



README Document for

Global Land Data Assimilation System Version 2 (GLDAS-2) Products

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Revision History

<i>Revision Date</i>	<i>Changes</i>	<i>Author</i>
05/19/2010	Initial version based on information from Hiroko Beaudoin.	Hualan Rui
06/17/2010	Reviewed and revised	Hiroko Beaudoin
11/21/2011	Update GES DISC Helpdesk email address	Hualan Rui
10/16/2012	Add information for GLDAS Version 2.0	Hiroko Beaudoin
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11/15/2013	Add information for GLDAS Version 2.0 0.25 degree product	Hiroko Beaudoin

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Introduction

The goal of the Global Land Data Assimilation System (GLDAS) 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 (Rodell et al., 2004a).

GLDAS drives multiple, offline (not coupled to the atmosphere) land surface models, integrates a huge quantity of observation based data, and executes globally at high resolutions (2.5° to 1 km), enabled by the Land Information System (LIS) (Kumar et al., 2006). Currently, GLDAS drives four land surface models (LSMs): Catchment, Noah, the Community Land Model (CLM), and the Variable Infiltration Capacity (VIC). More information is available at the [Land Data Assimilation Systems \(LDAS\)](#) and [Land Information System \(LIS\)](#) websites. This document specifically describes the data products of Version 2 of the Global Land Data Assimilation System (hereafter, GLDAS-2).

Basic characteristics of the GLDAS-2 data

GLDAS-2 has two components: one forced entirely with the Princeton meteorological forcing data (hereafter, GLDAS-2.0), and the other forced with a combination of model and observation based forcing datasets (hereafter, GLDAS-2.1). GLDAS-2.0 currently covers from 1948 to 2010 and will be extended to recent years as the dataset becomes available. GLDAS-2.1 covers from 2001 (2000 for 0.25 degree) to present with about 1 month latency and will be updated monthly. It is analogous to GLDAS-1 product stream.

The temporal resolution for the GLDAS-2 products is 3-hourly. Monthly products are also generated through temporal averaging of the 3-hourly products. Output files from Noah model are briefly described here. Table 1 lists some basic characteristics of the GLDAS-2 data. Please check the release news at the [GES DISC Hydrology Portal](#) for the current data release status.

Table 1. Basic characteristics of the GLDAS-2 data.

Contents	Outputs from NOAH Land surface model
Format	GRIB
Latitude extent	-60° to 90°
Longitude extent	-180° to 180°
Spatial resolution	1.0°, 0.25°
Temporal resolution	3-hourly and monthly
Temporal coverage	GLDAS-2.0: 3Z January 1, 1948 – 21Z December 31, 2010
	GLDAS-2.1: 0Z March 1, 2001 - present for the 1.0° data 0Z February 24, 2000 – present for the 0.25° data
Dimension	360 (lon) x 150 (lat) for the 1.0° data 1440 (lon) x 600 (lat) for the 0.25° data
Origin (1 st grid center)	(179.5W, 59.5S) for the 1.0° data (179.875W, 59.875S) for the 0.25° data
Land surface models	NOAH 3.3, GLDAS/NOAH

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The model simulation was initialized on simulation date January 1, 1948, using soil moisture and other state fields from the LSM climatology for that day of the year. The simulation was forced by the global meteorological forcing data set from Princeton University (Sheffield et al., 2006). The simulation used the common GLDAS data sets for land cover (MCD12Q1: Friedl et al., 2010), land water mask (MOD44W: Carroll et al., 2009), soil texture (Reynolds, 1999), and elevation (GTOPO30). The MODIS based land surface parameters are used in the current GLDAS-2.x products while the AVHRR base parameters were used in GLDAS-1 and previous GLDAS-2 products (prior to October 2012).

What are the differences between GLDAS-1 and GLDAS-2?

GLDAS-1 forcing data sources were switched several times, over the record from 1979 to present, which introduced unnatural trends and resulted in highly uncertain forcing fields in 1995-1997. More information about the GLDAS-1 forcing data is available at <http://ldas.gsfc.nasa.gov/gldas/GLDASforcing.php>.

GLDAS-2 has two components, GLDAS-2.0 and GLDAS-2.1. The main objective for GLDAS-2.0 is to create more climatologically consistent data sets, using the “[Global Meteorological Forcing Dataset](#)” from Princeton University, currently extending from 1948 - 2010. GLDAS-2.1 is analogous to GLDAS-1 product stream, with upgraded models forced by [a combination of GDAS, disaggregated CMAP, and AGRMET radiation data sets](#).

Other enhancements made in GLDAS-2 include model version upgrade, switching to MODIS-based land surface parameter data sets, and initialization of soil moisture over desert. In the Noah model, the bottom layer temperature was also updated. More details regarding the land surface parameter data changes are available at <http://ldas.gsfc.nasa.gov/gldas/>.

Updates

Please check periodically the [GES DISC web site](#) and [GES DISC Hydrology Portal](#) for the latest GLDAS-2 data.

Acknowledgement

Please refer to Rodell et al. (2004) for more information about the GLDAS project.

NASA requests that you include the following acknowledgment in papers published using these data:

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"The data used in this study were acquired as part of the mission of NASA's Earth Science Division and archived and distributed by the Goddard Earth Sciences (GES) Data and Information Services Center (DISC)."

