Global Energy and Water Cycle Experiment

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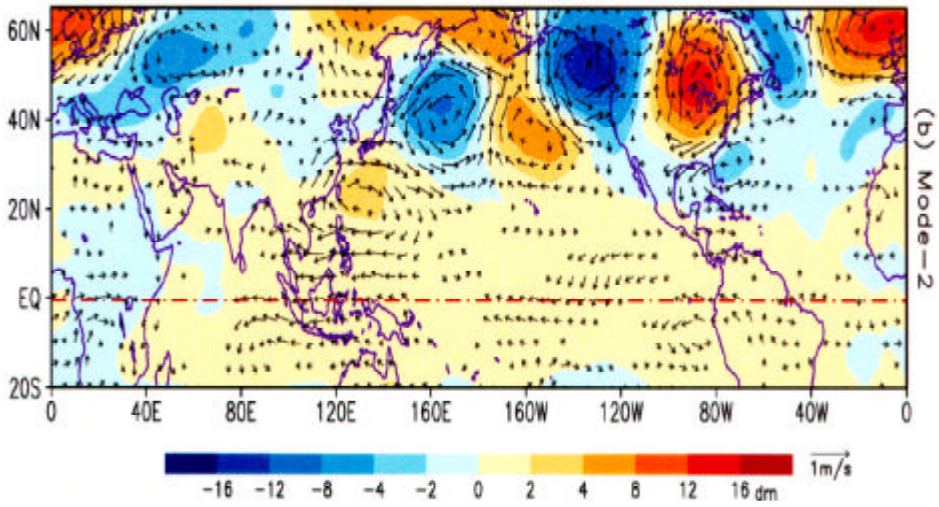
World Climate Research Programme–WCRP

WHAT'S NEW IN GEWEX

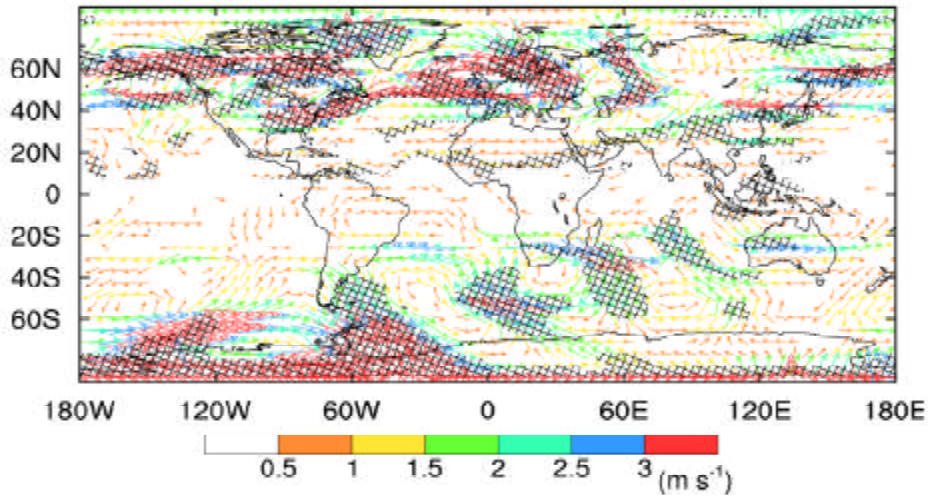
COORDINATED ENHANCED OBSERVATION PERIOD (CEOP) SIMULTANEITY MAY BETTER DEFINE CLIMATE TELECONNECTIONS



Climate teleconnection patterns linking U.S. drought and floods (note strong cyclone-anticyclone pair over North America) to the Asian monsoon indicate the potential value of simultaneous CEOP observations (forty-four years of NCEP wind/ geopotential height regressed against temporal coefficients). See article on page 5.

LAND SURFACE TREATMENT MAY BE INFLUENCING GLOBAL CIRCULATION

Northward shift of Northern Hemisphere jet stream results from changes in the treatment of subgrid vegetation information. Red areas show maximum changes in 300 mb wind vectors. See article on page 7.



COMMENTARY

GEWEX LAND-SURFACE INITIATIVE

Soroosh Sorooshian, Chairman
GEWEX Scientific Steering Group

This issue of the *GEWEX News* emphasizes some of the activities related to the role of the land-surface processes and their interaction with a number of geophysical and biological disciplines in the context of the climate system. Specifically, the article by Polcher et al. (this issue, page 3) briefly outlines the philosophy and implementation elements of the GEWEX Land-Atmosphere System Study (GLASS). As one would expect, the role of land-surface schemes (LSS) in the climate system and their proper incorporation into climate models (in an end-to-end approach) have resulted in a more inter-disciplinary collaboration, shifting the responsibility of the model development more towards a joint effort between atmospheric scientists, hydrologists, oceanographers, and biogeochemists, among others.

Historically speaking, LSSs were developed out of the necessity to provide terrestrial latent and sensible heat fluxes within the first atmospheric models. Although the sensitivity of GCMs to land-surface fluxes has been known for some time, recent work in the field has exposed the limitations of the earlier versions of such models, thereby necessitating the need for more sophisticated and complex land-surface schemes. PILPS (Project for Inter-comparison of Land-surface Parameterization Schemes) was initiated due to the leadership of Ann Henderson-Sellers and a number of other colleagues. PILPS was designed to allow for a systematic and orderly comparison of the various LSSs in order that differences in modeling approaches could be more easily identified and, consequently, considered in attempts to converge towards improved model formulations.

It is timely to incorporate the current stages of investigation into a framework of activities that will lead to the increased levels of complexity necessary to meet our goals for improved climate predictions. We should expect that, through the GLASS initiative, more advanced and physically realistic LSSs will emerge with new prognostic variables. For example, more traditional land-surface processes (such as frozen soil, heat exchange from snow and water, etc.) should be among these new variables brought to the LSS.

GLASS will be implemented fully within the GEWEX Modeling and Prediction Panel (GMPP). However, elements of the study (chaired by Dr. Jan Polcher at LMD in France) will link to earlier and ongoing work associated with the Global Soil Wetness Project (GSWP) and to PILPS (see article by Lettenmaier and Bowling, page 8, on soil freezing and runoff interactions). In addition, GLASS will link to other elements of GEWEX, including both the GEWEX Radiation Panel (GRP) and the GEWEX Hydrometeorology Panel (GHP), especially the International Satellite Land-Surface Climatology Project (ISLSCP) and the GEWEX Continental-Scale Experiments (CSE) currently being developed around the globe. Cooperation with activities being undertaken outside the WCRP/GEWEX framework, such as the Biospheric Aspects of the Hydrologic Cycle (BAHC) core project, also will be central to the broader development of GLASS.

This issue of the *GEWEX News* gives an overview of the land-surface initiatives that the GEWEX program is fostering.

