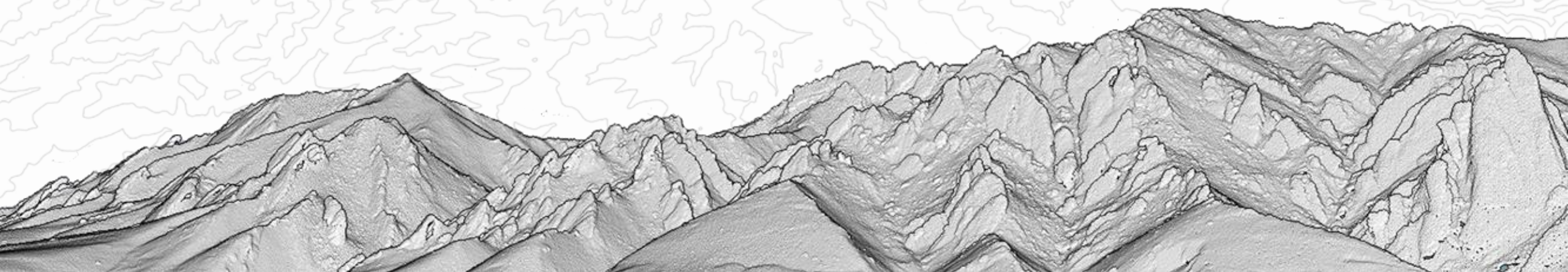


Differencing in OpenTopography

Cassandra Brigham

CLaSH Workshop | September 23, 2026



Differencing in the OpenTopography web portal



Go to <https://opentopography.org>

Choose an area with
<20M points

Questions along the way?

slido.com
#8124649



**OpenTopography**

High-Resolution Topography Data and Tools

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DEVELOPERS/API

Black Rock Desert Wilderness, Nevada

Latest News

[August 2026 Data Releases](#)

Sep 15, 2026

New lidar coverage was added this month in California, Virginia, and Pennsylvania, including a NOAA bathymetry dataset spanning the Appalachian rivers of West Virginia and Pennsylvania that captures depth data along these major waterways. Two large...

[July 2026 Data Releases](#)

Aug 17, 2026

This month's release brings new coverage across Europe, Central America, and the US. High-resolution, country-wide digital elevation models covering Norway, Finland, Switzerland, and Liechtenstein were added, offering national bare-earth and surface

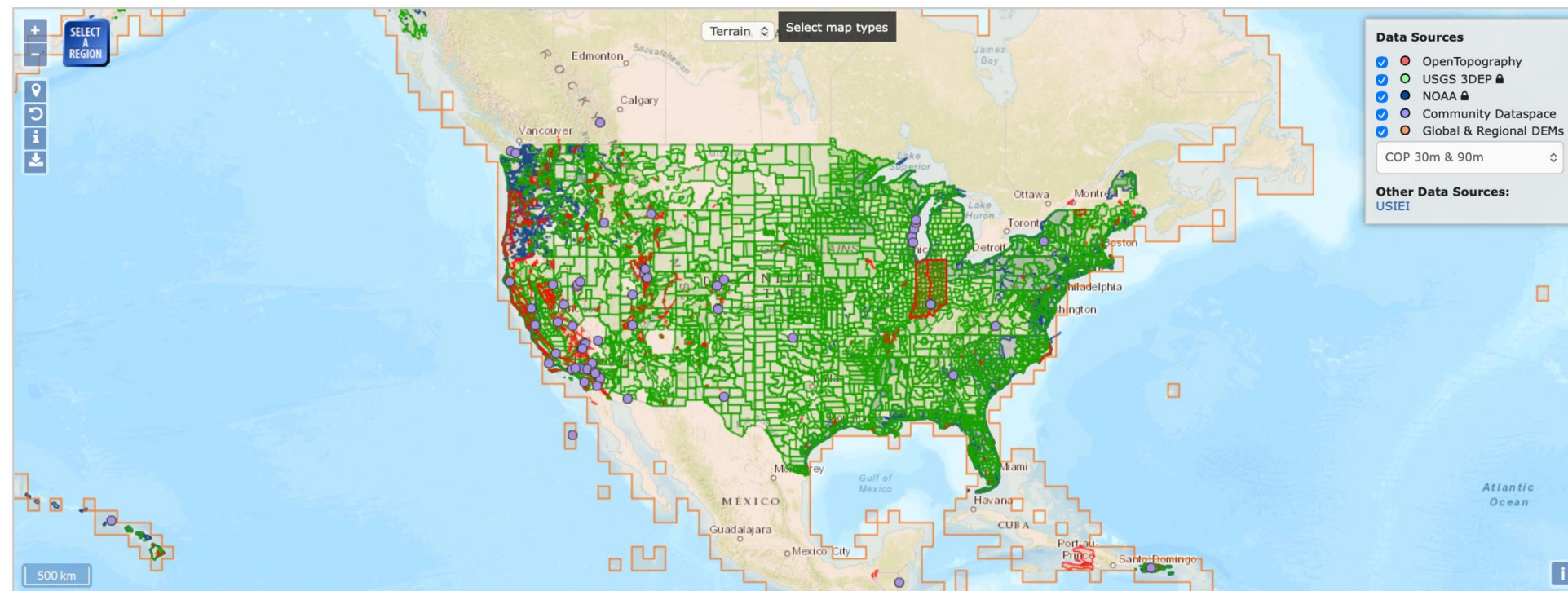
[What is OpenTopography?](#)[Request an API Key](#)[OT+ Subscription \(Non Academics\)](#)

Latest Datasets:

[📍 Switzerland 50 Centimeter](#)[Digital Elevation Models](#)[📍 Finland 2 Meter Digital Elevation Model](#)[📍 Norway 1 Meter Digital Elevation](#)

