README Document for

Global Land Data Assimilation System Version 1 (GLDAS-1) Products

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Revision History

Revision Date	***Changes***	***Author***
08/21/2007	Initial version	Hongliang Fang
10/05/2007	Revise based on review	Hongliang Fang
03/05/2008	Add GDS service	Hongliang Fang
07/31/2008	Add VIC products, reprocessed monthly data	Hongliang Fang
05/15/2009	Add Data Services	Hongliang Fang
10/06/2009	Add Online Visualization and Analysis in Giovanni	Hongliang Fang
12/07/2009	Add Caveats section	Hongliang Fang
11/08/2010	Update two outdated links for GLDAS Forcing parameters	Hualan Rui
11/09/2010	Add a column into the Table 2 to indicate GLDAS Forcing parameters and modify the corresponding table description.	Hualan Rui
03/15/2011	Update the outdated links related to GLDAS-1 data migration from agdisc to hydro1.	Hualan Rui
11/21/2011	Update GES DISC Helpdesk email address	Hualan Rui
05/11/2015	Add Table 3: DOIs for GLDAS-1 data products	Hualan Rui
05/27/2016	Updated hydro1 related URLs	Hualan Rui

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Caveats

Dec 1, 2009. An input parameter error for the 3-hourly products for CLM, Mosaic and Noah models covering August 1-13, 2009 was corrected and republished in October, 2009. Users of these products delivered in September, 2009 are recommended to download the republished data.

Dec 1, 2009. Due to uncertain data quality in the rainfall, pressure and humidity forcing data during mid 1995-1997, the soil moisture and other fields during this period are highly uncertain.

Introduction

This document provides basic information on the land surface state (e.g., soil moisture and surface temperature) and flux (e.g., evaporation and sensible heat flux) parameters generated by the Global Land Data Assimilation System (GLDAS). 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): Mosaic, 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.

The temporal resolution for the GLDAS products is 3-hourly. Monthly products are also generated through temporal averaging of the 3-hourly products. Output files from these four models are briefly described here. Table 1 lists some basic characteristics of the GLDAS data.

Table 1. Basic characteristics of the GLDAS data.

Contents	Water and energy budget components, forcing data
Latitude extent	-60° to 90°
Longitude extent	-180° to 180°
Spatial resolution	0.25°, 1.0°
Temporal resolution	3-hourly or monthly
Temporal coverage	January 1, 1979 to present for the 1.0° data February 24, 2000 to 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 (1st grid center)	(179.5W, 59.5S) for the 1.0° data (179.875W, 59.875S) for the 0.25° data
Land surface models	CLM 2.0, GLDAS/CLM experiment 691 (1.0°) MOSAIC, GLDAS/MOSAIC experiment 691 (1.0°) NOAH 2.7, GLDAS/NOAH experiment 691 (1.0°)

	VIC water balance, GLDAS/VIC experiment 692 (1.0°) NOAH 2.7, GLDAS/NOAH experiment 881 (0.25°)

The data used by LIS include parameter data and forcing data. All model simulations were initialized on January 1, 1979 using soil moisture and other state fields from the respective LSM climatology for that day of the year. The 1.0 degree resolution data range from 1979 to present for the four models. The 0.25 degree data cover 2000 to present from the NOAH model. The forcing data set combines multiple data sets for the period of January 1, 1979 to present:

1979-1993: bias-corrected European Center for Medium-Range Weather Forecasts (ECMWF) Reanalysis data (Berg et al., 2003)
1994-1999: bias-corrected National Center for Atmospheric Research (NCAR) Reanalysis data (Berg et al., 2003)
2000: NOAA/GDAS atmospheric analysis fields (Derber et al., 1991)
2001-present: a combination of NOAA/GDAS atmospheric analysis fields, spatially and temporally disaggregated NOAA Climate Prediction Center Merged Analysis of Precipitation (CMAP) fields, and observation-based downward shortwave and longwave radiation fields derived using the method of the Air Force Weather Agency's AGRicultural METeorological modeling system (AGRMET)

In NOAH experiment 881, snow cover data derived from the MODIS sensor aboard NASA's Terra satellite were assimilated in order to constrain the modeled snow water equivalent (SWE), using the updating technique described by Rodell and Houser (2004). SWE was adjusted when and where there was a discrepancy between the modeled SWE state (snow or no snow) and the MODIS snow cover state. A quantity of 10 mm SWE was added to pixels where the model did not have snow but the fractional MODIS snow cover was greater than 40%. Snow was removed from model pixels where MODIS indicated fractional snow cover was less than 10%.

Updates

The initial release of the GLDAS LSM data is in three phases. Currently, with Phase 1 and Phase 2, users can access the data by searching and downloading via anonymous ftp or Mirador. Mirador, a Spanish word for a window offering an extensive view, uses keywords to find data quickly in a Google-like interface. Users can perform spatial and parameter subsetting and transform the data into netCDF format on-the-fly. The GLDAS data are also provided to GrADS Data Server (GDS) users via http://hydro1.gesdisc.eosdis.nasa.gov/dods/. GDS users can access the data, perform subsetting and analysis operations without first downloading them. More advanced tools will be provided in Phase 3 and later releases, such as temporal aggregation in Mirador, and an online visualization and analysis tool (Giovanni). Giovanni is a Web-based application developed by the GES DISC that provides a simple and intuitive way to visualize, analyze, and access vast amounts of Earth science remote sensing data without having to download the data.

Please check periodically the GES DISC web site for the latest GLDAS data.

Data Citation

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:

"*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:

GES DISC Help Desk
Code 610.2
NASA/Goddard Space Flight Center
Greenbelt, MD 20771

Data Organization

File Naming Convention

1. 3-hourly data set

For the 3-hourly data from the CLM, Mosaic and Noah models, the GLDAS files are named in accordance with the following convention:

GLDAS_<Land surface model><LSM resolution>SUBP_3H.A<date>.<HHHH>.<product version>.<Production date and time>.grb

The format for the date is <YYYY><Day of year>. The format for the production date and time is

<YYYY><Day of year><HHMMSS>

For example, the 1.0°×1.0° GLDAS data from NOAH model at 15:00Z on January 2, 1979 can be found in the file named: "GLDAS_NOAH10SUBP_3H.A1979002.1500.001.2007159150213.grb".

For the 3-hourly VIC data, the files are named with the following convention:

GLDAS_<Land surface model><LSM resolution>_3H.A<date>.<HHHH>.<product version>.grb

For example, the file "GLDAS_VIC10_3H.A2008121.2100.001.grb" is of the 1.0°×1.0° VIC data at 21:00Z on April 30, 2008.

2. Monthly average data set

The monthly data are named in accordance with the following convention:

> GLDAS_<Land surface model><LSM resolution>_M.A<date>.<product version>. grb

The format for the date is <YYYY><Month>. For example, the 1.0°×1.0° data from CLM model in January, 2007 are in the following file: "GLDAS_CLM10_M.A200701.001.grb".

File Format Structure

The GLDAS LSM data were created using the GRIdded Binary (GRIB) format. For more details about the GRIB format, please see http://www.nco.ncep.noaa.gov/pmb/docs/on388/.

Please note that GLDAS applies user-defined parameter tables (see Appendix B) for the GRIB files.

Users can also download the GLDAS products in netCDF format on-the-fly from the Mirador search and access tool. The converted netCDF files are compliant with the Climate and Forecast (CF) metadata convention. For more details about the netCDF format, please see http://www.unidata.ucar.edu/software/netcdf/

Data Contents

Table 2 shows a list of parameters provided in the GRIB files. This table shows the GRIB Product Definition Section (PDS) ID, the corresponding parameter name, the units, the time information, and the indication of Forcing parameters. The GLDAS data set includes predicted fields from the land surface models as well as input meteorological fields that were used as forcing. See the Parameter Information Page (PIP) for details about the parameters.

Table 2. Geophysical parameters in the subsetted GLDAS data set

PDS IDs	Full Name	Unit	Time	Forcing Parameter
001	Surface pressure	Pa	Instantaneous	Yes
011	Near surface air temperature	K	Instantaneous	Yes
032	Near surface wind magnitude	m/s	Instantaneous	Yes

051	Near surface specific humidity	kg/kg	Instantaneous	Yes
057	Total evapotranspiration	kg/m^2/s	Past 3-hr average	
065	Snow water equivalent	kg/m^2	Instantaneous	
071	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[1]	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	
122	Sensible heat flux	W/m^2	Past 3-hr average	
131	Snowfall rate	kg/m^2/s	Past 3-hr average	Yes
132	Rainfall rate	kg/m^2/s	Past 3-hr average	Yes
138	Average surface temperature	K	Instantaneous	
155	Ground heat flux	W/m^2	Past 3-hr average	
204	Surface incident shortwave radiation	W/m^2	Instantaneous	Yes
205	Surface incident longwave radiation	W/m^2	Instantaneous	Yes
234	Subsurface runoff	kg/m^2/s	Past 3-hr average	
235	Surface runoff	kg/m^2/s	Past 3-hr average	

[1]kg/m^2/s for the CLM, Mosaic and VIC models and kg/m^2 for the Noah model (both 1.0º and 0.25 º).

The number of vertical levels for Soil Temperature (PDS 085) and Soil Moisture (PDS 086) is model specific. There are 10, 3, 4 and 3 layers for the CLM2, Mosaic, Noah, and VIC models, respectively.

The VIC simulation is in water balance mode and does not compute energy fluxes. Therefore the VIC data includes water budget components and forcing fields but without energy budget components (see the list of components at the Parameter Information Page (PIP)).

Reading the Data

WGRIB, GrADS, or other GRIB readers are required for reading the GLDAS data. WGRIB is a program to manipulate, inventory, and decode GRIB files. The source code and installation instructions for WGRIB are available from http://www.cpc.ncep.noaa.gov/products/wesley/wgrib.html.

WGRIB version 1.7.X is recommended to avoid any possible discrepancies caused by different WGRIB versions. The GLDAS data set applies a user-specific parameter table to indicate the content and parameter number.

