

## UNAVCO TLS Support Resources:

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

## Support Resources

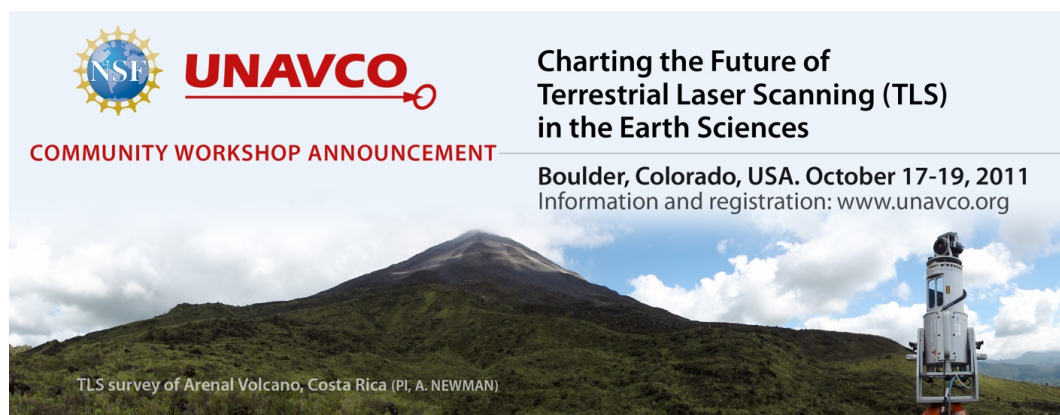
- Instrumentation
- Field engineering
- Data processing
- Training
- Data archiving & dissemination

## Community Building

- Workshops
- Inter-Agency collaborations & partnerships

## Education and Outreach

- Training courses
- Field courses



## Scanners funded by the National Science Foundation



Riegl VZ-2000



Riegl VZ-1000



Riegl VZ-400



Riegl Z620



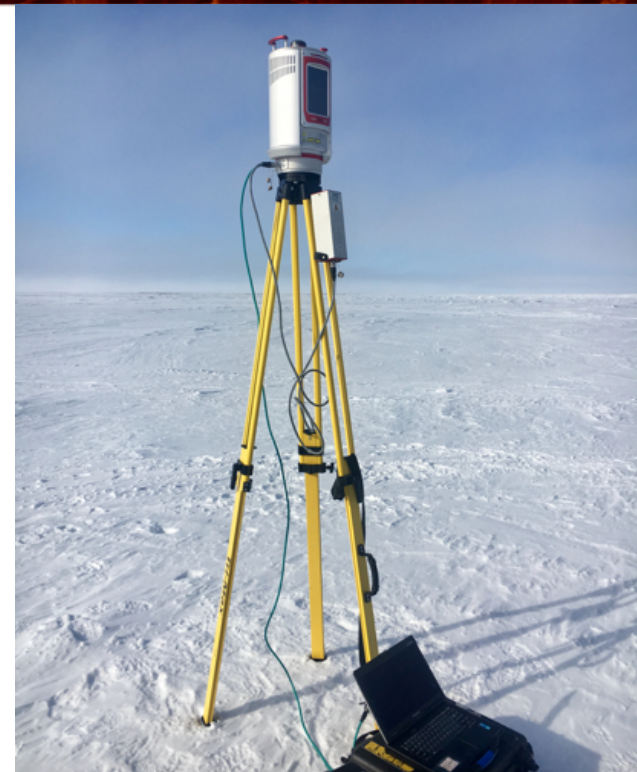
Leica C10

<b>Laser wavelength</b>	Near infrared				532 nm (green)
<b>Effective range</b>	2050 m	1400 m	500 m	2000 m	150 m
<b>High-speed meas. rate</b>	396,000 pts/sec	122,000 pts/sec	125000 pts/sec	11,000 pts/sec	50,000 pts//sec
<b>Precision</b>	5 mm	5 mm	5 mm	10 mm	4 mm
<b>Accuracy</b>	8 mm	8 mm	5 mm	10 mm	6 mm
<b>Field of view</b>	100°x 360°	100°x 360°	100°x 360°	80°x 360°	270°x 360°
<b>Dimensions</b>	308 mm x 196 mm	308 mm x 180 mm	308 mm x 180 mm	463 mm x 210 mm	238 mm x 395 mm
<b>Weight</b>	9.9 kg	9.8 kg	9.8 kg	16 kg	13 kg



Newest instrument: Riegl VZ-6000 long range scanner for PLR PI project. Chris Polashenski, Dartmouth: *Snow, Wind, and Time: Understanding Snow Redistribution and Its Effects on Sea Ice Mass Balance*

~6km range, NIR class 3B laser. Eye safety considerations make this a limited use instrument.