Contents

GLASS : GLOBAL LAND-ATMOSPHERE SYSTEM STUDY

Jan Polcher[1], Peter Cox[2], Paul Dirmeyer[3], Han Dolman[4], Hoshin Gupta[5], Ann Henderson-Sellers[6], Paul Houser[7], Randy Koster[7], Taikan Oki[8], Andy Pitman[9], and Pedro Viterbo[10]

[1]Laboratoire de Meteorologie Dynamique du CNRS, [2]Hadley Centre, [3]Center for Ocean-Land-Atmos. Studies, [4]Alterra, [5]University of Arizona, [6]ANSTO, [7]NASA/Goddard Space Flight Center, [8]University of Tokyo, [9]Macquarie University [10]European Centre for Med.-Range Weather Forecasts

A new generation of land surface schemes (LSS) is emerging. The schemes are evolving from general circulation model parameterizations that provide fluxes to the atmosphere into independent models that are increasingly being compared to models of hydrology, biogeochemistry and ecology. This expanding scope is driven by the growth of interdisciplinary studies of the earth system. GLASS aims to encourage these developments by coordinating the evaluation and intercomparison of this new generation of LSSs, and applying them to scientific queries of broad interest.

Workshops organized by GEWEX, the European Centre for Medium-Range Weather Forecasts (ECMWF), the International Geosphere-Biosphere Programme (IGBP), and the Institut National des Sciences de l'Univers (INSU) during the past few years have pointed out a number of directions in which innovation in the next generation of LSSs will be necessary. The **first point** identified was the inclusion of bio-physical processes. There is a need to **include the carbon cycle** in order to be able to provide the atmospheric models with CO_2 fluxes and to simulate the evolution of the vegetation and thus the feedbacks between climatic variations and the state of the biosphere. The **second feature** that will set this new generation apart will be the **larger importance given to the horizontal complexity of the surface**. Indeed, previous LSSs were characterized by a very sophisticated description of the vertical processes while retaining simple assumptions on the horizontal variance of surface conditions. The **final innovation** to be included in the next generation will be **data assimilation methods** for either the analysis of the state of the surface or the evaluation of surface schemes at the global scale. The remotely sensed variables that will become available in the years to come will demand from LSSs new methods for taking advantage of the new information. With this increase in complexity, new feedbacks between the atmosphere and the surface will be simulated and a more systematic analysis of the sensitivity of the climate to surface processes is needed.

Land surface scheme validation and intercomparison projects such as the Project for Intercomparison of Land-surface Parameterization Schemes (PILPS) (Henderson-Sellers et al., 1995) and the Global Soil Wetness Project (GSWP) (Dirmeyer et al., 1999) helped to assess the previous generation of LSSs. PILPS made major contributions to their evaluation at the local scale using observed atmospheric forcing and high quality measured fluxes for the validation of the simulated processes. In GSWP on the other hand, the LSSs were used in a mode much closer to their application in GCMs (i.e., on a global grid with a resolution coarser than the typical spatial scales of surface processes). Both of these projects proved very useful and need to be continued with the next generation for the validation of added processes. However, they also need to be supplemented by new experiments.

As land surface schemes are applied from the plot scale to the regional scale and in a forced or coupled mode, the new experiments will specifically have to address the issues of sub-grid scale variability of the surface and the feedbacks existing between surface processes and the atmosphere. The complementarity of the various applications of LSSs provides a richness of research and can be illustrated, for instance, with the case of simulated soil moisture. In the PILPS experiments the soil moisture simulated with the atmospheric forcing observed at a site could be compared to the measured values (Shao and Henderson-Sellers, 1996). In GSWP, only the soil moisture anomalies at 1^ox1^o could be evaluated as the models use different water holding capacities, which were all different from the one that can be deduced from observed values (Entin et al., 1999). When an LSS is coupled to an atmospheric column model the relationship between the soil moisture and the atmospheric conditions can be explored at the local scale. This set-up was used by Douville et al. (2000) to determine how the assimilation of near surface temperature and humidity could help improve the simulated soil moisture. Finally, with coordinated GCM sensitivity experiments the impact of the different approaches to soil moisture modelling on climate change could be evaluated (Crossley et al., 2000). Unfortunately, we are

not presently able to say how the results obtained in PILPS can be related to the uncertainty in soil moisture changes found for a climate with increased greenhouse gas concentrations. Thus, a coordination of projects is needed to take full advantage of the diversity of application areas for LSSs.

The aim of GLASS is to foster an evaluation of the next generation of LSSs and to coordinate the evaluation of LSSs in their different applications. GLASS will also serve as an interface between the land-surface community and other GEWEX projects. The proposed structure of GLASS (see figure below) highlights the spatial scales at which the schemes are applied and the degree of interaction allowed with the atmosphere. This denotes four actions which will coordinate intercomparisons in their field of land-surface scheme applications. GLASS will also include one transversal action [Assistance for Land-surface Modelling Activities (ALMA)] which will provide an infrastructure and technical support for these intercomparisons.

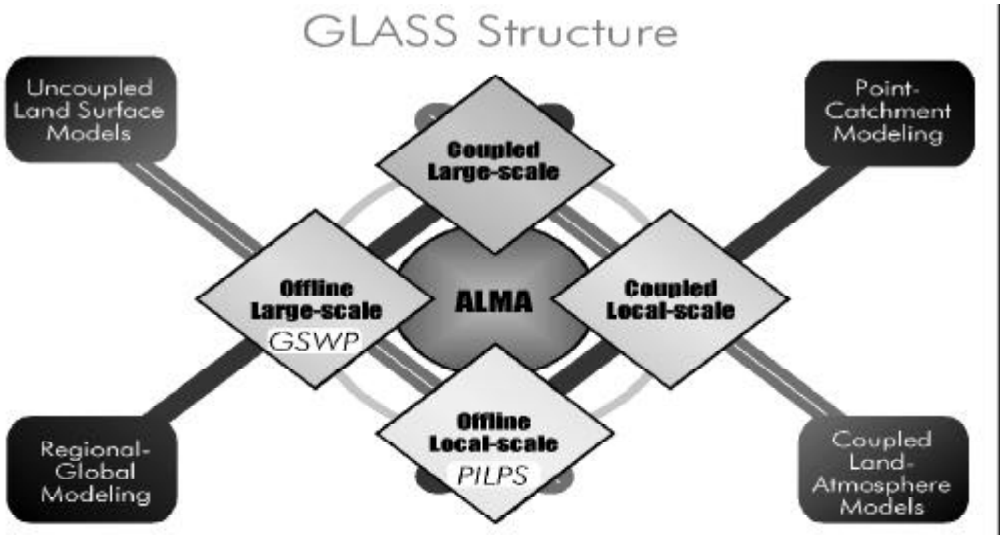
The action dedicated to local scales and off-line simulations is the continuation of the PILPS project. **The next intercomparisons will be carried out over the Torne basin in Sweden (see article on page 8) and over a mature forest at the Russian Valdai site**. These experiments will allow an evaluation of cold-season processes in LSSs. It is expected that in the near future a PILPS experiment will be launched to evaluate the newly gained ability of land-surface schemes to simulate CO_2 fluxes.