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://cola.gmu.edu/grads/grads.php.

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~B.4, for each land surface model, respectively. 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 on the shell.

Example:

```
set GRIBTAB=~/data/gribtab                    (MS-DOS or Windows)
export GRIBTAB=~/data/gribtab                 (bash)
setenv GRIBTAB ~/data/gribtab                 (csh)
GRIBTAB=$HOME/data/gribtab; export GRIBTAB    (sh)
```

S*ample WGRIB Usage*

Download the GRIBTAB and set the environmental variables (See Appendix B) first before using wgrib! By default, WGRIB uses the NCEP parameter tables instead of the GLDAS ones.

1. GRIB data verbose inventory

Usage: ./wgrib [grib file] [options]
Example:

wgrib GLDAS_CLM10SUBP_3H.A2007121.0000.001.2007297114034.grb -v > t

```
1:0:D=2007043021:SWnet:sfc:kpds=111,1,0:0-3hr ave:"Net Shortwave Radiation          W/m^2
2:37204:D=2007043021:LWnet:sfc:kpds=112,1,0:0-3hr ave:"Net Longwave Radiation          W/m^2
3:72510:D=2007043021:Qle:sfc:kpds=121,1,0:0-3hr ave:"Latent Heat Flux                W/m^2
4:109714:D=2007043021:Qh:sfc:kpds=122,1,0:0-3hr ave:"Sensible Heat Flux              W/m^2
5:146918:D=2007043021:Qg:sfc:kpds=155,1,0:0-3hr ave:"Ground Heat Flux                W/m^2
6:184122:D=2007050100:Snowf:sfc:kpds=131,1,0:anl:"Snowfall rate                  kg/m^2/s
7:221326:D=2007050100:Rainf:sfc:kpds=132,1,0:anl:"Rainfall rate                  kg/m^2/s
8:258530:D=2007050100:Evap:sfc:kpds=57,1,0:anl:"Total Evapotranspiration         kg/m^2/s
9:293836:D=2007050100:Qs:sfc:kpds=235,1,0:anl:"Surface Runoff                    kg/m^2/s
10:331040:D=2007050100:Qsb:sfc:kpds=234,1,0:anl:"Subsurface Runoff               kg/m^2/s
11:368244:D=2007043021:Qsm:sfc:kpds=99,1,0:0-3hr ave:"Snowmelt                   kg/m^2/s
12:380778:D=2007050100:AvgSurfT:sfc:kpds=138,1,0:anl:"Average Surface Temperature      K
13:412288:D=2007050100:SWE:sfc:kpds=65,1,0:anl:"Snow Water Equivalent            kg/m^2
```

```
14:449492:D=2007050100:TSoil10:0-110 cm down:kpds=85,112,110:anl:"Average layer 10 soil
temperature   K
15:481002:D=2007050100:TSoil10:0-109 cm down:kpds=85,112,109:anl:"Average layer 10 soil
temperature   K
16:512512:D=2007050100:TSoil10:0-108 cm down:kpds=85,112,108:anl:"Average layer 10 soil
temperature   K
17:544022:D=2007050100:TSoil10:0-107 cm down:kpds=85,112,107:anl:"Average layer 10 soil
temperature   K
18:575532:D=2007050100:TSoil10:0-106 cm down:kpds=85,112,106:anl:"Average layer 10 soil
temperature   K
19:607042:D=2007050100:TSoil10:0-105 cm down:kpds=85,112,105:anl:"Average layer 10 soil
temperature   K
20:638552:D=2007050100:TSoil10:0-104 cm down:kpds=85,112,104:anl:"Average layer 10 soil
temperature   K
21:670062:D=2007050100:TSoil10:0-103 cm down:kpds=85,112,103:anl:"Average layer 10 soil
temperature   K
22:701572:D=2007050100:TSoil10:0-102 cm down:kpds=85,112,102:anl:"Average layer 10 soil
temperature   K
23:733082:D=2007050100:TSoil10:0-101 cm down:kpds=85,112,101:anl:"Average layer 10 soil
temperature   K
24:764592:D=2007050100:SoilM10:0-110 cm down:kpds=86,112,110:anl:"Average layer 10 soil moisture
kg/m^2
25:801796:D=2007050100:SoilM10:0-109 cm down:kpds=86,112,109:anl:"Average layer 10 soil moisture
kg/m^2
26:839000:D=2007050100:SoilM10:0-108 cm down:kpds=86,112,108:anl:"Average layer 10 soil moisture
kg/m^2
27:876204:D=2007050100:SoilM10:0-107 cm down:kpds=86,112,107:anl:"Average layer 10 soil moisture
kg/m^2
28:913408:D=2007050100:SoilM10:0-106 cm down:kpds=86,112,106:anl:"Average layer 10 soil moisture
kg/m^2
29:950612:D=2007050100:SoilM10:0-105 cm down:kpds=86,112,105:anl:"Average layer 10 soil moisture
kg/m^2
30:987816:D=2007050100:SoilM10:0-104 cm down:kpds=86,112,104:anl:"Average layer 10 soil moisture
kg/m^2
31:1025020:D=2007050100:SoilM10:0-103 cm down:kpds=86,112,103:anl:"Average layer 10 soil
moisture   kg/m^2
32:1062224:D=2007050100:SoilM10:0-102 cm down:kpds=86,112,102:anl:"Average layer 10 soil
moisture   kg/m^2
33:1099428:D=2007050100:SoilM10:0-101 cm down:kpds=86,112,101:anl:"Average layer 10 soil
moisture   kg/m^2
34:1136632:D=2007050100:Canopint:sfc:kpds=71,1,0:anl:"Total canopy water storage    kg/m^2
35:1170040:D=2007050100:Wind:sfc:kpds=32,1,0:anl:"Near surface wind magnitude     m/s
36:1197756:D=2007050100:Tair:sfc:kpds=11,1,0:anl:"Near surface air temperature      K
37:1229266:D=2007050100:Qair:sfc:kpds=51,1,0:anl:"Near surface specific humidity    kg/kg
38:1245594:D=2007050100:PSurf:sfc:kpds=1,1,0:anl:"Surface pressure                Pa
39:1282798:D=2007043021:SWdown:sfc:kpds=204,1,0:0-3hr ave:"Surface incident shortwave radiation
W/m^2
40:1320002:D=2007043021:LWdown:sfc:kpds=205,1,0:0-3hr ave:"Surface incident longwave radiation
W/m^2
```

The above inventory consists 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 (LAND=land/sea mask)
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 with the GRIB files for more details about the Type of level/layer information.

2. Extract a specific field from GRIB data, e.g., Total Evapotranspiration

Usage: wgrib -s infile | grep ":Evap:" | wgrib -i infile -o outfile
For example:

```
wgrib -s GLDAS_CLM10SUBP_3H.A1979002.0000.001.2007219013746.grb | grep ":Evap:" |
wgrib -i GLDAS_CLM10SUBP_3H.A1979002.0000.001.2007219013746.grb –o
evap.1979002.0000.grb
```

To convert it into a text file:

```
wgrib -s GLDAS_CLM10SUBP_3H.A1979002.0000.001.2007219013746.grb | grep ":Evap:" |
wgrib -i –text GLDAS_CLM10SUBP_3H.A1979002.0000.001.2007219013746.grb -o
evap.1979002.0000.txt
```

A sample evap.1979002.0000.txt file looks like:

```
 360 150
9.999e+20
9.999e+20
9.999e+20
9.999e+20
9.999e+20
9.999e+20
…
293.09
293.9
293.49
293.55
294.4
294.53
292.49
293.51
```

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

Preparation of GrADS Control File

Set the environmental variables (See Appendix B) first before starting GrADS. For more information, please visit grib2ctl home page.

1. Make a GrADS control file for GRIB files

Usage: grib2ctl [options] [grib file] [optional index file] >[control file]
Example:

grib2ctl.pl GLDAS_CLM10SUBP_3H.A1979002.0000.001.2007219013746.grb >clm10.ctl

2. Create the "map" file for using GRIB data in GrADS

Usage: gribmap [options] [control file]
Example:

```
gribmap -e -i clm10.ctl
gribmap -0 –i vic10.ctl
```

Hereunder is an example of a control file (clm10.ctl):

```
DSET   ^GLDAS_CLM10SUBP_3H.A1979002.0000.001.2007219013746.grb
INDEX ^GLDAS_CLM10SUBP_3H.A1979002.0000.001.2007219013746.grb.idx
UNDEF 9.999E+20
TITLE  GLDAS_CLM10SUBP_3H.A1979002.0000.001.2007219013746.grb
*  produced by grib2ctl v0.9.12.5p33i
DTYPE grib 0
YDEF   150 linear -59.500000 1
XDEF   360 linear -179.500000 1.000000
TDEF   2 linear 21Z01jan1979 3hr
ZDEF   10 levels
110 109 108 107 106 105 104 103 102 101
VARS 22
    AvgSurfTsfc  0 138,1,0  ** surface Average Surface Temperature       K
    Canopintsfc  0 71,1,0  ** surface Total canopy water storage    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
    Rainfsfc  0 132,1,0  ** 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
    Snowfsfc  0 131,1,0  ** surface Snowfall rate                    kg/m^2/s
    SoilM10dlr 10 86,112,0 ** Average layer 10 soil moisture     kg/m^2
    TSoil10dlr 10 85,112,0 ** Average layer 10 soil temperature  K
    Tairsfc  0 11,1,0  ** surface Near surface air temperature      K
    Windsfc  0 32,1,0  ** surface Near surface wind magnitude     m/s
ENDVARS
```

Retrieve GLDAS data through the GrADS Data Server (GDS)

