GEWEX WCRP

Global Energy and Water Cycle Experiment

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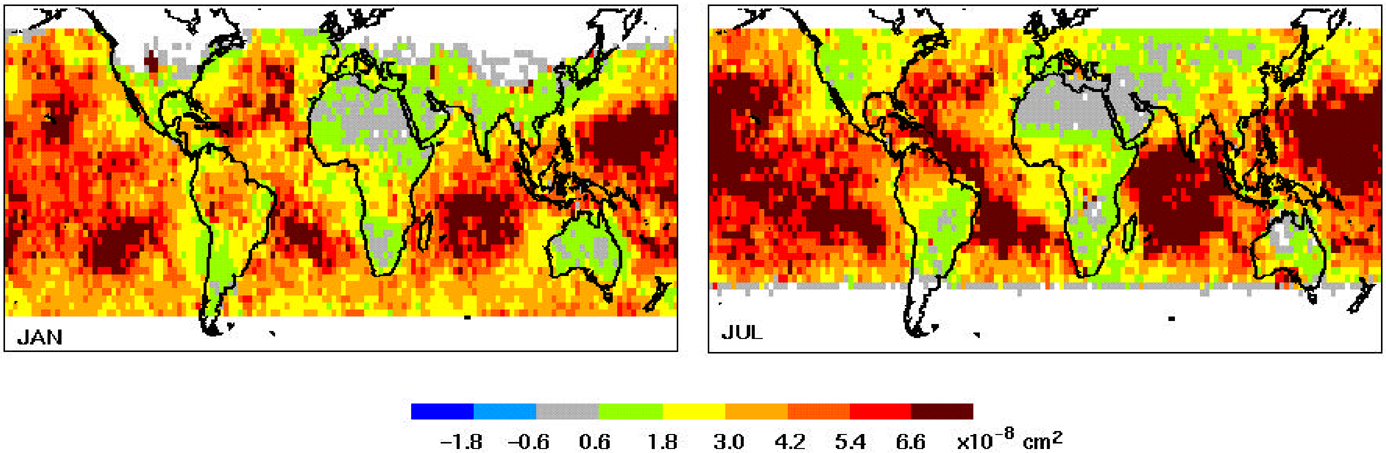
KEY IPCC CLIMATE ISSUE ADDRESSED WITH ISCCP DATA (GLOBAL AEROSOL INDIRECT EFFECT)



ISCCP data show large albedo increases due to increase in droplet concentration (indirect aerosol effect) over most oceanic clouds and little albedo change for clouds over most continents (see Han et al. article on page 3.)

CEOP PLANS ADVANCE AT WORKSHOP

The GEWEX Hydrometeorology Panel (GHP) held a workshop, 22–29 January 2000, to further develop the plans for a Coordinated Enhanced Observing Period (CEOP) in the first half of this decade. The Workshop was hosted by the International Pacific Research Center and was held in the East-West Center of Hawaii, Honolulu, Hawaii.

The CEOP is now planned for two major phases over a five-year period. The data collection phase will be carried out during the 2001 through 2003 time period. The principal research phase is scheduled for the period of 2003 through 2005. The focus of the CEOP is on evaluating the impact of land and hydrological processes on the predictability of weather and climate, with emphasis on application to water resources. The variability in water resources is linked to the global water and energy cycle. The participants in CEOP are setting out to improve the understanding of the role of land on the global water cycle leading to a better understanding of the causes of interannual variability in the global distribution of water resources.

The results of the GHP Continental Scale Experiments to date have emphasized the water budgets on continental scales in specific regions to improve our understanding of mechanisms governing land surface and atmospheric interactions. The CEOP represents a pilot project in extending the results for

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WHAT'S NEW

- *BALTEX On Schedule, Points To CEOP*
- *GCSS Updates Science/Implementation Plan*
- *CEOP Coordinates With Other Projects*
- *New Leadership at GRDC*
- *GCSS WG1 Tests Models Over Land*
- *NASA Administrator Emphasizes Need for More Focus on Precipitation (see page 9)*

COMMENTARY

GEWEX SSG ACTIVITIES

Soroosh Sorooshian, Chairman
GEWEX Scientific Steering Group

The GEWEX Science Steering Group (SSG) meeting took place 31 January – 5 February 2000 in the East/West Center of the University of Hawaii in Honolulu. The meeting was graciously hosted by the International Pacific Research Center (IPRC). As is usually the case for GEWEX SSG meetings, the agenda was quite full because of a large number of activities. The three main panels, namely the GEWEX Hydrometeorology Panel (GHP), the GEWEX Radiation Panel (GRP), and the GEWEX Modeling and Prediction Panel (GMPP), reported on progress as well as a wide range of future activities which have either been planned or are under planning. In this commentary, I will try to address several of these activities.

As you are well aware, under the auspices of the GHP, planning for the Coordinated and Enhanced Observing Period (CEOP) has been underway for over a year now. Because all five GEWEX Continental Scale Experiments (CSE) are to be participants in the CEOP, there is a wide ranging set of issues that have been under development. Quite a bit of lively discussion took place and constructive suggestions were made to the CEOP working group, which hopes to have, within a very short time period, a final draft for the CEOP implementation plan. The CEOP plan for the GAME CSEs (thanks to the help of our Japanese colleagues, Professors Tetsuzo Yasunari and Toshio Koike) is very well advanced and will serve as a good model for the development of the overall plan. Of particular emphasis are strategies for the use of satellite data, distribution of as much data as possible via the Global Telecommunications System (GTS), effective management and collection of results into a single unique data set on appropriate media (i.e., CD-ROM), and coordination with other elements of WCRP [e.g., Climate Variability and Predictability (CLIVAR), and Climate and Cryosphere (CLIC)].

