ASO L4 Lidar Snow Depth 3m UTM Grid, Version 1

USER GUIDE

How to Cite These Data

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

Painter, T. 2018. *ASO L4 Lidar Snow Depth 3m UTM Grid, Version 1*. [Indicate subset used]. Boulder, Colorado USA. NASA National Snow and Ice Data Center Distributed Active Archive Center. https://doi.org/10.5067/KIE9QNVG7HP0. [Date Accessed].

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

FOR CURRENT INFORMATION, VISIT https://nsidc.org/data/ASO_3M_SD

National Snow and Ice Data Center

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1 DATA DESCRIPTION

This data set is a collection of 3 m resolution snow depth maps, measured by the Airborne Snow Observatory (ASO), a coupled imaging spectrometer and scanning lidar system created by NASA/JPL. The imaging spectrometer is used to quantify spectral albedo, broadband albedo, and radiative forcing by dust and black carbon in snow. The scanning lidar measures snow depth using the differential altimetry approach of subtracting snow-free gridded elevation data from snow-covered gridded elevation data (Deems et al., 2013). The 3 m gridded snow depth data in this data set were used to aggregate the 50 m snow depth measurements provided in the *ASO L4 Lidar Snow Depth 50m UTM Grid* data set.

1.1 Parameters

The data product featured in this data set is snow depth in meters. An example is shown in Figure 1.

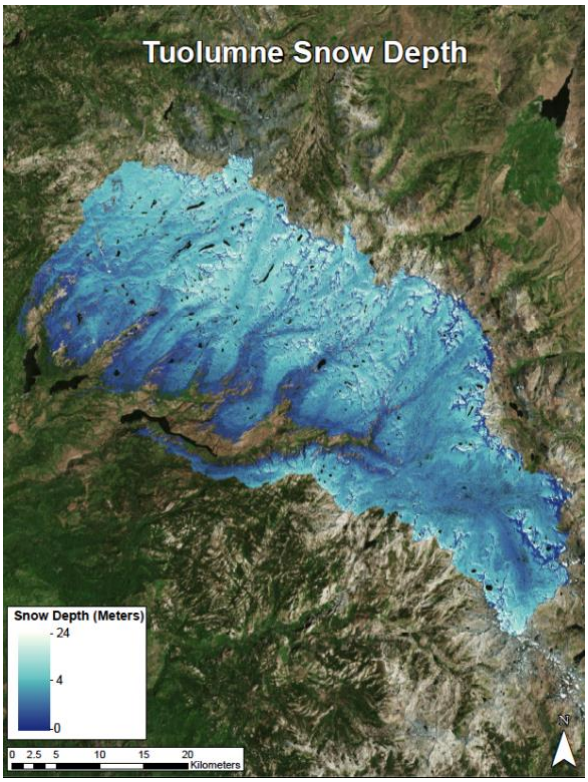

Figure 1. Snow depth (in meters) in the Tuolumne Basin, California, on 01 April 2017. Image courtesy of NASA/JPL Airborne Snow Observatory.

1.2 File Information

1.2.1 Format

Data are provided as GeoTIFF (.tif) formatted files. Each GeoTIFF file is paired with an associated XML file, which contains additional metadata.

1.2.2 Naming Convention

Example file name:

```
ASO_3M_SD_USWAOL_20160208.tif
```

Data files are named after the following convention, which is described in Table 1:

```
ASO_3M_SD_CCSCBC_YYYMMDD.tif
```

Table 1. File Naming Convention

File Designator	Description
ASO_3M_SD	Data set ID (*)
CC	Two digit country code, e.g. US = United States
SC	Two digit US state code, e.g. WA = Washington
BC	Two digit basin (site) code, e.g. OL = Olympic Mountains. See the ASO basins spreadsheet for a list of basins and basin codes.
YYYYMMDD	Data acquisition date
.tif	GeoTIFF formatted file

(*)**Note:** Five sets of data files spanning the time period from 08 to 25 February 2017 are labeled with the designator "USCOGM" (i.e., Grand Mesa basin) and contain two GeoTIFF files each; the first one contains the snow depth measurements and the second one contains quality flags for each pixel. The quality flags file is marked with the file designator "QF" instead of "SD" (e.g., ASO_3M_QF_USCOGM_20170208.tif).

1.3 Spatial Information

1.3.1 Coverage

Spatial coverage for this data set includes several basins listed in the ASO basins spreadsheet. Figure 2 depicts four California basins as an example.

