High Mountain Asia LIS Model Terrestrial Hydrological Parameters, Version 1

USER GUIDE

How to Cite These Data

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

Kumar, S. V. and Y. Yoon. 2019. *High Mountain Asia LIS Model Terrestrial Hydrological 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/ENXL5FDN5V8C. [Date Accessed].

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

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

National Snow and Ice Data Center

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1 DATA DESCRIPTION

1.1 Parameters

The data files contain estimates of water, energy fluxes, and land surface states. Seven of the parameters have a third, vertical dimension, which allows for the representation of those parameters at several discrete depths(*). The parameter names generally follow the Assistance for Land-surface Modelling activities (ALMA) data exchange convention. All the parameters provided in this data set are listed in Table 1. Parameters with the extension `_tavg` have been time-averaged, whereas parameters with the extension `_inst` are instantaneous snapshots, i.e., not time-averaged.

(*)Note: Some of the parameters have a third, vertical dimension, which allows for the representation of various depth layers. The number in parentheses next to these parameters in Table 1 represents the number of available depth layers (vertical dimension). The parameters `SoilMoist_tavg`, `SoilTemp_tavg`, and `z_soil_inst` have four (4) vertical layers at the following depths: 0.1 m, 0.3 m, 0.6 m, and 1 m. The parameters `SnowIce_inst`, `SnowLiq_inst`, `SnowTProf_inst`, and `z_snow_inst` have three (3) vertical layers at variable depths, as the snow layers grow and shrink depending on the snow depth.

Table 1. Parameter Descriptions

Parameter	Description	Units	Dimensions
ActSnowNL_inst	Actual number of snow layers	-	2D
Albedo_tavg	Surface albedo	-	2D
AvgSurfT_tavg	Surface temperature	K	2D
CanopInt_tavg	Total canopy water storage	kg m^{-2}	2D
ECanop_tavg	Interception evaporation	kg m^{-2} s^{-1}	2D
ESoil_tavg	Bare soil evaporation	kg m^{-2} s^{-1}	2D
Evap_tavg	Total evapotranspiration	kg m^{-2} s^{-1}	2D
LAI_tavg	Leaf area index	-	2D
lat	Latitude	Degrees North	2D
lon	Longitude	Degrees East	2D
LWdown_f_tavg	Surface downward longwave radiation	W m^{-2}	2D
Lwnet_tavg	Net downward longwave radiation	W m^{-2}	2D
Psurf_f_tavg	Surface pressure	Pa	2D
Qair_f_tavg	Specific humidity	kg kg^{-1}	2D
Qg_tavg	Soil heat flux	W m^{-2}	2D

Parameter	Description	Units	Dimensions
Qh_tavg	Sensible heat flux	W m^{-2}	2D
Qle_tavg	Latent heat flux	W m^{-2}	2D
Qs_tavg	Surface runoff	kg m^{-2} s^{-1}	2D
Qsb_tavg	Subsurface runoff amount	kg m^{-2} s^{-1}	2D
Qsm_tavg	Snowmelt	kg m^{-2} s^{-1}	2D
RadT_tavg	Surface radiative temperature	K	2D
Rainf_f_tavg	Rainfall flux	kg m^{-2} s^{-1}	2D
Rainf_tavg	Precipitation rate	kg m^{-2} s^{-1}	2D
SnowAge_tavg	Snow age Note: this parameter is model-specific and has no units.	-	2D
SnowCover_tavg	Snow cover	-	2D
SnowDepth_tavg	Snow depth	m	2D
Snowf_tavg	Snowfall rate	kg m^{-2} s^{-1}	2D
SnowIce_inst	Snow ice	mm	3D (3)
SnowLiq_inst	Snow-layer liquid water	mm	3D (3)
SnowTProf_inst	Snow temperature profile	K	3D (3)
SoilMoist_tavg	Soil moisture content	m^3 m^{-3}	3D (4)
SoilTemp_tavg	Soil temperature	K	3D (4)
SubSnow_tavg	Snow sublimation	kg m^{-2} s^{-1}	2D
SWdown_f_tavg	Surface downward shortwave radiation	W m^{-2}	2D
SWE_tavg	Snow water equivalent	kg m^{-2}	2D
Swnet_tavg	Net downward shortwave radiation	W m^{-2}	2D
Tair_f_tavg	Air temperature	K	2D
time	Time	Minutes since 2011-06-01 00:00:00	-
TotalPrecip_tavg	Total precipitation amount	kg m^{-2} s^{-1}	2D
TVeg_tavg	Vegetation transpiration	kg m^{-2} s^{-1}	2D
TWS_tavg	Terrestrial water storage	mm	2D
VegT_tavg	Canopy temperature	K	2D
Wind_f_tavg	Wind speed	m s^{-1}	2D
z_snow_inst	Depth from snow surface to snow layer bottom	m	3D (3)
z_soil_inst	Depth from snow surface to soil layer bottom	m	3D (4)

