High Mountain Asia TRMM-derived 3B42 Extreme Precipitation Indices, Version 1

USER GUIDE

How to Cite These Data

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

Kirschbaum, D. B. and T. A. Stanley. 2018. *High Mountain Asia TRMM-derived 3B42 Extreme Precipitation Indices, Version 1*. [Indicate subset used]. Boulder, Colorado USA. NASA National Snow and Ice Data Center Distributed Active Archive Center. https://doi.org/10.5067/5VPZ8AZ9LAKP. [Date Accessed].

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

FOR CURRENT INFORMATION, VISIT https://nsidc.org/data/HMA_Precip_3B42

National Snow and Ice Data Center

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1 DATA DESCRIPTION

The data presented in this data set were calculated from 3B42 Version 7 daily satellite precipitation estimates, and cover an equatorial band from 50º N to 50º S at a spatial resolution of 0.25º x 0.25º.

This data set is closely related to the *High Mountain Asia GFDL FLOR Extreme Precipitation Indices* data set, which features the same seven extreme precipitation indices. However, the GFDL FLOR data are modeled precipitation estimates, and cover the Himalayan region at a spatial resolution of 0.625º x 0.5º.

1.1 Parameters

The seven annual extreme precipitation indices are described in Table 1. Parameters represent yearly precipitation maximums (Rx1day, Rx5day), precipitation frequencies (R10mm, R20mm), length of precipitation events (CWD), and precipitation totals (R95pTOT, R99pTOT).

Table 1. Parameter Descriptions

Parameter	Description	Units
Rx1day	Maximum 1-day precipitation	mm
Rx5day	Maximum precipitation to fall over a consecutive 5-day period	mm
R10mm	Number of days in which more than 10 mm of precipitation fell	Days
R20mm	Number of days in which more than 20 mm of precipitation fell	Days
CWD	Longest number of consecutive days with precipitation greater than 1 mm	Days
R95pTOT	Sum of precipitation from all days that exceed the 95th percentile of precipitation; precipitation percentiles calculated based on 3B42 observations between 1999 and 2017	mm
R99pTOT	Sum of precipitation from all days that exceed the 99th percentile of precipitation; precipitation percentiles calculated based on 3B42 observations between 1999 and 2017	mm

1.2 File Information

1.2.1 Format

The data are in TIFF (`.tif`) format, represented as 64-bit floating point values.

Each data file is paired with an associated XML file (`.xml`), which contains additional metadata.

1.2.2 Naming Convention

The data files are organized in chronological order. Each file name contains the precipitation index and the year for that file. Example file names include:

```
HMA_Precip_3B42_CWD_2000.tif
HMA_Precip_3B42_CWD_2000.tif.xml
```

Files are named according to the following convention and as described in Table 2.

```
HMA_Precip_3B42_index_YYYY.xxx
```

Table 2. File Naming Convention

Variable	Description
`HMA_Precip_3B42`	Short name for High Mountain Asia TRMM-derived 3B42 Extreme Precipitation Indices
`index`	Precipitation index: • Rx1day • Rx5day • R10mm • R20mm • CWD • R95pTOT • R99pTOT
`YYYY`	Four-digit survey year
`.xxx`	Indicates file type: • `.tif` = TIFF data file • `.tif.xml` = XML metadata file

1.3 Spatial Information

1.3.1 Coverage

The spatial coverage includes the tropics, subtropics, and parts of the temperate climate zones, as noted by the spatial extents below:

Northernmost Latitude: 50° N
Southernmost Latitude 50° S
Easternmost Longitude: 180° E
Westernmost Longitude: 180° E

1.3.2 Resolution

The horizontal resolution of this data set 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 January 1999 to 31 December 2017

1.4.2 Resolution

Yearly

2 DATA ACQUISITION AND PROCESSING

2.1 Background

This data set features 7 extreme precipitation indices (Table 1) selected from the 27 climate indices established by the joint CCI/CLIVAR/JCOMM Expert Team (ET) on Climate Change Detection and Indices (ETCDDI). These seven factors can provide insight on the future of rainfall-triggered natural hazards, such as landslides, in High Mountain Asia. Landslides are a particular concern in this region due to the frequency with which deadly events occur; the Himalayan Mountains' stark relief combined with heavy monsoon rainfalls and occasional seismicity result in a region with a high risk of landslides.

