

OpenTopography

Chris Crosby & Ramon Arrowsmith

Monday, September 30th 2019

SDSC

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Supported by the US National Science Foundation (EAR/IF No 1833703, 1833643 & 1833632)



EARTHcube RESEARCH COORDINATION NETWORK:

Advancing the Analysis of High Resolution Topography (A2 HRT)



EARTHcube
TRANSFORMING GEOSCIENCES RESEARCH

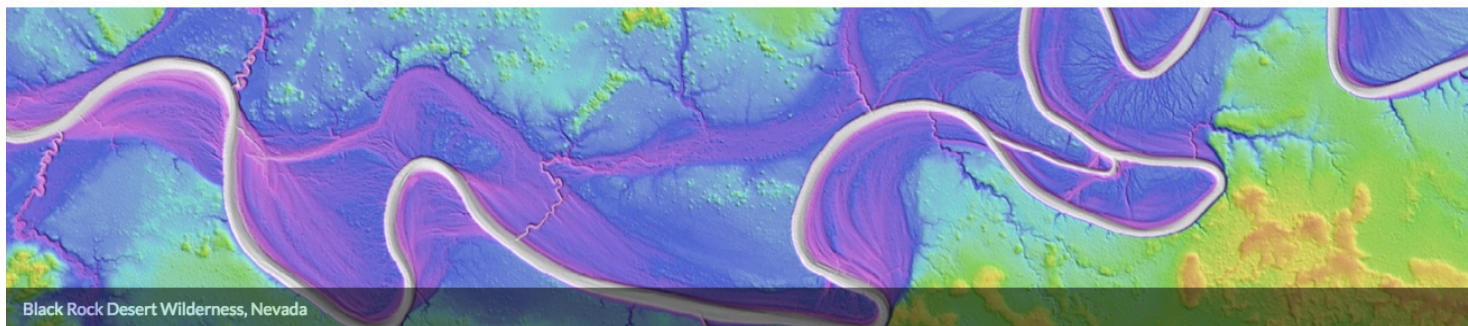
***Democratize* online access to high-resolution topography**

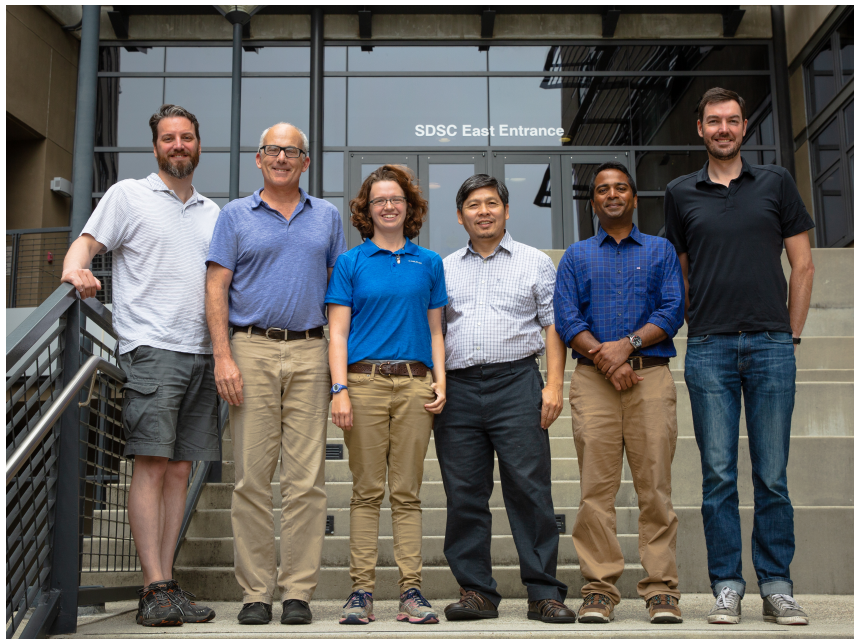
- Lidar, photogrammetry, & satellite
- Access to data – from raw point cloud to easy to use derived products

OpenTopography.org



[HOME](#) [ABOUT](#) [DATA](#) [TOOLS](#) [LEARN](#) [COMMUNITY](#)





- Founded in 2009
- Community focused
- Small, efficient team
- Collaboration between computing & science domain experts

SDSC
SAN DIEGO SUPERCOMPUTER CENTER

UNAVCO

ASU
ARIZONA STATE UNIVERSITY

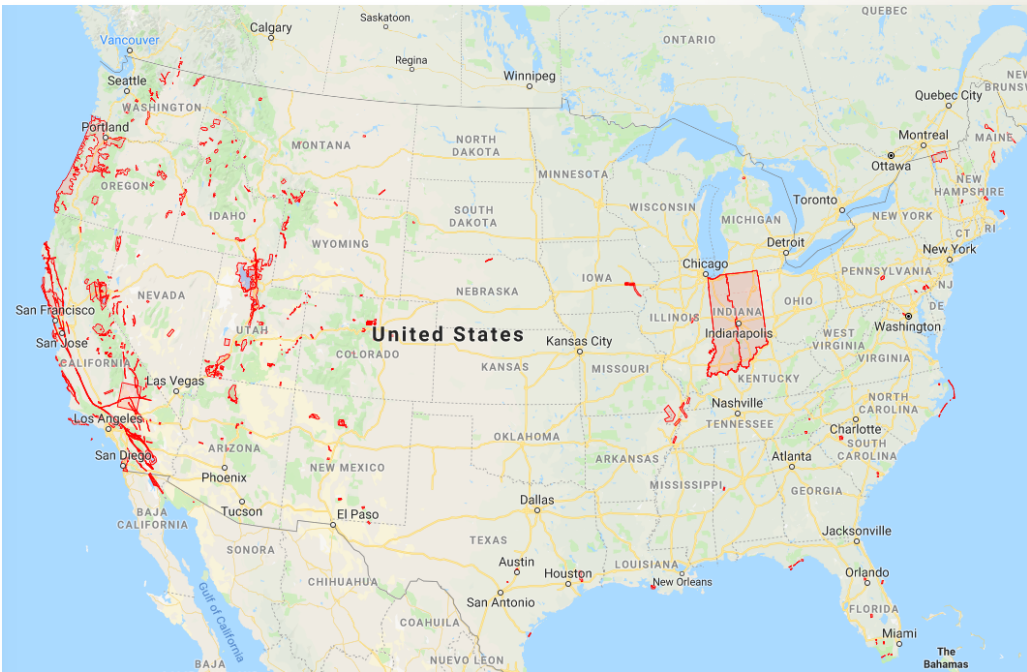


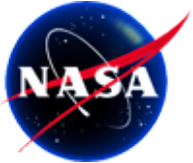
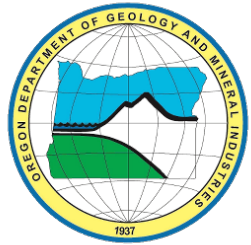
*Current Data holdings:
conservatively valued at \$44.7 Million*

