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NEWS

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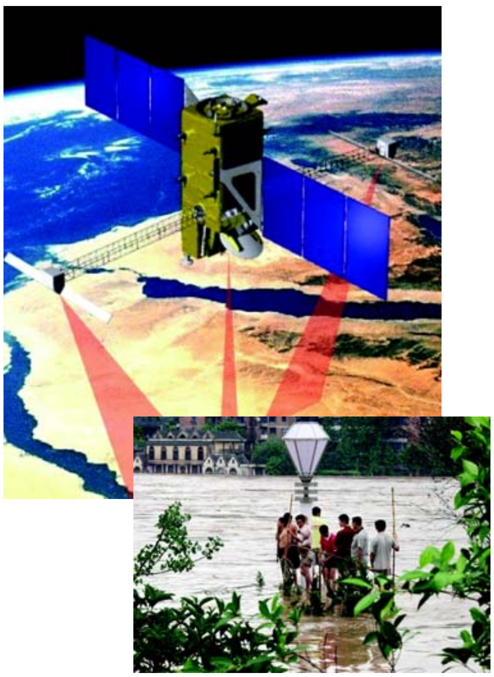
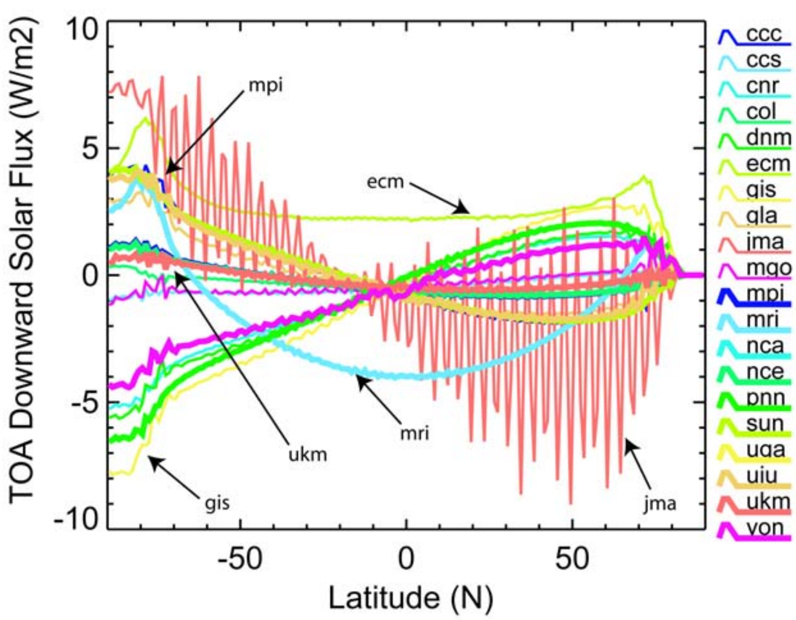
PROPOSED SATELLITE MISSION MAY ANSWER KEY WATER CYCLE AND WATER MANAGEMENT QUESTIONS



Conceptual model of WatER.

Predictions of runoff in many parts of the world cannot be properly compared with *in situ* measurements because these observations are very sparse and not always shared internationally. A proposed interferometric mission, WatER, may provide a solution to these problems. **See article on page 6.**

AMIP-2 GCM CLIMATOLOGIES MAY BE IMPACTED BY VARIATIONS IN TOP-OF-ATMOSPHERE INSOLATION FORCING



Incoming solar radiation at TOA during the month of February (average of the years 1985 to 1988). Differences between zonal averages of each model are indicated using AMIP-2 models and ISCCP results. (Data from M. Wild, ETHZ; computations by S. Kinne and M. Giorgetta, MPI Hamburg). See article on page 15.

COMMENTARY

TAPPING INTO NEW EARTH OBSERVATION ACTIVITIES AND PLANS: GEWEX RISES TO THE CHALLENGE

Rick Lawford
International GEWEX Project Office

The past 12 months have been exhilarating for the Earth observations community with the approval of the Global Earth Observation System of Systems (GEOSS) 10-year implementation plan; the establishment of the GEO Secretariat at the World Meteorological Organization (WMO) in Geneva; the development of several national GEOSS plans (e.g., Japan, USA); and the discussion that has been generated as various groups have been developing a work program for the first 3 years of GEOSS (2005-2007). At the same time Earth observations programs in some space agencies have gone through a stressful time with program redirections. In this regard the recent National Academy of Sciences report, "Earth Science and Applications from Space: Urgent Needs and Opportunities to Serve the Nation" provided an important perspective from the science community that is contributing to a balanced approach to Earth observations. This report supports some of the activities of value to GEWEX, such as extending the lifetime of the Tropical Rainfall Measuring Mission (TRMM), rekindling hope that the TRMM operating period may overlap with some elements of the Global Precipitation Mission.

For GEWEX, the Coordinated Observation and Prediction of Earth Systems of the World Climate Research Programme (WCRP) and its WCRP Observations and Assimilation Panel (WOAP) have opened new doors for GEWEX collaboration with other WCRP projects in areas related to satellite data product development and applications. A high level advisory committee on satellites in WMO will help to ensure that the issues raised by this Panel are considered by the space agencies. In addition, GEWEX continues to provide leadership to the Integrated Global Water Cycle Observations (IGWCO) theme of the Integrated Global Observing Strategy–Partners (IGOS-P). IGWCO has stimulated the development of plans for an intercomparison of high resolution precipitation products that is being planned as a collaborative activity of IGWCO, GEWEX and GEOSS. In addition, the Coordinated Enhanced Observing Period plays a central role in IGWCO and GEOSS.

These developments all could contribute to integrating satellite development activities and GEWEX research. GEWEX is well known and widely respected for its long-term global water and energy cycle data sets derived from satellite data that are now being used by the climate community. These data sets rely heavily on the weather satellites operated by the National Oceanic and Atmospheric Administration (NOAA), the European Organization for the Exploitation of Meteorological Satellites, and the Japanese Meteorological Agency. Opportunities to exploit operational observations for a wider range of long-term products will increase when the NOAA National Polar-Orbiting Operational Environmental Satellite System and other new operational satellites by Europe, China, Japan and India are launched.

Historically, the decision to pursue a new water cycle mission has created new opportunities for research related to the variables being measured by the mission. In the future, GEWEX research could play a greater role in the development of technologies in preparation for new missions and in the derivation of products using data from the new missions. This Newsletter describes some of these new opportunities. Other satellites (currently functional or in the planning stages) such as CloudSat, the Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observation

Contents

satellite, the Gravity Recovery and Climate Experiment, and Aqua, among others, are important to GEWEX but are not discussed in detail here. For each of these satellites GEWEX could make major contributions to support the mission's development and implementation by joint modeling and observational projects. This leads to questions regarding whether the present structure and emphases in GEWEX optimize these interactions.

A number of opportunities exist for which GEWEX could provide leadership in the application of satellite data. For example, the Water Resources Applications Project and the Hydrological Ensembles Prediction Experiment are well positioned to assess how satellite data can best support water management decisions. Results from these projects could be very helpful for the capacity building activities that are planned under GEOSS. Projects that address these and other opportunities are needed.

As GEWEX considers how it should address these new opportunities it may need to examine its overall role with respect to satellites to determine if new approaches and structures are needed. The following questions are examples of the issues to be addressed:

- What is the appropriate balance between research directed at process understanding and algorithm and product development in advancing our understanding of the global water and energy cycle?

- Are satellite issues best addressed by studying their development and applications on a variable by variable basis or is it worth studying them as platforms which sample a range of frequencies of radiation and develop a common strategy for their processing and analysis?

Over the next 1-2 years GEWEX will need to clarify its approach to these issues if it wants to fully exploit the opportunities GEOSS presents.

NEW GEWEX SSG VICE-CHAIR

Prof. Ulrich Schumann, Institut für Physik der Atmosphäre, Deutsches Zentrum für Luft- und Raumfahrt (DLR), has accepted the vice-chairmanship of the GEWEX Scientific Steering Group (SSG). He has been a member of the GEWEX SSG since 2000.

RECENT NEWS OF RELEVANCE TO GEWEX

WOAP HOLDS FIRST MEETING

On 1-3 June 2005, the World Climate Research Programme (WCRP) Observations and Assimilation Panel (WOAP) met at the Goddard Institute for Space Studies in New York. This Panel, which is responsible for addressing data issues across all WCRP projects and working groups, including the implementation of the Coordinated Observations and Prediction of the Earth Systems (COPES), is chaired by Dr. Kevin Trenberth with Dr. Gilles Sommeria providing secretariat services. Members of the Panel include representatives from each of the WCRP projects, the working groups on climate modeling and numerical experimentation, the Global Earth Observation System of Systems and the Global Climate Observing System. Dr. William Rossow serves as the GEWEX representative. Issues discussed at the meeting included reanalyses (for both numerical weather prediction products and satellite data products), satellite observations, Coordinated Enhanced Observing Period data issues, data assimilation approaches, and data management. It was clear that the broad research agenda of WCRP, which draws on a wide range of data sources, has led to a diversity of approaches in data management and analysis. The dialogue initiated through WOAP and COPES, promises to bring a more coordinated approach to these issues in the future.

