OpenTopography: Increasing the Impact of High Resolution Topography through Open, Online Access to Data and Processing

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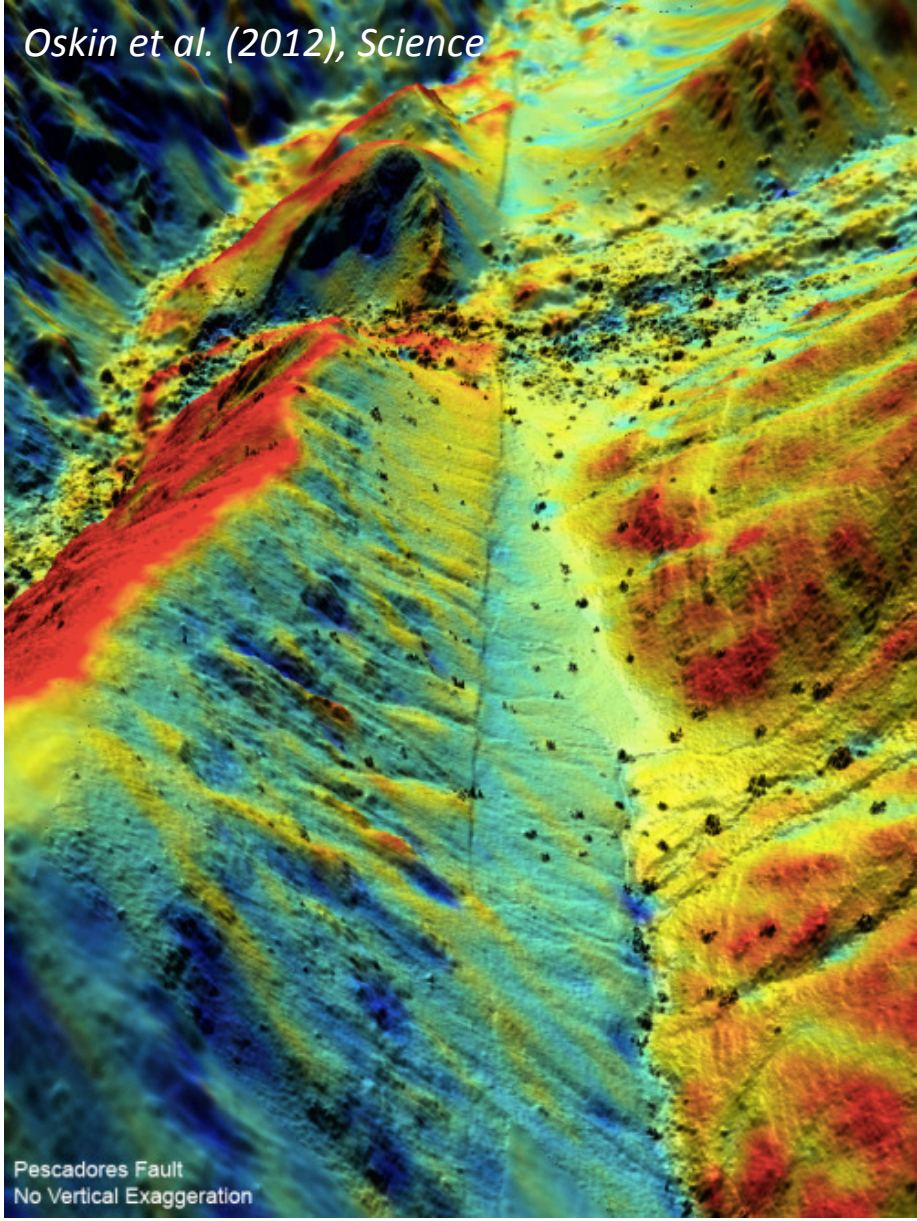
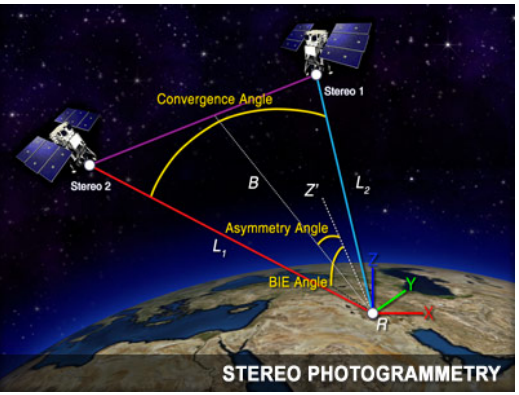


OpenTopography

Multi-Temporal, High-Resolution Topography

D Space-based radar & photogrammetry



DigitalGlobe

PLÉIADES CONSTELLATION

polar geospatial center

A Airborne LiDAR

onboard GPS and IMU constrain position and orientation of aircraft

distance between scanner and ground return determined from delay between outgoing pulse and reflected return

laser pulse

C Structure from Motion

motion of camera provides depth information

sequence of photographs

scene **structure** refers to both camera positions and orientations *and* the topography

