

GEWEX HYDROMETEOROLOGY PANEL (GHP) WATER AND ENERGY BUDGET STUDY (WEBS)

REPORTING PERIOD: Project Starting Date: 2003/10

STARTING DATE: GHP WEBS will Transition to CEOP/WESP/WEBS this Year

WEB ADDRESS: <http://ecpc.ucsd.edu/projects/ghp/WEBS/>

CHAIR: John Roads (2003-present)

Overview

The goal of GHP WEBS is to develop the “best available water and energy budgets”, for the global land regions associated with the GEWEX Continental-Scale Experiments (CSEs). The time period chosen for the initial GHP study, 1986-1995, occurs before most of the CSE start dates (ca 1995) because that is when many global data sets, thanks in part to the recently released GEWEX International Satellite Land Surface Comparison Project (ISLSCP-I and II), finally became available to the general research community.

Status

GHP WEBS is now using observationally based GEWEX Radiation Panel (GRP) global data sets including: the NASA Water Vapor Product (NVAP), the International Satellite Cloud Climatology Project (ISCCP) radiation and water vapor products, the Surface Radiation Budget (SRB) radiation products and Global Precipitation Climatology Project (GPCP) precipitation. GHP WEBS is also using two Global Runoff Data Center (GRDC) runoff based global data products developed by the Univ. of New Hampshire, as well as the Climate Prediction Center Merged Analysis of Precipitation (CMAP) precipitation and surface temperature and the Climate Research Unit (CRU) surface temperature global data sets. Using more than one set of observationally based global data sets, allows some characterization of the potential level of uncertainty in currently available global water and energy observation based data sets.

WEBS is also utilizing global reanalyses from the National Centers for Environmental Prediction (NCEP R1 and R2), the European Centre for Medium Range Weather Forecasts (ERA40), Japanese Reanalysis Agency (JRA) as well as data from the NASA Global Land Data Assimilation System (GLDAS) and Global Soil Wetness Project (GSWP) - a project under the GEWEX Modeling and Prediction Panel (GMPP). In particular, GLDAS is providing 3 unique LDAS simulations from the MOSAIC, Noah, and CLM land surface models, with the same observationally based forcing data. Although some hydrometeorological processes and variables can only be obtained from these atmospheric and land based model analyses, there are at least some observations, mentioned above, that can be used for evaluations.

In order to make progress, the initial GHP WEBS activity has been limited to analysis of the bulk-integrated water and energy processes in the atmosphere and land. State variables include: precipitable water, soil moisture, snow equivalent water, atmospheric energy, surface air and skin temperature. Water and energy budget processes include: precipitation, moisture convergence, evaporation, runoff, heat convergence, latent heat of condensation, atmospheric radiative cooling, surface radiative heating, sensible and latent heat transfers from the surface to the atmosphere, ground heat flux, and the associated radiation fluxes.

New Directions:

GEWEX has the larger goal of developing similar “best available global budgets” over both the ocean and land and in collaboration with the companion World Climate Research Programme (WCRP) Climate Variability and Predictability Programme (CLIVAR) for the ocean itself on much longer time scales. GRP is currently focused on comparisons of GEWEX data sets for a few key variables, such as radiation and precipitation. GHP and GRP WEBS assessment efforts, which also include atmospheric and land data assimilation systems will thus need to be eventually merged.

A long-term goal is to eventually have a much more comprehensive description of not only the global average bulk water and energy processes, but also a better description of the associated vertical and temporal distributions and how these variations might change in the atmosphere, land surface (including

snow and ice) and ocean on diurnal to centennial time scales. This will ultimately require collaborative efforts with other WCRP projects, including: the Climate and Cryosphere (CliC) and Stratospheric Processes and their Role in Climate (SPARC). We also need to take advantage of the higher resolution and more comprehensive CEOP data sets coming on line. In short, CEOP and GEWEX will need to work closely together to develop a comprehensive time and space description of various water and energy variables and processes.

Future: Next Year's Foreseen Activities:

It took a major effort to gather all of the chosen observation and reanalysis data sets and then another major effort to figure out how to plot them. The next major effort will be to draft a global description and to then ask the CSE representatives and data set providers to provide relevant discussion framing the global and regional plots. The 2006 pan-GEWEX meeting will be used to identify the key participants in drafting a summary exposition.