The action concentrating on global off-line applications of LSSs is the continuation of GSWP. Before the next phase of GSWP can be launched with the International Satellite Land Surface Climatology Project (ISLSCP) Initiative II data, sensitivity experiments will be carried out to evaluate the impact of errors in the forcing data. Experiments are also planned to evaluate our ability to take into account the spatial variability of soil wetness at a 1^ox1^o resolution. Later, with the 10 years of ISLSCP Initiative II data the inter-annual variability of LSSs will be evaluated.

The local coupled action will concentrate on data assimilation issues. The first step towards this goal will be to set up a simplified coupled system in which LSSs and their interaction with the atmosphere can be compared. With this tool in hand the simulated interactions between sub-grid variability and the planetary boundary layer will be compared. This will also serve to evaluate data assimilation methods for land-surface schemes.

In the global coupled action, the sensitivity of the atmosphere to land-surface processes will be studied using an ensemble of general circulation models and LSSs. The two issues that are most in need of model independent assessments are the role of climate variability and the sensitivity of climate to anthropogenic forcing. This action will work in close collaboration with the two Atmospheric Model Intercomparison Project (AMIP) diagnostic sub-projects which deal with the validation of surface processes in GCM simulations.

The infrastructure action, ALMA, will help the four actions described above by providing data exchange standards and software to manage the data.



ALMA will also help participating groups with the implementation of the PILPS-4c coupler (Polcher et al., 1998) and ensure the exchange of software and expertise with the aim of facilitating the participation in GLASS projects.

GLASS will be managed by a science panel composed of the leaders of the five actions and representatives of the GEWEX Hydrometeorology Panel (GHP), ISLSCP, IGBP/ Biospheric Aspects of the Hydrologic Cycle (BAHC) and the Working Group on Numerical Experimentation (WGNE). Its role will be to coordinate the five actions and ensure that all application areas of LSSs benefit from progress made in the various projects. The panel will hold its first meeting this summer and at that time the implementation plan of GLASS will be finalized. The first local scale off-line experiment (PILPS-2e) will be launched this month and the data exchange protocol to be used has been developed in collaboration with ALMA. Other actions have submitted projects for funding and will start before the end of the year. The evolution of GLASS can be followed at its **Web site: http://hydro.iis.u-tokyo.ac.jp/GLASS/.**

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REMOTE FORCING OF SUMMERTIME U.S. DROUGHTS AND FLOODS BY THE ASIAN MONSOON

K. M. Lau and Hengyi Weng
Climate and Radiation Branch
NASA/Goddard Space Flight Center

Based on 44 years (1955-1998) of U.S. monthly rainfall data, sea surface temperature (SST) and National Centers for Environmental Prediction (NCEP) wind and geopotential reanalysis (Kalnay et al., 1996), we find two distinct climate teleconnection patterns that link major U.S. summertime droughts and floods to variability in the Asian summer monsoon. To focus on interannual variability, decadal variability (more than 8 years) is first removed and then Singular Value Decomposition (SVD) analysis between rainfall and SST was carried out to obtain the interannual climate modes. The first mode (see top left panel on back page) is associated with excessive rainfall over the Midwest, coupled to deficient rainfall over the east and southeast United States. This rainfall pattern is similar to that associated with the great Midwest flood of 1993, and severe east coast drought in 1998. The second mode (see top right panel on back page) is associated with a large-scale drought (flood) centered over the central U.S. The pattern shown on the right panel is reminiscent of the severe drought of 1988 and 1983 affecting the central and eastern U.S. The association of Mode-1 and Mode-2 with specific drought/flood events is confirmed by large amplitude in the corresponding temporal coefficient (not shown).

The 500 hPa geopotential heights regressed against the temporal coefficients are shown for Mode-2 on page 1 and for Mode-1 on center back page. The magnitude shown is normalized by the standard deviation of the respective temporal coefficents. Also superimposed is the 850-hPa wind regressed against the respective coefficients. Over the U.S., Mode-1 (shown on back page) is clearly associated with a low level anticyclonic flow over the southeast U.S., which supplies low-level moisture to the flooding over the Midwest. The mid-tropospheric geopotential height pattern over the U.S. is consistent with previous studies (Ting and Wang, 1997; Mo et al., 1997; Higgins et al., 1999). A remarkable feature (see back page showing the geopotential height and wind regressed against the temporal coefficient) is the strong signal found further upstream in the East Asia/Japan region. Here, the teleconnection

takes on the shape of a zonally elongated pattern, which is characteristic of the variation of the East Asian monsoon (Lau et al., 2000). This pattern is likely to be associated with the variability of the East Asian/Pacific jetstream, which may stem from both extratropical forcings and tropical heating in the southeast Asian monsoon region. This mode has some relationship with the El Niño, as evident in the anomalous westerly wind in warm SST (not shown) in the equatorial eastern Pacific.

On the other hand, Mode-2 (see front page) appears to be associated with a distinct "Pan-Pacific" wavetrain emanating from a region northeast of the Philippines, across the North Pacific rim, ending in a cyclone-anticyclone pair over North America. This cyclone-anticyclone pair is consistent with severe drought conditions over the central U.S., such as 1988 (see upper right panel on back page). Contrary to some previous studies (Trenberth et al., 1988), this mode indicates no remote forcing signals from the equatorial eastern Pacific region. It is similar to the summertime teleconnection pattern noted by previous monsoon researchers (Nitta, 1987; Huang, 1985; Lau, 1992; Lau and Peng, 1992; and others). The low-level anticyclone over the East China Sea has been identified as one of the key features responsible for major droughts and floods associated with the East Asian monsoon (Lau and Wu, 2000; Lau and Weng, 2000).

The presence of the aforementioned teleconnection patterns suggests that there may be a far field source of remote forcing related to the occurrences of major summertime floods and droughts over the U.S. It is the authors' opinion that this is a missing piece needed for a better understanding of the warm season precipitation over the U.S. Currently, the GEWEX Hydrometeorology Panel is planning a Coordinated Enhanced Observing Period (CEOP) to link various components of the GEWEX sub-programs and address some of the critical aspects of the climate system involving land areas over a 2-year period beginning in mid 2001. With its focus on monsoonal circulations and transferability and predictability of water-related parameters over land areas, CEOP can accelerate the cross-fertilization of the scientific communities and help bridge the gap in our understanding of the connection between the Asian monsoon and U.S. summertime climate.

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MAGS FUNDING CONTINUED

The Natural Sciences and Engineering Research Council (NSERC), the Canadian university funding agency, has awarded the Mackenzie GEWEX Study (MAGS) another 5 years of funding for the period 2001-05. This particular funding will go to eight universities, and 20 investigators, across Canada. Through partnerships, this support will also continue the strong involvement of Environment Canada researchers with GEWEX.

