High Mountain Asia 8-meter DEM Mosaics Derived from Optical Imagery, Version 1

USER GUIDE

How to Cite These Data

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

Shean, D. 2017. *High Mountain Asia 8-meter DEM Mosaics Derived from Optical Imagery, Version 1*. [Indicate subset used]. Boulder, Colorado USA. NASA National Snow and Ice Data Center Distributed Active Archive Center. https://doi.org/10.5067/KXOVQ9L172S2. [Date Accessed].

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

FOR CURRENT INFORMATION, VISIT https://nsidc.org/data/HMA_DEM8m_MOS

National Snow and Ice Data Center

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1 DETAILED DATA DESCRIPTION

The DEM mosaics provided in this data set were generated from very-high-resolution (VHR) along- and cross-track stereoscopic imagery from DigitalGlobe satellites.

To generate DEM mosaic tiles, over 4000 DEM strips were merged with a weighted-average mosaicking routine that reduced errors and removed seams.

Mosaic tiles are 100 km by 100 km with 12500 x 12500 pixels at 8 m.

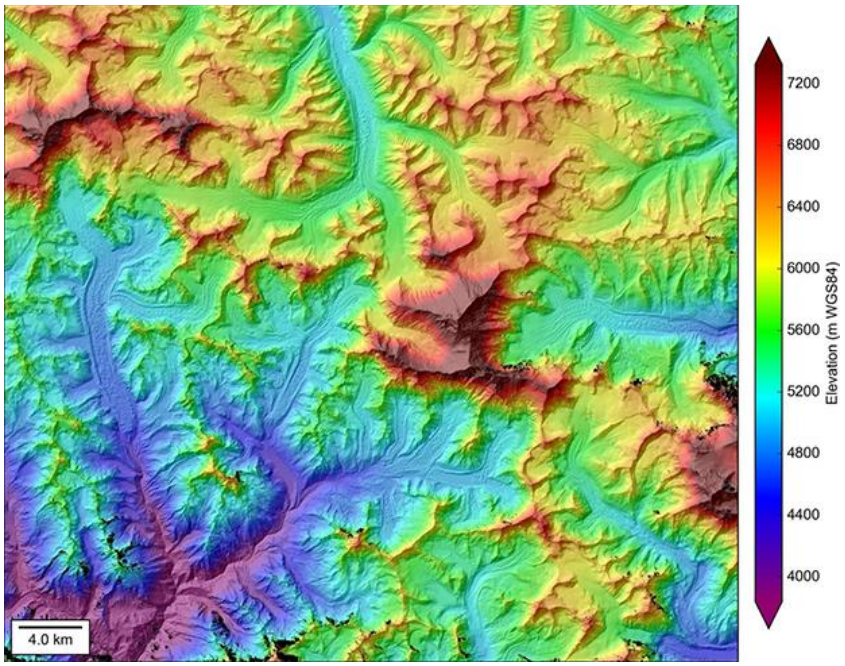

Figure 1. Sample Data Record. Sample of DEM mosaic over the Everest region of Nepal. Produced by D. Shean for the NASA High Mountain Asia project.

1.1 Parameter

This data set reports elevation in meters above the WGS84 ellipsoid. The mosaics are derived from all available DEMs, regardless of date or sensor. The values represent a weighted average of all valid elevations at each pixel. Weights are assigned to penalize isolated pixels or “islands,” so that values from more spatially continuous DEMs have higher weights. The fill value for pixels containing no data is -9999.

1.2 Format

Mosaics are provided as tiled, LZW-compressed* GeoTIFFs (.tif) with elevations stored as single precision, floating point numbers (Float32).

Shaded relief browse images in PNG (.png) format accompany each mosaic file. These images were created using a standard azimuth setting of 315 degrees and an elevation of 45 degrees.

An associated Extensible Markup Language (XML) metadata file is also provided for each data file.

*Refers to lossless Lempel–Ziv–Welch (LZW) compression.

1.3 File Naming Convention

File names vary slightly as shown in the following examples. Variables used in the file names are defined in Table 1.