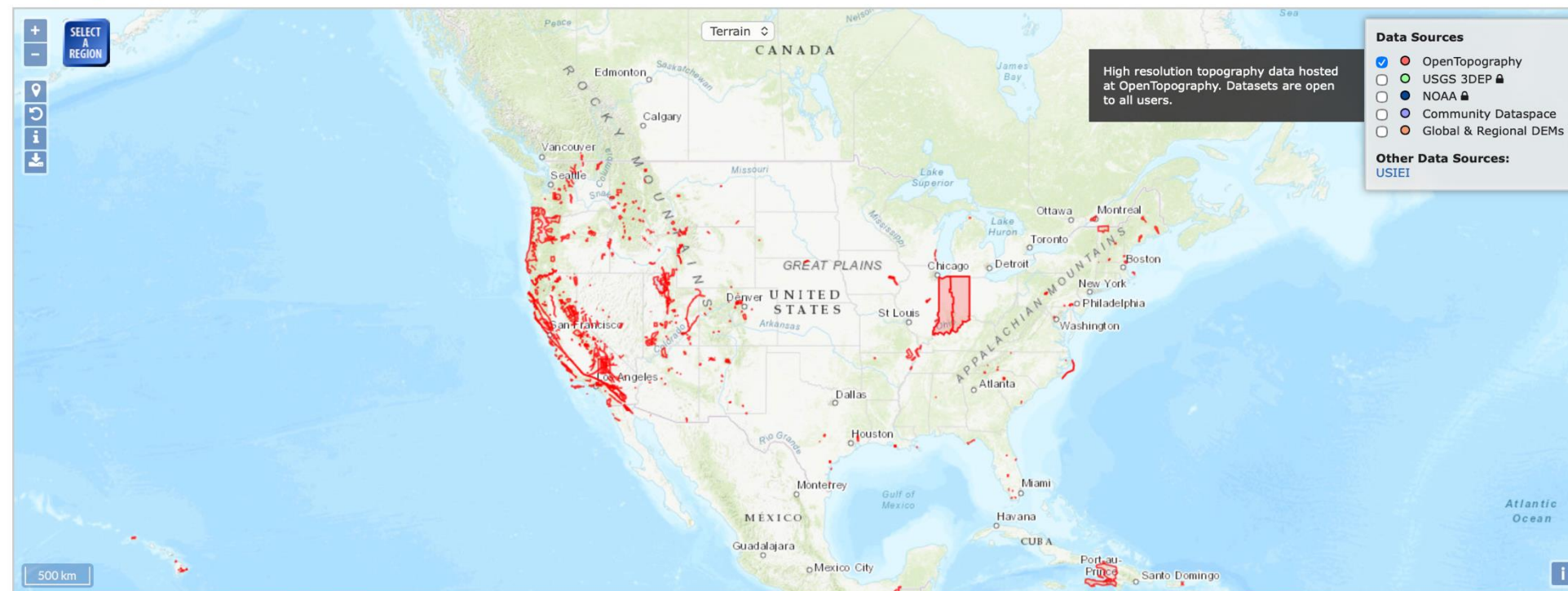


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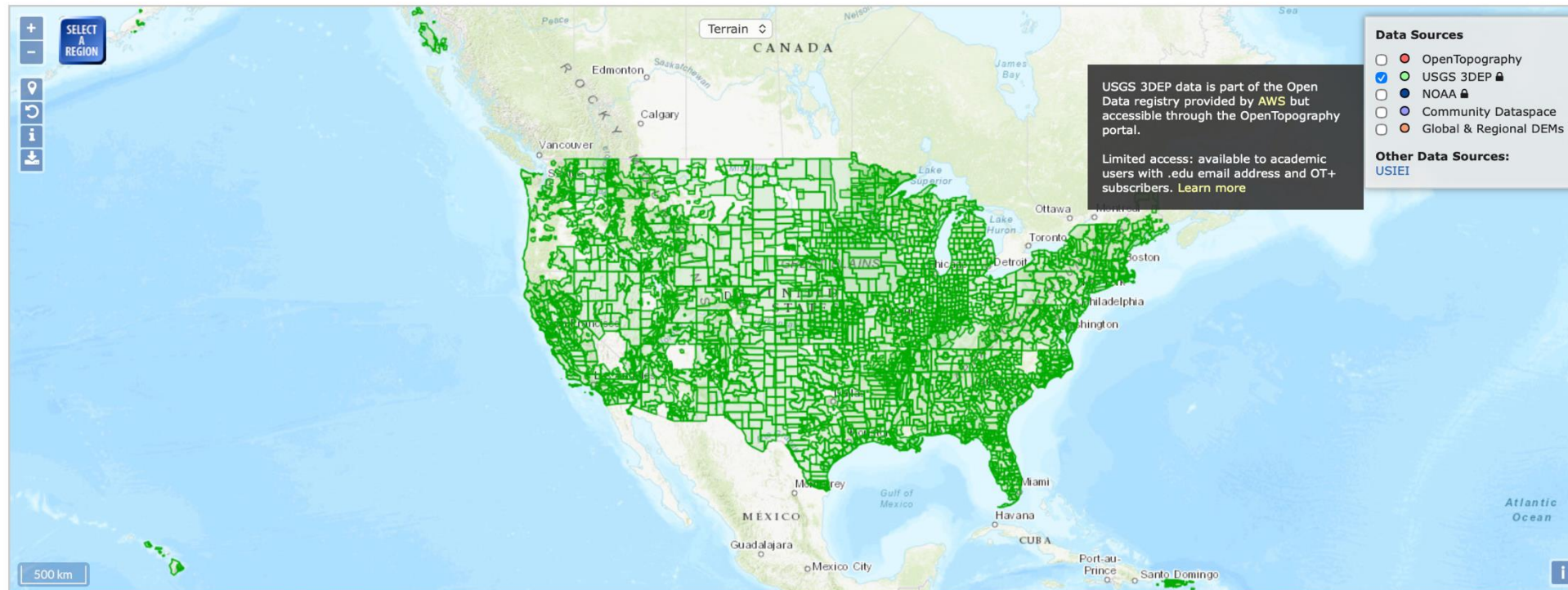
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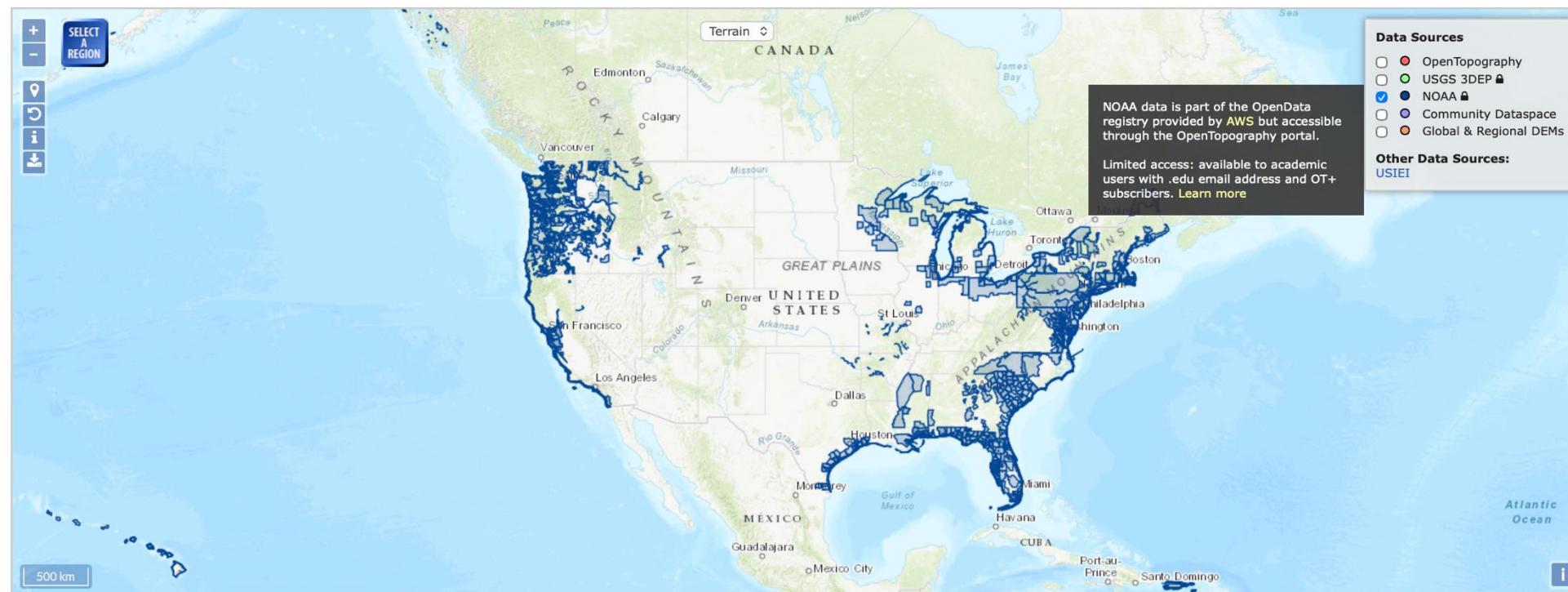
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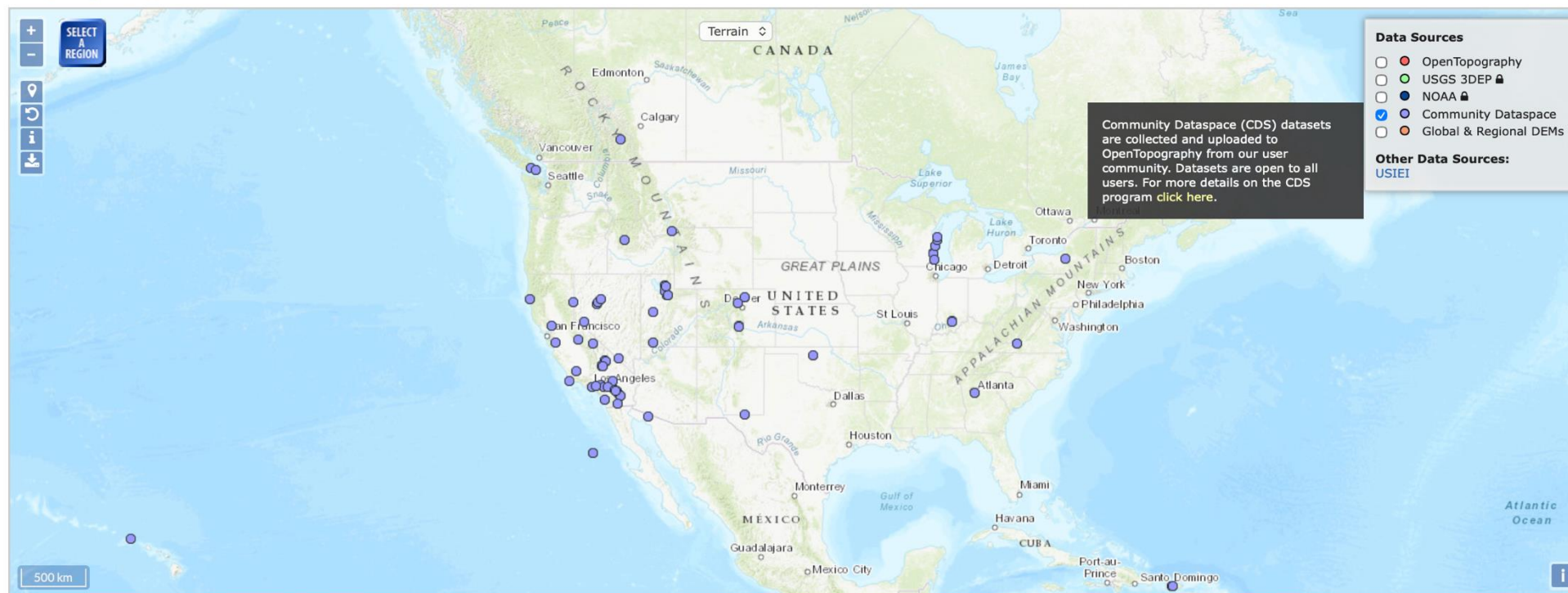