We would appreciate receiving a copy of your publication, which can be forwarded to the following address:

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Email: gsfc-help-disc@lists.nasa.gov

Data Organization

File Naming Convention

GLDAS-2 data are named in accordance with the following convention:

GLDAS_<Model><Grid spacing>_<Temporal spacing>_A<Date>.<Product version>.<Processing date>.grb

Attribute	Description
<Model>	"NOAH" for the Noah Model "Catchment" for the Catchment Model "CLM" for the Common Land Model "VIC" for the VIC Model
<Grid spacing>	"025" for 1/4th degree "10" for 1 degree
<Temporal spacing>	"3H" for 3-hourly datasets "M" for monthly datasets
<Date> *	<YYYYMMDD>.<HHHH> for 3-hourly datasets <YYYYMM> for monthly datasets
<Processing date>	<YYYYMMDDHHMMSS> for 3-hourly datasets No <processing date> for monthly datasets
<Product version>	"020" for GLDAS-2.0 "021" for GLDAS-2.1

* (4-digit year; 2-digit month; 2-digit day of month; 4-digit GMT hour of day)

For examples, file name for 3-hourly 1.0 degree GLDAS-2.0 Noah data at 00:03Z on 1 January 1948 is "GLDAS_NOAH10_3H.A1948001.0300.2012307135845.020.grb," and

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file name for monthly 1-degree GLDAS-2.0 Noah data in January 1948 is “GLDAS_NOAH10_M_A194801.020.grb.”

File Format Structure

The GLDAS LSM data are created using the GRIdded Binary (GRIB) format, WMO GRIB-1. For more details about the GRIB format, please see:

<http://www.nco.ncep.noaa.gov/pmb/docs/on388/>.

GRIB parameter tables for GLDAS-2 data are provided in Appendix B. WGRIB or other GRIB reader (grib2ctl.pl) is required to read the files. The GLDAS-2 data files utilize [GRIB-1 Parameter Table 130](#), which is oriented toward land/hydrology modeling and land/hydrology physics. GLDAS-2 parameter IDs names, units, and abbreviations are defined in the [GRIB-1 Parameter Table 130](#). The parameter IDs 000-127 in Part 1 of Table 130 are identical to those defined in [ON388 Table 2](#).

Data Contents

Noah Model Data

GLDAS-2 Noah model data contains twenty-eight fields.

Table 2 shows a list of parameters provided in the GLDAS-2 Noah model data GRIB files. This table shows the GRIB Product Definition Section (PDS) ID and the corresponding parameter name and unit, as well as if the variable is instantaneous or backward-accumulated (over the entire previous hour before the time listed in the dataset).

Table 2. Parameters in the GLDAS-2 Noah model data

PDS IDs	Full Name	Unit	Time
001	Surface pressure	Pa	Instantaneous
011	Near surface air temperature	K	Instantaneous
032	Near surface wind magnitude	m/s	Instantaneous
051	Near surface specific humidity	kg/kg	Instantaneous
057	Total evapotranspiration	kg/m ² /s	Past 3-hr average
065	Snow water equivalent	kg/m ²	Instantaneous
223	Total canopy water storage	kg/m ²	Instantaneous
085	Average layer soil temperature	K	Instantaneous
086	Average layer soil moisture	kg/m ²	Instantaneous
099	Snowmelt	kg/m ² /s	Past 3-hr average
111	Net shortwave radiation	W/m ²	Past 3-hr average
112	Net longwave radiation	W/m ²	Past 3-hr average
121	Latent heat flux	W/m ²	Past 3-hr average

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122	Sensible heat flux	W/m ²	Past 3-hr average
161	Snowfall rate	kg/m ² /s	Past 3-hr average
162	Rainfall rate	kg/m ² /s	Past 3-hr average
148	Average surface temperature	K	Instantaneous
155	Ground heat flux	W/m ²	Past 3-hr average
204	Surface incident shortwave radiation	W/m ²	Past 3-hr average
205	Surface incident longwave radiation	W/m ²	Past 3-hr average
234	Subsurface runoff	kg/m ² /s	Past 3-hr average
235	Surface runoff	kg/m ² /s	Past 3-hr average

Data Interpretation

1. Due to the fact that forcing data for Greenland are unreliable and the lack of a glacier/ice sheet model, snow water equivalent accumulates indefinitely in Greenland and a few other Arctic points. Therefore it is highly recommended that Greenland and other points with abnormally large snow water equivalent values be masked out when performing global analyses.
2. Total precipitation is the sum of rainfall and snowfall.
3. Total runoff is the sum of subsurface runoff and surface runoff.
4. Terrestrial water storage is the sum of soil moisture in all layers, accumulated snow, and plant canopy surface water.
5. Use temporal averaging, not accumulation, to upscale the data to different temporal resolutions. For example, rainfall and snowfall are provided as rates, i.e., kg/m²/s. So the correct method of upscaling is averaging, which does not change the units.
6. Monthly average files contain straight averages of 3-hourly data, so that each monthly average has units PER 3 HOURS. For example, total evapotranspiration (evap) for April 1979 is the average 3-hour mean rate of evapotranspiration over all the 3-hour intervals in April 1979. It is NOT the accumulated evapotranspiration in April 1979. To compute the latter, use this formula:

$$\text{total_evapt (April)} = \text{evapsfc (April)} * 10800 \{ \text{sec/3hr} \} * 8 \{ \text{3hr/day} \} * 30 \{ \text{days} \}$$

This would be irrelevant, and the above formula should not be used, if the field of interest were a state (e.g., soil moisture)

7. Heights of forcing fields depend on the data sets used to drive the simulation. Presently, all the GLDAS data sets use the 2 m temperature and specific humidity and the 10 m wind for the entire time span.
8. The number of vertical levels for Soil Temperature (PDS 085) and Soil Moisture (PDS 086) is model specific. NOAH has total of 4 layers thickness: 0-10, 10-40, 40-100, and 100-200 cm.
9. The mean fields in monthly data (e.g. evapotranspiration, see Table 2) contain straight average over 3z on the 1st day of month to 0z on the next day of month. The instantaneous fields are averaged over 0z on the 1st day of month to 21z on the last day of month.

