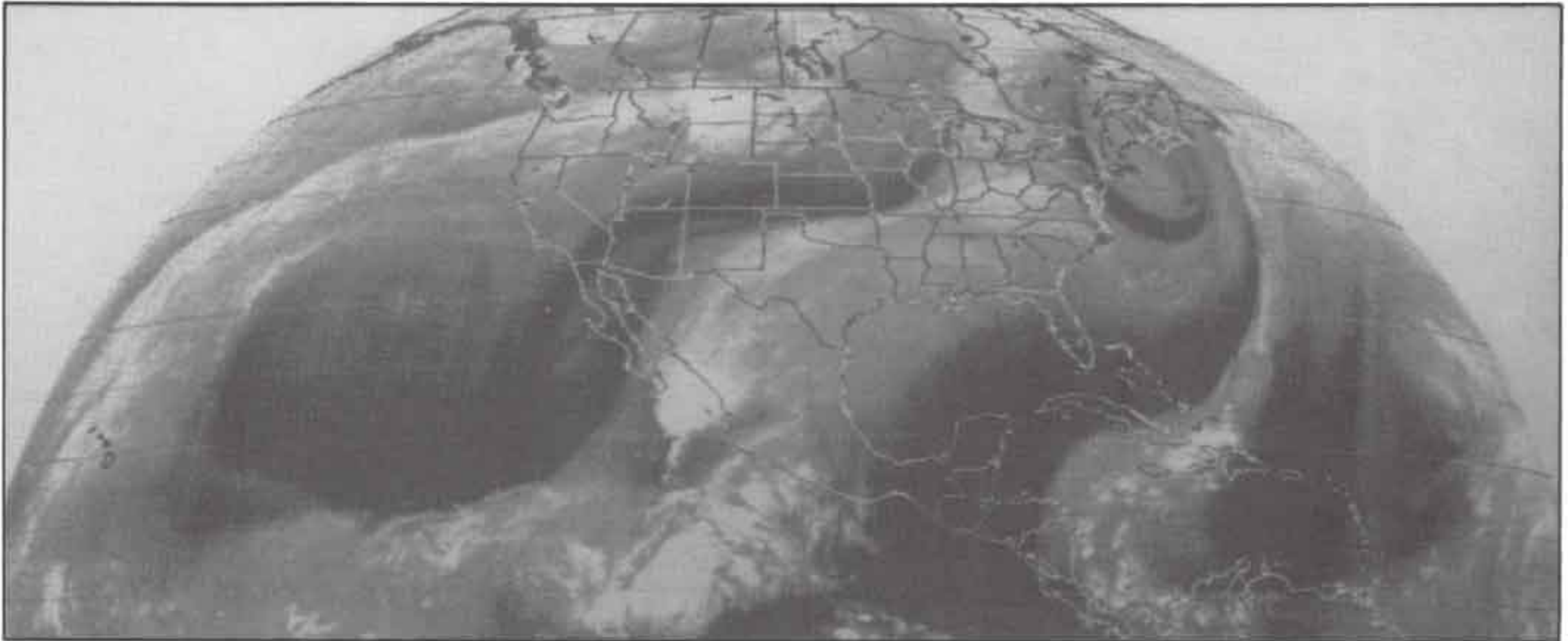


## World Climate Research Programme—WCRP



*National Oceanic and Atmospheric Administration Geostationary Operational Environmental Satellite (GOES), Water Vapor Channel Image, 1200 UT 12 November 1991, showing transport of water vapor from the Pacific Ocean over the Mississippi River basin.*

### **GVaP: A NEW GEWEX ACTIVITY**

**S. H. Melfi and David O'C. Starr**  
**NASA Goddard Space Flight Center**

Water vapor, the most significant greenhouse gas, plays a fundamental role in the energy and water cycle processes. The accurate global measurement, modelling, and long-term prediction of water vapor is a primary goal of international global change science and GEWEX. The GEWEX Water Vapor Project (GVaP) is an effort to improve measurement and global data availability. The concept for GVaP was formulated in the late 1980s, and following a series of workshops and meetings, a strategic plan was prepared (Starr and Melfi, 1991). The GVaP Pilot Phase Implementation Plan has been prepared following a GVaP November 1991 workshop.

