



High Mountain Asia Daily 0.05 x 0.05 deg Noah-MP Land Surface Model Reanalysis, Version 1

USER GUIDE

How to Cite These Data

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

Maina, F. Z., S. V. Kumar, A. Getirana, B. A. Forman, B. F. Zaitchik, B. D. Loomis, V. Maggioni, Y. Xue, Y. Zhou, and S. McLarty. (2023). *High Mountain Asia Daily 0.05 x 0.05 deg Noah-MP Land Surface Model Reanalysis, Version 1*. [Indicate subset used]. Boulder, Colorado USA. NASA National Snow and Ice Data Center Distributed Active Archive Center.
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FOR QUESTIONS ABOUT THESE DATA, CONTACT NSIDC@NSIDC.ORG

FOR CURRENT INFORMATION, VISIT https://nsidc.org/data/HMA2_NLSMR



National Snow and Ice Data Center

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1 DATA DESCRIPTION

This data set consists of a water budget reanalysis for the High Mountain Asia (HMA) region spanning the years 2003 through 2020. The data were generated using the Noah Multi-Parameterization (Noah-MP) land surface model (LSM), Version 4.0.1, driven by precipitation estimates and other hydrological inputs developed specifically for HMA.

1.1 Parameters

Parameters include estimates of storages; fluxes; snow depth, extent, and snow water equivalent; temperature (land surface, soil, snow, and ice); surface albedo; soil moisture; evapotranspiration; and streamflow. For a complete list of parameters, see Table 1 below.

1.2 File Information

1.2.1 Format

NetCDF-4 classic

1.2.2 File Contents

Data files contain the following NetCDF variables (i.e., parameters). All variables are formatted as data type float, except for “crs” (data type char).

Table 1. Variable Names and Descriptions

Variable	Description	Variable	Description
latitude	Latitude (° N)	SnowDepth	Snow depth (m)
longitude	Longitude (° E)	Soil_Layers	Soil layer ¹ (0.0, 1.0, 2.0, or 3.0)
crs	Information about the coordinate reference system (See “Section 1.3.3” for more details.).	SoilMoist	Mass ratio of moisture to dry soil
Swnet	Net downward shortwave radiation in air (W/m ²)	SoilTemp	Soil temperature (K)

¹ The 2 m soil column is divided into four layers (0.0, 1.0, 2.0, or 3.0) with thicknesses of 0.1 m, 0.3 m, 0.6 m, and 1.0 m.

Variable	Description	Variable	Description
Lwnet	Net downward longwave radiation in air (W/m ²)	PotEvap	Potential evapotranspiration, water (kg/m ² ·s)
Qle	Surface downward latent heat flux (W/m ²)	TVeg	Vegetation transpiration flux (kg/m ² ·s)
Qh	Surface downward sensible heat flux (W/m ²)	ESoil	Evaporation (kg/m ² ·s), bare soil (soil not covered by vegetation)
Qg	Downward heat flux in soil (W/m ²)	WaterTableD	Water table depth (mm)
Snowf	Snowfall rate derived from total precipitation (kg/m ² ·s)	TWS	Terrestrial water storage (mm)
Rainf	Rainfall rate derived from total precipitation (kg/m ² ·s)	GWS	Groundwater storage (mm)
Evap	Water evapotranspiration flux (kg/m ² ·s)	Snowcover	Fractional snow cover
Qs	Surface runoff flux (kg/m ² ·s)	GPP	Gross primary production of biomass expressed as carbon (g/m ² ·s)
Qsb	Subsurface runoff flux (kg/m ² ·s)	NPP	Net primary production of biomass expressed as carbon (g/m ² ·s)
Qsm	Surface snowmelt flux (kg/m ² ·s)	NEE	Net ecosystem exchange (g/m ² ·s)
BareSoilT	Temperature (K), bare soil (soil not covered by vegetation)	LAI	Leaf area index ²

² Defined as the green leaf area (broadleaf canopies) or one half the total needle surface area (coniferous canopies) per unit area of ground. See Myneni et al., 2021.

Variable	Description	Variable	Description
SurfT	Land surface temperature (K)	TotalPrecip	(kg/m ² ·s)
Albedo	Surface albedo	WT	Total water column in the aquifer and saturated soil (mm)
SWE	Snow water equivalent (kg/m ²), surface snow		

1.2.3 Naming Convention

Data files utilize the following naming convention:

Naming Convention

HMA2_NLSMR_YYYYMMDD_Vxx.x.nc

Example

HMA2_NLSMR_20030219_V01.0.nc

The following table describes the variables in the file naming convention:

Table 2. File Naming Convention Variables and Descriptions

Variable	Description
HMA2_NLSMR	Unique identifier for the “High Mountain Asia Daily 0.05 x 0.05 deg Noah-MP Land Surface Model Reanalysis” data set
YYYYMMDD	Data date, formatted as the 4-digit year, 2-digit month, and 2-digit day
Vxx.x	Data set major and minor version number. E.g., V01.0 = Version 1.0
nc	NetCDF file extension