Reading the Data

WGRIB, GrADS, or other GRIB reader is required for reading the GLDAS data.

Set GLDAS-specific GRIB Parameter Table

GRIB files identify the contents (e.g., soil moisture, temperature) by parameter numbers. These numbers are linked to their respective parameter names in a parameter table. The parameter tables used for GLDAS data are shown in Appendices B.1 for each land surface model, as indicated. The name of the user-defined table is searched for in the following order:

1. Environment variable "GRIBTAB"
2. Environment variable "gribtab"
3. File gribtab

Defining an environment variable depends on the operating system and the shell.

Examples for setting the environment variable GRIBTAB:

MS-DOS or Windows:	<code>set GRIBTAB=~/data/gribtab</code>
Bash:	<code>export GRIBTAB=~/data/gribtab</code>
Csh:	<code>setenv GRIBTAB ~/data/gribtab</code>
Sh:	<code>GRIBTAB=\$HOME/data/gribtab; export GRIBTAB</code>

Reading the data by WGRIB

WGRIB is a program to manipulate, inventory, and decode GRIB files; version 1.7.X (or later) is recommended to avoid any possible discrepancies caused by different WGRIB versions. The source code and installation instructions for WGRIB are available from:

<http://www.cpc.ncep.noaa.gov/products/wesley/wgrib.html>.

Download the corresponding GRIBTAB (See Appendix B) and set the environmental variable GRIBTAB (See Set GLDAS-specific GRIB Parameter Table above) first before using WGRIB.

1. GRIB data verbose inventory

Usage:	<code>./wgrib grib_file [options]</code>
Example:	<code>wgrib -v GLDAS_NOAH10_3H.A19480101.0300.020.grb</code>

Result from the sample wgrib command:

```
1:0:D=1948010103:SWnet:sfc:kpds=111,1,0:time?:"Net Shortwave Radiation [W/m^2]
2:39202:D=1948010103:LWnet:sfc:kpds=112,1,0:time?:"Net Longwave Radiation [W/m^2]
3:74596:D=1948010103:Qle:sfc:kpds=121,1,0:time?:"Latent Heat Flux [W/m^2]
4:111894:D=1948010103:Qh:sfc:kpds=122,1,0:time?:"Sensible Heat Flux [W/m^2]
```

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```

5:151096:D=1948010103:Qg:sfc:kpds=155,1,0:time?:"Ground Heat Flux [W/m^2]
6:190298:D=1948010103:Snowf:sfc:kpds=161,1,0:time?:"Snowfall rate [kg/m^2/s]
7:223788:D=1948010103:Rainf:sfc:kpds=162,1,0:time?:"Rainfall rate [kg/m^2/s]
8:261086:D=1948010103:Evap:sfc:kpds=57,1,0:time?:"Total Evapotranspiration [kg/m^2/s]
9:290770:D=1948010103:Qs:sfc:kpds=235,1,0:time?:"Surface Runoff [kg/m^2/s]
10:324260:D=1948010103:Qsb:sfc:kpds=234,1,0:time?:"Subsurface Runoff [kg/m^2/s]
11:352040:D=1948010103:Qsm:sfc:kpds=99,1,0:time?:"Snowmelt [kg/m^2/s]
12:364590:D=1948010103:AvgSurfT:sfc:kpds=148,1,0:anl:"Average Surface Temperature [K]
13:398080:D=1948010103:SWE:sfc:kpds=65,1,0:anl:"Snow Water Equivalent [kg/m^2]
14:444896:D=1948010103:SoilM:0-10 cm down:kpds=86,112,10:anl:"Soil moisture content [kg/m^2]
15:482194:D=1948010103:SoilM:10-40 cm down:kpds=86,112,2600:anl:"Soil moisture content [kg/m^2]
16:521396:D=1948010103:SoilM:40-100 cm down:kpds=86,112,10340:anl:"Soil moisture content [kg/m^2]
17:562502:D=1948010103:SoilM:100-200 cm down:kpds=86,112,25800:anl:"Soil moisture content [kg/m^2]
18:605510:D=1948010103:TSoil:0-10 cm down:kpds=85,112,10:anl:"Soil temperature [K]
19:639000:D=1948010103:TSoil:10-40 cm down:kpds=85,112,2600:anl:"Soil temperature [K]
20:670588:D=1948010103:TSoil:40-100 cm down:kpds=85,112,10340:anl:"Soil temperature [K]
21:702176:D=1948010103:TSoil:100-200 cm down:kpds=85,112,25800:anl:"Soil temperature [K]
22:733764:D=1948010103:Canopint:sfc:kpds=223,1,0:anl:"Plant canopy surface water [kg/m^2]
23:757736:D=1948010103:Wind:sfc:kpds=32,1,0:anl:"Near surface wind speed [m/s]
24:785516:D=1948010103:Tair:sfc:kpds=11,1,0:anl:"Near surface air temperature [K]
25:819006:D=1948010103:Qair:sfc:kpds=51,1,0:anl:"Near surface specific humidity [kg/kg]
26:837268:D=1948010103:PSurf:sfc:kpds=1,1,0:anl:"Surface pressure [Pa]
27:882180:D=1948010103:SWdown:sfc:kpds=204,1,0:time?:"Surface incident shortwave radiation [W/m^2]
28:921382:D=1948010103:LWdown:sfc:kpds=205,1,0:time?:"Surface incident longwave radiation [W/m^2]

```

The above inventories consist of several fields separated by colons. The contents of the fields are as follows:

- 1) Record number
- 2) Position in bytes
- 3) Date (YYYYMMDDHH)
- 4) Parameter name
- 5) Type of level/layer (grib PDS octet 10)
- 6) KPDS5, KPDS6, KPDS7 (grib PDS octets 9, 10, 11-12)
- 7) Forecasts, analysis, etc.
- 8) Description of parameter type

Users are suggested to refer to the metadata associated (See Appendix A) with the GRIB files for more details about the type of level/layer information.

2. Extract a specific field from GRIB data

Usage	<code>wgrib -s infile grep ":field_name:" wgrib -i infile -o outfile</code>
Convert to a binary file	<code>wgrib -s GLDAS_NOAH10_3H.A19480101.0300.020.grb grep ":SoilM:0-10" wgrib -i GLDAS_NOAH10_3H.A19480101.0300.002.grb -o SoilM0_10cm.1948010103.bin</code>
Convert to a text file	<code>wgrib -s GLDAS_NOAH10_3H.A19480101.0300.020.grb grep ":SoilM:0-10" wgrib -i GLDAS_NOAH10_3H.A19480101.0300.002.grb -text -o SoilM0_10cm.1948010103.txt</code>

Examples are for converting a specific GRIB field, e.g., Soil Moisture to a binary file and a text file respectively.

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A sample swe.1948010103.txt file looks like:

```
360 150
9.999e+20
9.999e+20
.....
9.999e+20
9.999e+20
24.403
23.854
23.289
23.22
21.48
9.999e+20
.....
```

The first line shows there are 150 (lines) by 360 (columns) grids globally from south to north. The values are actually listed in one column. The undefined value is 9.999e+20.

Reading/viewing the data by GrADS

The Grid Analysis and Display System (GrADS) is an interactive desktop tool for easy access, manipulation, and visualization of earth science data. GrADS supports several data formats, such as binary, GRIB, NetCDF, and HDF. The documentation and software for GrADS can be found at: <http://grads.iges.org/grads/>.

1. Preparation for using GrADS

Set the environmental variables (See *Set GLDAS-specific GRIB Parameter Table* above) first before starting GrADS. For more information, please visit [grib2ctl home page](#).

1) Create a GrADS control file for GRIB files by using script grib2ctl.pl

Usage:	<code>grib2ctl.pl [options] [grib file] [optional index file]>[control file]</code>
Example:	<code>grib2ctl.pl GLDAS_NOAH10_3H.19480101.0300.020.grb>GLDAS_NOAH10_3H.020.ctl</code>

2) Create the "grib map" file by using gribmap (gribmap is in GrADS)

Usage:	<code>gribmap [options] [control file]</code>
Example:	<code>gribmap -O -i GLDAS_NOAH10_3H.020.ctl</code>

Notes:

- A. Be sure to use appropriate option for each product.
- B. Also, the output from grib2ctl.pl (step #1 above) may list the "tdef" line with 2 times instead of 1, and the start time with one hour before the time of the file. If so, before step #2, edit the "ctl" file to change "tdef 2" to "tdef 1" and change the hour of the file, OR leave the "ctl" file as is, and then after step #2 and opening GrADS, be sure to "set t 2" before plotting the data.

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Sample GrADS control file for viewing the 3-hourly data (GLDAS_NOAH10_3H.020.ctl):

