High Mountain Asia LDAS 1 km Snow and Temperature Parameters, Version 1

USER GUIDE

How to Cite These Data

As a condition of using these data, you must include a citation:

Houser, P., V. Maggioni, and Y. Xue. 2019. *High Mountain Asia LDAS 1 km Snow and Temperature Parameters, Version 1*. [Indicate subset used]. Boulder, Colorado USA. NASA National Snow and Ice Data Center Distributed Active Archive Center. https://doi.org/10.5067/RHXNCZ3KYRQZ. [Date Accessed].

FOR QUESTIONS ABOUT THESE DATA, CONTACT NSIDC@NSIDC.ORG

FOR CURRENT INFORMATION, VISIT https://nsidc.org/data/HMA_STParams

National Snow and Ice Data Center

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1 DATA DESCRIPTION

1.1 Parameters

This data set comprises daily-averaged estimates of snow water equivalent (SWE), snow depth, surface (air) temperature, and soil temperature profile from four different experiments conducted using the NASA Land Information System (LIS) across the High Mountain Asia domain for the period 01 September 2007 to 31 August 2008. Here, LIS is driven by uncorrected Modern-Era Retrospective Analysis for Research and Applications, Version 2 (MERRA-2) and uses the Noah Multi-Parameterization Land Surface Model (Noah-MP) at the spatial resolution of 1 km.

The four simulations consist of:

1. An open-loop (i.e., without assimilation) experiment
2. A snow cover assimilation experiment
3. A freeze/thaw assimilation experiment
4. A dual assimilation of both snow cover and freeze/thaw experiment

Table 1 summarizes the parameters provided, which are common to all four experiments. Refer to Xue et al. (2019) for a complete description of the experimental framework.

Table 1. Parameter Descriptions

Parameter	Description	Units	Dimensions
lat_2D	Latitude	degrees north	2D
lon_2D	Longitude	degrees east	2D
SD_m	Snow depth	m	2D
SWE_mm	Snow water equivalent	mm	2D
Tsoil_profile_K	Soil temperature profile*	K	3D (4)
Tsurf_K	Surface temperature	K	2D

*Note: A four-layer soil column configuration is used in the Noah-MP, with soil thicknesses of 0.1 m, 0.3 m, 0.6 m, and 1.0 m from top to bottom, respectively.

1.2 File Information

1.2.1 Format

Daily data files are provided in netCDF (`.nc`) format

1.2.2 File Contents

Daily files contain the aforementioned parameters from each of the data assimilation experiments.
The netCDF structure of `LIS_NoahMP_OL` is reprocessed from the open-loop (i.e., without assimilation) experiment output.
The structure of `LIS_NoahMP_DA_SC` is reprocessed from the snow cover assimilation experiment output.
The structure of `LIS_NoahMP_DA_FT` is reprocessed from the freeze/thaw assimilation experiment output.
The structure of `LIS_NoahMP_DUAL_DA` is reprocessed from the dual assimilation of both snow cover and freeze/thaw experiment output.
All structures are formatted in a similar manner.

1.2.3 Naming Convention

Example file name:

`HMA_STParams_LIS_NoahMP_OL_20080301_1km.nc`

The files are named according to the following convention, which is described in detail in Table 2:

`HMA_STParams_LIS_NoahMP_[exp]_[yyyy][mm][dd]_1km.nc`

Table 2. File Naming Convention

String segment	Description
HMA_STParams	Short name for High Mountain Asia LDAS 1 km Snow and Temperature Parameters
LIS_NoahMP	Modeling system used to generate the data
[exp]	Type of experiments: OL = open-loop; no assimilation DA_FT = freeze-thaw assimilation DA_SC = snow cover assimilation DUAL_DA = freeze-thaw and snow cover assimilation
[yyyy][mm][dd]	Four-digit year, two-digit month, and two-digit day of simulation run
1km	Spatial resolution
.nc	File extension denoting netCDF format

1.3 Spatial Information

1.3.1 Coverage

Spatial coverage includes the High Mountain Asia region, defined here by the following boundaries:
Northernmost latitude: 40.975° N
Southernmost latitude 20.025° N
Easternmost longitude: 100.975° E
Westernmost longitude: 66.025° E

1.3.2 Resolution

The model's spatial resolution is 0.01° by 0.01° (or 1 km by 1 km)

1.3.3 Geolocation

Parameters `lat_2D` and `lon_2D` are provided on the same grid as the snow and temperature parameters, so that each grid point can be mapped to its specific geographic coordinate.

