UNAVCO TLS Support Resources:

- What support does UNAVCO provide?
- How do I request support?
- Priorities and scheduling?
- Cost?
- Other resources to be aware of
- Online data access?
- Future trends & technology
Support Resources

- Instrumentation (6 scanners)
- Field engineering
- Data processing
- Training
- Data archiving & dissemination

Community Building

- Workshops
- Inter-Agency collaborations & partnerships

Education and Outreach

- Training courses
- Field camps (~90 students in 2013)
UNAVCO TLS Instrument Pool

- TLS instrument pool = 6 scanners
  - 3x Riegl VZ400
  - 1x Riegl VZ1000 (full waveform) **NEW!**
  - 1x Riegl Z620
  - 1x Leica C10

- Campaign and RTK GPS, tripods, various power supply options

- Instrument validation range

- License server w/ access to RiScan Pro, Cyclone, Polyworks, ArcGIS, Quick Terrain Modeler, MatLab, etc

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Scanners funded by the National Science Foundation

<table>
<thead>
<tr>
<th></th>
<th>Riegl VZ-1000</th>
<th>Riegl VZ-400</th>
<th>Riegl Z620</th>
<th>Leica C10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Laser Wavelength</td>
<td>1550 nm (near IR)</td>
<td>1550 nm (near IR)</td>
<td>1550 nm (near IR)</td>
<td>532 nm (green)</td>
</tr>
<tr>
<td>Effective Range (max)</td>
<td>1400 m</td>
<td>500 m</td>
<td>2000 m</td>
<td>150 m</td>
</tr>
<tr>
<td>High-speed meas. rate</td>
<td>122,000 points/sec</td>
<td>125,000 points/sec</td>
<td>11,000 points/sec</td>
<td>50,000 points/sec</td>
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<tr>
<td>Precision</td>
<td>5 mm</td>
<td>5 mm</td>
<td>10 mm</td>
<td>4 mm</td>
</tr>
<tr>
<td>Accuracy</td>
<td>8 mm</td>
<td>5 mm</td>
<td>10 mm</td>
<td>6 mm</td>
</tr>
<tr>
<td>Field of View</td>
<td>100° x 360°</td>
<td>100° x 360°</td>
<td>80° x 360°</td>
<td>270° x 360°</td>
</tr>
<tr>
<td>Dimensions</td>
<td>308mm x 180mm</td>
<td>308mm x 180mm</td>
<td>463mm x 210mm</td>
<td>238mm x 395mm</td>
</tr>
<tr>
<td>Weight</td>
<td>9.8kg</td>
<td>9.8kg</td>
<td>16kg</td>
<td>13 kg</td>
</tr>
</tbody>
</table>
Education and Community Engagement:

• Short courses and workshops
  - Partners wanted

• Growing online knowledgebase of TLS tutorials, documentation, best practices.

• Incorporation of TLS into teaching – K-12, undergraduate
  - Geology field camps have momentum
UNAVCO TLS Support Costs:
• For NSF-supported projects, PI pays field engineer travel and equipment shipping.
• For non-NSF supported work, full cost recovery required.

Project Prioritization:
• UNAVCO sponsors = NSF- EAR and NSF-OPP = highest priority.
• NSF-other and non-NSF = projects supported as resources allow.
  ➢ Schedule flexibility helps
All support requests must be formally logged through UNAVCO support request system.


UNAVCO staff will follow up to coordinate specifics.

*Get in touch at proposal development stage* – UNAVCO can provide a budget, letters of support, planning advice
NSF EAR IF investment in lidar data and instrumentation

Cooperative facilities supporting NSF earth science

OpenTopography
- Lidar data discovery & hosting
- Data processing & derived products
- Online data archive & preservation
- Cyberinfrastructure R&D
- Education & Outreach

MOU:
- NCALM data distribution & online archive

Community Support:
- workshops & courses
- Event response (e.g., EMC EQ)

MOU:
- TLS data distribution
- Shared staff (Crosby)
- CI R&D (e.g. NASA ROSES)
- EarthCube

- TLS instrument pool
- TLS data collection
- PI Interaction
- Geodetic imaging tech. R&D
- Data archive
- Education & Outreach

NCALM
- Airborne lidar collection
- PI Interaction
- Funding (grad. seed grants)
- Geosensing tech. R&D
- Education & Outreach

UNAVCO
- TLS instrument pool
- TLS data collection
- PI Interaction
- Geodetic imaging tech. R&D
- Data archive
- Education & Outreach
Online Resources

- UNAVCO (http://www.unavco.org/tls)
- OpenTopography (http://www.opentopography.org)
- NCALM (http://www.ncalm.org)
- University of Texas - Dallas http://www.utdallas.edu/research/interface/Resources.html

- Manufacturers, e.g.,
  - Riegl (http://www.riegl.com)
  - Optech (http://www.optech.ca)
  - Leica (http://hds.leica-geosystems.com)
Organization & archive of TLS project data

- Raw scan data
- Point clouds
- Raw & processed GPS
- Metadata & site photos.
- Derived products.