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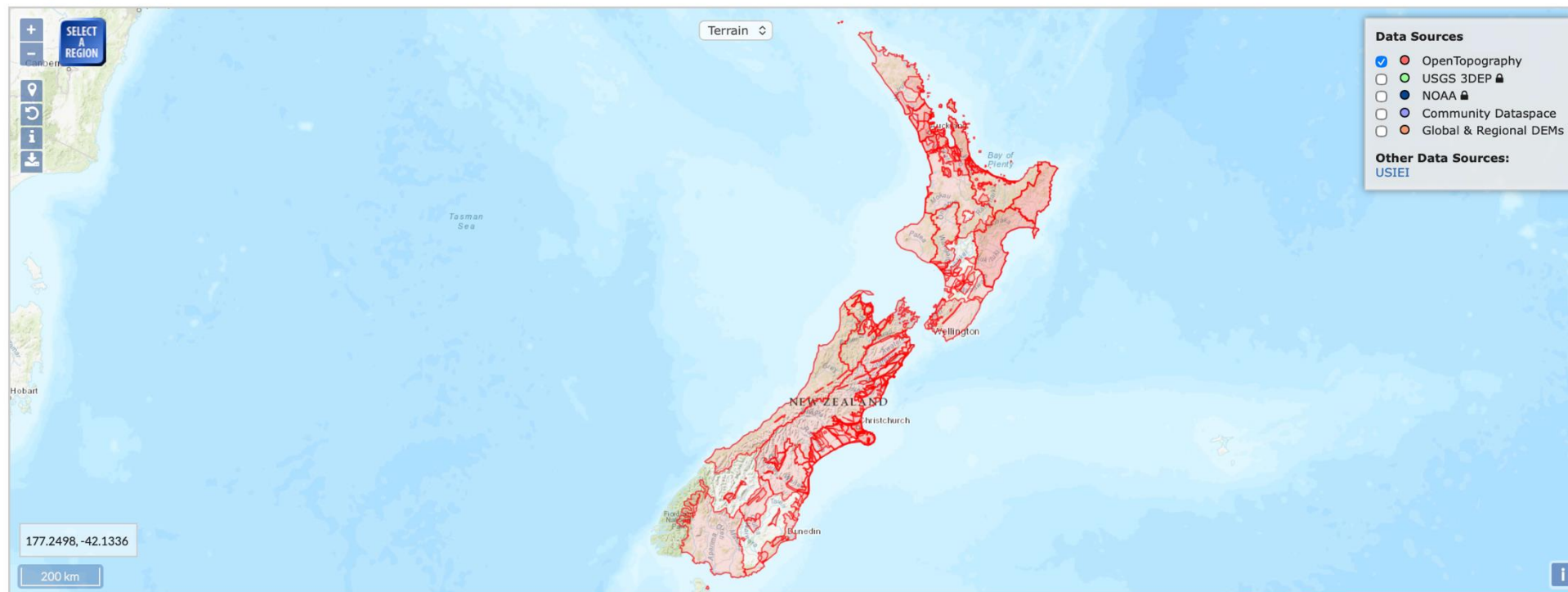
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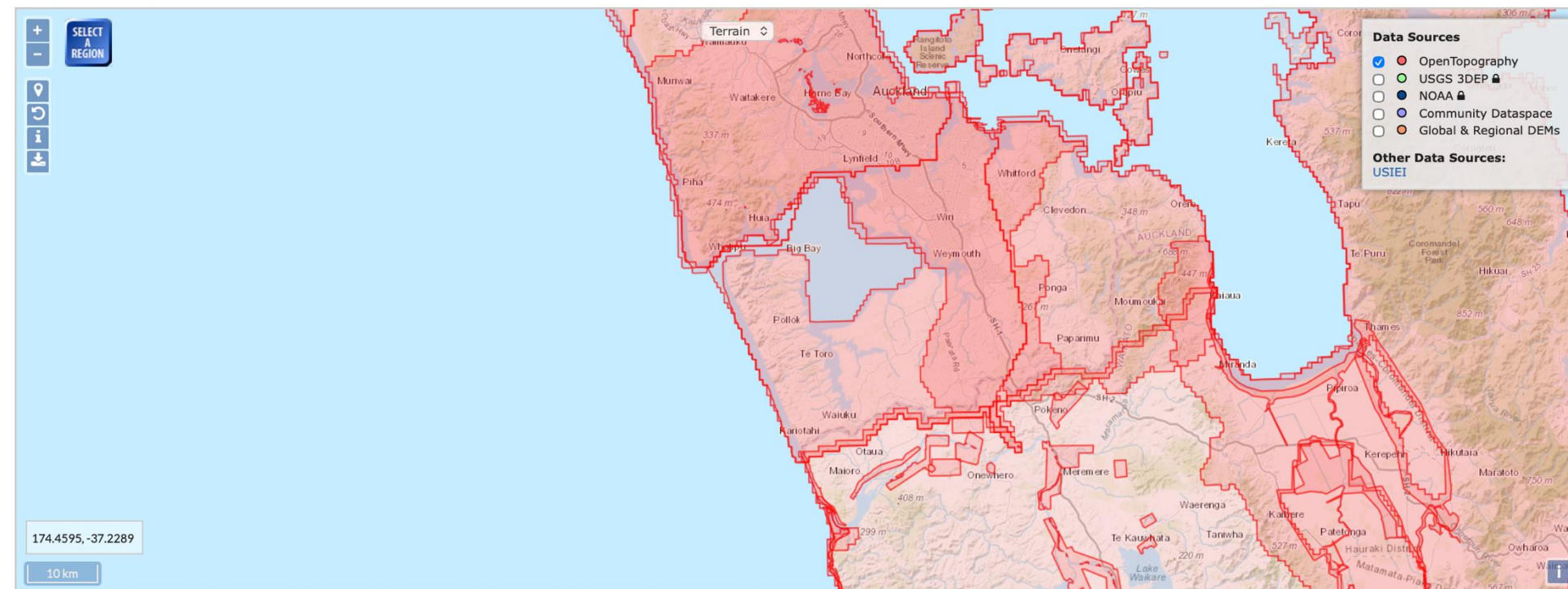
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Dataset Name Auckland South, New Zealand 2016-2017