HETEROGENEOUS VEGETATION AFFECTS GCM-MODELED CLIMATE

Eleanor J. Burke, W. James Shuttleworth, and Z.–Liang Yang
University of Arizona

At the grid scale of a General Circulation Model (GCM), the land-surface cover is strongly heterogeneous, even though the dominant cover type within each grid cell is usually used to represent it. Recently, high resolution global land-cover data sets have become available (e.g., EDC DAAC) that can be combined with "aggregation rules" (Shuttleworth et al., 1997) to define more representative (aggregate) land-cover parameters for use in GCMs. **GCM modeling results show that using these aggregate parameters affects the partition of fluxes locally at the land surface and, more unexpectedly, global-scale circulation patterns.**

Aggregation rules define grid-averaged land-cover parameters in such a way that the surface energy fluxes are similar to those found using an explicit representation of the individual patches of vegetation. For most parameters, a weighted linear averaging rule is sufficient. However, if the fluxes are not proportional to the parameters, more complex averaging procedures are required (Shuttleworth, 1991; Shuttleworth et al., 1997). A comparison of the aggregate land-cover parameters with the parameters of the dominant land cover within each grid cell shows significant percentage differences over at least half the land area. For example, the differences in the aerodynamic resistance between the aggregate and dominant land cover are illustrated on the lower left side of the back page. The effective aerodynamic resistance is lower in the boreal and tropical forests because of the inclusion of shorter patches of vegetation. **In fact, the global average aerodynamic roughness length is reduced by 36% in the aggregate representation compared to the dominant representation (Arain et al., 2000).**

The aggregate and default parameters were used as input data for two 10-year CCM3/BATS model simulations. There are statistically significant differences (using the Student's t-test at the 95% confidence level) in the surface heat fluxes and temperature between the two CCM3/BATS simulations. A simulation result is shown in the lower right panel on the back page illustrating significant differences between the aggregate and default temperatures. These frequently appear to be a local response to the complex changes at the land surface (Arain et al., 2000). It is interesting, but presumably not entirely accidental, that the GEWEX Continental Scale Experiment (CSE) study areas broadly correspond to areas that exhibit the most significant change.

There are statistically significant differences in the wind vectors (at all levels in the atmosphere) between the aggregate and default parameter runs. However, over the oceans and Antarctica, these non-local responses may be the result of changes in the larger scale circulation. The lower panel on the front page illustrates the difference between the aggregate and default 300 mb wind vector for the 10-year average of June, July, and August. The hatching indicates regions of significant difference. The main difference shown on the front page is the significant northward shift in the Northern Hemisphere jet stream between 40°N and 70°N. Planetary scale changes in the global circulation are seen in the velocity potential and stream function fields. These two fields show large coherent regions of significant difference—the velocity potential increases over the Americas and decreases over the Far East, while the stream function increases over the Northern Hemisphere jet stream and decreases in the Southern Hemisphere. Such large-scale effects might cause non-local responses like the modeled changes in air temperature over oceans (see back page lower right panel).

The aerodynamic roughness length is the land-cover parameter that causes most of the differences between the aggregate and default CCM3/BATS simulations (Burke et al., 2000). (There is remarkable similarity between a simulation where all the land-cover parameters were set to their aggregate values and a simulation where just the aerodynamic roughness was set to its aggregate value.) It is likely that the northward shift in the Northern Hemisphere jet stream is directly related to the decrease in roughness length around 60°N and the slight increase around 30°N.

These results illustrate that the inclusion of subgrid vegetation information can have a significant impact on the GCM-modeled climate. This underlines the importance of including subgrid information on the land cover when determining the land surface parameters for GCM simulations.

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EDC DAAC, Earth Resources observing system, Data Center Distributed Active Archive Center, *http://edcwww.cr.usgs.gov/landdaac/glcc/glcc.html*.

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ANNOUNCEMENT

ARM Fellow Position Established

The U.S. Department of Energy's Atmospheric Radiation Measurement (ARM) program is establishing an ARM Fellow position at the National Centers for Environmental Prediction (NCEP) in Camp Springs, Maryland. The one- to two-year post-doctoral appointment will assist ARM and NCEP in improving cloud and radiation parameterizations used for climate and weather predictions.

According to Dr. Thomas Ackerman, ARM Chief Scientist, the work will primarily focus on aspects of cloud parameterizations, radiative transfer in cloudy atmospheres and column energy balance. The ARM program is looking for applicants with an interest in numerical modeling and parameterization development, as well as familiarity with ARM data products. The ARM Fellow will collaborate with NCEP scientists to use ARM data in the testing and evaluation of NCEP cloud and radiation parameterizations. Ackerman says the program will consider post-doctoral candidates or senior applicants wishing to spend a sabbatical year at NCEP. In addition to research, the ARM Fellow will serve as a liaison between NCEP and related data analysis within the ARM program.

Further information is available from Dr. Ackerman at ackerman@pnl.gov or 509-372-6032.

ARCTIC MODEL INTERCOMPARISON STUDY INITIATED

Dennis Lettenmaier and
Laura Bowling
University of Washington

Climate modeling studies indicate that global warming may be larger at high latitudes than elsewhere primarily due to reduced albedo associated with contraction of sea ice extent and seasonal snow cover. The strength of the coupling between the ocean, land, and atmosphere in the Arctic is particularly important because of its influence on the net transfer of heat northward, and fresh water southward, which in turn affects global climate and weather. Furthermore, recent work by Betts et al. (1996) has shown substantial systematic biases in spring temperature forecasts produced by the European Centre for Medium-Range Weather Forecasts model in the continental interior of the northern hemisphere due to the model's improper representation of two important high latitude processes: snow albedo, and soil freezing.

All of these considerations motivate the improvement of high-latitude land surface representations within coupled land-atmosphere models used for numerical weather and climate prediction. The objective is to evaluate performance of land surface parameterizations in high latitudes, in a context that allows evaluation of their ability to capture key processes spatially. These include snow accumulation and ablation, soil freeze/thaw and permafrost, and the existence of large seasonally frozen lakes and wetlands. For this purpose, the study design must go beyond one-dimensional tests to evaluate model performance in the context of moderate to large sized river basins.

Among the science questions to be addressed by an intercomparison of land surface schemes in Arctic regions are:

- What is the ability of the intercomparison models to estimate runoff in gauged and ungauged catchments?
- How would Arctic river runoff respond to spatial and temporal variations in climate forcings?
- What are the effects of permafrost on the surface water and energy cycles, and their

related impacts on carbon sequestration at high latitudes?