1.3 Spatial Information

1.3.1 Coverage

N: 46.0° N

S: 20.0° N

E: 111.0° E

W: 60.0° E

1.3.2 Resolution

0.05° × 0.05°

1.3.3 Geolocation

The following tables provide information for geolocating this data set:

Table 3. Geolocation Details

Geographic coordinate system	World Geodetic System 1984
Projected coordinate system	N/A
Longitude of true origin	Prime Meridian, Greenwich
Latitude of true origin	N/A
Scale factor at longitude of true origin	N/A
Datum	WGS 84
Ellipsoid/spheroid	WGS 84
Units	degree
False easting	N/A
False northing	N/A
EPSG code	EPSG:4326
PROJ4 string	+proj=longlat +datum=WGS84 +no_defs
Reference	https://epsg.io/4326

Table 4. Grid Details

Grid cell size (x, y pixel dimensions)	0.05°, 0.05°
Number of rows	520
Number of columns	1020
Geolocated lower left point in grid	20.025° N 60.025° E
Nominal gridded resolution	0.05° × 0.05°
Grid rotation	N/A
ulxmap – x-axis map coordinate of the center of the upper-left pixel (XLLCORNER for ASCII data)	60.05° E
ulymap – y-axis map coordinate of the center of the upper-left pixel (YLLCORNER for ASCII data)	45.95° N

1.4 Temporal Information

1.4.1 Coverage

1 January 2003 to 31 December 2020

1.4.2 Resolution

1 day

2 DATA ACQUISITION AND PROCESSING

The following HMA-specific inputs were developed from available satellite/sensor records (optical, thermal, passive microwave, laser, and gravity) to better represent the water budget in the region:

- Ensemble consensus precipitation (Maina et al., 2022).
- Irrigation (Zhou et al., 2022)
- Soil moisture (Dorigo et al., 2017)
- Leaf area index (Myneni et al, 2021)
- Snow water equivalent (Kraaijenbrink et al., 2021)
- Terrestrial water storage (Loomis et al., 2021)

The community Noah-MP LSM is the result of a collaboration between the National Center for Atmospheric Research (NCAR), the National Centers for Environmental Prediction (NCEP), and NASA. For more information see, [Noah-Multiparameterization Land Surface Model \(Noah-MP LSM\)](#).

3 VERSION HISTORY

Version 1 (initial release)

4 RELATED DATA SETS

[High Mountain Asia \(HMA\) | Data](#)

5 RELATED WEBSITES

[NASA's High Mountain Asia Team](#)

6 REFERENCES

Dorigo, W., Wagner, W., Albergel, C., Albrecht, F., Balsamo, G., Brocca, L., Chung, D., Ertl, M., Forkel, M., Gruber, A., Haas, E., Hamer, P. D., Hirschi, M., Ikonen, J., de Jeu, R., Kidd, R., Lahoz, W., Liu, Y. Y., Miralles, D., Mistelbauer, T., & Lecomte, P. (2017). ESA CCI Soil Moisture for improved Earth system understanding: State-of-the art and future directions. *Remote Sensing of Environment*, 203, 185–215. <https://doi.org/10.1016/j.rse.2017.07.001>

Kraaijenbrink, P. D. A., Stigter, E. E., Yao, T., & Immerzeel, W. W. (2021). Climate change decisive for Asia's snow meltwater supply. *Nature Climate Change*, 11(7), 591–597. <https://doi.org/10.1038/s41558-021-01074-x>

Loomis, B. D., Felikson, D., Sabaka, T. J., & Medley, B. (2021). High-Spatial-Resolution Mass Rates From GRACE and GRACE-FO: Global and Ice Sheet Analyses. *Journal of Geophysical Research: Solid Earth*, 126(12). <https://doi.org/10.1029/2021jb023024>

Maina, F. Z., Kumar, S. V., Dollan, I. J., & Maggioni, V. (2022). Development and Evaluation of Ensemble Consensus Precipitation Estimates over High Mountain Asia. *Journal of Hydrometeorology*, 23(9), 1469-1486. <https://doi.org/10.1175/JHM-D-21-0196.1>

Myneni, R., Knyazikhin, Y., & Park, T. (2021). MODIS/Terra Leaf Area Index/FPAR 8-Day L4 Global 500m SIN Grid V061 [dataset]. NASA EOSDIS Land Processes Distributed Active Archive Center. <https://doi.org/10.5067/MODIS/MOD15A2H.061>

Zhou, Y., Zaitchik, B. F., Kumar, S., Nie, W., Loomis, B. D., Richey, A., & Appana, R. (2022). Satellite-informed simulation of irrigation in South Asia: opportunities and uncertainties. Wiley. <https://doi.org/10.1002/essoar.10512174.1>

7 DOCUMENT INFORMATION

7.1 Publication Date

November 2023

7.2 Date Last Updated

November 2023