12th IGOS Partners Meeting

The 12th meeting of the Integrated Global Observing Strategy Partners (IGOS-P) was held in Geneva on May 26. It was preceded by a meeting of the Committee on Earth Satellites Strategic Implementation Team (CEOS-SIT) and a meeting between the IGOS theme leaders and representatives of the Global Earth Observing System of Systems (GEOSS) Secretariat. The IGOS themes reported on progress related to the inplementation (water cycle, oceans, coastal, atmospheric chemistry) or their development (cryosphere, land). While GEWEX has had the greatest involvement in the Global Water Cycle Observations (IGWCO) theme, it also has programmatic links between with the cryosphere, land and atmospheric chemistry themes. At this meeting, IGOS-P and CEOS-SIT also endorsed the plans of the IGWCO theme to proceed with regional capacity building workshops.

ESA MISSIONS ADDRESSING THE WATER AND ENERGY CYCLE

Einar-Arne Herland

ESA – European Space Research and Technology Centre, The Netherlands

The European Space Agency (ESA) is implementing observational capability that supports GEWEX and related global water cycle activities. These Earth Explorer missions include CryoSat, the Soil Moisture and Ocean Salinity (SMOS) mission, the Advanced Dynamics Mission (ADM)-Aeolus, and the Earth Clouds, Aerosols and Radiation Explorer (EarthCare).

The scientific objectives of **CryoSat** include determining the rate of change of variations in the thickness and mass of polar marine ice and continental ice-sheets in response to climate changes. Scheduled for launch in September 2005, CryoSat will carry an innovative Synthetic Aperture Radar (SAR)/Interferometric Radar Altimeter (SIRAL) that is capable of operating in SAR interferometric mode around the peripheries of the ice-sheets. It will observe Arctic sea ice cover in SAR mode and the level ice-sheet plateau in Low Resolution Mode (LRM). CryoSat is a nominal 3-year mission plus a 6-month commissioning phase, and will fly in a polar, non-sun-synchronous low-earth orbit.

SMOS is designed to observe the soil moisture of Earth's land masses and salinity in the oceans. Scheduled for launch in 2007, SMOS will exploit an innovative two-dimensional interferometer for acquiring brightness temperature observations at L-band (1.4 GHz) globally and with a revisit time less than 3 days, a spatial resolution better than 50 km, and with a range of viewing angles (0-50 degrees) for the estimation of soil moisture and ocean salinity. Time series of soil moisture at mesoscale will provide a better representation of land surfaces in global circulation models. Because ocean surface salinity is closely correlated with estimates of net evaporation minus precipitation (E-P), SMOS will also give insight into the phenomena driving the thermohaline circulation and allow better estimation of the latent heat flux.

The aim of **ADM-Aeolus** is to demonstrate measurements of vertical wind profiles from space where the current deficiencies are largest in the tropics and over the oceans, using a high performance Doppler wind lidar based on direct-detection interferometric techniques. Measurement of the Doppler shift from successive levels in the atmosphere provides the vertical wind profiles. The satellite measurements will provide about 3000 globally distributed wind profiles per day, above thick clouds or down to the surface in clear or partly cloudy air, at typically 200-km separation along the satellite track. The satellite will fly in a sun-synchronous dawn-dusk orbit, at an altitude of 400 km, providing near-global coverage. The target date for launch is 2008. The expected improved knowledge of the global wind field is crucial to climate research and weather prediction.

The objective of **EarthCARE**, a joint European-Japanese mission, is to quantify aerosol-cloud-radiation interactions so that they may be included correctly in climate and numerical weather forecasting models. EarthCARE, with a planned 2012 launch, will carry a lidar, a radar, a multispectral imager and a broad-band radiometer. The imager will enable different cloud types and aerosols to be distinguished and will provide the meteorological/optical context of the sampled profiles. The radiometer will provide broad-band radiances at the top of the atmosphere, allowing the consistency of the retrievals of cloud radiative properties from the active instruments to be tested. EarthCARE will provide (a) vertical profiles of natural and anthropogenic aerosols on a global scale, their radiative properties and interaction with clouds; (b) vertical distribution of atmospheric liquid water and ice on a global scale, their transport by clouds and radiative impact; and (c) cloud overlap in the vertical, cloud-precipitation interactions and the characteristics of vertical motion within clouds. The combination of the retrieved aerosols and cloud properties will allow scientists to derive the profile of atmospheric radiative heating and cooling.

ESA looks forward to collaboration with GEWEX in the development and implementation of its new missions.

ISLSCP II BETA DVD AVAILABLE

A number of beta versions of DVDs with the International Satellite Land-Surface Climatology Project (ISLSCP) Initiative II data sets have been prepared and are available to anyone willing to evaluate the products. Those wishing to obtain a beta version should e-mail Dr. Forrest Hall (fghall@ltpmail.gsfc.nasa.gov) or Dr. Jim Collatz (jcollatz@biome.gsfc.nasa.gov).

NASA ENERGY AND WATER CYCLE STUDY (NEWS)

Paul R. Houser[1] and Jared K. Entin[2]

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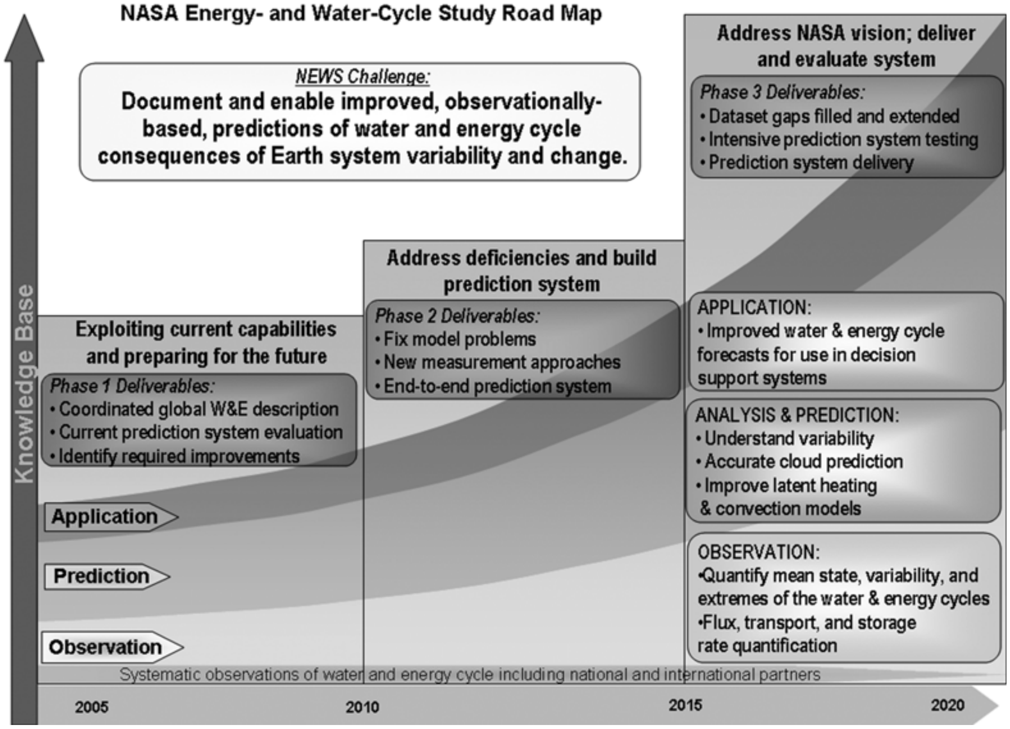
Water is essential to life and is central to society's welfare, progress, and sustainable economic growth. The water cycle operates on a continuum of time and space scales and exchanges large amounts of energy as water undergoes phase changes and moves through the Earth system. Furthermore, it is widely recognized that the most significant manifestation of climate change for humans and the environment is an intensification and alteration of the global water cycle, leading to increased global precipitation, faster evaporation, and a general exacerbation of extreme hydrologic regimes, floods, and droughts. Therefore, it is essential that we produce an accurate accounting of the key reservoirs and fluxes associated with the global water and energy cycle, including their spatial and temporal variability, and potential response to climate change.

With its unprecedented new observation capacity, and revolutions in modeling capability, the National Aeronautics and Space Administration (NASA) has an opportunity to make significant advances in water and energy cycle prediction. To realize this goal, NASA must develop its unique discipline of prediction and verification through the integration of water and energy cycle observations and models, and to verify model predictions against observed phenomena to ensure that its research programs deliver reliable answers to society's questions. To this end, the NASA Energy and Water cycle Study (NEWS), has been established to document and enable improved, observationally based, predictions of water and energy cycle consequences of Earth system variability and change.

To achieve the NEWS grand challenge and produce credible climate change predictions, NASA will seek collaborations with international, federal, state, and local agencies, as well as the scientific community at large. This will be primarily accomplished through the interagency working group for the water cycle under the Climate Change Science Program (CCSP). Such collaborations will include studies and activities concerning experimental and operational observations and analysis tools for characterizing air/sea fluxes, ocean circulation, atmospheric state, land surface vegetation, sub-surface hydrology, snow and ice. The development of an end-to-end water and energy cycle program that improves decision support with new research products and tools will also be supported.

NASA's water and energy cycle connection to the international science community is through the World Climate Research Programme (WCRP), especially GEWEX, as well as the project on CLImate VARiability and predictability (CLIVAR), the CLimate and Cryosphere (CLiC) Project, the Global Water Systems Project (GWSP), the Integrated Global Observing Strategy (IGOS), and the Global Earth Observation System of Systems (GEOSS).



Implementation of the NEWS research program is planned in three phases with each successive phase being focused on a range of research activities, representing advances beyond the current status of observations, modeling and applications. The centerpiece of this plan is the development of an observation-driven Earth system model that faithfully represents water and energy cycling, climate trends, and weather-scale variability including extremes. The emphasis during Phase 1 is to exploit current capabilities and prepare for future developments of NEWS program elements. Phase 2 focuses on addressing deficiencies and building a viable prediction system. Phase 3 focuses on the delivery of an end-to-end system.