294 datasets

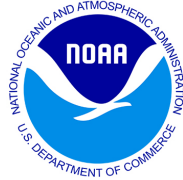
**>240,000 km²
mapped with
lidar**

**1.27 trillion
lidar points**





University of Colorado
Boulder



THE UNIVERSITY OF TEXAS AT AUSTIN

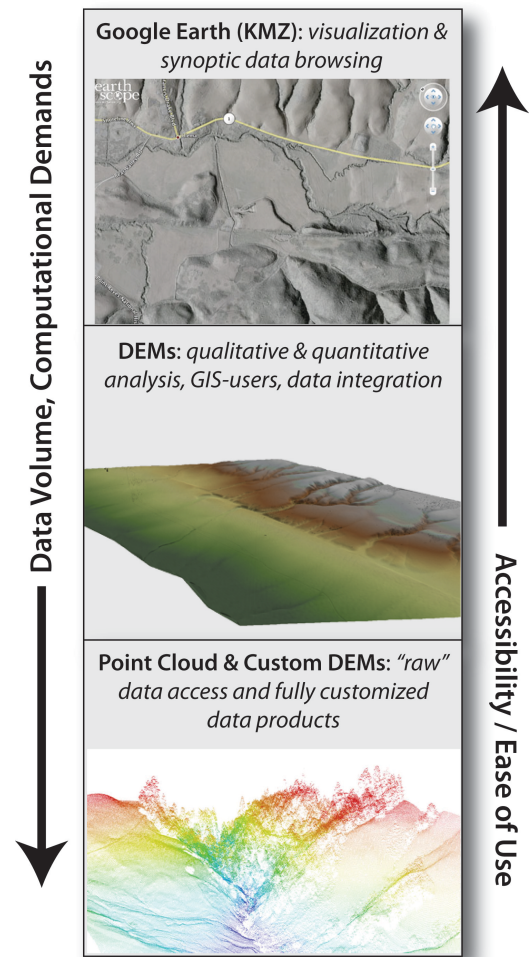


THE WORLD BANK

Data Products & Access for a diverse user community :

- Range of available data products:
 - Easy to access products for browsing and education.
 - Browse images, Google Earth, 3D visualization
 - Majority of users want a standard gridded product:
 - GIS products (e.g. DTM, DSM, etc.)
 - “raw” point cloud data for modeling or analysis

- Range of available data access methods:
 - Select AOI on map interface
 - Download entire datasets via bulk download option
 - APIs & OGC web services coming soon



State of Utah Acquired LiDAR Data - Wasatch Front

DOI: [10.5069/G9TH8JNQ](https://doi.org/10.5069/G9TH8JNQ)
OT Collection ID: OT.122014.26912.1
OT Collection Name: State of Utah Acquired LiDAR Data - Wasatch Front
Short Name: UGS_Wasatch
Collection Platform: Airborne Lidar

Metadata Download:
• [ISO 19115 \(Data\)](#)
• [Plain Text](#)

Download and Access Products:

[Point Cloud Data](#) [Bulk Download](#) opentopoID: OTLAS.122014.26912.1

[Raster Data](#) [Bulk Download](#) opentopoID: OTSEM.122014.26912.1

Collection Overview:

The State of Utah, including the Utah Automated Geographic Reference Center, Utah Geological Survey, and the Utah Division of Emergency Management, along with local and federal partners, including Salt Lake County and local cities, the Federal Emergency Management Agency, the U.S. Geological Survey, and the U.S. Environmental Protection Agency, have funded and collected over 8380 km² (3236 mi²) of high-resolution (0.5 or 1 meter) Lidar data across the state since 2011, in support of a diverse set of flood mapping, geologic, transportation, infrastructure, solar energy, and vegetation projects. The datasets include point cloud, first return digital surface model (DSM), and bare-earth digital terrain/elevation model (DEM) data, along with appropriate metadata (XML, project tile indexes, and area completion reports).

This 0.5-meter 2013-2014 Wasatch Front dataset includes most of the Salt Lake and Utah Valleys (Utah), and the Wasatch (Utah and Idaho), and West Valley fault zones (Utah).

Other recently acquired State of Utah data include the 2011 Utah Geological Survey Lidar dataset covering Cedar and Parowan Valleys, the east shore/wetlands of Great Salt Lake, the Hurricane fault zone, the west half of Ogden Valley, North Ogden, and part of the Wasatch Plateau in Utah.

Dataset Acknowledgement:

The datasets acquired by the State of Utah and its partners are in the public domain and can be freely distributed with proper credit to the State of Utah and its partners. The datasets are presented as received from our acquisition vendors, and do not necessarily conform to State of Utah and its partners technical, editorial, or policy standards; this should be considered by an individual planning to take action based on the contents of the datasets. The State of Utah and its partners makes no warranty, expressed or implied, regarding its suitability for a particular use and shall not be liable under any circumstances for any direct, indirect, special, incidental, or consequential damages with respect to users of this product.

Dataset Keywords: Utah, Box Elder, Weber, Davis, Salt Lake, Juab, Idaho, Oneida, Wasatch Fault, Wasatch Front

Survey Date: 10/18/2013 - 05/31/2014

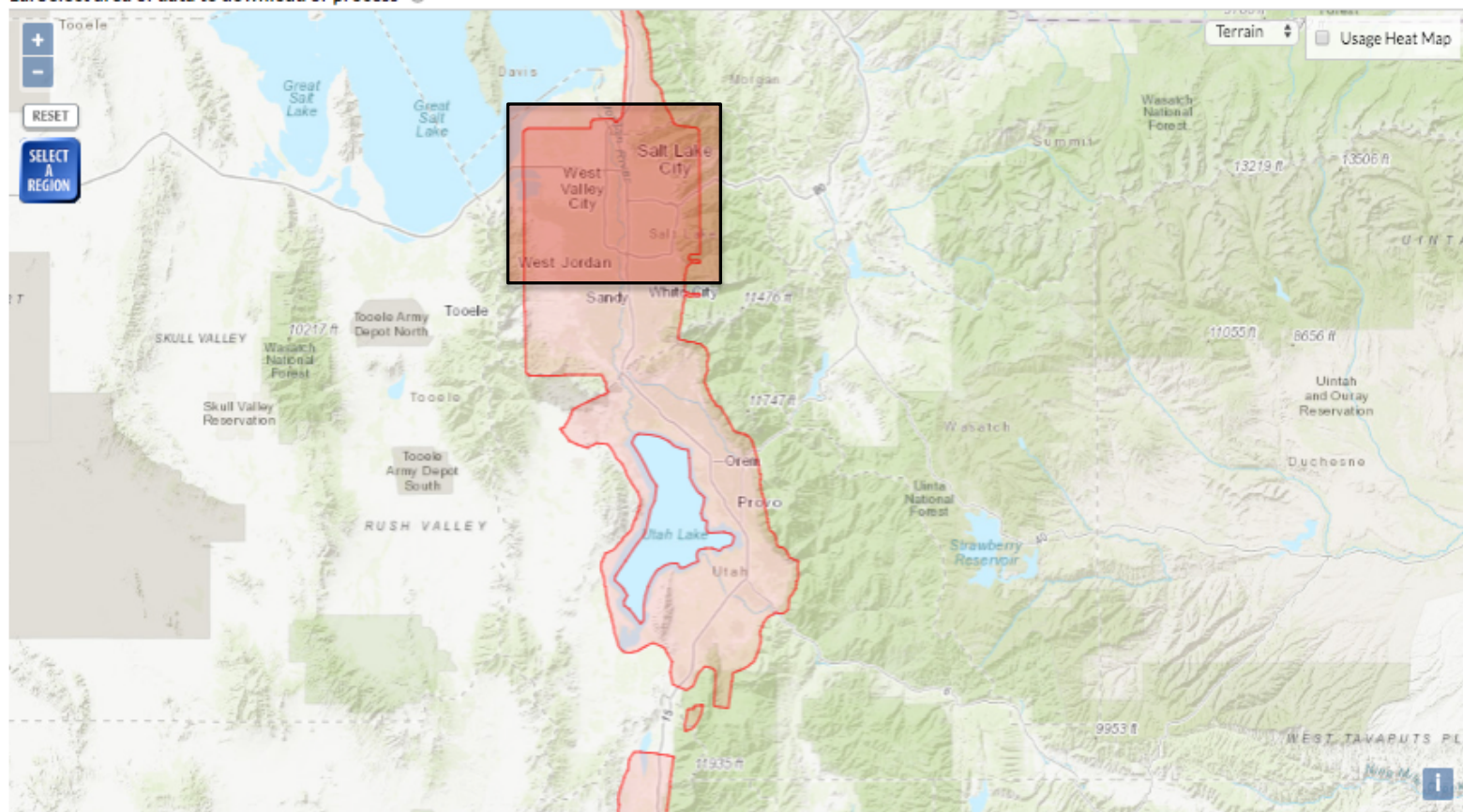

Publication Date: 01/29/2015



Each OT Dataset contains:

