

WORLD CLIMATE RESEARCH PROGRAMME

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GEWEX

ANNUAL PROGRESS REPORT

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DELIVERED-ADDED VALUE OF ACTIVITY / PROJECT

For more than 15 years, GEWEX has been contributing to the scientific foundation to predict the response of climate to external forcing. As IPCC reports indicate, the most uncertain component of global climate models lies in their treatment of atmospheric hydrology, particularly clouds, precipitation, surface hydrology and land surface-atmosphere interactions. GEWEX, a critical and mature component of the WCRP, provides unique expertise that contributes to characterizing, understanding and modeling these components of the climate system. It combines observations and modeling studies to provide an integrated approach to understanding atmospheric properties and surface-atmosphere interactions.

GEWEX is making progress through its coordinated research strategy by building upon improved long-term global data sets and high-resolution time series of energy and water properties; model parameterization evaluation and development studies constrained by the data sets; and support for global and regional model development activities through process studies across a wide range of spatial and temporal scales.

GEWEX has added value through its research results and its coordination and incubator functions, as well as its outreach. As such, many new research results and programs have developed that would not exist without the involvement GEWEX. The unique contributions of GEWEX rest upon:

- 1) Development and improvement of long-term global data sets and high-resolution time series of energy and water properties. GEWEX has developed homogeneous long-term data sets from satellite data for energy and water cycle variables including global top-of-atmosphere radiation, surface radiation, cloud and precipitation datasets used by nearly every reputable climate modeling group to evaluate their models. As noted earlier, GEWEX has contributed to sensor conceptualizations and designs that have resulted in to new space-borne instruments. The success of GEWEX can be seen by comparing the Earth Observation Systems requirements defined at the inception of GEWEX and the more recent list prepared by GCOS. With the exception of solid/high latitude precipitation, all of these requirements have been met and have lead to new insights and new requirements.

- 2) Parameterization evaluation and development constrained by the data sets. GEWEX has developed tools that bring its data sets and field campaign results to model developers and include the Continuous Intercomparison of Radiation Codes (CIRC) organization and website, which assists in the evaluation of radiation codes, and the ISCCP simulator (GCSS-DIME), which allows direct comparison of model results with observations using joint probability distributions of cloud vertical location and optical properties.

- 3) Modeling across a wide range of spatial and temporal scales. GEWEX has brought the hydrologic and atmospheric science communities together to collaboratively develop fully coupled land-atmosphere models that are now considered to be the benchmark for updated climate models.

END USERS OF ACTIVITY / PROJECT OUTCOMES

GEWEX interfaces with a large number and variety of users; its results are being utilized in activities ranging from fundamental research to applications and from development to operations. GEWEX Modeling and Prediction Panel (GMPP) is the main body within WCRP that deals with the evaluation and development of parameterizations. As such, it serves both the climate and the weather prediction modeling communities in ways that will be enhanced by the stronger connections being developed between GMPP and WGNE. Furthermore, model skill is being evaluated with **Coordinated Energy and Water Cycle Observations Project (CEOP)** data at individual NWP centers and the process of model development—particularly at smaller NWP centers—has been accelerated. With the establishment of Hydrologic Applications Project (HAP) and the Extremes working group within CEOP, an interface is established between GEWEX and the users of (regional) hydrological applications that can feed into resource management applications. GEWEX through CEOP also interfaces with other programs such as GWSP, UNESCO-IHP and WWAP. GEWEX Radiation Panel (GRP) provides the foundation for the GCOS/GEO climate data collections through the support of Baseline Surface Radiation Network (BSRN). Furthermore, GRP projects have pioneered the development of multi-satellite analysis capabilities as well as formulated the rationale for and developed the approaches to systematic and coordinated data product reprocessing.