Recognizing that the development of useful water and energy cycle predictions is a significant challenge that independent investigations are unlikely to meet, NEWS is adopting a tightly integrated team approach to this research challenge. The three principal NEWS elements are:

- **Product-driven investigations:** Systematic research investigations intended to combine and interpret past and current observations, derive global analysis and prediction tools and products and identify technological and observational requirements to guide future NASA investments.

- **Discovery-driven investigations:** Fundamental investigations to identify key missing elements and explore new scientific frontiers to improve capabilities and knowledge of the energy and water components of the Earth system.

- **Integration studies:** Integration of the science activities to serve the overall purpose of NASA by acting as an interface with other earth science research foci and activities, coordinating the execution of the NEWS Implementation Plan, and leading specific studies needed for integration of the results of independent NEWS investigations.

NASA has recently selected 21 NEWS product and discovery research projects, which are expected to interact as a tightly coordinated team to make decisive progress toward the NEWS grand challenge. NASA has also established a NEWS Science Integration Team that will serve as an interface to NASA system components, and to coordinate and integrate the results of the NEWS investigations.

We invite community participation to enhance the NEWS program through involvement in open NEWS workshops and townhall meetings, critical reviews and edits of the NEWS Implementation Plan, partnerships with the NEWS investigators and integration team, and participation in future NEWS research solicitations. Information on these opportunities can be found at the NEWS web site: http://wec.gsfc.nasa.gov.

OBSERVING SURFACE WATER FROM SPACE: WatER MISSION

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[1]Ohio State University, [2]University of Washington, [3]University of California, Irvine, [4]University of New Hampshire

Surface fresh water is essential for life, yet current observing networks provide surprisingly poor knowledge of the spatial and temporal dynamics of water storage and discharge in the world’s rivers, floodplains, wetlands, and lakes. Key societal issues, such as the susceptibility of life to drought and floods, cannot be answered with the current global observing networks. Alsdorf and Lettenmaier (2003) and Alsdorf et al. (2003) outlined the potential for spaceborne observations via methods that have been used to define the surface profile of the world's oceans for several decades to address these issues. The Water Elevation Recovery (WatER) mission, a proposed joint European Space Agency (ESA) and National Aeronautics and Space Administration (NASA) program, would acquire elevations of water surfaces at spatial (10-100 m) and temporal (1 week) scales necessary for answering key water cycle and water management questions.

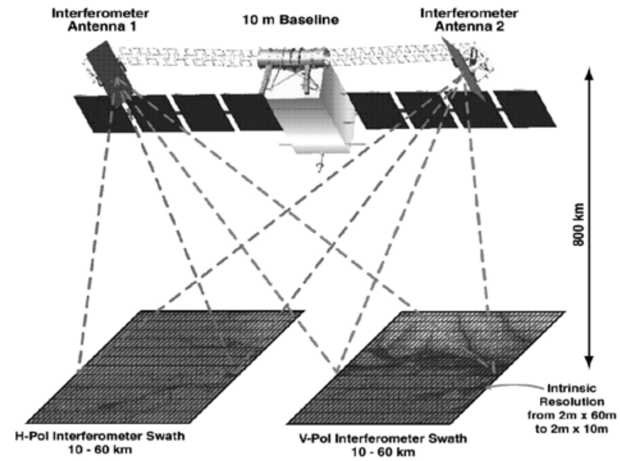
The WatER mission concept was developed after a 1998 NASA effort to define post-Earth Observing System satellite missions when NASA’s Terrestrial Hydrology Program formed a Surface Water Working Group (SWWG; www.geology.ohio-state.edu/swwg) to foster development of satellite applications to surface water problems. SWWG encouraged the development of spaceborne technologies capable of collecting global surface water measurements that would help address existing voids in global surface water observations (Alsdorf et al., 2003). Similarly, a community of researchers throughout Europe met at the Hydrology from Space Workshop at the Centre National d’Etudes Spatiales, (CNES) in Toulouse in September 2003 and initiated actions intended to lead to a spaceborne platform capable of measuring surface water hydrology.

WatER is an interferometric altimeter based on the rich heritage of (1) the many highly successful ocean observing radar altimeters, (2) the Shuttle Radar Topography Mission (SRTM), and (3) a development effort for a Wide Swath Ocean Altimeter. WatER would provide surface elevation data in a

120-km wide swath using two Ka-band synthetic aperture radar (SAR) antennae at opposite ends of a 10-m boom. Interferometric SAR processing of the returned pulses will yield a 5-m azimuth and 10-m to 70-m range resolution, with elevation accuracy of ± 50 cm. Polynomial based averaging increases the height accuracy to about ± 3 cm. The orbital repeat cycle is designed to permit a global sampling of all surface water bodies every 8 days using a collection of ascending and descending tracks in a 16-day repeat period.

By themselves, none of the presently operating satellite technologies supply the surface water measurements needed to represent the space-time variability of inland water storage and movement, or to provide information necessary for water management purposes (Alsdorf and Lettenmaier, 2003). Problems range from poor spatial or temporal resolutions to inability to penetrate clouds or smoke. Coarse spatial resolutions are associated with the Gravity Recovery and Climate Experiment mission (GRACE) and all profiling altimeters. Conventional radar and lidar altimetry is nadir viewing and misses water bodies between orbital tracks. Although SRTM produced a high spatial resolution image of land surface topography, the errors over water surfaces are quite large (e.g., ±5.51 m for C-band). Optical sensors cannot penetrate the canopy of inundated vegetation and typically fail to image water surfaces when clouds or smoke are present. The prevalent vegetation and atmospheric conditions in the tropics lead to very reduced performances for technologies operating in and near the optical spectrum.

Global models of weather and climate could be constrained spatially and temporally by stream discharge and surface storage measurements. Yet this constraint is rarely applied, despite modeling results showing that precipitation predicted by weather forecast models is often inconsistent with observed discharge. For example, Roads et al. (2003) found that the predictions of runoff by numerical weather prediction and climate models were often in error by 50%, and even mismatches of 100% with observations were not uncommon. Coe (2000) found similar results for climate model predictions of the discharge of many of the world's large rivers. The interseasonal and interannual variations in surface water storage volumes as well as their impact on balancing regional differences between precipitation, evaporation, infiltration and runoff are not well known. Lacking spatial measurements of wetland locations and sizes, hydrologic models often do not properly represent the effects of surface storage on



Conceptual view of WatER. Maximum incidence angle is 4.3º; thus the instrument operates very near nadir where water surfaces are very bright. At Ka band, the interferometer will easily penetrate clouds and relies on subtle canopy openings to penetrate to any underlying water surfaces (openings of only 20% are sufficient).

river discharge. Errors can exceed 100% because wetlands moderate runoff through temporary storage and change the surface area available for direct interception of precipitation and free evaporation (e.g., Coe, 2000). While Earth system models continue to improve through incorporation of better soils, topography, and land-use land-cover information, their representations of the surface water balance are still greatly in error, in part due to the absence of an adequate observational basis for quantifying river discharge and surface water storage. **WatER would be a valuable data source for the GEWEX community and enable GEWEX scientists to address questions such as "What is the spatial and temporal variability in the world's terrestrial surface-water storage?" This is a question that cannot be answered with either current *in situ* or space-based observations.**

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TOWARDS INTEGRATED GLOBAL SOIL MOISTURE OBSERVATIONS

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Soil moisture observations are critical for understanding the global water and energy cycles, for predicting precipitation, and for developing the information that supports water resource decision makers. Surface soil moisture is a determinant of the partitioning of surface precipitation into infiltration and runoff. Across much of the extra-tropical landscapes soil moisture and its freeze/thaw state control evapotranspiration providing the link between terrestrial water, energy, and carbon cycles. Based on theory and experiments to date, there is general agreement that improvements in our understanding of the water cycle and ability to predict short-term events (hydrometeorology) and long-term patterns (seasonal) is dependent on developing an integrated global soil moisture observing system. GEWEX has a rich history in soil moisture research and has supported a number of key projects that have advanced the science and application of the data.

GEWEX can now play an important role in the future of soil moisture observing systems by being the driver for realizing climate research dividends for important operational applications. Droughts and floods can significantly affect the functioning of both industrialized and developing countries. The availability of reliable predictions will change how decision makers prepare mitigation measures to deal with these events. A key for success is to develop confidence in the climate information and remove the multiplicity of data and sources. GEWEX can play a significant role in promoting the integration of various data sources into consistent water cycle estimates. Through verification, outreach, and pilot project activities, GEWEX can be an agent of change on how variations in water availability impact vulnerable activities.

The steps towards this goal would involve addressing several key questions: (a) What assimilation approaches are best suited for the problem of blending emerging satellite mapping of water cycle variables, such as surface soil moisture and precipitation? (b) What calibration and verification activities should be in put in place to ensure the growth in confidence about the climate information, especially related to soil water availability? (c) From the suite of satellite sensor data and *in situ* network observations, what mix emerges as the best set for future water cycle monitoring and prediction?

