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

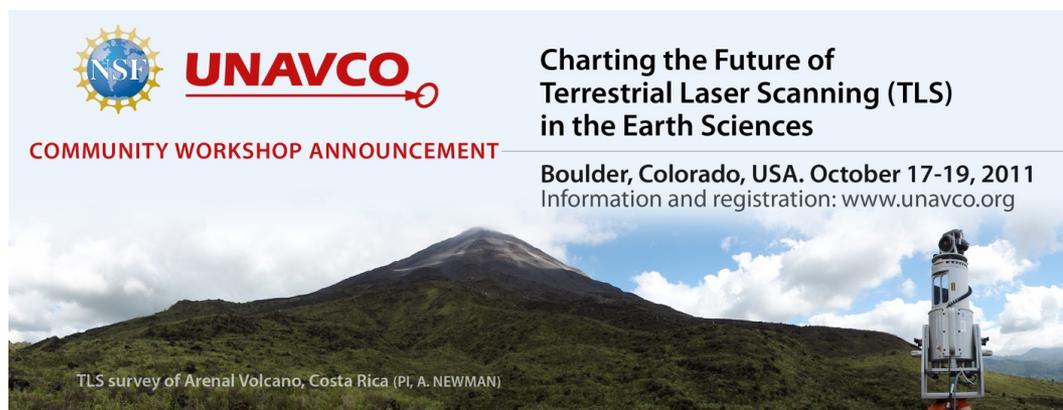*C. Crosby, UNAVCO, Boulder, CO*

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

Charting the Future of Terrestrial Laser Scanning (TLS) in the Earth Sciences

COMMUNITY WORKSHOP ANNOUNCEMENT

Boulder, Colorado, USA. October 17-19, 2011
Information and registration: www.unavco.org

TLS survey of Arenal Volcano, Costa Rica (PI, A. NEWMAN)

Scanners funded by the National Science Foundation

	Riegl VZ-2000	Riegl VZ-1000	Riegl VZ-400	Riegl Z620	Leica C10
Laser wavelength	Near infrared				532 nm (green)
Effective range	2050 m	1400 m	500 m	2000 m	150 m
High-speed meas. rate	396,000 pts/sec	122,000 pts/sec	125000 pts/sec	11,000 pts/sec	50,000 pts//sec
Precision	5 mm	5 mm	5 mm	10 mm	4 mm
Accuracy	8 mm	8 mm	5 mm	10 mm	6 mm
Field of view	100°x 360°	100°x 360°	100°x 360°	80°x 360°	270°x 360°
Dimensions	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
Weight	9.9 kg	9.8 kg	9.8 kg	16 kg	13 kg

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*

TLS Projects & Proposals Supported
January 2008 - September 30, 2017

Legend:
- Community
- NSF-Other
- EAR
- PLR Arctic
- PLR Antarctic
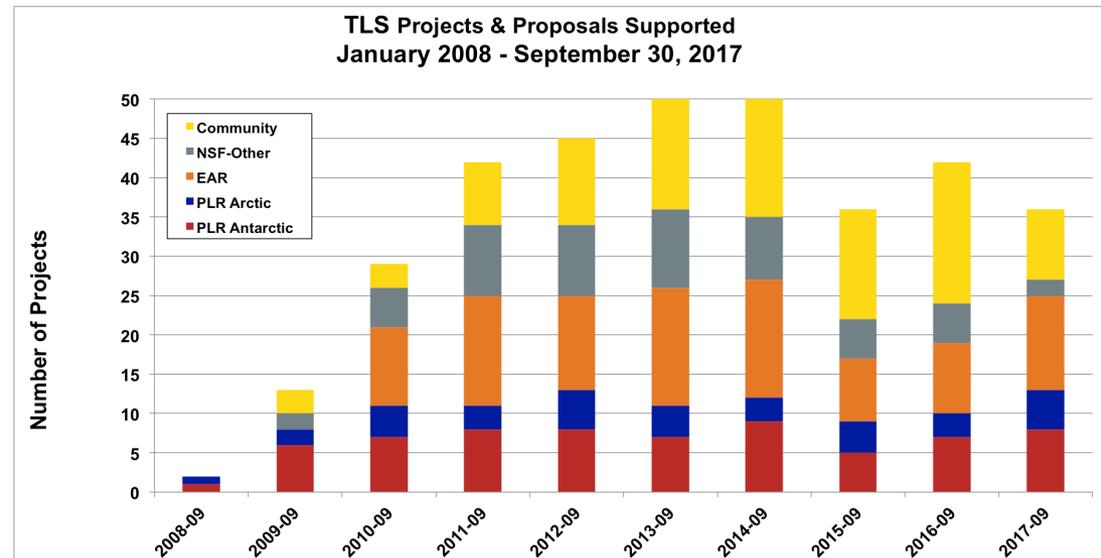
All support requests must be formally logged through UNAVCO support request system.

