High Mountain Asia Glacier Thickness Change Mosaics from Multi-Sensor DEMs, Version 1

USER GUIDE

How to Cite These Data

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

Maurer, J., S. Rupper, and J. Schaefer. 2019. *High Mountain Asia Glacier Thickness Change Mosaics from Multi-Sensor DEMs, Version 1*. [Indicate subset used]. Boulder, Colorado USA. NASA National Snow and Ice Data Center Distributed Active Archive Center. https://doi.org/10.5067/KE2LG72Z89LN. [Date Accessed].

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

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

National Snow and Ice Data Center

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1 DATA DESCRIPTION

Himalayan glaciers are crucial suppliers of meltwater to densely populated areas in South Asia. To better understand regional climate forcing and assess resulting impacts on glacier-fed rivers, regional observations of glacier change over multiple decades are necessary.

This data set contains two mosaics of glacier thickness change for glaciers of the Himalayan mountains. The mosaics are multi-decadal averages for two subsequent time periods: 1975 to 2000 and 2000 to 2016. The mosaics were created by combining digital elevation models (DEMs), which were derived from imagery from KH-9 HEXAGON, a series of military satellites used by US intelligence agencies for reconnaissance during the Cold War era; and from ASTER, a sensor launched aboard the satellite Terra as part of a cooperative effort between NASA and Japan's Ministry of Economic Trade Industry in 1999.

The DEMs are provided in the related data set *High Mountain Asia Gridded Glacier Thickness Change from Multi-Sensor DEMs* in netCDF format. The data set *High Mountain Asia Average Glacier Thickness Change from Multi-Sensor DEMs* provides averaged thickness changes for each of the DEMs in ESRI shapefile format.

1.1 Parameters

The parameter provided in this data set is glacier thickness change in cm/yr.

1.2 File Information

1.2.1 Format

The data files are provided in GeoTIFF (.tif) format. Each data file has an associated browse image in PNG (.png) format, as well as an XML file (.xml) containing additional metadata.

1.2.2 File Contents

Figure 1 shows a geographical subset of the total mosaic for 1975 to 2000 from the file `HMA_Glacier_dH_Mosaics_elevationTrend_1975-2000.tif`.

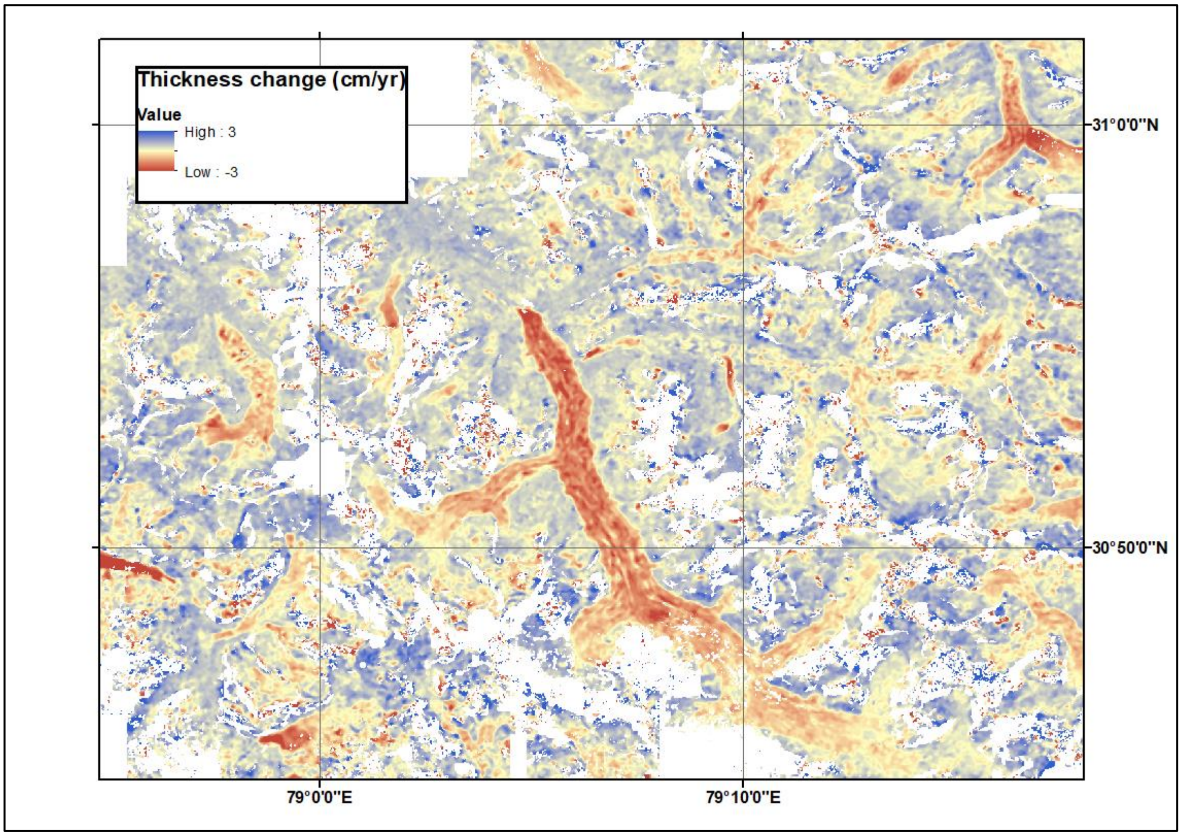

Figure 1. Glacier thickness change from 2000 to 2016 in cm/yr. Figure created using the GeoTIFF-visualization software ArcMap.