Users can retrieve GLDAS data from a GDS server using analysis tools such as GrADS, Ferret, Matlab, or IDL. Here is an example of the GrADS script to access the GDS server and draw the Layer 10 soil moisture (soilm10) parameter from the CLM model.

```
'reinit'
'sdfopen
http://hydro1.gesdisc.eosdis.nasa.gov/dods/GLDAS_CLM10SUBP_3H'
'set lon -180 180'
'set lat -60 90'
'set gxout grfill'
'set grads off'
'set t 1'
'd soilm10'
'draw title GLDAS CLM 3-Hourly 1.0 degree Average Layer 10 Soil
```

Users can convert the GLDAS data to ASCII or binary format on the fly, using a standard web browser through a constructed URL. For example:
http://hydro1.gesdisc.eosdis.nasa.gov/dods/GLDAS_NOAH10_M.ascii?evap[0:1:1][91:1:93][81:1:85]

The output looks like:

```
evap, [2][3][5]
[0][0], 1.386E-5, 1.518E-5, 1.526E-5, 1.641E-5, 1.726E-5
[0][1], 1.577E-5, 1.554E-5, 1.56E-5, 1.628E-5, 1.786E-5
[0][2], 1.366E-5, 1.42E-5, 1.403E-5, 1.429E-5, 1.36E-5

[1][0], 1.691E-5, 1.694E-5, 1.69E-5, 1.864E-5, 2.04E-5
[1][1], 1.619E-5, 1.61E-5, 1.797E-5, 1.781E-5, 1.97E-5
[1][2], 1.495E-5, 1.556E-5, 1.655E-5, 1.718E-5, 1.742E-5


time, [2]
722451.0, 722482.0
lat, [3]
31.5, 32.5, 33.5
lon, [5]
-98.5, -97.5, -96.5, -95.5, -94.5
```

Data Interpretation

Please see Appendix B for the user-defined parameter tables needed for interpreting GRIB files.

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. The number of vertical levels for soil moisture (SOILM) and soil temperature (TSOIL) is model specific. Please follow the table below for the correct depths of soil layers.

CLM 2.0 (10 layers)	
Depths	0-0.018, 0.018-0.045, 0.045-0.091, 0.091-0.166, 0.166-0.289, 0.289-0.493, 0.493-0.829, 0.829-1.383, 1.383-2.296, and 2.296-3.433 m.
MOS (3 layers)	
Depths	0-0.02,0.02-1.50, and 1.5-3.50 m.
NOAH (4 layers)	
Depths	0-0.1, 0.1-0.4, 0.4-1.0, and 1.0-2.0 m.
VIC (3 layers)	
Depths	0-0.1, 0.1-1.6, and 1.6-1.9 m.

5. The generic GRIB table defines the different soil layers as SoilM1, …, SoilM*N*, where *N* is the number of soil layers (See Appendix B).

6. Terrestrial water storage is the sum of soil moisture in all layers, accumulated snow, and plant canopy surface water.

7. 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.

8. 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:

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

9. 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.

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.

Data Volume

1. 3-hourly data

Model	Resolution	Files/day	GB/year
CLM	1.0° × 1.0°	8	3.8
Mosaic	1.0° × 1.0°	8	2.3
Noah	1.0° × 1.0°	8	2.6
Noah	0.25° × 0.25°	8	42
VIC	1.0° × 1.0°	8	2.1

2. Monthly data

Model	Resolution	Files/year	MB/year
CLM	1.0° × 1.0°	12	12.1
Mosaic	1.0° × 1.0°	12	9.0
Noah	1.0° × 1.0°	12	9.6
Noah	0.25° × 0.25°	12	153.6
VIC	1.0° × 1.0°	12	7.6

Search and Access System

GLDAS data can be accessed via the GES DISC's Hydrology Data and Information Services Center (HDISC)
http://disc.gsfc.nasa.gov/hydrology

Use the Mirador service to search and download GLDAS data in a batch mode (http://mirador.gsfc.nasa.gov/). Mirador is a fast interface for searching Earth science data at NASA GES DISC. In the Mirador interface, GLDAS data can be searched through a keyword (e.g., Noah) and the time span.

The GLDAS products are provided to the GrADS Data Server (GDS) users via http://hydro1.gesdisc.eosdis.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.

Anonymous ftp

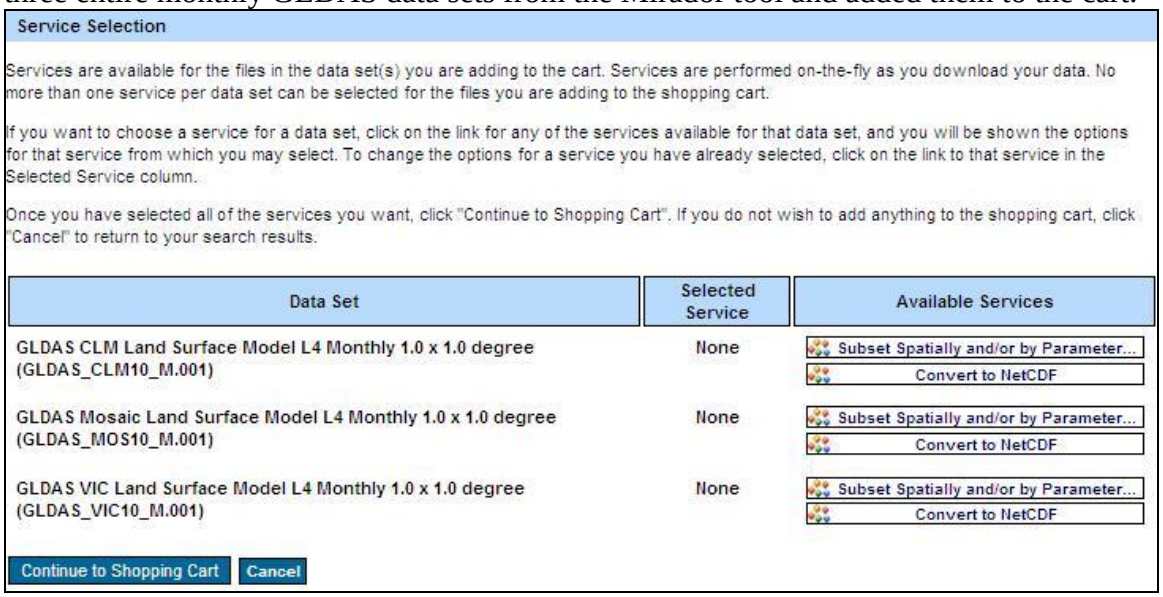
The 3-hourly GLDAS data can be downloaded directly via the GES DISC http: http://hydro1.gesdisc.eosdis.nasa.gov/data/GLDAS_V1/.

The monthly GLDAS data can be downloaded from http://hydro1.gesdisc.eosdis.nasa.gov/data/s4pa/GLDAS_V1/.