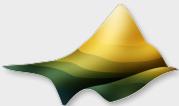http://achaia.unavco.org/public/newproject/supportform.aspx

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

UNAVCO	• **Terrestrial laser scanning (TLS) instrumentation and expertise** • **PI & graduate student support** • **Data archiving** • **Education and training**
NCALM THE NATIONAL CENTER FOR AIRBORNE LASER MAPPING	• **Airborne lidar data collection** • **PI & graduate student support** • **Graduate student seed grants (funding)** • **Education**
OpenTopography	• **Online data discovery and access** • **Custom data products and processing** • **Cyberinfrastructure R&D** • **Education and training**

NCALM

THE NATIONAL CENTER FOR AIRBORNE LASER MAPPING

- 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.
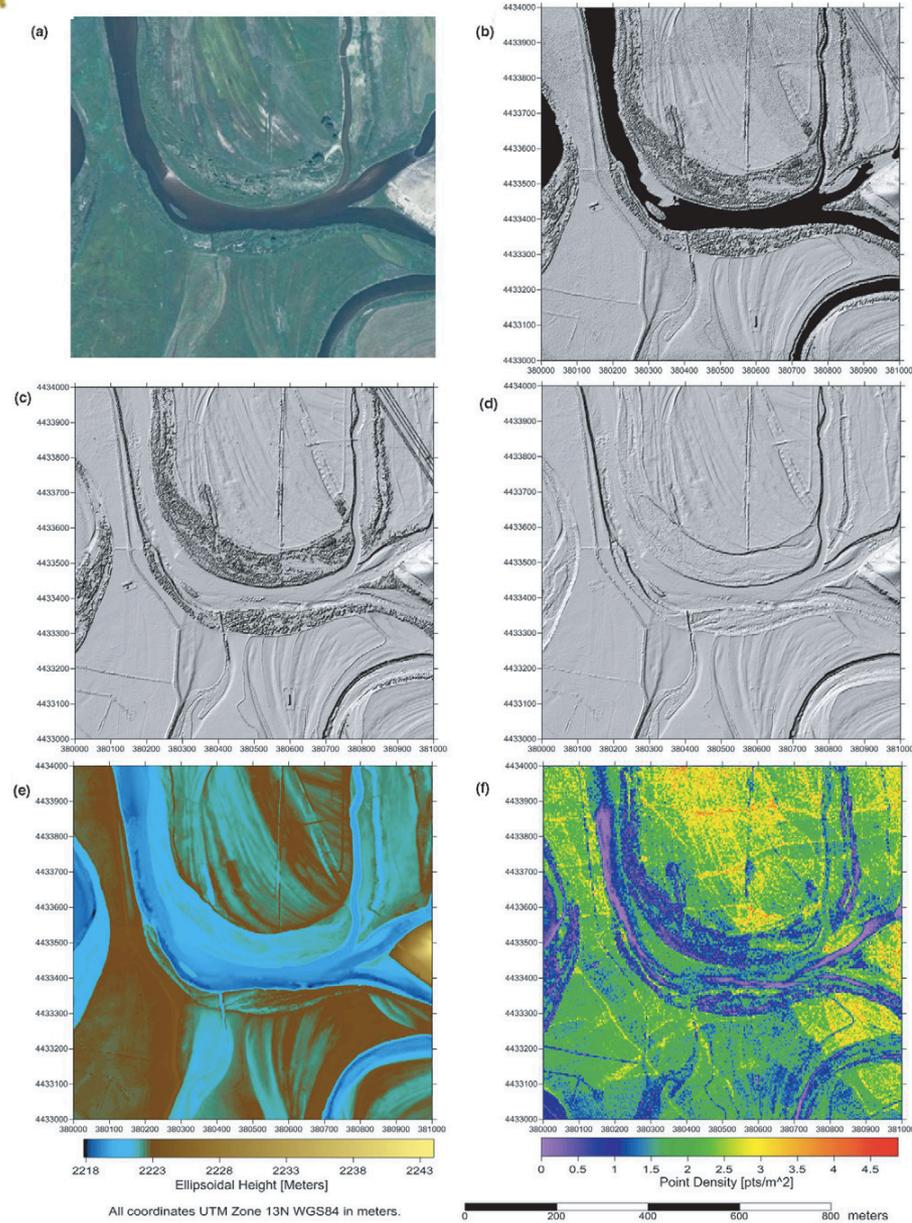
Research-oriented data

Typically 8+ pts/m^2, 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^2 of data for graduate students through annual proposal process.