```
dset ./GLDAS_NOAH10_3H.020/%y4/%m2/%d2/GLDAS_NOAH10_3H.A%y4%m2%d2.%h200.020.grb
options template
index ^./GLDAS_NOAH10_3H.020.idx
undef 9.999E+20
title GLDAS Version 2.0 Noah 1.0 degree 3-hourly data
* produced by grib2ctl v0.9.12.5p39c
dtype grib 0
xdef 360 linear -179.500000 1.000000
ydef 150 linear -59.500000 1
zdef 1 linear 1 1
tdef 184087 linear 03Z01jan1948 3hr
vars 28
AvgSurfTsf 0 148,1,0 ** surface Average Surface Temperature [K]
CanopIntsf 0 223,1,0 ** surface Plant canopy surface water [kg/m^2]
EvapSfc 0 57,1,0 ** surface Total Evapotranspiration [kg/m^2/s]
LWdownSfc 0 205,1,0 ** surface Surface incident longwave radiation [W/m^2]
LWnetSfc 0 112,1,0 ** surface Net Longwave Radiation [W/m^2]
PSurfSfc 0 1,1,0 ** surface Surface pressure [Pa]
QairSfc 0 51,1,0 ** surface Near surface specific humidity [kg/kg]
Qgsfc 0 155,1,0 ** surface Ground Heat Flux [W/m^2]
Qhsfc 0 122,1,0 ** surface Sensible Heat Flux [W/m^2]
Qlesfc 0 121,1,0 ** surface Latent Heat Flux [W/m^2]
Qssfc 0 235,1,0 ** surface Surface Runoff [kg/m^2/s]
Qsbsfc 0 234,1,0 ** surface Subsurface Runoff [kg/m^2/s]
Qsmsfc 0 99,1,0 ** surface Snowmelt [kg/m^2/s]
RainSfc 0 162,1,0 ** surface Rainfall rate [kg/m^2/s]
SWEsfc 0 65,1,0 ** surface Snow Water Equivalent [kg/m^2]
SWdownSfc 0 204,1,0 ** surface Surface incident shortwave radiation [W/m^2]
SWnetSfc 0 111,1,0 ** surface Net Shortwave Radiation [W/m^2]
SnowSfc 0 161,1,0 ** surface Snowfall rate [kg/m^2/s]
SoilM0_10cm 0 86,112,10 ** 0-10 cm underground Soil moisture content [kg/m^2]
SoilM10_40cm 0 86,112,2600 ** 10-40 cm underground Soil moisture content [kg/m^2]
SoilM40_100cm 0 86,112,10340 ** 40-100 cm underground Soil moisture content [kg/m^2]
SoilM100_200cm 0 86,112,25800 ** 100-200 cm underground Soil moisture content [kg/m^2]
TSoil0_10cm 0 85,112,10 ** 0-10 cm underground Soil temperature [K]
TSoil10_40cm 0 85,112,2600 ** 10-40 cm underground Soil temperature [K]
TSoil40_100cm 0 85,112,10340 ** 40-100 cm underground Soil temperature [K]
TSoil100_200cm 0 85,112,25800 ** 100-200 cm underground Soil temperature [K]
TairSfc 0 11,1,0 ** surface Near surface air temperature [K]
WindSfc 0 32,1,0 ** surface Near surface wind speed [m/s]
ENDVARS
```

Sample GrADS control file for monthly the data (GLDAS_NOAH10_M.020.ctl):

```
dset ^./GLDAS_NOAH10_M.020/%y4/GLDAS_NOAH10_M.A%y4%m2.020.grb
options template
```

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```
index ^./GLDAS_NOAH10_M.020.idx
undef 9.999E+20
title GLDAS Version 2.0 Noah 1.0 degree monthly data
* produced by grib2ctl v0.9.12.5p39c
dtype grib 255
xdef 360 linear -179.500000 1.000000
ydef 150 linear -59.500000 1
zdef 1 linear 1 1
tdef 756 linear 00Z01jan1948 1mo
vars 28
AvgSurfTsf 0 148,1,0 ** surface Average Surface Temperature [K]
Canopintsf 0 223,1,0 ** surface Plant canopy surface water [kg/m^2]
Evapstsf 0 57,1,0 ** surface Total Evapotranspiration [kg/m^2/s]
LWdownstsf 0 205,1,0 ** surface Surface incident longwave radiation [W/m^2]
LWnetstsf 0 112,1,0 ** surface Net Longwave Radiation [W/m^2]
PSurfstsf 0 1,1,0 ** surface Surface pressure [Pa]
Qairstsf 0 51,1,0 ** surface Near surface specific humidity [kg/kg]
Qgstsf 0 155,1,0 ** surface Ground Heat Flux [W/m^2]
Qhstsf 0 122,1,0 ** surface Sensible Heat Flux [W/m^2]
Qlestsf 0 121,1,0 ** surface Latent Heat Flux [W/m^2]
Qsstsf 0 235,1,0 ** surface Surface Runoff [kg/m^2/s]
Qbstsf 0 234,1,0 ** surface Subsurface Runoff [kg/m^2/s]
Qsmstsf 0 99,1,0 ** surface Snowmelt [kg/m^2/s]
Rainstsf 0 162,1,0 ** surface Rainfall rate [kg/m^2/s]
SWEstsf 0 65,1,0 ** surface Snow Water Equivalent [kg/m^2]
SWdownstsf 0 204,1,0 ** surface Surface incident shortwave radiation [W/m^2]
SWnetstsf 0 111,1,0 ** surface Net Shortwave Radiation [W/m^2]
Snowfstsf 0 161,1,0 ** surface Snowfall rate [kg/m^2/s]
SoilM0_10cm 0 86,112,10 ** 0-10 cm underground Soil moisture content [kg/m^2]
SoilM10_40cm 0 86,112,2600 ** 10-40 cm underground Soil moisture content [kg/m^2]
SoilM40_100cm 0 86,112,10340 ** 40-100 cm underground Soil moisture content [kg/m^2]
SoilM100_200cm 0 86,112,25800 ** 100-200 cm underground Soil moisture content [kg/m^2]
TSoil0_10cm 0 85,112,10 ** 0-10 cm underground Soil temperature [K]
TSoil10_40cm 0 85,112,2600 ** 10-40 cm underground Soil temperature [K]
TSoil40_100cm 0 85,112,10340 ** 40-100 cm underground Soil temperature [K]
TSoil100_200cm 0 85,112,25800 ** 100-200 cm underground Soil temperature [K]
Tairstsf 0 11,1,0 ** surface Near surface air temperature [K]
Windstsf 0 32,1,0 ** surface Near surface wind speed [m/s]
ENDVARS
```