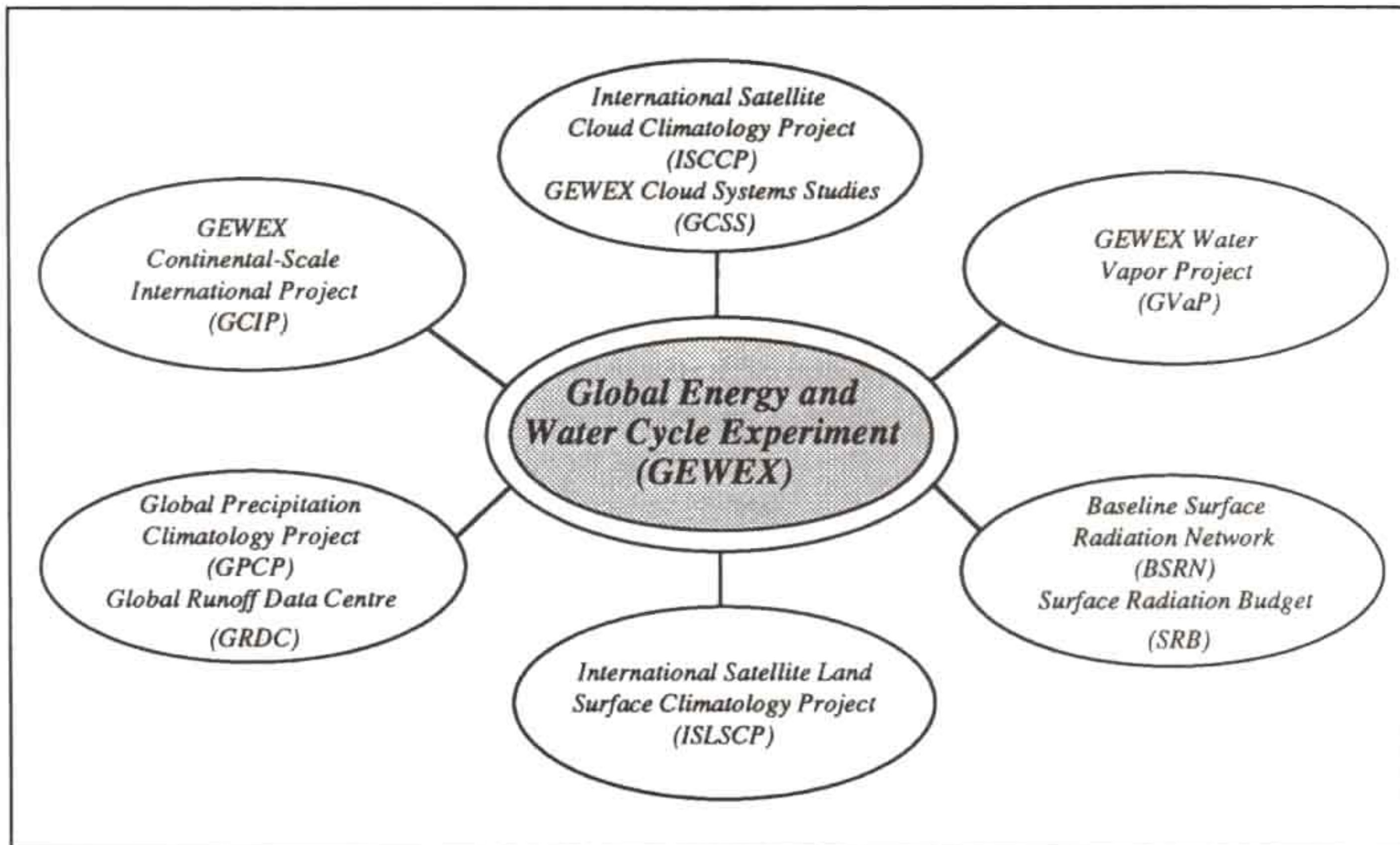
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### **WHAT'S NEW IN GEWEX**

- ISLSCP and WGRF join GEWEX
- Draft GCSS Science Plan completed
- GVaP Pilot Phase Implementation Plan published
- GCIP Atmospheric Subpanel Report completed
- GCIP Data Workshop Report concluded
- Canadian GEWEX Plan distributed

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*GEWEX components now cover the full range of science disciplines (e.g., cloud and precipitation systems, hydrometeorology, and radiation) that address the global energy and water cycles.*

**COMMENTARY**

**GEWEX PROGRAMME ADDITIONS**

**Moustafa T. Chahine**

**Chairman, GEWEX Science Steering Group**

Better understanding of land surface processes and radiation processes is crucial to the attainment of GEWEX objectives. Two major programs have recently become formally associated with GEWEX: the International Satellite Land Surface Climatology Project (ISLSCP) and the Joint Scientific Committee's Working Group on Radiative Fluxes (WGRF).

The International Satellite Land Surface Climatology Project has a long history of successful contributions to advancing our understanding of land surface processes through the planning and coordination of field campaigns and the fostering of advanced studies. The experience and expertise of the ISLSCP science community, led by Dr. Piers Sellers and Dr. Josef Cihlar, will provide valuable support for several GEWEX activities, especially the GEWEX Continental-Scale International Project (GCIP). The need within GCIP to better understand scale integration issues and land

surface process interactions has led logically to ISLSCP becoming an integral part of GEWEX. As a result, a full-time ISLSCP Executive Secretary, Ms. Danielle Lucid, has been added to the IGPO staff.

Similarly, studies of radiation processes, surface radiation fluxes, flux divergence in the atmosphere, and cloud properties are integral parts of the GEWEX program. The WGRF, chaired by Dr. Thomas Vonder Haar, has agreed to serve as a Radiation Science Panel for GEWEX. This specifically brings the efforts of the International Satellite Cloud Climatology Project (ISCCP), the Surface Radiation Budget Climatology Project, the World Climate Research Project Baseline Surface Radiation Network (BSRN), and the Earth radiation budget measurements at the top of the atmosphere to bear on GEWEX objectives.

Dr. Piers Sellers, Dr. Vonder Haar, and Professor Ehrhard Raschke have been added as members of the GEWEX Science Steering Group as a result of the liaisons. These ties strengthen the ability of GEWEX to accomplish its goals. The figure above shows the full range of GEWEX components, and the present membership of the GEWEX Science Steering Group is shown in the following table.

