Data Access, Visualization, Analysis and Usage of Terrestrial Hydrological Data From NASA's Hydrology Data and Information Services Center (HDISC)

Hongliang Fang[1,3], Hiroko K. Beaudoing[2,4], David M. Mocko[2], Matthew Rodell[2], Bill Teng[1,3], Bruce Vollmer[1]

[1]Goddard Earth Sciences Data and Information Services Center, Code 610.2, Goddard Space Flight Center, NASA, Greenbelt, MD 20771, United States
[2]Hydrological Sciences Branch, Code 614.3, Goddard Space Flight Center, NASA, Greenbelt, MD 20771, United States
[3]Wyle Information Systems, Inc., 1651 Old Meadow Road, McLean, VA 22102, United States
[4]Earth System Science Interdisciplinary Center, University of Maryland, College Park, MD 20742, United States

AGU 2009 Annual Conference, San Francisco CA, December 14-18, 2009

http://disc.gsfc.nasa.gov/hydrology
Email: Hongliang.Fang.1@nasa.gov

A series of land surface state (e.g., soil moisture and surface temperature) and flux (e.g., evaporation and sensible heat flux) products simulated by land surface models (CLM, Mosaic, Noah, SAC and VIC) from the North America and Global Global Land Data Assimilation System (NLDAS and GLDAS) are now accessible at the Hydrology Data and Information Services Center (HDISC), a component of NASA Goddard Earth Sciences Data and Information Services Center (GES DISC).

Hydrology Data and Information Services Center (HDISC)

The Hydrology DISC currently supports the North America and Global Land Data Assimilation System (NLDAS and GLDAS) data products generated by GSFC's Hydrological Sciences Branch. HDISC has the capability to support more hydrology data products and provide more advanced data access and visualization tools. The goal is to develop HDISC as a data and services portal that supports weather and climate forecast, and water and energy cycle research (http://disc.gsfc.nasa.gov/hydrology).

North America (NLDAS) and Global Land Data Assimilation System (GLDAS)

NLDAS and GLDAS systems integrate data from multiple space-based Earth observing systems using advanced land surface modeling and assimilation techniques. These products support weather and climate forecast experiments, water resources applications, and water and energy cycle research

	NLDAS	GLDAS
Content	Water and energy budget data, forcing data	
Spatial extent	Conterminous US, parts of southern Canada and northern Mexico	All land north of 60 degree south
Spatial resolution	1/8 degree	1 degree and 0.25 degree
Time period	Jan 1, 1979 to present for NLDAS-2 Oct 1, 1996 to Dec 31, 2007 for NLDAS-1	Jan 1, 1979 to present for the 1.0° data Feb 24, 2000 to present for the 0.25° data
Temporal resolution	Hourly and monthly	3-hourly and monthly
Forcing	Multiple data sets derived from satellite measurements, radar estimation, precipitation gauges, and atmospheric analyses	Multiple data sets derived from satellite measurements and atmospheric analyses
Land surface models	Mosaic, Noah, SAC and VIC	CLM, Mosaic, Noah, VIC
Output format	GRIdded Binary (GRIB)	
Elevation definition	GTOPO 30	
Vegetation definition	University of Maryland, 1 km	

Parameters for GLDAS (L), NLDAS-2 Forcing (M) and NLDAS-2 Mosaic output (R)

PDS IDs	Full Name	Unit
001	Surface pressure	Pa
011	Near surface air temperature	K
032	Near surface wind magnitude	m/s
051	Near surface specific humidity	kg/kg
057	Total evapotranspiration	kg/m^2/s
065	Snow water equivalent	kg/m^2
071	Total canopy water storage	kg/m^2
085	Average layer soil temperature	K
086	Average layer soil moisture	kg/m^2
099	Snowmelt	kg/m^2/s
111	Net shortwave radiation	W/m^2
112	Net longwave radiation	W/m^2
121	Latent heat flux	W/m^2
122	Sensible heat flux	W/m^2
131	Snowfall rate	kg/m^2/s
132	Rainfall rate	kg/m^2/s
138	Average surface temperature	K
155	Ground heat flux	W/m^2
204	Surface incident shortwave radiation	W/m^2
205	Surface incident longwave radiation	W/m^2
234	Subsurface runoff	kg/m^2/s
235	Surface runoff	kg/m^2/s