### 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.



HOME | ABOUT | CONTACT | HELP

SEARCH

Community Projects Instrumentation Data Software Science Education



UNAVCO, A NON-PROFIT UNIVERSITY-GOVERNED CONSORTIUM, FACILITATES GEOSCIENCE RESEARCH AND EDUCATION USING GEODESY.



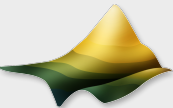
<http://achaia.unavco.org/public/newproject/supportform.aspx>

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's investment in high resolution topography



	<ul style="list-style-type: none"> <li>• Terrestrial laser scanning (TLS) instrumentation and expertise</li> <li>• PI &amp; graduate student support</li> <li>• Data archiving</li> <li>• Education and training</li> </ul>
 <p>THE NATIONAL CENTER FOR AIRBORNE LASER MAPPING</p>	<ul style="list-style-type: none"> <li>• Airborne lidar data collection</li> <li>• PI &amp; graduate student support</li> <li>• Graduate student seed grants (funding)</li> <li>• Education</li> </ul>
 <p>OpenTopography</p>	<ul style="list-style-type: none"> <li>• Online data discovery and access</li> <li>• Custom data products and processing</li> <li>• Cyberinfrastructure R&amp;D</li> <li>• Education and training</li> </ul>



- Based at University of Houston & University of CA, Berkeley
- Funded by NSF EAR-IF program. Initiated in 2003, funded through 2018.
- Cessna 337 Skymaster:
  - Titan three wavelength (532, 1064, and 1550 nm), 300 kHz (per wavelength) lidar
  - AQUARIUS Green bathymetric/topographic lidar
- Collect data for NSF-funded researchers. Cost integrated into proposal budgets.



Research-oriented data

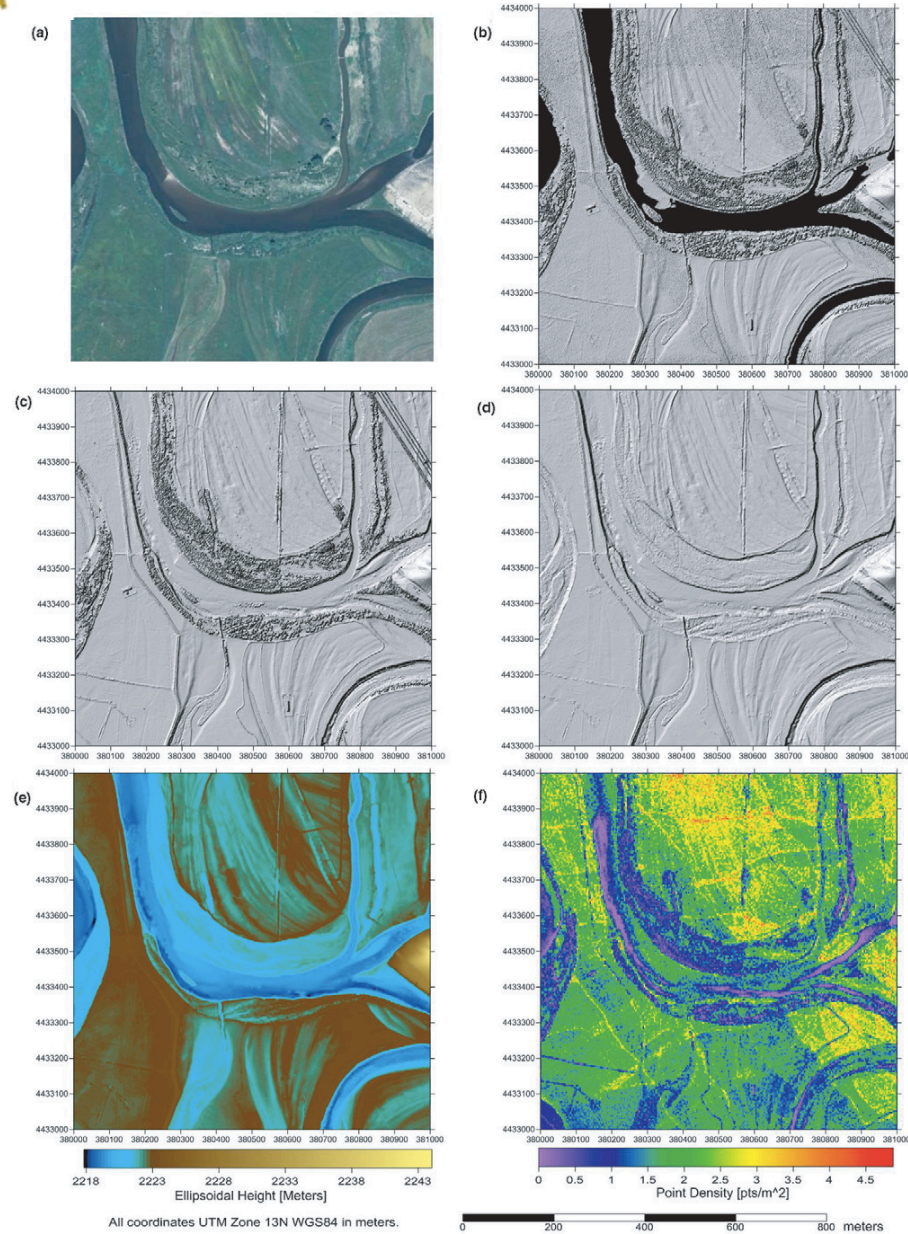
Typically 8+ pts/m<sup>2</sup>, 0.5 - 1 meter resolution DEMs.