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

- Lidar (ALS & TLS), Structure from Motion, satellite (e.g., SRTM)
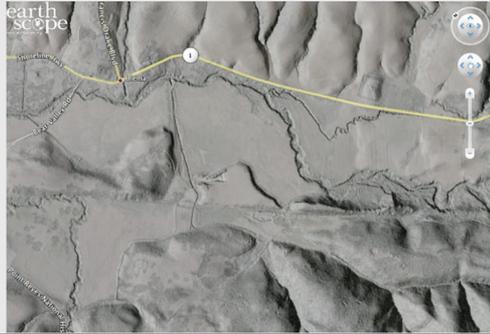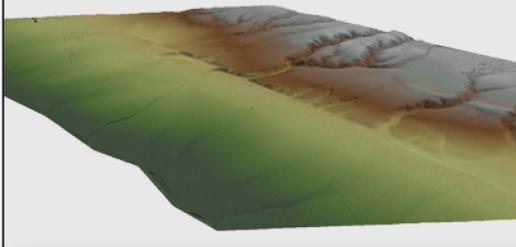
Black Rock Desert Wilderness, Nevada
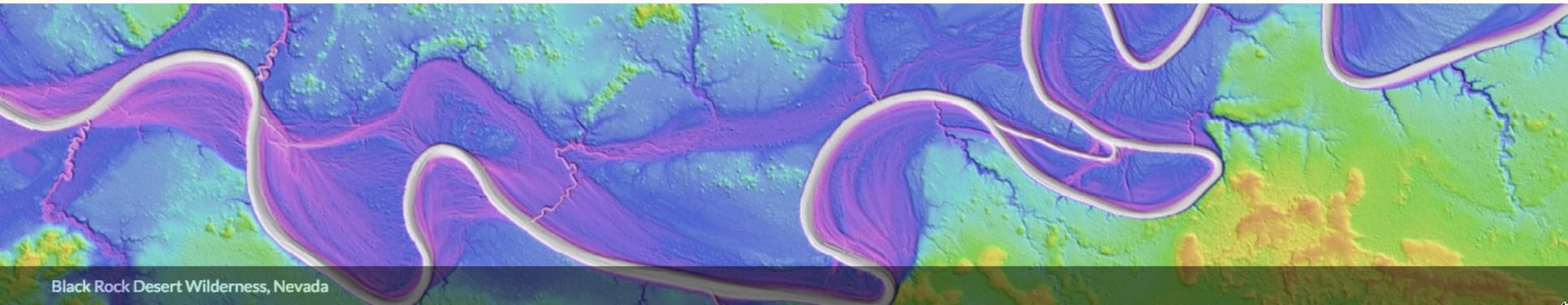
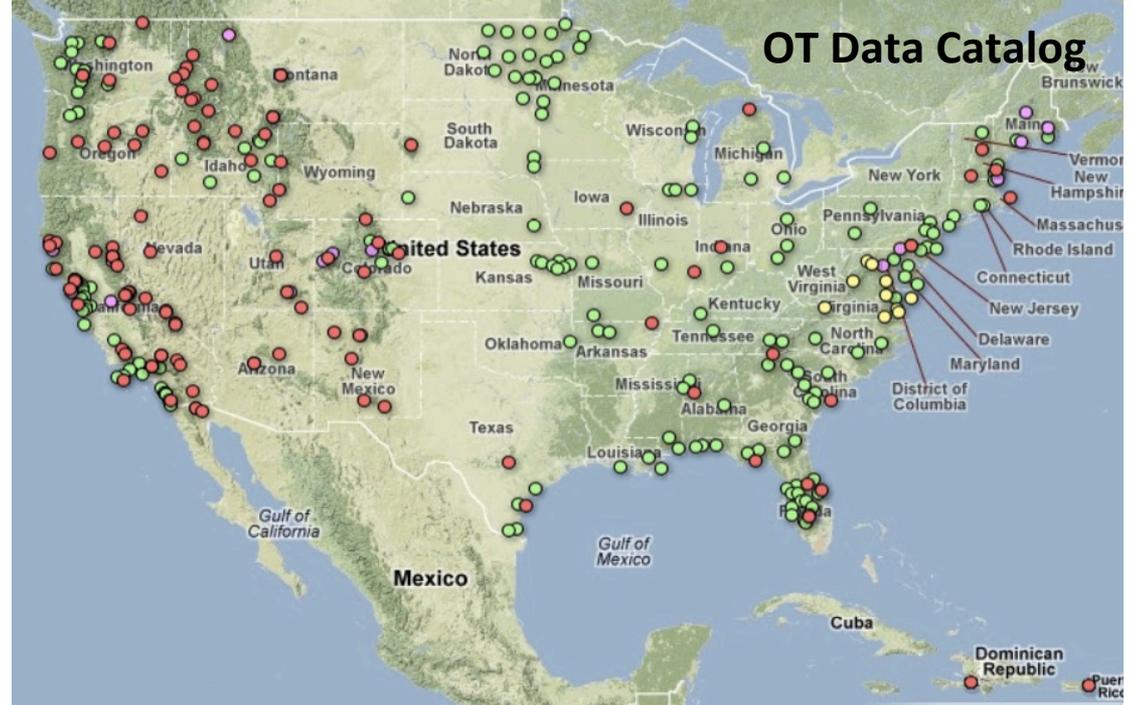## OpenTopography Multi-Tiered Data Products