Collection Platform Airborne Lidar

Products available Point Cloud Data

Survey date 2016-09-09Z - 2017-02-06Z

Please use the 'SELECT A REGION' button to get more information and to access this dataset in results area below the map.

[View 13 more datasets](#)

OpenTopography [Open Data](#)

Dataset Name Auckland Part 1, New Zealand 2024

[List all datasets](#) [Filter by Data Sources](#) [Filter by Location](#) [Advanced Filtering](#)

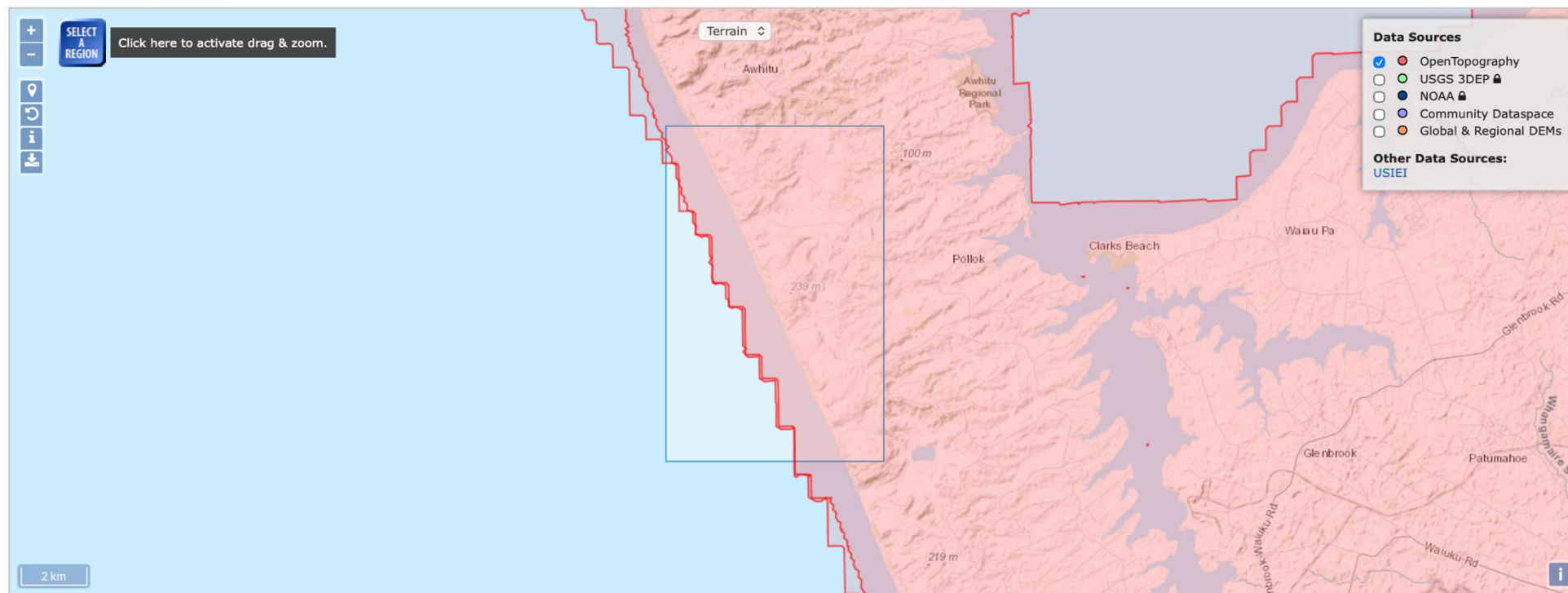




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RESULTS:

Total 13 datasets found for all data sources.

☒ Global & Regional DEM ^[10]

☒ High Resolution Topography ^[2]

☐ Community Contributed ^[1]

☒ OpenTopography ^[2]

☐ Point Cloud USGS 3DEP ^[0]

☐ NOAA Coastal Lidar ^[0]



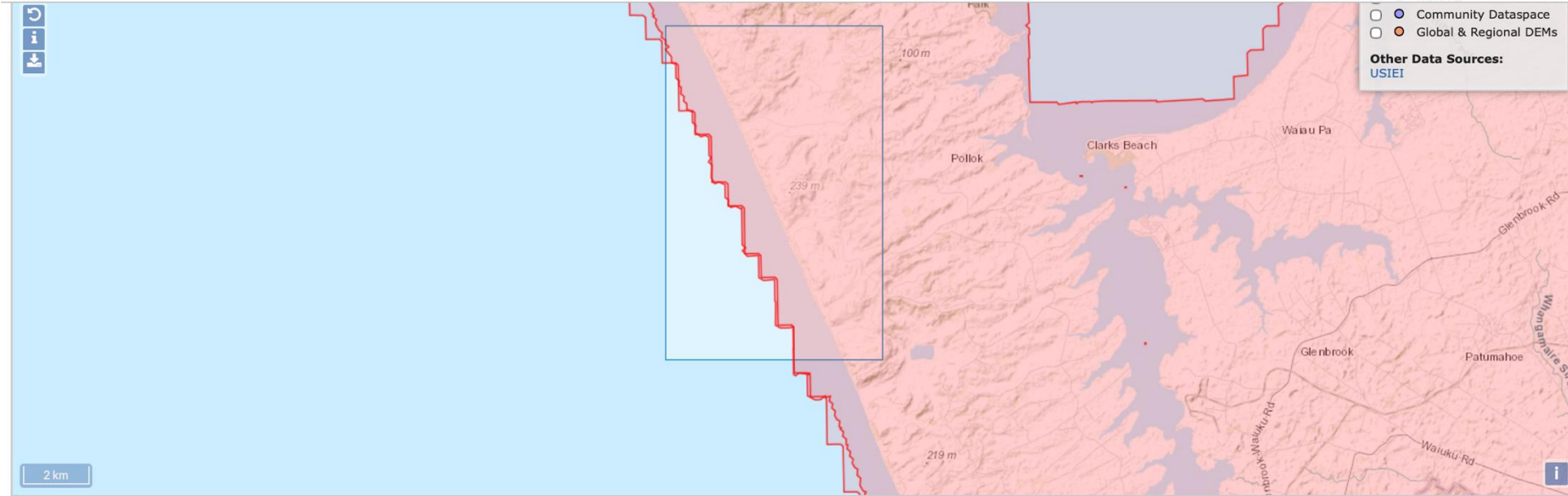
Datasets listed below are hosted by OpenTopography and are available in point cloud format for download and processing (e.g., creating custom DEMs). In some cases derived data products such as raster and Google Earth Image overlays are also available. Click the button to the right of the dataset name to access the available data products.

1 Open Data Auckland Part 1, New Zealand 2024

Differencing

[Get Point Cloud Data](#)





List all datasets

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RESULTS:

Total 13 datasets found for all data sources.

☒ Global & Regional DEM ^[10]

☐ High Resolution Topography ^[2]

☐ Community Contributed ^[1]

☒ OpenTopography ^[2]

☐ Point Cloud USGS 3DEP ^[0]

☐ NOAA Coastal Lidar ^[0]



Datasets listed below are hosted by OpenTopography and are available in point cloud format for download and processing (e.g., creating custom DEMs). In some cases derived data products such as raster and Google Earth Image overlays are also available. Click the button to the right of the dataset name to access the available data products.

1 ☒ Open Data Auckland Part 1, New Zealand 2024

Differencing

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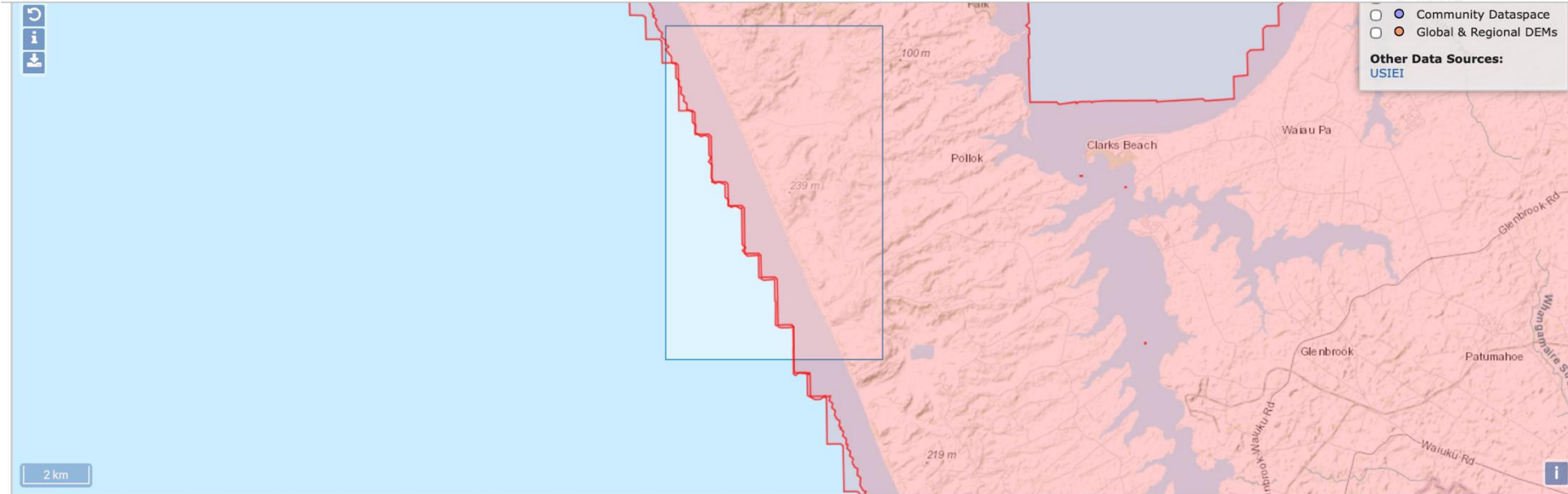


2 ☒ Open Data Auckland South, New Zealand 2016-2017

Differencing

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Filter by Location ▾

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RESULTS:

Total 13 datasets found for all data sources.