The second aspect to discuss relates to my commentary in the previous issue of the GEWEX News, namely the role of GEWEX in water resources application. The discussions on this topic were extremely constructive and useful. There was clear recognition that, because of the complex and wide ranging requirements of the water resources community, careful evaluation and planning are needed to determine the most effective interface between GEWEX and water resource applications. In order to address this issue, a working group has been formed and will be led by Rick Lawford and Dennis Lettenmaier. The first activity of this group will be to plan and hold a workshop involving representation from all CSEs and participation from a number of water resource groups, including both national and international agencies. The new initiative, Hydrology for Environment, Life and Policy (HELP), will be one of the main international activities, whose role and interface with GEWEX will be important.

The third issue to address is the GEWEX Global Land-Atmosphere System Study (GLASS), which has been formulated by the community in a series of workshops. The GLASS initiative is spearheaded by the GMPP in close association with the Working Group on Numerical Experimentation (WGNE). Needless to say, GLASS will work closely with ISLSCP and the Biosphere Aspects of the Hydrologic Cycle (BAHC) in order to facilitate smooth coordination with the model intercomparison studies which BAHC wishes to perform.

In summary, the level of enthusiasm about GEWEX remains extremely high. This sentiment was clearly and strongly expressed by Roger Newson, the Acting Director of WCRP, who attended the entire meeting and provided very constructive input from the WCRP's perspective.

The SSG is committed to seizing every opportunity to strengthen coordination and collaboration with other international programs. The chair of International Geosphere Biosphere Programme (IGBP) (Dr. Berrien Moore), the co-chair of CLIVAR SSG (Dr. Antonio Busalacchi), the chair of BAHC (Dr. Pavel Kabat), and the chair of the World Weather Research Program (WWRP) SSG (Dr. Richard Carbone), were in attendance at the SSG meeting. This is a strong indicator of the level of everyone's commitment towards strengthening collaborations.

ISCCP DATA USED TO ADDRESS A KEY IPCC CLIMATE ISSUE: AN APPROACH FOR ESTIMATING THE AEROSOL INDIRECT EFFECT GLOBALLY

Q. Han[1], W. B. Rossow[2], J. Chou[1], and R. M. Welch[1]

[1]Department of Atmospheric Science University of Alabama in Huntsville
[2]Goddard Institute for Space Studies, NASA

Among possible radiative forcings that can cause long-term climate change, the effect of changing tropospheric aerosols on cloud properties (called the aerosol indirect effect) is the most uncertain (0 to -1.5 Wm^{-2}) relative to the other known forcings. It is also the only one without even a mid-range estimate (IPCC, 1996). Recent model studies further suggest that the indirect aerosol effect may be playing a vital role in global change (Hansen et al., 1997). One approach to estimate the aerosol indirect effect is to evaluate the cloud albedo change due to variations of aerosol loading. Twomey (1991) first introduced the concept of cloud susceptibility, defined as cloud albedo change versus number concentration change of cloud droplets, *da/dN*, which is a very important parameter that can indicate at which part of the world clouds are more susceptible to be influenced by the cloud-aerosol interaction. However, the accuracy of calculation and feasibility of remote sensing of this parameter have been limited by the assumption used in the calculation and certain information required in the remote sensing (liquid water content). Traditionally, the calculation of cloud susceptibility is based on an assumption of constant liquid water content and cloud geometrical thickness (Platnick and Twomey, 1994; Taylor and Mchaffie, 1994), which means that cloud liquid water content and cloud geometrical thickness are fixed when cloud droplet size changes. These assumptions are not valid according to most observations (for a detailed discussion, see Han et al. 1998a and the references therein). The feasibility of remote sensing of cloud susceptibility is further limited by the fact that the equation used was in the form

$$\frac{d\alpha}{dN} = \frac{4\pi\rho_w}{9w}\alpha(1-\alpha)r_v^3; \ \alpha \approx \frac{(1-g)\tau}{2+(1-g)\tau}$$

which requires the value of liquid water content, *w* (Platnick and Twomey, 1994). In the study of Platnick and Twomey, $g \approx 0.85$, $r_v = r_e$, $w = 0.3 g/m^3$ were assumed in order to retrieve cloud susceptibility using satellite data. This approach is valid for case studies when the liquid water content can be obtained by other measurements. However, for global surveys, liquid water content depends on entrainment and saturated adiabatic values that vary strongly from cloud to cloud. The values of liquid water content range from 0.2 g/m^3 up to 5g/m^3 (e.g., Pruppacher and Klett, 1997, p. 23), which may cause the resultant uncertainty in cloud susceptibility more than one order of magnitude.

To supply necessary information for the study of the cloud-aerosol interaction, we used ISCCP data to estimate cloud susceptibility on a near-global scale. Because of the difficulties in calculation and the remote sensing for the original parameter of cloud susceptibility, we develop a similar parameter, *column susceptibility*, which can be (1) easily used in model calculations without the assumption of constant liquid water content, and (2) retrieved globally using satellite data without the assumption of an average value of liquid water content.

The column susceptibility is defined by $S_c = da/dN_c$ where *a* is spherical albedo and N_c is column droplet concentration. The column droplet concentration is defined by $N_c = NAh$. The retrieval method for N_c, validation effort, and results of a global-survey have been described by Han et al. (1998b). **The global distribution of N_c shows the expected increase of column droplet concentrations between ocean and continental clouds and in tropical areas during dry seasons where biomass burning is prevalent**. It is demonstrated that column droplet concentration is a good indication of available CCN populations in certain areas.