MAJOR ACTIVITIES AND ACHIEVEMENTS IN 2007

The merger of the Coordinated Enhanced Observation Period ('*CEOP*') with the GEWEX Hydrometeorology Panel (GHP) into the Coordinated Energy and water cycle Observations Project (CEOP) took place in 2007. A new Strategic Implementation Plan has been developed that provides a solid outlook and practical strategy for the future, further streamlining Regional Hydroclimatology Projects (RHPs) and making them more efficient and coherent through the support and use of the observational systems that have been developed during '*CEOP*'. Within CEOP, the Hydrologic Applications Project has started to develop stronger ties with GWSP, UNESCO-IHP, GMPP and CLIVAR, and is now establishing test-beds jointly with GWSP and CEOP. The Hydrological Ensembles Prediction Experiment (HEPEX) liaised with HAP and organised its 3rd Workshop in Italy, where much progress was shown, in particular through the contributions from ECMWF and the European Flood Alert System by the JRC. The Extremes working group (formerly WISE) is now focusing on further understanding processes over land that lead to drought, heavy precipitation and floods in different global regions and as such will directly contribute to the WCRP Extremes Cross Cut. Through its initial Canadian project on drought, it is developing plans for studies of drought and other extremes on an international basis. CEOP as a whole has strongly contributed to the development of the Asian Monsoon Year (AMY) as part of the International Monsoon Studies (IMS) as well as linking the ESSP MAIRS project and CLIVAR (through MAHASRI). CEOP, in collaboration with GRP and GMPP, continues to lead the Monsoons Crosscut on behalf of GEWEX.

Many of the plans for IMS, AMY and CEOP were solidified during a September workshop in Bali, Indonesia. The RHPs continue to provide regional comprehensive, essential and extensive data sets and are proving invaluable in both regional and global modeling and analysis. The addition in 2007 of NEESPI as a new RHP has provided a significant opportunity to develop valuable high latitude data sets for the Northern Hemisphere.

Through the GEWEX Radiation Panel (GRP), GEWEX has supported the continued development and maintenance of surface-based long-term networks such as BSRN, for which the data archive will be re-established at the Alfred Wegener Institute in Potsdam,

Germany. GRP has also supported the development of global-satellite products such as those from the Global Precipitation Climatology Project; these are key in identifying natural variability and trends; validating satellite observations and developing retrieval algorithms, developing parameterization schemes to more accurately represent the atmospheric behaviour, and evaluating the fidelity of model simulations of the hydrological and energy cycles. GRP has completed an assessment of its long-term products and has concluded that a major reanalysis is merited, given the unique ability of these data sets to provide the first long-term look at climate trends on a truly global basis for a number of climate variables. At a Workshop in Toulouse, France, GRP initiated its LANDFLUX activity, aimed at determining the turbulent sensible and latent heat fluxes over land (and snow-ice) surfaces.

The GEWEX Modeling and Prediction Panel (GMPP) has established itself as the prime model parameterization development and evaluation body in WCRP. The GMPP strategy consists of identifying important regimes in the climate system; evaluating model performance generally and using long-term data sets and field campaign data sets in critical regimes; developing new parameterization approaches through process studies targeting regimes that are not well represented in current models; and supporting the implementation of newly developed parameterizations in climate and NWP models. Among recent examples of GMPP contributions to climate modeling is the GLACE project—which revolutionized land-feedback studies by elucidating areas of strong land-atmosphere coupling—and GCSS, which contributed in a major way to the first climate models using a cloud-resolving model approach to parameterization. GEWEX, led by GMPP, has worked with IGAC and iLEAPS to establish a new initiative known as Aerosols, Clouds, Precipitation & Climate (ACPC). A stronger link has been established with iLEAPS and the Global Land/Atmosphere System Study (GLASS) through the LUCID project, which looks at the effects of land cover change on climate change.

GOALS AND PLANS FOR MAJOR ACTIVITIES IN 2008 INTO 2009

Climate change and the anthropogenic influences that contribute to it are likely to remain high on the international political agenda. The looming environmental crises, in particular regarding our water and energy resources, is an area where GEWEX can provide essential insight in fundamental processes and help in providing the necessary data and models for improved risk assessment and mitigation predictions.

CEOP with HAP will initiate studies to demonstrate the added value of Earth observational data, along with process studies and model development in poorly or ungauged basins. CEOP will develop an inventory of floods and droughts as well as the role of land-atmosphere interactions in causing these events. Within GMPP the intercomparison of water cycle feed-back processes in Single Column Models involving the atmosphere only will become a point of focus. CEOP will organize a workshop on Extremes that, along with the Extremes workshop organised by CLIVAR, will help set up a small scoping group and focus on the direction and development of the WCRP Extremes crosscut. As part of the Monsoons crosscut, the contributions from GEWEX, particularly outside of the Asian region, need to be strengthened with respect to the IMS, the AMY initiative and links to the YOTC.