line of sight

features matched in multiple photographs

shadow zone

laser pulse

B Terrestrial LiDAR

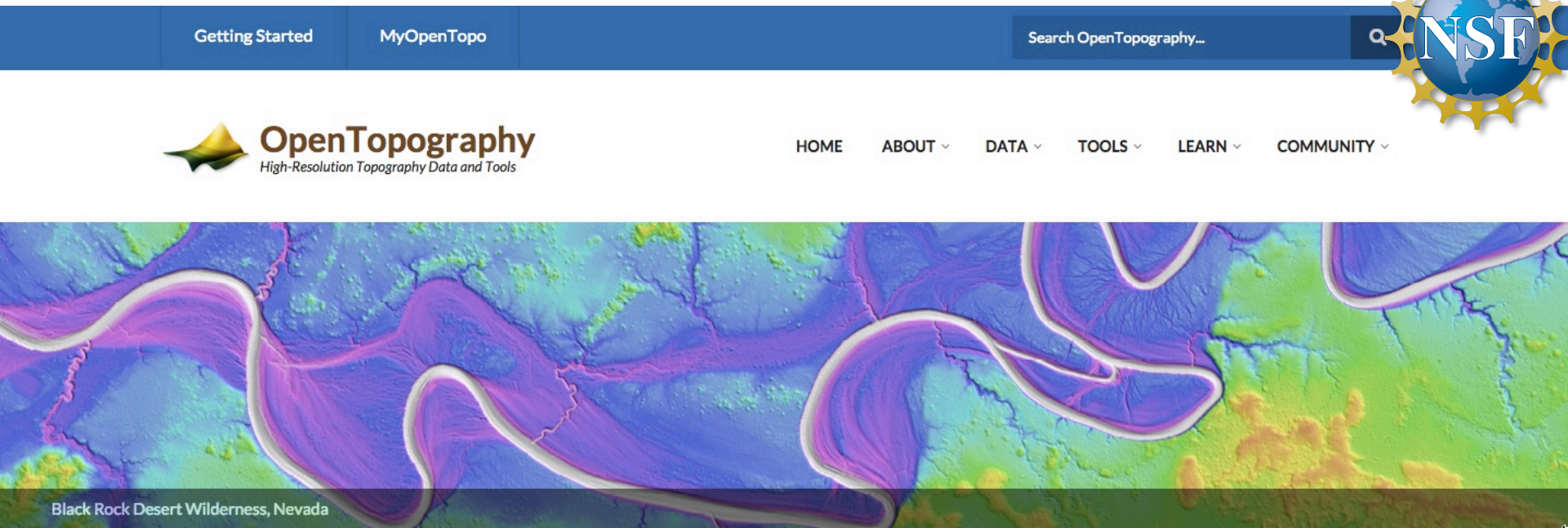
lines show track of scan across ground
circles show actual ground return footprints

Johnson et al., Geosphere, 2014

OpenTopography

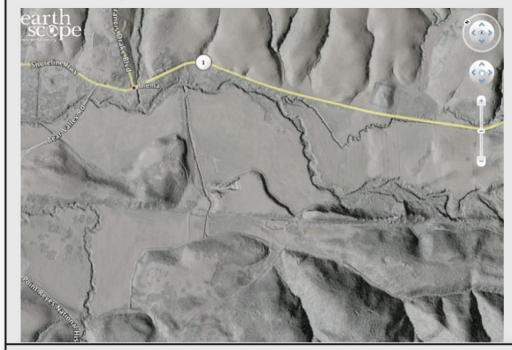
Democratize online access to Earth science-oriented high-resolution topography

- Lidar (ALS & TLS), Structure from Motion photogrammetry, satellite (SRTM, AW3D30)
- Tiered access to data – from raw point cloud to easy to use derived products

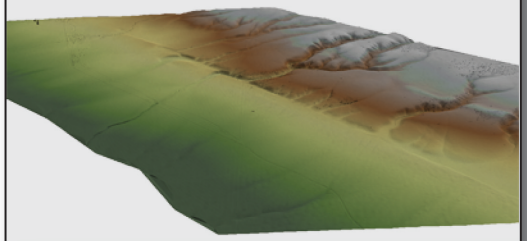


OpenTopography
Multi-Tiered Data Products

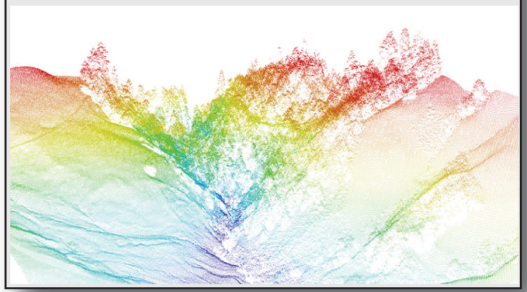
Google Earth (KMZ): *visualization & synoptic data browsing*



DEMs: *qualitative & quantitative analysis, GIS-users, data integration*



Point Cloud & Custom DEMs: *"raw" data access and fully customized data products*



Data Volume, Computational Demands

Accessibility / Ease of Use

Motivations:

EarthScope collected high-resolution topography along active faults in the western United States

- Goal: maximize access to data to achieve greatest scientific impact
- Big data – treat data as an asset that can be used and reused
  - *Co-locate data with processing*

OpenTopography

Supported by the US National Science Foundation
(*EAR/IF No. 1226353 & 1225810*)