☒ Global & Regional DEM ^[10]

☐ High Resolution Topography ^[2]

☐ Community Contributed ^[1]

☒ OpenTopography ^[2]

☐ Point Cloud USGS 3DEP ^[0]

☐ NOAA Coastal Lidar ^[0]



Datasets listed below are hosted by OpenTopography and are available in point cloud format for download and processing (e.g., creating custom DEMs). In some cases derived data products such as raster and Google Earth Image overlays are also available. Click the button to the right of the dataset name to access the available data products.

1 ☒ Open Data Auckland Part 1, New Zealand 2024

Differencing

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2 ☒ Open Data Auckland South, New Zealand 2016-2017

Differencing

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Vertical Differencing

[\[Video Tutorial \]](#)Welcome Cassandra Brigham ([Sign Out](#))

Auckland Part 1, New Zealand 2024

Overview

LiDAR was captured for Regional Software Holdings Limited (RSHL) by Woolpert between 30th of April and 27th of June 2024. The project was funded by Ministry for the Environment (MFE) in response to the effects of the Auckland anniversary day flooding. This dataset is being refined by Auckland Council. Once improvements to this dataset have been completed the dataset will be updated. The datasets were generated by Woolpert and their subcontractors. Data management and distribution is by Toitū Te Whenua Land Information New Zealand.



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Environment
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Toitū Te Whenua
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New Zealand

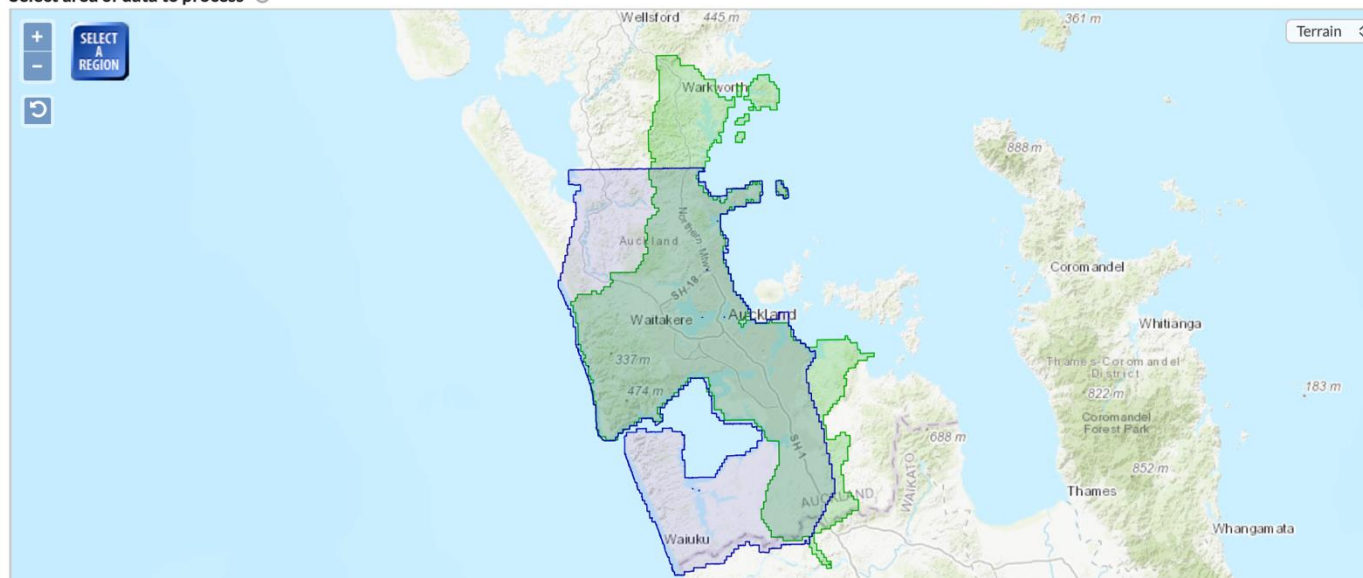
Reference Dataset [Full Metadata](#)
Compare Dataset [Full Metadata](#)

Total points: 46,185,028,276 pts
Total points: 10,709,321,570 pts

Survey Area: 2,743 km²
Survey Area: 2,250 km²

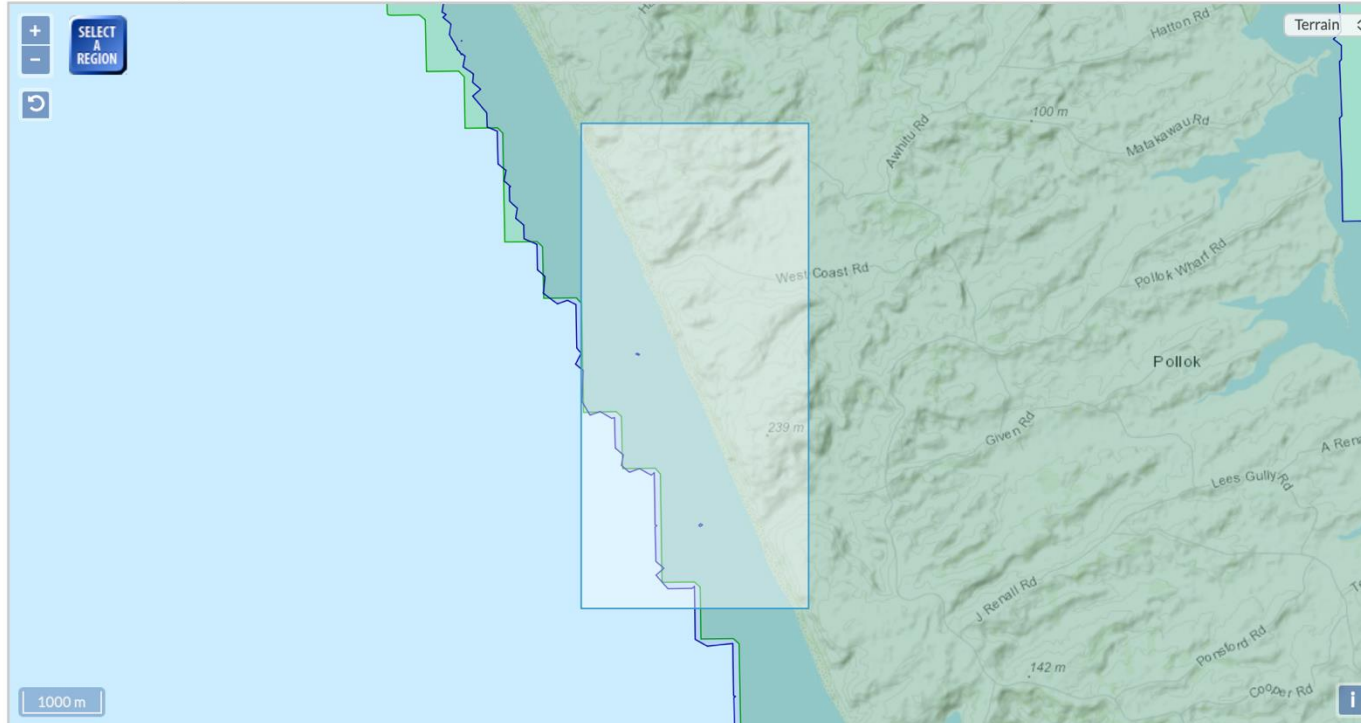
Point Density: 16.83 pts/m²
Point Density: 4.76 pts/m²

Select area of data to process ⓘ





Select area or data to process ⓘ



1. Vertical Differencing Datasets and Coordinate System ⓘ

Select a dataset for vertical differencing:

Auckland South, New Zealand 2016-2017 (09/09/2016 - 02/06/2017) ▾

Reference dataset:

Dataset: Auckland Part 1, New Zealand 2024

Survey Date: 04/30/2024 - 06/27/2024

Horizontal Coordinates: NZTM2000 NZGD2000 Meters [EPSG: 2193]

Vertical Coordinates: NZVD2016 [EPSG: 7839]

Units: meter

Data Selection Coordinates (Select an area on map)

$X_{\min} = 1738649.396683$ $Y_{\min} = 5885208.497367$ $X_{\max} = 1741630.494884$ $Y_{\max} = 5891272.199328$

