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

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Multi-Temporal, High-Resolution Topography

D Space-based radar & photogrammetry

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

B Terrestrial LiDAR
- lines show track of scan across ground
- circles show actual ground return footprints

C Structure from Motion
- motion of camera provides depth information
- scene structure refers to both camera positions and orientations and the topography
- features matched in multiple photographs

Johnson et al., Geosphere, 2014
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
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

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

Community focused collaboration between cyberinfrastructure & domain experts
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

- 242 datasets
- 211,628 km² lidar pt cloud data
- 1 Trillion pts
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 by using a high-resolution digital topographic database of Earth. SRTM consisted of a specially modified radar system that was flown during an 11-day mission in February of 2000. SRTM is an international project spearheaded by NASA and the National Geospatial-Intelligence Agency (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 under the NASA System Data Records for Use in Research Environments (SDR/RE) Program. Ultimately, this was achieved primarily from the ASTER GDEM2 (Global Digital Elevation Model Version 2) and secondarily from the USGS National Elevation Dataset (NED). NASA SRTM V3.0 three-arc-second data are produced from (1) averaging of the one-arc-second samples, and (2) by extracting the middle sample of those same data. On this website visit the LP DAAC NASA Shuttle Radar Topography Mission Global 1 arc second.

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 (JAXA), 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 Q
Collecter: JAXA

Select Other Available Data Products: Raster Bulk Download

1. Select area of data to process:
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: 239,126,000 km²
High resolution DEM area: 135,916 km²
• 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 m². Blue = catchment area > 610,000 m². 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*)
Thanks!

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