3.5.6.4 Special Bureau for Hydrology

The Special Bureau for Hydrology provides internet access to data sets of water storage load variations for major land areas of the world. The web site contains results from three numerical models, the NCEP (National Center for Environmental Prediction) reanalysis, the ECMWF (European Center for Medium Range Weather Forecasting) reanalysis, and the CPC (Climate Prediction Center) Land Data Assimilation System (LDAS). Global terrestrial water storage changes estimated from GRACE (Gravity Recovery and Climate Experiment) time variable gravity observations are provided as the new addition to our online data archive (at <http://www.csr.utexas.edu/research/ggfc/>). The NCEP reanalysis and CPC LDAS data products are updated on a regular basis.

The NCEP reanalysis model is a fixed data-assimilating global numerical model, designed mainly for atmospheric studies. It has been run for a period starting in 1948, up to the present. NCEP results are valuable for their global coverage and long duration. The hydrologic part of this model is mainly employed as a lower boundary condition in the model, and reflects a combination of an imposed (non data-assimilating) hydrologic cycle, and interaction with the atmosphere. The NCEP reanalysis variations are probably representative of the real Earth, but not accurate in detail. They lack the level of inter-annual variability expected in the real hydrologic cycle, and observed in some more sophisticated data-assimilating land surface model results. In addition, there are evident flaws over Antarctica and Greenland, which probably result from locating highly variable sea ice at land grid points. Therefore Antarctica and Greenland are excluded from geodetic calculations. The web site includes daily NCEP water storage in Gaussian grid (T62) form for Jan. 1979 – Dec. 2004, and polar motion and length of day excitation time series for Jan. 1948 – Dec. 2004, as well.

The ECMWF data-assimilating reanalysis model, similar to NCEP, also has a surface hydrologic cycle. We find that it appears more realistic than NCEP, showing greater interannual variability. In addition, its seasonal cycle resembles long-term average results based on local budget (Precipitation-Evaporation-Runoff) calculations. The web site includes 2.5 degree gridded values at daily intervals for the period 1979–1993.

CPC LDAS is forced by observed precipitation, derived from CPC daily and hourly precipitation analyses, downward solar and longwave radiation, surface pressure, humidity, 2-m temperature and horizontal wind speed from NCEP reanalysis. The output consists of soil temperature and soil moisture in four layers below the ground. At the surface, it includes all components affecting energy and water mass balance, including snow cover, depth, and albedo.

Monthly averaged soil water storage changes are provided on a 1 x 1 degree grid. These data are averaged from the original 0.5 x 0.5 degree grid and converted into NetCDF and standard ASCII format. The data cover the period Jan. 1980 through Dec. 2004. No estimate is provided over Antarctica. A README file and a few matlab scripts used for doing the conversion are provided as a reference to the data format.

The README file with the NCEP and ECMWF data also includes details on the way in which actual loads are calculated from the soil moisture model field. Data are available in both ascii and NetCDF (.nc) formats. In addition, there are helpful sample Matlab commands lists and m-files for reading the data in NetCDF format with Matlab, and for interpolating from the original model grid to a uniform (for example 1 x 1 degree) grid.

A new addition to our data archive is equivalent surface water storage estimated from GRACE time variable gravity observations provided by the GRACE team at the Center for Space Research, University of Texas at Austin. 22 monthly GRACE solutions covering the period April 2002 to July 2004 are used to estimate global surface mass change on a 1 x 1 degree grid. Results with 3 different spatial Gaussian smoothing scales, 600 km, 800 km, and 1000 km are provided. The GRACE spherical harmonics are truncated at degree and order 60, and the C20 term is not included.

The Special Bureau for Hydrology is currently planning to provide the community a few new data products, which should be available online in late 2005. The new data products include terrestrial water storage change estimates from the NASA Global Land Data Assimilation System (GLDAS). GLDAS has been used in many GRACE related studies, as it covers the GRACE period and has a high temporal resolution of 3 hours. It's been demonstrated by recent studies that GLDAS appears to show major improvement in modeling large-scale surface water storage changes when compared with earlier models.

Another new product will be combined surface mass load changes from the atmosphere, ocean, and land water. The purpose is to provide a product similar to the GRACE atmospheric and oceanic dealiasing (AOD) dataset, but to also include the hydrology part and apply a full baroclinic ocean general circulation model. The plan is to combined NCEP reanalysis 6-hourly atmospheric pressure change, 12-hourly ocean bottom pressure change from the ECCO (Estimating the Circulation and Climate of the Ocean) data assimilating ocean general circulation model, and the GLDAS 3-hourly terrestrial water storage change to generate a 6-hourly AOW (atmosphere, ocean, and water) surface mass load product. A number of issues need to be addressed, including mass conservation of a dynamically coherent system, data representation (spherical har-

monics and surface grids), data format, and etc.

Below is a table found on the website that summarizes the current datasets in our online data archive.

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Data Resources:

Parameters	Sources	Information
Water Storage Change From GRACE (New!)	GRACE (Gravity And Climate Experiment)	Time Span: Apr/May 2002 - Jul 2004 Sampling Rate: Monthly, 22 Solutions Grid: 1 x 1 Degree Grid Gaussian Smoothing: 600, 800, 1000 km Truncation at degree 60, No C20
CPC Monthly Water Storage	CPC Land Data Assimilation System	Time Span: Jan. 1980 - Dec. 2004 Sampling Rate: Monthly Grid: 1 x 1 Degree
NCEP Daily Water Storage	NCEP/NCAR Reanalysis Soil Moisture and Snow	Time Span: Jan. 1979 - Dec. 2004 Sampling Rate: Daily Grid: Gaussian (T62), ~1.904 x 1.875 Degree
ECMWF Daily Water Storage	ECMWF Reanalysis Soil Moisture and Snow	Time Span: 1979 - 1993 Sampling Rate: Daily Grid: 2.5 x 2.5 Degree
Water Storage	NCEP/NCAR Climate Data Assimilation Syatem I (CDAS-1) soil moisture and snow	Time Span: 1993 - 1998 Sampling Rate: Monthly Grid: 1 x 1 degree
Water Flux	NCEP/NCAR Climate Data Assimilation Syatem I (CDAS-1) soil moisture and snow	Time Span: 1993 - 1998 Sampling Rate: Monthly Grid: 1 x 1 degree

NEW! Daily hydrological excitations of polar motion and LOD from NCEP/NCAR Reanalysis (1948-2004)!

NEW! Water storage and flux changes of global major basins !!! (Underconstruction)

List of global major artificial reservoirs ! (by courtesy of Dr. Ben F. Chao)