1.2.3 Naming Convention

Each file name contains the time period of the calculated thickness change. Example file names include:

```
HMA_Glacier_dH_Mosaics_elevationTrend_1975-2000.tif
HMA_Glacier_dH_Mosaics_elevationTrend_1975-2000_browse.tif
HMA_Glacier_dH_Mosaics_elevationTrend_1975-2000.xml
```

The files are named according to the following convention, which is described in detail in Table 1:

```
HMA_Glacier_dH_Mosaics_elevationTrend_YYYY-yyyy.ext
HMA_Glacier_dH_Mosaics_elevationTrend_YYYY-yyyy_browse.ext
```

Table 1. File Naming Convention

Variable	Description
HMA_Glacier_dH_Mosaics	Short name for High Mountain Asia Glacier Thickness Change Mosaics from Multi-Sensor DEMs
elevationTrend	Indicates that this data set provides thickness changes.

Variable	Description
YYYY-yyyy	Time period of data averaging: 1975–2000 2000–2016
browse	Indicates a browse image file.
.ext	File type: .tif = GeoTIFF data file .png = browse image file .xml = XML metadata file

1.3 Spatial Information

1.3.1 Coverage

Spatial coverage includes the High Mountain Asia region, as noted by the spatial extents below.

Northernmost latitude: 34.4° N

Southernmost latitude 27.4° N

Easternmost longitude: 92.9° E

Westernmost longitude: 75.4° E

1.3.2 Resolution

30 m by 30 m

1.3.3 Geolocation

Table 2 provides geolocation information for this data set.

Table 2. 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 1975 to 01 January 2016 (nominal reference period)

The time period of an underlying DEM used to create the mosaics can extend as early as 01 January 1974 and as late as 31 December 2017.

1.4.2 Resolution

Multi-decadal averages: 1975–2000 and 2000–2016

2 DATA ACQUISITION AND PROCESSING

2.1 Instrumentation

KH-9 Hexagon: Also known as Big Bird or Keyhole-9, KH-9 Hexagon was a series of photographic satellites launched by the US between 1971 and 1986. The KH-9 Hexagon images used in this data set were obtained for reconnaissance purposes between 1973 and 1980 by US intelligence agencies. A telescopic camera system acquired film photographs, which were subsequently ejected in capsules from the satellites and parachuted back to Earth over the Pacific Ocean. The ground resolution of the frame camera is approximately 6 to 9 m, and individual frames overlap by 55 to 70%, allowing for stereo photogrammetric processing.

ASTER: The ASTER satellite sensor is one of the five state-of-the-art instrument sensor systems onboard the satellite Terra, which was launched on 18 December 1999. ASTER's nadir and backward-viewing telescopes provide stereoscopic capability at a ground resolution of 15 m. A single ASTER DEM covers approximately 3600 km2.

2.2 Acquisition

The KH-9 Hexagon images were digitally scanned by the USGS at a resolution of 7 µm, and are available for download at the USGS EarthExplorer website. For more information on how the DEMs were extracted from overlapping KH-9 Hexagon images, see Maurer et al. (2015).

The ASTER DEMs were downloaded via the METI AIST satellite Data Archive System (MADAS), which is maintained by the Japanese National Institute of Advanced Industrial Science and Technology and the Geological Survey of Japan (AIST).

2.3 Processing

All individual DEMs were processed to minimize cloud errors, spatially co-registered to JPL's Shuttle Radar Topography Mission (SRTM) data set, and resampled to a horizontal resolution of 30 m. Manually refined versions of the Randolph Glacier Inventory (RGI 5.0) were used to delineate glaciers from surrounding terrain, and robust linear trends were fit to every time series of elevation pixels over glacier surfaces using the random sample consensus (RANSAC) method.

To create the mosaics from the individual DEMs, the glacier thickness change grids (called `elevationTrend` in the data set *High Mountain Asia Gridded Glacier Thickness Change from Multi-Sensor DEMs*) were exported to GeoTIFF files. Then, all the GeoTIFF files from one time period (1975–2000 or 2000–2016) were combined into a single mosaic using bilinear interpolation sampled at a resolution of approximately 30 m.

For more information on the acquisition and processing steps, see Maurer et al. (2015).

2.4 Quality, Errors, and Limitations

This data set doesn't provide any specific error quantifications or quality assessments. For more information on the glacier thickness change error, see the documentation for the related data set *High Mountain Asia Gridded Glacier Thickness Change from Multi-Sensor DEMs*.

3 SOFTWARE AND TOOLS

Software that recognizes the GeoTIFF file format includes QGIS and ArcMap. The metadata fields can be extracted using the gdalinfo command line utility available from the Geospatial Data Abstraction Library (GDAL) website.

4 RELATED DATA SETS

High Mountain Asia Gridded Glacier Thickness Change from Multi-Sensor DEMs
High Mountain Asia Average Glacier Thickness Change from Multi-Sensor DEMs
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

Joshua Maurer
Lamont-Doherty Earth Observatory
Columbia University
Palisades, NY, USA

Summer Rupper
Department of Geography
University of Utah
Salt Lake City, UT, USA

Joerg Schaefer
Lamont-Doherty Earth Observatory
Columbia University
Palisades, NY, USA

7 REFERENCES

Maurer, J., & Rupper, S. (2015). Tapping into the Hexagon spy imagery database: A new automated pipeline for geomorphic change detection. ISPRS Journal of Photogrammetry and Remote Sensing, 108, 113–127. https://doi.org/10.1016/j.isprsjprs.2015.06.008

8 DOCUMENT INFORMATION

8.1 Publication Date

12 March 2019

8.2 Date Last Updated

21 July 2020