*(continued on page 3)*

**Commentary (continued from page 2)**

**GEWEX SCIENCE STEERING GROUP (SSG) MEMBERSHIP**

Dr. M. Chahine, Chairman	-	USA
Dr. J.C. Andre	-	France
Dr. K. Browning	-	UK
Dr. A. Hollingsworth	-	UK
Prof. E. Raschke	-	Germany
Dr. D.B. Rossow	-	USA
Dr. P. Sellers	-	USA
Dr. J.C. Schaake	-	USA
Prof. G.A. Schultz	-	Germany
Dr. R.E. Stewart	-	Canada
Dr. I.A. Shiklomanov	-	Russian Fed.
Prof. T. Takeda	-	Japan
Prof. T. Vonder Haar	-	USA

- (2) Operation of a state-of-the-art, research quality, multisensor Water Vapor Reference Station at the ARM CART site near Lamont, Oklahoma for a continuous period of 3 months planned for spring of 1995.
- (3) Conduct of a systematic, intensive intercomparison spanning the entire range of available in situ and remote sensing atmospheric water vapor sensors during a 4-week deployment of as many sensors and observing platforms as possible to the ARM CART site during operation of the Water Vapor Reference Station.
- (4) Initiation of research and development to define and fully characterize a best water vapor sensor and data processing system for use with operational radiosondes and to work toward international standardization in coordination with the World Meteorological Organization.

**GVaP: A New GEWEX Activity (continued from page 1)**

This plan describes a specific coordinated program of research activities to be conducted in the next 3 years that will provide a firm foundation for follow-on research. The GVaP Pilot Phase Plan reflects a realistic appraisal of planned resources such as those being implemented under the Atmospheric Radiation Measurement (ARM) program. GVaP will be one of the first cooperative efforts between the ARM program and GEWEX under the joint ARM/GEWEX "Memorandum of Participation." The ground measurement and intercomparison activities of GVaP will be conducted at the ARM Cloud Radiation Testbed (CART) site located near Lamont, Oklahoma. The CART facility has an array of ground-based instrumentation and plans frequent radiosonde launches. It is located within the Mississippi River basin, the domain of the GEWEX Continental-Scale International Project (GCIP).

**GVaP Pilot Phase**

There are four major components of the GVaP Pilot Phase. They are

- (1) Assessment of current capabilities to determine the global distribution of atmospheric water vapor content using various spaceborne remote sensing instruments and algorithms through a rigorous comparison focused on a 2-year period starting in July 1987.

Global space-borne measurements of water vapor are of critical importance to GEWEX and are addressed in the first component of the GVaP Pilot Phase. This article focuses on the second and third components that involve joint participation with ARM.

**Water Vapor Reference Station**

A state-of-the-art, research quality, Water Vapor Reference Station will be established for a period of not less than 3 months during the GVaP Pilot Phase. It will be located at the ARM CART site.

Specific instruments at the reference station include water vapor observations using Raman lidar (Melfi et al., 1989) and passive radiometric remote sensors, state-of-the-art radiosonde humidity sensors, and surface observations, as well as highly complementary remote sensing observations using wind profilers and radio-acoustic sounders. Observations of wind and temperature profiles at a spatial and temporal resolution approaching that of the Raman lidar water vapor observations are essential for establishing the context and causes of water vapor variability and for the satellite retrieval calibration activity. These measurements will provide information about the spatial mean and (subgrid scale) variability within satellite footprints and global circulation model grid boxes. Sampling strategy and CART site instrumentation are discussed in the Implementation Plan for the Pilot Phase of GVaP. The Water Vapor Reference Station will include a Raman

*(continued on page 4)*

### **GVaP: A New GEWEX Activity** (continued from page 3)

lidar, wind profilers, radio-acoustic sounding systems, dual-channel microwave radiometers, Fourier transform interferometers, surface and tower meteorological measurements, and special three-hourly radiosondes.

The data obtained from these instruments will be used for evaluating the feasibility of measuring high vertical resolution profiles of atmospheric water vapor on a nearly continuous basis over long time periods using Raman lidar. Other applications, including techniques to blend data for models, and calibration of satellite-derived water vapor estimates are discussed in the GVaP Implementation Plan (Starr and Melfi, 1992).

#### **Water Vapor Measurement Intercomparisons**

A systematic, intensive intercomparison spanning the entire range of available in situ atmospheric water vapor sensors and remote sensing systems will be initiated during the GVaP Pilot Phase. These activities will include a simultaneous field deployment of as many sensors as possible to a common location. It is essential that instrumented research aircraft be very involved in the field deployment in addition to surface-based systems. It is also important that this activity be international in scope and coordinated with the satellite comparisons planned during the GVaP Pilot Phase. A 4-week intercomparison field campaign will be conducted at the ARM CART site in Oklahoma during the spring of 1995 in coordination with the operation of the GVaP Water Vapor Reference Station. During this time, a limited data set will also be obtained for a maritime environment by deploying the aircraft to the Gulf of Mexico in coordination with satellite observations. Other individual intercomparisons, field projects, and laboratory calibration activities should be encouraged.

Overall, the general quality of present water vapor measurements is highly uncertain. Relative accuracies of 5% or better are needed to address major scientific issues relating to change and variability of the global and regional climates, such as the global hydrologic cycle and the radiative effects of trace gases. Although accuracies of from 5% to 10% are often given for individual water vapor sensors, intercomparisons have more typically revealed larger discrepancies. Sometimes the disagreements are explained as simple, but nonetheless troubling, bias or offset errors. However, significant random error is often present, which in many cases appears to not be random at all but

rather attributable to specific conditions such as the presence of clouds or other meteorological factors.

This intercomparison study is a basic and long overdue activity. It should significantly improve knowledge of present observing capabilities and the quality and characteristics of available water vapor data.

#### **Conclusion**

The total GVaP addresses fundamental deficiencies in the present understanding of moist atmospheric processes and the modelling of these processes from regional to global scales. The cooperative effort described in this article should provide a science base for application to global measurements of water vapor from planned spaceborne instruments and existing operational systems. The joint GVaP and ARM activities are designed to optimize available resources in obtaining new knowledge to achieve the common research objectives of GEWEX and ARM.