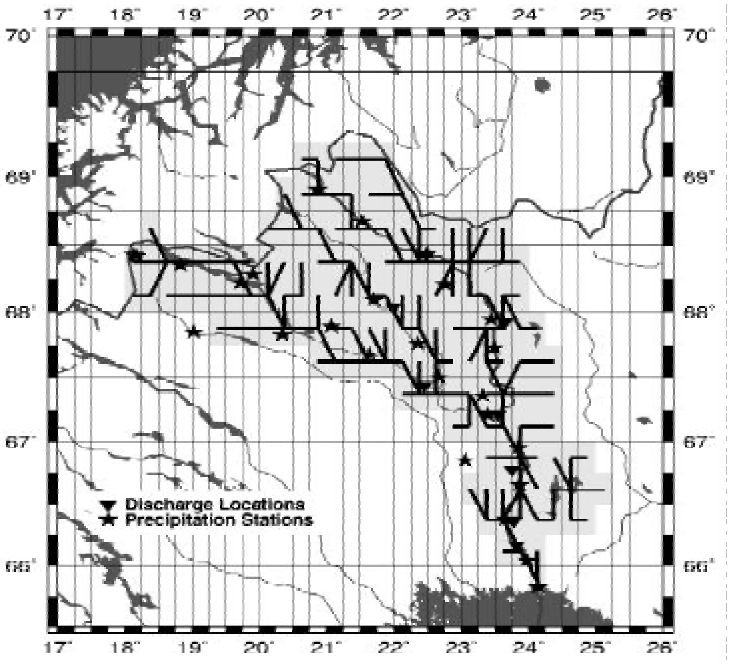
- What is the feasibility of using the intercomparison models for assessment of hydrologic impacts in Arctic drainage basins via long-term climate simulations?

In collaboration with the Arctic Climate System Study and the GEWEX Hydrometeorology Panel the proposed model intercomparison will be carried out following the framework of both off-line and on-line intercomparisons as described in Henderson-Sellers et al. (1993; 1995).

The experiment will be carried out in three stages, with each stage focused on a different region. The first stage study site will be the Torne River in Sweden, followed by the Mackenzie River in Canada and the Lena River in Russia. A lead principal investigator (PI) will be designated for each phase of the experiment to organize the experimental procedure, as well as the comparison and ultimate dissemination of model results. The lead PI for stage 1 will be Dennis P. Lettenmaier from the University of Washington.

The design of the intercomparison experiments is expected to follow roughly the Project for Intercomparison of Land-Surface Schemes (PILPS) (Wood et al., 1998) design, modified as necessary to account for specific physical and observational characteristics of the Arctic and known here as PILPS 2e. The evaluation will focus on simulations conducted over multiple grid cells on decadal time scales, with some point process evaluation at smaller intensive study areas. Different data sets will be available for model forcing, calibration and evaluation in each stage and as such, the specific focus of each stage will be adapted in accordance with the basin hydrology and available data sets.

Phase 1 of PILPS 2e will be conducted in the Torne Basin, part of the GEWEX Baltic Sea Experiment study area. The basin area is 40,200 km^2, of which 57% lies in Sweden, 42% in Finland and 1% in Norway. The western part of the basin consists of mountainous terrain and the predominate vegetation is boreal forest with significant bog areas. The basin does not contain permafrost, although seasonal freezing occurs at the higher elevations. River flows are unregulated.



Routing network and station locations for the Torne River Basin

For the Torne application, intercomparison models will be run over approximately 218 grid cells at 0.25° resolution. Meteorological forcings (precipitation, downwelling radiation, air temperature, wind speed and humidity) will be provided at hourly intervals for a 10-year period (1989-1998). Participants will perform the experiments at their home institutions and submit the results to the lead PI.

PILPS 2e is being designed as a prototype for demonstration and testing of the ALMA (Assistance for Land-surface Modeling Activities) standard data exchange protocols. ALMA is part of the new GEWEX Global Land-Atmosphere System Study (GLASS) described in this issue, and is intended to streamline data handling and quality control for projects like PILPS. Model inputs and outputs will be distributed and archived in netCDF format in accordance with ALMA protocols.

Evaluation of model performance will be performed in close accordance with the procedures described by Wood et al. (1998). Streamflow is a critical factor for comparison, and will be divided into a calibration and evaluation data set. Evapotranspiration will also be evaluated using atmospheric budget computations to the extent possible. Addi-

tional parameters pertinent to high latitude processes will be evaluated where possible, including: snow cover extent, snow water equivalent, soil freeze/thaw, and lake ice cover. Output variables will be collected from each participating scheme at a sub-daily temporal resolution. Models that do not include all of the variables will be permitted to participate. The specific evaluation criteria will be formulated separately for each phase.

The design of Phase 1 of PILPS 2e began in early 2000 with the solicitation of participating schemes. A detailed experimental design and proposed model parameters will be circulated among the participants in May 2000. Approximately one month will be allowed for discussion and agreement on the parameters and design. The forcing data, final model parameters and validation data will be made available to the participants in summer 2000. Model results will be returned in approximately two months, to be summarized in a workshop in autumn 2000 or winter 2001.

Anyone interested in participating in the intercomparison should contact Laura Bowling (**lbowling@u.washington.edu**) or Dennis Lettenmaier (**dennisl@u.washington.edu**) or visit **http://www.hydro.washington.edu/Lettenmaier/CurrentResearch/PILPS-2e/index.htm** for more information.

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ISLSCP ACCOMPLISHMENTS TO DATE AND PROMISE FOR THE FUTURE

S.I. Rasool and H.-J. Bolle

Seventeen years after the foundation of the International Satellite Land-Surface Climatology Project (ISLSCP) several members of its very first Steering Committee, who were and are still active in this field, met in 1999 at the International Space University in Strasbourg, jointly with representatives of the parent sponsoring organizations, to assess the past accomplishments relative to the initial objectives of the project, and discuss the future potential of ISLSCP in the present state of climate research and newly acquired remote sensing capabilities.

ISLSCP was initiated following discussions within the Joint Scientific Committee of WCRP about the role of land-surface processes in the climate system. At that time, in the early 1980s, a first mesoscale land-surface experiment at a scale of 10^4 km^2 (approaching the GCM grid square) was being planned in France, HAPEX-MOBILHY. A small number of scientists were, however, of the opinion that a time-series of data on land-surface characteristics which determine the interactions between the land surface and the atmosphere would be necessary on continental and even on global scales to both initialize and validate the regional and global climate models. ISLSCP was formally established in 1983 with seed funding from UNEP and support from NASA, NOAA, ESA and CNES. The initial objectives were:

- A demonstration of what measurements from satellites can usefully contribute to the assessment of climate relevant changes which have occurred at the surface.
- Specification of type, resolution, and accuracy of information needed for climate studies, constituting the basis for development and improvement of the algorithms to derive this information from the "primary" measurement of pixel-radiance.
- Development of methods to validate and calibrate by direct surface observations (e.g., field experiments) the information inferred from satellite measurements.