Founded 2009. Built on concepts & tech initiated in ~2004

Community focused collaboration between cyberinfrastructure & domain experts

SDSC
SAN DIEGO SUPERCOMPUTER CENTER

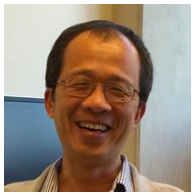
ASU
ARIZONA STATE UNIVERSITY

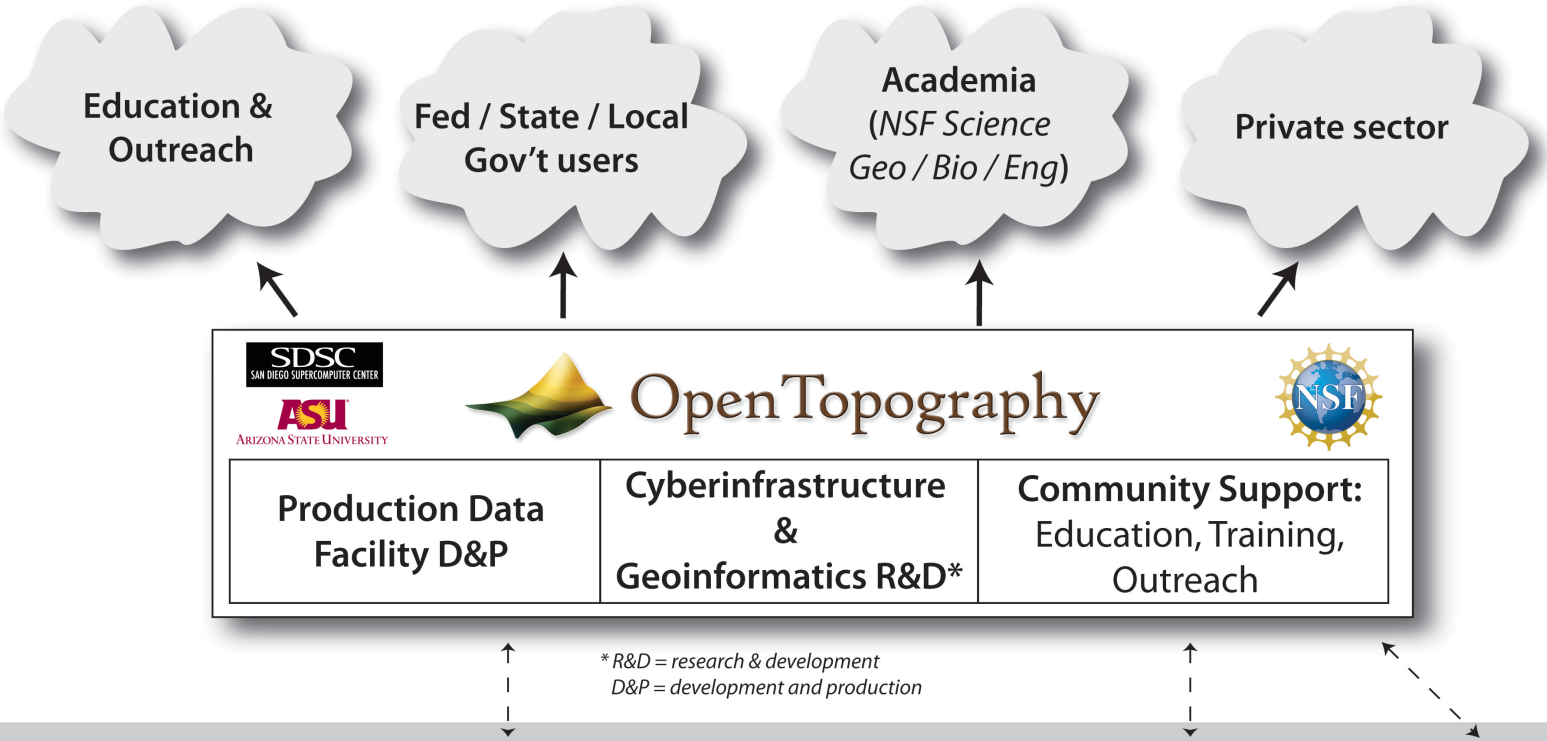
UNAVCO









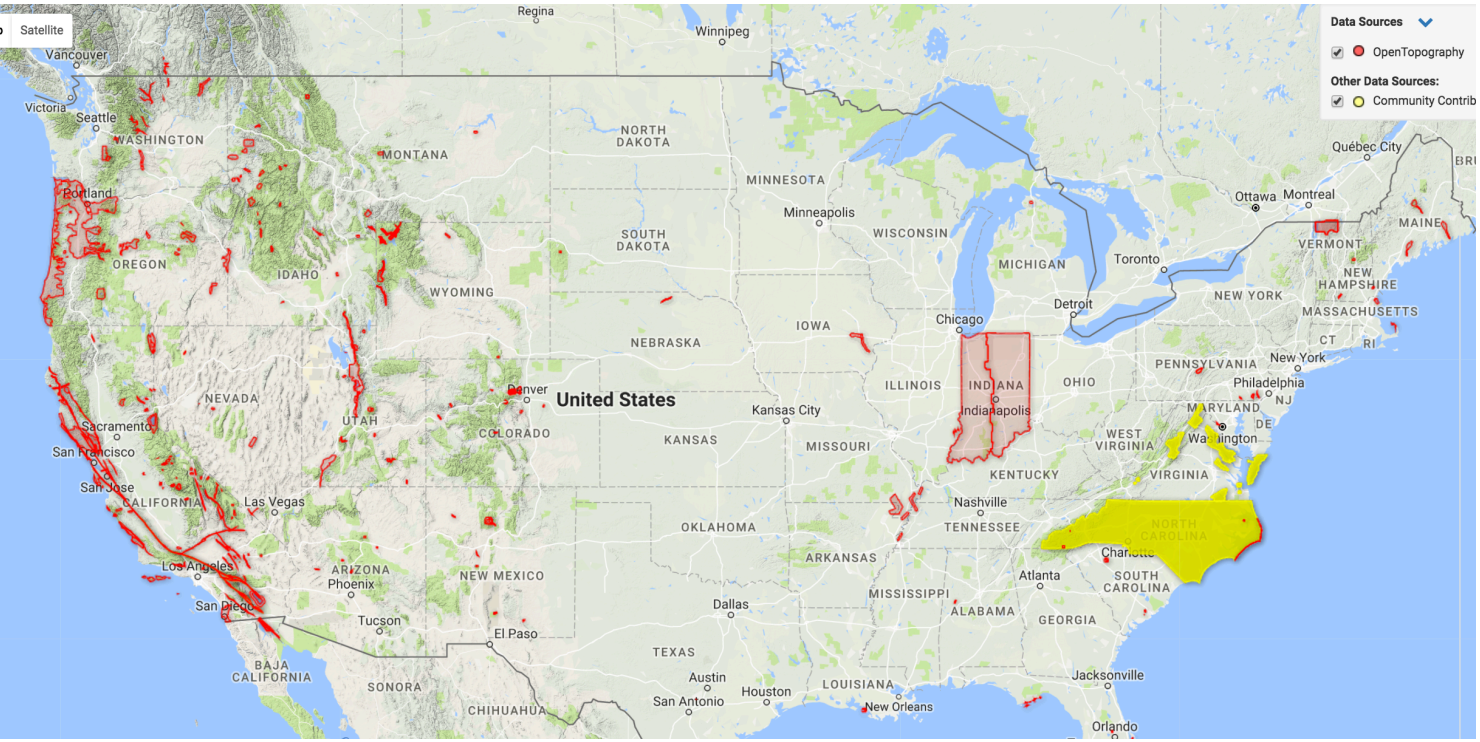
OpenTopography user communities:

Active utilization and strong support of OT from all communites.

Data partners / collaborators:

Data hosting, data archive, federated data access.

Data



- 242datasets

- 211,628 km^2 lidar pt cloud data

- 1 Trillion pts

Data Partnerships:

NSF: NCALM, UNAVCO, CZOs, LTER

Other: USGS, World Bank, Tahoe Regional Planning Authority, Teton Conservation District, Oregon Lidar Consortium, Idaho Lidar Consortium, Sonoma County Veg Map, State of Indiana, PG&E, Land Info New Zealand

Global Topographic Data

Shuttle Radar Topography Mission (SRTM GL1) Global 30m

Overview

The Shuttle Radar Topography Mission (SRTM) obtained elevation data on a near-global scale t
digital topographic database of Earth. SRTM consisted of a specially modified radar system that
during an 11-day mission in February of 2000. SRTM is an international project spearheaded by
(NGA) and the National Aeronautics and Space Administration (NASA).

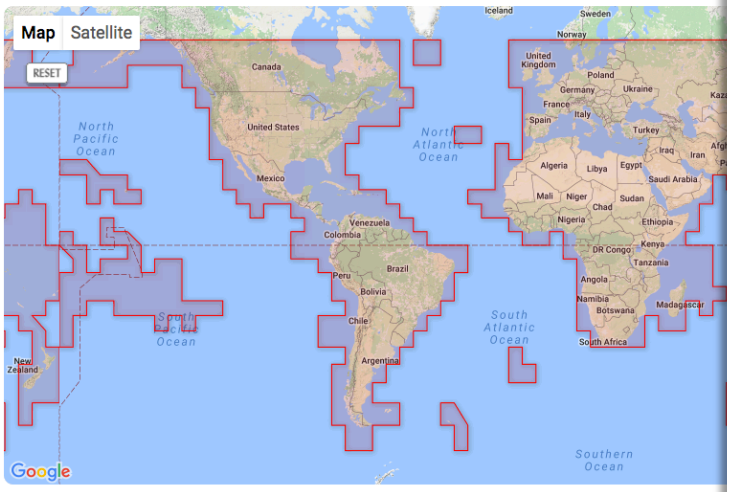
Version 3: Elimination of the voids in the NASA SRTM DEM was the primary goal of a project ur
System Data Records for Use in Research Environments) Program. Ultimately this was achieved
primarily from the ASTER GDEM2 (Global Digital Elevation Model Version 2) and secondarily f
the USGS National Elevation Dataset (NED). NASA SRTM V3.0 three-arc-second data are provi
averaging of the one arc-second samples, and (2) by extracting the middle sample of those same
on this dataset visit the LP DAAC NASA Shuttle Radar Topography Mission Global 1 arc second

Platform: Satellite Data | *Survey Area*: 119,560,000 km^2 | *Raster Resolution*: 30 m

Full Metadata | Dataset Acknowledgement | *Partners*: NASA, NGA

Select Other Available Data Products: Raster: [SRTM GL3] [SRT

1. Select area of data to process:



ALOS World 3D - 30m

Overview

The ALOS Global Digital Surface Model (AW3D30) is a global dataset generated from images collected using the Panchromatic Remote-sensing Instrument for Stereo Mapping (PRISM) aboard the Advanced Land Observing Satellite (ALOS) from 2006 to 2011. As described by the Japan Aerospace Exploration Agency: The Japan Aerospace Exploration Agency (JAXA) releases the global digital surface model (DSM) dataset with a horizontal resolution of approx. 30-meter mesh (1 arcsec) free of charge. The dataset has been compiled with images acquired by the Advanced Land Observing Satellite "DAICHI" (ALOS). The dataset is published based on the DSM dataset (5-meter mesh version) of the "World 3D Topographic Data", which is the most precise global-scale elevation data at this time, and its elevation precision is also at a world-leading level as a 30-meter mesh version. This dataset is expected to be useful for scientific research, education, as well as the private service sector that uses geospatial information.

