EXPERIMENTAL CLPX NLDAS DATA

Contents

Version History

The current version of the CLPX NLDAS Grids document is V0.0 released July 21, 2003.

1. Initial version.

Purpose

The document describes the North American Land Data Assimilation System (NLDAS) data that have been submitted for use in the Cold Land Processes Field Experiment (CLPX). These NLDAS data have been delivered on an $1/8^{th}$ degree regular latitude/longitude grid covering the Large-Regional Study Area (LRSA).

This document may be useful to anyone interested in using NLDAS data in conjunction with CLPX. It may also prove relevant for those providing data for CLPX from other model-based systems.

LRSA and NLDAS Grids

The Cold Land Processes Field Experiment (CLPX) Large-Regional Study Area (LRSA) is defined by a latitude-longitude bounding box as follows:
Upper Left: 42 N, 108.5 W
Lower Right: 38.5 N, 104 W

NLDAS data, originally in GRIB format and covering a central North American domain, were converted to ASCII format and subsetted to the LRSA domain. Outer bounds of this NLDAS-LRSA domain are:
Lower Left: 38.5 N, 108.5 W
Lower Right: 38.5 N, 104 W
Upper Left: 42 N, 108.5 W
Upper Right: 42 N, 104 W

The coordinates of the center points of each of these bounding grid boxes are:
Lower Left: 38.5625 N, 108.4375 W
Lower Right: 38.5625 N, 104.0625 W
Upper Left: 41.9375 N, 108.4375 W
Upper Right: 41.9375 N, 104.0625 W

To see a broad view of the LRSA, **CLICK HERE**. The map depicts the LRSA (4.5 x 3.5 degrees) in north central Colorado and south central Wyoming. Several smaller CLPX study regions exist inside of the larger LRSA domain. The largest sub-region of the LRSA is the Small-Regional Study Area (SRSA), and is located in north-central Colorado (105-107.5W, 39.5-41N). Within this SRSA there exist three Meso-cell Study Areas (MSA)--Rabbit Ears, Northpark and Fraser. The table below provides LRSA, SRSA and MSA maps overlayed with NLDAS X, Y, or 1-D grid coordinates. The same ASCII data files are used for all five study areas, and specific cells from each area can be selected and analyzed given its X and Y, or 1-D coordinates from the maps in the table below. It is important to note that each grid box contains 43 NLDAS data fields. Example fortran programs to read the ASCII data files are located in the Data Formats Section.

X Coordinates	Y Coordinates	1-D Coordinates
LRSA map	LRSA map	LRSA map
SRSA map	SRSA map	SRSA map
Fraser MSA map	Fraser MSA map	Fraser MSA map

The 1/8th degree data grid features a Y dimension of 28 rows, and an X dimension of 36 columns. The resolution in the Y direction of each 1/8th degree NLDAS pixel is 13899 meters over the whole domain. The resolution in the X direction ranges from 10878 meters at the southern edge of the LRSA to 10329 meters at the northern edge of the LRSA (it decreases as the distance between longitude lines decreases). The following may be useful grid defining equations:

Row = [(Latitude - 38.5625) / Resolution_in_degrees] + 1

Column = [(108.4375 + Longitude) / Resolution_in_degrees]

Latitude = 38.5625 + [(Row - 1) * Resolution_in_degrees]

Longitude = [(Column - 1) * Resolution_in_degrees] - 108.4375

Note: Lat/Lon represents gridbox centerpoints, and longitude is negative

Within each of the 43 records, there exist 1008 elements. If you are looking for a specific element within each record given a specified center-point latitude/longitude, use the following equation:

Element#=[36*(Latitude-38.5625)/Resolution_in_degrees]+[(Longitude+108.4375)/Resolution_in_degrees]+1

NLDAS Data Products

The NLDAS data set contains 43 model and observation-based fields produced by the LDAS uncoupled modeling system at the NASA Goddard Space Flight Center using the Mosaic Land Surface Model (LSM). The experimental real-time data sets available via Anonymous FTP to hsbserv.gsfc.nasa.gov/NLDAS/CLPX/ cover the time period from January 1, 2001 through August 1, 2003. These 43 data sets are described in the table below. While most of the forcing variables (listed in the table below) are derived from the National Centers for Environmental Prediction's (NCEP) Eta Data Assimilation System (EDAS), precipitation and solar radiation are based on GOES SW and Stage II /CPC observations when such data is available. Non-forcing variables listed in the table below are output from the Mosaic LSM. All data sets feature a spatial resolution of 1/8th degree on a regular latitude/longitude grid with an hourly temporal resolution.