Two approaches are used to retrieve cloud column susceptibility. One approach uses the assumption of constant liquid water content and the other ap-

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proach does not. In both approaches, cloud optical thickness and effective droplet radius are retrieved using the three-channel method. We retrieve cloud optical thickness (t) and effective droplet radius (r_e) from satellite-measured radiances at 0.63, 3.7 and 10.7 µm wavelength (channels 1, 3 and 4 of AVHRR on NOAA polar orbiting satellites). This is performed by comparison with calculations from a radiative transfer model that represents the spectral and angle dependence of radiation, accounting for multiple scattering by gases and clouds and for other atmospheric and surface effects (Han et al., 1994). The analysis is applied to pixel-level data (stage CX data) from the International Satellite Cloud Climatology Project (Rossow and Schiffer, 1991) which identifies cloudy satellite pixels. Liquid water clouds are identified by channel 4 brightness temperatures > 273 K, implying cloud tops below the freezing level. Individual pixels are about 5 km across and have been sampled at intervals of about 30 km. Since cloud scattering at 0.63 µm is conservative, t values represent the whole cloud layer. However, most of the signal at 3.7 µm used to determine r_e comes from the uppermost portion of the cloud (Han et al., 1994).

Approach One assumes constant liquid water content. Under the assumption of constant water content, the column cloud susceptibility is

$$S_c = \frac{d\alpha}{dN_c} \approx \frac{\partial\alpha}{\partial\tau}\frac{d\tau}{dN_c} = \frac{\alpha(1-\alpha)}{3N_c}.$$

The column droplet concentration, N_c, and the spherical albedo of cloud, a, are retrieved from satellite radiance data (Han et al., 1998a, b). Based on these retrievals, the column susceptibility can be derived for each cloud pixel.

Under Approach Two, a regression method, there are no assumptions about liquid water content and biases caused by such an assumption are eliminated. The column susceptibility $S_c = \frac{d\alpha}{dN_c} \approx \frac{\Delta\alpha}{\Delta N_c}$ is derived from statistical regression with N_c and a retrieved from satellite radiance data. The column susceptibility values of each 2.5°x2.5° grid box are derived from a linear regression of all water cloud pixels (determined by cloud top temperature >273 K) within this grid box during one month. Typical pixel numbers are >100 for each grid box. If pixel count in a grid box is less than 10, no regression is conducted and the grid box is left blank.

Figures on the front and back pages are the retrieved column susceptibility for thin (τ≤15) clouds by the first and the second approaches, respectively. **Both approaches show the striking contrast of cloud column parameters between continental and maritime clouds. For clouds over most of continents, the column cloud susceptibility is around zero or slightly positive (≤1.8x10^{-8} cm^2), suggesting little cloud albedo change due to the cloud column droplet concentration change. For most oceanic clouds, the column susceptibilities are high, suggesting a large albedo increase due to an increase in the column droplet concentration.** In a clean oceanic environment, for a typical maritime cloud with 300 m physical thickness, the column cloud susceptibility of 6.6x10^{-8} cm^2 means that an increase in volume cloud droplet concentration of 10 cm^{-3} would increase cloud albedo by 2.0%. This is plausible due to the volume cloud droplet concentration of a typical marine cloud being only about 40 cm^{-3}. The main difference between approach results shown is that the column susceptibility is smaller if no constant water content is assumed in the retrieval. This difference is more significant over continents and surrounding ocean areas. For example, in July, over the mid latitude Western Atlantic, the average cloud column susceptibility drops from about 9.0x10^{-8} cm^2 (assuming constant liquid water content) to about 1.6x10^{-8} cm^2 (no assumption about liquid water content). This may be caused by the air pollution from the East Coast of the United States during summer.

The major difficulty in understanding the statistically regressed susceptibility is the negative values because the derivative da/dN_c should never be smaller than zero, which is a direct result from the assumption of the constant liquid water content used in the derivation. To be more specific, an increase of cloud droplet number may lead to two consequences: increasing cloud optical thickness and decreasing cloud droplet size, and, by "intuition", both will increase cloud albedo. Therefore, the cloud droplet number concentration was thought to be positively related to cloud albedo and the cloud column susceptibility could not be negative. However, part of this "intuition" is implicitly based on the assumption of constant liquid water content. In fact, a decrease of cloud droplet size will decrease the optical thickness and thus the cloud albedo for most clouds on the earth if no assumption of constant liquid water content is made (Han et al., 1998a). Therefore, these two consequences of increasing cloud droplet number usually are opposite in sign and this is why cloud column susceptibility is smaller when no assumption of cloud liquid water content is made. When the effect of decreasing droplet size is strong, usually in heavily polluted areas, the column susceptibility is close to zero or even becomes negative.

Cloud susceptibility is an important parameter in the indirect aerosol effect studies and from it the derived relation between cloud column droplet number concentration and albedo can be used in models for parameterization in estimating the indirect aerosol effects.

Editor's Note: The complementary GEWEX global data sets from the Surface Radiation Budget (SRB) project and the Global Aerosol Climatology Project (GACP), may be able to help complete the global picture by linking these results to both the source of the effect and the resultant radiative impact.

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REMINDER

New web site location
www.gewex.com

CEOP PLANS ADVANCE

(Continued from page 1)

specific continental scale areas to understand and predict global climate and water cycle and specifically, water resources in specific regions. The GHP, in planning for CEOP, also recognizes a confluence of factors towards the realization of its long-range strategic objective to work with other WCRP initiatives to demonstrate skill in predicting changes in water resources and soil moisture on time scales up to seasonal and annual as an integral part of the climate system. The opportunity to carry out the CEOP is unfolding in the 2001 to 2003 time period based on the following factors:

* GHP has progressed enough so that it will be ready to address over-arching issues in a collective manner.

* Other GEWEX efforts in the Radiation Panel (GRP) and the Modeling and Prediction Panel(GMPP) have also progressed and are ready for more collaboration.

* Monsoonal flow efforts under CLIVAR (in addition to those underway and planned within GAME) are beginning to interact with GHP to address land-ocean-atmosphere interactions.