Further assessment of the global data products and the observations and diagnosis of causes of global energy and water cycle variations from daily to decadal scales is needed. This can be extended to include turbulent fluxes over land surfaces.

INTERACTIONS (ESPECIALLY WITH WCRP'S SPONSORS & PARTNERS)

GEWEX uniquely extends WCRP interactions to a large network of satellite programs and the hydrology community. In addition to its strong links with CLIVAR, WGNE, WOAP, CliC and SPARC, GEWEX makes distinct and meaningful contributions to each of the WCRP cross-cuts. GEWEX also has many links with IGBP within the larger ESSP community, mainly through iLEAPS and more recently through IGAC, and through HAP has

maturing interactions with GWSP and other ESSP cross-cuts. In addition, GEWEX has programmatic links to the UNESCO International Hydrology Programme (IHP), the International Association of Hydrological Sciences (IAHS) and GCOS.

GEWEX represents WCRP on the Executive of the Integrated Global Water Cycle Observations (formerly a theme under IGOS-P) and serves on several GEO committees. GEWEX scientists also lead several GEO tasks. Through the extensive collaboration CEOP has with CEOS, GEWEX and WCRP have had better opportunities to influence and benefit from the Earth Observation community. In addition, GEWEX has established links at the national level with many funding agencies, programs, data services, research groups and environmental organizations. For example, the RHPs have connections with both national and international funding agencies (e.g., Global Environmental Facility) and programs. The money invested by WCRP to foster these activities through travel support to meetings has been multiplied a hundred times over in regional studies that support WCRP objectives and WCRP links into dozens of countries where it might otherwise be absent.

With support from WCRP, GEWEX contributes in a variety of ways to the actions, priorities and policies of international and national programs. In the observations field, the value of GEWEX to WCRP is seen through the utility of the data sets and the quality of advice that GEWEX provides through its research. GEWEX has played a major role in bringing climate and water issues and the needs of climate research to a number of space agencies and national environmental programs. CEOP has stimulated a strong financial commitment to water cycle research in Japan and has been the primary motivator for the emerging Asian Water Cycle Initiative. In the U.S., NASA has launched the multimillion dollar, multi-year NASA Energy and Water Cycle Study (NEWS) research program. The NEWS Implementation Plan drew heavily from the plans and research activities of GEWEX in defining its goals and its roadmap.

GEWEX has supported the policy of a free and open exchange of data, promoted by WMO and GEO. Through CEOP, GEWEX has demonstrated to stations in its reference site network a strategy for achieving this goal by developing standards, procedures and policies for data formatting, collection, processing, archiving, release, and dissemination. CEOP data providers—even those from countries with restrictive data policies—are freely exchanging data on a routine basis.

In addition to the examples of responsiveness outlined above, GEWEX has been responsive to the research agenda of the U.S. Climate Change Science Program (CCSP) and has collaborated with its water cycle program. GEWEX was the principal architect and advocate of the water cycle science component of CCSP when it was initiated. Through CEOP and GAME/MAHASRI, GEWEX has been an important contributor to the ascendancy of the water cycle as a priority in the Japanese Government's science priorities. Based on recommendations from WCRP and others, the European Community has made more funding available for the support of water cycle research and has funded GEWEX-linked projects such as WATCH. GEWEX Extremes research on drought in Canada is now contributing to a Canadian drought response strategy.

CHALLENGES AND CONSTRAINTS

GEWEX remains committed to the goals and objectives of WCRP. It brings more than 1500 scientists from over 50 countries to address critical aspects of climate prediction issues. Since these scientists are volunteers, good will, trust and commitment are essential attributes that must be present to advance the GEWEX research agenda. GEWEX believes it is essential to provide its scientists with a science framework and a stable programmatic platform as they seek funding and collaborators for their research. GEWEX has recently consulted with its community and developed a roadmap for the 2007 to 2012 period that clarifies the roles and expectations from each GEWEX panel and project.

PUBLICATIONS AND OTHER PRODUCTS

WCRP can assist GEWEX in a timely way in the areas of communications and commitment. WCRP has provided new ways for GEWEX to become more visible through its EZine Newsletter, the Annual WCRP Report and the promotion of GEWEX activities on its web site. WCRP can continue to help by articulating the overarching strategic plan for achieving climate research goals to funding agencies and the public, and also by providing a united voice to the international organizations. However, this will require better internal communications.