2.2 Acquisition

3B42 is a satellite-based product derived primarily from the Tropical Rainfall Measuring Mission (TRMM).

2.3 Processing

The precipitation data were summarized into annual ETCCDI indices in R using the `climdex.pcic` library.

2.4 Quality, Errors, and Limitations

The seven extreme precipitation indices have not been evaluated for error against an absolute reference. However, the methods used to generate these indices are well defined; thus, any errors in the values of the indices reflect errors in the underlying precipitation data. Errors in TRMM data have been extensively analyzed elsewhere (e.g.: Huffman et al., 2007; Bharti and Singh, 2015)

2.5 Instrumentation

2.5.1 Description

The TRMM satellite launched on 27 November 1997. It was operational for 17 years before being turned off on 08 April 2015. During operation, the TRMM satellite was equipped with radar, microwave imaging, and lightning sensors used to study rainfall in the tropical and sub-tropical regions of the Earth. The details of these sensors are described below.

- **Visible and Infrared Scanner (VIRS):** a five-channel, cross-track scanning radiometer operating at 0.63, 1.6, 3.75, 10.8, and 12 µm; provided high-resolution observations on cloud coverage, cloud type, and cloud top temperatures.
- **TRMM Microwave Imager (TMI):** a multichannel passive microwave radiometer operating at five frequencies (10.65, 19.35, 37.0, and 85.5 GHz at dual polarization and 22.235 GHz at single polarization); provided information on the integrated column precipitation content, cloud liquid water, cloud ice, rain intensity, and rainfall types (e.g., stratiform or convective).
- **Precipitation Radar (PR):** an electronically scanning radar, operating at 13.8 GHz, that measured the 3-D rainfall distribution over both land and ocean and defined the layer depth of precipitation.
- **Clouds and the Earth's Radiant Energy System (CERES):** measured the energy at the top of the atmosphere and estimated energy levels within the atmosphere and at the Earth’s surface.
- **Lightning Imaging Sensor (LIS):** detected and located lightning over the tropical regions of the Earth.

More information about the TRMM satellite and its sensors can be found on the NASA TRMM Home Page.

2.5.2 Trajectory and Attitude

The TRMM satellite's orbit was circular, non-sun-synchronous, with an inclination of 35° to the Equator. From 27 November 1997 to 06 August 2001, the orbit altitude was 350 km. From 24 August 2001 until the termination of the mission on 08 April 2015, the orbit altitude was 403 km. Between 07 August 2001 and 14 August 2001, the operating altitude increased from 350 km to 403 km; this period is referred to as the TRMM Boost.

3 SOFTWARE AND TOOLS

The climate indices were calculated in R using the `climdex.pcic` library. More details can be found on the climdex.PCIC CRAN repository or the Pacific Climate Impacts Consortium website.

4 RELATED DATA SETS

High Mountain Asia GFDL FLOR Modeled Extreme Precipitation Indices
High Mountain Asia at NSIDC | Data Sets

5 RELATED WEBSITES

High Mountain Asia at NSIDC | Overview
NASA Tropical Rainfall Measuring Mission (TRMM)
NASA High Mountain Asia Project
NASA Research Announcement: Understanding Changes in High Mountain Asia
GLIMS: Global Land Ice Measurements from Space

6 CONTACTS

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7 REFERENCES

Bharti, V., & Singh, C. (2015). Evaluation of error in TRMM 3B42V7 precipitation estimates over the Himalayan region. Journal of Geophysical Research: Atmospheres, 120(24), 12458–12473. https://doi.org/10.1002/2015jd023779

Huffman, G. J., Bolvin, D. T., Nelkin, E. J., Wolff, D. B., Adler, R. F., Gu, G., Hong, Y., Bowman, K. P., & Stocker, E. F. (2007). The TRMM Multisatellite Precipitation Analysis (TMPA): Quasi-Global, Multiyear, Combined-Sensor Precipitation Estimates at Fine Scales. Journal of Hydrometeorology, 8(1), 38–55. https://doi.org/10.1175/jhm560.1

8 DOCUMENT INFORMATION

8.1 Publication Date

13 February 2019

8.2 Date Last Updated

16 March 2020