- Landing page with metadata
 - Accessible via OGC CSW service
 - Discoverable on all major search engines using schema.org dataset specification
- Logos & information on funders, partners, collectors.
- Citable DOI – persistent URL
- Options to download via web-map or “bulk” download

Web Map Selection of Area of Interest:

1a. Select area of data to download or process 

Job Customization:

- Filter by Point Classification
- Output formats: LAS, LAZ, ASCII
- Dynamically create DEMs using TIN or local gridding algorithms
- Output DEMs in Geotiff, IMG, or ESRI Arc GRID format

1. Coordinates & Classification

Horizontal Coordinates: UTM Zone 12N, NAD83 (2011) [EPSG: 26912]
Vertical Coordinates: NAVD88 (GEOID12A) [EPSG: 5703]

Data Selection Coordinates: Manually enter selection coordinates (in the horizontal coordinate system listed above)

Choose Return Classification Ground Unclassified

2. Point Cloud Data Download

Point cloud data in LAS format Point cloud data in LAZ format Point cloud data in ASCII format

3A. DEM Generation (TIN) ⓘ

Gridding Method <input checked="" type="checkbox"/> Calculate TIN	Gridding Parameters <input checked="" type="checkbox"/> Grid Resolution (Default = 1 meter) <input type="text" value="1"/> <input checked="" type="checkbox"/> Max. triangle size (Default 50 units) <input type="text" value="50"/>	Grid Format <input type="text" value="GeoTiff"/>
---	---	--

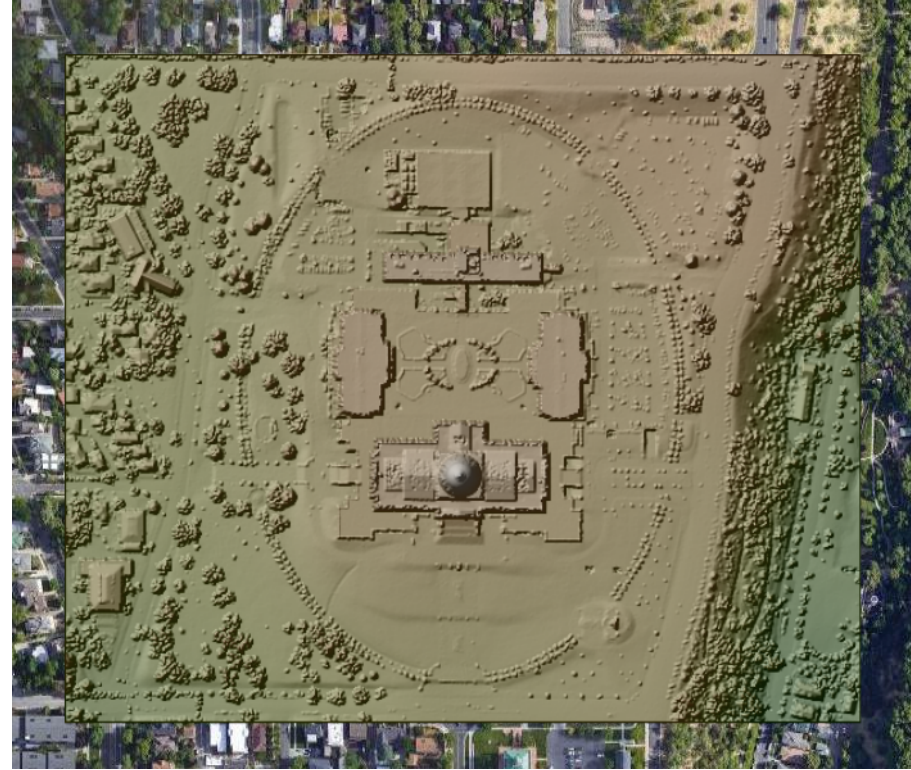
3B. DEM Generation (Local Gridding) ⓘ

Gridding Method <input type="checkbox"/> Calculate Zmin grid <input type="checkbox"/> Calculate Zmax grid <input type="checkbox"/> Calculate Zmean grid <input type="checkbox"/> Calculate Zidw grid <input type="checkbox"/> Calculate all (single layered image) grid <input type="checkbox"/> Calculate standard deviation <input type="checkbox"/> Calculate point count	Gridding Parameters <input checked="" type="checkbox"/> Grid Resolution (Default = 1 meter) <input type="text" value="1"/> <input checked="" type="checkbox"/> Radius value (Default = 1.4142 meter) <input type="text" value="1.4142"/>	Grid Format <input type="text" value="GeoTiff"/> Null Filling <input type="text" value="None"/>
--	---	--

Z-min Hillshade KML



Shaded TIN Hillshade KML



Tools

Scene



Export:

JSON DXF

Objects

- Point Clouds
 - pc1567014274115
- Measurements
- Annotations
- Other
 - Camera

Properties

Point size: 3.00

Point sizing

FIXED

Shape

SQUARE

Opacity: 1.00

Display Attribute

RGB

Gamma: 1.00

Brightness: 0.00

Contrast: 0.00

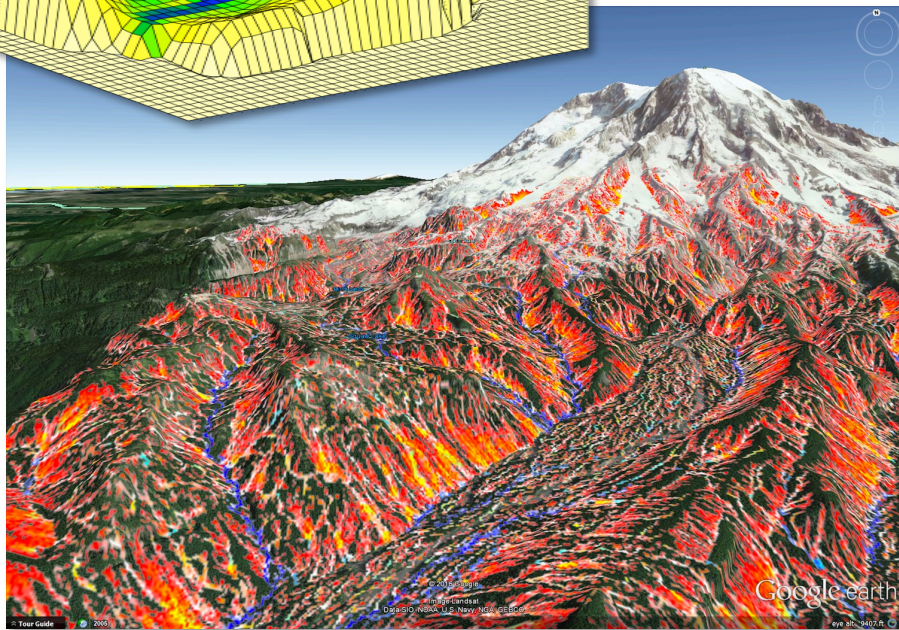
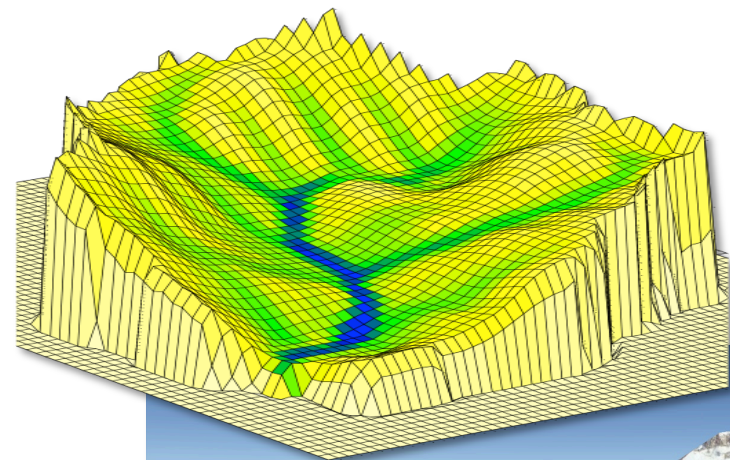
GPS Time