* A new generation of remote sensing satellites (including TERRA, AQUA, ENVISAT, ADEOS-II) in addition to TRMM, Landsat-7, NOAA-K series and other operational satellites should be available over the 2001 to 2003 time period.

The Workshop participants considered the current schedule for launching the experimental satellites, which in several cases have been delayed by as much as one year. These delays could have some significant impacts on several potential participants in the CEOP because of the difficulties in extending further resources with the ongoing enhanced observing period schedules within their own Continental Scale Experiment. However, the continuing nature of the CSEs is providing a solid basis for the data sets to be provided by CEOP and each CSE will consider ways to minimize the impact of any satellite delays.

The CEOP Working Group was requested to take into account the delays in the satellite launch dates together with the contribution plans of the CEOP participants and develop a more detailed Science and Implementation Plan consistent with the resources expected to be available. The major CEOP emphasis is to be on the following scientific issues:

* How do atmosphere-land surface interactions operate and feed back onto the regional and larger scale climate system?

* How do these interactions operate over cycles from the diurnal to the annual and what are their most critical periods in terms of feedbacks?

* How do land areas respond to the large-scale climate system?

The CEOP results related to these three specific issues are also linked to the basic scientific issue: How do land-area water and energy cycles operate and how are they linked to predictability?

CEOP is an opportunity that we must take advantage of for GHP and indeed for all of GEWEX to move ahead.

"QUEST TO UNDERSTAND OUR OWN PLANET"*

The Terra spacecraft or EOS AM-1, launched on 18 December 1999, is one of the many Earth monitoring satellites planned for the next decade that will benefit GEWEX investigators (see article on CEOP, page 1; Dr. Goldin's remarks, page 9). NASA has plans to launch 25 satellites in the next few years as part of EOS. Terra begins a new self-consistent data record to be obtained for the next 15 years by NASA satellites and satellite systems launched by other countries. The Terra spacecraft has five instruments with new or improved capability to study global energy and water cycles. Terra is a joint international effort of the United States, Japan, and Canada. The instruments on Terra provided by the United States are the Clouds and the Earth's Radiant Energy System (CERES), the Multi-Angle Imaging Spectroradiometer (MISR), and the Moderate-Resolution Imaging Spectroradiometer (MODIS). Japan provides the Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER), and the Measurements of Pollution in the Troposphere (MOPITT) is a Canadian instrument.

The GEWEX hydrometeorology, modeling, prediction, radiation and land surface scientists will be users of data derived from MODIS, CERES, and the other Terra instruments. For example, hydrologists will use MODIS data to study seasonal river basin land cover changes that impact on the prediction of droughts, floods, and climate systems. Land surface scientists requiring data on soil and vegetation will also use MODIS data in their studies.

MODIS will provide new data for the GEWEX Continental Scale Experiments, other GEWEX projects, and other WCRP studies. Examples include the monitoring of global snow cover for estimating water supply available for drinking water, agriculture, fisheries, recreation, and when rapid melting produces floods. GEWEX Cloud System Study scientists will be users of MODIS data to investigate cloud types, structure, size of cloud particles, and radiative properties that impact the role of clouds in weather and climate predictions. The CERES radiation measurements will be used by atmospheric modelers and will provide the first information to compare changes in radiation with changes in cloud systems.

In addition to CERES and MODIS instruments, the measurements from ASTER will be used by GEWEX scientists studying heat coming off different land surfaces. A combination of MISR, MODIS, and ASTER data are to be used by ecosystem scientists studying, for example, how temperature and rainfall impact the length of growing seasons. MOPITT will provide, for the first time, global data for following, with six-hour updates, plumes of specific atmospheric constituents from a source.

Terra is clear evidence of the international space agencies' long-term commitment to provide global observations of the Earth's atmosphere, oceans, and land surface for the purpose of improving scientific understanding of natural processes that impact climate changes and natural hazards. The launch of Terra is an encouraging step towards achieving the objectives of CEOP (see page 1).

Additional information on Terra is available at http://terra.nasa.gov.

**A quote from Dr. Daniel Goldin's Keynote Address at the American Meteorological Society Meeting, 8 January 2000 (see page 9).*