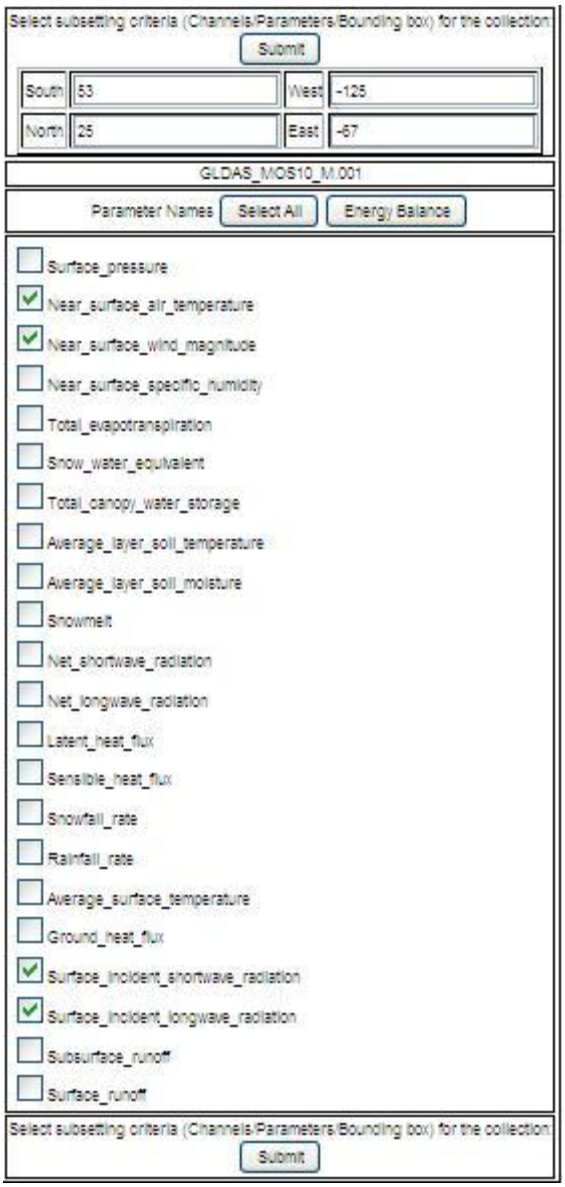
Data Services

On-the-Fly (OTF) Parameter and Spatial Subset

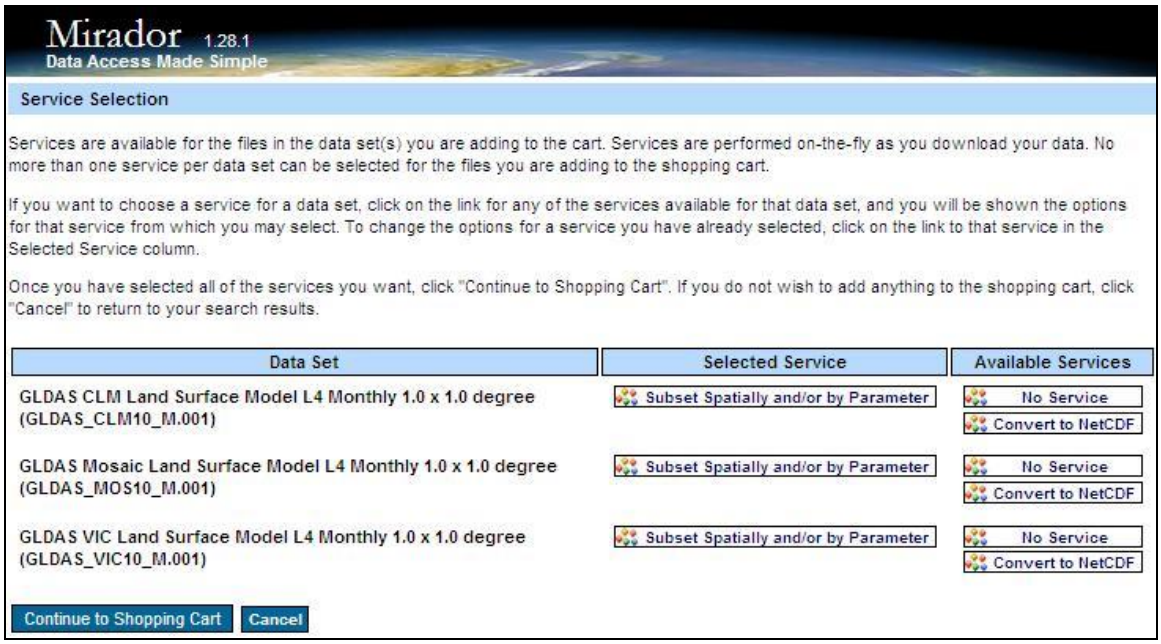
Users can subset the GLDAS products by a parameter and spatial region, before downloading them from the Mirador search and order tool. For example, a user selects three entire monthly GLDAS data sets from the Mirador tool and added them to the cart.



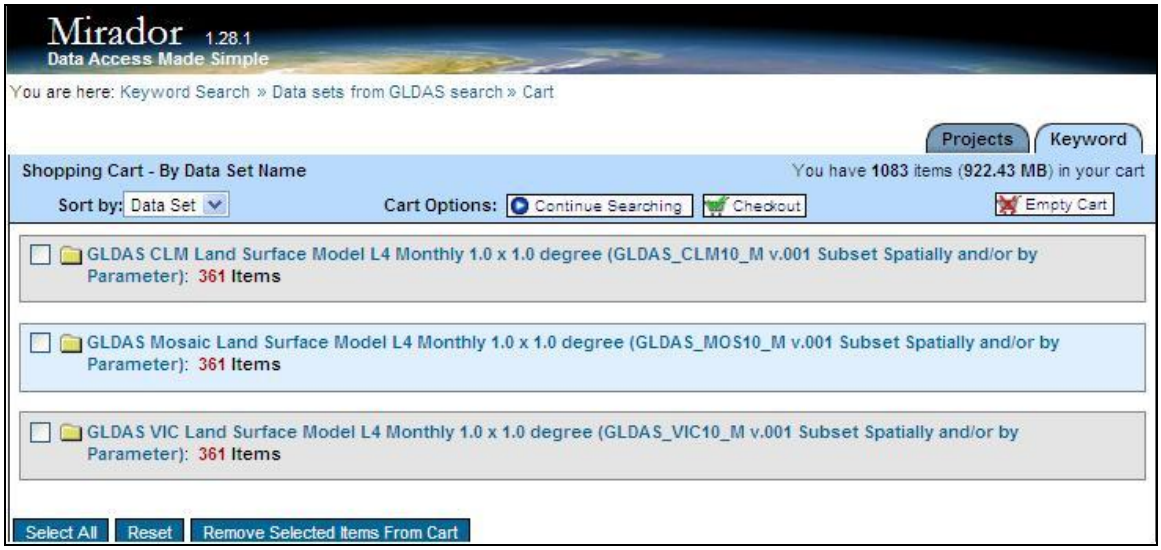
And then, the user selects “Subset Spatially and/or by Parameter” from the list of “Available Services”. Clicking the “Subset spatially and/or by Parameter” button will pop up a window to allow users to select the parameter(s) and spatial region of interest to subset.



Clicking the “Submit” button will move the “Subset Spatially and/or by Parameter” service to the “Selected Service” column.

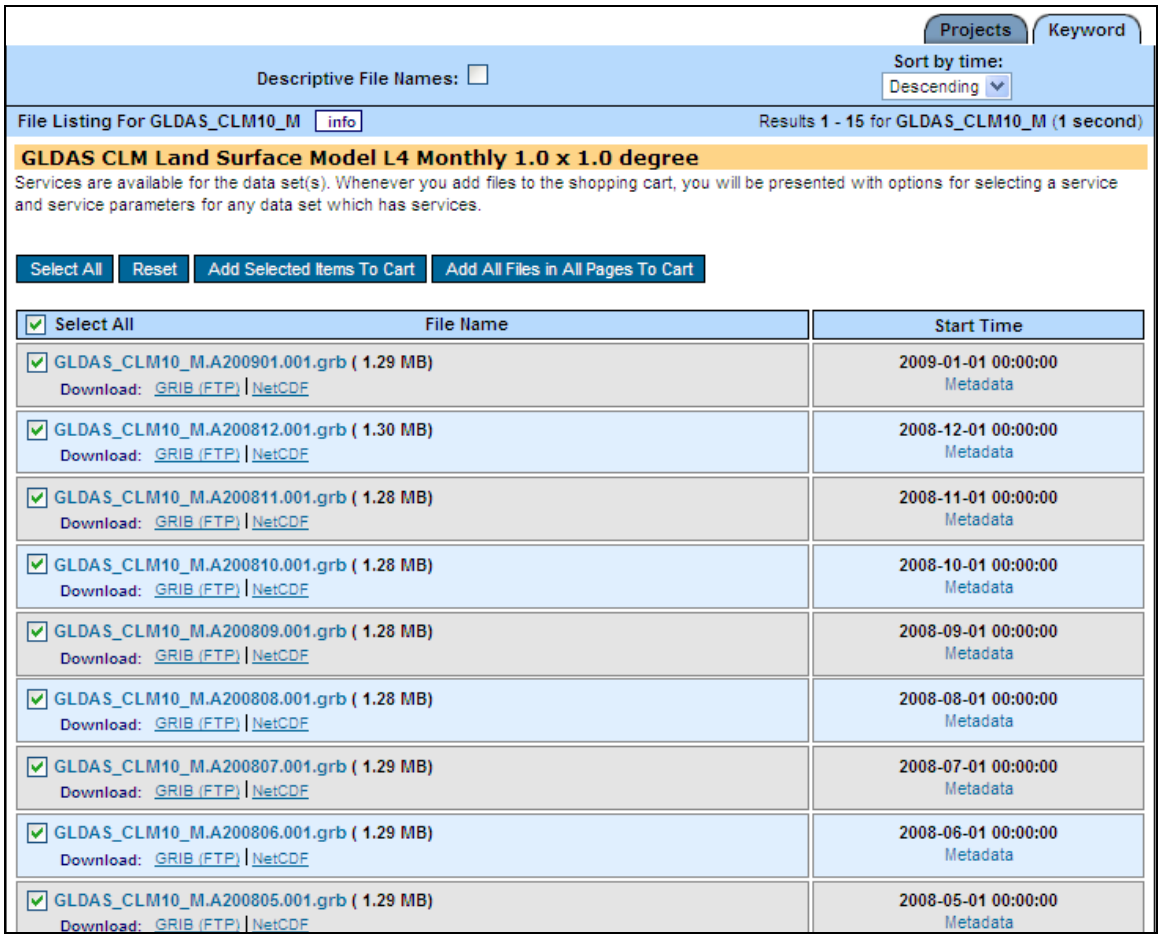


By clicking "Continue to Shopping Cart", the user will see all selected files in the shopping cart. The "Checkout" button leads to a batch download interface for the subsetted files. The subsetted data are in the GRIB format, same as that of the original GLDAS products.