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- Starr, D. O'C., and S. H. Melfi, 1991: *The Role of Water Vapor in Climate: A Strategic Plan for the Proposed GEWEX Water Vapor Project (GVaP)*. NASA Conference Publication 3120, 50 pp.
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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. In the future, the plan is to have at least one article reporting research results in each issue. Next year and beyond short technical articles are envisioned to be a significant part of the GEWEX Newsletter.

**SCIENCE PLAN SUMMARY  
FOR THE  
CANADIAN COMPONENT OF THE FIRST PHASE  
OF THE GEWEX PROGRAMME**

**R. G. Lawford  
Canadian Climate Center**

Furthering our understanding of the terrestrial hydrological cycle and the ability to observe and model it on scales appropriate for climate studies is a priority for the International GEWEX Programme. For this reason, the Global Continental-Scale International Project (GCIP) will be an important activity of the GEWEX Programme. Based on an extensive review, the Scientific Steering Group for GEWEX selected the Mississippi River basin for GCIP. Other geographical areas will also be studied because not all important hydrological processes occur within the Mississippi basin, and the need exists to validate models and results developed for the Mississippi and to ensure their transferability to other basins. The Canadian GEWEX Programme is designed to help meet that need.

**Strategies for Canadian GEWEX Programme**

Activities within Canada corresponding to the International GEWEX Programme are within the purview of the Canadian Climate Program and the Canadian Global Change Program. Organizations involved with these programs and others have contributed to the development of a Canadian GEWEX Programme science plan with the following components:

- (1) Large-scale hydrological and related atmospheric and land-atmosphere studies linked to GCIP, to be conducted during (1992-98) and called the Mackenzie GEWEX Study (MAGS).
- (2) Process studies and regional energy and water budget analyses directly or indirectly linked to GCIP and GEWEX objectives.
- (3) Contributions to the hydrological and hydrometeorological aspects of the (ISLSCP) effort Boreas Ecosystem-Atmospheric Study (BOREAS) and Cryospheric System to Monitor Global Change in Canada (CRYSYS), an effort complementing the proposed World Climate Research Programme (WCRP) Arctic Climate Systems Studies (ACSYS).

- (4) Participation in experiments related to improved understanding and modelling of cloud-precipitation-radiation processes for climate models, as contributions to the GEWEX Cloud System Study (GCSS).
- (5) Continued global climate model development and contributions to international projects related to GEWEX, including the International Satellite Cloud Climatology Project (ISCCP), the Global Precipitation Climatology Project (GPCP), and others.
- (6) Planning for Canadian participation in GEWEX into the late 1990s.

Canada can make a number of contributions to GEWEX. These contributions will come through research on scientific issues and problems of special Canadian concern and where Canadians have special expertise. Clearly, snow and ice, or in general, scientific issues related to the solid phase of water, must be high priority. Scientific activities should include a range of process studies, development of observational techniques and methods of data processing, and both hydrological and atmospheric modelling. Where appropriate, the process and modelling studies could be conducted within the Mississippi basin as a direct contribution towards GCIP.

Another strategy for augmenting Canada's GEWEX initiatives will involve the enhancement of hydrometeorological and hydrological studies being carried out in other areas. Specific research initiatives will involve energy and water fluxes and budgets on a range of scales as well as evaporation, evapotranspiration, precipitation, and snow distribution processes.

Together these strategies and activities will form a strong and important scientific program that will make significant contributions to the International GEWEX Programme and toward improvements in understanding and managing Canada's water resources.

**The Mackenzie GEWEX Study (MAGS)**

In selecting the Mississippi basin for the GCIP study the GEWEX Science Steering Group applied a number of criteria including the requirement for the basin to encompass a wide range of climate, soil moisture conditions, vegetation types, and surface topographies. Since no single basin can completely

*(continued on page 6)*

## Science Plan (continued from page 5)

satisfy the global needs for this criteria, there is a need for a variety of "continental scale" basins in which to conduct model testing, with each basin offering unique characteristics not found in the Mississippi basin. The requirements for a cold regions basin can be satisfied by the Mackenzie River basin. This basin meets most of the GCIP basin selection criteria; its main shortcoming is the poor existing database. Because Mackenzie basin data are scarce, the region could serve as a test basin for models developed for the Mississippi basin.

The Mackenzie and Mississippi watersheds taken together provide a true continental area in which to test and validate a GCIP macroscale hydrological model. Further advantages of the Mackenzie are the limited regulation on the river and the significant role it plays in the ice cover and circulation of the Arctic Ocean. The Mackenzie, therefore, provides strong ties to the ocean mixed layer aspects of GEWEX. The Mackenzie GEWEX Study will draw upon the expertise, data sets, and facilities of the Arctic Weather Centre in Edmonton.

The investigators challenge to advance understanding of the energy and water cycles of the Mackenzie basin are similar to those of the Mississippi basin. Studies on both basins include modelling and observational methods.

### Models

The Canadian GEWEX science plan devotes considerable attention to realistic treatment of physical conditions at different time and space scales from microscale to the assimilation of these processes up through regional models and to global climate models. It is in the area of the parameterization of subgrid scale processes that GEWEX is expected to be of the greatest aid to modellers, for example, the generation of precipitation on the basis of subgrid variations in cloud cover. Also, satisfactory simulations of the intensity and spatial distribution of surface transfers of heat, moisture, and momentum in physical terms require pioneering research. The Canadian GEWEX Science Plan emphasizes selected topics where there exists established Canadian expertise.