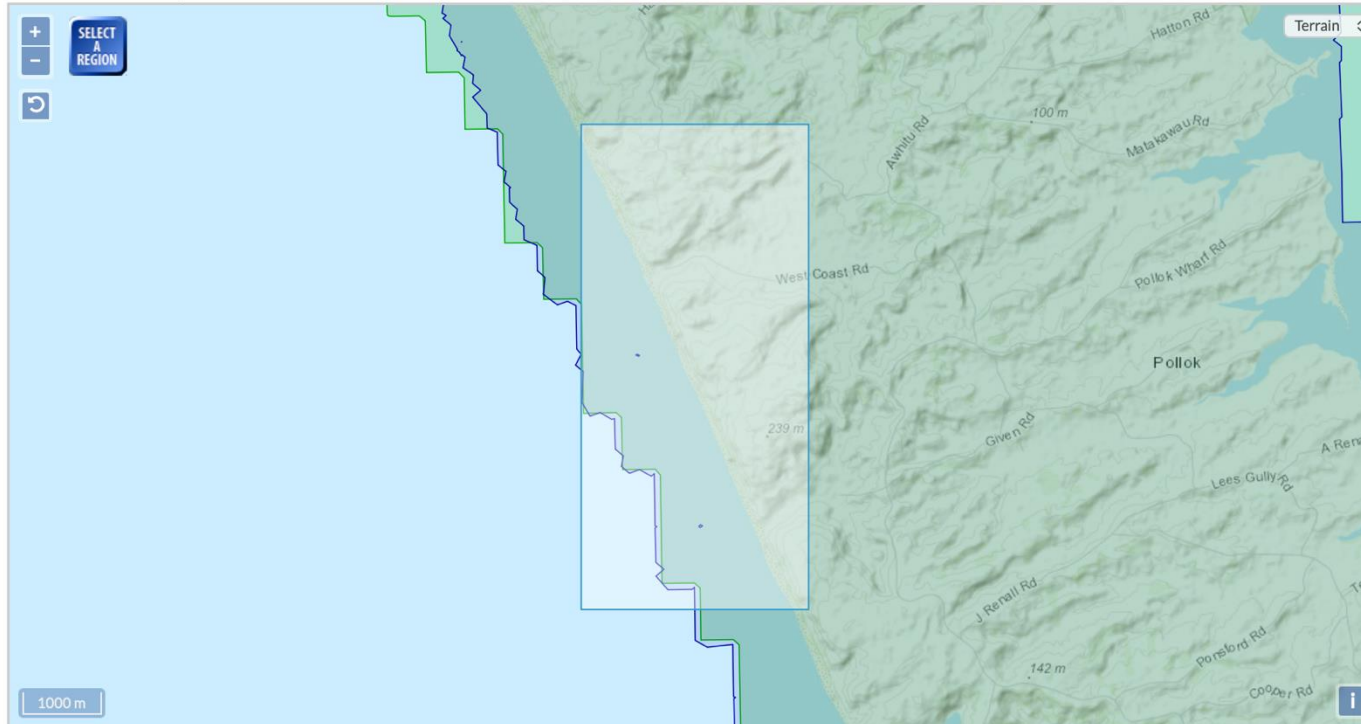
☐ Manually enter selection coordinates (in the horizontal coordinate system listed above)

The selection area contains approximately 158,600,000 points.

ⓘ Choose Return Classification ☐ Ground



Select area or data to process



1. Vertical Differencing Datasets and Coordinate System

Auckland, New Zealand 2013 (07/29/2013 - 11/23/2013)

✓ Auckland South, New Zealand 2016-2017 (09/09/2016 - 02/06/2017)

Auckland North, New Zealand 2016-2018 (08/01/2016 - 08/01/2018)

Reference dataset:

Dataset: Auckland Part 1, New Zealand 2024

Survey Date: 04/30/2024 - 06/27/2024

Horizontal Coordinates: NZTM2000 NZGD2000 Meters [EPSG: 2193]

Vertical Coordinates: NZVD2016 [EPSG: 7839]

Units: meter

Data Selection Coordinates (Select an area on map)

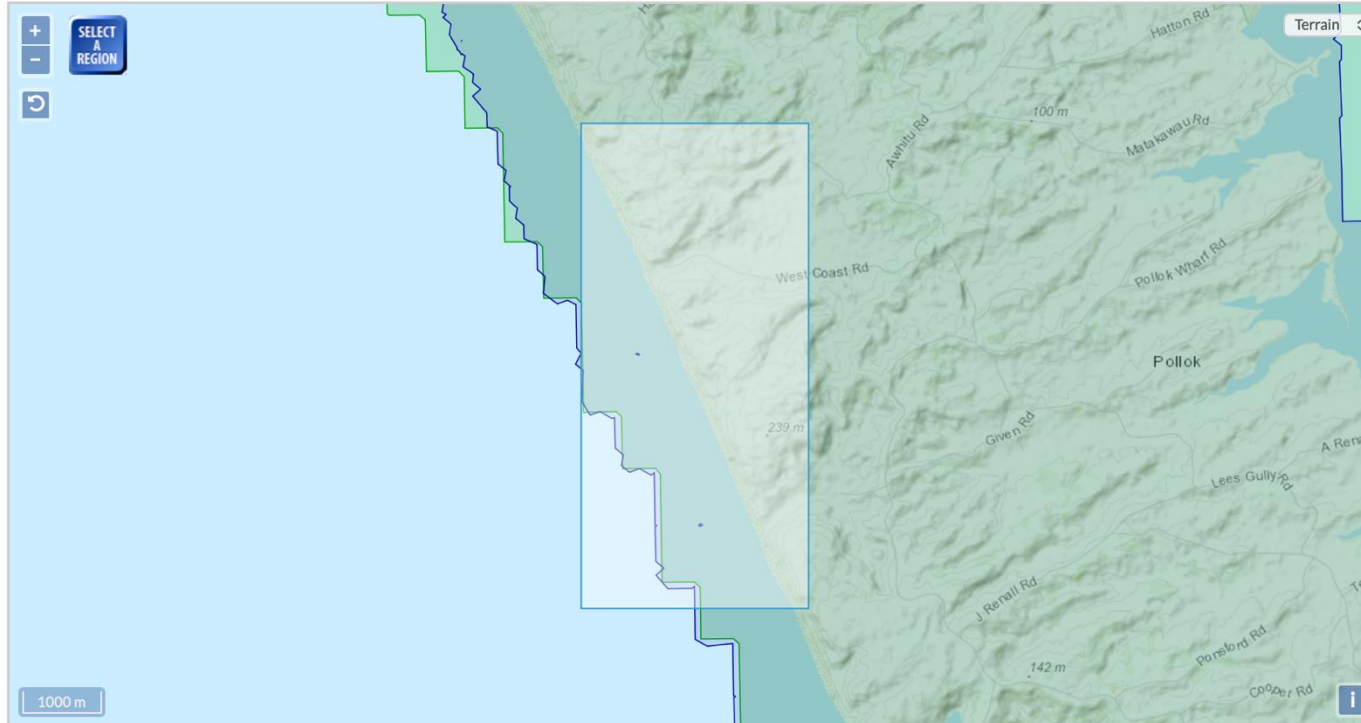
 $X_{\min} = 1738649.396683$ $Y_{\min} = 5885208.497367$ $X_{\max} = 1741630.494884$ $Y_{\max} = 5891272.199328$ ☐ Manually enter selection coordinates (in the horizontal coordinate system listed above)

The selection area contains approximately 158,600,000 points.

☒ Choose Return Classification ☐ Ground



Select area or data to process



1. Vertical Differencing Datasets and Coordinate System

Select a dataset for vertical differencing:

Auckland South, New Zealand 2016-2017 (09/09/2016 - 02/06/2017)

☒ Reference dataset:

Dataset: Auckland Part 1, New Zealand 2024

Survey Date: 04/30/2024 - 06/27/2024

Horizontal Coordinates: NZTM2000 NZGD2000 Meters [EPSG: 2193]

Vertical Coordinates: NZVD2016 [EPSG: 7839]

Units: meter

Data Selection Coordinates (Select an area on map)

$X_{\min} = 1738649.396683$ $Y_{\min} = 5885208.497367$ $X_{\max} = 1741630.494884$ $Y_{\max} = 5891272.199328$

☐ Manually enter selection coordinates (in the horizontal coordinate system listed above)

The selection area contains approximately 75,929,000 points.