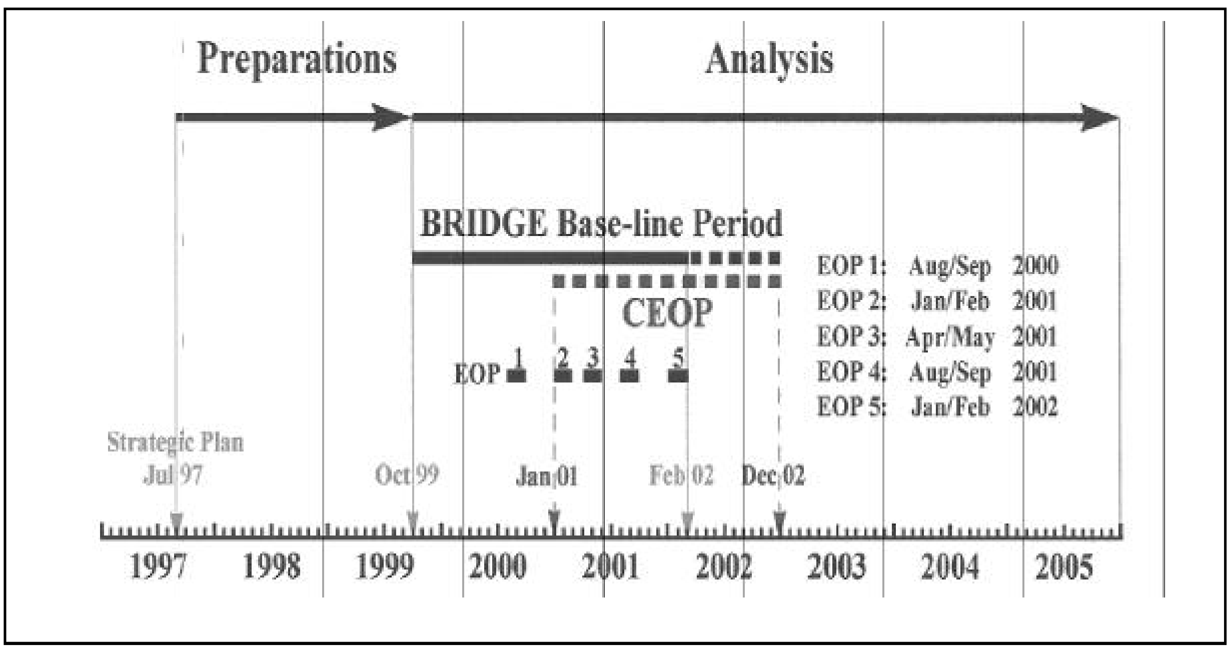
BRIDGE ON TRACK

Ehrhard Raschke, Jens Meywerk
BALTEX Secretariat at GKSS in Geesthacht, Germany

The enhanced observational period of the Continental-Scale Experiment (CSE) BALTEX called BRIDGE began its operational phase in October 1999, using data from the dense network of radiosonde, climate and synoptic stations within the BALTEX area and enhanced by two additional radiosonde stations on islands in the Baltic Sea. Furthermore during BRIDGE, data will be collected from several hundred rain gauges that are not part of those regularly reporting data through the Global Telecommunication System. Modelers will continue to develop coupled models integrating processes in the atmosphere with those at the land surfaces and upper soil layers, where in addition interactive models for the Baltic Sea and the larger freshwater lakes in the BALTEX area will be developed. The 4-dimensional assimilation of data will be a new challenge within BRIDGE. This enhanced observational period will last until the end of the year 2002.

Special Enhanced Observing Periods (EOPs) have been set up to provide support to various process-oriented field studies over land at different climate zones and over the Baltic Sea, where detailed measurements of the stratification of the Baltic Sea will also be conducted. These EOPs cover the early fall seasons (August/September) in 2000 and 2001, the winter (January to March) in 2001 and 2002 and the snow melting period in April/May 2001. During this latter period the Baltic Sea receives most of its freshwater by melting processes.

During its last session in Warsaw, the BALTEX Science Steering Group agreed on this time plan for BRIDGE and identified persons and institutions who are willing to take the lead in these various activities. The overall coordination remains at the BALTEX Secretariat in Geesthacht. More than 45 institutions from 12 nations, of which Austria and the Netherlands are located entirely outside the BALTEX area, expressed their interest in a memorandum to participate actively in BRIDGE affairs. **BRIDGE data will complement the data sets of the other GEWEX-CSEs within the frame of the Coordinated Enhanced Observing Period.**



Main Baltic Sea Experiment (BRIDGE) Time Line showing BALTEX enhanced observing periods during the GEWEX Continental Scale Experiments Coordinated Enhanced Observing Period (CEOP).

GEWEX CLOUD SYSTEM STUDY (GCSS)
Updating Science Plan

The GCSS Science Plan was developed and published in the early 1990s (GCSS, 1993; Browning, 1994; GCSS Science Plan, 1994). The aim of GCSS is to develop better parameterization of cloud systems in numerical weather prediction and climate models. The early focus was on understanding the coupled physical processes within different types of cloud systems and to couple cloud resolving models (CRM) and single column models (SCM) to numerical prediction models. To accomplish the overall objective, working groups were established. Presently there are five working groups. They are: (1) Boundary layer cloud systems dominated by turbulent boundary layer processes, (2) Cirrus cloud systems, (3) Extra-tropical layer cloud systems, (4) Precipitating convectively driven cloud systems, and (5) Polar cloud systems. Each of these working groups conducts frequent workshops (see example on page 11). These workshops, some of which are joint, have made and are continuing to make progress in developing cloud models that are derived from field experiment and for some test cases are using GEWEX global climatological data sets such as those produced and planned by the International Satellite Cloud Climatology Project.

In recent years, it has become apparent to the GCSS leaders that GCSS progress in developing cloud models, the availability of relevant GEWEX and other data sets, the advances in global weather and climate models including the improvement of data assimilation schemes require the original GCSS Science Plan be revisited. The updated version will be based on common scientific issues of the GCSS working groups and other GEWEX projects. Issues such as radiative cloud feedback and data integration. The new plan will likely be published late in the year 2000.

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GEWEX SESSION AT AMERICAN GEOPHYSICAL UNION MEETING

The National Research Council's (NRC) Global and Water Cycle Experiment (GEWEX) Panel is conducting a review of U.S. contributions to GEWEX. The purpose of this review is to document progress, identify gaps, and help develop future U.S. opportunities and coordination. To this end a special session at the American Geophysical Union Spring Meeting, Washington, D.C. (see meetings calendar, page 12), is being arranged. Areas of GEWEX interest include contributions from the International Satellite Land Surface Climatology Project (ISLSCP), Project for Intercomparison of Land Surface Parameterizations (PILPS), Baseline Surface Radiation Network (BSRN), Surface Radiation Budget (SRB), GEWEX Water Vapor Project (GVaP), International Satellite Cloud Climatology Project (ISCCP), GEWEX Cloud Systems Study (GCSS), Global Precipitation Climatology Project (GPCP), Global Aerosol Climatology Project (GACP), and GEWEX Continental-Scale International Project (GCIP). Co-convenors of the AGU session are: John Roads, UCSD-0224, La Jolla, CA, 92093-0224, USA, Tel: 858-534-2099, Fax: 858-534-8561, E-mail: **jroads@ucsd.edu**; Peter Schultz, National Research Council, 2101 Constitution Avenue, NW, HA 476, Washington, D.C. 20418, USA, Tel: 202-334-1499, Fax: 202-334-3825, E-mail: **pschultz@nas.edu**

CHANGES AT GLOBAL RUNOFF DATA CENTRE (GRDC)

Wolfgang Grabs has left GRDC for a position at WMO. His new address is: Dr. Wolfgang Grabs, Chief, Water Resources Division, Hydrology and Water Resources Department, World Meteorological Organization (WMO), Case Postale No. 2300, 7 bis avenue de la Paix, CH-1211, Geneve 2, Switzerland, Phone: +41 22 730 8358, Fax: +41 22 730 8043, E-mail: **grabs_w@gateway.wmo.ch**.