With respect to soil moisture, two forthcoming satellite missions and growing international cooperation in establishing *in situ* networks have created real and exciting opportunities. The European Space Agency (ESA) is implementing the Soil Moisture and Salinity (SMOS) mission to be launched in 2007. SMOS will operate a low frequency (21-cm wavelength) radiometer with multiple look angles in order to derive surface (0–5 cm) soil moisture and vegetation water content. Instruments operating at such low frequencies are well suited for measuring soil moisture since signal transmissivity through vegetation and the sensing depth both improve with increasing wavelength. NASA's Hydros mission (2010 launch) will also make low frequency microwave measurements but it will include an active radar system near the same frequency band. Both high-resolution soil moisture and its freeze/thaw state can be detected with the combined active and passive sensors.

The community perspective on soil moisture observations parallels that described in Leese et al. (2001). This included *in situ* measurements, satellite observations, and modeling that must all be developed and integrated, primarily through a data assimilation framework.

To obtain improved soil moisture information, it will be necessary to enhance both *in situ* observing systems and satellite data. This will involve network enhancement by expansion and standardization, dedicated soil moisture missions, and improved coordination of soil moisture data network planning, observing standards, and data exchange. Some support for this exists under the emerging Integrated Global Observing Strategy-Partnership (IGOS-P) and the Global Earth Observation System of Systems (GEOSS) programs. Key to the growth of these efforts is the recognition by the agencies that soil moisture is as an emerging climate variable, finding a sponsoring agency that will commit to a global network of *in situ* soil moisture measurements, and getting commitments from space agencies for developing a quasi-operational soil moisture data product.

Coordination of some of these efforts is being attempted by an International Soil Moisture Working Group under the IGOS-P Integrated Global Water

Cycle Observation Theme. The working group is considering:

- A coordinated plan for soil moisture networks at both the national and international levels.
- A supersite program to provide the comprehensive data sets needed for sensor evaluation and calibration, for developing soil wetness algorithms, and for the evaluation of climate model outputs.
- Enhancing capabilities to measure soil moisture from space from committed missions and the assessment of the utility of soil moisture measurements derived from space.
- Research on ways to remove the vegetation effect from the signal that is being used to derive soil moisture; and
- Quantification of or at least understanding the relationships between surface soil wetness and deep soil moisture profiles

In situ networks will occupy a key position in integrated water cycle understanding and quantitative prediction. In addition to supporting the validation of satellite retrieval algorithms, *in situ* data can help address questions such as: (a) What is the soil moisture memory and how does it depend on climate variability, soil hydraulic properties and vegetation characteristics? (b) How does soil moisture at the surface and below the surface respond to precipitation events and restore itself during dry-downs? (c) What is the functional relationship between soil moisture and evaporation? How does it depend on vegetation and soil type? (d) What level of accuracy is needed in Land Surface Models (LSMs) and their assimilation?

The enhancement of observations includes: (a) taking advantage of existing infrastructure; (b) taking advantage of opportunities for network expansion as they arise; (c) promoting consistency and standardization in observations; (d) linking long-term points to short-term spatial averages; (e) utilizing temporal stability; (f) conducting research and scaling up from a single point or a cluster at a station to provide data for satellite product validation of data assimilation products; and (g) ensuring measurements at 5 cm to link to satellite observations.

Some of the points mentioned above are illustrated in the figure on page 20 which shows an *in situ* network of 21 sites that was created using an existing precipitation network as its basis. Sensor data were validated using large numbers of conventional measurements during a short-term field campaign. The scaling and reliability of the network is clearly demonstrated.

Issues related to satellite mapping of soil moisture involve dedicated missions, data sharing, calibration, and validation. In general, international cooperation in research and applications supporting soil moisture satellite missions has been effective. However, soil moisture mapping satellites are just a few years away, though an effective program to generate and validate a preliminary soil moisture product is lacking. This issue provides a link between current [Advanced Microwave Scanning Radiometer (AMSR)] and future higher frequency microwave sensing missions [Conical-scanning Microwave Imager/Sounder on the National Polar-orbiting Operational System with a planned launch in 2009 and the Global Change Observation Mission, a potential Japan Aerospace Exploration Agency remote sensing system with a possible 2009 launch] and includes SMOS and Hydros.

Future sensors will have a variety of unique capabilities such as different scan strategies, as well as active radar and passive radiometer sensors. Initiatives and coordination are required to ensure that the soil moisture estimates from the different missions are consistent and that together they form a useful long-term data set for the users.

Near-term priorities include: (a) improving the quality of satellite products being provided by current satellites (e.g., Aqua AMSR-E) through algorithm enhancements; (b) coordinating the science and data activities of SMOS and Hydros with those of the larger water cycle research and application communities; (c) improving the quality of current and future satellite microwave observations through multiple satellite cross-calibration and vicarious calibration targets; (d) increasing the acceptance of satellite soil moisture products through rigorous validation

We are entering a new era in satellite remote sensing with a wide range of microwave instruments included on research and operational satellite platforms. GEWEX and the soil moisture community need to work together to ensure that we make the most of the current satellites, ensure the implementation and success of planned research missions, and identify the path to an operational system.

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HIGHLIGHTS FROM THE 5TH INTERNATIONAL SCIENTIFIC CONFERENCE ON THE GLOBAL ENERGY AND WATER CYCLE

Paul Try
International GEWEX Project Office

Nearly 300 scientists from 23 countries attended the Conference, which was held 20-24 June 2005 in Costa Mesa, California. The 158 oral presentations and 170 poster presentations presented at the Conference showed the significant progress made in GEWEX related research since the last conference in 2001.

Peter Lemke opened the Conference by detailing the World Climate Research Programme's (WCRP) new integrated strategy, the Coordinated Observation and Prediction of the Earth System (COPES), and the key role GEWEX will be playing in this strategy. Soroosh Sorooshian followed with his views for refocusing the GEWEX Phase II role in the application arena. The National Aeronautics and Space Administration's (NASA) and the European Space Agency's (ESA) future plans and visions were covered by Jack Kaye and Einar-Arne Herland, respectively.

Each day's lead-off plenary sessions provided an outstanding grouping of special invited talks to set the stage for the focused sessions on the Conference themes to follow:

T1 - The role of clouds and their effects on the radiation budget in climate prediction

T2 - Predictions for water management

T3 - Roles of land fluxes in water and energy cycles

T4 - The role of modeling in predictability and prediction studies

T5 - New strategies for characterizing and predicting energy and water budgets

T6 - Measuring and predicting precipitation

Tuesday's Plenary (Themes 1 and 2) began with Pierre Morel's challenge to answer the key climate question — *How will the global distribution of atmospheric water vapor adjust to changes in Earth's temperature?* His conclusion that a *realistic simulation of cloud systems and precipitation is key to understanding changes in water vapor distribution and predicting climate* then demands *a "visionary" observing strategy to infer a realistic representation of global processes from thinly sampled high-quality measurements.* Andras Szollosi-Nagy's talk, "Strange Bedfellows in International Waters: Hydrology and Politics," brought home many of the key issues involved in the societal end-game of delivering water to the people, globally. Pavel Kabat provided the new focus of the International Geosphere-Biosphere Program (IGBP) for the next decade and Berrien Moore reminded us of the need to better understand the full chemistry-climate connections within the total Earth system. Susan Solomon then concluded this session with the more immediate community needs addressed by her talk – "Questions on the Role of Energy and Water in Climate Variability and Change: an Intergovernmental Panel on Climate Change (IPCC) Working Group 1 Perspective." Her talk stimulated several subsequent GEWEX science inputs to IPCC deliberations.







The Themes 3 and 4 Plenary invited talks began with Jan Polcher laying out the primary challenge for the GEWEX Modeling and Prediction Panel, including the view that "phase changes of water are well mastered at the microscopic scale, but we need macroscopic representations to address the hydrological cycle of the Earth and its feedbacks," including a focus on the diurnal cycle as the key area on which to measure our advances. Tony Busalacchi outlined the latest progress from the CLImate VARiability and predictability (CLIVAR) Project, highlighting the new joint GEWEX-CLIVAR collaborations. Julia Slingo focused on the importance of understanding the water cycle within the monsoon climates and their low predictability, especially for precipitation. While multiscale interactions are not yet well understood, convection remains the number one problem for modelers. Toshio Koike emphasized the importance of data integration and information fusion in attempting to process the extremely large volumes of Coordinated Enhanced Observing Period (CEOP) data now being made available to the community, and Paul Mason reviewed how far the Global Climate Observing System (GCOS) has come in providing global support for climate observations.

The Themes 4 and 5 Plenary was led off by Kevin Trenberth's estimate of the global water budget and the changes occurring based upon both observations and model output. His analyses made clear the critical need to better represent the water cycle in models and to reprocess the global data sets as soon as possible. Mous Chahine illustrated how new satellite data, such as from Atmospheric Infrared Sounder (AIRS), have had a significant impact on our global prediction capabilities and A.R. Ravishankara reminded us how the chemistry of water is so critical to our understanding and modeling of weather and climate systems.

Jared Entin emphasized the key role that both the Global Earth Observation System of Systems and the Integrated Earth Observing System have in providing critical international support. Pavel Kabat described the importance and planned contributions for the new International Land Ecosystem-Atmospheric Processes Study Project of IGBP.

The Friday lead-off Plenary for Theme 6 began with Eric Smith highlighting the reappraisal of the scientific basis for the new Global Precipitation Mission (GPM), followed by Bob Adler's presentation of the significant contributions that the Tropical Rainfall Measuring Mission (TRMM) has made to our ability to predict precipitation. Phil Arkin provided an assessment of the global precipitation products noting that with over 1,000 citations for use (National Centers for Environmental Prediction reanalysis has just over 3,000 citations) of these data, reanalysis is urgently needed and new, even higher resolution products are required for precipitation. Christoph Beck described the extensive *in situ* gauge data set by the Global Precipitation Climatology Centre from 1951-2000, indicating that while no significant global trend exists, local trends do occur. Dan Cayan concluded this Plenary with a description of the importance to overall climate understanding of the mountainous regions watersheds and ecosystems.