Choose Return Classification ☒ Ground



Vertical Coordinates: [NZVD2016 \[EPSG: 7839\]](#)

Units: meter

Data Selection Coordinates (Select an area on map)

$X_{\min} = 1738649.396683$

$Y_{\min} = 5885208.497367$

$X_{\max} = 1741630.494884$

$Y_{\max} = 5891272.199328$

☐ Manually enter selection coordinates (in the horizontal coordinate system listed above)

The selection area contains approximately 75,929,000 points.

Choose Return Classification

☒ Ground

2. DEM Generation (TIN)

Grid Resolution (Default = 1.0 meter)

Max. triangle size (Default 50 units)

3. Error handling (optional)

☐ Estimate mean uncertainty using geostatistical approach.

☐ User-defined Minimum Level of Detection



4. Visualization

☒ Generate additional hillshade images from DEMs for reference and compare datasets.

Altitude of the light: (in range: [0-90] degrees)

Azimuth of the light: (in range: [0-360] degrees)

Job Description & Notification

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☐ Do not send job notification email

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Vertical Coordinates: NZVD2016 [EPSG: 7839]

Units: meter

Data Selection Coordinates (Select an area on map)

X_{min} = 1738649.396683

Y_{min} = 5885208.497367

X_{max} = 1741630.494884

Y_{max} = 5891272.199328

☐ Manually enter selection coordinates (in the horizontal coordinate system listed above)

The selection area contains approximately 75,929,000 points.

Choose Return Classification

☒ Ground

2. DEM Generation (TIN)

Grid Resolution (Default = 1.0 meter)

1.0

Max. triangle size (Default 50 units)

3. Error handling (optional)

☐ Estimate mean uncertainty

☐ User-defined Minimum Level of Detection

The TIN (Triangulated Irregular Network) interpolation algorithm offered by OpenTopography is an implementation of Martin Isenburg's high-performance code for generating raster digital elevation models (DEMs) from mass points via streaming Delaunay triangulation. A TIN model represents the landscape as a surface composed of contiguous and non-overlapping triangles constructed between the cloud of lidar returns. Within each triangle the surface is represented by a plane. A raster DEM is then constructed by sampling the triangulated surface elevation at the DEM nodes. More information on Isenburg's TIN is available at: <http://www.cs.unc.edu/~isenburg/tin2dem/>

LABS

4. Visualization

☒ Generate additional hillshade images from DEMs for reference and compare datasets.

Altitude of the light: (in range: [0-90] degrees)

45

Azimuth of the light: (in range: [0-360] degrees)

315

Job Description & Notification

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cabrigha@asu.edu

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Vertical Coordinates: NZVD2016 [EPSG: 7839]

Units: meter

Data Selection Coordinates (Select an area on map)

$X_{\min} = 1738649.396683$ $Y_{\min} = 5885208.497367$ $X_{\max} = 1741630.494884$ $Y_{\max} = 5891272.199328$

☐ Manually enter selection coordinates (in the horizontal coordinate system listed above)

The selection area contains approximately 75,929,000 points.

☐ Choose Return Classification ☒ Ground

2. DEM Generation (TIN) ?

☐ Grid Resolution (Default = 1.0 meter)

1.0

☐ Max. triangle size (Default 50 units)

50

3. Error handling (optional) ?

☐ Estimate mean uncertainty using

☐ User-defined Minimum Level of

Topographic datasets contain multiple sources of error. These errors are often pronounced in differencing results. Accounting for error in vertical differencing results allows for more robust interpretations of the topographic change.

LABS

4. Visualization ?

☒ Generate additional hillshade images from DEMs for reference and compare datasets.

Altitude of the light: (in range: [0-90] degrees)

45

Azimuth of the light: (in range: [0-360] degrees)

315

Job Description & Notification

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Vertical Coordinates: NZVD2016 [EPSG: 7839]

Units: meter

Data Selection Coordinates (Select an area on map)

X_{min} = 1738649.396683

Y_{min} = 5885208.497367

X_{max} = 1741630.494884

Y_{max} = 5891272.199328

☐ Manually enter selection coordinates (in the horizontal coordinate system listed above)

The selection area contains approximately 75,929,000 points.

Choose Return Classification

☒ Ground

2. DEM Generation (TIN)

Grid Resolution (Default = 1.0 meter)

1.0

Max. triangle size (Default 50 units)

50

3. Error handling (optional)

☐ Estimate mean uncertainty using geostatistical approach.

☐ User-defined Minimum Level of Detection

4. Visualization

☒ Generate additional images and compare datasets.

OpenTopography will generate images of hillshades from the DEMs you produce in the previous section.

Altitude of the light: (in range: [0-90] degrees)

45

Azimuth of the light: (in range: [0-360] degrees)

315

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Vertical Coordinates: NZVD2016 [EPSG: 7839]

Units: meter

Data Selection Coordinates (Select an area on map)

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Y_{min} = 5885208.497367

X_{max} = 1741630.494884

Y_{max} = 5891272.199328

☐ Manually enter selection coordinates (in the horizontal coordinate system listed above)

The selection area contains approximately 75,929,000 points.

Choose Return Classification

☒ Ground

2. DEM Generation (TIN) ⓘ

Grid Resolution (Default = 1.0 meter)

1.0

Max. triangle size (Default 50 units)

50

3. Error handling (optional) ⓘ

☐ Estimate mean uncertainty using geostatistical approach. ⓘ

☐ User-defined Minimum Level of Detection ⓘ



4. Visualization ⓘ

☒ Generate additional hillshade images from DEMs for reference and compare datasets.

Altitude of the light: (in range: [0-90] degrees)

45

Azimuth of the light: (in range: [0-360] degrees)

315

Job Description & Notification

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Title (up to 150 characters)

Title

Description (up to 750 characters)

Description



Differencing Job Results

Welcome Cassandra Brigham ([Sign Out](#))

Modify and resubmit this job

[Full job metadata](#)

Dataset Citation: Ministry for the Environment, Regional Software Holdings Limited, Toitū Te Whenua Land Information New Zealand (LINZ) (2025). Auckland Part 1, New Zealand 2024. Collected by Woolpert, distributed by OpenTopography and LINZ. <https://doi.org/10.5069/G9HH6H8T>. Accessed 2026-09-23
Use License: **CC BY 4.0**

Job Id	Reference	Compare	Title	Submission / Completion	Duration	Last Service Update
vd1790130808606	NZ24_Auckland Num. points: N/A	NZ16_SAuckland Num. points: N/A		2026-09-23 02:33:28 N/A	N/A	LasSelectService_cmp

- Querying** (reference dataset): Extracting point cloud data for the area of interest.
- TIN** (reference dataset): Generating Digital Elevation Model (DEM) from point cloud.
- Querying** (compare dataset): Extracting point cloud data for the area of interest.
- TIN** (compare dataset): Generating Digital Elevation Model (DEM) from point cloud.
- Differencing Products:** Generating vertical differencing output from 2 DEMs
- Visualization:** Generating hillshade images and Google Earth files from DEMs

Depending upon the size of your job and system load, your job may take greater than an hour to complete. You may close this page at any time. Status of running jobs can also be monitored through [Differencing Jobs](#). You will receive an email notification once the job is complete.

[Share Job Results](#)





Differencing Job Results

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Dataset Citation: Ministry for the Environment, Regional Software Holdings Limited, Toitū Te Whenua Land Information New Zealand (LINZ) (2025). Auckland Part 1, New Zealand 2024. Collected by Woolpert, distributed by OpenTopography and LINZ. <https://doi.org/10.5069/G9HH6H8T>. Accessed 2026-09-23 
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Job Id	Reference	Compare	Title	Submission / Completion	Duration	Final Status
vd1790130808606	NZ24_Auckland Num. points: 116,084,740	NZ16_SAuckland Num. points: 51,192,735		2026-09-23 02:33:28 2026-09-23 02:45:44	736 secs	Done ✓

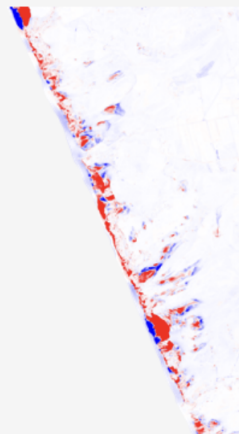
Download Data

Differencing Products

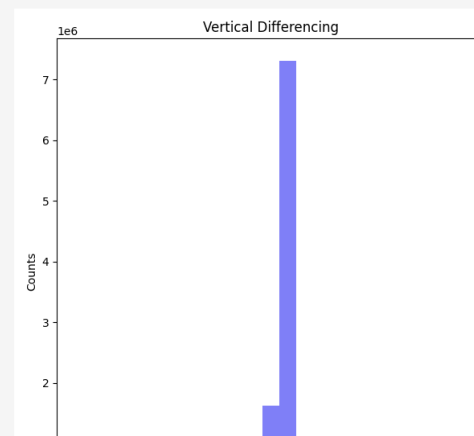
- Download DEMS and vertical differencing results [vertical_differencing.tar.gz](#) (94.8 MB)

Visualization Products

Vertical Differencing

[View on map](#)

histogram





Job Id	Reference	Compare	Title	Submission / Completion	Duration	Final Status
vd1790130808606	NZ24_Auckland Num. points: 116,084,740	NZ16_SAuckland Num. points: 51,192,735		2026-09-23 02:33:28 2026-09-23 02:45:44	736 secs	Done ✓

Download Data ?