Filters

About

TERRAIN ANALYSIS USING DIGITAL ELEVATION MODELS (TauDEM) by David Tarboton et al



Demo:

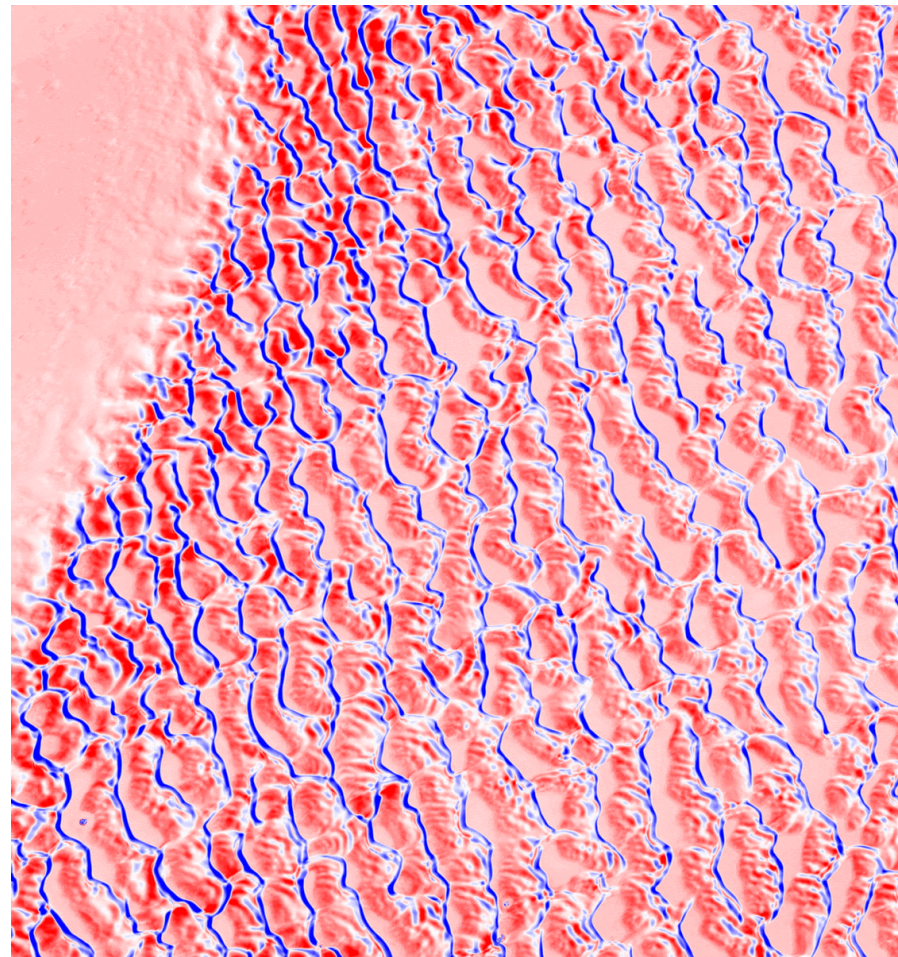
https://cloud.sdsc.edu/v1/AUTH_opentopography/www/shortcourses/17Utah/20170917_Topographic_Metrics.pdf

Web-based, on-demand, vertical
topographic differencing for
overlapping datasets

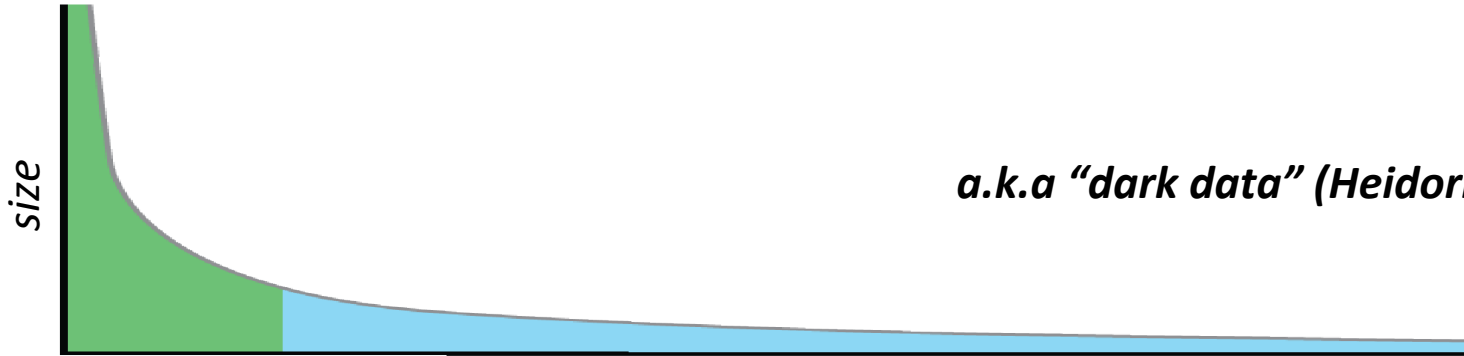
Assumes the same coordinate system

Windowed ICP differencing coming
soon...

*White Sands, NM – difference between ALS
datasets collected in September 2009 and
June 2010*

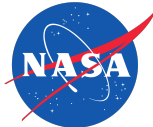


LONG TAIL TOPOGRAPHIC DATA



a.k.a “dark data” (Heidorn, 2008)