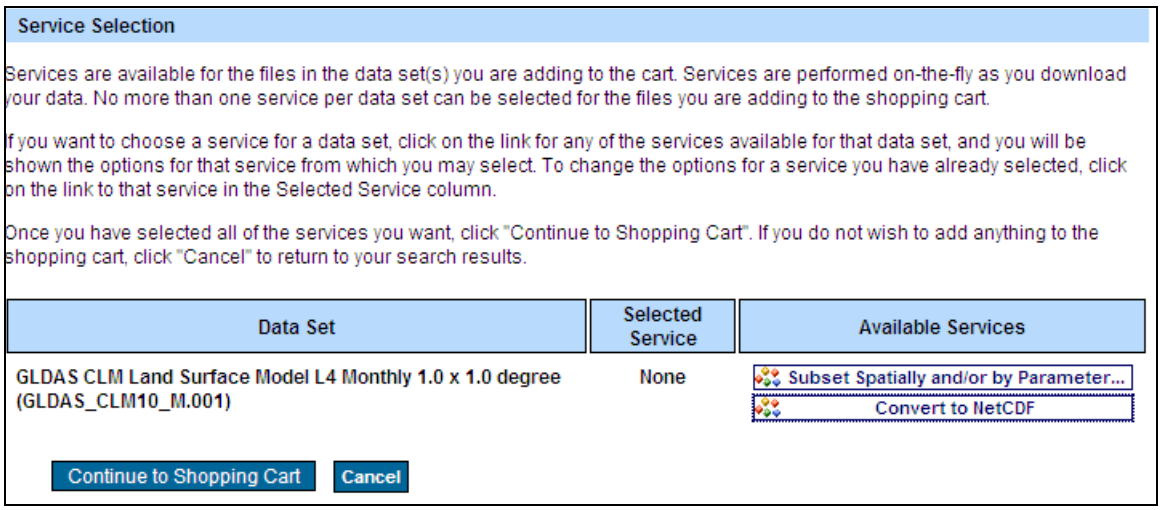


On-the-Fly (OTF) NetCDF Conversion

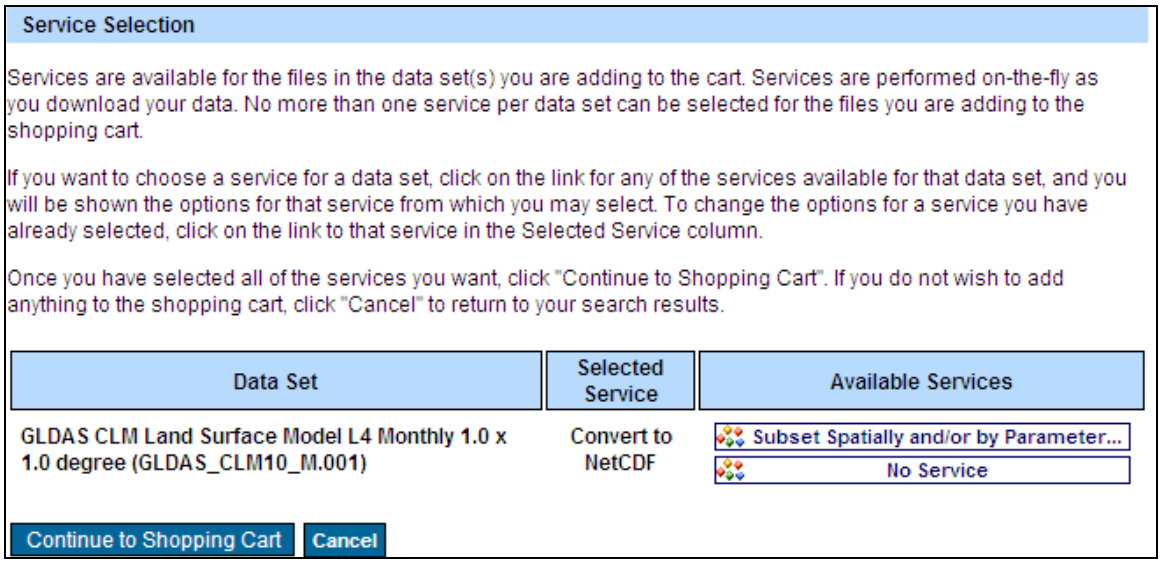
The GLDAS data sets can be converted from GRIB format into netCDF format with the Climate and Forecast (CF) metadata convention through an on-the-fly (OTF) GRIB-to-netCDF conversion service. As an example, a user selects the monthly 1.0 degree CLM data set from the Mirador tool. A "NetCDF" button can then be clicked to download the file in netCDF format.



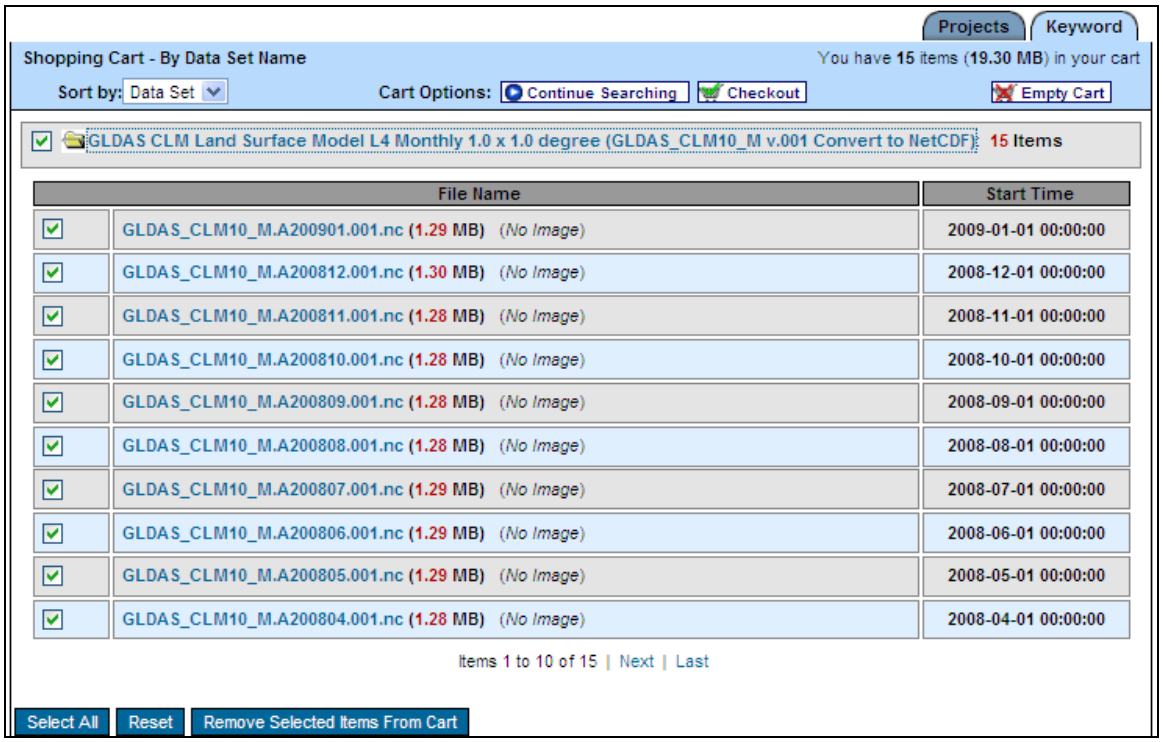
Alternatively, a user can add all of the selected files into a shopping cart by clicking the "Add Selected Items to Cart" button and selecting "Convert to NetCDF" from the list of "Available Services."



Clicking the "Convert to NetCDF" button will move the "Convert to NetCDF" service to the "Selected Service" column.



By clicking "Continue to Shopping Cart", the user will see a list of files with the ".nc" suffix. The "Checkout" button leads to a batch download interface for the netCDF files.



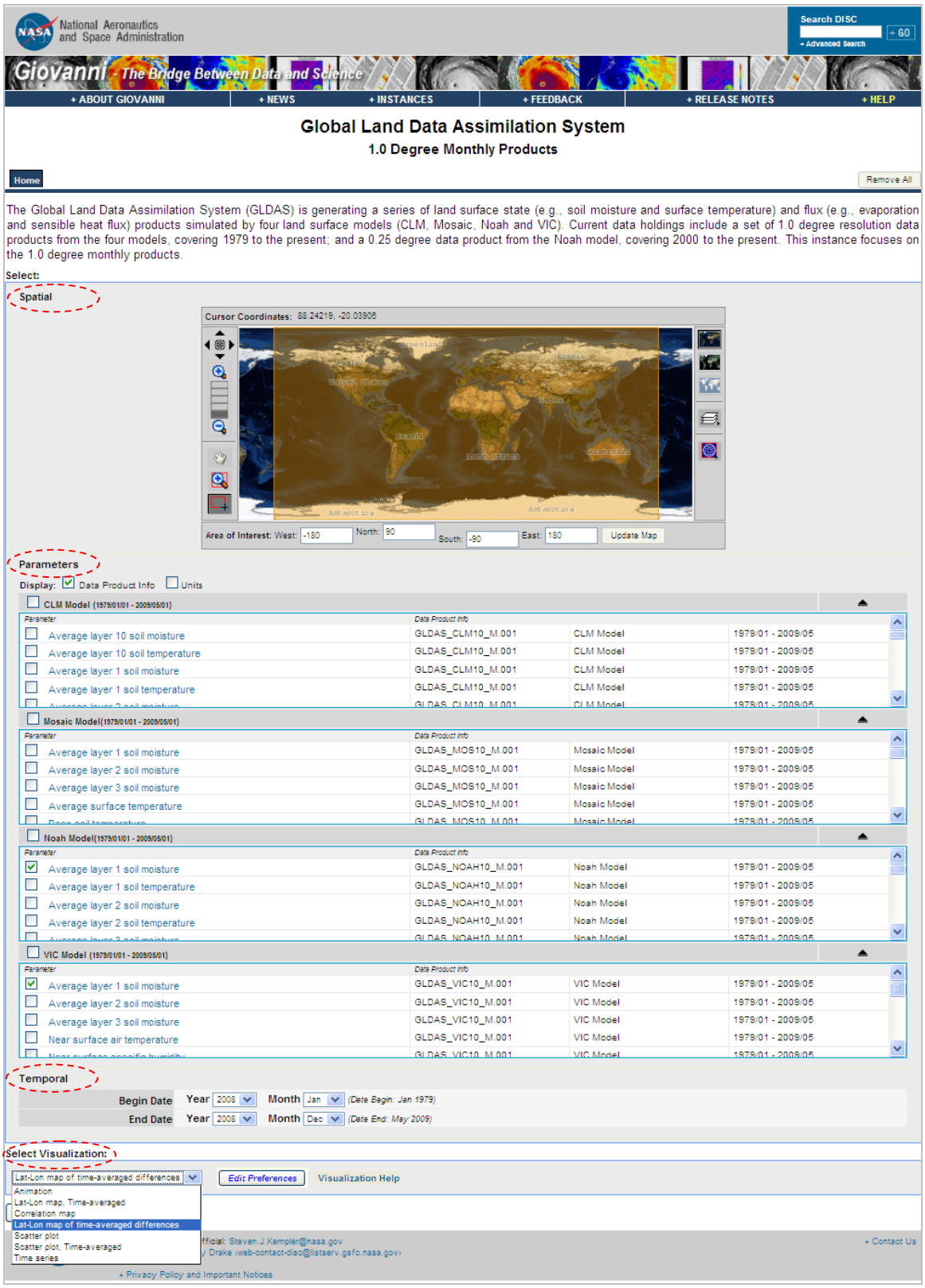
The converted netCDF file can be processed with software packages such as GrADS, IDL, NCL, and HDFView. A sample netCDF descriptor file for GrADS users is attached in Appendix C.