PDS IDs	Full Name	Unit
NLDAS-2 Primary Forcing Data		
61	Precipitation hourly total	kg/m^2
157	180-0 mb above ground Convective Available Potential Energy	J/kg
153	Fraction of total precipitation that is convective	unitless
205	LW radiation flux downwards (surface)*	W/m^2
204	SW radiation flux downwards (surface)	W/m^2
228	Potential evaporation	kg/m^2
1	Surface pressure*	Pa
51	2-m above ground Specific humidity*	kg/kg
11	2-m above ground Temperature*	K
33	10-m above ground Zonal wind speed	m/s
34	10-m above ground Meridional wind speed	m/s
NLDAS-2 Secondary Forcing Data		
179	Aerodynamic conductance	m/s
63	Convective precipitation hourly total	kg/m^2
61	Precipitation hourly total	kg/m^2
204	SW radiation flux downwards (surface)	W/m^2
7	NARR hybrid level Geopotential height	gpm
1	NARR hybrid level Pressure	Pa
51	NARR hybrid level Specific humidity	kg/kg
11	NARR hybrid level Temperature	K
33	NARR hybrid level Zonal wind speed	m/s
34	NARR hybrid level Meridional wind speed	m/s

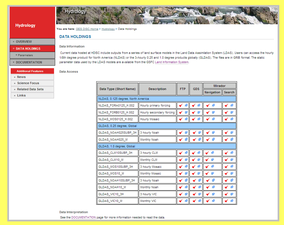
PDS IDs	Full Name	Unit
179	Aerodynamic conductance	m/s
84	Albedo	%
162	Rainfall (unfrozen precipitation)	kg/m^2
161	Snowfall (frozen precipitation)	kg/m^2
148	Average surface skin temperature	K
234	Subsurface runoff (baseflow)	kg/m^2
181	Canopy conductance	m/s
223	Plant canopy surface water	kg/m^2
205	LW radiation flux downwards (surface)	W/m^2
204	SW radiation flux downwards (surface)	W/m^2
199	Direct evaporation from bare soil	W/m^2
200	Canopy water evaporation	W/m^2
57	Evaporation	kg/m^2
155	Ground heat flux	W/m^2
182	Leaf Area Index (0-9)	unitless
121	Latent heat flux	W/m^2
207	0-40 cm root zone Moisture availability	%
207	0-200 cm total column Moisture availability	%
112	LW radiation flux net (surface)	W/m^2
111	SW radiation flux net (surface)	W/m^2
198	Sublimation (evaporation from snow)	W/m^2
122	Sensible heat flux	W/m^2
66	Snow depth	m
229	Snow phase-change heat flux	W/m^2
99	Snow melt	kg/m^2
238	Snow cover	%
86	0-10 cm layer 1 Soil moisture content	kg/m^2
86	0-40 cm root zone Soil moisture content	kg/m^2
86	0-100 cm top 1 meter Soil moisture content	kg/m^2
86	0-200 cm total column Soil moisture content	kg/m^2
86	10-40 cm layer 2 Soil moisture content	kg/m^2
86	40-200 cm layer 3 Soil moisture content	kg/m^2
235	Surface runoff (non-infiltrating)	kg/m^2
210	Transpiration	W/m^2
85	Deep soil temperature	K
87	Vegetation	%
65	Accumulated snow water-equivalent	kg/m^2

Access HDISC Data

- Anonymous http and ftp data downloading
- Mirador - that provides discovery of, and access to, a Google-like search and download tool based on keywords

Mirador Data Search Interface

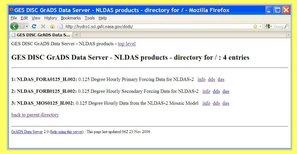
HDISC Data Holdings



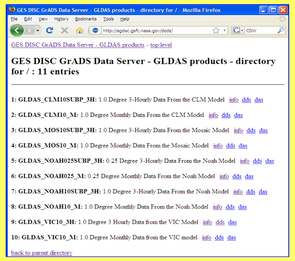
GrADS Data Server (GDS)

GDS provides subsetting and analysis services across the internet. GDS supports any operation that can be expressed in a single GrADS expression.