Alpha version online:

http://tls.unavco.org
TLS Archive Features:

- GPS: RINEX creation, submission to OPUS for position processing, generation of control point lists for georeferencing in RiScan or Cyclone.

- Laptop-based version for use by field engineers (tested summer 2012) to document metadata and manage data during field projects. Content synced with archive server upon return to Boulder.

- On-the-fly:
  - Format conversion (LAS, ASCII)
  - Data thinning and AOI subsetting
  - Simple gridding, visualization, export to Google Earth.
Spotlight

NSF Renews Funding for OpenTopography

We are happy to announce that the National Science Foundation (NSF) has renewed funding for OpenTopography. The three-year renewal under the National Science Foundation's Geoinformatics and Earth Sciences: Instrumentation and Facilities (EAR-IF) program follows an initial three-year award from EAR-IF and the Office of Cyberinfrastructure, announced in late 2009.

Latest News

OpenTopography at 2013 European Geosciences Union Meeting

Posted: April 07, 2013
OpenTopography will be at the 2013 European Geosciences Union (EGU) Meeting this week in Vienna, Austria and presenting a talk... [more]

10 New Point Cloud Datasets from Brazil, Alaska, California, Montana, North Carolina & Oregon

Connect with OpenTopography

9 days ago: 10 new #lidar datasets posted - data in AK, CA, MT, NC, OR, PA & Brazil, our 1st dataset from the S. Hemisphere: opentopography.org/index.php/news...

Data Summary

- Total Coverage: 93,147 km²
- Total Number of Lidar Returns: 533,927,158,741

Latest Lidar Datasets:
- Flathead Lake Biological Station, MT (September 2005)
- Mojave Desert, CA: Evolution of the Hector Mine Earthquake Surface Rupture
- North Sister, OR: Collier Cone Lava Flow
- Coastal Dune Fields of Garopaba and Vila Nova, Santa Catarina State, Brazil
• Large user community with variable needs and levels of sophistication.

• Goal: maximize access to data to achieve greatest scientific impact.

• Big data – treat data as an asset that can be used and reused
Download KMZ file: viz.tin.hs.kmz
View with Google Earth browser plug-in

Download KMZ file: viz.tin.crhs.kmz
View with Google Earth browser plug-in
Data Status

- ~710 billion LIDAR returns
- 177 datasets
- 170,476 km²

MOUs & Partnerships

**NSF:** NCALM, UNAVCO, CZOs, LTER

**Other:** World Bank, Tahoe Regional Planning Authority, Teton Conservation District, Oregon Lidar Consortium, Idaho Lidar Consortium, ...

**Service Agreements:** State of Indiana Watershed Sciences Inc (for PG&E)

Diverse user base for these data, 3470 registered users, 21,000+ jobs, >30 billion pts/month downloaded.
• Access to TLS instruments and data acquisition no longer “roadblocks” to NSF investigators. These are now “speed bumps”.
  • More instruments are available and are easier to use.
  • Workflows optimized for Earth science applications.
  • New instruments still desired for special capabilities (i.e. water penetration, full waveform, very long range, etc.) and to ensure meeting demand.

• TLS data handling, processing and analysis are the new roadblocks. We are working to turn them into speed bumps now too.
  • Need for post processing workflows and best practices.
  • Need for data (and metadata) formats and standards.
  • Need for data analysis training.
Future Trends

• Faster & longer data collection
• Full waveform
• More streamlined workflows
• Better & more powerful analysis software
• Error analysis
• Continuous scanning deployments
• Mobile laser scanning (e.g., Blidar)
• Integration with other datasets (ALS, GPR, terrestrial radar/INSAR, etc.)
**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.

**Structure from Motion**

- **Motion of camera**: provides depth information.
- **Sequence of photographs**: scene structure refers to both camera positions and orientations and the topography.
- **Features matched in multiple photographs**.

**Terrestrial LiDAR**

- **Lines**: show track of scan across ground.
- **Circles**: show actual ground return footprints.
Structure from Motion: another way to gather high resolution topographic data

Nissen, et al. in prep.
Structure from Motion: another way to gather high resolution topographic data

Fig. 1. Camera locations and image overlap.

Nissen, et al. in prep.

5 cm/pixel orthophoto

5 cm/pixel DEM

1 m/pixel B4 DEM