Version: May 2016: Global terrestrial region (within approx. 82 deg. of N/S latitudes) of Version 1 released (approx. 22,100 tiles)

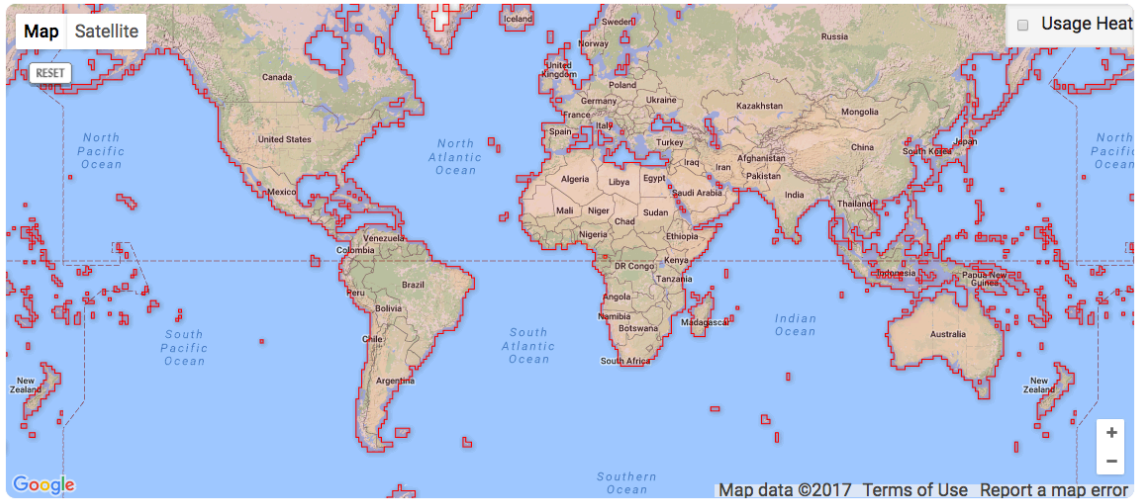
Note: JAXA provides two versions of AW3D30 created from the original 5-meter mesh using different downsampling methods: average (provided here) and median (not available from OpenTopography).

Platform: Satellite Data | *Survey Area*: N/A | *Raster Resolution*: 30 meter | *Survey Date*: 01/01/2006 - 01/01/2011

Full Metadata | Dataset Acknowledgement | *Collector*: JAXA

Select Other Available Data Products: Raster Bulk Download

1. Select area of data to process:



QuickTime Player File Edit View Window Help 16 100% Wed Mar 8 8:46 PM Christopher Crosby

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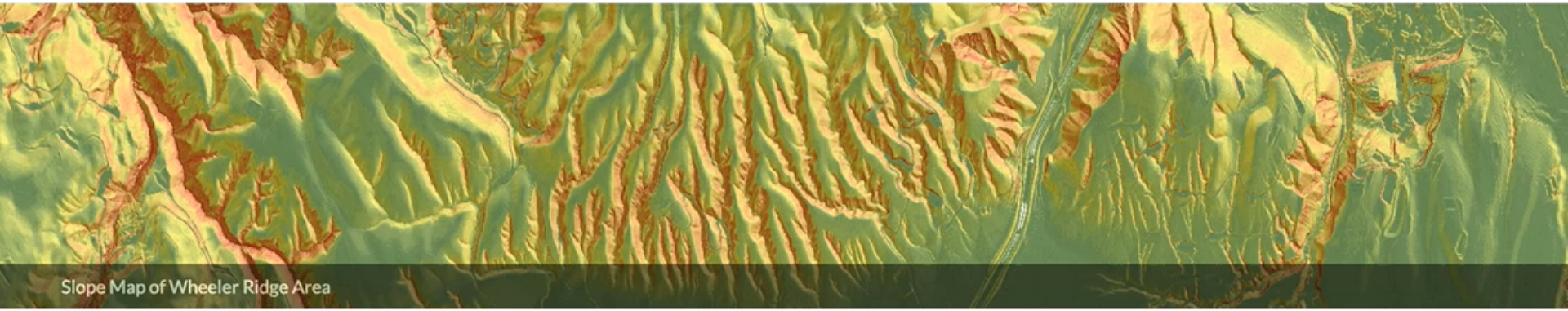


Slope Map of Wheeler Ridge Area

Latest News

OpenTopography Team to Develop Cyberinfrastructure for NASA's ICESat-2 Data

Mar 7, 2017

The San Diego Supercomputer Center (SDSC) and Scripps Institution of Oceanography at the University of California San Diego, in collaboration...

Three new global topographic datasets available (SRTM Ellipsoidal, ALOS World 3D, GMRT)

Feb 1, 2017

Data Summary

Point Cloud datasets: 232

Point Cloud area: 195,273 km²

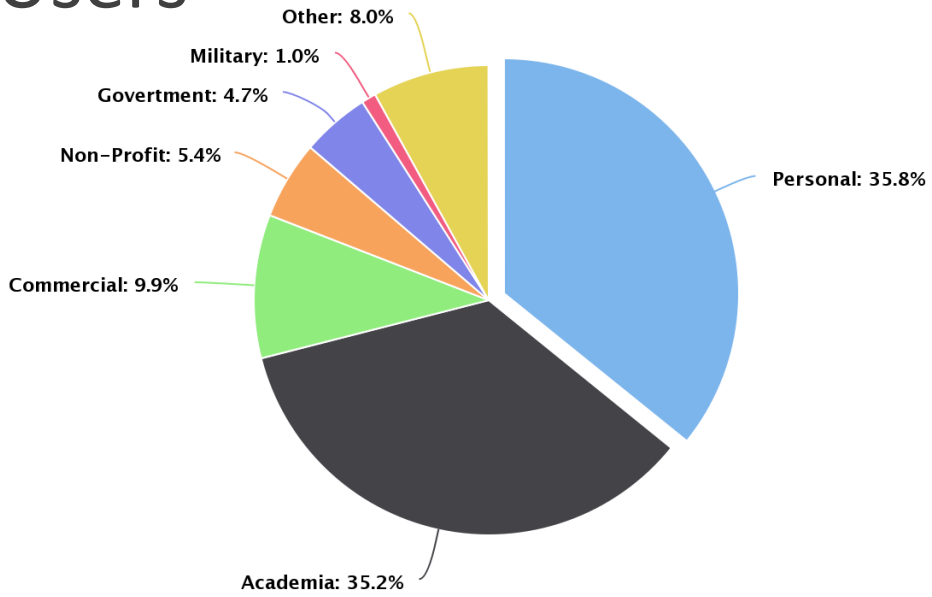
Number of lidar returns: 923,353,723,459