The Conference concluded with a Panel on GEWEX Phase II, discussing how GEWEX can provide the leadership needed for the advances in climate understanding and supporting Earth observations. Pierre Morel, Soroosh Sorooshian, Toshio Koike and Rick Lawford provided excellent insight into what is required to ensure continued progress for GEWEX.

Although choosing some of the key results from the over 300 presentations and posters is difficult, it is worth noting a few significant issues that are particularly critical to the future progress of GEWEX and the scientific understanding of the global energy and water cycle, and these are given below.

Key Results Presented at the 5th Conference

- Current global data sets must be reanalyzed as soon as possible to take advantage of new knowledge and provide improved resources for assessing climate change.
- Cloud, aerosol and precipitation representation in models must be improved and multiple approaches to achieving these improvements must be pursued.
- Convection and its representation in models deserve a continued special focus as it may provide the greatest potential for improvement.
- The diurnal cycle remains a key focus area to ensure improved model and observational representation of water and energy processes.
- Feedback processes are complex and must continue to be assessed, but in a more complete and non-linear manner.
- Renewed emphasis on a vision for the future, focused on the critical scientific uncertainties is needed to assist in defining the new global/international observational needs.
- Renewed focus on applications related to water resources as well as climate and weather prediction is needed to ensure the improvements being achieved that have immediate societal benefits are better understood and implemented.

This Conference would not have been possible without the support of the following sponsors: NASA, NOAA, WCRP, the National Science Foundation, the American Meteorological Society, the University of California at Irvine, the International Atomic Energy Agency, the Metropolitan Water District of Southern California, the National Water Research Institute, the Los Angeles Department of Water and Power, and the Fariborz Maseeh/Massiah Foundation.

FIRST RESULTS FROM iPILPS

Ann Henderson-Sellers[1], Matthew Fischer[1] and Parviz Irannejad[1&2]

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Isotopes, particularly the stable water isotopes (SWIs), are one of the most useful and innovative tools for understanding complex processes in the water cycle, paleoclimate and biogeochemistry on many timescales. The stable isotopes of hydrogen and oxygen carried by water have been used to interpret long-term temperature trends and to monitor biological and abiological sources and sinks of CO_2 and CH_4. Atmospheric Global Climate Models were used to verify and interpret isotopic measurements over 20 years ago and recently climate models around the world have "rediscovered" the potential of SWIs (e.g., Stable Water Isotopes Intercomparison Group).

The naturally occurring water isotopes of interest as possible tracing and validation tools in hydrological simulations are $^{1}H_2{}^{18}O$ and $^{1}H^{2}H^{16}O$. Isotopic enrichments, $\delta^{18}O$ and δD, relative to the Vienna Mean Ocean Water (VSMOW) exhibit systematic variations in the water cycle as a result of phase change and diffusion-derived isotopic fractionation. Coupled with measurement of isotopes in water sources, SWI characteristics are just beginning to provide insight into basin-integrated hydroclimates (Henderson-Sellers et al., 2004).

Isotopes in PILPS (iPILPS), under the GEWEX Land-Atmosphere Systems Study (GLASS), is a new Project for the Intercomparison of Land-surface Parameterization Schemes (PILPS; Henderson-Sellers et al., 1993) experiment synergistically linking land surface scheme (LSS) modeling and SWI analysis. iPILPS will establish, in collaboration with the International Atomic Energy Agency (IAEA) Moisture Isotopes in the Biosphere and Atmosphere, a globally spanning set of isotope-based sites in well-monitored catchments for LSS evaluation and improvement. The goals of iPILPS are to (i) offer a framework for intercomparison of isotope-enabled land-surface schemes (ILSSs) and (ii) encourage improvement of these schemes by evaluation against high quality (isotope) observations.

Phase 1 of this new GEWEX project tests the hypothesis that: Observation and analysis of the diurnal fluxes of $^{1}H_2{}^{18}O$ and $^{1}H^{2}H^{16}O$ among the soil, plants and atmosphere can accurately determine the partitioning of precipitation into transpiration, evaporation and total runoff (surface plus soil drainage). iPILPS will contribute to (i) improving the accuracy with which land-surface schemes partition net available surface energy into latent and sensible heat fluxes, and thus, (ii) to decreasing uncertainty in hydroclimate modelling and water resource vulnerability predictions.

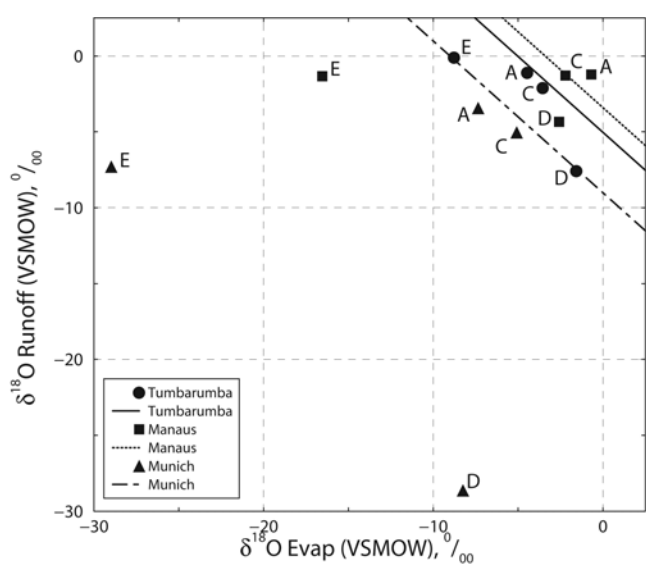
The iPILPS experiment was conducted for three sites covering a range of climatologies: (i) mid-latitude (deciduous) grass/woods, nominally at Munich, 48°N 11°E; (ii) tropical (evergreen) rainforest, nominally at Manaus, 3°S 60°W; and (iii) mid-latitude eucalypt (evergreen) forest, nominally at Tumbarumba, 35°S 148°E. These three locations were selected to link iPILPS to three GEWEX Continental-Scale Experiments (CSEs): the Baltic Sea Experiment (BALTEX), the Large Scale Biosphere-Atmosphere Experiment in Amazonia (LBA) and the Murray-Darling Basin (MDB) Project.

Four years of forcing data was provided for the three locations from the isotope-enabled atmospheric model, REgionales MOdel: Max Planck Institute for Meteorology (REMO), nested into the "climatological" version of ECHAM General Circulation Model (GCM). One of the isotopic LSSs did not use the provided forcing, but ran coupled with the isotope-enabled Goddard Institute for Space Studies (GISS) GCM. The experimental design directed each ILSS to use the first year's forcing repeatedly for as many years as that ILSS required to achieve equilibrium (this experimental component was designated EQY1), and then used the next 3 years' forcing to create 3 years' simulations (BC24). **Here we present preliminary results of the EQY1 experiment by five ILSSs whose simulations are already available.** The five ILSSs whose simulations are included here are (see Henderson-Sellers *et al*. (2005) for corresponding references): REMOiso ILSS, GISS ILSS, MATSIROiso, ICHASM and ISOLSM. In keeping with PILPS usual practice of model anonymity, we have randomly designated letters *A* to *E* to the ILSSs. They correspond to a Soil Vegetation Atmosphere Transfer (SVAT) (A), a Bucket (B), a complex SVAT (C), a SVAT/Bucket (D) and SVAT (E).

Each ILSS initialized water reservoirs at half capacity, all water isotope reservoirs at the VSMOW and all temperatures at the supplied annual mean surface air temperature. Equilibrium was defined as being the first occasion on which the January mean values of surface radiative temperature, latent and sensible heat fluxes, and rootzone soil moisture did not change by more than 0.01 K, 0.1 W m^{-2} and 0.1 mm, respectively, in 2 consecutive years; no criteria were specified for isotopic equilibrium. **The results show large differences among the participating ILSSs in simulating components of the surface energy and water budgets.** The intermodel ranges of the mean annual sensible heat flux are 24, 43 and 49 Wm^{-2} and for evaporation they are 28, 46 and 45 kg m^{-2} $month^{-1}$ for Tumbarumba, Manaus and Munich, respectively.

Scaling the annual mean sensible and latent heat fluxes of individual ILSSs by the average of all models' net radiation, confirms strong association between the partitioning of surface available energy and model complexity; the more complex the model the lower the simulated mean annual Bowen ratio, in line with the earlier PILPS findings (e.g. Henderson-Sellers *et al*., 2003). The pattern is less clear for partitioning of precipitation between evaporation and runoff.

The partitioning of mean isotope delta values of precipitation ($\overline{\delta P}$) to isotopic delta values of evaporation ($\overline{\delta E}$) and runoff ($\overline{\delta R}$) for the EQY1 is shown in the figure below for the three sites. The results should lie on lines with an intercept of $\overline{\delta P}$ and a slope of -1. ILSS B is excluded from the figure due to an as-yet unexplained error in its hydrology files. The main feature of this analysis is that no ILSS fits the expected lines, although *A* and *C* are generally closer than *D* and *E*. *D* has a runoff value that is too isotopically depleted for all sites. This is probably because ILSS *D* is not in isotopic equilibrium, although



Evaporation v. runoff $\delta^{18}O$ (‰) simulated components of the annual mean water isotope budget for Tumbarumba, Manaus and Munich. The diagonal lines are the mean ^{18}O in precipitation as prescribed from REMOiso.