Key Results:

- One of the major efforts this year was that we finally began to move beyond annual and monthly mean plots to interannual variations, as shown in **Fig. 1** (see below).
- Development of these interannual variations (actually interannual variations of monthly means, which are not shown) provided the background uncertainty for the ensemble monthly means shown in **Fig. 2** (see below).
- Of particular interest here is that the level of uncertainty from different models for evaporation is greater than the uncertainty estimated from interannual variations.
- Another point of interest is that the GLDAS land surface models have an uncertainty comparable to the atmospheric reanalyses, despite the GLDAS models all having similar precipitation and downward solar input. Apparently the chosen land surface model is another source of large uncertainty in these budgets (Roads 2006)

Issues and Recommendations:

- GHP WEBS activities need to be done more in concert with CSE and data set provider representatives. It is important for this activity to now gain a greater GEWEX community participation.
- GHP WEBS activities will eventually transition to CEOP/WESP/WEBS activities. It is important to understand the longer period GEWEX background for these intrinsically higher resolution CEOP studies.
- GEWEX WEBS activities are really land based in that GEWEX mostly comprises scientists with expertise in the coupled land atmosphere system. To develop a complete global WEBS will require more interaction with the oceanographic community.

Contributions to WCRP strategic framework (including overall strategy on observation, assimilation and modeling, and WCRP cross-cutting task teams):

GHP WEBS is making use of observationally based products developed by GEWEX and other global communities as well as products from the current global atmospheric and land reanalyses in order to establish not only the current uncertainty in estimating water and energy processes and variables from current observations and models but also to understand better how well these processes and variables can be simulated and ultimately predicted. These observation/model comparisons may eventually become a key contribution toward the development of better climate predictions of water and energy processes in climate models.

Contributions to Society and to WCRP/GEWEX Visibility:

WEBS provides an estimate as to how accurately we can currently close large-scale water and energy budgets. By contrast, popular or traditional estimates indicate little uncertainty in many of these numbers. Understanding and showing this variability will help the research community better understand what we still need to overcome in order to develop better predictions of key climate variables.

Summary

GHP WEBS is attempting to assess our current ability to characterize and close bulk atmospheric and surface water and energy budgets over the CSEs in particular and over the global land region in general. GHP WEBS efforts will eventually transition to developing higher resolution CEOP/WESP/WEBS activities. Future WEBS efforts will also connect to GRP and oceanographic WEBS in order to eventually develop a global WEBS.

List of Key Publications:

- Marengo, J. A., 2006. On the Hydrological Cycle of the Amazon Basin: A historical review and current State-of-the-art. In Press, Revista Brasileira de Meteor
- Marengo et al. 2006: Assessments of Water and Energy Budgets in the Amazon Basin. GEWEX Newsletter, Vol. 16, No. 2. 10-11.
- Roads, J., Closing the Water Cycle, GEWEX News, 12, 1, 6-8, 2002.
- Roads, J., M. Kanamitsu, R. Stewart, 2002: CSE Water and Energy Budgets in the NCEP-DOE Reanalysis II. J. Hydrometeorology, 3 (3), 227-248.
- Roads, J., R. Lawford, E. Bainto, E. Berbery, S. Chen, B. Fekete, K. Gallo, A. Grundstein, W. Higgins, M. Kanamitsu, W. Krajewski, V. Lakshmi, D. Leathers, D. Lettenmaier, L. Luo, E. Maurer, T. Meyers, D. Miller, K. Mitchell, T. Mote, R. Pinker, T. Reichler, D. Robinson, A. Robock, J. Smith, G. Srinivasan, K. Verdin, K. Vinnikov, T. Vonder Haar, C. Vorosmarty, S. Williams, E. Yarosh, 2003: GCIP Water and Energy Budget Synthesis (WEBS). J. Geophys. Res. 108 (D16), 10.1029/2002JD002583.
- Roads, J; 2006: GHP Water and Energy Budget Study. GEWEX Newsletter, Vol. 16, No. 2. 6-8
- Szeto, K. K., et al. 2006: MAGS Water and Energy Budget Study. J. Hydromet., submitted
- Szeto K., 2006: Assessing Water and energy budgets for the Mackenzie Basin - MAGS WEBS. GEWEX Newsletter, Vol. 16, No. 2. 12-13.

