High Mountain Asia Supraglacial Lake Extents on Debris Covered Glaciers, 1988-2023, Version 1

USER GUIDE

How to Cite These Data

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

Zeller, L., Daniel McGrath, and Scott W. McCoy. 2025. *High Mountain Asia Supraglacial Lake Extents on Debris Covered Glaciers, 1988-2023, Version 1*. [Indicate subset used]. Boulder, Colorado USA. NASA National Snow and Ice Data Center Distributed Active Archive Center. https://doi.org/10.5067/W73XC2LOCV5J. [Date Accessed].

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

FOR CURRENT INFORMATION, VISIT https://nsidc.org/data/HMA2_DCG_SGL

National Snow and Ice Data Center

TABLE OF CONTENTS

1 DATA DESCRIPTION

1.1 Summary

This data set identifies the extent of supraglacial lakes (SGLs) from 1988 through 2023 on 769 of the largest debris-covered glaciers in the High Mountain Asia region. SGLs were generated via automated processing of 30 m Landsat imagery and are provided at 1-year intervals from 2004–2023; at 2-year intervals from 1992–2003; and as a single 4-year interval from 1988–1991.

1.2 Parameters

Supraglacial lake extent

1.3 File Information

1.3.1 Format

ESRI Shapefile

1.3.2 File Contents

Three shapefiles are available for each time period: one that contains the extents of all the supraglacial lakes in the study region for the time period, plus minimum and maximum extent shapefiles derived from an error analysis.

1.3.3 Naming Convention

An ESRI shapefile is a geospatial, vector data storage format consisting of multiple related file types, each with its own file extension (.ext). A complete shapefile for this data set comprises the following four file types:

Table 1. Shapefile File Extensions and Descriptions

File Extension	Description
.shp	Main file with shapes and vertices for each record
.dbf	dBASE table of attributes for each record
.prj	Coordinate reference system information
.shx	Index file

Lake extent shapefiles utilize the following naming convention, where ".ext" refers to the file extensions in Table 1:

Convention

HMA2_DCG_SGL_V01.0_[year(s)]_supraglacial-lake-extents.[ext]
HMA2_DCG_SGL_V01.0_[year(s)]_supraglacial-lake-extents-[min or max].[ext]

Examples

HMA2_DCG_SGL_V01.0_2004_supraglacial-lake-extents.[ext]
HMA2_DCG_SGL_V01.0_2004_supraglacial-lake-extents-min.[ext]
HMA2_DCG_SGL_V01.0_2004_supraglacial-lake-extents-max.[ext]

HMA2_DCG_SGL_V01.0_1988-1991_supraglacial-lake-extents.[ext]
HMA2_DCG_SGL_V01.0_1988-1991_supraglacial-lake-extents-min.[ext]
HMA2_DCG_SGL_V01.0_1988-1991_supraglacial-lake-extents-max.[ext]

Lastly, the extent of each glacier's investigated debris-covered area is available in a shapefile named "HMA2_DCG_SGL_V01.0_1988-2023_debris-cover-extent.[ext]."

1.4 Spatial Information

1.4.1 Coverage

N: 42.45° N
S: 22.57° N
E: 101.99° E
W: 70.03° E

The study area includes all glaciers within regions 13 (Central Asia), 14 (South Asia West), and 15 (South Asia East) of the Randolph Glacier Inventory, Version 7, and that are larger than 2 km^2 and have debris spanning 500 m or more of the glacier width at the terminus.

1.4.2 Resolution

30 m

1.4.3 Geolocation

EPSG:4326 (WGS 84)
Datum: World Geodetic System 1984 ensemble
CRS Type: Geographic 2D (latitude/longitude)

1.5 Temporal Information

1.5.1 Coverage

1988–2023

1.5.2 Resolution

4 years (1988–1991)
2 years (1992–2003)
1 year (2004–2023)

2 DATA ACQUISITION AND PROCESSING

2.1 Acquisition

This data set was generated by analyzing the entire archive of Collection 2 Landsat 5, 7, 8, and 9 Level 1 surface reflectance images from 1988–2023.

2.2 Processing

ⓘ The following section summarizes the approach used to identify SGL extents. A complete description is available in Zeller et al. [manuscript submitted for publication].

The predominantly debris-covered areas within each glacier outline were manually delineated using high resolution ESRI and Google Earth imagery basemaps, cloud-free and snow-free Sentinel-2 imagery, and the debris-cover extents in Herreid and Pellicciotti, 2020 as a reference. Narrow longitudinal bands of debris cover and debris-covered areas adjacent to exposed glacier ice were excluded from analysis, as areas with mixed debris and ice are frequently misclassified as water. Lastly, due to the substantially reduced image availability in the earlier years, multiple years of observations were combined during 1988-2003 to increase the number of usable observations.

The algorithm identifies usable areas by first masking out areas with terrain shadows and cloud cover, plus areas of exposed glacier ice (using a buffer of 60 m), which are often incorrectly identified as water. SGLs are identified in the remaining usable areas of each image by computing the normalized difference water index (NDWI) with 13 different thresholds ranging from 0.13–0.25.

Final SGL extents consist of pixels identified as water by at least 50% of the 13 thresholds tests; similarly, minimum and maximum extents are produced using pixels identified as water by at least 25% and 75% of the thresholds, respectively.

3 VERSION HISTORY

Version 1 (initial release)

4 RELATED DATA SETS

Randolph Glacier Inventory - A Dataset of Global Glacier Outlines, Version 7

5 REFERENCES

Herreid, S., & Pellicciotti, F. (2020). The state of rock debris covering Earth's glaciers. Nature Geoscience, 13(9), 621–627. https://doi.org/10.1038/s41561-020-0615-0

Zeller, L., McGrath, D., & McCoy, S. W. [manuscript submitted for publication]. 21st Century Expansion of Supraglacial Lakes in High Mountain Asia. Department of Geosciences, Colorado State University.

6 DOCUMENT INFORMATION

6.1 Publication Date

August, 2025

6.2 Date Last Updated

August, 2025