High Mountain Asia 4-km Dynamically Downscaled Meteorological Data, 2000-2015, Version 1

USER GUIDE

How to Cite These Data

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

Wolvin, S., A.K. Kochanski, and C. Strong. 2024. *High Mountain Asia 4-km Dynamically Downscaled Meteorological Data, 2000-2015, Version 1*. [Indicate subset used]. Boulder, Colorado USA. NASA National Snow and Ice Data Center Distributed Active Archive Center. https://doi.org/10.5067/90SYW7APOXKX. [Date Accessed].

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

FOR CURRENT INFORMATION, VISIT https://nsidc.org/data/HMA2_DDSMET

National Snow and Ice Data Center

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1 DATA DESCRIPTION

This High Mountain Asia (HMA) data set contains simulated meteorological data for the Indus Basin from 2000 through 2015, at three horizontal resolutions (36 km, 12 km, and 4 km) and nine pressure levels spanning 1000 hPa – 200 hPa. The data were generated by using the Advanced Research Weather Research & Forecasting (ARW-WRF) model to dynamically downscale Climate Forecast System Reanalysis (CFSR) data into three nested domains with increasing horizontal resolution.

1.1 Parameters

Output parameters comprise 35 science variables, including surface and 2-m temperature; potential temperature; dew point temperature; specific and relative humidity; mixing ratios; accumulated cumulus and total precipitation; snow depth and snow water equivalent; surface and subsurface runoff; downwelling shortwave/longwave fluxes; upwelling sensible/latent heat fluxes; albedo; and component wind velocities.

1.2 File Information

1.2.1 Format

NetCDF-4

1.2.2 File Contents

ⓘ For the remainder of this document, the spatial domains are referred to by their corresponding horizontal resolutions: 36 km, 12 km, or 4 km.

Data files in each of the three domains contain the same parameters. For a complete list of output parameters and variable names, see “Appendix A – Output Variables.”

In addition to the increasing horizontal resolution, data in each of the three domains are reported at increasing temporal resolutions. To keep data files at manageable sizes, individual files within the 4 km domain span a shorter length of time (typically 48 hours) than files in the 36 km and 12 km domains (1 calendar month). Table 1 lists the temporal resolution and temporal coverage of individual files for each of the three domains.

Table 1. Data File Temporal Coverage by Domain

Domain	Temporal Resolution	Temporal Coverage
36 km	12 h	1 calendar month
12 km	3 h	1 calendar month
4 km	1 h	Approx. 48 h[1]

1.2.3 Naming Convention

Naming Convention

HMA2_DDSMET_[NN]KM_[MM]HR_[YYYYMMDD]T[hhmm]Z_V[VV.v].nc

Examples

HMA2_DDSMET_36KM_12HR_20000101T0000Z_V01.0.nc

HMA2_DDSMET_12KM_03HR_20000801T1500Z_V01.0.nc

HMA2_DDSMET_04KM_01HR_20000909T0400Z_V01.0.nc

Table 2. File Name Variables and Descriptions

Variable	Description
HMA2_DDSMET	High Mountain Asia 4-km Dynamically Downscaled Meteorological Data, 2000-2015
NN	Horizontal spatial resolution in km. E.g., 04KM = 4 km resolution
MM	Temporal resolution in hours. E.g., 01HR = 1 h resolution
YYYYMMDD	File start date in YYYYMMDD format. E.g., 20000101 = 1 Jan 2000
T	Time follows
hhmm	File start time in hhmm format on given date. E.g., “20000801T1500Z” indicates that the file starts at 15:00Z (UTC) on 1 Aug 2000.
VV.v	Major (VV) and minor (v) version number. E.g., V01.0 = Version 1.0
nc	NetCDF file extension

1.3 Spatial Information

1.3.1 Coverage

The following table lists the spatial coverages for the 36 km, 12 km, and 4 km domains:

[1]The 4 km domain files may span as many as 72 hours or as little as 24 hours.

Table 3. Spatial Coverages for the 36 km, 12 km, and 4 km Domains

Domain	North (°N)	South (°N)	East (°E)	West (°E)
36 km	48.725983	10.520058	108.543396	43.456604
12 km	42.272057	17.936966	94.81329	56.770508
4 km	38.0514	23.2367	87.8268	64.1732

1.3.2 Resolution

36 km

12 km

4 km

1.3.3 Geolocation

Data are provided in the Lambert Conformal Conic projection with one standard parallel at 30.75001° N. The “crs” variable within the data files contains a complete description of this projection.