Online Visualization and Analysis in Giovanni

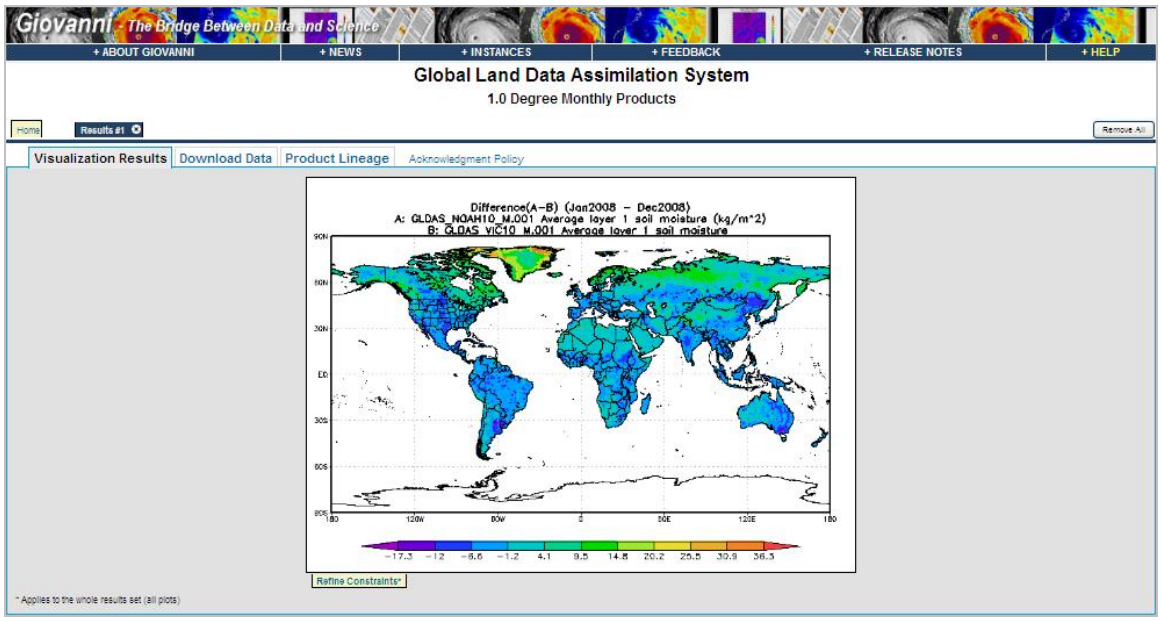
Giovanni is a Web-based application developed by the GES DISC that provides a simple and intuitive way to visualize, analyze, and access vast amounts of Earth science remote sensing data without having to download the data. All 1.0 degree monthly GLDAS parameters from the four land surface models are available from the GLDAS instance in Giovanni.

Users simply select one or more parameters, spatial and temporal ranges, and the visualization function. Seven visualization and analysis functions are available in the current instance: animation, lat-lon map (time-averaged), correlation map, lat-lon map (time-averaged differences), scatter plot, scatter plot (time-averaged), and time series. More advanced services will be added in the future.

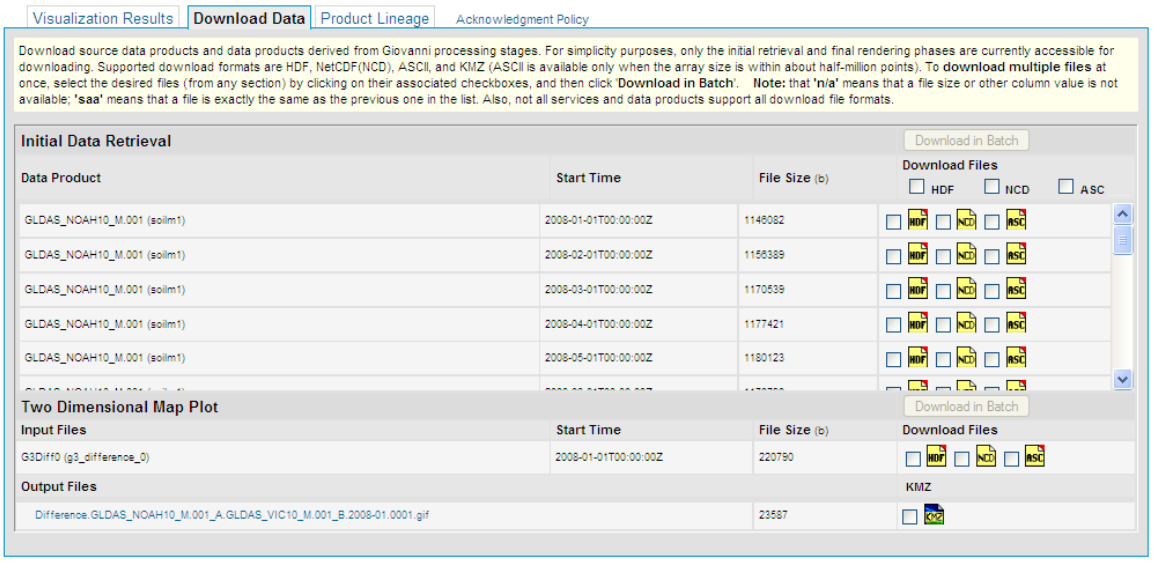
In the example below, a user selects the global average layer 1 soil moisture from both Noah and VIC models for 2008. Then, the user selects the “lat-lon map of time averaged differences” function to examine the difference of layer 1 soil moisture estimated from the two land surface models.


National Aeronautics and Space Administration
Search DISC
+ GO
+ Advanced Search
Giovanni - The Bridge Between Data and Science
+ ABOUT GIOVANNI
+ NEWS
+ INSTANCES
+ FEEDBACK
+ RELEASE NOTES
+ HELP
Global Land Data Assimilation System
1.0 Degree Monthly Products
Home
Remove All
The Global Land Data Assimilation System (GLDAS) is generating 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 four land surface models (CLM, Mosaic, Noah and VIC). Current data holdings include a set of 1.0 degree resolution data products from the four models, covering 1979 to the present; and a 0.25 degree data product from the Noah model, covering 2000 to the present. This instance focuses on the 1.0 degree monthly products.
Select:
Spatial
Cursor Coordinates: 88.24219, -20.03906
Area of Interest: West: -180 North: 90 South: -90 East: 180 Update Map
Parameters
Display: Data Product Info Units
CLM Model (1979/01/01 - 2009/05/01)
Parameter
Data Product Info
Average layer 10 soil moisture GLDAS_CLM10_M.001 CLM Model 1979/01 - 2009/05
Average layer 10 soil temperature GLDAS_CLM10_M.001 CLM Model 1979/01 - 2009/05
Average layer 1 soil moisture GLDAS_CLM10_M.001 CLM Model 1979/01 - 2009/05
Average layer 1 soil temperature GLDAS_CLM10_M.001 CLM Model 1979/01 - 2009/05
Mosaic Model (1979/01/01 - 2009/05/01)
Average layer 1 soil moisture GLDAS_MOS10_M.001 Mosaic Model 1979/01 - 2009/05
Average layer 2 soil moisture GLDAS_MOS10_M.001 Mosaic Model 1979/01 - 2009/05
Average layer 3 soil moisture GLDAS_MOS10_M.001 Mosaic Model 1979/01 - 2009/05
Average surface temperature GLDAS_MOS10_M.001 Mosaic Model 1979/01 - 2009/05
Noah Model (1979/01/01 - 2009/05/01)
Average layer 1 soil moisture GLDAS_NOAH10_M.001 Noah Model 1979/01 - 2009/05
Average layer 1 soil temperature GLDAS_NOAH10_M.001 Noah Model 1979/01 - 2009/05
Average layer 2 soil moisture GLDAS_NOAH10_M.001 Noah Model 1979/01 - 2009/05
Average layer 2 soil temperature GLDAS_NOAH10_M.001 Noah Model 1979/01 - 2009/05
VIC Model (1979/01/01 - 2009/05/01)
Average layer 1 soil moisture GLDAS_VIC10_M.001 VIC Model 1979/01 - 2009/05
Average layer 2 soil moisture GLDAS_VIC10_M.001 VIC Model 1979/01 - 2009/05
Average layer 3 soil moisture GLDAS_VIC10_M.001 VIC Model 1979/01 - 2009/05
Near surface air temperature GLDAS_VIC10_M.001 VIC Model 1979/01 - 2009/05
Temporal
Begin Date Year 2008 Month Jan (Date Begin: Jan 1979)
End Date Year 2008 Month Dec (Date End: May 2009)
Select Visualization:
Lat-Lon map of time-averaged differences
Edit Preferences
Visualization Help
Animation
Lat-Lon map, Time-averaged
Correlation map
Lat-Lon map of time-averaged differences
Scatter plot
Scatter plot, Time-averaged
Time series
+ Contact Us
+ Privacy Policy and Important Notices

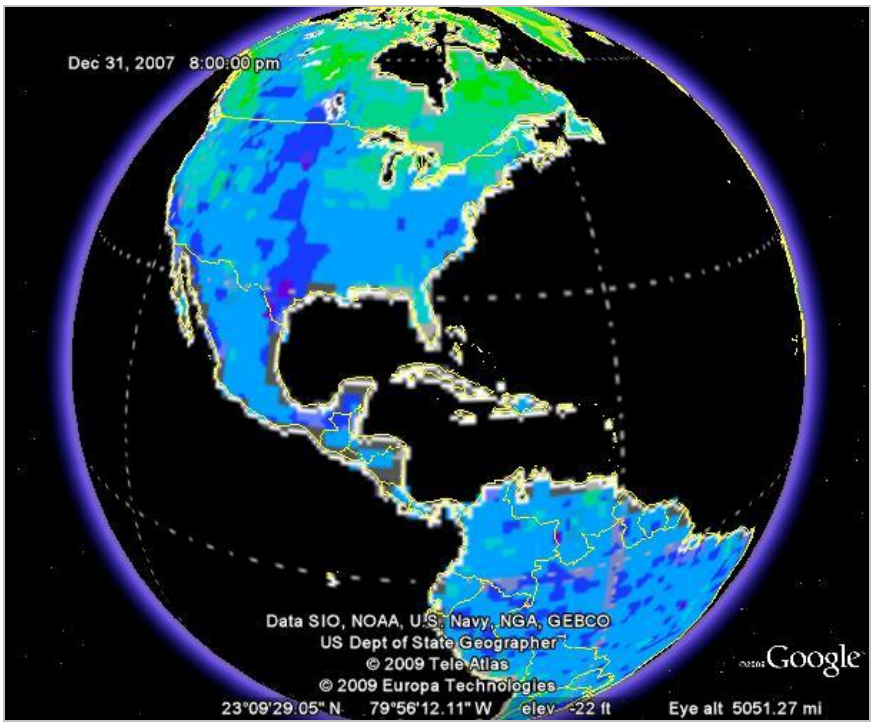
By clicking the "Generate Visualization" button, the user will see the resultant difference map of layer 1 soil moisture from the two models in 2008.