Example File Names

- HMA_DEM8m_MOS_20170716_tile-043.tif
- HMA_DEM8m_MOS_20170716_tile-043_hs_05pct.png

Naming Conventions

- HMA_DEM8m_MOS_[YYYYMMDD]_tile-NNN.tif
- HMA_DEM8m_MOS_[YYYYMMDD]_tile-NNN_hs_05pct.png

Table 1. File Name Variables and Definitions

Variable	Definitions
HMA_DEM8m_MOS	Data set ID [abbreviation for High Mountain Asia (HMA) DEM 8 m Mosaic]
YYYYMMDD	Mosaic generation date (4-digit year, 2-digit month, 2-digit day)
tile-NNN	3-digit tile number
hs_05pct	Shaded relief/hillshade (hs) 5 percent size browse image

1.4 Spatial Coverage

Northernmost Latitude: 46° N

Southernmost Latitude: 26° N

Easternmost Longitude: 103° E

Westernmost Longitude: 67° E

Coverage extends to portions of the following eleven countries:

- Afghanistan
- Bhutan
- China

- India
- Kazakhstan
- Kyrgyzstan
- Myanmar
- Nepal
- Pakistan
- Tajikistan
- Uzbekistan

Figure 2 shows the spatial coverage of the mosaic and the number of DEM strips at each location.

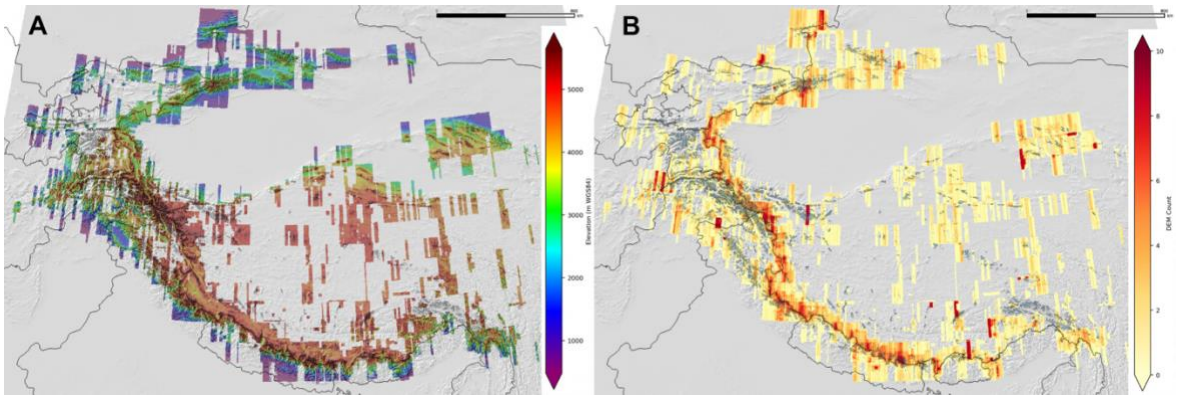

Figure 2. Spatial Coverage Map

Spatial coverage map showing the HMA-wide 8 m DEM mosaic (A) and the number of DEM strips available at each location (B). Areas with higher DEM counts offer improved mosaic accuracy with fewer voids. The overlapping DEM strips can be used for elevation change analysis; refer to the Data Sources section for individual AT and CT DEMs.

To view the coverage of a particular DEM, refer to the Knowledge Base FAQ: What is the spatial extent of individual HMA DEMs?

Note: Initial archive request and processing was limited to images that intersected one or more of the Randolph Glacier Inventory (RGI) glacier polygons. Future releases will include expanded HMA coverage.

1.4.1 Spatial Resolution

The DEM mosaics have 8 m posting (output grid pixel size).

1.4.2 Projection and Grid Description

The DEM mosaics are provided in a custom Albers Equal-Area projection with standard parallels at 25° N and 47° N, and central longitude of 85° E. Projected coordinates are meters, with the origin at 85° E, 36° N. Elevations are in meters above the WGS84 ellipsoid. Refer to Table 2 for more details.