HEAD



number

LONG TAIL



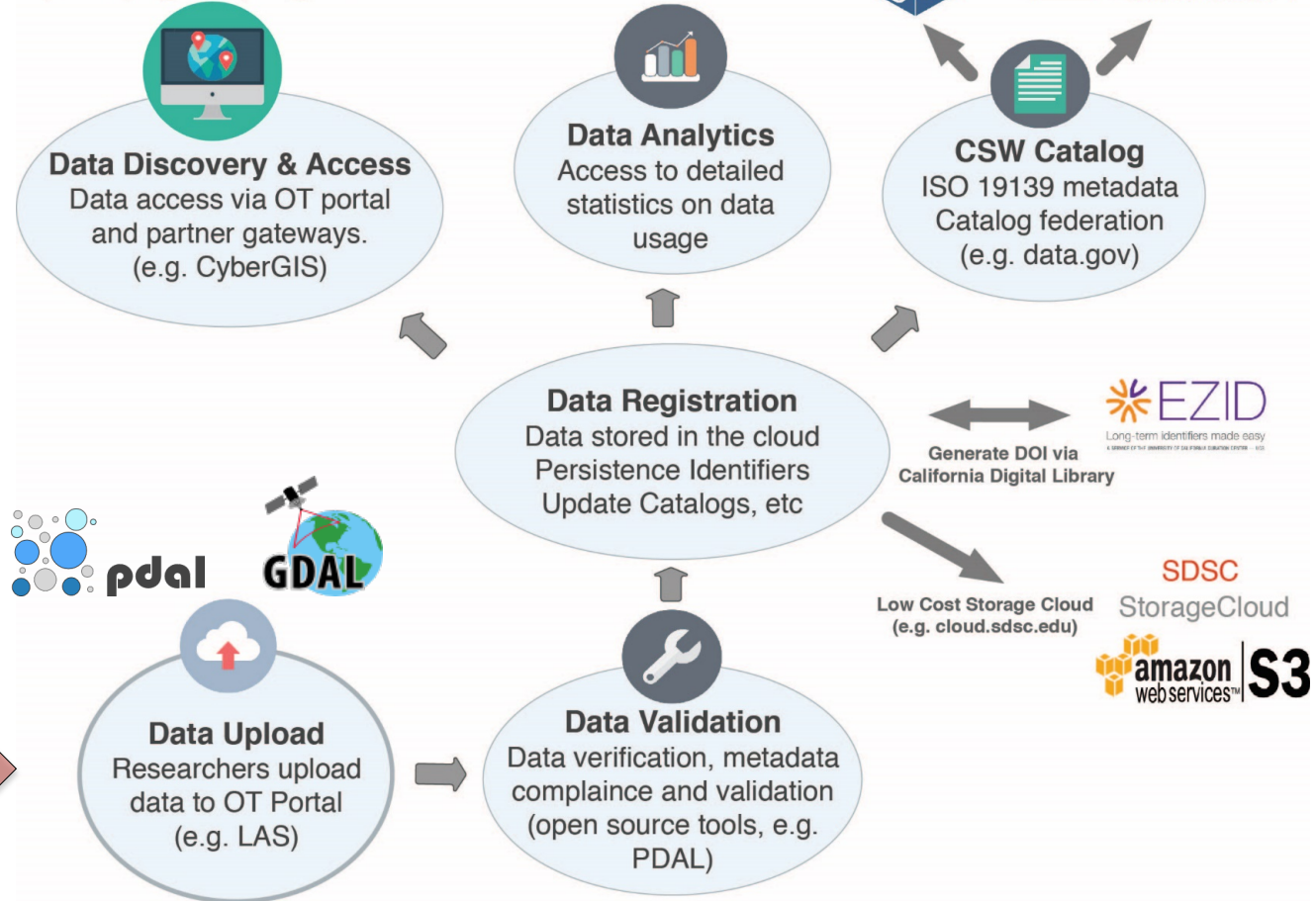
- Acquired by individual investigators or small teams
- Modest size but great value



OT COMMUNITY DATASPACE

EARTHCUBE CINERGI

opentopography.org/data



OT COMMUNITY DATASPACE

OpenTopogra OpenTopography Dataspace: Add Dataset

Step 1 of 4: Basic Inf

Step 2 of 4: Data Upload

[Notes](#)

Dataset Name *

Lee Adoyta, Ledi Gerar

Collection Platform

Structure from Motion

Data Product Form

Point Cloud f


A template of metadat:

Point Cloud Upload

Add files or drag and drop files here to upload. (Only las/laz)

Choose Files

 LA_Inspire_thin.laz

11.11 MB 

Start upload

Raster Upload

Add files or drag and drop files here to upload. (Only: img/tif)

Choose Files

Images for SfM Upload

Add files or drag and drop files here to upload. (Only: jpg/jpeg/png/dng)

Choose Files

OT COMMUNITY DATASPACE

Dataset Information

We have extracted some metadata from the files you uploaded. Please complete the

Dataset Name * Photogrammetric model of a portion of the Lee Adoyta Basin, Afar

Overview Description * These data were collected in the Lee Adoyta basin of Ledi Geraru f research. The area comprises gently tilted 2.7 million year old rock Rowan, J., Dupont-Nivet, G., Deino, A. L., Bibi, F., Lewis, M. E., Sourc Record and the Environmental Context of early Homo from Afar, E

Data Products Point Cloud, Raster, Images

Collection Platform Structure from Motion / Photogrammetry

Horizontal Coordinates WGS 84 / UTM zone 37N

Vertical Coordinates Ellipsoidal from DGPS georeferencing

Horizontal EPSG Code * 32637

Vertical EPSG Code

Dataset Keywords Sedimentary, paleontology, Pliocene, Afar

Project URL <http://paleoecore.org/projects/lgrp/>

Dataset Acknowledgement Arrowsmith, J. R., DiMaggio, E. N., Garello, D. I., Villmoare, B. and th Institute of Human Origins at Arizona State University. Collected i

User Contact Information J Ramón Arrowsmith
Professor of Geology at Arizona State University
School of Earth and Space Exploration

Additional Information The position information in the EXIF tags in the JPG images is INC were georeferenced using dGPS positions for markers in Agisoft P



Point Cloud Extent Raster Extent

Show Data Files

Point Cloud Data

	File Name	Size	Points	Area (m ²)	Density	
1	LA6_hires_UTM37_cleaned.laz	856.02 MB	122,479,973	95,999	1,275.85	View Detail

SpatialReference:

```
COMPD_CS["unknown"];PROJCS["WGS 84 / UTM zone 37N",GEOGCS["WGS 84",DATUM["WGS_1984",SPHEROID["WGS 84",6378137,298.257223563,AUTHORITY["EPSG":"7030"]],TOWGS84[0,0,0,0,0,0],AUTHORITY["Greenwich",0],UNIT["degree",0.0174 532925199433],AUTHORITY["EPSG":"4326"]],PROJECTION["Transverse_Mercator"],PARAMETER["latitude_of_origin",0],PARAMETER["central_meridian",39],PAR AMETER["scale_factor",0.9996],PARAMETER["false_easting",500000],PARAMETER["false_northing",0],UNIT["metre",1,AUTHORITY["EPSG":"9001"]],AUTHORITY["EPSG":"32637"]],VERT_CS["unknown",VERT_DATUM["unknown",2005],UNIT["metre",1.0,AUTHORITY["EPSG":"9001"]],AXIS["Up",UP]]]
```

Lat/Lon/Elevation Boundary:

North-East (lat,lon,elev): [11.36167694, 40.86388512, 498.9730007]
South-West (lat,lon,elev): [11.35902683, 40.85942062, 442.3320007]

Coordinates Boundary:

North-East (X,Y): 703399.045, 1256619.52
South-West (X,Y): 702913.526, 1256329.442

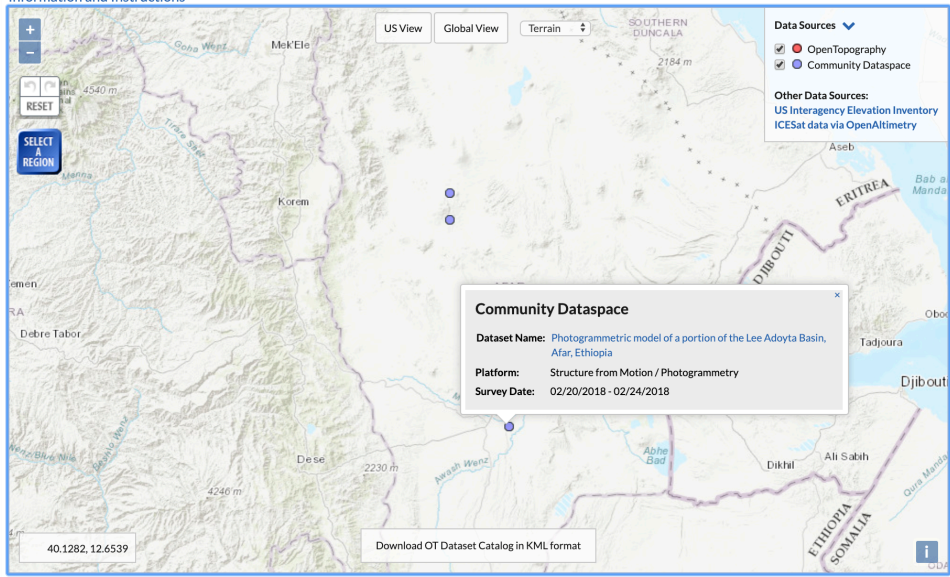
Classifications:

Class 0 (Created, never classified): 122,479,973

OT COMMUNITY DATASPACE

Find Topography Data

Information and Instructions



Publish, discover, download, cite

Arrowsmith, J R., DiMaggio, E. N., Garello, G. I., Villmoare, B. and LediGeraru Research Project (2018): Photogrammetric model of a portion of the Lee Adoyta Basin, Afar, Ethiopia (point cloud [122M points], orthophoto [2cm/pix], and DEM [25 cm/pix]). Distributed by OpenTopography. Accessed October 23, 2018. <https://doi.org/10.5069/G95X271W>



OpenTopography

OpenTopography facilitates community access to high-resolution, Earth science-oriented, topography data, and related tools and resources. OpenTopography is based at the San...