1.4 Temporal Information

1.4.1 Coverage

1 Jan 2000 - 31 Dec 2015

1.4.2 Resolution

36 km: 12 h

12 km: 3 h

4 km: 1 h

2 DATA ACQUISITION AND PROCESSING

2.1 Acquisition

These data were generated using ARW-WRF, Version 3.8.1 and 6-hour CFSR data from the National Oceanic and Atmospheric Administration (NOAA) National Centers for Environmental Prediction (NCEP).

2.2 Processing

The ARW-WRF model was configured with three nested domains with increasing horizontal resolutions, from 36 km to 12 km to a convection-permitting 4 km, such that the innermost domain did not rely on a cumulus parameterization and would be fine enough to resolve orographic precipitation. The simulations were generated as a continuous run with a spin-up year (2000) to equilibrate soil moisture, snow cover, and temperature at the beginning of the simulation. The simulations were then compared with Tropical Rainfall Measuring Mission (TRMM) and station data for the same time period using root mean squared error, percentage bias, mean bias error, and the Pearson correlation coefficient.

A complete description of how this data set was generated and evaluated is available in Dars et al. 2020. For specific information about how the ARW-WRF was applied, see " WRF Users Guide Documentation | WRF Output."

2.3 Quality, Errors, and Limitations

While the precipitation and temperature simulations largely improve from lower to higher resolutions, the WRF tends to overestimate precipitation and underestimate temperature in all three domains.

3 VERSION HISTORY

Version 1 (July 2024)

4 REFERENCES

Dars, G. H., Strong, C., Kochanski, A. K., Ansari, K., & Ali, S. H. (2020). The Spatiotemporal Variability of Temperature and Precipitation Over the Upper Indus Basin: An Evaluation of 15 Year WRF Simulations. In Applied Sciences (Vol. 10, Issue 5, p. 1765). https://doi.org/10.3390/app10051765

5 DOCUMENT INFORMATION

5.1 Publication Date

July 2024

5.2 Date Last Updated

July 2024

APPENDIX A – OUTPUT PARAMETERS

Array dimensions can be 1D – 4D depending on whether the parameter being reported is, e.g., time, the latitude/longitude in each grid cell, the surface temperature in each grid cell through time, or the temperature at each of the nine atmospheric pressure levels in each grid cell through time.

The following table lists each parameter along with its variable name and description. Note that the size of the lat/lon grids and time variable differs for each domain due to having different spatial and temporal resolutions and durations.

Table A - 1: Variables and Descriptions

Variable Name	Description
LH	Latent Heat Flux - Upward - at surface - instant
LW_d	Longwave Flux - Downward - at surface - instant
LandMask	Binary land mask (0 = water, 1 = land)
LandUse	Land Use Category[2]
SH	Sensible Heat Flux - Upward - at surface - instant
SST	Sea surface temperature
SW_d	Shortwave Flux - Downward - at surface - instant
SfcRunoff	Surface runoff
SnowHgt	Surface snow depth
SnowWater	Snow water equivalent
SubRunoff	Subsurface runoff
T_2m	Temperature at 2 m
T_p	Air temperature (time, pressure level)
T_sfc	Surface temperature
Td_2m	Dew point temperature at 2 m
Td_p	Dew point temperature (time, pressure level)
Z_p	Geopotential Height (time, pressure level)
Z_sfc	Terrain height

[2] To decode the values stored in the LandUse variable, see LANDUSE.TBL at the wrf-model/WRF/run/LANDUSE.TBL GitHub page.

Variable Name	Description
albedo	Surface albedo
crs	Coordinate reference system
lat	Latitude
lon	Longitude
p_sfc	Surface air pressure
precip_c	Accumulated total cumulus (convective) precipitation
precip_g	Accumulated total grid scale precipitation
pressure	Pressure levels
q_2m	Specific humidity at 2 m
q_p	Specific humidity (time, pressure level)
r_cloud_p	Mass fraction of cloud liquid water in air (time, pressure level)
r_ice_p	Mass fraction of cloud ice in air (time, pressure level)
r_rain_p	Mass fraction of rain in air (time, pressure level)
r_snow_p	Mass fraction of snow in air (time, pressure level)
r_v_2m	Water vapor mixing ratio at 2 m
r_v_p	Water vapor mixing ratio (time, pressure level)
rh_2m	Relative humidity at 2 m
rh_p	Relative humidity (time, pressure level)
theta_p	Potential temperature (time, pressure level)
time	Minutes since 2000-01-01 00:00:00
u_10m_gr	u-component (east) of wind at 10 m (grid)
u_gr_p	u-component (east) of wind (time, pressure level)
v_10m_gr	v-component (north) of wind at 10 m (grid)
v_gr_p	v-component (north) of wind (time, pressure level)
w_p	w-component (vertical) of wind (time, pressure level)
x	x coordinate of projection
y	y coordinate of projection