# High Mountain Asia Daily 5 km Downscaled SPEAR Precipitation and Air Temperature Projections, Version 1

# USER GUIDE

**How to Cite These Data**

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

Nikolopoulos, E. I. and D. S. A. Araujo. 2023. *High Mountain Asia Daily 5 km Downscaled SPEAR Precipitation and Air Temperature Projections, Version 1*. [Indicate subset used]. Boulder, Colorado USA. NASA National Snow and Ice Data Center Distributed Active Archive Center. https://doi.org/10.5067/GXAA63DTMC34. [Date Accessed].

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

FOR CURRENT INFORMATION, VISIT https://nsidc.org/data/HMA2_DSPAT

National Snow and Ice Data Center

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# 1 DATA DESCRIPTION

## 1.1 Parameters

This data set consists of daily, 5 km resolution precipitation and mean near-surface air temperature projections from 2015 through 2100 for the High Mountain Asia (HMA) region. The data were generated by statistically downscaling 0.5° resolution model data from the GFDL SPEAR[1] CMIP6[2] 30-member ensemble climate model.

Projections are provided for two Shared Socioeconomic Pathways (SSPs): SSP2-4.5 and SSP5-8.5. A historical model run for 1990 through 2014 is also available.

ⓘ The Shared Socioeconomic Pathways, or SSPs, comprise five different projected climate futures based on both emissions scenarios and socioeconomic factors, such as population, economic growth, education, urbanization, and technological development. See Riahi et al 2017 for details.

## 1.2 File Information

### 1.2.1 Format

NetCDF-4

### 1.2.2 File Contents

Historical data files contain 11 years (1990-2000), 10 years (2001-2010), or 4 years (2011-2014) of daily data. Projection data files contain 10 years of daily data, except for the initial six-year period from 2015-2020.

Precipitation and mean near-surface temperatures are stored in d × 1020 × 520 (d, x, y) arrays, where d = the number days in the file's date range.

Data files contain the variables described in Table 1.

Table 1. Data File Variables and Descriptions

| Variable Name | Description | Data Type |
|---|---|---|
| crs | Information about the coordinate reference system | string |

[1] The Geophysical Fluid Dynamic Laboratory Seamless System for Prediction and EArth System Research (Maina, 2022).
[2] Coupled Model Intercomparison Project Phase 6. See CMIP Phase 6 (CMIP6) for details.

| Variable Name | Description | Data Type |
|---|---|---|
| latitude | Latitude (°N) | 32-bit floating-point |
| longitude | Longitude (°E) | 32-bit floating-point |
| temperature or precipitation | Mean near-surface air temperature (K) or precipitation (mm/day), stored with a scale factor of 0.01. To obtain values in the specified units, divide the value stored in the array by 100. | 16-bit integer |
| time | Days since 1900-01-01 00:00:00 | 32-bit integer |

### 1.2.3 Naming Convention

Precipitation and mean near-surface air temperatures are provided in separate files for each of the 30 ensemble members in the historical, SSP2-4.5, and SSP5-8.5 model runs. Data files utilize the following naming convention:

**Naming Convention**

HMA2_DSPAT_[PARAM]_hist_[EMC]_[StartDate]-[EndDate]_v[xx].[x].nc
HMA2_DSPAT_[PARAM]_SSP[nnn]_[EMC]_[StartDate]-[EndDate]_v[xx].[x].nc

**Examples**

HMA2_DSPAT_pr_hist_r1i1p1f1_19900101-20001231_v01.0.nc
HMA2_DSPAT_tas_hist_r1i1p1f1_19900101-20001231_v01.0.nc
HMA2_DSPAT_pr_SSP245_r1i1p1f1_20150101-20201231_v01.0.nc
HMA2_DSPAT_tas_SSP245_r1i1p1f1_20150101-20201231_v01.0.nc
HMA2_DSPAT_pr_SSP585_r1i1p1f1_20150101-20201231_v01.0.nc
HMA2_DSPAT_tas_SSP585_r1i1p1f1_20150101-20201231_v01.0.nc