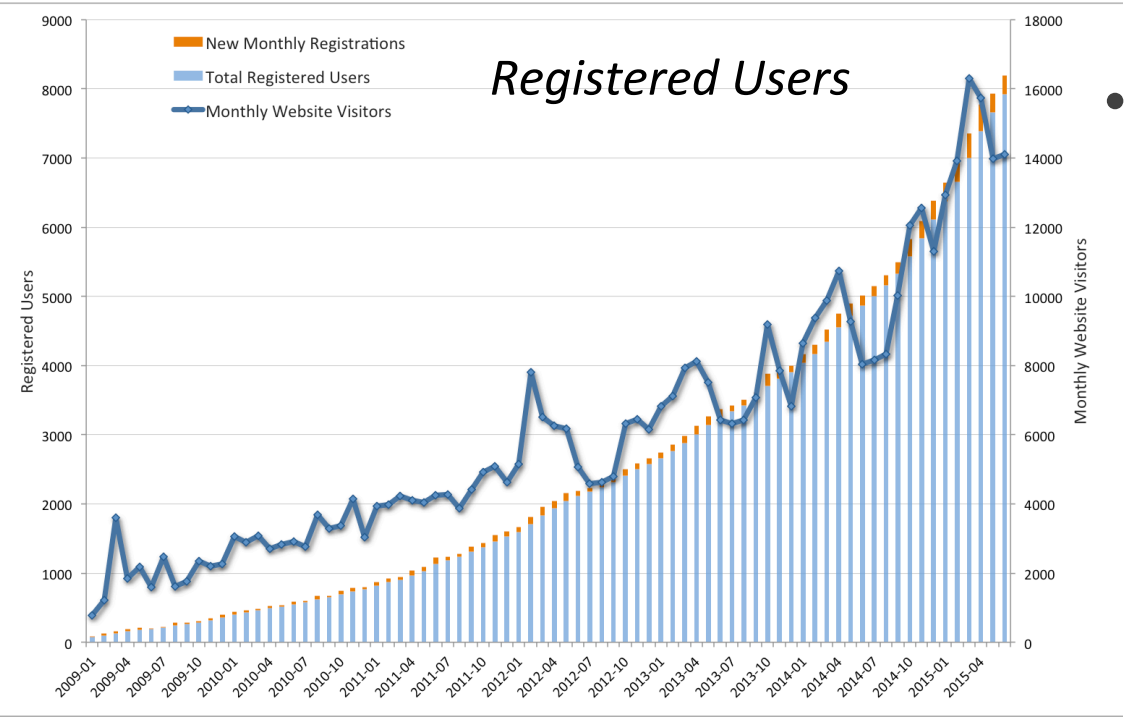
Raster datasets: 116

Global DEM area: 239,120,000 km²

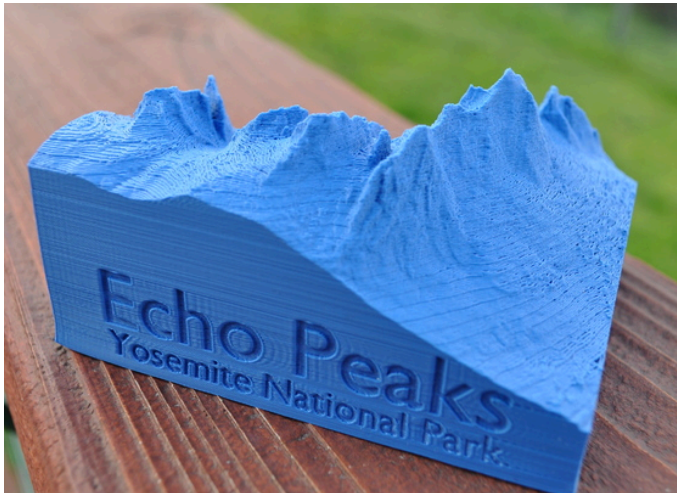
High resolution DEM area: 135,916 km²

Users



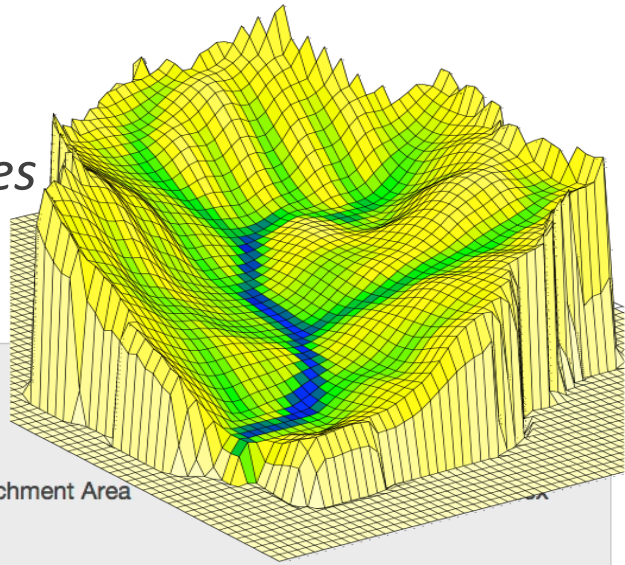


- 16,548 registered users
- Diverse (& international) user base across academia, industry, government
- 183,000 jobs, 3.4 trillion points processed
- 86,000 SRTM & AW3D30 jobs