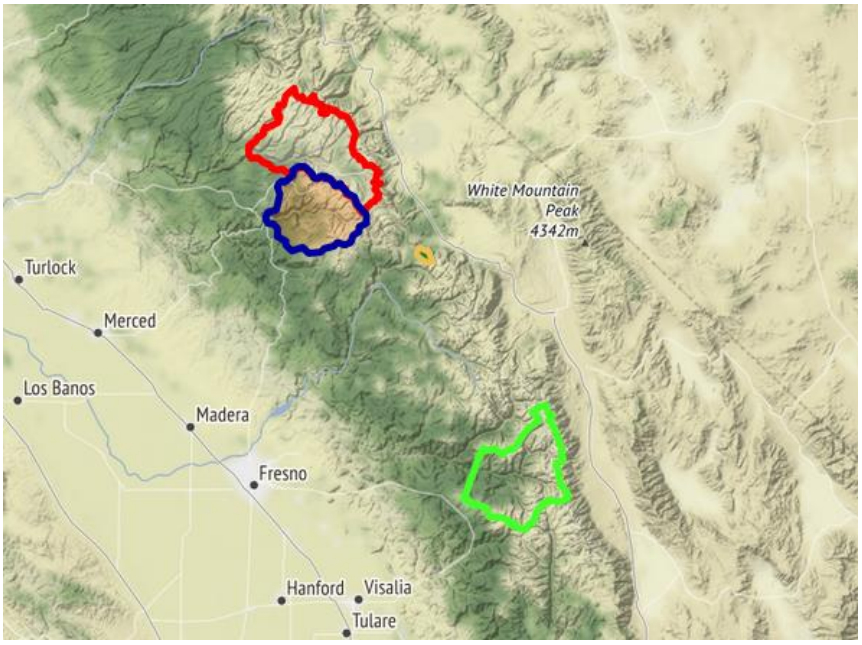

Figure 2. ASO California basins: Tuolumne Basin (red), Merced Basin (blue), Lake Basin (orange), and Kings Basin (green). Image courtesy of NASA/JPL Airborne Snow Observatory.

1.3.2 Resolution

3 m x 3 m grid

1.3.3 Geolocation

- Datum: WGS84 Ellipsoidal
- UTM zones: 10N, 11N, 12N, 13N
- EPSG codes: 32610, 32611, 32612, 32613

1.4 Temporal Information

1.4.1 Coverage

03 April 2013 to 15 July 2019

ASO Snow-Off campaigns typically occur between August and October, while the Snow-On campaigns are typically conducted between February and June.

1.4.2 Resolution

Varies by seasonal campaigns. In general, given the rapidly changing nature of snow cover presence, depth, and surface properties that modulate its melt, ASO flies target basins on a weekly basis from mid-winter through complete snowmelt.

2 DATA ACQUISITION AND PROCESSING

2.1 Processing

The reader is referred to Painter et al. (2016) for details on the processing steps used to generate these data.

2.2 Quality, Errors, and Limitations

The reader is referred to Painter et al. (2016) for more information on the quality of the data.

2.3 Instrumentation

2.3.1 Lidar System

The Riegl LMS-Q1560 airborne laser scanner (ALS) measures surface elevations from which snow depths are calculated. The Q1560 uses dual lasers at 1064 nm wavelength, each with a 60° scan angle (±30° across-nadir) and a 14° angle relative to the cross-track axis, producing an up to 8° fore/aft look angle (off-nadir in the along-track direction). A 1064 nm wavelength system is used because of its relatively small laser penetration depth in snow and relatively high snow reflectance at that wavelength, as well as greater penetration through vegetation canopies.

Note: Current processing uses some data from the CASI 1500 imaging spectrometer data to discriminate processing steps, but the bulk of the snow depth information comes from the Riegl Q1560 airborne laser scanner.

The required level of geolocation accuracy is achieved through the use of a single lidar-integrated Trimble Applanix POS/AV 510 GPS and Inertial Measurement Unit (IMU). The IMU has angular uncertainties of 0.005° in roll, 0.005° in pitch, and 0.008° in true heading after post-processing, and a resultant attitude uncertainty of 0.011°.

For more detailed information see Deems et al. (2013) and Painter et al. (2016).

3 SOFTWARE AND TOOLS

Software that recognizes the GeoTIFF file format is recommended for these images, such as the GIS software QGIS and ArcGIS. See also the libGeoTIFF and GDAL websites for more information.

4 RELATED DATA SETS

ASO L4 Lidar Snow Depth 50m UTM Grid
ASO L4 Lidar Snow Water Equivalent 50m UTM Grid
NASA SnowEx data sets at NSIDC

5 RELATED WEBSITES

Airborne Snow Observatory Project at NASA/JPL
SnowEx Project at NASA

6 CONTACTS AND ACKNOWLEDGMENTS

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6.2 Acknowledgments

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7 REFERENCES

Deems, J. S., Painter, T. H., & Finnegan, D. C. (2013). Lidar measurement of snow depth: a review. Journal of Glaciology, 59(215), 467–479. https://doi.org/10.3189/2013jog12j154

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8 DOCUMENT INFORMATION

8.1 Publication Date

23 May 2018

8.2 Date Last Updated

18 March 2020