List of WEBS Meetings, Workshops:

WEBS has previously provided a general forum for various workshops and special sessions describing water and energy budgets. Relevant meetings this past year include:

2006/04 European Geosciences Union, General Assembly, Vienna
HS22 Coupling hydrology and atmosphere from catchment to global scales
Conveners: Rosbjerg, D.; Roads, J.; Kunstmann, H.; Jacob, D.; Döll, P

2006/11 Earth System Science Partnership, Open Science Conference, Beijing
Modeling Coupled Dynamics and their Uncertainties in the Earth System
Conveners: Hibbard, K., M. Collins, J. Roads

Planned Meetings, Workshops:

2007/04 European Geosciences Union, General Assembly, Vienna
HS22 Coupling hydrology and atmosphere from catchment to global scales
Conveners: Rosbjerg, D.; Roads, J.; Kunstmann, H.; Jacob, D.; Döll, P

List of Members and their Term Dates:

J. Roads currently chairs WEBS and is drawing together the data sets. Key contributions have already been provided K. Masuda, Japan, M. Rodell, GLDAS, W. Rossow and eventually others (CSE representatives) TBD at 2006 pan-GEWEX meeting.

1986-95 GHP 1986-95 Annual Anomalies, E (mm/day)

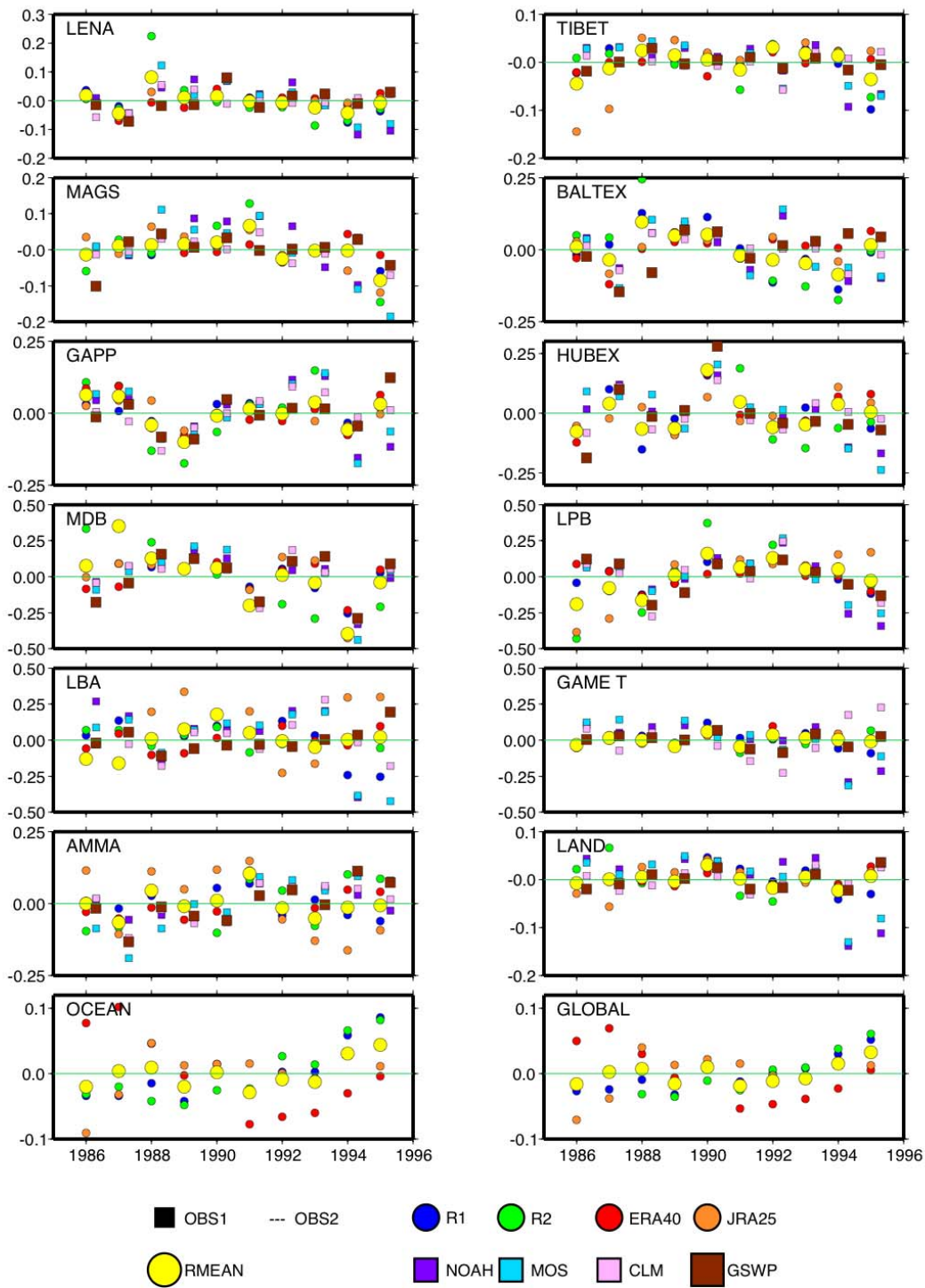


Fig. 1 Annual mean evaporation anomalies for the different CSEs, models.