Role of Clouds and Precipitation in Atmospheric Models. The Arctic and the Mackenzie River Valley are exposed to many of the same types of cloud systems that affect the rest of Canada. Extra-tropical cyclones, deep convection, orographically-driven systems, and widespread low cloud all occur. However, many of the

extra-tropical cyclones have entered their occluded state by the time they reach high latitudes, and new cyclonic systems are often produced in the Mackenzie Valley through lee cyclogenesis. As well, during the open water season, small-scale vortices (polar lows) occasionally develop along the edge of the sea ice in the Beaufort Sea. In the summer, severe convection is fairly common over the central and western mainland. In winter, low clouds predominate. It is not known how such cloud systems will differ if climatic change ensues. How will climatic change affect the dominant circulation regimes and the intensity of cyclonic activity? Will there be more occluded systems affecting the region? Will storm tracks tend to be coupled to topography and consequently be resistant to climatic change? What effect will a reduction in ice cover have on synoptic and mesoscale systems, and what feedbacks will develop?

Programs are being established in Canada to develop realistic cloud process parameterization for GEWEX. Because of the large variability of radiational properties and precipitation within cloud systems, mapping these patterns is only a first step; prediction and incorporation into numerical simulations require that the patterns be understood.

Another group is being established to determine the radiational and precipitation characteristics of clouds important to Canada, to incorporate these features into realistic simulations of the high latitude hydrological cycle, and to study the possible role of these clouds in future climate. This research will be closely coordinated with the GEWEX Cloud System Study (GCSS) to keep continually abreast of and to contribute to complementary international efforts.

Hydrological Models and Land Processes. Research initiatives are needed in a number of areas to resolve the needs of the hydrological modelling community. Opportunities that will be incorporated into Canadian GEWEX initiatives are described in the Canadian GEWEX Science Plan. Cold region hydrological processes initiatives include

- development of appropriate parameterization techniques of cold region processes for meso-scale and macroscale hydrologic models
- use of remote sensing
- role of snow cover
- role of permafrost and evaporation

(continued on page 7)

## Science Plan (continued from page 6)

### Observations and Data Management

Conventional meteorological and hydrological point observations will continue to be the basic data source for many of the proposed Canadian GEWEX science initiatives. In addition, they will be a primary source of information for the development and validation of algorithms for deriving geophysical variables from remote sensors and for the validation of modelled atmospheric and hydrological parameters. The majority of these conventional data are readily accessible from archives operated by the Canadian Climate Centre and the Inland Waters Directorate. In addition, there are numerous regional, provincial, or agency-specific databases that could be used in GEWEX if they were made available.

A very important aspect of studies of the energy and water cycles, particularly at the global scale, will be the representation of variables at scales compatible with both atmospheric and hydrological models. Such variables include, but are not limited to snow water equivalent, soil moisture, vegetation classification and indices, surface albedo and emissivity, and evaporation and evapotranspiration. Satellite remote sensing represents a promising approach in quantifying these variables, and in some cases it may be the only viable means of complementing conventional data and characterizing them at scales appropriate to GEWEX. Furthermore, it provides a basis for standardizing measurements from different countries.

Aircraft will play a role in validating satellite retrieval algorithms. Although the snow components are not a priority in the International GEWEX Science Plan, the development of remote sensing methods for measuring snow in Canada is an essential part of the Canadian GEWEX Programme.

Data analysis, assimilation, and management are topics high on the agenda in the implementation of the Canadian GEWEX Science Plan. For that reason, a workshop was convened in Saskatoon, Saskatchewan, 5-8 May 1992, specifically to address those topics in the context of GCIP. A summary of the workshop is reported under Summaries of Meetings.

### International Linkages

The Canadian GEWEX Programme has close ties to the WCRP International GEWEX Programme. For example, as part of the GEWEX Programme land-surface experiments, Canadians will be participating in

the BOREAS. Another example of linkage is a planned joint project within Canadian Atlantic Storms Program Phase II (CASP II), with the objective of mapping out the precipitation fields within extra-tropical cyclones using satellite data, verifying this with in situ measurements, and understanding this organization through the development of conceptual and perhaps numerical models. There are plans to work closely with the GEWEX Cloud System Study and other elements of the WCRP, such as the Arctic Climate System Study. The connection with GEWEX will be through common interest in the energy and water cycles, and in particular in the continental runoff at high latitudes.

The Canadian GEWEX Programme is coordinated by a GEWEX Management Committee and a Scientific Committee. The GEWEX Programme is also represented on the Research Committee of the Canadian Climate Program, and the Scientific Steering Committee of the Canadian Global Change Program, and the GEWEX Scientific Committee is associated with the Canadian Global Change Committee structure. The National Hydrology Research Centre in Saskatoon provides a secretariat service for the Canadian GEWEX Programme.

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### UNITED KINGDOM INSTITUTE OF HYDROLOGY SOIL MOISTURE MEASUREMENT PROGRAMME

**T.J. Dean**  
**Institute of Hydrology**

In the implementation of programmes such as GCIP the lack of observations on soil moisture has been recognized as a major data issue requiring resolution. Since the 1960s, the Institute of Hydrology (IOH) at Wallingford, U.K., has had an active programme of research and development of instrumentation for the measurement of both soil water content and tension. The drive for this has been the hydrological requirement for data on both soil water storage and transport. The IOH pioneered the development of the neutron probe and pressure transducer tensiometers and currently is following a comprehensive programme of sensor and system development.