1.2 File Information

1.2.1 Format

Each data file is provided in netCDF (`.nc`) format. In addition, each netCDF file is paired with a browse image file in PNG (`.png`) format. Due to the large number of parameters in this data set, only the parameter `Swnet_tavg` was chosen to represent the browse files.

1.2.2 File Contents

As an example of the file contents, Figure 1 shows modeled soil temperature (`AvgSurfT_tavg`) at 0.1 m depth on 01 February 2003 over the Himalayan study area from the file `HMA_LIS_LandSurfaceHydro_20030201.nc`. Figure 2 shows modeled snow cover (`SnowCover_tavg`) for the same study area and from the same file.

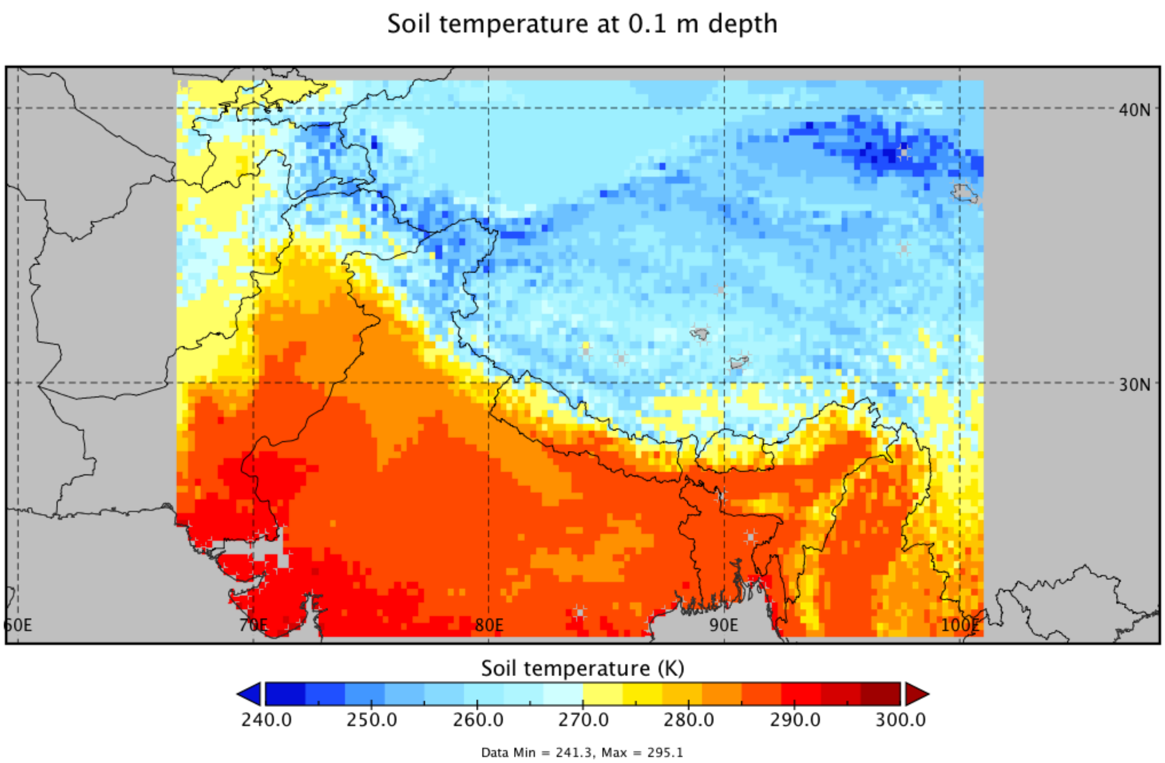

Figure 1. Modeled soil temperature (in K) at 0.1 m depth on 01 February 2003.