1986-95 GHP Monthly Climatology, Evap (mm/day)

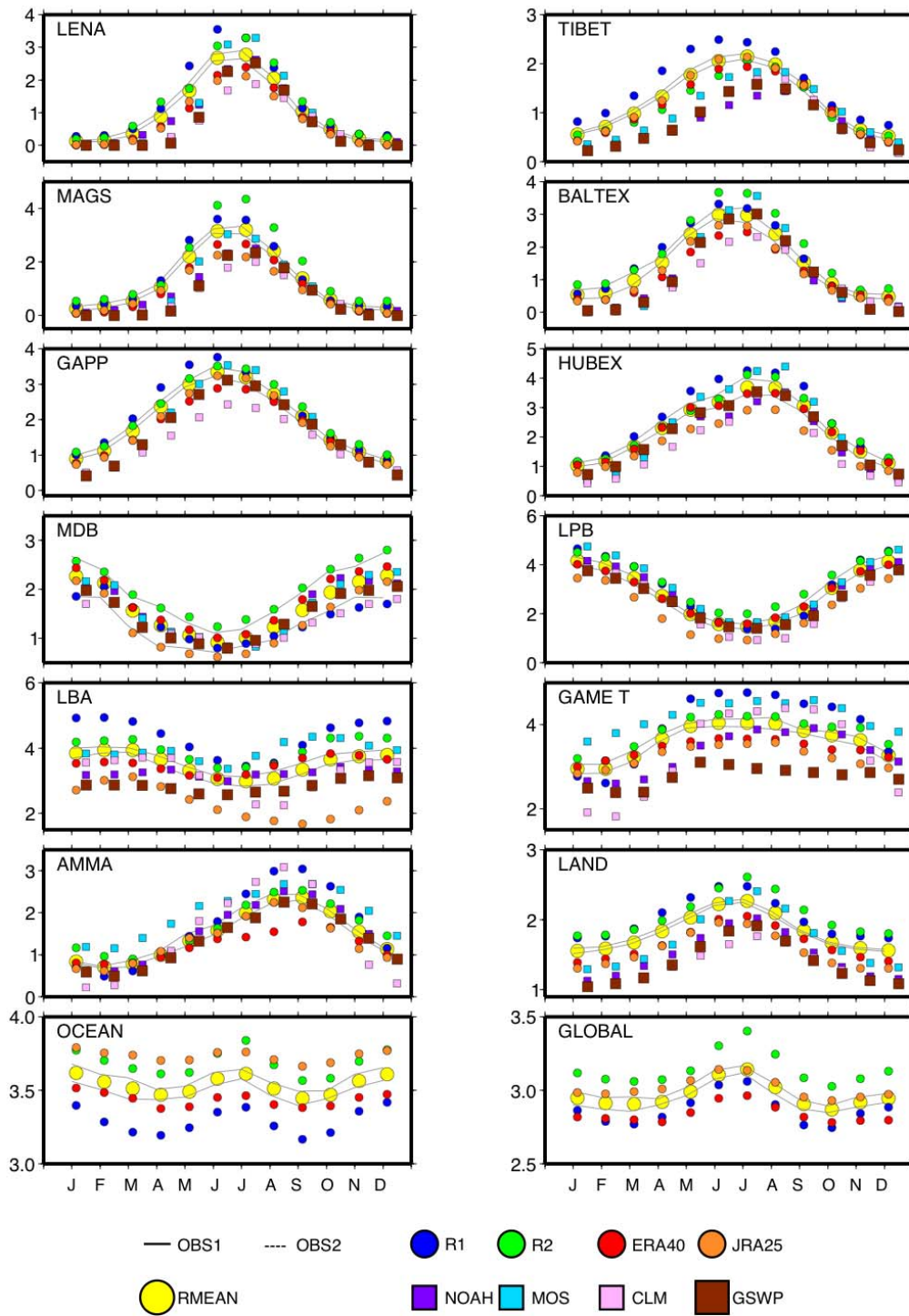


Fig. 2 Monthly mean evaporation anomalies for the different CSEs, models. The SD envelope curves bracket the RMEAN values.