Contact

info@opentopography.org

Share on Social Sites

- Google+
- Twitter
- Facebook

Dataset extent



This is a Non-Federal dataset covered by different Terms of Use than Data.gov.

Photogrammetric model of a portion of the Lee Adoyta Basin, Afar, Ethiopia

Metadata Updated: July 25, 2019

These data were collected in the Lee Adoyta basin of Ledi Geraru Research Project, Lower Awash Valley, Afar, Ethiopia. They were produced in support of paleontological research. The area comprises gently tilted 2.7 million year old rocks faulted against 3 million year old basalts. The area was described by DiMaggio, E. N., Campisano, C. J., Rowan, J., Dupont-Nivet, G., Deino, A. L., Bibi, F., Lewis, M. E., Souron, A., Garello, D., Werdelin, L., Reed, K. E., Arrowsmith, J. R., Late Pliocene Fossiliferous Sedimentary Record and the Environmental Context of early Homo from Afar, Ethiopia, Science, VOL 347 ISSUE 6228, 10.1126/science.aaa1415, 2015.

Collected with a DJI Mavic Air by Ramon Arrowsmith in coordination with Erin DiMaggio. Dominique Garello and Brian Villmoare assisted in ground control and planning.

Access & Use Information

- Non-Federal: This dataset is covered by different Terms of Use than Data.gov.
- License: No license information was provided.

Downloads & Resources

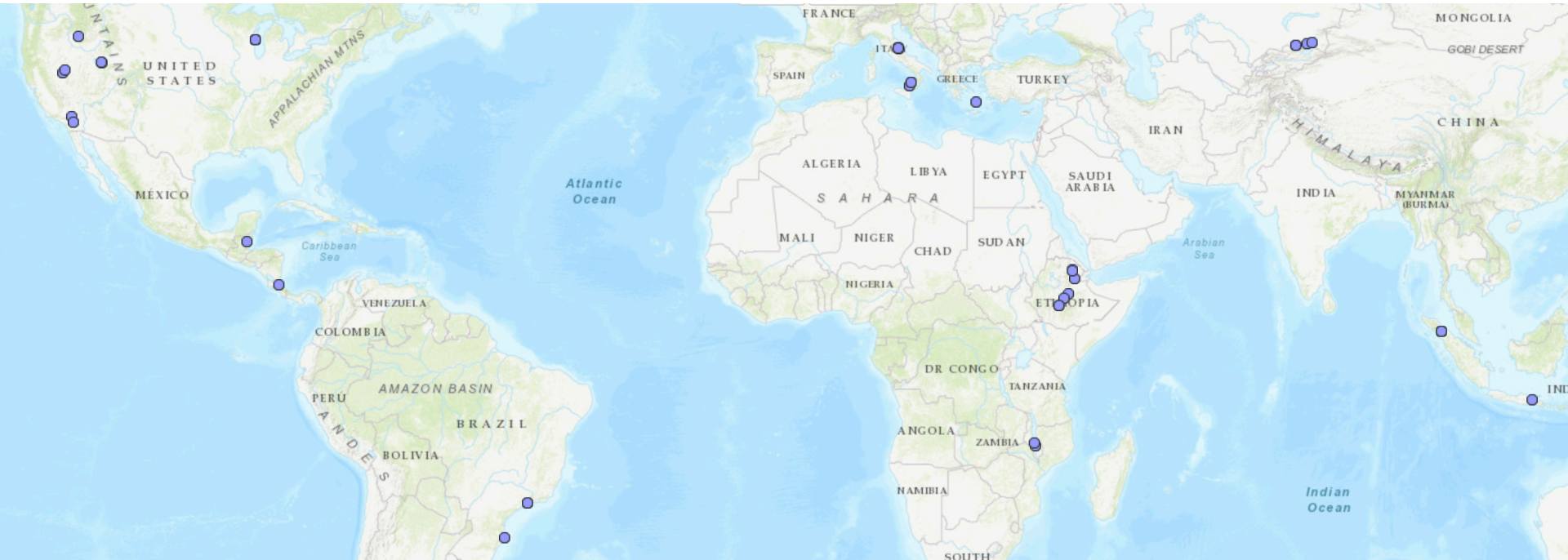
Download

Navigate directly to the URL for data access and download.

Visit page

STATUS

- 44 datasets uploaded in past 10 months (32 SfM, 6 TLS, 6 ALS)
- Belize, Brazil, Costa Rica, Ethiopia, Greece, Indonesia, Italy, Kazakhstan, Malawi, Vanuatu



UNAVCO TLS (& SFM) DATA

Projects >> B-421

B-421 - Taylor Valley Stream Hydrology (B-421, B-506, C-506, C-509)

PI: Dr. Diane McKnight

Project Lead: Michael Gooseff

Funding Source: [NSF/PLR 1041742 & 1115245](#)

Location: McMurdo Dry Valleys, Antarctica

Dates: 2009-01-17 to 2016-03-01

Project Summary

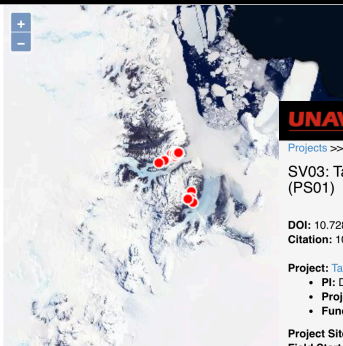
This project is the "streams" component of the McMurdo LTER. Researchers operate a network of 16 stream flow gauges, collect water quality samples from 30 streams, and make hydrologic measurements. TLS is used to create ground models of transects of the streams above stream gauges.(from usap.gov)

Project Sites

1. PS01 Huey Creek
2. PS02 Anderson Creek
3. PS03 Bohner Stream
4. PS04 Priscu Stream
5. PS05 Upper Delta Stream
6. PS06 Canada Stream
7. PS07 Green and Bowles Creeks
8. PS08 Upper Von Guerard Stream
9. PS09 Crescent Creek
10. PS10 Crescent Delta
11. PS11 Crescent Creek Thermokarst
12. PS12 Crescent Thermokarst Upstream Site
13. PS13 Garwood Valley Creek
14. PS14 Lawson Creek
15. PS15 Lower Miers Creek
16. PS16 Upper Miers Creek
17. PS17 Lower Delta Stream
18. PS18 Von Guerard - Orton Reach
19. PS19 Adams Stream
20. PS20 Lower Von Guerard - F6

Related Publications

tls.unavco.org



Projects >> B-421 >> PS01 >> SV03

SV03: Taylor Valley Stream Hydrology (B-421, B-506, C-506, C-509) (B-421) - Huey Creek (PS01)