The table below identifies the attributes of the data that are located in the ASCII text files:

Record #	Variable	Units	Positive Sign Convention	Time	Height
1	Aerodynamic Conductance	M/S	Always	Instantaneous	Surface
2	Convective Precipitation	Kg/m2	Always	Accumulation	Surface
3	Surface Albedo	%	Always	Instantaneous	Surface
4	Rainfall (Unfrozen Precipitation)	Kg/m2	Always	Accumulation	Surface
5	Snowfall (Frozen Precipitation)	Kg/m2	Always	Accumulation	Surface
6	Average Surface Temperature	K	Always	Instantaneous	Surface
7	Subsurface Runoff	Kg/m2	Exit Grid Box	Accumulation	Bottom Of Column
8	Canopy Conductance	M/S	Always	Instantaneous	Surface
9	Plant Canopy Surface Water Storage	Kg/m2	Always	Instantaneous	Surface
10	Downward Longwave Radiation Flux	W/m2	Always	Average	Surface
11	Downward Solar Radiation Flux	W/m2	Always	Average	Surface
12	Bare Soil Evaporation	W/m2	Upward	Average	Surface
13	Canopy Surface Water Evaporation	W/m2	Upward	Average	Surface
14	Total Evaporation (All Sources)	Kg/m2	Upward	Accumulation	Surface
15	Ground Heat Flux	W/m2	Upward	Average	Surface
16	Leaf Area Index (LAI)	--	Always	Instantaneous	Surface
17	Latent Heat Flux	W/m2	Upward	Average	Surface
18	Total Soil Column Wetness	%	Always	Instantaneous	0-200cm
19	Root Zone Wetness	%	Always	Instantaneous	0-40cm
20	Net Long Wave Radiation	W/m2	Upward	Average	Surface
21	Net Short Wave Radiation	W/m2	Upward	Average	Surface
22	Surface Press (Not Adjusted To Sea Lvl)	Pa	Always	Instantaneous	Surface
23	Snow Sublimation	W/m2	Upward	Average	Surface
24	Sensible Heat Flux	W/m2	Upward	Average	Surface
25	Snow Depth	M	Always	Instantaneous	Surface
26	Snow Phase Change Heat Flux	W/m2	Solid To Liquid	Average	Surface
27	Snow Melt	Kg/m2	Solid To Liquid	Accumulation	Surface
28	Snow Cover	%	Always	Instantaneous	Surface
29	Layer 1 Soil Moisture	Kg/m2	Always	Instantaneous	0-10cm
30	Layer 2 Soil Moisture	Kg/m2	Always	Instantaneous	10-40cm
31	Layer 3 Soil Moisture	Kg/m2	Always	Instantaneous	40-200cm
32	Total Soil Column Wetness	%	Always	Instantaneous	0-200cm
33	Root Zone Soil Moisture	Kg/m2	Always	Instantaneous	0-40cm

37	Two Meter Temperature	K	Always	Instantaneous	2 Meters
38	Canopy Transpiration	W/m2	Upward	Average	Surface
39	Deep Soil Temperature	K	Always	Instantaneous	Deep Soil
40	U Wind Component	M/S	Eastward	Instantaneous	10 Meters
41	Vegetation Greenness	%	Always	Instantaneous	Surface
42	V Wind Component	M/S	Northward	Instantaneous	10 Meters
43	Snowpack Water Equivalent	Kg/m2	Always	Instantaneous	Surface

File Naming Convention

Each hourly ASCII file is approximately 350 KB. For easier access, these hourly files have been tarred/gzipped by month, and placed onto an anonymous ftp server (monthly file size = 60 Megabytes). Once the files from the ftp server have been gunzipped and untarred by month, NLDAS ASCII data files have file names in the following form:

<year><month><day>.<time>.mosaic.text

example: 20010409.18.mosaic.text

where

<year> is the four digit year the data were acquired, e.g., "2001".
<month> is the two digit month of year the data were acquired, e.g., "04" is April.
<day> is the two digit day of the month the data were acquired, e.g., "09" for the 9th day of April.
<hour> is the two digit UTC hour of the data. The time is 18Z in the example.