High Performance Computing

More data & users, complex analysis = increased compute challenges



TauDEM – Hydrologic analysis of terrain data:

4. Hydrologic Terrain Analysis Products (TauDEM):

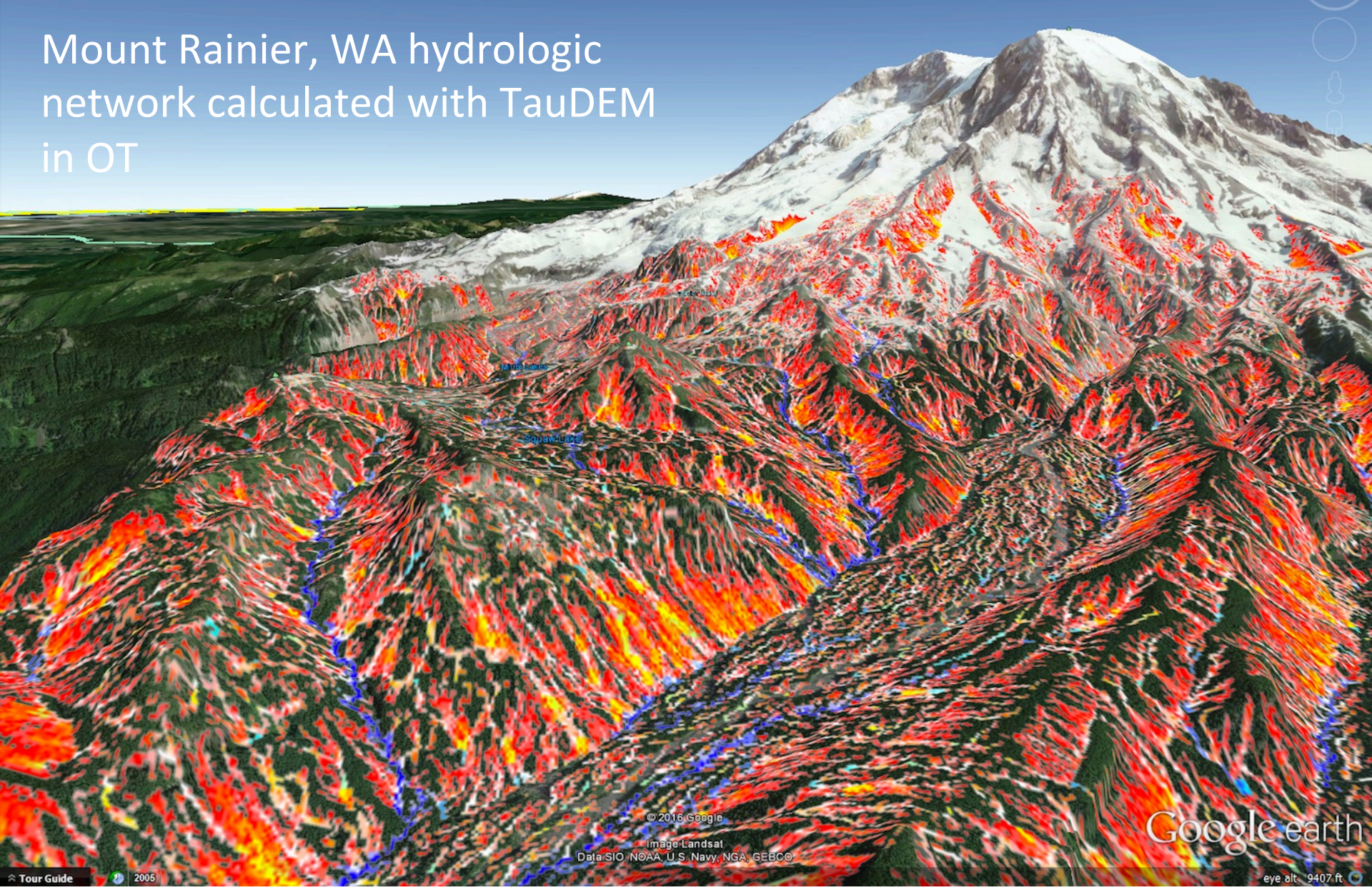
- Hydrologically correct DEM with pits filled
- D-Infinity Flow Direction
- D8 Flow Direction:
- D-Infinity Specific Catchment Area
- D8 Contributing Area

Dedicated Gordon supercomputer node:

I/O Node 48 GB Memory/4.8TB Flash memory + 16 Compute nodes, 64GB memory + InfiniBand

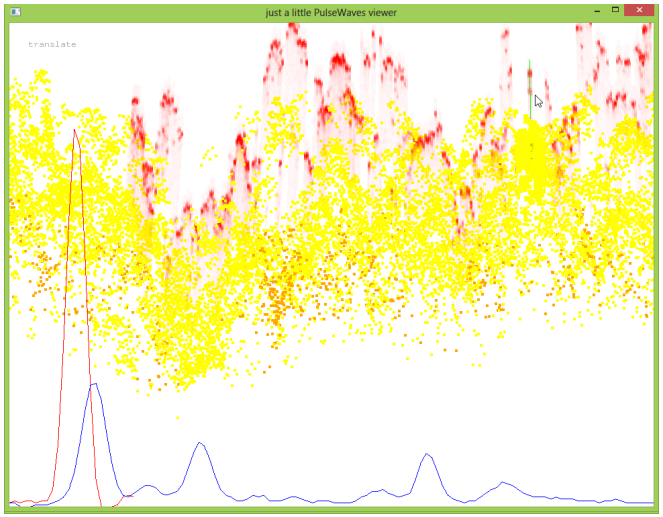
***Democratization* of supercomputing resources**

Mount Rainier, WA hydrologic network calculated with TauDEM in OT



Red = catchment area of 100 m^2. Blue = catchment area > 610,000 m^2.
Kautz Creek flows through the large valley near the center of the image.