Nestor R. Correa, Eng.D., is the new Head of GRDC. Address: Dr. Nestor R. Correa, Head, Global Runoff Data Centre (GRDC), Federal Institute of Hydrology (BfG), Am Mainzer Tor 1, D-56058 Koblenz, P.O. Box 20 02 53, D-56002 Koblenz, Germany (*Please note new location of GRDC*), Phone: (49-261) 1306-5224; Fax: (49-261) 1306-5280, E-mail: **correa@bafg.de; grdc@bafg.de; E-mail: dr_correa_nestor@hotmail.com** (if out of office on a mission abroad).

GEWEX AT AMERICAN METEOROLOGICAL SOCIETY (AMS) MEETING

8–14 January 2000
Long Beach, California, USA

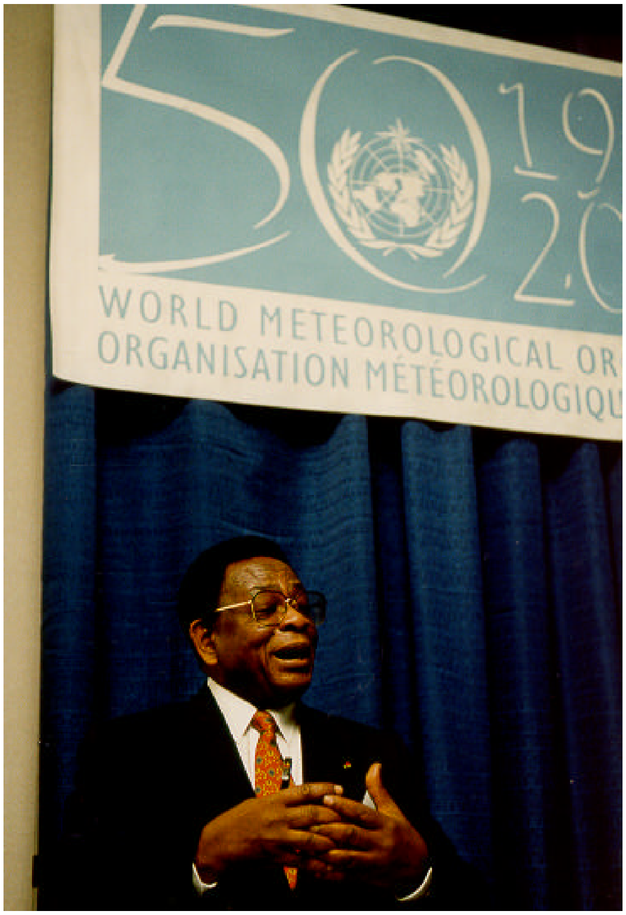
During the week of 8 January 2000, the approximately 3000 attendees of the 80th AMS Annual Meeting could choose from many scientific presentations of interest to the GEWEX community. The topics of the symposia and conferences at the meeting included hydrology, global change, remote sensing, artificial intelligence, integrated observing systems, integrated processing and atmospheric chemistry. In addition to the scientific presentations, there were several invited talks by international and United States leaders in science and technology. Examples include Dr. Daniel S. Goldin, NASA Administrator's address on Sunday evening, 8 January. He opened his presentation by saying, "What most people don't know is that our NASA efforts to open the space frontier are largely based on our **quest to understand our own planet**. While the highly visible space-based missions are taking place, we are also working to understand global climate by using space-based labs to improve life on Earth. That's why I'd like to spend most of my time tonight talking about the climate and three key areas NASA is studying: climate forcing, climate response, and the processes connecting the two."

Dr. Goldin noted that Earth scientists have already identified key climate forcing agents, specifically mentioning that clouds, aerosols, changes in land cover, and solar irradiance contribute to climate change. He said, "Take solar irradiance, the external force on Earth's climate, for example. There's no way to measure it other than getting above the atmosphere, and we've been doing this with satellites for some 20 years now. In contrast to our previous concept of the "solar constant," these measurements have conclusively shown that the total solar irradiance varies in synchronization with the 11-year sun spot cycle. Recent satellite measurements have shown that most of the solar variability occurs at ultraviolet (UV) and shorter wavelengths, which influence both the ozone chemistry and temperature of the upper atmosphere." He continued by saying it is essential to understand climate forcing agents and that **"Clouds and aerosols are still the biggest unknowns among forces acting on climate, but we're working hard to understand them. Just last month we launched the Terra satellite to target these unknowns." He identified temperature as an important variable measured from space but cautioned "... there's a lot more to climate response than just temperature. And as we move beyond temperature, we realize just how little we actually know. Take precipitation. You'd think we'd know how much precipitation falls around the world, but historically that just isn't true. Over the oceans, in unpopulated land areas, over tundra and ice regions, precipitation measurements are not obvious."**

Dr. Goldin stressing key NASA efforts.

Dr. Goldin's entire speech was encouraging with mention of the success of Tropical Rainfall Measurement Mission and NASA plans to launch the Ice, Clouds and Land Elevation Satellite (ICEsat) which he commented demonstrates NASA's commitment to provide 15-year climate data. NASA views the Earth as a single dynamic climate system. He noted that NASA will launch 25 satellites between 1999 and 2003 as part of the Earth Observing System and specifically mentioned the quest to better understand the water cycle.