Data openly available after 2 yrs via OpenTopography.

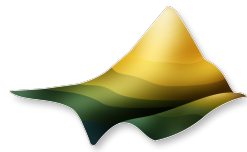
152 datasets collected through 2015

Numerous publications and educational impacts from these data

**Seed grant** program provides 40km<sup>2</sup> of data for graduate students through annual proposal process.







# OpenTopography

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

- Lidar (ALS & TLS), Structure from Motion, satellite (e.g., SRTM)

Getting Started

MyOpenTopo

Search OpenTopography...



**OpenTopography**

High-Resolution Topography Data and Tools

HOME

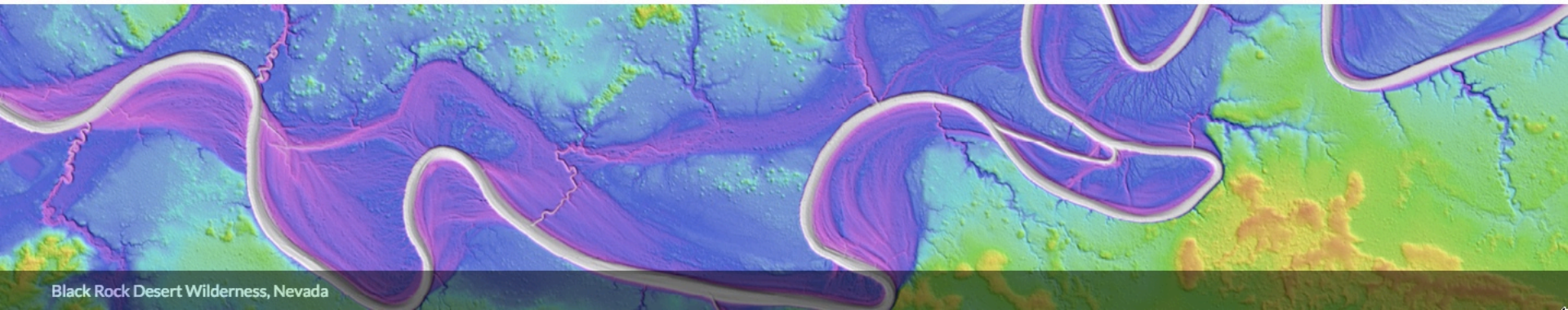
ABOUT ▾

DATA ▾

TOOLS ▾

LEARN ▾

COMMUNITY ▾



Black Rock Desert Wilderness, Nevada

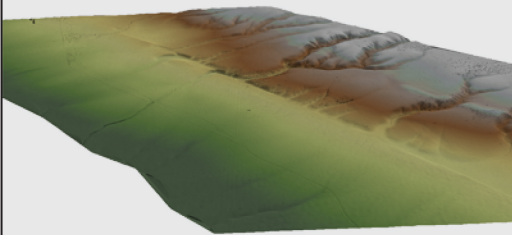


OpenTopography  