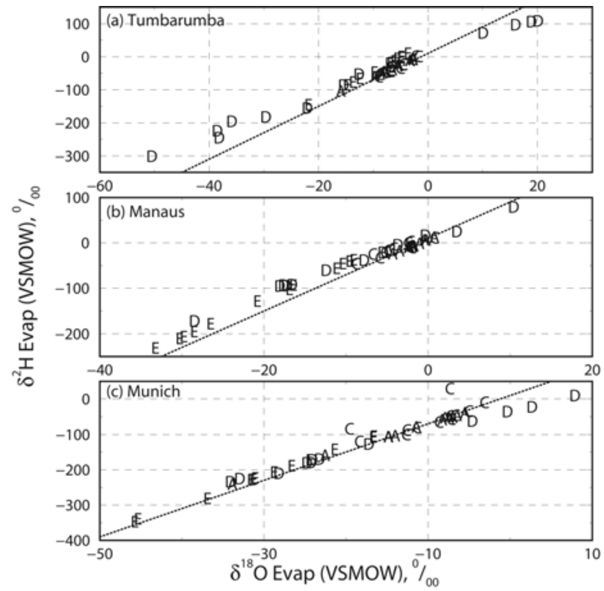
it has reached equilibrium with respect to the total (or bulk) energy and moisture.

The $\delta^{18}O$:δ^2H ratio in evapotranspiration compared to the Global Meteoric Water Line (GMWL) indicates the relative contribution from evaporation and transpiration to the total evapotranspiration. The figure on the right illustrates the monthly $\delta^{18}O$:δ^2H plots for evapotranspiration in the three sites. Linearity of scatter occurs if the monthly pattern of δ^2H is the same as $\delta^{18}O$, while departures from the GMWL show deuterium excess excursions. The $\delta^{18}O$:δ^2H ratio is different between different ILSSs. The expectation is that δ evaporation from soil will fall to the left of the GMWL, since the evaporation should be isotopically depleted, relative to the soil water and canopy-intercepted water. However, if the total evapotranspiration is made up of a relatively high proportion of transpiration, then the δ evaporation flux should fall closer to the GMWL, since at monthly timescales the expectation is that δ transpiration ≈δ root zone water.

Typically, moisture exchanges are complex and ILSS simulations respond to, for example, root zone isotope gradients driven by soil evaporation and plant transpiration. These effects are the basis for testing the iPILPS hypothesis. Our preliminary analysis shows the *d* evaporation values of ILSSs *D* and *E* appear to be more affected by soil and canopy evaporation than by transpiration. ILSSs *A* and *C* show a wide range of behaviours from place to place (see the figure on page 13). For example, for *C*, in Manaus, *d* evaporation is depleted relative to the GMWL while *A* is not. In comparison, *A* and *C* are both depleted in Tumbarumba, but not to the extent of E and *D*. These behaviors, likely functions of the size and residence times of the soil reservoirs which are the source of evaporation and transpiration, and the mixing and selection processes which affect these reservoirs, underpin the current iPILPS investigations.

In view of the importance of isotope modeling in understanding the variability of both contemporary and paleoclimate and the interpretation of isotope observations, understanding the isotope feedback between the land surface and the atmosphere is critical for perceptive interpretation over a wide range of timescales. **From the iPILPS experiments, thus far, three conclusions can be drawn:**

i) Isotopic equilibrium is independent of the total water and energy budget, that is, an ILSS that is in equilibrium with respect to bulk energy and water is not necessarily in isotopic equilibrium;



$\delta^{18}O$ v. δ^2H components of the 12 monthly water isotopes in evapotranspiration, shown for the final year of the equilibration simulation, EQY1, all in ‰ relative to VSMOW for (a) Tumbarumba, (b) Manaus, and (c) Munich. The GMWL line is the dashed diagonal.

ii) SWIs exhibit complex responses to the hydrological parameterizations of different land-surface schemes (given the same surface properties and forcing data for a particular location); and

iii) SWIs offer new tools for land-atmosphere parameterization evaluation. The isotope transfer characteristics allow investigation of parameterized relationships between moisture partitioning and land-surface scheme complexity.

iPILPS is open to all land-surface schemes owners and users. To participate contact ipilps@ansto.gov.au. All the current experiments and results are available at http://ipilps.ansto.gov.au. We anticipate that new simulations will be proposed around November which will probe the sensitivity of ILSSs to time constants of surface water reservoirs.

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HOW WELL DO WE COMPUTE THE INSOLATION AT TOA IN RADIATION CLIMATOLOGIES AND IN GCMS?

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Solar radiation is the prime source for all processes within our climate system. Its total amount, the total solar irradiance (TSI) reaching the top-of-atmosphere (TOA), and its variability are now quite accurately known on the basis of multiple satellite measurements and extremely careful calibration activities (Fröhlich and Lean, 2004). It amounts to about 1366.5 Wm^{-2} of which the Earth due to its spherical shape can consume about 341.5 Wm^{-2}. The areal distribution and temporal variability of this insolation is entirely determined by the well-known astromechanical laws, the Earth's shape and by the Sun's activities. Computations, therefore, should be relatively easy. Once a general agreement on the cut-off angle for sunrise and sunset is observed, models and climatological studies should produce the same results. *It is apparently a more difficult problem.*

In our attempts to assess the recently published time series of the radiation products computed within the International Satellite Cloud Climatology Project (ISCCP) and the Surface Radiation Budget (SRB), we compared monthly zonal averages of the solar irradiance at TOA. Here we considered eight latitudinal zones as given in the figure at the top of page 20, which were chosen to represent major climate zones on Earth. Differences between the values of ISCCP and SRB, as shown in this figure are relatively small in tropical and mid-latitudinal regions equatorward of 60°N and 60°S. Over the polar and sub-polar regions these differences reach values of more than 50 Wm^{-2}, which is already a large fraction of the total amounts over those areas. This discrepancy might be based on the fact that in ISCCP a minimum height for the sun above horizon of 0.0005 degrees has been allowed, while in the SRB this angle amounted to about 11.5 degrees (cos=0.2). They affect all other quantities in the solar radiation budget.

The solar forcing used in 20 models participating in the Atmospheric Model Intercomparison Project (AMIP-2) was compared with the same quantity computed for ISCCP. Models and climatology should agree at least in this quantity, however, the figure at the bottom of page 1 shows a large disagreement.

It can be speculated that such different meridional profiles of the solar radiative forcing at TOA should also have impact on the computed atmospheric circulation pattern, in particular when simulations over periods of several decades to several centuries are performed. Therefore, related projects within the World Climate Research Program should take appropriate steps to avoid systematic discrepancies as shown above and to estimate their possible impact on the resulting climate and circulation changes.

Reference

Fröhlich, C., and J. Lean, 2004. Solar radiative output and its variability: evidence and mechanisms. *Astron. Astrophys. Rev.*, 12, 273-320.

SOME GEWEX-RELATED SESSIONS AT THE 2005 AGU MEETING

The Fall American Geophysical Union Meeting will feature a number of sessions of interest to GEWEX scientists. These include:

A15: Climatological Crossroads: The Atmosphere of Southwest Asia. Contact: Jeff Reid (reidj@nrlmry.navy.mil).

A20: Observations of Interannual to Decadal Variability in Clouds and Radiation. Contact: Roger Davies (Roger.Davies@jpl.nasa.gov).

GC03: Integrated Environmental and Water Decision-Making in a Changing Climate. Contact: Shaleen Jain (Shaleen.Jain@noaa.gov).

H56: Precipitation Processes in Complex Terrain across a Broad Range of Climatic and Physiographic Regions. Contact: Ana Barros (barros@duke.edu).

H57: Role of Observed Precipitation in Atmospheric and Land Surface Models. Contact: John Roads (jroads@ucsd.edu).

GEWEX RELEVANT PUBLICATIONS OF INTEREST

Intersatellite Radiance Biases for the High-Resolution Infrared Radiation Sounders (HIRS) on board *NOAA-15, -16,* and *-17* from Simultaneous Nadir Observations

Reference: Changyong Cao, Hui Xu, Jerry Sullivan, Larry McMillin, Pubu Ciren and Yu-Tai Hou, 2005. *Journal of Atmospheric and Oceanic Technology*: Vol. 22, No. 4, pp. 381–395.

Summary/Abstract: Intersatellite radiance comparisons for the 19 infrared channels of the HIRS on board *NOAA-15*, *-16*, and *-17* are performed with simultaneous nadir observations at the orbital intersections of the satellites in the polar regions, where each pair of the HIRS views the same earth target within a few seconds. Analysis of such data sets from 2000 to 2003 reveals unambiguous intersatellite radiance differences as well as calibration anomalies.

The results show that in general, the intersatellite relative biases are less than 0.5 K for most HIRS channels. The method presented in this study works particularly well for channels sensing the stratosphere because of the relative spatial uniformity and stability of the stratosphere, for which the intercalibration accuracy and precision are mostly limited by the instrument noise. This method is simple and robust, and the results are highly repeatable and unambiguous. Intersatellite radiance calibration with this method is very useful for the on-orbit verification and monitoring of instrument performance, and is potentially useful for constructing long-term time series for climate studies.

Evaluation of Cirrus Cloud Properties Derived from MODIS Data Using Cloud Properties Derived from Ground-Based Observations Collected at the ARM SGP Site

Reference: Gerald G. Mace, Yuying Zhang, Steven Platnick, Michael D. King, Patrick Minnis and Ping Yang, 2005. *Journal of Applied Meteorology*: Vol. 44, No. 2, pp. 221–240.