Table 2. Projection and Grid Details

Projection	Albers Equal-Area Conical (custom)
Grid Spacing	8 m
Latitudes of True Scale (Standard Parallels)	25°, 47° N
Central Longitude (Meridian)	85° E
Central Latitude	36° N
Datum	WGS84
Ellipsoid	WGS84
Units	Meters
EPSG Code	None (custom projection parameters)
PROJ4 String	+proj=aea +lat_1=25 +lat_2=47 +lat_0=36 +lon_0=85 +x_0=0 +y_0=0 +datum=WGS84 +units=m +no_defs

1.5 Temporal Coverage

The optical images used for the mosaics were obtained between 2008 and 2017, with the majority of coverage from 2013 to 2016. For HMA stereo:

- The WorldView-1 (WV-1) record began in late 2008.
- The WorldView-2 (WV-2) record began in mid 2010.
- The WorldView-3 (WV-3) record began in late 2014.
- The GeoEye-1 (GE-1) record began in late 2009.

1.6 Temporal Resolution

The blended mosaics are created using DEMs from several years, and therefore do not have a single timestamp. Future releases will offer several mosaicked products, including timestamped mosaics with most recent DEMs on top and mosaics with earliest DEMs on top.

2 SOFTWARE AND TOOLS

GeoTIFF files with embedded geospatial metadata can be accessed using GIS software such as QGIS and ArcGIS, or command-line tools such as the GDAL (Geospatial Data Abstraction Library) utilities and API.

3 DATA ACQUISITION AND PROCESSING

3.1 Sensors

For detailed information on the various satellites and sensors used to produce the source imagery for this data set, refer to the DigitalGlobe, Inc. Web site. Satellite and sensor details are also provided in Shean et al. (2016).

3.2 Data Sources

The DEM mosaics were generated from along-track and cross-track DEM strips from the following sources:

> High Mountain Asia 8-meter DEMs Derived from Along-track Optical Imagery (HMA_DEM8m_AT)
> High Mountain Asia 8-meter DEMs Derived from Cross-track Optical Imagery (HMA_DEM8m_CT)

See Shean et al. (2016) for details of the full processing workflow. For information regarding ASP, refer to the official documentation (PDF, 21 MB).

3.3 Derivation Techniques and Algorithms

All individual DEM strips were generated using the NASA Ames Stereo Pipeline (ASP) and methodology described in Shean et al. The data were processed using the NASA High-Performance Computing (HPC) resources, primarily the NASA Pleiades Supercomputer at the NASA Ames Research Center.

3.3.1 Processing Steps

The tiled mosaics were generated using the *dem_mosaic_validtiles.py* utility in the *gmbtools* repository (https://github.com/dshean/gmbtools). This wrapper runs parallel instances of the ASP dem_mosaic utility for each tile in the output mosaic, with all available along-track and cross-track DEMs.

3.4 Error Sources

In general, the mosaicked products have reduced errors and fewer data voids than the individual DEM strips, especially where several overlapping DEMs are available for the same location. The

investigators elected to preserve only "valid" DEM pixels, and did not perform any additional interpolation or filling to remove voids. Future releases will include void-filled products.

Information regarding error sources is provided in the following user guides:

- High Mountain Asia 8-meter DEMs Derived from Along-track Optical Imagery (HMA_DEM8m_AT)
- High Mountain Asia 8-meter DEMs Derived from Cross-track Optical Imagery (HMA_DEM8m_CT)

3.5 Quality Assessment

As noted above, quality checks and corrections were performed throughout the processing steps. Refer to Shean et al. (2016) for details.

4 REFERENCES AND RELATED PUBLICATIONS

Shean, D. E., O. Alexandrov, Z. Moratto, B. E. Smith, I. R. Joughin, C. C. Porter, and P. J. Morin. 2016. An automated, open-source pipeline for mass production of digital elevation models (DEMs) from very high-resolution commercial stereo satellite imagery, *ISPRS J. Photogramm. Remote Sens*, 116:101-117. http://dx.doi.org/10.1016/j.isprsjprs.2016.03.012.

4.1 Related Data Collections

High Mountain Asia Data

Polar Geospatial Center Data

4.2 Related Websites

Contribution to High Asia Runoff from Ice & Snow (CHARIS) Project

Global Land Ice Measurements from Space (GLIMS) Project

DigitalGlobe, Inc.

NSIDC Scientific Data Search

NASA Ames Stereo Pipeline NeoGeographyToolkit on GitHub

5 CONTACTS

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7 DOCUMENT INFORMATION

7.1 Publication Date

December 2017

7.2 Date Last Updated

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