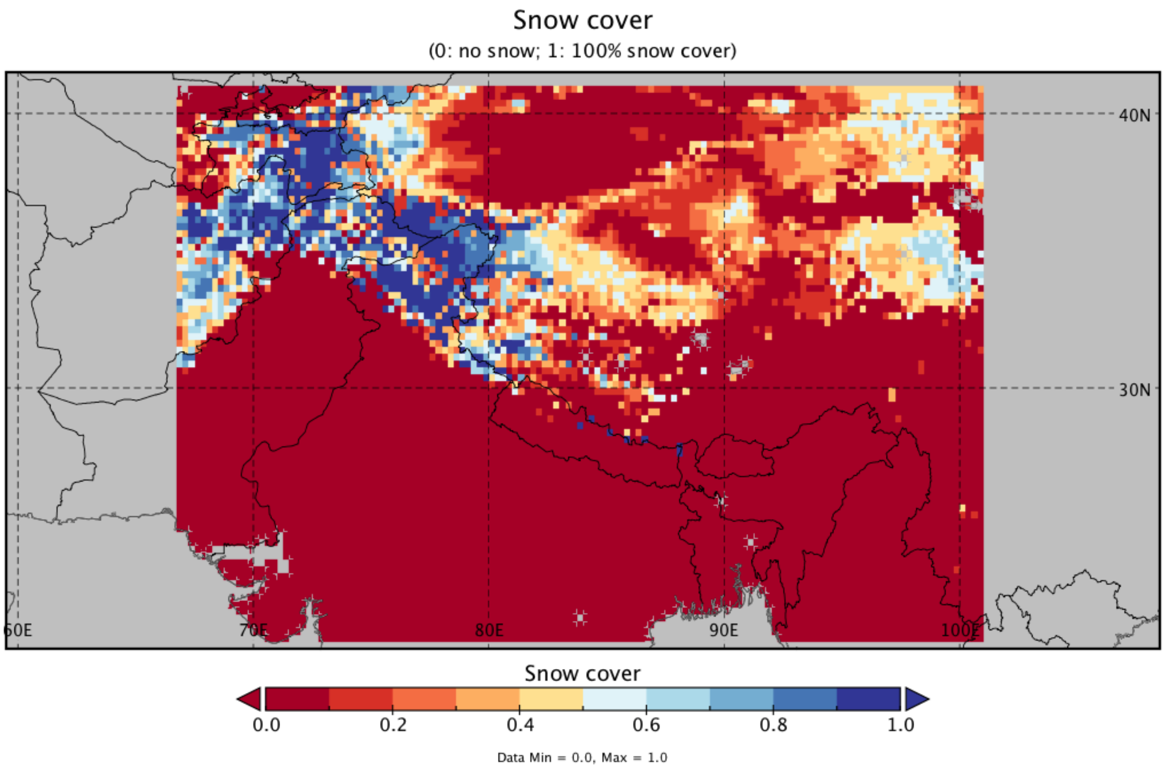

Figure 2. Modeled snow cover on 01 February 2003. A value of 0 means 0% snow cover; a value of 1 means 100% snow cover.

Figure 3 shows modeled snow cover (`SnowCover_tavg`) for 01 February 2017 from the file `HMA_LIS_LandSurfaceHydro_20170201.nc`.