The IGPO publishes quarterly its GEWEX Newsletter and also the IGPO document series used for community reports. Representation of GEWEX at numerous national and international conferences, meetings and workshops has resulted in various publications, including proceedings, peer reviewed literature and more. GEWEX also contributed articles to the GEO "Full Picture" and other documentation. In addition, GEWEX activities related to drought were featured in the WCRP report to GEO. This year the IGPO prepared a special issue of the AMS Journal of Hydrometeorology, published in August 2007, composed of papers from the 5th International Scientific Conference on the Global Energy and Water Cycle in June 2005.

The organization of Workshops such as the Mountain Hydrometeorology workshop co-organized with NOAA and NASA in October 2007 or the planned GEWEX-iLEAPS international Science Conference has lead to publication of flyers and other informational products.

OUTREACH AND CAPACITY BUILDING ACTIVITIES

GEWEX provides value through its outreach activities developed in many areas because of WCRP coordination. WCRP has fostered a number of GEWEX links with the space community by asking the Committee on Earth Observation Satellites (CEOS) to support CEOP and by asking GEWEX to take the lead in developing the IGOS Global Water Cycle Observations (IGWCO) theme and nominate GEWEX members to GEO working groups and tasks. GEWEX has benefited from these linkages and used these opportunities to advance WCRP science in forums such as the World Water Forum and side meetings of the Commission for Sustainable Development.

There is a major thrust by many international bodies both inside and outside the United Nations to support capacity building. GEWEX scientists have been contributing to the development of GEO and IGWCO Capacity Building activities in Asia and Latin America; both programs will serve WCRP interests. Many of the GEWEX RHPs (e.g., CPPA, LBA, BALTEX, LPB, AMMA, MAHASRI, NEESPI) include scientists from underdeveloped countries. This regional focus has been useful for giving these projects new scientific opportunities. Some regional projects (such as BALTEX) have held training programs to enable young scientists to better use GEWEX data sets and services. Furthermore, the European Union recently provided funding to a number of African nations and organizations to enable them to play a larger role in AMMA and strengthen their hydrometeorological services to provide more useful information to national agencies.

IPO, PROGRAM ADMINISTRATION AND MANAGEMENT

The IGPO is funded primarily by the U.S. as part of its commitment to WCRP. In particular, the National Aeronautics and Space Administration (NASA) funds the IGPO through a grant to the University of Maryland, Baltimore County GEST Center. During 2007 the GEST Center employed IGPO Director Rick Lawford and Senior Scientist Dr. Robert Schiffer, and subcontracted with the Science and Technology Corporation (STC) for its support staff (Dr. Paul Try, Dawn Erlich, and Cathryn Kulat). The National Oceanic and Atmospheric Administration (NOAA) supported some domestic travel for the IGPO Director through a small grant to the University Corporation for Atmospheric Research (UCAR).

In addition, ESA pays the salary and travel for the European GEWEX Coordinator, Dr. Peter van Oevelen, while CMA pays the salary of the Chinese coordinator, Dr. Yuping Yan.

Dr. Vladimir Ryabinin of the WCRP Joint Planning Staff and Sam Benedict, international coordinator for the Coordinated Enhanced Observing Period (CEOP), continue to provide support on different aspects of GEWEX.

In January 2008, Dr. Peter van Oevelen became the new Director of IGPO. Negotiations are now underway to gain ESA support for continuing the European GEWEX Coordinator position

ADDITIONAL COMMENTS FOR THE JSC

In view of the data needs of the new WCRP cross-cuts, GEWEX recommends that WCRP take the lead in defining the observing system requirements and support re-processing and analysis activities by tasking an appropriate group (e.g., WOAP) to provide for their coordination across the core projects and the cross-cuts.

It is recommended that the JSC reaffirm the WCRP commitment to support the development of GEOSS and encourage its projects and personnel to play a more active role in this process.

It is recommended that the JSC establish a task force to explore the implications of the potential water and energy crises in terms of the needs and opportunities for climate research and data.

It is recommended that JSC clarify the role of the core projects within the management of the cross cuts.

It is recommended that JSC request the new JPS Director to seek support for a new professional member who can oversee GEWEX and develop its related connections with WMO and GEO.

It is recommended that the D/WCRP write a letter to the European Space Agency in support of continuing the European GEWEX Coordinator.

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