Summary/Abstract: The Moderate Resolution Imaging Spectroradiometer (MODIS) on board the NASA *Terra* satellite has been collecting global data since March 2000 and the one on the *Aqua* satellite since June 2002. In this paper, cirrus cloud properties derived from ground-based remote sensing data are compared with similar cloud properties derived from MODIS data on *Terra*. To improve the space–time correlation between the satellite and ground-based observations, data from a wind profiler are used to define the cloud advective streamline along which the comparisons are made. In this paper, approximately two dozen cases of cirrus clouds are examined and a statistical approach to the comparison that relaxes the requirement that clouds occur over the ground-based instruments during the overpass instant is explored. The statistical comparison includes 168 cloudy MODIS overpasses of the Southern Great Plains region and approximately 300 h of ground-based cirrus observations. The physical and radiative properties of cloud layers are derived from MODIS data separately by the MODIS Atmospheres Team and the Clouds and the Earth's Radiant Energy System Science Team using multiwavelength reflected solar and emitted thermal radiation measurements. Using two ground-based cloud property retrieval algorithms and the two MODIS algorithms, a positive correlation in the effective particle size, the optical thickness, the ice water path, and the cloud-top pressure between the various methods is shown, although sometimes there are significant biases. Classifying the clouds by optical thickness, it is demonstrated that the regionally averaged cloud properties derived from MODIS are similar to those diagnosed from the ground.

The Geostationary Earth Radiation Budget (GERB) Project

Reference: J. E. Harries, J. E. Russell, J. A. Hanafin, H. Brindley, J. Futyan, et al., 2005. *Bulletin of the American Meteorological Society*: Vol. 86, No. 7, pp. 945–960.

Summary/Abstract: This paper reports on a new satellite sensor, the GERB experiment which is designed to make the first measurements of the Earth's radiation budget from geostationary orbit. Measurements at high absolute accuracy of the reflected sunlight from the Earth, and the thermal radiation emitted by the Earth are made every 15 minutes, with a spatial resolution at the subsatellite point of 44.6 km (north–south) by 39.3 km (east–west). With knowledge of the incoming solar constant, this gives the primary forcing and response components of the top-of-atmosphere radiation. An evaluation of the instrument performance after its first year in orbit, including comparisons with data from the Clouds and the Earth's Radiant Energy System satellite sensors and with output from numerical models, are also presented.

3RD PAN-GCSS MEETING ON CLOUDS, MODELS AND CLIMATE

16-20 May 2005
Athens, Greece

Christian Jakob

Bureau of Meteorology Research Centre, Melbourne, Australia

Over 150 scientists, including all GEWEX Cloud System Study (GCSS) Working Groups convened at the 3rd Pan-GCSS Meeting to discuss the role of clouds in the climate system and their representation in models. The meeting comprised four mornings of plenary sessions, four afternoons of GCSS working group meetings, two poster sessions presenting 120 posters altogether, a plenary discussion session at the end of the meeting, as well as a meeting of the GCSS Science Steering Group (SSG). The new format for the Pan-GCSS meetings proved very successful in bringing together not only scientists already involved in GCSS but also attracting interest from other research groups and most importantly involving a large number of graduate students and postgraduates.

The plenary sessions were organized around themes that GCSS considers most relevant to its current activities. The first of those sessions was dedicated to reviewing the role of clouds in the climate system and featured presentations ranging from a general description of that role, to the importance of clouds and convection in tropical circulation systems, cloud-aerosol interactions and their potential role for climate, contrails and climate, as well as new space-borne observing systems for clouds, such as the upcoming CloudSat mission. It was evident from this rather general session that the work carried out in GCSS has a broad impact – from furthering our understanding of clouds, to improving their representation in models, to supporting observational programs.

The second plenary session was dedicated to discussing methods and more importantly metrics that the community could apply to measure both success and progress in the representation of clouds in models, in particular those used for climate simulations. It was pointed out that while the Numerical Weather Prediction community has a well-defined system of metrics to measure success in their application of models, such a system does not strictly exist for climate models. During the session and in the following discussion GCSS decided to take a leading role in helping the establishment of such a system of metrics by contributing both methods and measures relevant to clouds. To further this aim a new portfolio for model evaluation has been added to the GCSS SSG.

The third plenary session discussed the fundamental role of precipitation in cloud systems. The session aimed at highlighting the obvious link between the energy and water cycle that clouds provide – a theme central to the goals of GEWEX. The importance of the small-scale dynamics and microphysics in influencing large-scale circulation systems was highlighted by an impressive series of talks ranging from discussions of cloud particle nucleation to the global distribution of convective systems.

The final session reviewed progress in the representation of clouds in large-scale models in talks describing recent advances in parameterization development, the use of cloud-resolving models that are embedded in global models in the superparameterization technique to very high-resolution (a few kilometers) simulations for the globe. The session highlighted the enormous progress that has been made in representing clouds in models while at the same time critically assessing the level of effort afforded to this problem by the wider community. The meeting stressed the necessity for an increased level of funding and recognition of the importance and difficulties involved in the development of cloud representations in large-scale models.

The afternoons of the meeting were dedicated to working group meetings. All GCSS working groups had the opportunity to discuss their current and future activities. It was evident from the lively discussions in these meetings that GCSS is a major contributor to cloud system research across all cloud types encountered globally. Like the meeting as a whole, the working groups brought together scientists from a large variety of communities much in the spirit of addressing complex problems through the combination of tools and skills of the observational, cloud modeling and large-scale modeling community that form the backbone of GCSS. In addition to the existing working groups two new efforts were discussed. The GCSS Pacific Cross-Section Intercomparison (GPCI, see article in the February 2005 issue of *GEWEX News*) was embraced by a large number of modeling groups and was given Working Group status by the GCSS SSG. In addition a lively discussion took place to decide how GCSS can more directly contribute to studies of cloud microphysical processes in general and cloud-aerosol interactions in particular. Given its current focus on cloud systems as a whole GCSS is naturally studying cloud microphysics, but it was felt that a special effort focusing on these issues might prove advantageous. While no firm conclusion was drawn at the meeting it was decided to add a microphysics portfolio to the GCSS SSG in order to establish closer links to existing efforts outside GCSS in this important area of research.

A session of the GCSS SSG was held on the last day. The SSG rated the meeting as a major success, and having been able to participate in the activities of all working groups, expressed its satisfaction with the growing level of activities in GCSS and the increasing role the project is playing in the wider community. Discussions mostly ranged around issues that were brought up throughout the week, and as mentioned above, decisions on increasing the level of effort on model evaluation and microphysics within GCSS were confirmed. Furthermore, a collaboration of the GCSS Working Group on deep convection with the Stratospheric Processes And their Role in Climate (SPARC) Project to study the influence of deep convection on troposphere-stratosphere exchange processes was approved. Given the overwhelming success of the meeting the GCSS SSG proposed to hold the 4th Pan-GCSS meeting in 2007.

The success of any meeting is obviously due to all of its participants. However, as the Chair of GCSS I would like to take this opportunity to express some special thanks to the local organizer of the meeting, Dr. George Tselioudis, National Aeronautics and Space Administration (NASA) Goddard Institute for Space Studies, as well as to the sponsors of the meeting – NASA, the National Oceanic and Atmospheric Administration, the US Department of Energy’s Atmospheric Radiation Measurement Program, the US National Science Foundation, the Academy of Athens and the World Climate Research Programme. Without their commitment and support the meeting would not have been possible. Finally, I would like to extend an invitation to the readers of this article to participate in any of the GCSS activities and to attend the 2007 Pan-GCSS meeting.

1ST PAN-WCRP WORKSHOP ON MONSOON CLIMATE SYSTEMS

15-17 June 2005
Irvine, California, USA

Tetsuzo Yasunari[1] and Kenneth R. Sperber[2]

[1]FRCGC/JAMSTEC and HyARC/Nagoya University, Japan, [2]Lawrence Livermore National Laboratory/PCMDI, USA

The 1st Pan-WCRP Workshop on Monsoon Climate systems was hosted by the University of California, Irvine and sponsored by the World Climate Research Programme (WCRP). More than 50 invited scientists from various monsoon-related projects participated. The Workshop was held to promote closer collaboration of monsoon research between GEWEX and the CLImate VARiability and predictability (CLIVAR) Project by assessing and integrating their current understanding of the fundamental physical processes governing monsoon variability. The overall goal of the Workshop was to improve monsoon predictions using global and regional models.

GEWEX promotes regional monsoon studies as a part of the Continental-Scale Experiments (e.g., the GEWEX Asian Monsoon Experiment in Asia, the GEWEX Americas Prediction Program in North America, and the Large-scale Biosphere Atmosphere Experiment in Amazonia in South America) by focusing on land-atmosphere interactions and their variability on diurnal to intraseasonal time scales. CLIVAR's primary focus is on intraseasonal, seasonal, interannual, and decadal variability of the monsoons through the study of atmosphere-ocean, and in collaboration with GEWEX, atmosphere-land interactions. Coordination of monsoon related research activities between these two projects will facilitate a better understanding and prediction of the monsoon systems.

