Societal Benefits of GEWEX And Related Water Cycle Research

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GEWEX: TURNING OBSERVATIONS INTO SCIENTIFIC KNOWLEDGE
1) TO SUPPORT IMPROVED DECISION MAKING,
2) TO REDUCE UNCERTAINTY, AND
3) TO FACILITATE PLANNING AND TO ADVISE POLICY
SOME USES OF GEWEX DATA AND OBSERVATIONS

GEWEX CONTRIBUTED TO THE GLOBAL CLIMATE OBSERVING SYSTEM (GCOS) BY DEVELOPING THE BASELINE SURFACE RADIATION NETWORK WHICH NOW SERVES AS A GCOS BENCHMARK DATA SYSTEM.

A 10-YEAR DATA SET OF SATELLITE DERIVED LAND SURFACE DATA WAS COMPLETED AND DISTRIBUTED. THESE DATA SETS WERE USED IN RESEARCH AND IN MANY UNIVERSITIES AND SCHOOLS FOR EDUCATIONAL PURPOSES.

AMATEUR ASTRONOMERS FROM CANADA WISHED TO IDENTIFY THE BEST PLACE FOR A LARGE TOUR GROUP TO OBSERVE THE 2008 ECLIPSE. THEY TURNED TO THE ONLY CLOUD CLIMATOLOGY PRODUCT THEY HAD CONFIDENCE IN - THE ISCCP MONTHLY AVERAGES TO SELECT THE AREA.
GEWEX has overseen the development of many merged Data Sets:

These include 30-year global data sets such as the Global Precipitation Climatology Project maps:

and higher resolution products such as PERSIANN which are more regional in scope.

These data sets are being used in climate studies, to drive water resource models and to support studies of regional and global water budgets.
CEOP data systems are facilitating the development and use of the First Global Integrated Data Sets of the Water Cycle and serving as a prototype for GEO data systems.
GEWEX/GLASS has developed a range of Land Data Assimilation Systems (LDAS) which has a growing clientele.

**GOAL:** Produce optimal output fields of land surface states and fluxes.

**APPROACH:** Parameterize, force, and constrain multiple, sophisticated land surface models with data from advanced ground and space-based observing systems.

**FORCING DATA**
- Precipitation
- Temperature
- Radiation
- Other variables

**PARAMETERS**
- Vegetation Types
- Soil Classes
- Elevation
- Other data

**Output**
- Soil Moisture
- Evapotranspiration
- Energy fluxes
- River runoff
- Snowpack characteristics

Courtesy Paul Houser, formerly NASA
GEWEX field studies have led to a number of prediction capabilities and reanalysis products:

GCIP/GAPP process studies led to improved predictions of surface temperatures through the improvement of the NOAH land surface model.

GCSS cloud data sets through field campaigns have been used in a sophisticated data system to support model development.
GEWEX RHPs and HAP have developed models for water resource applications

Through GEWEX studies hydrologic models that utilize the extensive distributed information available through remote sensing have been developed. These models require less calibration than most lumped models.

These models have been easier to interface with atmospheric models and have become central to land data assimilation activities.
GEWEX/ GRP and GCSS played major roles in advancing the Cloudsat mission (from GRP presentations).

CloudSat and the A-Train Stephens et al., 2002; Bulletin of American Meteorology Society, 2002

ISCCP simulator has been very successful making link between models and observations

CloudSat data (top) and radar simulator data (mid and bottom)
Insights on the value of water cycle observations (Based on a report by from a manager in a major North American Hydropower company)

In January 2008, when this Hydropower company had to make its Spring projection for power generation it found that 9 remote climate stations in the Williston reservoir basin had failed in mid-November.

They used climate estimates to predict the snow accumulation rather than send a technician out to fix the stations. In February they did send out a technician and found that the stations were reporting much less snow on the ground than they had anticipated.

Result: there was a 6% drop in the Williston reservoir forecast production amounting to 860 GWh worth $50 million.

The cost of a trip to check the stations: < $10,000.

Benefit to Cost ratio: $50,000,000/ $10,000 = 5000 to 1

(Courtesy of S. Smith)
Practical Demonstration Projects

New experimental LDAS products are being used in conjunction with Decision Support Tools to put new guidance material on the web to assist BoR water resource managers with their water allocation and water storage decisions.
GEWEX research has expanded our understanding of the role of soil moisture in forcing the atmosphere.

The GLACE project showed that while the 12 participating models differ in their land-atmosphere coupling strengths, certain features of the coupling patterns are common to many of the models. These features are brought out by averaging over all of the model results.

GEWEX Discovery science tracks the latest climate anomalies
(after P. Groisman)

**Sept. 2007**

More moisture is being released from the Arctic Ocean to the atmosphere in the early winter causing more snow over Siberia.

Dramatic warming in Siberia => projected land cover change (cf., Vygodskaya et al. 2007)

![Map showing number of days with deep snow cover on the ground (>20 cm) and linear trends for the 1951-2006 period.](map.png)

**Impact of permafrost degradation on surface hydrology and vegetation**

![Image of thawing of ice-rich permafrost, triggered by the forest fire in Central Yakutia, transforming boreal forest into steppe-like habitats.](thawing.png)

*Thawing of ice-rich permafrost, triggered by the forest fire in Central Yakutia, transforms boreal forest into steppe-like habitats (photo by V. Romanovsky)*
Policy Advice:

Characteristics of the communication problem:
GEWEX/GLASS has developed the tools needed to assess the land surface factors influencing change.

While the role of greenhouse gases is important, we also need to consider other human factors that have feedbacks to the climate.

The effects of the changing global distribution of crops needs to be assessed. (at resolution of 1° x 1°) (Ramankutty & Foley 1999)

Hydrologic models: The impacts of reservoirs on streamflows and climate need to be modeled.
GEWEX RHPs can provide input for Environmental Policy Development

(From H.J.Isemer)

Environmental policy for the Baltic Sea requires an Interdisciplinary approach involving meteorology, hydrology and oceanography.

The Helsinki Commission (HELCOM) is an environmental policy maker for the Baltic Sea area by developing common environmental objectives and actions. The present Contracting Parties to HELCOM are Denmark, Estonia, European Community, Finland, Germany, Latvia, Lithuania, Poland, Russia and Sweden.
To support this activity we must be capable of closing water budgets on different space scales. J. Roads evaluated model estimates of various water cycle variables and water budget closure over the GEWEX RHPs.
On June 21, 2008 GEWEX CEOP lost a leader, a friend, and a colleague when John Roads passed away. John was committed to closing water and energy budgets and to making a difference with his research. It is appropriate to dedicate this scientific Session on CEOP activities to his memory.

One of the greatest contributions of GEWEX to society has been the scientific experts and leaders it has developed. Here are some of the leaders that have developed their talents and expanded their ability to contribute through GEWEX/CEOP.
Summary:

GEWEX has made many contributions to society through its scientific findings, observational programs and campaigns, data assimilation, model development and analysis although the emergence of many of these benefits have been serendipitous rather than planned. A more systematic analysis of the potential benefits of GEWEX and other water cycle research could provide an additional perspective on priorities for climate research. Given the increasing value of water one the greatest payoffs from GEWEX and water cycle research could come from reducing the uncertainties in water inventories and in predictions of water cycle variables.
In the case of a drought the value of water increases and the optimum quantity of water decreases.