ASO L4 Lidar Point Cloud Digital Terrain Model 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. H. and K. J. Bormann. 2020. *ASO L4 Lidar Point Cloud Digital Terrain Model 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/10.5067/2EHMWG4IT76O. [Date Accessed].

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

FOR CURRENT INFORMATION, VISIT https://nsidc.org/data/ASO_3M_PCDTM

National Snow and Ice Data Center

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1 DATA DESCRIPTION

This data set is a collection of 3 m resolution Point Cloud Digital Terrain Models (PCDTMs). Bare earth elevation (excluding trees) was measured by the Airborne Snow Observatory (ASO), a coupled imaging spectrometer and scanning lidar system created by NASA's Jet Propulsion Laboratory. The data were collected during snow-free conditions in Colorado and California and serve as the baseline for ASO snow-on products.

1.1 Parameters

The main parameter for this data set is bare earth elevation, measured in meters.

1.2 File Information

1.2.1 Format

Data are provided as GeoTIFF (`.tif`) 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_PCDTM_USCAAE_20171101_20171118.tif

ASO_3M_PCDTM_USCAAE_20171101_20171118.tif.xml
```

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

```
ASO_3M_PCDTM_CCSCBC_YYYYDDMM_yyyymmdd.ext
```

Table 1. File Naming Convention

File Designator	Description
ASO_3M_PCDTM	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	Basin survey start date
yyyymmdd	Basin survey end date

File Designator	Description
.ext	File type: GeoTIFF data file (.tif) or XML metadata file (.tif.xml)

1.3 Spatial Information

1.3.1 Coverage

Data were collected in various basins in the western part of the continental United States. The ASO basins spreadsheet provides a list of basins and basin codes. Figure 1 depicts five California basins as an example.

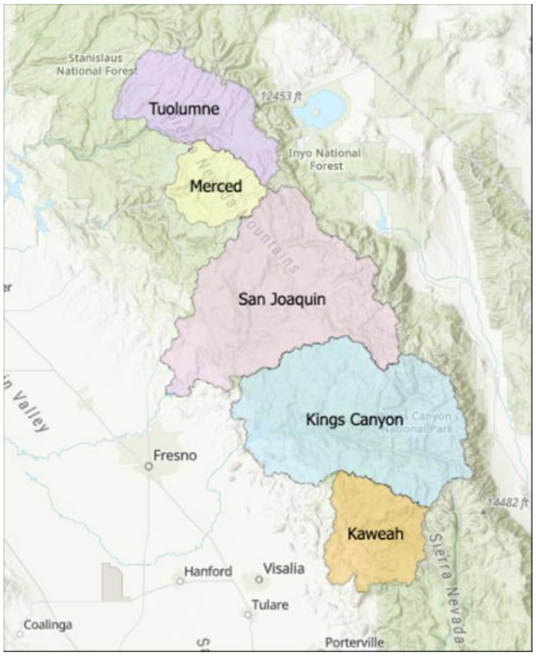

Figure 1. This image depicts five ASO California basins: Tuolumne (purple), Merced (yellow), San Joaquin (red), Kings Canyon (blue), and Kaweah (orange). Image courtesy of NASA/JPL Airborne Snow Observatory.

1.3.2 Resolution

3 m by 3 m grid

1.3.3 Geolocation

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

1.4 Temporal Information

1.4.1 Coverage

23 August 2014 to 10 October 2019

1.4.2 Resolution

Each survey site was visited only once.

2 DATA ACQUISITION AND PROCESSING

2.1 Acquisition

To measure unvegetated surface elevation, ASO used a Riegl LMS-Q1560 airborne scanning lidar flown at a constant altitude. For more details see Painter et al. (2016).

2.2 Processing

The Riegl RiPROCESS software converts the raw lidar range data into georeferenced point cloud data.

The georeferenced point cloud data are filtered to remove any points that are more than 100 m away from a reference digital terrain model, or DTM (air clutter).

A custom algorithm is used to extract the bare ground elevation from the filtered, georeferenced point cloud data.

The algorithm then builds a raster surface elevation model on a 3 m horizontal grid. For each grid cell, it determines the minimum surface elevation from the lowest quartile of point cloud elevations falling within that cell.

The resulting 3 m raster is then void-filled using search windows centered on the empty grid boxes to fill any data gaps with scaled averages of valid elevations within the search window. The search window size is increased systematically (3 m by 3 m, 5 m by 5 m, ... , 11 m by 11 m, 15 m by 15 m) until either all voids are filled or the search window size reaches 15 m by 15 m.

Users should refer to Painter et al. (2016) for more details.

2.3 Quality, Errors, and Limitations

As ASO is primarily concerned with the relative registration between snow-free (this data set) and snow-covered data sets for the purposes of measuring snow properties, ground control or line-to-line point cloud adjustments were not utilized to ensure absolute accuracy. Since these data are not ground-controlled, the DTMs require further control referencing before being used for any application that utilizes absolute elevations.

2.4 Instrumentation

2.4.1 Description

The Riegl LMS-Q1560 scanning lidar measures surface elevations. 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).

Geolocation is achieved by using an integrated GNSS/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 resulting attitude uncertainty of 0.011°.

For more detailed information see 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 Water Equivalent 50m UTM Grid
ASO L4 Lidar Snow Depth 50m UTM Grid
ASO L4 Lidar Snow Depth 3m UTM Grid
NASA ASO data sets at NSIDC
NASA SnowEx data sets at NSIDC

5 RELATED WEBSITES

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

6 CONTACTS AND ACKNOWLEDGMENTS

6.1 Contacts

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6.2 Acknowledgments

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7 REFERENCES

Painter, T. H., Berisford, D. F., Boardman, J. W., Bormann, K. J., Deems, J. S., Gehrke, F., … Winstral, A. (2016). The Airborne Snow Observatory: Fusion of scanning lidar, imaging spectrometer, and physically-based modeling for mapping snow water equivalent and snow albedo. Remote Sensing of Environment, 184, 139–152. https://doi.org/10.1016/j.rse.2016.06.018

8 DOCUMENT INFORMATION

8.1 Publication Date

10 April 2019

8.2 Date Last Updated

14 April 2020