CHALLENGES & OPPORTUNITIES



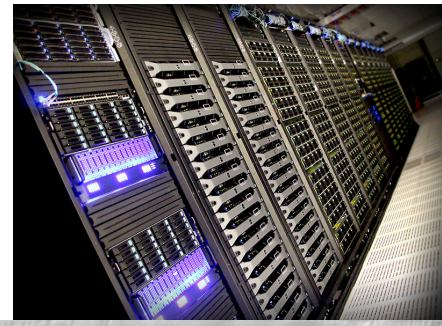
- Bigger, faster, more complex
- More data, more users

- Data collection technology eclipses algorithms and software – 33 khz (*2003*) vs 900 khz (*today*)
- Full waveform lidar & integration w/ hyperspectral

- Integration of community developed processing into architecture (*pluggable services*)

Open Science Grid

COMET



Thanks!

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I ♥ LIDAR

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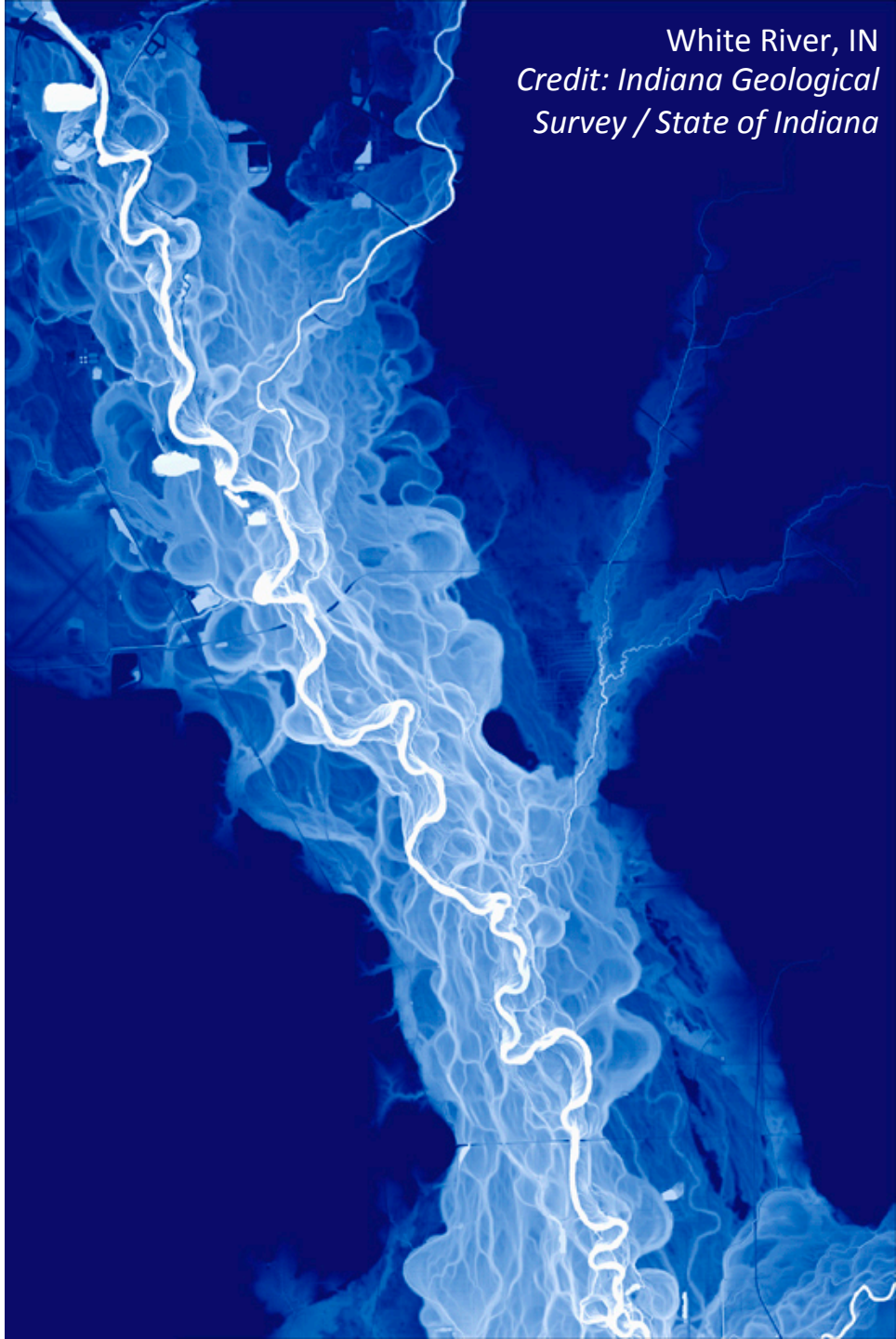

White River, IN
Credit: Indiana Geological Survey / State of Indiana