Over the last 17 years ISLSCP has had a very positive impact on research in land-surface processes, essentially by adding the remote sensing component to regional and global scale studies. A large number of field studies have been carried out around the world, helping to improve algorithms to convert satellite-measured radiances to land-surface parameters. At the same time, added effort on behalf of several space agencies has resulted in analyses (and reanalyses) of satellite data to produce long-term series of standardized and validated data sets on land-surface that are critical for the studies of global change. In this context, the production and distribution of the Initiative 1 CD-ROM is particularly noteworthy. We are also witnessing the inclusion of land-surface parametrization in global climate models, efforts on up- and down-scaling are underway, and the project has logically evolved from deriving not only radiation parameters on the surface to hydrological and even biogeochemically relevant parameters from space.

However, a number of issues remain and it was recommended that ISLSCP take a lead role in the following areas.

Production of Long-Term Standardized Data Series

- Reprocess AVHRR 1979-now with state-of-the-art methodologies for correcting for sensor degradations, drifts in equator crossing times, cloud screening and other atmospheric effects.

- Develop and implement an atmospheric aerosols measurement system over the land surface. Lack of our knowledge on their distribution and optical properties is, today, probably the single most significant source of error in converting satellite-measured radiances to surface parameters.

- Derive 20-year time series of Normalized Difference Vegetation Index (NDVI), vegetation cover, skin temperature, surface albedo, fires, drought index and insolation.

- Derive schemes to assure compatibility of the upcoming generation of satellites (e.g., MODIS and MERIS) with those now in operation, particularly AVHRR and VEGETATION/SPOT4, in order not to lose continuity in multi-annual and decadal-scale data sets of land-surface characteristics.

Scaling Issues Over Heteorogeneous Terrain

- Enhance research efforts to improve up-scaling methodology to go from local to regional, particularly over heterogeneous and complex landscapes.

- Initiate concerted effort, through established international programs, to install instrumented anchor stations around the world which can be used, on long-term basis, for validation of satellite-derived land-surface parameters.

- Extend GEWEX continental-scale experiments now underway in many regions of the world to Southern Europe, where GEWEX could benefit by the scientific infrastructure and know-how developed during a number of smaller scale ISLSCP related experiments carried out during this decade, particularly over heterogeneous terrain.

Fostering Use of Land Surface Data Series in Models and Diagnostic Studies

- Accelerate operational use of land-surface observations in NWP models.

- Promote use of land-surface multi-annual data sets now becoming available to improve climate model initialization and validation.

- Establish a well documented archive of available regional data sets and results obtained from using them.

The full report (editors H.-J. Bolle and S.I. Rasool), is to be published by the European Commission, DG XII. Preprint requests should be addressed to Hans-Jürgen Bolle <**hansj.bolle@lrz.badw-muenchen.de**>

HELP INITIATIVE

James Shuttleworth
University of Arizona

UNESCO and WMO have endorsed a new global initiative, entitled Hydrology for the Environment, Life, and Policy (HELP), which will establish a global network of catchments to improve the links between hydrology and the needs of society. The importance of water in sustaining human and environmental health has been widely recognized; however, no international hydrological program has ever addressed key water resource management issues in the field and integrated them with policy and management needs. HELP will change this by creating a new approach to integrated catchment management.

The policy issue addressed in HELP that relates most directly to GEWEX concerns the policy and management implications of the inter-relationship between water and climate. This component of HELP, referred to as Global-HELP, will address how knowledge, understanding, and predictive modeling of the influence of global variability and change on hydrological variables and remotely sensed data can be used to improve the management and design of water resource, agro-hydrologic and eco-hydrologic systems.

Global-HELP will use the results of research carried out by GEWEX through projects like GPCP, GVaP, and the GEWEX Continental Scale Experiments that derive and improve remotely sensed and model-derived global and regional data sets that can potentially be used to benefit the management and design of water systems.

The products of the GEWEX projects and other efforts, such as IGBP, CLIVAR, and IAHS will ultimately lead to realistic, global-scale, coupled, ocean-atmosphere-land models, with a mesoscale grid mesh, that can be run in ensemble mode to provide seasonal-to-interannual predictions. These results will have utility in water resource applications at the scale of HELP catchments.

For further information, access the HELP web page via **http://www.unesco.org/science/**.

GEWEX, ARM AND EOS TERRA PLAN A COORDINATED OBSERVING PERIOD

David Starr, Chairman, GCSS WG2
NASA, Goddard Space Flight Center

The GEWEX Cloud System Study (GCSS) Working Group on Cirrus Cloud Systems (WG2), provided significant input into planning the Spring 2000 Cloud Intensive Observations Period (IOP) at the Department of Energy Atmospheric Radiation Measurements Program (ARM) Southern Great Plains (SGP) Cloud and Radiation Testbed (CART) site in Oklahoma (**http://www.arm.gov/docs/iops/2000/sgp2000sprcloud/cloud.html**). The NASA Earth Observing System Terra Validation Program (**http://eospso.gsfc.nasa.gov/validation/valpage.html**) conducted an airborne field mission in close coordination with the ARM Spring 2000 IOP. Program cooperation in addressing separate but related objectives is an increasing trend in field missions (see for example, February issue of *GEWEX News*, the items reporting on the plan 2001 and beyond for the GEWEX Coordinated Enhanced Observing Period). The GCSS WG2 contributed to development of the experiment plan by the ARM Cloud Working Group, led by Jay Mace who is also an "observational expert" member of WG2. Specifically, WG2 made detailed observing strategy recommendations for airborne *in situ* sampling focused on key science issues identified through the WG2 Idealized Cirrus Model Comparison Project. These strategies were at some variance to remote sensing or cloud field objectives and involved emphasis on sampling in the upper portion of cirrus generating layers at cold temperatures. The objective was to provide observational guidance in resolving significant systematic inter-model differences in simulated ice crystal populations that cascade through the model physics to very significantly affect even gross measures of the cloud, such as total ice water path. The signal observed in cirrus generating cells will be least ambiguous, from both theoretical and practical viewpoints. GCSS WG2 had similar input into the development of the recently released CRYSTAL Research Plan (**http://asd-www.larc.nasa.gov/fire/index.html**) focused on tropical cirrus systems.

GCIP PRINCIPAL INVESTIGATORS MEETING

27–28 March 2000
Potomac, Maryland USA

Over 90 GEWEX Continental-Scale International Project (GCIP) investigators exchanged information on recent achievements and plans. Including posters, over 80 presentations were given in three major categories: (a) modeling, (b) diagnostic studies and data activities, and (c) applications. In addition, there were presentations on how GCIP objectives relate to National Oceanic and Atmospheric Administration (NOAA) and the National Aeronautics and Space Administration (NASA) mission goals, as well as overviews of GCIP science and data activities. Some noteworthy GCIP achievements in mesoscale GCIP modeling such as advances in parameterization of subgrid scale clouds and precipitation were reported in detail and the effects of surface heteorogeneity on them. Other advances reported included land data assimilation schemes, improved parameterizations in land surface and atmospheric models, and the GCIP achievements in water resource applications ranging from climate forecasting to individual catchments. Also, the participants were briefed on programs related to GCIP. These update briefings included reports on: (a) the progress of joint GCIP and U.S. Department of Energy Atmospheric Radiation Measurements projects, (b) Hydrology for Environment, Life and Policy effort, (c) World Weather Research Program, (d) other GEWEX activities, (e) the U.S. Water Cycle Initiative, and (f) the US CLIVAR office.