DOI: 10.7283/R3SD1F

Citation: 10.7283/R3SD1F

Project: Taylor Valley Stream Hydrology (B-421, B-506, C-506, C-509) (B-421)

- PI: Dr. Diane McKnight
- Project Lead: Michael Gooseff
- Funding Source: [NSF/PLR 1041742 & 1115245](#)

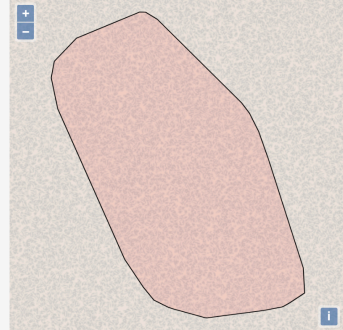
Project Site: Huey Creek (PS01)

Field Start Date: Jan. 20, 2017

Field End Date: Jan. 20, 2017

Field Engineer: Brendan Hodge

Metadata Report: [2017-01-20_C-506_HueyStream_TLSmetadataReport.pdf](#)



Products

Deliverables

Filename	Coord Sys	Product Level	File Format	Date Archived	Filesize
2017-01-20_C-506-HueyStream_AOI-UTM58S.las	EPSG:32758	Level 2	LAS	2017-06-12	1.6 GB
2017-01-20_C-506-HueyStream_ECEF.las	EPSG:4978	Level 2	LAS	2017-06-12	1.6 GB

Project Files

Documentation

Photos

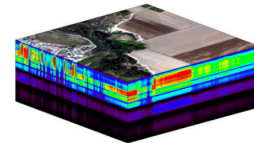
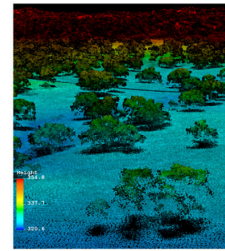
Project Files

Filename	Date Archived	Filesize
2017-01-20_C-506-HueyStream_GeoReg.beh.final.RiSCAN.tar.gz	2017-06-13	5.5 GB
2017-01-20_C-506-HueyStream.tbc.zip	2017-06-12	30.4 MB
77870200.T02	2017-06-12	176 KB
R10_201701200018.T02	2017-06-12	338.7 KB

NEON AOP



- NSF funded continental-scale observation facility
- 3x Airborne Observing Platforms (AOP) systems = fwf lidar, hyperspectral, aerial photography.



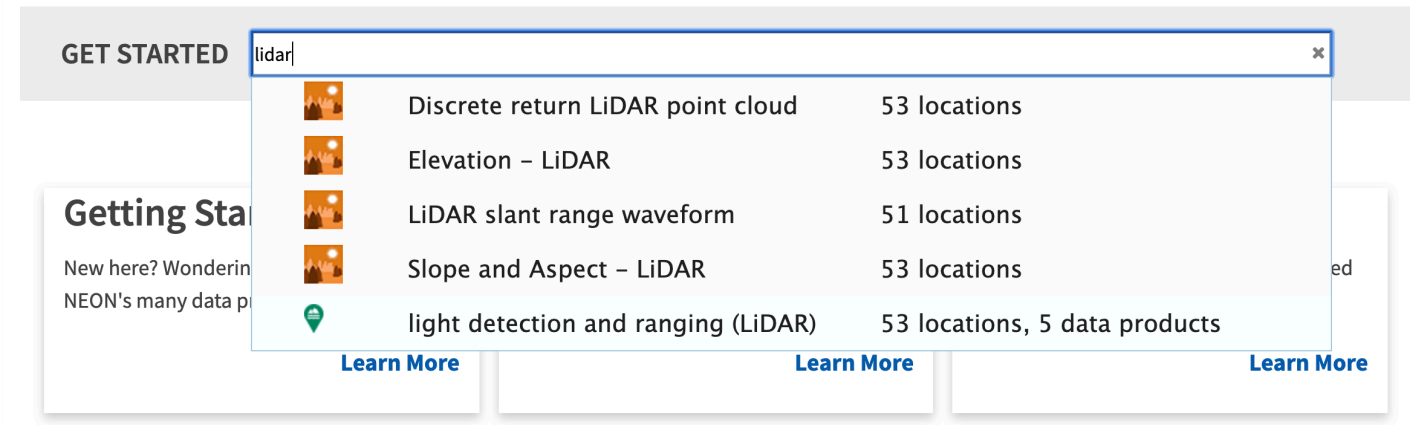
NEON AOP

Open access data available via the NEON data portal:






<https://data.neonscience.org>

Welcome to the NEON Data Portal

The National Ecological Observatory Network provides **open data** to understand changing ecosystems. NEON data are currently construction-grade and provisional - learn more at our [Data Quality Program webpage](#). To learn more about NEON, check out the Resources tab above or visit our [main portal](#) by clicking the NEON icon in the upper left corner of this page. Visit the [Data Product Catalog](#) for more specific information about individual data products, the [Data Availability webpage](#) to learn more about when data will become available after collection, or [Data Portal News](#) for occasional updates.



The screenshot shows a search interface on the NEON Data Portal. A search bar contains the text 'lidar'. Below the search bar, a dropdown menu displays five search results, each with a small icon representing the data product. The results are as follows:

Icon	Data Product	Locations
	Discrete return LiDAR point cloud	53 locations
	Elevation – LiDAR	53 locations
	LiDAR slant range waveform	51 locations
	Slope and Aspect – LiDAR	53 locations
	light detection and ranging (LiDAR)	53 locations, 5 data products

Below each result is a 'Learn More' link. To the left of the search results, there is a 'GET STARTED' button and a 'Getting Started' section with the text 'New here? Wonderin... NEON's many data p...'. In the bottom left corner of the screenshot, there is a logo for the National Science Foundation (NSF).



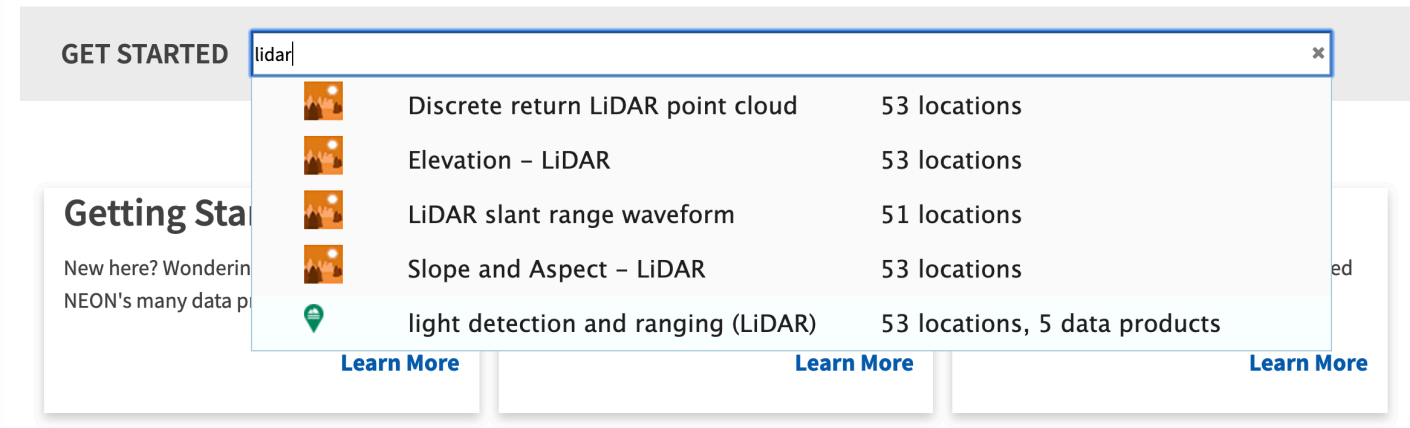
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NEON AOP