The opening presentation on Monday, at the Symposium on Environmental Applications, was an invited address by Professor G.O.P. Obasi, Secretary General of the World Meteorological Organization, Geneva, Switzerland. He reviewed the history from the early 1800s to today's WMO that is celebrating this year its 50th Anniversary. Professor Obasi's topic was how the WMO (and its predessors) have, are presently, and will contribute to help in mitigating natural disasters. His emphasis was on the societal needs of the next millenium, commenting on the role of the WMO World Climate Research Programme activities, of which GEWEX is one.



Dr. Obasi reviewing WMO history and mission.

Highlights on Tuesday included Professor R.E. Munn, University of Toronto, Toronto, Canada, who presented the invited "Walter Orr Roberts Lecture in Interdisciplinary Science." Professor Munn's talk on the global view of emerging environmental issues could well have been a GEWEX overview. The theme and delivery of the talk captured memories of Dr. Roberts' enthusiasm and pioneering of ideas such as connecting solar variability to weather and climate. Dr. John W. Zillman, WMO, Geneva, Switzerland, gave an invited talk on meteorology and the environment. He described the WMO cross discipline organizational approach for studying geophysical systems, the model GEWEX also follows.

On Wednesday, the Conference Luncheon speaker, Dr. D. James Baker, United States

Dr. Baker noting importance of global change studies.

Undersecretary of Commerce for Oceans and Atmosphere, Administrator for NOAA presented an encouraging talk for GEWEX investigators. He specifically cited proposed increased funding for global change studies and mentioned for operational weather and climate predictions a new National Centers for Environmental Prediction computer.

Throughout the week the invited speakers common theme was bringing together disciplines. An example on Thursday was the Bernard Haurwitz Memorial Lecture presented by Professor Conway Leovy, University of Washington, Seattle, Washington, USA. Professor Leovy addressed the role of cloud feedback in the climate system. He reported radiative forcing by clouds varied, and convective clouds predominately in the range minus 100 W/m^2 for marine stratus, but for middle level clouds the radiative forcing was positive in the 50 W/m^2 range.

Evening meetings of interest to the GEWEX community include a "town meeting" that convened on Monday evening for the purpose of informing attendees on the status and plans for the GEWEX America Prediction Project (GAPP). This effort is a continuation of GCIP with the geographic region extended west and southwest to the adjoining Pacific Ocean and into Mexico. The GAPP funding will likely start in October 2000. The GAPP Science Plan was presented indicating most of the science topics previously addressed by GCIP will support the GAPP objective to improve weather and climate prediction. In addition, there will be more attention to regional moisture transports as reflected by the American Monsoon.

On Tuesday evening there was a panel discussion on the Emerging U.S. Global Water Cycle Initiative. The panel members at the meeting were

Kenneth Mitchell, National Centers for Environmental Prediction, John Roads, Scripps Institute of Oceanography, Randal Koster, NASA Goddard, and Dennis Lettenmaier, University of Washington. There was a comprehensive discussion on fundamental science questions that will be undertaken by future government initiatives on this topic. The panel agreed to identify "gaps" in ongoing programs and gap filling studies, such as hydrological studies in polar regions, undertaken by the new initiatives will accelerate the progress and the results of the related ongoing water cycle and energy projects, such as GEWEX.

There was also a GVaP evening meeting with participation of investigators, project leaders and funding agency representatives. The purpose of this meeting was to discuss the present status of the GVaP implementation activities and planning. Recent activities reported including the U.S. National Research Council Report, "The GEWEX Global Water Vapor Project – U.S. Opportunities" published by the U.S. Academy of Science, and the Chapman Conference, "Water Vapor and Climate Systems," held in Potomac, Maryland, in October 1999. This report endorsed GVaP (See GEWEX News, Volume 9, No. 4, November 1999, pages 14-15). The participants noted that GVaP implementation is proceeding close to schedule and receiving international and U.S. science endorsements. There were several suggestions for action. They include continuing: (1) contacts with the activities of the Stratospheric Processes and their Role in Climate project, (2) to collaborate with the integrated water vapor observing system tests, e.g., investigators using Atmospheric Radiation Measurement Sites, (3) to produce and improve global water vapor data sets. However, the participants acknowledged that the exemplary accomplishments using the creative funding of recent years will be difficult to continue without new resources.

There were far too many GEWEX related individual technical presentations to report here. For example, during the five days of the 15th Conference on Hydrology results there were reports on GCIP and other Continental Scale Experiments. Not surprisingly, there were presentations during the 10th Conference on Satellite Meteorology and Oceanography on ISCCP, GPCP and other GEWEX activities. The 11th Symposium on Global Change was the venue for essentially every GEWEX activity.

Photos courtesy of the American Meteorological Society.