1.4 Temporal Information

1.4.1 Coverage

01 September 2007 to 31 August 2008

1.4.2 Resolution

Daily

2 DATA ACQUISITION AND PROCESSING

2.1 Data Simulation

Model output is generated using the NASA Land Information System (LIS). Refer to Xue et al. (2019) for descriptions of the simulations' forcing fields and relevant model components.

Input data for assimilation:

- Snow cover: *MODIS/Terra Snow Cover Daily L3 Global 500m SIN Grid, Version 6*
- Freeze/thaw: *MEaSUREs Global Record of Daily Landscape Freeze/Thaw Status, Version 1*

Algorithms: direct insertion of satellite-based observations

- `DA_SC`: Following Rodell and Houser (2004) and Arsenault et al. (2013), the Noah-MP model assimilates satellite-derived binary snow cover observations. The updates take place daily at 00:00 (UTC). If the model-derived results and the corresponding MODIS-derived snow cover observations agree with each other, or the observations are flagged as "no-value", or the model-derived snow cover estimates are undetermined, then no updates occur. If the model indicates a snow-covered grid cell, but the observation indicates snow-free conditions, both the SWE and snow depth states are reduced to zero. If the model indicates a snow-free grid cell, but the observation indicates snow-covered conditions, the modeled SWE during the analysis update step is increased to 5 mm and the snow depth is increased accordingly to 0.02 m to initiate the snowpack growth. All other snow-related states, such as number of snow layers, snow depth distribution profile (as a function of the snow layers), snow temperature profile, snow liquid water content, and snow ice content, are also modified accordingly within the Noah-MP routines.
- `DA_FT`: Following Reichle et al. (2010) and Farhadi et al. (2015), the Noah-MP model assimilates the satellite-derived binary freeze/thaw observations on a daily basis. The updates take place twice a day at 01:30 (AM;UTC) and 13:30 (PM;UTC), which corresponds to the AM and PM freeze/thaw observations, respectively. If the model-derived results and the corresponding freeze/thaw observations agree with each other, or the observations are flagged as "no-value", or the model-derived freeze/thaw conditions are undetermined, then no updates occur. In addition, it is important to note that model grid cells covered with a significant amount of snowpack (i.e., snow cover fraction > 50% or snow depth > 5 cm, as simulated by the Noah-MP model) are not updated during the `DA_FT` process. This is due to the limited penetration depth of the 36 GHz brightness temperature (Tb) channel used in the MEaSUREs detection algorithm. Both soil temperature and surface temperature states are adjusted during this process.
- `DUAL_DA`: Both algorithms described above are incorporated.

2.2 Quality, Errors, and Limitations

Assessments of each of the data assimilation systems are summarized in Xue et al. (2019).

3 SOFTWARE AND TOOLS

NetCDF data files can be opened using netCDF-visualization software, such as Panoply.

4 RELATED DATA SETS

High Mountain Asia at NSIDC | Data Sets

MODIS/Terra Snow Cover Daily L3 Global 500m SIN Grid, Version 6

MEaSUREs Global Record of Daily Landscape Freeze/Thaw Status, Version 1

5 RELATED WEBSITES

High Mountain Asia at NSIDC | Overview

NASA High Mountain Asia Project

6 CONTACTS

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7 REFERENCES

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8 DOCUMENT INFORMATION

8.1 Publication Date

5 September 2019

8.2 Date Last Updated

18 September 2019