Open access data available via the NEON data portal:

<https://data.neonscience.org>

Available Datasets

Location Availability

 Partial  All selected locations

Name

Jun 2012 Oct 2012 Feb 2013 Jun 2013

 LiDAR slant range waveform



hide options

Learn more about [LiDAR slant range waveform](#)

Download Options

Available for: [51 sites from 2013-6 to 2019-6](#)

About

The Level 1 Slant Range Waveform Lidar data product provides a geolocated waveform for each laser pulse in a binary output format. The X and Y coordinates are reported in the output horizontal datum and projection and the Z values are reported in absolute elevation in the output vertical datum. The waveform product saves the continuous received signal versus time (digitized into 1 nsec time bins. The waveform shapes might provide important information about scattering properties, especially in the case of vegetation. Each AOP flight line is saved as an individual zip file, which includes a set of binary files plus the quality check (QC) first return LAS file. A nominal 10 km long flight line flown at a speed of approximately 100 knots will take about 200 seconds to collect. At a pulse repetition frequency (PRF) value of 100 kHz, the resulting product will contain approximately 20 million laser pulses. The return waveforms are saved as a binary data file with 250 columns (the 1 nsec time bins) by the number of rows equaling the number of laser pulses. A nominal waveform zip file will be approximately 50 GB and contains several files. Waveform lidar data have many uses: 3D visualization; generation of surface models such as bare-Earth digital elevation models (DEM) also referred to as digital terrain models (DTM), digital surface models (DSM), and canopy height models (CHM); analysis of vegetation structure, leaf area index, and biomass; analysis of canopy light penetration and attenuation; and watershed analysis.

Latency: AOP data will be available 60 days after the final collection day at a site. AOP legacy data (those collected in 2013 through 2016) currently has partial availability, and will be completely available by April of 2019.

*Note: Data are being migrated to the data portal. If you don't find the data you are looking for (e.g., from specific sites or years), please request data [here](#).

Documentation

Include [relevant documents](#) for this Data Product

[EML](#) files for this Data Product are included in all downloads (More about EML at [NEON](#) and [KNB](#).)

Showing 1 to 100 of 17,023 entries

Previous

1

2

3

4

5

...

171

Next

Format

7Z, ASC, HDR, IMG, KML, LAS, PDF, PLS, PLZ, TXT, WVS, WVZ ([Learn more about file types](#))

Estimated size (uncompressed): 31.22 TB

Your request is rather large, you might consider [filling out a data request](#)

DOWNLOAD DATASET

OPENALTIMETRY

ADVANCED DISCOVERY, PROCESSING, AND VISUALIZATION SERVICES FOR ICESAT AND ICESAT-2 ALTIMETER DATA

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[Quick Start Tutorial - ICESat](#) | [ICESat-2](#)

DATA AVAILABILITY

Legacy ICESat data are available for the entire mission. Data for the new ICESat-2 mission were released to the public on May 28, 2019 and have limited availability. OpenAltimetry provides access to all ICESat-2 data for which there is a complete set of data products. This dataset will continue to expand as ICESat-2 collects new data in the years to come.

Date: [2018-11-01](#) | [2019-01-31](#) | [2019-05-02](#)

ELEVATION PROFILE

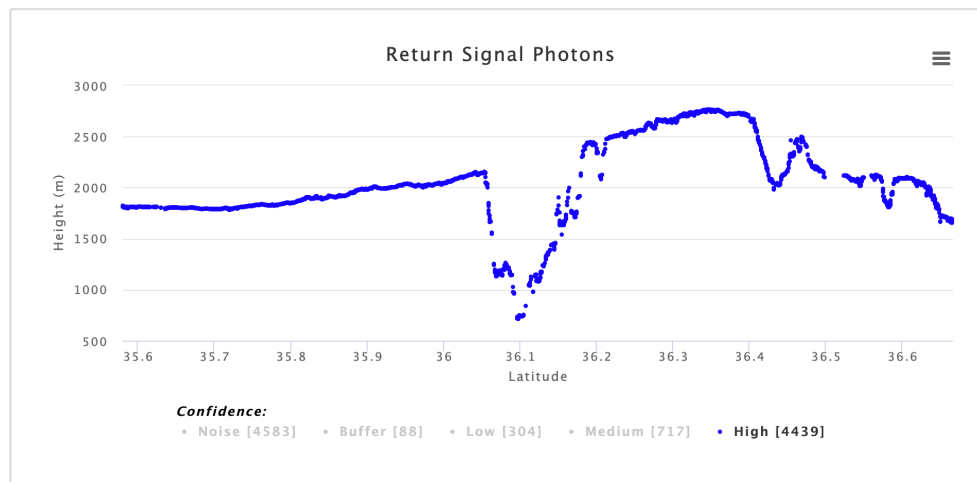
ATL03 PHOTON HEIGHTS

Select ATLAS beam [gt3r \(weak\)](#) | [gt3l \(strong\)](#) | [gt2r \(weak\)](#) | [gt2l \(strong\)](#) | [gt1r \(weak\)](#) | [gt1l \(strong\)](#)

Track ID: 516 - Beam: gt3l - Sample Rate: 1.43%

Total number of photons: 709,120 - Total segments: 6,039 - Segment range: [798,413 - 804,451]

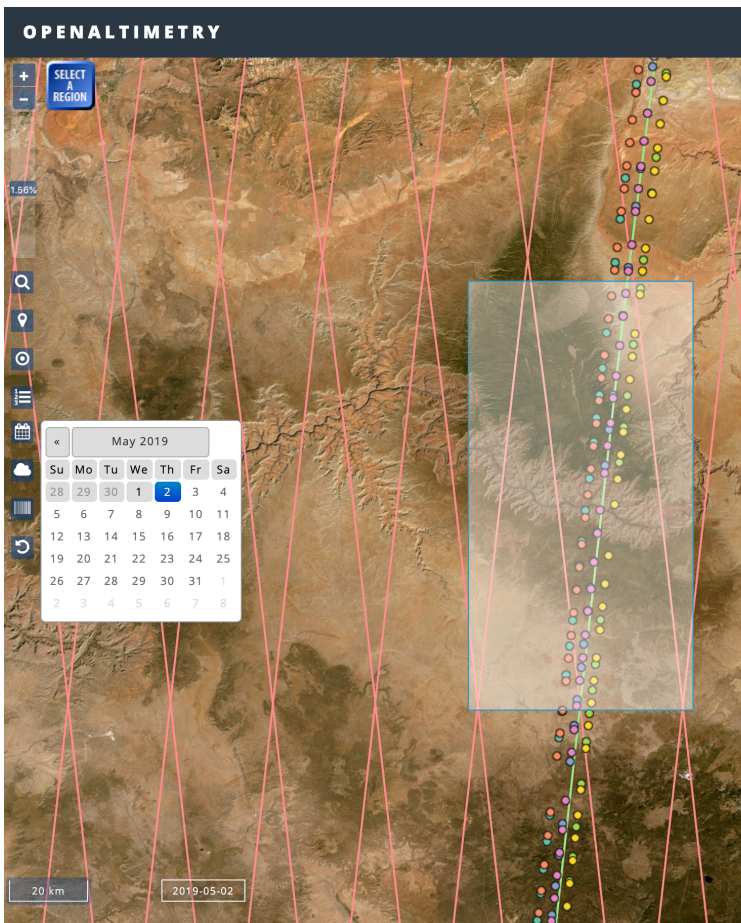
Drag zoom on the plot below to view more detail.



[Download data as CSV](#)

[Download subsetted HDF5 \(via NSIDC\) \(Requires \[Login\]\(#\)\)](#)

[Analyze in Jupyter Notebook](#)



THANKS!



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Geological Survey /
State of Indiana