**Introduction**

Terrestrial hydrological variables are important in global hydrology, climate, and cycle studies. Generating global fields of these variables, however, is still a challenge. The goal of a land data assimilation system (LDAS) is to ingest satellite- and ground-based observational data products, using advanced land surface modeling and data assimilation techniques, in order to generate optimal fields of land surface states and fluxes data and, thereby, facilitate hydrology and climate modeling, research, and forecast.

**GLDAS and NLDAS Data at HDISC/NASA**

**NLDAS:** North American Land Data Assimilation System

**GLDAS:** Global Land Data Assimilation System

**NLDAS** and **GLDAS** data are produced by specific instances of the Land Information System (LIS) software framework for high-performance land-surface modeling and data assimilation. US is developed by the Hydrological Sciences Branch at NASA Goddard Space Flight Center. **NLDAS** is a collaboration project between several groups (NOAA/NCEP/EMC, NASA/GSFC, Princeton University, University of Washington, NOAA/OAHD, and NOAA/NCEP/CPC) and is a core project of NOAA/CPPA. **GLDAS** is supported by the NASA Energy and Water cycle Study (NEWS). To date, both **NLDAS** and **GLDAS** have produced more than 30 years (1979 to present) of quality-controlled, spatially and temporally consistent, land-surface model data.

**NLDAS**
- **Content**: Water and energy budget data, forcing data
- **Spatial coverage**: Continental US except southern Canada and northern Mexico
- **Spatial resolution**: 0.125°, 0.25° and 1.0°
- **Temporal coverage**: Phase 1: Jan. 1, 1979 – present
- **Temporal resolution**: Hourly and monthly
- **Forcing**: Multiple data sets from satellite measurements, radar estimation, precipitation gauges,
  and atmospheric analyses
- **Land surface models**: Mosaic, Noah, SAC, VIC
- **Output format**: GRIB
- **Elevation definition**: TOPO 30
- **Vegetation definition**: University of Maryland, 1 km

**GLDAS**
- **Model - resolution**: GLDAS-1, GLDAS-2
- **Remarks**
  - NOAH 1.0: Version 2.7
  - CLM 1.0: Version 2.0
  - VIC 1.0: Water balance mode
  - VIC 1.0: Energy balance mode
  - Mosaic model: Catchment
  - Noah model: Catchment, Modis, Noah, VIC

More information about **GLDAS** and **NLDAS** and model data validation can be found at Land Data Assimilation Systems Web site at http://disc.gsfc.nasa.gov/hydrology/daac-bin/gladsaas

**Giovanni:**
- [Online Visualization and Analysis](http://gdata1.sci.gsfc.nasa.gov/daac-bin/G Giovanni/gladsaas/index.html?instance=GLDAS10_M)

**Giovanni** provides a simple and intuitive way to visualize, analyze, and access Earth science remote sensing data online. **Giovanni** allows users to simply select one or more parameters, spatial and temporal ranges, and a visualization function, and returns in image, HDF, NetCDF, or KML format.

**Visualization types in GLDAS Giovanni**
- Lat-Lon map, Time-averaged
- Image download
- Simple and fast
- Navigation based on data products, years, and Julian dates.

**What’s New about NL Das and GLDAS Data**

**NLDAS Phase I (NLDAS-1) Forcing data product**
- The 30-year hourly 0.125 degree resolution **NLDAS Phase 2** (NLDAS-2) data were released at the end of 2009 and continue to be produced with a typically 2-4 day lag from the present. Additionally, the **NLDAS Phase 1 data (1996 – 2007)** were recently added to the **GES DISC** archives and released to the public, to continue to serve users of NLDAS-1 data and allow easier comparisons between the two phases of **NLDAS**.

**GLDAS Version 2 (GLDAS-2)**
- **Mosaics**:
  - Create more climatologically consistent data sets
  - Upload the LISMs versions
  - Enhancements
- **Use of the global meteorological forcing data set from Princeton University (Sheffield et al. 2006)**
- **Initialization of soil moisture over desert**
- **Updated model specific parameter files**
- **Advanced snow assimilation scheme** (NOAH 2.5)
- **Major differences between GLDAS-2 & GLDAS-1**
- In the presence of precipitation data, the **GLDAS** temporal coverage is extended back to 1948. In **GLDAS-1**, forcing sources switched several times throughout the year, resulting in introduced unnatural trends and exhibited highly uncertain forcing fields in 1976-1993. **GLDAS-2** has two streams of simulations:
  - Princeton-based from 1948 up to present
  - Observation-based from 2001 to present
- **GLDAS-2 has multiple experiments for NOAH model.**