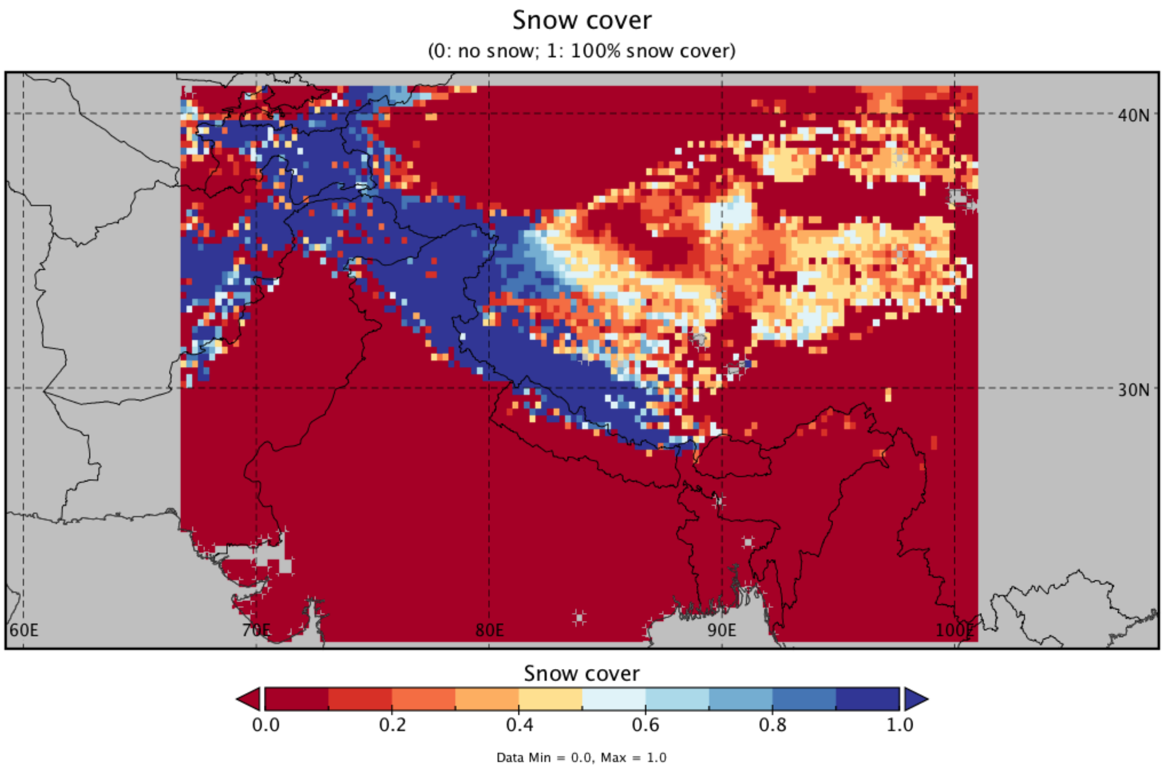

Figure 3. Modeled snow cover on 01 February 2017. A value of 0 means 0% snow cover; a value of 1 means 100% snow cover.

1.2.3 Naming Convention

Example file names:

```
HMA_LIS_LandSurfaceHydro_20180131.nc
HMA_LIS_LandSurfaceHydro_20180131_Swnet_tavg_BROWSE.png
```

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

```
HMA_LIS_LandSurfaceHydro_YYYYMMDD.ext
HMA_LIS_LandSurfaceHydro_YYYYMMDD_Swnet_tavg_BROWSE.ext
```

Table 2. File Naming Convention

Variable	Description
HMA_LIS_LandSurfaceHydro	Short name for High Mountain Asia LIS Model Terrestrial Hydrological Parameters
YYYYMMDD	Four-digit year, two-digit month, two-digit day
Swnet_tavg_BROWSE	Designates a PNG browse image. Only the parameter `Swnet_tavg` (net downward shortwave radiation) was chosen to represent the browse files.
.ext	File type: `.nc` = netCDF data file `.png` = browse image file

1.3 Spatial Information

1.3.1 Coverage

Spatial coverage includes the High Mountain Asia region, as noted by the spatial extents below.