In the first session of the Workshop, overviews of key modeling and observational issues relevant to various GEWEX and CLIVAR related projects were reported. In the second session various issues on fundamental physics and dynamics of monsoons [e.g., air-sea interaction, land-atmosphere interaction, surface flux/Planetary Boundary Layer (PBL) interaction, low level jets, role of orography, and cloud/precipitation processes] on multi-time scales (i.e., diurnal cycle, intraseasonal variability, and seasonal cycle) were comprehensively reviewed. The third session was devoted to break-out and plenary discussions on the key issues in modeling and prediction of monsoons, including: 1) a strategy for parameterization development and observational data requirement for process studies; 2) a strategy for system modeling and observational data for large-scale model validation; and 3) the development of a monsoon prediction and monitoring network.

Recommendations from the Workshop include the following priorities for GEWEX/CLIVAR research to improve monsoon modeling and prediction.

- Correct simulation of diurnal cycles of precipitation and convection.
- Comprehensive modeling of surface, PBL and convection.
- Understanding of intraseasonal oscillation.
- Impact of atmospheric moisture distribution and transport.
- Futher focus on process studies and modeling studies of the maritime continent and the Indian Ocean.
- Sensitivity testing to determine the resolution necessary in global models to simulate the multi-scale interactions that dominate the Earth's monsoon systems.

Initial implementation of these collaborative tasks within WCRP will occur through a series of targeted workshops that will try to meet in conjunction with (or be components of) planned meetings. In the near-term (~1 year) the emphasis will be on improving the diurnal cycle of precipitation in global models. Over both land and ocean global models typically exhibit large phase errors compared to observational estimates. Given that regional and cloud-resolving models perform much better in this respect, we envision that a better understanding of the factors involved (e.g., physics and model resolution) in realistically simulating the diurnal cycle in these models can be translated to an improved representation in global models. This will promote closer interaction in monsoon-related modeling activities under CLIVAR and GEWEX as part of a new Pan-WCRP initiative of monsoon research within the Coordinated Observation and Prediction of the Earth System (COPES) activity.

GEWEX/WCRP MEETINGS CALENDAR

For a complete listing of meetings, see the GEWEX web site (http://www.gewex.org)

19–23 September 2005—LOCO/GABLS WORKSHOP and 6TH GLASS PANEL MEETING, De Bilt, The Netherlands.

26–30 September 2005—11TH MEETING OF THE GEWEX HYDROMETEOROLOGY PANEL, Melbourne, Australia.

3–6 October 2005—16TH SESSION OF THE GEWEX RADIATION PANEL, Paris, France.

3–5 October 2005—9TH SESSION OF WGCM AND JOINT WGCM-WMP MEETING AND 1ST SESSION OF THE WCRP MODELING PANEL, Exeter, UK.

11–13 October 2005—IPWG/GPM/GRP WORKSHOP ON GLOBAL MICROWAVE MODELING AND RETRIEVAL OF SNOWFALL, Madison, Wisconsin, USA.

7–11 November 2005—9TH SESSION OF THE GMPP/21ST SESSION OF THE CAS/JSC WGNE, St. Petersburg, Russia.

14–17 November 2005—3RD GRP WGDMA MEETING, Darmstadt, Germany.

15–18 November 2005—INTERNATIONAL WORKSHOP ON LAND SURFACE MODELS AND THEIR APPLICATIONS, Zhuhai, Guangdong Province, China.

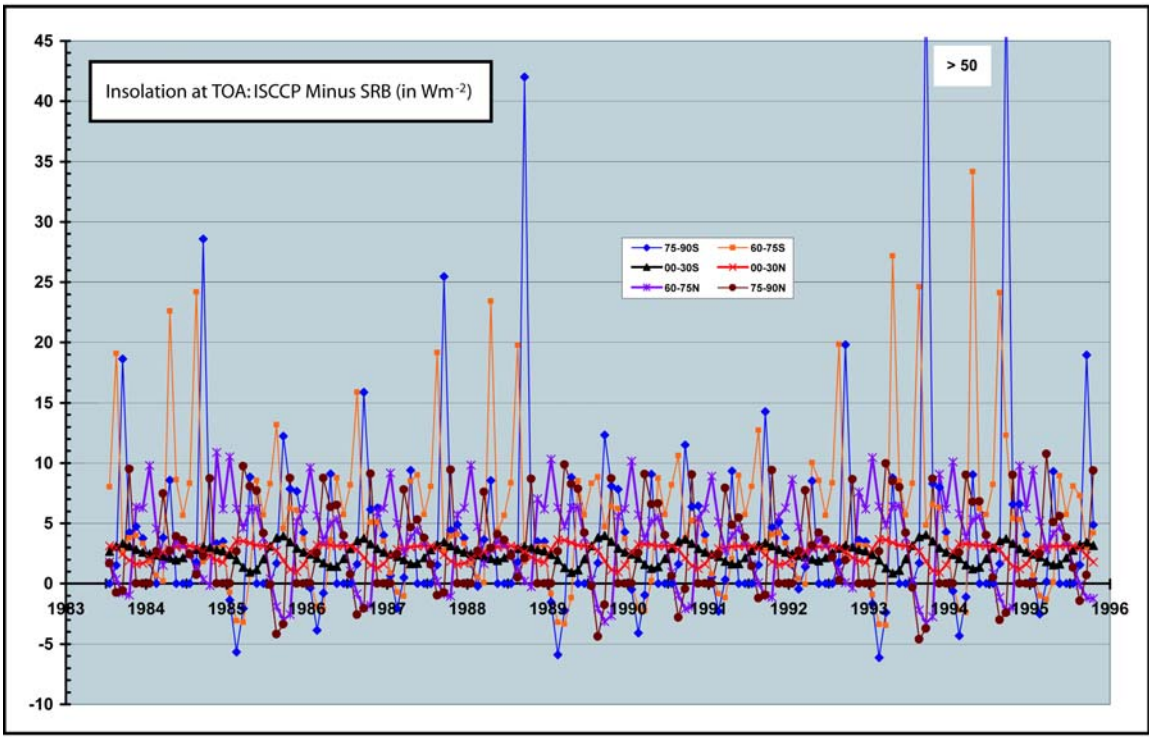
28 November – 2 December 2005—FIRST INTERNATIONAL AMMA CONFERENCE ON THE WEST AFRICAN MONSOON, Dakar, Senegal.

9–13 January 2006—GEWEX SSG-18, Dakar, Senegal.

GSWP-2 MULTI-MODEL ANALYSIS – VERSION 1.0 DVDs AVAILABLE

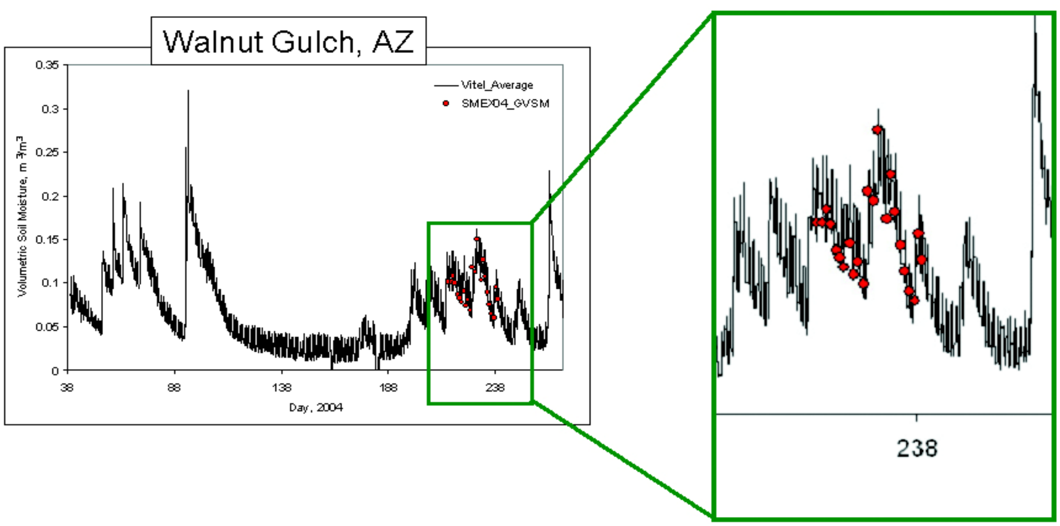
The Second Global Soil Wetness Project (GSWP-2) compares and evaluates 10-year simulations produced by a broad range of land surface models under controlled conditions. A major product of GSWP-2 is a 1-degree global gridded multi-model analysis of land surface state variables and fluxes for the period of 1986-1995. The analysis includes the input of 13 land models from five nations. The models are driven by forcing data derived from a combination of gridded atmospheric reanalyses and observations. The resulting analysis includes multi-model means and standard deviations on the monthly time scale, as well as daily profiles of soil moisture and temperature at six levels. To receive the GSWP-2 DVD, send an e-mail to gewex@gewex.org. For more information about GSWP-2, see http://grads.iges.org/gswp/.

DIFFERENCES BETWEEN ISCCP AND SRB TOP-OF-ATMOSPHERE SOLAR RADIATION SHOW LATITUDINAL DEPENDENCIES



Differences between mean monthly incoming solar radiation over the polar regions and over the tropical belts as computed in the ISCCP and SRB data sets. *See article on page 15.*

AUTOMATED *IN SITU* SOIL MOISTURE MEASUREMENTS AGREE WELL WITH GRAVIMETRIC MEASUREMENTS AND PROVIDE GREATER TIME RESOLUTION



Comparison of automated in situ sensor (solid-line time-series) and gravimetric measurements (red symbols). The example demonstrates that reliable and no-man-in-the-loop sensors can be implemented in the field. Long time-series measurements from such sensors can be used to characterize the temporal variability and dynamic behavior of surface and profile soil moisture. *See article on page 8.*

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