Multi-Tiered Data Products

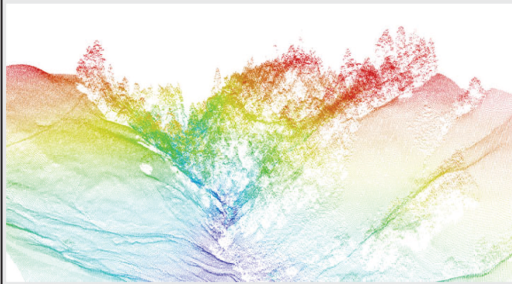
Google Earth (KMZ): *visualization & synoptic data browsing*



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



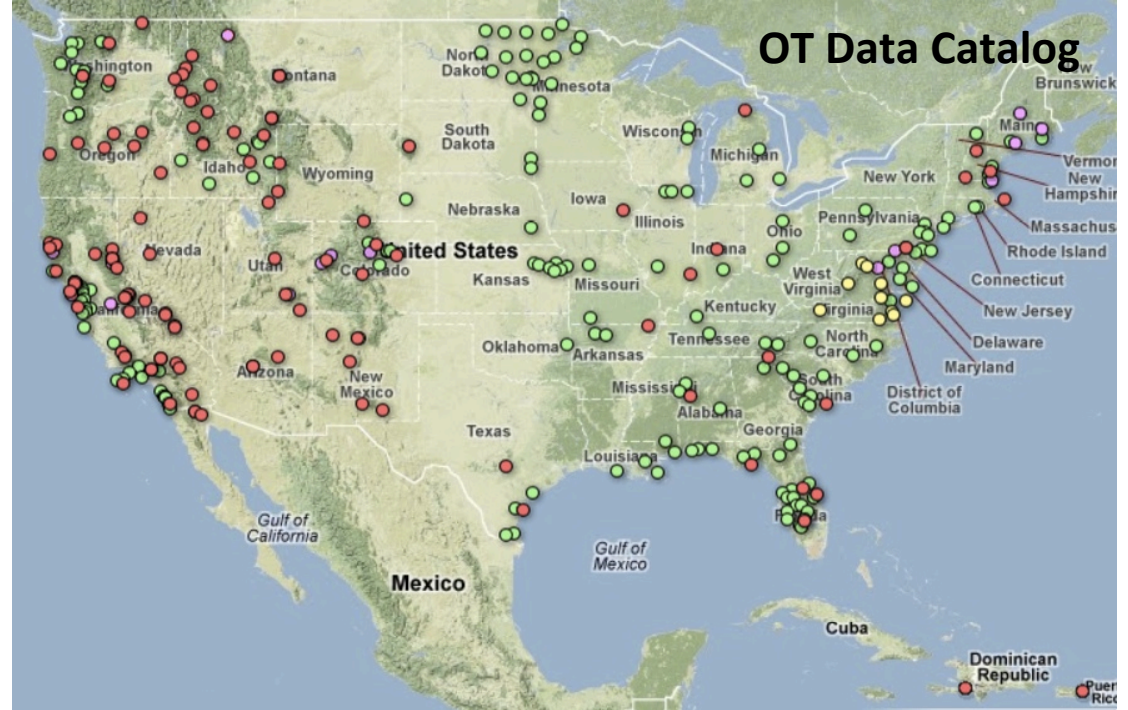
Point Cloud & Custom DEMs: *"raw" data access and fully customized data products*



Data Volume, Computational Demands



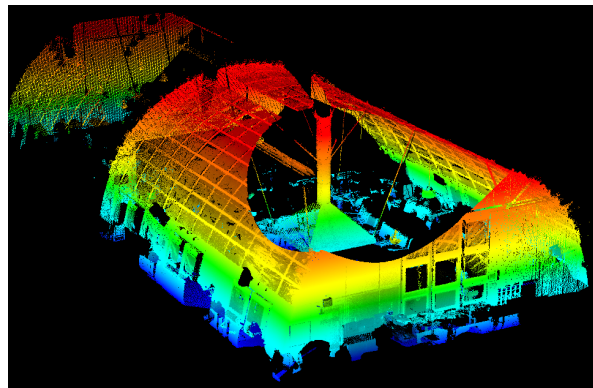
Accessibility / Ease of Use



- 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

## Two dozen field education projects since '09

- Indiana University (8x)
- University of Michigan (7x),
- University of Houston (3x)
- UC Santa Cruz, Cal Poly Pomona, U. Saint Thomas, Stanford, NM State University, Montana State University, Rocky Mountain College