Northernmost latitude: 40.875° N

Southernmost latitude 20.875° N

Easternmost longitude: 100.875° E

Westernmost longitude: 66.875° E

1.3.2 Resolution

The model's horizontal resolution is 0.25° by 0.25°.

1.3.3 Geolocation

Table 3 provides geolocation information for this data set.

Table 3. Geolocation Details

Geographic coordinate system	WGS 84
EPSG code	4326
PROJ4 string	+proj=longlat +datum=WGS84 +no_defs
Reference	https://epsg.io/4326

1.4 Temporal Information

1.4.1 Coverage

01 February 2003 to 31 January 2018

1.4.2 Resolution

Daily

2 DATA ACQUISITION AND PROCESSING

2.1 Data Simulation

The initial land surface model (LSM) output is simulated over the High Mountain Asia region using the Noah-Multiparameterization Land Surface Model (Noah-MP LSM; Niu et al., 2011; Yang et al., 2011) Version 3.6 within the NASA Land Information System (LIS; Kumar et al., 2006) Version 7.2.

LIS is a terrestrial hydrology modeling and data assimilation system, which allows for single or ensemble LSM simulations; it supports multiple data assimilation techniques and the integration of satellite-derived data. Noah-MP LSM was developed from Noah LSM and incorporates extensive upgrades, such as dynamic vegetation phenology, a carbon budget and carbon-based photosynthesis, an explicit vegetation canopy layer, a multilayer snowpack representation, and the addition of a groundwater module.

To generate daily output of water balance components, Noah-MP LSM is run with a 15-minute time step from 2003 to 2018 at a horizontal resolution of 0.25°. The initial conditions for the simulation are generated by running Noah-MP LSM twice for the whole time period and then re-initializing the model in 2003. The model configuration does not include representations of glaciers and human management impacts, such as groundwater extraction and irrigation. Noah-MP LSM is forced with the 6-hourly European Centre for Medium-Range Weather Forecasts (ECMWF) meteorological data set. To improve the spatial representation of the precipitation fields, daily data from the Climate Hazards group Infrared Precipitation with Stations (CHIRPS; Funk et al., 2015) Version 2.0 are used instead of the original ECMWF precipitation forcing. The CHIRPS data set is a thermal infrared-based, quasi-global (50° S to 50° N) precipitation product at a horizontal resolution of 0.05°; CHIRPS data are available at daily to monthly time scales, from 1981 to the near-real time period of record. High-resolution elevation data from the Shuttle Radar Topography Mission (SRTM; Rodriguez et al., 2005) are used to derive the topographical parameters elevation, slope, and aspect. Model integration uses the 20-category International Geosphere Biosphere Programme (IGBP)-Modified Moderate Resolution Imaging Spectroradiometer (MODIS) scheme

(Friedl et al., 2002), and soil data from the International Soil Reference and Information Centre (ISRIC; Hengl et al., 2014). The meteorological inputs, such as air temperature, humidity, surface pressure, wind, downward shortwave and longwave radiation, are adjusted for the elevation differences through lapse-rate and slope-aspect correction methods (Kumar et al., 2013).

2.2 Quality, Errors, and Limitations

The data files contain modeled output. No additional data quality flags are provided.

3 SOFTWARE AND TOOLS

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

The following software was developed by scientists to produce High Mountain Asia products from satellite data or reanalysis (climate model) data. These software products are not designed for non-specialist users in general, but may be useful to other scientists, and may facilitate learning the details of the algorithms behind some of the High Mountain Asia data products.

Land information system framework
Author(s): Sujay Kumar
Reference(s)/documentation: lis.gsfc.nasa.gov/

4 RELATED DATA SETS

High Mountain Asia at NSIDC | Data Sets

5 RELATED WEBSITES

High Mountain Asia at NSIDC | Overview
NASA High Mountain Asia Project
NASA LIS Overview
NASA LIS GitHub repository
UC Santa Barbara Climate Hazards Group CHIRPS web page

6 CONTACTS

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7 REFERENCES

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8 DOCUMENT INFORMATION

8.1 Publication Date

14 March 2019

8.2 Date Last Updated

23 July 2021