**Updates to each LSM are summarized in the table below.**

<table>
<thead>
<tr>
<th>Model - resolution</th>
<th>GLDAS-1</th>
<th>GLDAS-2</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>NOAH 1.0</td>
<td>Version 2.7</td>
<td>Version 2.7</td>
<td>Updated model parameters that specify the initial soil temperature</td>
</tr>
<tr>
<td>CLM 1.0</td>
<td>Version 2.0</td>
<td>Version 3.5</td>
<td>Used MODIS based parameter data sets, stand alone</td>
</tr>
<tr>
<td>VIC 1.0</td>
<td>Water balance mode</td>
<td>Energy balance mode</td>
<td>Includes all variables</td>
</tr>
<tr>
<td>Catchment 2.0</td>
<td>Mosaic model</td>
<td>Catchment</td>
<td>Modis switch</td>
</tr>
<tr>
<td>Noah 0.25</td>
<td>Version 2.7, Snow DA: direct insertion</td>
<td>Version 2.7, 2.8 Snow DA: forward-looking</td>
<td>Updated bottom temperature</td>
</tr>
</tbody>
</table>

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**Application Examples**

**GLDAS improves sub-seasonal weather forecasts**

Estimates of land surface states (e.g., soil moisture, surface temperature) produced by **GLDAS** can be used to initiate short term and seasonal numerical weather prediction systems. Precipitation and temperature forecasts are sensitive to land surface conditions at the start of the prediction period. **GLDAS** output can be used to initiate the land surface states and hence improve forecast accuracy.

**Diurnal cycle of summertime precipitation from NLDAS data products**

Fulton, T. D. and Mocko, M. L. recently examined diurnal cycles of summertime rainfall events over the continental United States, using a 10-year climatology (1998-2007) of assimilated hourly rain gauge data from NLDAS-2. The results clearly indicate:
- A dramatic but gradual change of the diurnal peak of precipitation from the Rocky Mountains (early afternoon) to the Great Plains (early morning).
- Well-defined regions of rainfall propagation over the Great Plains are identified, as well as an afternoon maximum area over the southern and eastern portions of the United States.

A Science Focus article on this work can be found in the **GES DISC** hydrology portal, [http://disc.gsfc.nasa.gov/hydrology/advanced/science-focus/nlds-diurnal-cycle](http://disc.gsfc.nasa.gov/hydrology/advanced/science-focus/nlds-diurnal-cycle).

NLDAS data improve the water quality model performance

Joseph Nigro and his colleagues investigated NLDAS precipitation data for use in the **NOAP Precipitation Estimator** (NPE). The use of **NLDAS** precipitation data dramatically improved the water quality model performance over the results obtained when weather station precipitation data were used. In particular, improvement was noted in the summer, when storm events are the primary source of precipitation. A article about this work, "NASA Modified Precipitation Products to Improve US EPA Point Source Water Quality Modeling for the Chesapeake Bay," was recently published in the Journal of Environmental Quality. More information and references can be found at the **GES DISC** News site at [http://disc.gsfc.nasa.gov/news/press/press_news_item_project](http://disc.gsfc.nasa.gov/news/press/press_news_item_project).

**Support NLDAS for BASINS applications**

The Better Assessment Science Integrating Point & Nonpoint Sources (BASINS), created by US EPA, is a tool for environmental analysis tool. Collaborated with BASINS Project, NASA GES DISC has made the NLDAS precipitation data available via the BASINS download tool. To enable the downloading of 30-year time series of hourly NLDAS precipitation data via a single request, the **Giovanni** GRIB files were parameter and spatial subsetting, archived in a way optimized for time series retrieval, and incorporated into GDS. With the access via **BASINS**, NLDas precipitation data can be easily analyzed and intercompared with other hydrological data in **BASINS**.

**Conclusions**

- All **NLDAS** and **GLDAS** data are accessible from the Hydrology Data and Information Services Center at NASA's Goddard Space Flight Center ([http://disc.gsfc.nasa.gov/hydrology](http://disc.gsfc.nasa.gov/hydrology)).
- The **GLDAS-2 NOAH** monthly and 3-hourly data have now been released to the public. **GLDAS-2** data from other models will be available soon.
- With the extended temporal coverage (Jan. 1948–present), the **GLDAS-2** data are expected to play an even more important role in global hydrology and climate studies.
- The **NLDAS-1** data (Aug. 1986 – Dec. 2007) were recently added to the **GES DISC** to continue to serve users of NLDAS-1 data, and to allow easier comparisons between the two phases of **NLDAS**.
- **NLDAS-2** monthly data will be available soon.
- **Giovanni** online visualization and analysis for 3-hourly **GLDAS** and hourly **NLDAS** are coming soon.

**Hydrology Data and Information Services Center (HDISC)**

**Data and Information Services Center (DISC)**

NASA-Goddard Space Flight Center (GSFC)

[Help Desk: help-disc@listserv.gsfc.nasa.gov](mailto:help-disc@listserv.gsfc.nasa.gov)