GES DISC GDS for NLDAS products



GES DISC GDS for GLDAS products



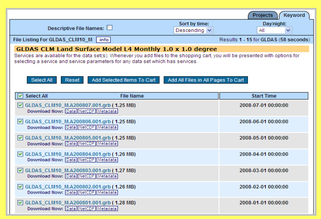
On-The-Fly Spatial and Parameter Subset

A. User selects data sets of interest

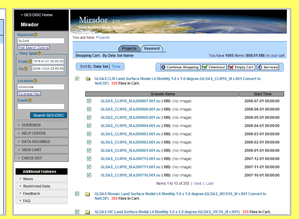
B. User selects OTF subset options: spatial and/or parameter

On-The-Fly Conversion to netCDF

A. Convert–to-netCDF service available for GLDAS data sets



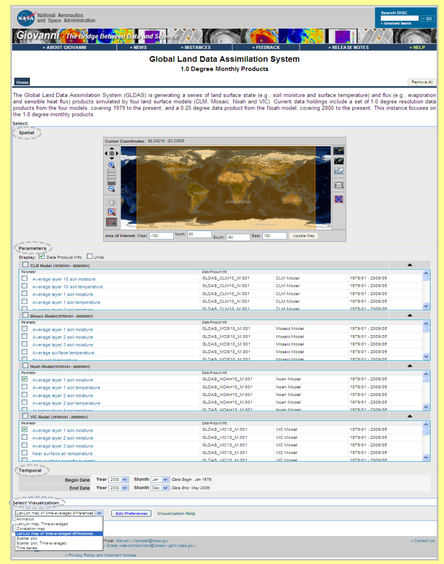
B. Run conversion and download netCDF files



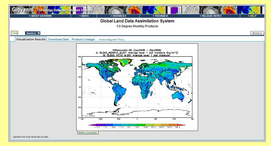
Online Visualization and Analysis (Giovanni)

Giovanni is a simple and intuitive way to visualize, analyze, and access Earth science remote sensing data online.

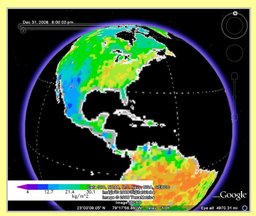
http://disc.sci.gsfc.nasa.gov/giovanni



GLDAS Giovanni users simply select one or more parameters, spatial and temporal ranges, and the visualization function. The example below shows the difference in soil moisture estimates from the Noah and VIC models for the year 2008.



Output from the visualization and analysis is available in HDF, netCDF and ASCII formats. The KMZ file option allows users to view the GLDAS data in Google Earth.



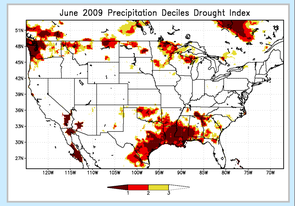
Drought Monitoring With NLDAS Data

The NLDAS-2 data are used in various combinations in a post-processor to generate different drought indices. The three main types of droughts to be investigated are:

- Meteorological (primarily from precipitation deficit)
- Hydrological (primarily from streamflow/runoff deficit)
- Agricultural (primarily from soil moisture deficit)

The different drought indices and output from the separate LSMs will be evaluated against historical and current drought observations.

Precipitation deciles drought index from the NLDAS forcing data



Further Development

- Support additional NLDAS products and monthly products.
- Advanced Giovanni services for GLDAS and NLDAS products.
- Support GLDAS new processing with improved forcing dataset.

Mitchell, K.E., D. Lohmann, P.R. Houser, E.F. Wood, J.C. Schaake, A. Robock, B.A. Cosgrove, J. Sheffield, Q. Duan, L. Luo, R.W. Higgins, R.T. Pinker, J.D. Tarpley, D.P. Lettenmaier, C.H. Marshall, J.K. Entin, M. Pan, W. Shi, V. Koren, J. Meng, B.H. Ramsay, and A.A. Bailey, 2004: The multi-institution North American Land Data Assimilation System (NLDAS): Utilizing multiple GCIP products and partners in a continental distributed hydrological modeling system. *J. Geophys. Res.*, 109, D07S90, doi:10.1029/2003JD003823.

Rodell, M., P. R. Houser, U. Jambor, J. Gottschalck, K. Mitchell, C.-J. Meng, K. Arsenault, B. Cosgrove, J. Radakovich, M. Bosilovich, J. K. Entin, J. P. Walker, D. Lohmann, and D. Toll, 2004. The Global Land Data Assimilation System. *Bull. Amer. Meteor. Soc.*, **85**(3): 381-394.