## GETSI Geodesy Tools for Societal Issues

Search the Site  Download

GETSI's Earth-focused Modules for Undergraduate Classroom and Field Courses

[Learn More](#)

### Analyzing High Resolution Topography with TLS and SfM

100 200 300 400

Advanced

1-3 Weeks

5 Units

[Bruce Douglas \(Indiana University-Bloomington\)](#)[Kate Shervais \(UNAVCO\)](#)[Chris Crosby \(UNAVCO\)](#)

With contributions from J. Ramon Arrowsmith, Marin Clark,  
Nathan Niemi, David Phillips, Nicholas Pinter  
Editor: [Beth Pratt-Sitaula \(UNAVCO\)](#)

#### Summary

**Part of GETSI Field Collection:** Geodetic imaging technologies have emerged as critical tools for a range of earth science research applications from hazard assessment to change detection to stratigraphic sequence analysis. In this module students learn to conduct terrestrial laser scanner (TLS) and/or Structure from Motion (SfM) surveys to address real field research questions of importance to society. Both geodetic methods generate high resolution topographic data and have widespread research applications in geodesy, geomorphology, structural geology, and more. The module can be implemented in four- to five-day field course or as several weeks of a semester course. [Prepared data sets](#) are available for courses unable to collect data directly. Instructors can [request support](#) for some types of technical assistance from UNAVCO, which runs NSF's Geodetic Facility.

[https://serc.carleton.edu/dev/getsi/teaching\\_materials/high-rez-topo/index.html](https://serc.carleton.edu/dev/getsi/teaching_materials/high-rez-topo/index.html)





- Faster & longer data collection
- Full waveform
- More streamlined workflows
- Better & more powerful analysis software
- Error analysis
- Continuous scanning deployments
- Mobile/kinnematic laser scanning
- 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

laser pulse

shadow zone

laser pulse

### Structure from Motion

motion of camera provides depth information

sequence of photographs

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

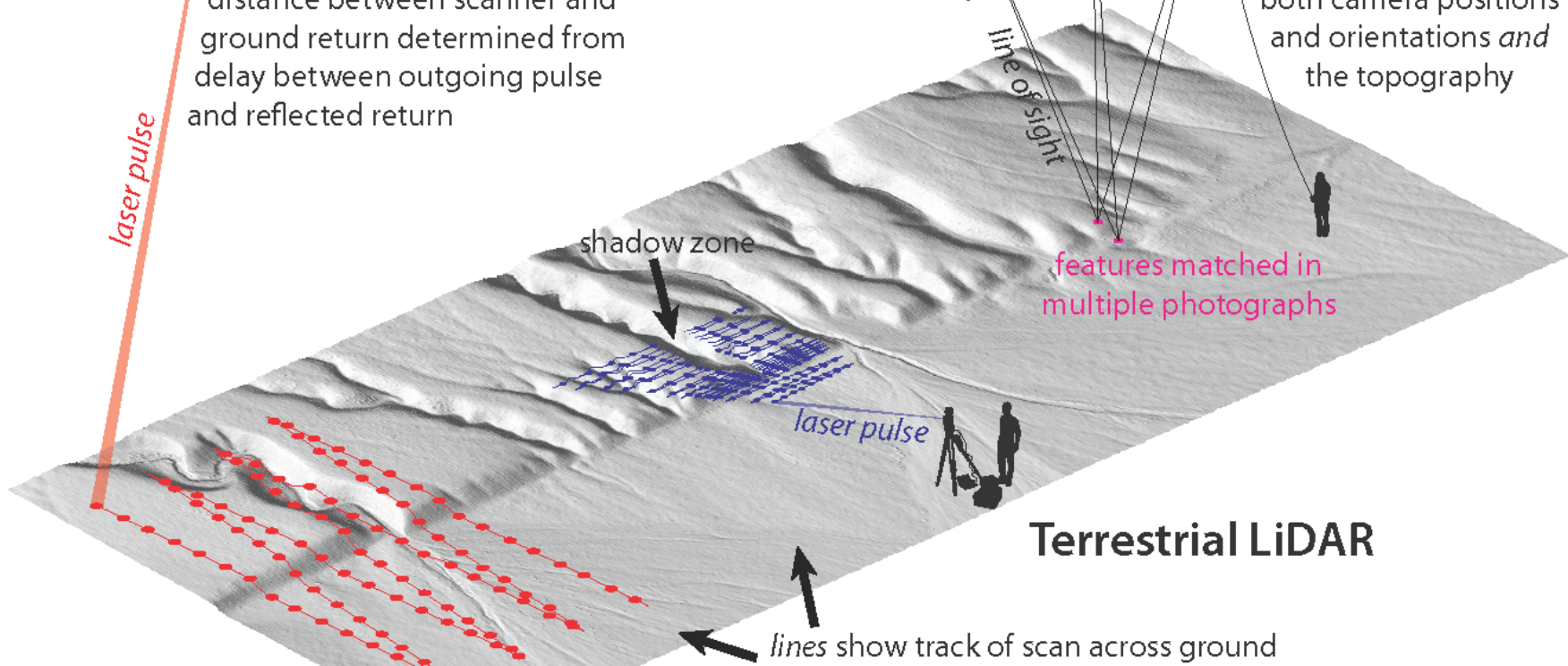
features matched in multiple photographs