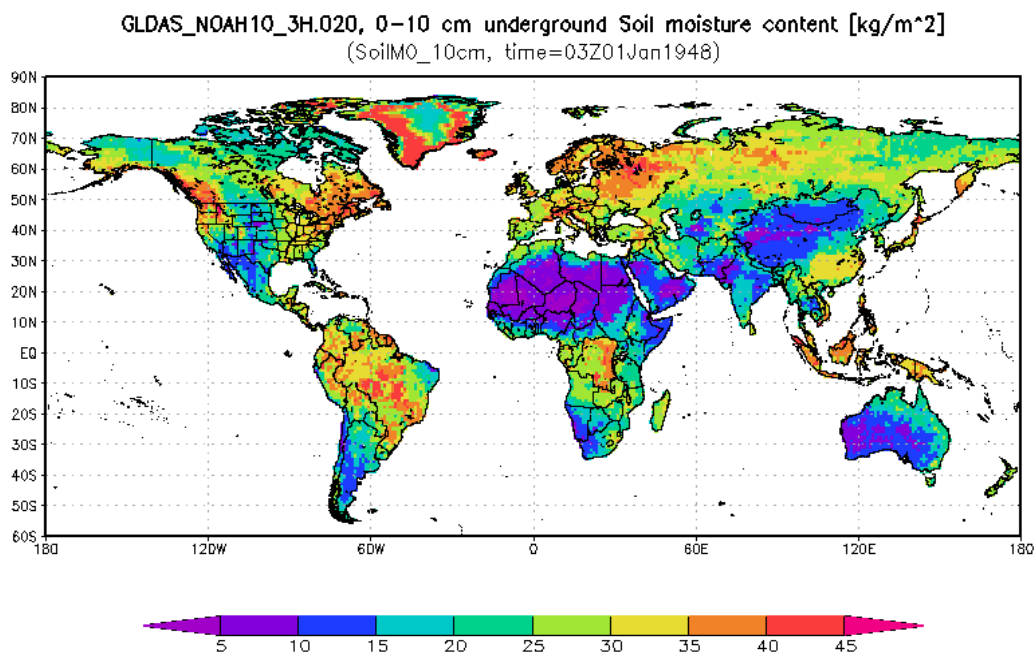
2. View the data by GrADS

Example for viewing GLDAS-2 data by GrADS:

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```
'reinit'  
'open GLDAS_NOAH025_3H.020.ctl'  
'set lon -180 180'  
'set lat -90 90'  
'set gxout grfill'  
'set grads off'  
'set time 03Z01Jan1948'  
'd SoilMO_10cm'  
'set rbclos'  
'run cbarn'  
'draw title GLDAS_NOAH025_3H.002, 0-10 cm Underground Average layer 4 soil moisture  
[kg/m^2] \ (SoilMO_10cm, time=03Z01Jan1948)'  
'printim GLDAS_NOAH10_M.SoilMO_10cm.A19480101.0300.020.gif white'
```

Sample image:



Retrieve Data through the GrADS Data Server (GDS)

The [GrADS Data Server](#) is a stable, secure data server that provides subsetting and analysis services across the internet. The GLDAS-2 data is accessible via [the GDS at GES DISC](#). Here is an example of the GrADS script to access the GDS server and plot the 0-10 cm underground average layer 4 soil moisture, without downloading the data.

Example for viewing GLDAS-2 data by GrADS via GDS access:

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```
'reinit'  
'sdfopen http://hydro1.sci.gsfc.nasa.gov/dods/GLDAS_NOAH10_3H.002'  
'open GLDAS_NOAH025_3H.002.ctl'  
'set lon -180 180'  
'set lat -90 90'  
'set gxout grfill'  
'set grads off'  
'set time 03Z01Jan1948'  
'd SoilMO_10cm'  
'set rbcsls'  
'run cbarn'  
'draw title GLDAS_NOAH025_3H.020, 0-10 cm Underground Average layer 4 soil moisture  
[kg/m^2] \ (SoilMO_10cm, time=03Z01Jan1948)'  
'printim GLDAS_NOAH10_M.SoilMO_10cm.A19480101.0300.020.gif white'
```

Users can convert the GLDAS data to ASCII or binary format on the fly, using a standard web browser through a constructed URL. Here is an example for “[How to retrieve GLDAS and GLDAS data via GDS as ASCII text?](http://hydro1.sci.gsfc.nasa.gov/dods/GLDAS_NOAH10_M.020.ascii?soilm0_10cm[0:2][50:53][110:116])”

[http://hydro1.sci.gsfc.nasa.gov/dods/GLDAS_NOAH10_M.020.ascii?soilm0_10cm\[0:2\]\[50:53\]\[110:116\]](http://hydro1.sci.gsfc.nasa.gov/dods/GLDAS_NOAH10_M.020.ascii?soilm0_10cm[0:2][50:53][110:116])