### Sensor Development

The neutron probe will continue to have important applications but is subject to constraint because of radiation hazard and the unsuitability for  
*(continued on page 8)*

**Soil Moisture** (continued from page 7)

automatic logging. The IOH has developed new soil moisture sensors measuring dielectric constant by the capacitance method. One version, for use in an access tube, is available commercially and overcomes the drawbacks stated for the neutron probe. Neither this new instrument nor the neutron probe is suitable for measuring the water content in the surface, or top 5 or 10 cm of the soil, and a significant new development is the Surface Capacitance Insertion Probe (SCIP). This device is readily portable, lightweight, relatively low cost, reads instantaneously, and is simply inserted into the soil to make a measurement. Capacitance sensors, of course, rest on the same basic principles of soil dielectric constant as do other sensors, and in many respects the techniques are complementary.

**System Development**

The IOH has developed and operated automatic weather stations for many years and is now extending the concept to automatic soil water stations (ASWS) using the logging version of the SCIP. A number of different configurations have been built and tested. The most comprehensive has a rain gauge and three spatially separated arrays, each of which measures soil water content, tension, and soil temperature. To date the emphasis has been on surface measurements with sensors at 5-, 10-, and 15-cm depths, but the future programme will extend this to 0.5 m. A further development will include an automatic depth profiling sensor operating in a 1-m access tube. These schemes all use data loggers that can be extended readily to provide telemetered data and programme adaptation.

**Applications**

The immediate use by the IOH is on surface measurements to validate aircraft and satellite programmes and for improved data sets to enhance the performance of flood forecasting models. A particularly exciting fundamental study underway is the dynamic determination, in the field, of the water release characteristic as it is generated by natural climatic events. Apart from the standard hydrological requirements, World Climate Research Programmes such as the Global Precipitation Climatology Project and GEWEX Continental-Scale International Project will clearly stand to benefit from the availability of equipment derived from the IOH programme.

**BALTEX—A JOINT INTERNATIONAL  
CONTRIBUTION TO GEWEX**

**Ehrhard Raschke**  
**GKSS Research Centre**

The Baltic Sea Experiment (BALTEX), like the GEWEX Continental-Scale International Project (GCIP), is aiming for improvements in our knowledge on all those processes involved in the Earth's energy and water cycles, important for climate. However, unlike the GCIP region, which has good observational coverage, BALTEX includes the entire Baltic Sea water catchment (an area covering about 2 million square kilometers of nine countries, and the Baltic Sea itself), which is not well covered with sophisticated ground-based observations. Furthermore, BALTEX requires the collaboration of at least three different science disciplines: hydrology, meteorology, and oceanography.

A workshop was held recently in Geesthacht, Germany, with the participation of representatives from almost all neighboring countries as well as from the World Climate Research Programme office in Geneva. At this first workshop concepts were developed for long-term cooperation in this project, whose scientific objectives are briefly

- To determine and model the energy and water budget and their changes in space and time over the entire Baltic Sea and its water catchment area
- To investigate interactions between circulation anomalies of the Baltic Sea and the water budgets of surrounding areas

Major emphasis in this project will be given to a thorough understanding of all those hydrological processes that are to be parameterized in global and limited area models. Monitoring activities using ground-based and spaceborne observational means will also be enhanced during BALTEX.

A first pilot project will adapt and use hydrological modelling in the Elbe-Weser river basins, which are well covered with observations. BALTEX will begin with a preparatory phase in 1993 and may last until the end of this century. A secretariat for coordinating and contact purposes will be installed soon. For further information on BALTEX, contact the author at GKSS Research Centre, Postfach 1160, D-2054 Geesthacht, Germany. Phone: 49 4152 871833.



## SUMMARIES OF MEETINGS

### **GEWEX Science Steering Group Meeting** 27-31 January 1992 Tokyo, Japan

At the Fourth Session of the GEWEX Science Steering Group (SSG) several international developments and plans related to GEWEX were reviewed. The high priority being given to climate and hydrologic system research by the international science community was a central theme. The minutes of this meeting are in final preparation. The Fifth Session GEWEX SSG will be 1-5 February 1993, San Diego, California. (See WCRP/GEWEX Meetings Calendar).

### **GCIP Atmospheric Subpanel Workshop** 18-19 March 1992 Silver Spring, Maryland

The GCIP Atmospheric Subpanel Workshop of 18-19 March 1992 was organized by the International GEWEX Project Office (IGPO) to consider atmospheric science questions and related assessment goals presented in the GCIP Science Plan (WCRP-67 WMO/TD No. 461). The workshop was held at the National Atmospheric and Oceanic Administration Office of Global Change. This workshop was one of the continuing activities of IGPO in preparing the GCIP Implementation Plan. Fourteen atmospheric scientists from government and academia participated in this workshop. The agenda consisted of invited presentations and working group discussions focused on the objectives of the workshop. The objectives were (1) identifying what advances related to atmospheric modelling can be derived from GCIP and (2) recommending specific implementation actions.

From the plenary presentations and discussions there evolved the concept of four working groups. Each working group formulated ideas with an underlying structure of considering studies that could be initiated before the GCIP Enhanced Observing Period (EOP) beginning about 1995 and efforts for the EOP and beyond. The four working groups were (1) GCIP Mesoscale Model Climate Sensitivity Project, (2) Diagnostic Studies, (3) Validation and Analysis Data Sets, and (4) Observational System Requirements. A summary report on this workshop is available from IGPO.