Data Formats

For the CLPX project, the data have been converted from GRIB to ASCII format. Two sample FORTRAN programs are provided for reading CLPX-NLDAS ASCII gridded data. First, a 2-D Sample FORTRAN program is provided for reading the data into a 2-D X,Y (36,28) array. Second, a 1-D Sample FORTRAN program is provided for reading the data into a 1-D (1008) array.

How to read the data

NLDAS data are stored in individual ASCII data files, with one file per hour. Within each hourly file, 43 data variables are stored in row-major order, starting at the lower-left coordinate. The data can be read in using the real Fortran format type.

The first line in the ASCII data sets represents the total number of columns (36) and rows (28) for the 1st data record.

Lines 2-1009 (1008 elements) contain the 1st record's data, with line 2 containing the lower-left corner data (with a center point at latitude 38.5625 N, longitude 108.4375 W) and line 1009 containing the upper-right corner data (with a center point at 41.9375 N, 104.0625 W). From west to east, all columns in the 1st row (bottom, southernmost row) are read first, then all columns in 2nd row, etc. until the northernmost row (28) is read.

Line 1010 contains the total number of columns and rows for the 2nd record. Lines 1011-2018 contain the 2nd record's data as described previously.

This process is repeated until all 43 data records (43387 lines) have been read for this hour.

Additional sources of information concerning the LDAS project:

Project Website: http://ldas.gsfc.nasa.gov/

Overview Papers

Mitchell, K., P. R. Houser, E. Wood, J. Schaake, D. Tarpley, D. Lettenmaier, W. Higgins, C. Marshall, D. Lohmann, M. Ek, B. A. Cosgrove, J. K. Entin, Q. Duan, R. Pinker, A. Robock, F. Habets, K. Vinnikov, GCIP Land Data Assimilation System (LDAS) project now underway, *GEWEX News*, Vol 9, No. 4, pp 3-6, 1999.

Mitchell, K. E., D. Lohmann, P. R. Houser, E. F. Wood, A. Robock, J. Schaake, B. A. Cosgrove, J. Sheffield, L. Luo, Q. Duan, D. Lettenmaier, R. T. Pinker, J. D. Tarpley, R. W. Higgins, J. Meng, C. Marshall, A. Bailey, F. Wen, and J. K. Entin, 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.*, (submitted) 2003.

Forcing Paper

Cosgrove, B. A., D. Lohmann, K. E. Mitchell, P. R. Houser, E. F. Wood, J. C. Schaake, A. Robock, C. Marshall, J. Sheffield, Q. Duan, L. Luo, R. W. Higgins, R. T. Pinker, J. D. Tarpley, and J. Meng, Real-time and retrospective forcing in the North American Land Data Assimilation System (NLDAS) Project, J. Geophys. Res., (accepted) 2003.

W. Higgins, R. T. Pinker, J. D. Tarpley, Snow process modeling in the North American Land Data Assimilation System (NLDAS). Part II: Evaluation of model simulated snow water equivalent, J. Geophys. Res., (submitted) 2003.

Sheffield, J., M. Pan, E. F. Wood, K. E. Mitchell, P. R. Houser, J. C. Schaake, A. Robock, D. Lohmann, B. A. Cosgrove, Q. Duan, L. Luo, R. W. Higgins, R. T. Pinker, J. D. Tarpley, B. H. Ramsay, Snow process modeling in the North American Land Data Assimilation System (NLDAS). Part I: Evaluation of model simulated snow cover extent, J. Geophys. Res., (submitted) 2003.