- Differencing Products
- Download DEMs and vertical differencing results [vertical_differencing.tar.gz](#) (94.8 MB)

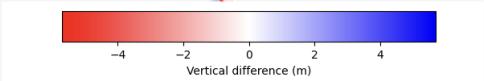
Visualization Products

Vertical Differencing

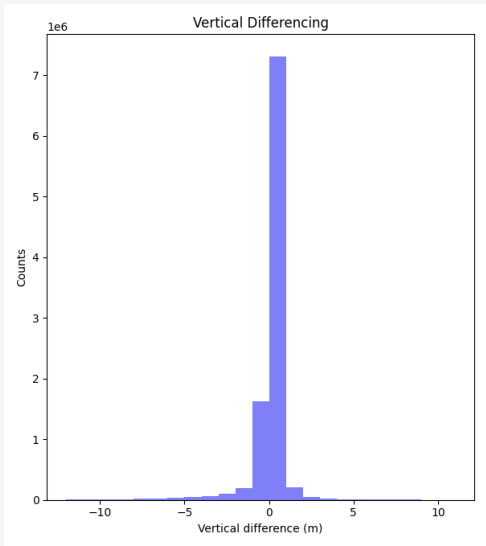
- [View on map](#)



Click to view this image in full resolution



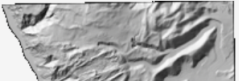
histogram



Hillshade Images

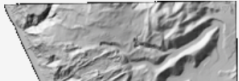
Compare dataset

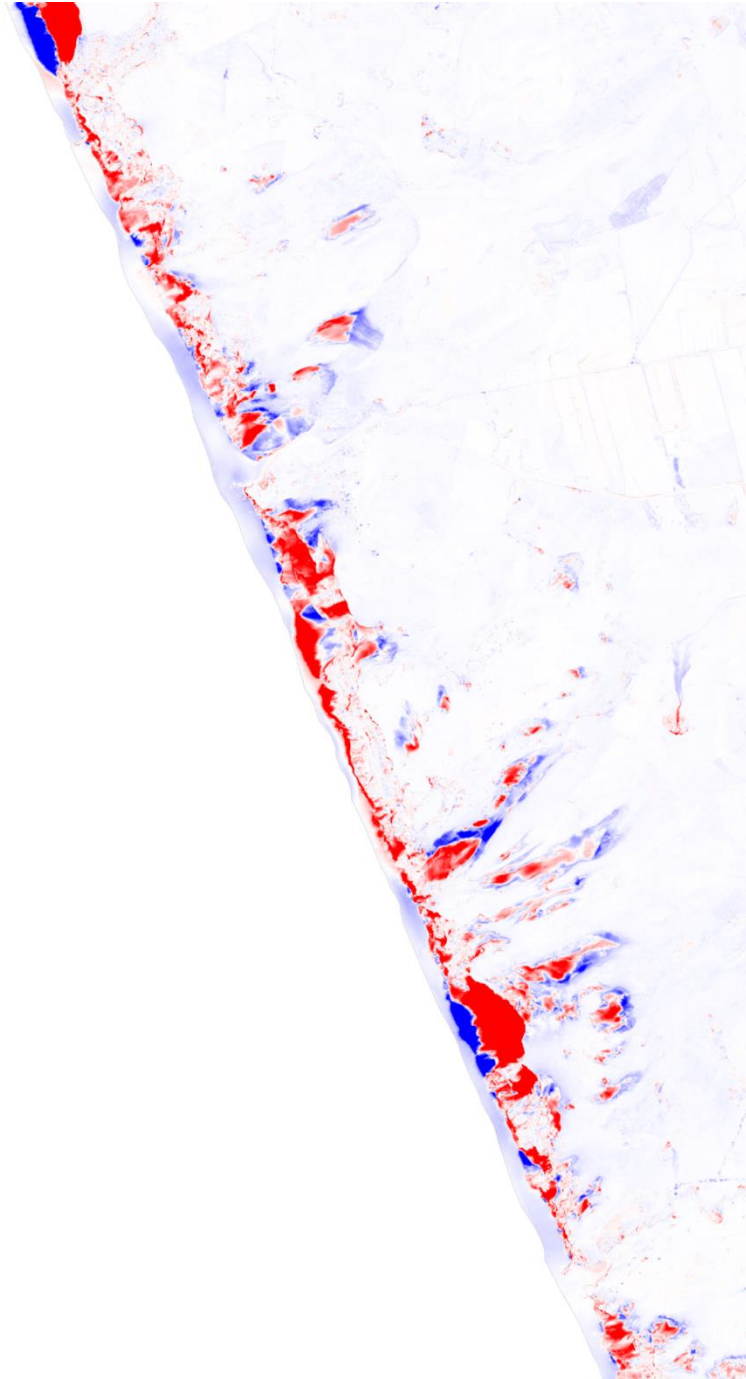
- Dataset: Auckland South, New Zealand 2016-2017
- Survey Date: 09/09/2016 - 02/06/2017



Reference dataset

- Dataset: Auckland Part 1, New Zealand 2024
- Survey Date: 04/30/2024 - 06/27/2024



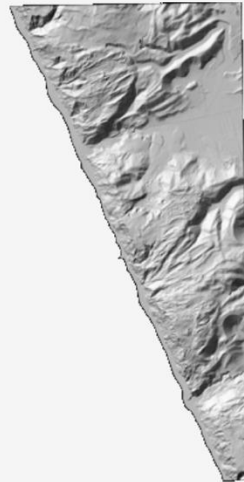




Hillshade Images

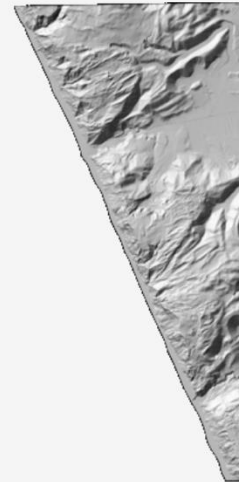
Compare dataset

- Dataset: Auckland South, New Zealand 2016-2017
- Survey Date: 09/09/2016 - 02/06/2017



Reference dataset

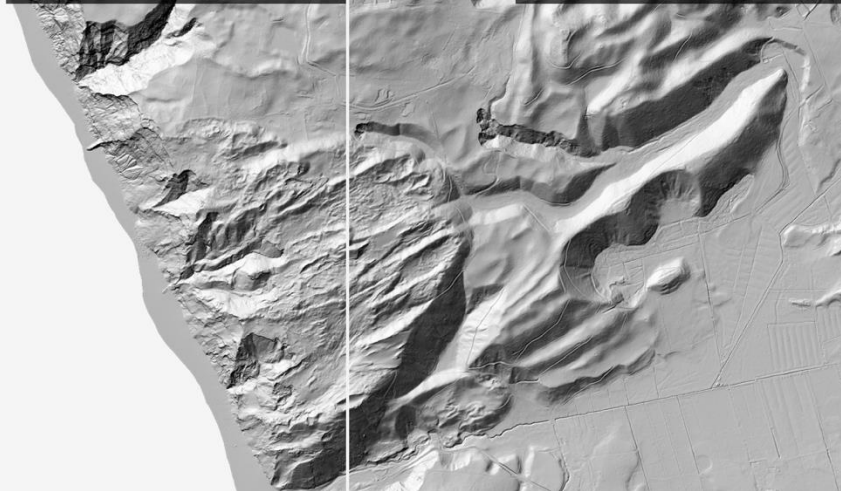
- Dataset: Auckland Part 1, New Zealand 2024
- Survey Date: 04/30/2024 - 06/27/2024



Hillshade Images Slider

Compare Data: 09/09/2016 - 02/06/2017

Reference Data: 04/30/2024 - 06/27/2024



Questions?



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