The meeting concluded with a discussion session chaired by Rick Lawford that reviewed GCIP success in closing the water and energy budgets for the Mississippi River Basin, advances in land surface models, use of remote sensing information, and data management. This concluding session was an excellent introduction to the transition to GCIP's follow-on, the GEWEX America Prediction Project (GAPP).

GAPP WORKSHOP

28–29 March 2000
Potomac, Maryland USA

The workshop objective was to review a preliminary draft of the GEWEX America Prediction Project (GAPP) Science Plan and to provide inputs to a GAPP Implementation Strategy. The workshop opened with a series of presentations and an overview of the progress in developing the GAPP science plan. Presentations were given on prediction systems, land memory processes, monsoonal circulations, water research applications and the planned GEWEX Coordinated Enhanced Observing Period (CEOP). In his introductory comments, Sam Benedict of WCRP noted the success of GCIP and presented WCRP's expectations for GAPP. The two primary objectives of GAPP are to:

- develop a capability to produce monthly to seasonal predictions of precipitation and land surface hydrologic variables, and

- interpret research findings for transfer to improved seasonal predictions for the management of water resources.

Given the increasing demand for quality water in the United States, particularly in the U.S. Southwest, water resource managers would benefit from improved seasonal predictions of precipitation.

The participants then discussed issues related to land/atmosphere interaction processes, predictability and prediction systems and hydrometeorological prediction and water resources in separate working groups. Some major changes to the plan were adopted as a result of these discussions. In particular, GAPP will include:

- a stronger land component for the North American Monsoon Experiment (NAME) in the implementation strategy,

- a plan for a cold season orography/precipitation field campaign, and

- a section on the development of remote sensing capabilities in support of CEOP and other predictability studies.

U.S. WATER CYCLE INITIATIVE MEETING

30–31 March 2000
Potomac, Maryland, USA

Progress on preparing the United States Water Cycle Initiative Science Plan was reviewed at an open meeting in Potomac, Maryland. Dr. George Hornberger opened the meeting by explaining the rationale for the initiative to improve understanding of the water cycle in sustaining human life and ecosystems from local and regional to global scales. This improved understanding of the water cycle includes the linkages to cycles of energy, carbon and nutrients. However, the rationale extends beyond basic science by including the water resource management and water quality issues.

The writing group leaders of the Draft Water Cycle Science Plan presented highlights for each of the chapter of the plan. Following discussions on each chapter, breakout sessions were convened to address: (a) science questions, (b) observations, and (c) modeling and applications. The synopsis of the science questions that follows includes comments not only from the breakout sessions.

Science Question 1: What are the underlying causes of variations in the water cycle on both global and regional scales, and to what extent is this variation induced by human activity? The breakout groups found little fault with the science discussion in the draft document, but recommended that (a) the plan include more attention to ocean-atmosphere coupling, (b) stay current on how space agency planned global missions will contribute, and (c) better articulate the science link to societal needs.

Science Question 2: To what extent are the variations in the global and regional cycle predictable? It was recommended that the discussion in the Draft Science Plan include a prediction concept based on a "calibration free" system. It was also suggested that the Plan include more attention to time scales, such as weather predictability, climate variability and shorter (decadal) climate change.

Science Question 3: How will variability and changes in the cycling of water through terrestrial and fresh water ecosystems be linked to variability and changes in cycling of carbon, nitrogen and other nutrients at regional and global scales? The topics addressed in the draft document on this question were to provide more emphasis on terrestrial moisture and elemental fluxes and to be more fully integrated with the earlier science questions.

A few general findings of the observations breakout group included comments on clarifying the linkage of observations in terms of the initiatives goals. Also, consideration should be given to how to exploit emerging technology to advance the goals of the initiative.

The breakout participants discussing modeling and applications identified a need for an earth science model with an objective to provide improved prediction of the global water cycle. The issues for greater resolution also involved a requirement for better computers. Key processes for which better understanding is required for model improvement included planetary boundary layer, radiative transfer (particularly role of clouds) and precipitation processes. Applications are tied to how well the science questions can be answered. Under the application topic there was also recognition of the need to strengthen application linkages to societal needs.

The Potomac Workshop on the Water Cycle Initiative was successful in building upon the "town meeting" held at the Fall American Geophysical Union national meeting in December 1999 and a similar "town meeting" held at the Annual American Meteorological Society Meeting in January 2000. Now the writers have the challenge to edit the existing draft based on the results of the productive activity at Potomac, Maryland and to present the finalized science plan to the management of the U.S. Global Change Research Program (USGCRP) and the Interagency Water Cycle Working Group.

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

ISLSCP SCIENCE PANEL MEETING

April 10–14, 2000
Caracas, Venezuela

The ISLSCP Science Panel and the IGBP Biospheric Aspects of the Hydrological Cycle (BAHC) Science Steering Committee held joint planning meetings and a 1-day workshop on the role of the tropical South American biosphere in the climate system at the Simon Bolivar University in Caracas, Venezuela. The joint meetings are a part of a continued effort of developing linkages between BAHC and ISLSCP on the biophysical components of the climate system through joint experiments, data products, modeling efforts, and common workshops.

Over 50 international experts from major global change programs presented current research assessing the impact of changing vegetation in South American on climate and water cycles at the 1-day workshop. The workshop concluded with a panel discussion and review of a number of other regional and national studies and discussion on the integration of these in international global change and the role of policy makers in the use of global change results.

At the joint science planning meetings, several ISLSCP activity areas of mutual interest with BAHC were discussed. Actions are to complete the ISLSCP Initiative II Plan, update the ISLSCP Activity/Implementation Plan for 2001–2003, and to begin the development of the ISLSCP Initiative III activity (2-year overlapping data sets for exploiting the near land surface data from the array of new satellite sensors being launched in the 2000–2003 time frame). A joint executive summary is planned with separate implementation plans for ISLSCP and BAHC.

A joint GEWEX/BAHC workshop on soil moisture is planned for May 16–18, 2000 in Norman, Oklahoma. The purpose of the workshop is to develop a strategic plan for the next 5 years in soil moisture monitoring, analysis and prediction for hydrometeorological and hydroclimatological application. Also planned is a joint workshop on mountains in 2002.

The ISLSCP Science Panel will meet again in the Fall 2000 in conjunction with the second Initiative II workshop.

WCRP/GEWEX MEETINGS CALENDAR

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

15 May 2000—GLOBAL SOIL WETNESS PROJECT (GSWP) WORKSHOP, Norman, Oklahoma. One-day workshop on planning for the interim phase of GSWP-1.5 and GSWP-2.

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. 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.