In addition to the visualization and analysis services, users can get GLDAS files in HDF, netCDF and ASCII formats by clicking the "Download Data" tab.



Users can also view the GLDAS data in Google Earth by downloading the KMZ files under the "Download Data" tab. Below is the average layer 1 soil moisture difference map viewed in Google Earth.



More details about Giovanni can be found in the Giovanni Online User Manual.

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:

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Earth System Science Interdisciplinary Center
University of Maryland, College Park
Hydrological Sciences Laboratory, Code 617
NASA Goddard Space Flight Center
Greenbelt, MD 20771
Email: Hiroko.Kato-1@nasa.gov
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DOIs for GLDAS Version 1 Data Products

A Digital Object Identifier or DOI is a unique alphanumeric string used to identify a digital object and provide a permanent link online. DOIs are often used in online publications in citations. The table 3 list DOIs for GLDAS-1 data products.

Table 3. DOIs for GLDAS-1 Data Products

Short Name	Product Description	DOI
GLDAS_CLM10SUBP_3H	GLDAS CLM Land Surface Model L4 3 Hourly 1.0 x 1.0 degree Subsetted, Version 1	10.5067/83NO2QDLG6M0
GLDAS_CLM10_M	GLDAS CLM Land Surface Model L4 Monthly 1.0 x 1.0 degree, Version 1	10.5067/0JNJQ8ZDZRBA
GLDAS_MOS10SUBP_3H	GLDAS Mosaic Land Surface Model L4 3 Hourly 1.0 x 1.0 degree Subsetted, Version 1	10.5067/DLVU8VOPKN7L
GLDAS_MOS10_M	GLDAS Mosaic Land Surface Model L4 Monthly 1.0 x 1.0 degree, Version 1	10.5067/UFLFES5N9IGD
GLDAS_NOAH025SUBP_3H	GLDAS Noah Land Surface Model L4 3 Hourly 0.25 x 0.25 degree Subsetted, Version 1	10.5067/F4KOLPJZHKOT
GLDAS_NOAH025_M	GLDAS Noah Land Surface Model L4 Monthly 0.25 x 0.25 degree, Version 1	10.5067/7NP2052IA62C
GLDAS_NOAH10SUBP_3H	GLDAS Noah Land Surface Model L4 3 Hourly 1.0 x 1.0 degree Subsetted, Version 1	10.5067/7J0CPW2PF9N9
GLDAS_NOAH10_M	GLDAS Noah Land Surface Model L4 Monthly 1.0 x 1.0 degree, Version 1	10.5067/G6ON3ZR1EUIJ
GLDAS_VIC10_3H	GLDAS VIC Land Surface Model L4 3 Hourly 1.0 x 1.0 degree, Version 1	10.5067/Z7SA0KYUTBQS
GLDAS_VIC10_M	GLDAS VIC Land Surface Model L4 Monthly 1.0 x 1.0 degree, Version 1	10.5067/392CVTROXRKW

Each of DOIs in the Table 3 is linked to the corresponding data product page and Data Citation for the data product is on top of the page. If you use these data in your research or applications please include a reference in your publication(s) similar to the following example:

Matthew Rodell and Hiroko Kato Beaudoing, NASA/GSFC/HSL (08.16.2007), *GLDAS CLM Land Surface Model L4 Monthly 1.0 x 1.0 degree , version 001*, Greenbelt, Maryland, USA: Goddard Earth Sciences Data and Information Services Center (GES DISC), Accessed **Enter User Data Access Date** at doi:10.5067/0JNJQ8ZDZRBA

References

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Derber, J. C., D. F. Parrish, and S. J. Lord, 1991. The new global operational analysis system at the National Meteorological Center. *Weather Forecasting*, 6, 538-547.

Kumar, S. V., C. D. Peters-Lidard, Y. Tian, P. R. Houser, J. Geiger, S. Olden, L. Lighty, J. L. Eastman, B. Doty, P. Dirmeyer, J. Adams, K. Mitchell, E. F. Wood, and J. Sheffield, 2006: Land Information System - An interoperable framework for high resolution land surface modeling, *Environ. Modeling and Software*, 21, 1402-1415.

Rodell, M. and P. R. Houser, 2004. Updating a land surface model with MODIS derived snow cover, *J. Hydromet.*, 5(6), 1064-1075.

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
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

Hereunder are the parameter tables used for GLDAS data. It is necessary to set the respective parameter table before using WGRIB or GrADS to read the data.

Table B.1. GRIBTAB for CLM output (gribtab_clm.txt)

```
-1:-1:-1:-1
111:SWnet:Net Shortwave Radiation          W/m^2
112:LWnet:Net Longwave Radiation           W/m^2
121:Qle:Latent Heat Flux                  W/m^2
122:Qh:Sensible Heat Flux                W/m^2
155:Qg:Ground Heat Flux                  W/m^2
131:Snowf:Snowfall rate                     kg/m^2/s
132:Rainf:Rainfall rate                     kg/m^2/s
057:Evap:Total Evapotranspiration          kg/m^2/s
235:Qs:Surface Runoff                    kg/m^2/s
234:Qsb:Subsurface Runoff                 kg/m^2/s
099:Qsm:Snowmelt                          kg/m^2/s
068:DelSoilMoist:Change in soil moisture           kg/m^2
078:DelSWE:Change in snow water equivalent   kg/m^2
135:SnowT:Snow Temperature                  K
136:VegT:Vegetation Canopy Temperature     K
137:BaresoilT:Temperature of bare soil          K
138:AvgSurfT:Average Surface Temperature       K
139:RadT:Surface Radiative Temperature     K
084:Albedo:Surface Albedo, All Wavelengths   -
065:SWE:Snow Water Equivalent             kg/m^2
085:TSoil1:Average layer 1 soil temperature     K
085:TSoil2:Average layer 2 soil temperature     K
085:TSoil3:Average layer 3 soil temperature     K
085:TSoil4:Average layer 4 soil temperature     K
085:TSoil5:Average layer 5 soil temperature     K
085:TSoil6:Average layer 6 soil temperature    K
085:TSoil7:Average layer 7 soil temperature    K
085:TSoil8:Average layer 8 soil temperature    K
085:TSoil9:Average layer 9 soil temperature    K
085:TSoil10:Average layer 10 soil temperature   K
086:SoilM1:Average layer 1 soil moisture     kg/m^2
086:SoilM2:Average layer 2 soil moisture     kg/m^2
086:SoilM3:Average layer 3 soil moisture     kg/m^2
086:SoilM4:Average layer 4 soil moisture     kg/m^2
086:SoilM5:Average layer 5 soil moisture     kg/m^2
086:SoilM6:Average layer 6 soil moisture    kg/m^2
086:SoilM7:Average layer 7 soil moisture    kg/m^2
086:SoilM8:Average layer 8 soil moisture    kg/m^2
086:SoilM9:Average layer 9 soil moisture    kg/m^2
086:SoilM10:Average layer 10 soil moisture   kg/m^2
070:RootMoist:Root zone soil moisture          kg/m^2
207:SoilWet:Total Soil Wetness               -
210:TVeg:Vegetation transpiration         kg/m^2/s
200:ECanop:Interception evaporation       kg/m^2/s
199:ESoil:Bare soil evaporation            kg/m^2/s
071:Canopint:Total canopy water storage    kg/m^2
174:ACond:Aerodynamic conductance          m/s
```

```
032:Wind:Near surface wind magnitude     m/s
059:Rainfforc:Rainfall rate                  kg/m^2/s
064:Snowfforc:Snowfall rate                 kg/m^2/s
011:Tair:Near surface air temperature      K
051:Qair:Near surface specific humidity    kg/kg
001:PSurf:Surface pressure                 Pa
204:SWdown:Surface incident shortwave radiation  W/m^2
205:LWdown:Surface incident longwave radiation W/m^2
```

Table B.2. GRIBTAB for MOSAIC output (gribtab_mos.txt)

```
-1:-1:-1:-1
111:SWnet:Net Shortwave Radiation          W/m^2
112:LWnet:Net Longwave Radiation           W/m^2
121:Qle:Latent Heat Flux                  W/m^2
122:Qh:Sensible Heat Flux                W/m^2
155:Qg:Ground Heat Flux                  W/m^2
131:Snowf:Snowfall rate                     kg/m^2/s
132:Rainf:Rainfall rate                     kg/m^2/s
057:Evap:Total Evapotranspiration          kg/m^2/s
235:Qs:Surface Runoff                    kg/m^2/s
234:Qsb:Subsurface Runoff                 kg/m^2/s
099:Qsm:Snowmelt                          kg/m^2/s
068:DelSoilMoist:Change in soil moisture           kg/m^2
078:DelSWE:Change in snow water equivalent   kg/m^2
138:AvgSurfT:Average Surface Temperature       K
085:SoT:Deep Soil Temperature                  K
084:Albedo:Surface Albedo, All Wavelengths   -
065:SWE:Snow Water Equivalent             kg/m^2
086:SoilM1:Average layer 1 soil moisture     kg/m^2
086:SoilM2:Average layer 2 soil moisture     kg/m^2
086:SoilM3:Average layer 3 soil moisture     kg/m^2
207:SoilWet:Total Soil Wetness               -
200:ECanop:Interception evaporation       kg/m^2/s
210:TVeg:Vegetation transpiration         kg/m^2/s
199:ESoil:Bare soil evaporation            kg/m^2/s
070:RootMoist:Root zone soil moisture          kg/m^2
071:Canopint:Total canopy water storage    kg/m^2
174:ACond:Aerodynamic conductance          m/s
032:Wind:Near surface wind magnitude     m/s
059:Rainfforc:Rainfall rate                  kg/m^2/s
064:Snowfforc:Snowfall rate                 kg/m^2/s
011:Tair:Near surface air temperature      K
051:Qair:Near surface specific humidity    kg/kg
001:PSurf:Surface pressure                 Pa
204:SWdown:Surface incident shortwave radiation  W/m^2
205:LWdown:Surface incident longwave radiation W/m^2
```

