High Mountain Asia Langtang Snow Bidirectional Reflectance Factor, Version 1

USER GUIDE

How to Cite These Data

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

Tsay, S. 2019. *High Mountain Asia Langtang Snow Bidirectional Reflectance Factor, Version 1*. [Indicate subset used]. Boulder, Colorado USA. NASA National Snow and Ice Data Center Distributed Active Archive Center. https://doi.org/10.5067/ZLD430XEIP44. [Date Accessed].

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

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

National Snow and Ice Data Center

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1 DATA DESCRIPTION

This data set is closely related to *High Mountain Asia Langtang Snow Properties, High Mountain Asia Langtang Shortwave Downward Irradiance*, and *High Mountain Asia Langtang Automatic Weather Station Measurements*. All of these data sets feature point measurements that were collected on or near the Yala Glacier in Nepal.

1.1 Parameters

The main parameter provided in this data set is the bidirectional reflectance factor (BRF) of snow between 350 and 2500 nm. The parameters provided in the netCDF files are described in Table 1.

Table 1. Parameter Information

Parameter	Description	Units
altitude	Altitude	m
BRF	Bidirectional reflectance factor: 2151 wavelengths by 21 RAAs by 3 VZAs	-
latitude	Latitude	° N
longitude	Longitude	° E
RAA	Relative azimuth angle	degrees
SZA	Solar zenith angle	degrees
VZA	Viewing zenith angle	degrees
Wavelength	Wavelength: 350 - 2500 nm (1 nm resolution)	nm

1.2 File Information

1.2.1 Format

The data files are provided in netCDF (`.nc`) format.

1.2.2 Naming Convention

There are two data files in this data set:

```
HMA_SBRF_ICIMOD_BC_20180423_0325.nc
HMA_SBRF_Yala_Glacier_20180424_0324.nc
```

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

```
HMA_SBRF_[site]_[yyyymmdd]_[hhmm].[ext]
```

Table 2. File Naming Convention

Variable	Description
HMA_SBRF	Indicates the data set *High Mountain Asia Langtang Snow Bidirectional Reflectance Factor*
site	Indicates one of two measurement sites: • ICIMOD_BC • Yala_Glacier
yyyymmdd	Year, month, and day of data collection
hhmm	Hour and minute of data collection (UTC time)
.ext	Indicates file type: .nc = netCDF data file

1.3 Spatial Information

1.3.1 Coverage

Spatial coverage includes two locations on the Yala Glacier in Nepal, as noted by the spatial extents in Table 3.

Table 3. Information about Measurement Sites

Measurement Site Name	Latitude	Longitude	Altitude
ICIMOD BC	28.21502° N	85.60986° E	4905 m
Yala Glacier	28.23525° N	85.61268° E	5116 m

1.3.2 Resolution

This data set consists of two individual measurement sites that are located 2.3 km apart on the Yala Glacier in Nepal (see Table 3).

1.3.3 Geolocation

Each data file contains measurements for a single site (see Table 3).

1.4 Temporal Information

1.4.1 Coverage

23 April 2018 (ICIMOD BC)

24 April 2018 (Yala Glacier)

1.4.2 Resolution

Each data file contains a one-time measurement on either 23 April or 24 April 2018.

2 DATA ACQUISITION AND PROCESSING

2.1 Background

The bidirectional reflectance factor (BRF) describes the anisotropy of reflected radiance from a surface illuminated from a single direction. It is equal to Pi times the reflected radiance, divided by the incident irradiance from a single direction. The BRF of snow plays an important role for remote sensing over snow-covered surfaces. For instance, it is needed to correct for view and illumination angle effects (for example in image standardization and mosaicking), for deriving albedo, for land cover classification, for cloud detection, and for atmospheric correction and other applications.

2.2 Acquisition and Processing

The acquisition and processing steps include:

- In-lab control measurements of the reflectance of a white plate
- In-situ measurements of the snow surface reflectance using the Analytical Spectral Devices (ASD) FieldSpec spectroradiometer
- Post-calibration of the ASD FieldSpec spectroradiometer and the white plate

Then, the BRF was calculated from the ratio of snow surface and white plate reflectance.

2.3 Quality, Errors, and Limitations

The BRF errors are approximately 2% in the ultaviolet range, 1% in the visible range, and 2% in the near-infrared range.

2.4 Instrumentation

The radiance reflected by the snow surface and by a white plate with a known reflectance were measured using the Analytical Spectral Devices (ASD) FieldSpec spectroradiometer. For more information on this instrument, see the ASD FieldSpec spectroradiometer product website.

3 SOFTWARE AND TOOLS

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

4 RELATED DATA SETS

High Mountain Asia Langtang Snow Properties

High Mountain Asia Langtang Shortwave Downward Irradiance

High Mountain Asia Langtang Automatic Weather Station Measurements

High Mountain Asia at NSIDC | Data Sets

5 RELATED WEBSITES

High Mountain Asia at NSIDC | Overview

NASA High Mountain Asia Project

NASA Research Announcement: Understanding Changes in High Mountain Asia

6 CONTACTS

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NASA's Goddard Space Flight Center (GSFC)

7 ACKNOWLEDGMENTS

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8 DOCUMENT INFORMATION

8.1 Publication Date

16 January 2019

8.2 Date Last Updated

18 March 2020