### **Joint Cloud Process Study Meeting,** 29-30 April 1992 Fort Collins, Colorado

A fundamental science problem addressed at the Fort Collins meeting concerned the role of organized cloud convection and its parameterization in large-scale models. This is one of the science topics detailed in the draft GEWEX Cloud Systems Science (GCSS) Plan which emphasizes improvements in cloud resolving models for several classes of cloud systems. The GCSS development activities are being led by the United Kingdom. The GCSS research topics are of interest to scientists working under both the U.S. Weather Research Program (USWRP) project and U.S. Department of Energy (DOE) climate-related programs. Acquisition of improved understanding of the radiative properties

of convective clouds on the Earth's energy budget was another basic science issue addressed by the participants. This topic is of interest to GEWEX, the DOE Atmospheric Radiation Measurement (ARM) program, and programs under the National Aeronautics and Space Administration. Improved parameterization of cloud radiative properties is also a part of the GCSS Science Plan and a specific area to be addressed as a result of the GEWEX and ARM Memorandum of Participation.

The meeting ended with a proposal of possible candidates to constitute a science steering group for the agreed joint science effort. Dr. William Cotton was tasked to formulate a joint steering group with representatives from GEWEX, ARM, and USWRP. A principal, if not the primary, science to be addressed by the joint effort centers on parameterization of convective clouds for improved assimilation into numerical models. Dr. Mitchell W. Moncrief was delegated to prepare a plan for the agreed joint effort involving scientists associated with GEWEX, ARM, and USWRP.

### **GEWEX Continental-Scale International Project (GCIP) Data Workshop** 5-8 May 1992 Saskatoon, Saskatchewan, Canada

The GEWEX Continental-Scale International Project (GCIP) Data Workshop was held at the National Hydrology Research Centre in Saskatoon, Saskatchewan, Canada. The principal objective of the workshop was to identify and promote action on practical problems related to the collection, quality assurance, and archival and delivery of data needed to accomplish the objectives of the GCIP Project. Thirty-four persons from Canada and the U.S.A. participated in the workshop. The workshop considered 24 technical presentations on observing networks, data collection, and processing and management systems. Working groups considered more specialized topics related to in situ data, remote sensing data, and the GCIP needs for data management and services. These topics included (1) the ability of existing data collection systems to provide from the different observing networks to a central data archive; and (2) the adequacy of observations of key parameters such as soil moisture, difficulties in measuring precipitation (especially solid forms), and the accuracy implications of different types of meteorological instrumentation such as those used in Canada and the U.S.A. The utility of satellite, aircraft, and surface-based remotely sensed data in meeting the GCIP data needs was examined from a number of geophysical parameters. Deriving rainfall estimates from Doppler radar data was of particular interest at the workshop because of the unique network of Doppler radars now being installed in the U.S.A. A report of this workshop is available from IGPO.

### **International Symposium on Active Sensors and Non-synchronous Missions Dedicated to GEWEX** 15-19 June 1992 Paris, France

This symposium was sponsored by the Centre National d'Etudes Spatiales (CNES) in concert with the World Climate Research Programme (WCRP), the European Space Agency (ESA), the National Aeronautics and Space Administration  
(continued on page 10)

**Meeting Summaries (continued from page 9)**

(NASA), and the National Agency for Space Development of Japan (NASDA). The objectives of this symposium were (1) to provide an opportunity to discuss the rapidly evolving design strategy for the Earth Observing System series of satellites and its impact on GEWEX, and (2) to provide a forum for discussion of satellite requirements and international availability of other planned satellites to meet the goals and objectives of GEWEX.

**WCRP-GEWEX/IGBP-BAHC Joint Working Group on Land Surface Experiments for the Amazon Region****18-20 June 1992**

NASA Goddard Space Flight Center, Greenbelt, Maryland

Changes in land use and biomass burning in the Amazon region are resulting in a shift from forested lands to grasslands. The altering of previously consistent patterns of moisture cycling between vegetative evapotranspiration and precipitation are now anticipated, with global effects likely. It was within this context of coupled energy, atmospheric, and biological systems that the Joint Working Group, in cooperation with Brazilian scientists, outlined the needs and developed a plan for the scientific community in order to understand these coupling processes. A report is forthcoming from the IGPO.

**The International Satellite Land Surface Climatology Project (ISLSCP)****23-26 June 1992**

Columbia, Maryland

The meeting, headed by Dr. Piers Sellers and attended by over 200 people, was a working group that concentrated its efforts on developing a strategy to secure information on landcover and classification, hydrometeorology, radiation, soils and soil moisture. A report is forthcoming from the IGPO.

**THE FIRST PROJECT FOR INTERCOMPARISON OF LAND SURFACES PARAMETERIZATION (PILPS) WORKSHOP****24-26 June 1992**

Washington, D.C

The GCIP-WGNE Project for Intercomparison of Land-Surface Parameterization (PILPS) was held in conjunction with the ISLSCP Workshop. The PILPS Workshop, consisting of 30 groups, was led by Dr. Anne-Henderson Sellers and addressed specifics (e.g., determining the ability of 1-D, single column, and 2-D models to produce the needed framework for validation; identifying the necessary data sets; and establishing the schedules and final structure). Over 80 people participated in the PILPS Workshop, which included sessions in the evenings and on Friday afternoon.

To announce a GEWEX meeting or workshop in *GEWEX NEWS*, send details via OMNET: INTL.GEWEX or FAX: (202) 488-5364.