The output looks like:

```
soilm0_10cm, [3][4][7]  
[0][0], 29.814, 30.282, 30.037, 30.337, 30.304, 32.493, 38.007  
[0][1], 37.748, 32.297, 32.317, 32.549, 32.433, 32.604, 32.826  
[0][2], 38.14, 38.299, 32.915, 32.934, 32.487, 32.794, 32.679  
[0][3], 33.186, 33.405, 38.783, 33.299, 33.008, 32.815, 32.726  
  
[1][0], 29.386, 30.007, 29.575, 30.099, 29.799, 32.18, 38.319  
[1][1], 37.625, 31.946, 31.927, 31.849, 31.583, 31.601, 31.598  
[1][2], 37.951, 37.787, 32.15, 31.97, 31.714, 31.702, 31.131  
[1][3], 32.766, 32.704, 38.043, 32.259, 32.028, 31.528, 31.511  
  
[2][0], 30.262, 30.806, 29.965, 30.635, 30.717, 32.336, 37.944  
[2][1], 38.438, 32.994, 32.306, 32.579, 32.24, 32.762, 32.215  
[2][2], 38.276, 38.376, 32.901, 32.745, 32.452, 32.479, 32.511  
[2][3], 33.302, 33.147, 38.814, 33.395, 32.412, 32.383, 32.295  
  
time, [3]  
711128.0, 711159.0, 711188.0  
lat, [4]  
-9.5, -8.5, -7.5, -6.5  
lon, [7]  
-69.5, -68.5, -67.5, -66.5, -65.5, -64.5, -63.5
```

The expression `soilm0_10cm[0:2][50:53][110:116]` is an array expression; the numbers are array indexes, starting from 0; and "soilm0_10cm" is the variable name for "0_10 cm underground average layer 1 soil moisture".

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The dimension information is listed at the end of the results page. For this example, they are time, latitude, and longitude.

The time indexes, "711128.0, 711159.0, 711188.0" are for days referenced from 00z01Jan0001. For this GLDAS-2 Monthly Noah data, corresponding time steps are Jan 1948, Feb 1948, and Mar 1948.

10.
11.
12.
13.
14.
15.

16.
17.

Data Access

The NASA GES DISC maintains archives of all GLDAS data products and many other Hydrology data sets. The archived data can be accessed via FTP network transfer. GLDAS data can be accessed via the GES DISC's Hydrology Data and Information Services Center (HDISC), <http://disc.sci.gsfc.nasa.gov/hydrology/data-holdings>.

Data Volume

Model	Resolution	3-Hourly		Monthly	
		Files/day	Vol/Year	Files/year	Vol/Year
Noah	1.0° × 1.0°	8	2.6 GB	12	9.6 MB
Noah	0.25° × 0.25°	8	45 GB	12	190 MB
Catchment	1.0° × 1.0°	8			
CLM	1.0° × 1.0°	8			
VIC	1.0° × 1.0°	8			

The table will be updated as data volume information for other models become available.

Search and download data via Mirador

GLDAS data can be searched through a keyword (e.g., Noah) and the time span, and downloaded in a batch mode via Mirador, <http://mirador.gsfc.nasa.gov/>.

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Mirador is a fast interface for searching Earth science data at NASA GES DISC.

Access data via GrADS Data Server (GDS)

The GLDAS products are accessible via the GDS at <http://hydro1.sci.gsfc.nasa.gov/dods/>.

The GDS is a stable, secure data server that provides subsetting and analysis services across the internet. The GDS supports any operation that can be expressed in a single GrADS expression, including basic math functions, averages, smoothing, differencing, correlation, and regression. (See the example in Retrieve Data through the GrADS Data Server (GDS) above.)

Anonymous ftp

The GLDAS data can be downloaded directly via the GES DISC anonymous ftp: <ftp://hydro1.gsfc.nasa.gov/data/s4pa/GLDAS/>.

Points of Contact

For information about or assistance in using any GES DISC data, please contact the GES DISC Help Desk at:

GES DISC
Code 610.2
NASA Goddard Space Flight Center
Greenbelt, Maryland 20771
Email: gsfc-help-disc@lists.nasa.gov
301-614-5224 (voice)
301-614-5268 (fax)

For general science questions and comments, please contact:

Hiroko Kato Beaudoin, M.S.
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University of Maryland, College Park
Hydrological Sciences Laboratory, Code 617
NASA Goddard Space Flight Center
Greenbelt, MD 20771
Email: Hiroko.Kato-1@nasa.gov
Phone: 301-286-3951

Or

Matthew Rodell, Ph.D.
Hydrological Sciences Laboratory, Code 617
NASA Goddard Space Flight Center
Greenbelt, MD 20771

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References

Carroll, ML, Townshend, JR, DiMiceli, CM, Noojipady, P, Sohlberg, RA (2009). A new global raster water mask at 250 m resolution. INTERNATIONAL JOURNAL OF DIGITAL EARTH, 2(4), 291-308.

Friedl, M.A., Sulla-Menashe, D., Tan, B., Schneider, A., Ramankutty, N., Sibley, A., & Huang, X. (2010). MODIS Collection 5 global land cover: Algorithm refinements and characterization of new datasets. Remote Sensing of Environment, 114, 168-182.

Reynolds C.A., T. J. Jackson, and W.J. Rawls. (1999). Estimating Available Water Content by Linking the FAO Soil Map of the World with Global Soil Profile Databases and Pedo-transfer Functions. Proceedings of the AGU 1999 Spring Conference, Boston, MA. May 31-June 4, 1999.

Sheffield, J., G. Goteti, and E. F. Wood, 2006: Development of a 50-yr high-resolution global dataset of meteorological forcings for land surface modeling, J. Climate, 19 (13), 3088-3111

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.