26–27 June 2000—5th GAME INTERNATIONAL SCIENCE PANEL, Tokyo, Japan. Draft agenda available at http://www.ihas.nagoya-u.ac.jp/game/info/agenda-5th-gisp.html.

26–30 June 2000—ESTABLISHMENT OF GLOBAL HYDROLOGICAL NETWORK FOR CLIMATE, Offenbach, Germany.

17–21 July 2000 —GCSS JOINT (WG2 AND WG3) WORKING GROUP WORKSHOP**,** Reading, UK. See WG2 webpage for details, http://eos913c.gsfc.nasa.gov/gcs_wg2/.

19–21 July 2000 —1st GLASS SCIENCE MEETING, Sydney, Australia.

15–16 August 2000—THIRD MEETING OF THE GLOBAL AEROSOL CLIMATOLOGY PROJECT (GACP), Ann Arbor, Michigan.

11–15 September 2000—GEWEX HYDROMETEOROLOGY PANEL, Angra dos Reis, Brazil.

16–20 October 2000—WCRP/WGNE WORKSHOP ON SYSTEMATIC ERRORS, Melbourne, Australia. For information consult http://www.bom.gov.au/bmrc/admin/syserr.html.

29 January – 2 February 2001—GEWEX SSG, Barcelona, Spain.

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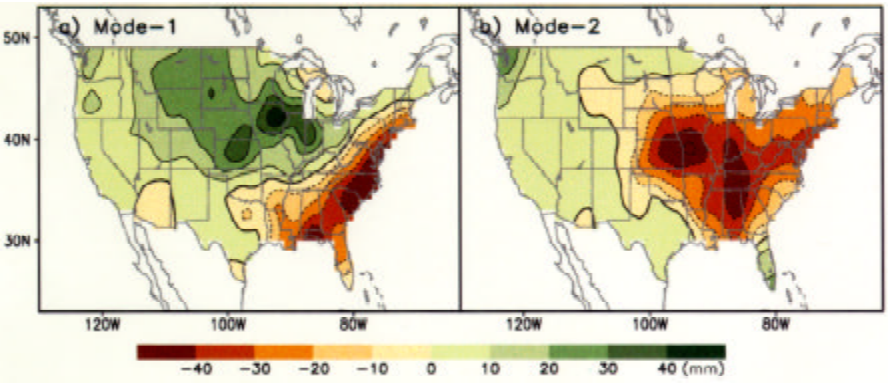
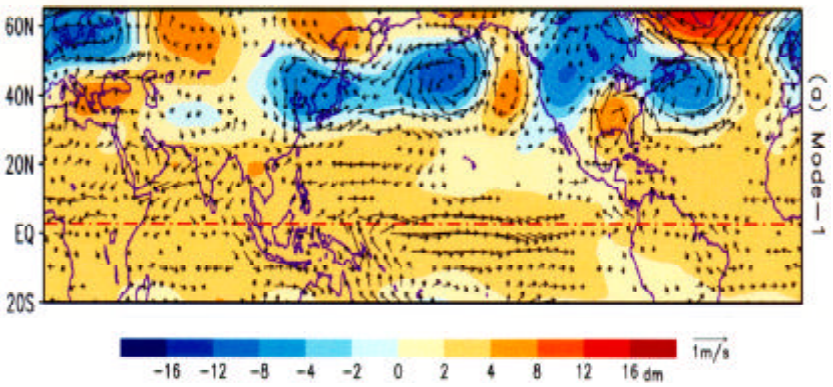
Assistant Editor: Dawn P. Erlich
Mail**:** International GEWEX Project Office
1010 Wayne Avenue, Suite 450, Silver Spring, MD 20910, USA
Tel: (301) 565-8345; Fax: (301) 565-8279
E-mail: gewex@cais.com
Web Site: http://www.gewex.com

REMOTE FORCING OF SUMMERTIME U.S. DROUGHTS AND FLOODS BY THE ASIAN MONSOON

(see Lau and Weng, page 5)



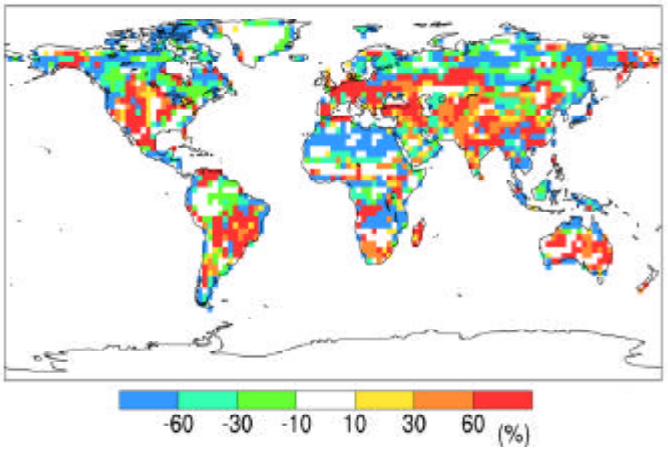
Shown above are two climate teleconnection patterns linking U.S. summer drought and flood patterns to the Asian summer monsoon. The top left panel shows excessive rainfall over the central U.S. and drought for the analysis shown below. The deficient rainfall depicted on the top right panel is associated with the Mode-2 analysis shown on the front page.



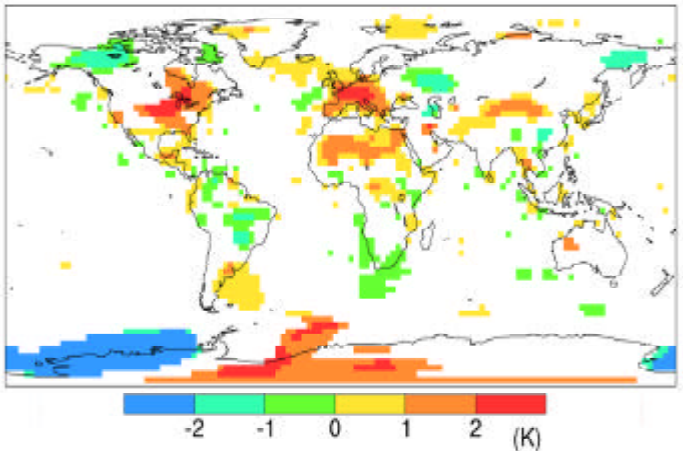
Geopotential height (500 hPa) and wind (850 hPa) regressed against the temporal coefficients.

Note the elongated pattern connecting the strong signal over Japan/Asia and the anti-cyclonic flow bringing moisture over the southeastern United States.

HETEROGENEOUS VEGETATION AFFECTS GCM-MODELED CLIMATE



Difference between the aggregate and default aerodynamic roughness expressed as a percentage of the mean of the aggregate and default values for the CCM3 3° x 3° grid. Note the negative percentages for boreal and tropical forest. See Burke et al., page 7.



Difference between the aggregate and default air temperature at the first model level for the 10-year average of June, July, and August. Only regions where the differences are statistically significant are shown.