**WCRP/GEWEX MEETINGS CALENDAR**

**3-5 August 1992**—GPCP. THE SIXTH SESSION OF THE JSC WORKING GROUP ON DATA MANAGEMENT FOR THE GLOBAL PRECIPITATION CLIMATOLOGY PROJECT will meet at the National Climatic Data Center (NCDC) in ASHEVILLE, NORTH CAROLINA. For further information contact Dr. Phillip Arkin, NOAA/NMC, 5200 Auth Road, Room 101, Camp Springs, MD 20746. PHONE: (301) 763-8317, FAX: (301) 423-9181.

**28 August - 5 September 1992**—COSPAR SYMPOSIUM ON GLOBAL CHANGE AND RELEVANT SPACE OBSERVATIONS to be held in WASHINGTON, D.C. For additional information, contact J. Fellows, PHONE: 33-1-45087648; FAX: 33-1-45087867, or World Space Congress in Washington, D.C. PHONE: (202) 646-7451; FAX: (202) 646-7508.

**7-11 September 1992**—SECOND INTERNATIONAL CONFERENCE ON MODELLING OF GLOBAL CLIMATE CHANGE AND VARIABILITY. The conference will be held at Max-Planck-Institut für Meteorologie, HAMBURG, GERMANY. For information contact Dr. Lydia Dumenil, Max-Planck-Institut für Meteorologie, Bundesstrasse 55, D-2000 Hamburg 13. PHONE: 49-40-41173-310; FAX: 49-40-41173-366.

**28 September - 2 October 1992**—CLOUDS AND OCEAN IN CLIMATE: An International WCRP Symposium will be held at Nagoya University, NAGOYA, JAPAN. This symposium will be dedicated to the review and assessment of the current state of knowledge of cloud-radiation processes and atmosphere-ocean interaction processes, including the presentation of results of the Japanese WCRP Programme. For additional information, contact Dr. Yasushi Fuyiyoshi, Water Research Institute, Nagoya, University, C ikusa-ku, Nagoya 464-01, Japan. PHONE: 81-52-781-5111, ext. 5741; FAX: 81-52-781-3998.

**27-30 October 1992**—A JOINT GEWEX AND WORKING GROUP ON NUMERICAL EXPERIMENTATION (WGNE) Workshop on Global Observations, Analyses, and Simulation of Precipitation near WASHINGTON, D.C. The purpose of the workshop will be to advise WGNE and the GEWEX SSG on the quality of forecasts and simulations of global precipitation, and on the quality and reliability of the validating observations and analyses. The workshop will consist of invited presentations, followed by the meeting of several working groups to formulate recommendations. For further information, contact the Chair of the Workshop Organizing Committee, Dr. P. Arkin, National Meteorological Center, NOAA/NWS-W/MNC, Washington, D.C. 20233. PHONE: (301) 763-8317; Fax: (301) 423-9181; E-Mail: OMNET/P.Arkin.

**10-13 November 1992**—THE THIRD ANNUAL GCIP SCIENCE PANEL MEETING, VICKSBURG, MISSISSIPPI, by invitation only. For information, contact Dr. Charles Arnold, IGPO.

*(continued on page 11)*

## Meetings Calendar (continued from page 10)

**17-22 January 1993**—THE 73RD ANNUAL MEETING OF THE AMERICAN METEOROLOGICAL SOCIETY IN ANAHEIM, CALIFORNIA. GEWEX contributions to symposium conferences and special sessions will be as follows: (1) Fourth Symposium on Global Climate Change being organized by Prof. Eric J. Barron, Earth System Science Center, Pennsylvania State University; (2) Conference on Hydrometeorology, chaired by Prof. Konstantine P. Georgakakos, Civil and Environmental Engineering Department, University of Iowa; (3) Session on Profiling of Water Vapor in the Free Troposphere and Stratosphere, organized by R.M. Hoff, Atmospheric Environment Service, Egbert Ontario; and (4) an important symposium on Challenges in Atmospheric and Earth Sciences. For information on this special symposium, contact Prof. Donald R. Johnson, Department of Atmospheric and Oceanic Sciences, University of Wisconsin-Madison. Details on these and other related GEWEX sessions at the 73rd AMS Meeting may be found in the March 1992 issue of the Bulletin of the American Meteorological Society.

**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; OMNET/T. Vonder Haar.

GEWEX WATER VAPOR PROJECT (GVaP), REPORT OF WORKSHOP, EASTON, MD, U.S.A., 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—WCRP-57, 21-25 JANUARY 1991 (WMO/TD-No. 413).

GLOBAL ENERGY AND WATER CYCLE EXPERIMENT (GEWEX)—REPORT OF THE FIRST GEWEX TEMPERATURE/HUMIDITY RETRIEVAL WORKSHOP, WCRP-XX, GREENBELT, MARYLAND, U.S.A., 23-26 OCTOBER 1990.

GEWEX CONTINENTAL-SCALE INTERNATIONAL PROJECT (GCIP). REPORT OF THE FIRST GCIP PLANNING WORKSHOP, RESTON, VIRGINIA, U.S.A., 8-10 OCTOBER 1990. IGPO Publication Series No. 1.

SCIENTIFIC PLAN FOR THE GLOBAL ENERGY AND WATER CYCLE EXPERIMENT—WCRP-40, AUGUST 1990 (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 programme 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.

## GEWEX REPORTS/DOCUMENTS (Available from IGPO)

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

GEWEX CONTINENTAL-SCALE INTERNATIONAL PROJECT (GCIP) ATMOSPHERIC SCIENCE COMPONENT; Report on Atmospheric Subpanel Workshop 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)—WCRP-67, February 1992 (WMO/TD-No. 461).

THE ROLE OF WATER VAPOR IN CLIMATE, A STRATEGIC RESEARCH PLAN FOR THE PROPOSED

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