Appendices

A. Description of Metadata

Table A.1. Collection level metadata

Metadata items	
C1. Collection data description	
1.	ShortName
2.	LongName
3.	TemporalRange
4.	SpatialCoverage
5.	DataResolution
6.	Format (e.g., GRIB1)
7.	LandSurfaceModel
8.	LandSurfaceModelVersionID
C2. ScienceParameter group (Parameters listed in Table 2)	

Table A.2. Granule level metadata

Metadata items	
G1. General description	
1.	GranuleID
2.	GranuleDate
3.	LatitudeResolution
4.	LongitudeResolution
5.	Format (e.g., GRIB1)
6.	SizeBytesDataGranule
7.	LandSurfaceModel
G2. Grib data description	
1.	SouthernmostLatitude
2.	NorthernmostLatitude
3.	WesternmostLongitude
4.	EasternmostLongitude
5.	BeginningDateTime
6.	EndingDateTime
G3. ScienceParameter Group	
1.	ParameterShortName
2.	ParameterLongName
3.	Center
4.	Subcenter
5.	Process
6.	Level (or Layer)
7.	Height (or Pressure)
8.	TimeRange
9.	PeriodTime1

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10.	PeriodTime2
11.	ForecastTimeUnit
12.	GridSize
13.	ForecastAnalysisFlag
14.	NumberGridsAverage
15.	MinValueData
16.	MaxValueData
G4.	Ingest information
1.	ProductionDateTime
2.	InsertDateTime

B. User-defined Parameter Tables for Different GRIB Files

Below is the parameter tables used for GLDAS-2 data. A master table is used for all GLDAS-2.x products. It is necessary to set the respective parameter table before using WGRIB or GrADS to read the data.

Table B.1. GLDAS-2 grib table

```
-1:-1:-1:-1
179:ACond:Aerodynamic conductance [m/s]
84:Albedo:Surface Albedo, All Wavelengths [unitless]
148:AvgSurfT:Average Surface Temperature [K]
147:BareSoilT:Temperature of bare soil [K]
223:Canopint:Plant canopy surface water [kg/m^2]
200:ECanop:Canopy water evaporation [kg/m^2/s]
199:ESoil:Bare soil evaporation [kg/m^2/s]
57:Evap:Total Evapotranspiration [kg/m^2/s]
22:Landcover:Vegetation type [unitless]
205:LWdown:Surface incident longwave radiation [W/m^2]
112:LWnet:Net Longwave Radiation [W/m^2]
228:PotEvap:Potential evaporation [kg/m^2/s]
59:Precforc:Total precipitation rate [kg/m^2/s]
1:PSurf:Surface pressure [Pa]
51:Qair:Near surface specific humidity [kg/kg]
155:Qg:Ground Heat Flux [W/m^2]
122:Qh:Sensible Heat Flux [W/m^2]
121:Qle:Latent Heat Flux [W/m^2]
235:Qs:Surface Runoff [kg/m^2/s]
234:Qsb:Subsurface Runoff [kg/m^2/s]
99:Qsm:Snowmelt [kg/m^2/s]
149:RadT:Surface Radiative Temperature [K]
162:Rainf:Rainfall rate [kg/m^2/s]
173:RootMoist:Root zone soil moisture [kg/m^2]
66:SnowDepth:Snow Depth [m]
161:Snowf:Snowfall rate [kg/m^2/s]
165:SnowT:Snow Surface Temperature [K]
```

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```
86:SoilM:Soil moisture content [kg/m^2]
224:Soiltype:Soil type [unitless]
204:SWdown:Surface incident shortwave radiation [W/m^2]
65:SWE:Snow Water Equivalent [kg/m^2]
111:SWnet:Net Shortwave Radiation [W/m^2]
11:Tair:Near surface air temperature [K]
85:TSoil:Soil temperature [K]
210:TVeg:Vegetation transpiration [kg/m^2/s]
146:VegT:Vegetation Canopy Temperature [K]
32:Wind:Near surface wind speed [m/s]
```

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C. Acronyms

The following acronyms and abbreviations are used in this document.

CAPE	Convective Available Potential Energy
CMORPH	CPC precipitation MORPHing technique
CPC	NCEP's Climate Prediction Center
CPPA	Climate Prediction Program for the Americas
EMC	NCEP's Environmental Modeling Center
GDS	GrADS Data Server
GES DISC	Goddard Earth Sciences Data and Information Services Center
Giovanni	GES-DISC Interactive On-line Visualization and Analysis Infrastructure
GLDAS	Global Land Data Assimilation System
GrADS	Grid Analysis and Display System
GRIB	GRIdded Binary
HDF	Hierarchical Data Format
HDISC	Hydrology Data and Information Services Center
LDAS	Land Data Assimilation System
LIS	Land Information System
LSM	Land Surface Model
Mirador	Fast interface for searching Earth science data at NASA GES DISC
NARR	North American Regional Reanalysis
NASA	National Aeronautics and Space Administration
NCEP	National Centers for Environmental Prediction
netCDF	network Common Data Form
NIDIS	National Drought Integrated Information System
NLDAS	North America Land Data Assimilation System
NOAA	National Oceanic and Atmospheric Administration
OHD	NOAA's Office of Hydrologic Development
PDS	Product Definition Section (for GRIB ID)
PRISM	Parameter-Elevation Regressions on Independent Slopes Model
SAC	Sacramento model
SVAT	Soil Vegetation Atmosphere Transfer model
VIC	Variable Infiltration Capacity macroscale model
WSR-88D	Weather Service Radar-Doppler