GCSS WORKING GROUP I

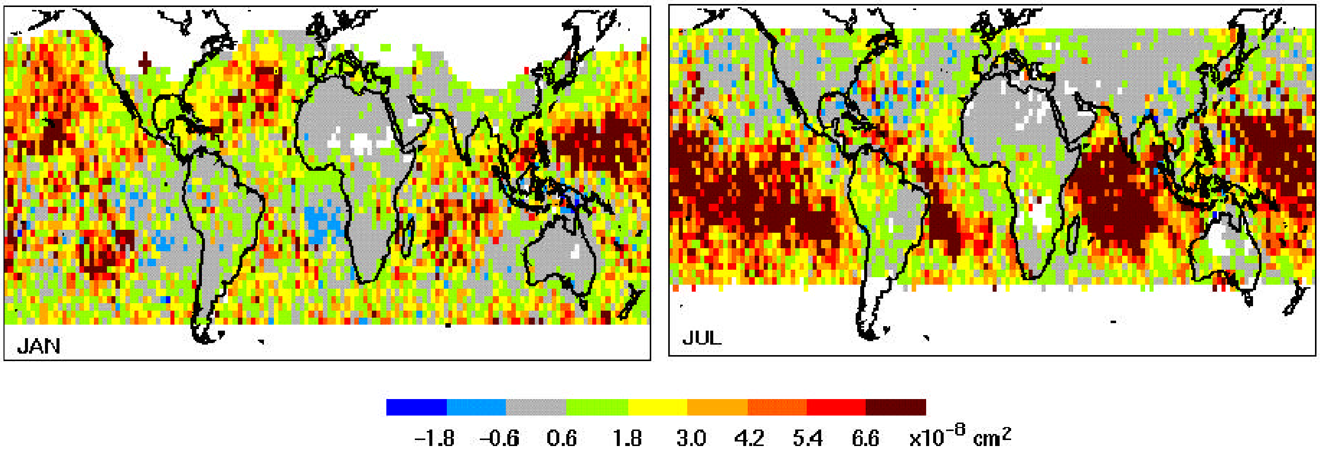
24–25 January 2000
Boulder, Colorado, USA
Andrew Brown and Adrian Lock
UK Meteorology Office

The sixth intercomparison workshop of GEWEX Cloud System Study (GCSS) Working Group 1 (boundary layer clouds) was held at the National Center for Atmospheric Research (NCAR). **The case under consideration examined the diurnal cycle of shallow cumulus convection over land and was based on data from the Southern Great Plains Atmospheric Radiation Measurement (ARM) site.** One of the main goals was to ascertain whether results and parameterizations developed on the basis of earlier studies of more weakly forced, steady-state convection over the sea (based on BOMEX and ATEX data) remain applicable in this case over land.

Results were presented from eight different large-eddy models. The results were generally in excellent agreement, and extra tests performed by individual participants showed that the results were encouragingly insensitive to issues such as resolution and subgrid model. Furthermore, the subcloud layer results were shown to be consistent with well-established mixed layer scalings. The new cumulus layer results were found to be qualitatively similar to those from the over sea studies (e.g., cloud fraction and mass flux decreasing with height), and scalings developed on the basis of those earlier studies. Also presented were the results from a number of single column models. It was shown that this non-steady case presents no fundamental problems for commonly used mass flux parameterizations, although a sensitivity to the details of the formulations (e.g., entrainment rate specifications) was noted. Being able to demonstrate that a single model can produce good results across all of the cases studied by WG-1 remains a challenging goal. Other presentations by participants from working groups 4 (precipitating convective clouds) and 5 (polar clouds) allowed for some useful cross-group discussions.

Thanks are due to Chin-Hoh Moeng and NCAR for hosting this successful workshop. The next case is planned to be a study of the diurnal cycle of stratocumulus, organized by Peter Duynkerke and Andreas Chlond. Details will appear on the WG-1 web page, **http://www.atmos.washington.edu/~breth/GCSS/GCSS.html**

INTERNATIONAL SATELLITE CLOUD CLIMATE PROJECT DATA USED TO ADDRESS A KEY INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE ISSUE (GLOBAL AEROSOL INDIRECT EFFECT)



Contrasts between continental and maritime clouds are shown using a cloud parameter retrieved from cloud radiance data without an assumption of constant liquid water content. Over continents this parameter suggests little cloud albedo change due to changes in column droplet concentrations while over oceans large albedo changes are noted (see Han et al. article on page 3).

WCRP/GEWEX MEETINGS CALENDAR

For calendar updates *see the GEWEX Web Site:* ***http://www.gewex.com***

13–17 March 2000—WCRP JOINT SCIENTIFIC COMMITTEE MEETING, Tokyo, Japan.

5–6 April 2000—U.S. NATIONAL RESEARCH COUNCIL GEWEX PANEL, Washington, D.C., USA.

10–16 April 2000—JOINT BAHC ISLSCP MEETING, Caracus, Venezuela.

17–20 April 2000—SHEBA/FIRE AND GCSS WG5 (POLAR) MEETINGS AND WORKSHOPS, Boulder, Colorado, USA. Agenda can be found at http://eosweb.larc.nasa.gov/ADEOS/workshop/.

25–29 April 2000—EUROPEAN GEOPHYSICAL SOCIETY XXV ASSEMBLY, Nice, France. Presentations of GEWEX interest are in the symposium "Water cycles over large and medium sized drainage area", the Hydrological, and the Ocean-Atmosphere sessions. For additional information: http://www.Copernicus.org/EGS/.

16–19 May 2000—GEWEX/BAHC INTERNATIONAL WORKSHOP ON SOIL MOISTURE MONITORING, ANALYSIS AND PREDICTION FOR HYDROMETEOROLOGICAL AND HYDRO-CLIMATOLOGICAL APPLICATIONS, University of Oklahoma, Norman, Oklahoma, USA. A poster session for current research results is planned. Poster Abstracts due 31 March 2000. For additional information: http://www.gewex.com/soilworkshop.htm.

30 May–3 June 2000—AMERICAN GEOPHYSICAL UNION SPRING MEETING, Special Sessions include GEWEX Research and Advances in GCIP Research, Washington, D.C., USA. For additional information: http://www.agu.org.

For a complete listing of GEWEX reports and documents, consult the GEWEX Web Site: http://www.gewex.com

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Dr. Paul D. Try, Director

Editor: Dr. Paul F. Twitchell
Mail: International GEWEX Project Office
1010 Wayne Avenue, Suite 450
Silver Spring, MD 20910, USA

Assistant Editor: Dawn P. Erlich
Tel: (301) 565-8345
Fax: (301) 565-8279
E-mail: gewex@cais.com

Web Site: http://www.gewex.com