Table B.3. GRIBTAB for NOAH output (gribtab_noah.txt)

```
-1:-1:-1:-1
111:SWnet:Net Shortwave Radiation          W/m^2
112:LWnet:Net Longwave Radiation           W/m^2
121:Qle:Latent Heat Flux                  W/m^2
122:Qh:Sensible Heat Flux                W/m^2
155:Qg:Ground Heat Flux                  W/m^2
131:Snowf:Snowfall rate                     kg/m^2/s
132:Rainf:Rainfall rate                     kg/m^2/s
```

```
057:Evap:Total Evapotranspiration          kg/m^2/s
235:Qs:Surface Runoff                    kg/m^2/s
234:Qsb:Subsurface Runoff                 kg/m^2/s
099:Qsm:Snowmelt                          kg/m^2/s
068:DelSoilMoist:Change in soil moisture           kg/m^2
078:DelSWE:Change in snow water equivalent   kg/m^2
138:AvgSurfT:Average Surface Temperature       K
084:Albedo:Surface Albedo, All Wavelengths   -
065:SWE:Snow Water Equivalent             kg/m^2
085:TSoil1:Average layer 1 soil temperature  K
085:TSoil2:Average layer 2 soil temperature  K
085:TSoil3:Average layer 3 soil temperature  K
085:TSoil4:Average layer 4 soil temperature  K
086:SoilM1:Average layer 1 soil moisture     kg/m^2
086:SoilM2:Average layer 2 soil moisture     kg/m^2
086:SoilM3:Average layer 3 soil moisture     kg/m^2
086:SoilM4:Average layer 4 soil moisture     kg/m^2
207:SoilWet:Total Soil Wetness               -
200:ECanop:Interception evaporation       kg/m^2/s
210:TVeg:Vegetation transpiration         kg/m^2/s
199:ESoil:Bare soil evaporation            kg/m^2/s
070:RootMoist:Root zone soil moisture          kg/m^2
071:Canopint:Total canopy water storage    kg/m^2
032:Wind:Near surface wind magnitude     m/s
059:Rainfforc:Rainfall rate                   kg/m^2/s
064:Snowfforc:Snowfall rate                  kg/m^2/s
011:Tair:Near surface air temperature      K
051:Qair:Near surface specific humidity    kg/kg
001:PSurf:Surface pressure                 Pa
204:SWdown:Surface incident shortwave radiation  W/m^2
205:LWdown:Surface incident longwave radiation W/m^2
```

Table B.4. GRIBTAB for VIC output (gribtab_vic.txt)

```
-1:-1:-1:-1
111:SWnet:Net Shortwave Radiation           W/m^2
112:LWnet:Net Longwave Radiation            W/m^2
121:Qle:Latent Heat Flux                  W/m^2
122:Qh:Sensible Heat Flux                W/m^2
155:Qg:Ground Heat Flux                  W/m^2
132:Rainf:Rainfall rate                     kg/m^2/s
131:Snowf:Snowfall rate                     kg/m^2/s
057:Evap:Total Evapotranspiration          kg/m^2/s
235:Qs:Surface Runoff                    kg/m^2/s
234:Qsb:Subsurface Runoff                 kg/m^2/s
250:Qfz:Re-freezign of water in the snow  km/m^2/s
239:SnowT: Snow temperature               K
138:AvgSurfT:Average Surface Temperature       K
149:RadT:Surface Radiative Temperature       K
084:Albedo:Surface Albedo, All Wavelengths   -
085:TSoil1:Average layer 1 soil temperature  K
085:TSoil2:Average layer 2 soil temperature  K
085:TSoil3:Average layer 3 soil temperature  K
086:SoilM1:Average layer 1 soil moisture     kg/m^2
086:SoilM2:Average layer 2 soil moisture     kg/m^2
086:SoilM3:Average layer 3 soil moisture     kg/m^2
```

```
210:TVeg:Vegetation transpiration         kg/m^2/s
199:ESoil:Bare soil evaporation            kg/m^2/s
207:SoilWet:Total Soil Wetness               -
070:RootMoist:Root zone soil moisture          kg/m^2
065:SWE:Snow Water Equivalent             kg/m^2
099:Qsm:Snowmelt                          kg/m^2/s
068:DelSoilMoist:Change in soil moisture           kg/m^2
078:DelSWE:Change in snow water equivalent   kg/m^2
179:Acond: Aerodynamic conductance       m/s
032:Wind:Near surface wind magnitude     m/s
059:Rainfforc:Rainfall rate                   kg/m^2/s
064:Snowfforc:Snowfall rate                  kg/m^2/s
011:Tair:Near surface air temperature      K
051:Qair:Near surface specific humidity    kg/kg
001:PSurf:Surface pressure                 Pa
204:SWdown:Surface incident shortwave radiation  W/m^2
205:LWdown:Surface incident longwave radiation W/m^2
```

C. Sample NetCDF descriptor file for GrADS users

```
dset ^GLDAS_CLM10_M.A200806.001.nc
undef -999.
title GLDAS_CLM10_M.A200806.001.nc
dtype netcdf
ydef 150 linear -59.500000 1
xdef 360 linear -179.500000 1.000000
tdef 1 linear 00Z01jun2008 1mo
zdef 10 levels 1 2 3 4 5 6 7 8 9 10
vars 22
AvgSurfT_0_SFC=>avgsurft_0_sfc  0 y,x  ** surface Average Surface
Temperature       K
Canopint_0_SFC=>canopint_0_sfc  0 y,x  ** surface Total canopy water
storage    kg/m^2
Evap_0_SFC=>evap_0_sfc  0 y,x ** surface Total Evapotranspiration
kg/m^2/s
LWdown_0_SFC_ave3h=>lwdown_0_sfc_ave3h  0 y,x  ** surface Surface
incident longwave radiation W/m^2
LWnet_0_SFC_ave3h=>lwnet_0_sfc_ave3h  0 y,x  ** surface Net Longwave
Radiation            W/m^2
PSurf_0_SFC=>psurf_0_sfc  0 y,x  ** surface Surface pressure
Pa
Qair_0_SFC=>qair_0_sfc  0 y,x  ** surface Near surface specific
humidity    kg/kg
Qg_0_SFC_ave3h=>qg_0_sfc_ave3h  0 y,x  ** surface Ground Heat Flux
W/m^2
Qh_0_SFC_ave3h=>qh_0_sfc_ave3h  0 y,x  ** surface Sensible Heat Flux
W/m^2
Qle_0_SFC_ave3h=>qle_0_sfc_ave3h  0 y,x  ** surface Latent Heat Flux
W/m^2
Qs_0_SFC=>qs_0_sfc  0 y,x  ** surface Surface Runoff
kg/m^2/s
Qsb_0_SFC=>qsb_0_sfc  0 y,x  ** surface Subsurface Runoff
kg/m^2/s
Qsm_0_SFC_ave3h=>qsm_0_sfc_ave3h  0 y,x  ** surface Snowmelt
kg/m^2/s
Rainf_0_SFC=>rainf_0_sfc  0 y,x  ** surface Rainfall rate
kg/m^2/s
SWE_0_SFC=>swe_0_sfc  0 y,x  ** surface Snow Water Equivalent
kg/m^2
SWdown_0_SFC_ave3h=>swdown_0_sfc_ave3h  0 y,x  ** surface Surface
incident shortwave radiation  W/m^2
SWnet_0_SFC_ave3h=>swnet_0_sfc_ave3h  0 y,x  ** surface Net Shortwave
Radiation           W/m^2
Snowf_0_SFC=>snowf_0_sfc  0 y,x  ** surface Snowfall rate
kg/m^2/s
SoilM1_0_DBLY=>soilm1_0_dbly  10 z,y,x ** underground Average layer
soil moisture   kg/m^2
TSoil1_0_DBLY=>tsoil1_0_dbly  10 z,y,x ** underground Average layer
soil temperature   K
Tair_0_SFC=>tair_0_sfc  0 y,x  ** surface Near surface air temperature
K
Wind_0_SFC=>wind_0_sfc  0 y,x  ** surface Near surface wind magnitude
m/s
ENDVARS
```

D. Acronyms

The following acronyms and abbreviations are used in this document.

AGRMET	Air Force Weather Agency's AGRicultural METeorological modeling system
CLM	Community Land Model
CMAP	Climate Prediction Center Merged Analysis of Precipitation
ECMWF	European Center for Medium-Range Weather Forecasts
GDAS	Global Data Assimilation System
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
MODIS	Moderate Resolution Imaging Spectroradiometer
NASA	National Aeronautics and Space Administration
NCAR	National Center for Atmospheric Research
netCDF	network Common Data Form
NEWS	NASA Energy and Water Cycle Study
NOAA	National Oceanic and Atmospheric Administration
NOAH	National Centers for Environmental Prediction/Oregon State University/Air Force/Hydrologic Research Lab Model
OPeNDAP	Open Source Project for a Network Data Access Protocol
OTF	On-The-Fly
PDS	Product Definition Section
PIP	Parameter Information Page
SWE	Snow Water Equivalent
VIC	Variable Infiltration Capacity