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

Table 2. File Naming Convention Variables and Descriptions

| Variable Name | Description |
|---|---|
| HMA2_DSPAT | Unique identifier for the “High Mountain Asia Daily 5 km Downscaled SPEAR Precipitation and Air Temperature Projections” data set |

| Variable Name | Description |
|---|---|
| PARAM | pr (precipitation) or tas (mean near-surface air temperature) |
| hist or SSP[nnn] | Model run. Historical (hist), SSP2-4.5 (SSP245), or SSP5-8.5 (SSP585) |
| EMC | Ensemble member code, following the CMIP6 convention. The code utilizes four indices—a realization index (r), initialization index (i), physics index (p), and forcing index (f)—to uniquely identify each ensemble member in a model run.<br>For this data set, only the realization index increments (as 1, 2, 3,…, 30). I.e., data files have one of the following ensemble member codes: r1i1p1f1, r2i1p1f1, r3i1p1f1,…, r30i1p1f1.[3] |
| StartDate-EndDate | File start date and end date in YYYYMMDD format |
| v[xx].[x] | Major [xx] and minor [x] version number. E.g., v01.0 = Version 1.0 |
| .nc | NetCDF file extension |

## 1.3 Spatial Information

### 1.3.1 Coverage

N: 45.975° N

S: 20.025° N

E: 110.975° E

W: 60.025° E

### 1.3.2 Resolution

5 km

[3] Each ensemble member in the historical run was used as the initial conditions for its corresponding ensemble member in the projections. E.g., HMA2_DSPAT_tas_hist_r1i1p1f1_19900101-20001231.nc was used as the initial conditions for HMA2_DSPAT_tas_SSP245_r1i1p1f1_19900101-20001231.nc and HMA2_DSPAT_tas_SSP585_r1i1p1f1_19900101-20001231.nc.

### 1.3.3 Geolocation

The following table contains 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 +type=crs |
| **Reference** | https://epsg.org/crs_4326/WGS-84.html |

## 1.4 Temporal Information

### 1.4.1 Coverage

1 Jan 1990 – 31 Dec 2014

1 Jan 2015 – 31 Dec 2100

### 1.4.2 Resolution

Daily

# 2 DATA ACQUISITION AND PROCESSING

## 2.1 Processing

To downscale both precipitation and temperature, mixed Cumulative Distribution Function (CDF) matching was applied to SPEAR climate model data at 0.5° resolution (SPEAR_MED[4]) (Delworth et al., 2020) over the historical period from 1990 through 2014 and compared to reference data sets. The data were then downsampled to 5 km resolution from 1990-2100.

Different CDF matching approaches were utilized for precipitation and temperature. The precipitation data from SPEAR_MED were downscaled with a parametric, mixed CDF matching statistical method similar to Emmanouil et al. (2021), but using CDF fits based on the maximum likelihood estimation method instead of the Multiple Threshold Method (Deida et al. 2010). The reference data set used for comparison was the localized probability matched mean (LPM) precipitation data set in Maina et al. (2022).

Mean near-surface air temperature data were also downscaled using CDF matching, but with a mixed CDF based on a generalized Pareto-Gaussian–Generalized Pareto formulation. The HMA-LDAS from Xue et al. (2020) was used as the air temperature reference data set.

# 3 VERSION HISTORY

Table 4. Version History

| Version | Release Date | Description |
|---|---|---|
| V1.1 | June 2024 | The following files in V1.0 were found to have temperature values 100 times too small due to an incorrect scaling factor:<br><br>HMA2_DSPAT_tas_hist_r12i1p1f1_19900101-20001231_v01.0.nc<br>HMA2_DSPAT_tas_hist_r13i1p1f1_19900101-20001231_v01.0.nc<br>HMA2_DSPAT_tas_hist_r4i1p1f1_20110101-20141231_v01.0.nc<br>HMA2_DSPAT_tas_hist_r25i1p1f1_20110101-20141231_v01.0.nc<br><br>For V1.1, these files were replaced with corrected versions and renamed to “v01.1”. No other files were affected. |

[4] See GFDL SPEAR Large Ensembles for more information.

| Version | Release Date | Description |
|---|---|---|
| V1.0 | Dec 2023 | Initial release |

# 4 RELATED DATA SETS

High Mountain Asia (HMA) | Data

# 5 RELATED WEBSITES

NASA's High Mountain Asia Team

# 6 ACKNOWLEDGEMENTS

The data providers would like to acknowledge the following individuals for contributing to this work:

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# 7 REFERENCES

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# 8 DOCUMENT INFORMATION

## 8.1 Publication Date

December 2023

## 8.2 Date Last Updated

June 2024