line of sight



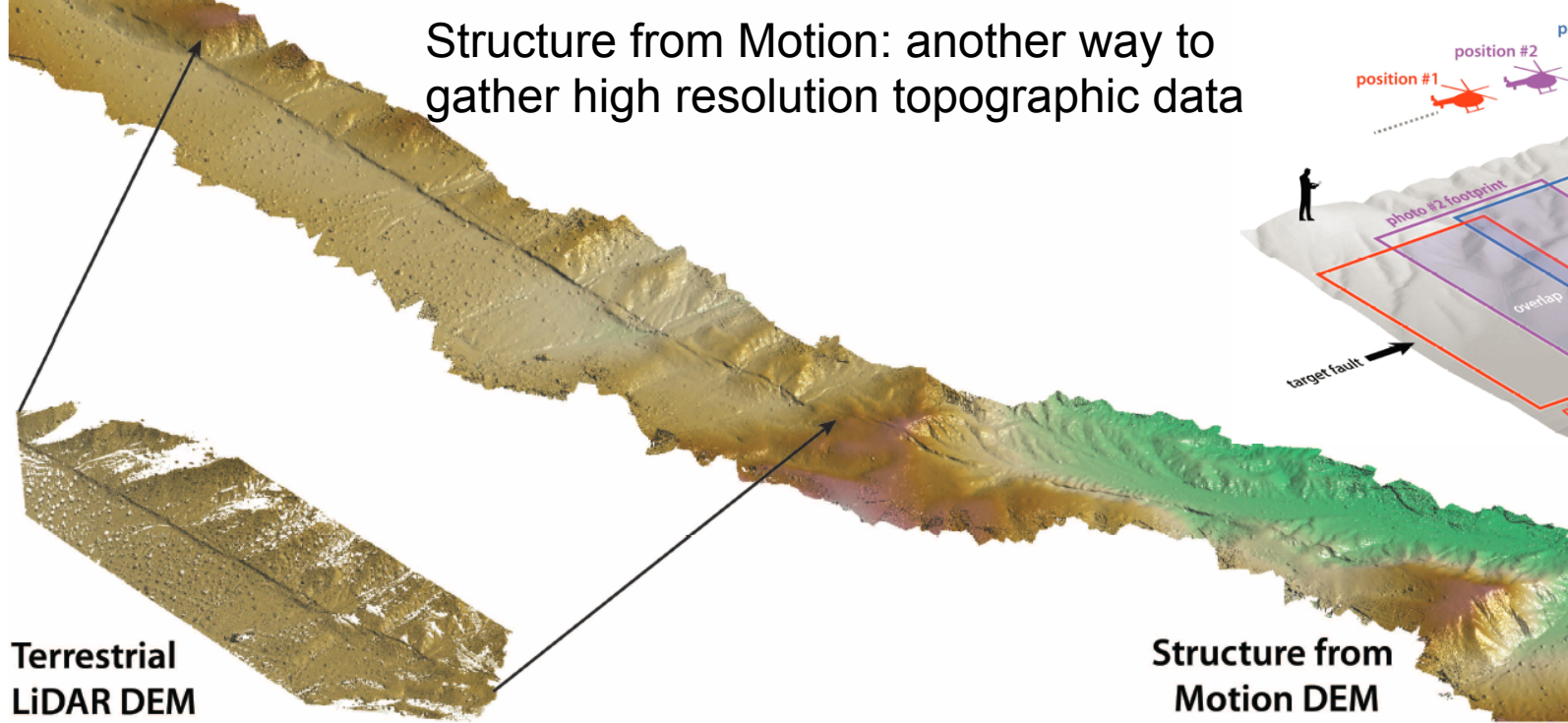
### Terrestrial LiDAR

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



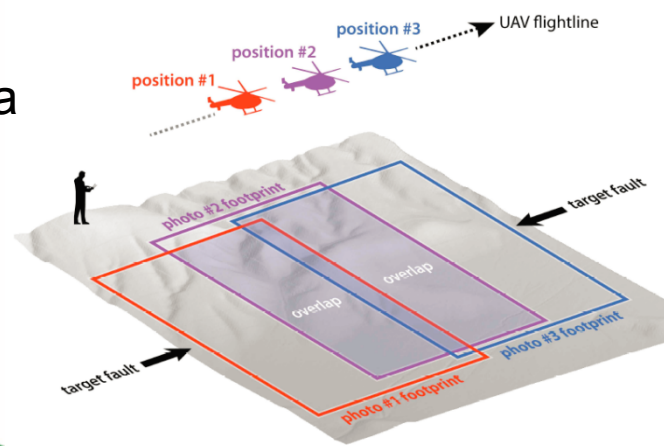


# Structure from Motion: another way to gather high resolution topographic data

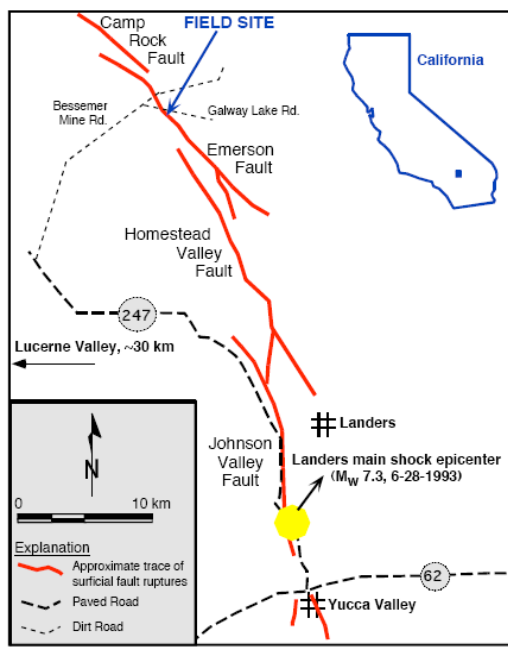


Terrestrial LiDAR DEM

Structure from Motion DEM



Nissen, et al. in prep.



6-30-1992: U S Geological Survey



# STRUCTURE FROM MOTION: PHOTOGRAMMETRIC HIGH RESOLUTION TOPOGRAPHIC DATA

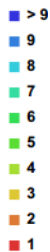
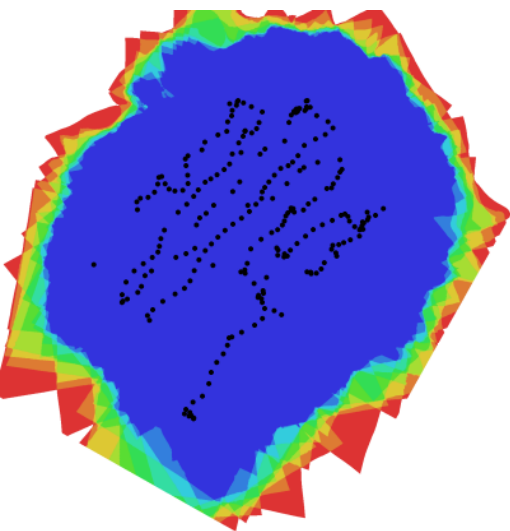


Fig. 1. Camera locations and image overlap.

Nissen, et al. in prep.