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 (downward arrow)

Accessibility / Ease of Use (upward arrow)

OT Data Catalog

- 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
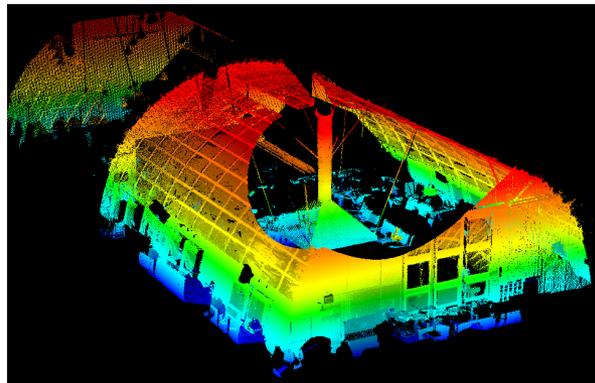
GETSI
GEodesy Tools for Societal Issues

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

Learn More

Search the Site | Go

Download

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
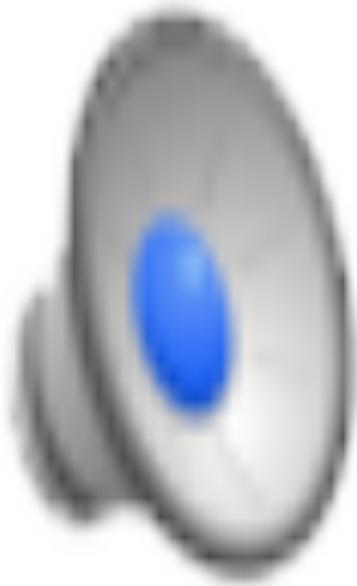
- Faster & longer data collection

- 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.)

New 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.

Anticipate instrument will be available via UNAVCO after property transfer from CH2M.

Well suited to continuous monitoring applications, complimentary to terrestrial radar (GBIR).

Airborne LiDAR

Structure from Motion

onboard GPS and IMU constrain position and orientation of aircraft

motion of camera provides depth information

sequence of photographs

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

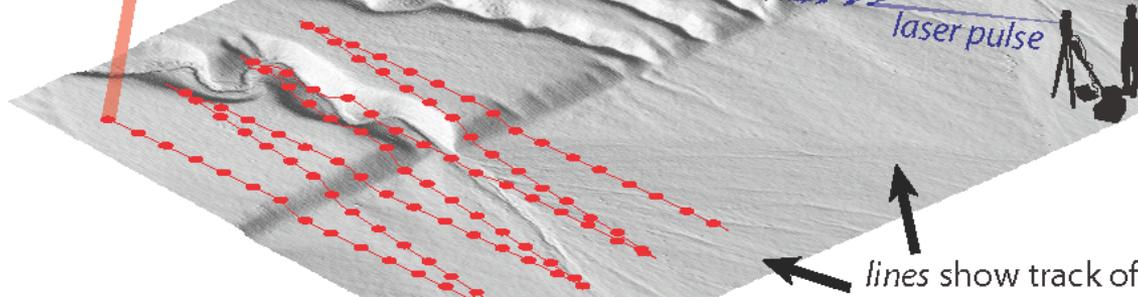scene **structure** refers to both camera positions and orientations *and* the topography

laser pulse

line of sight

shadow zone

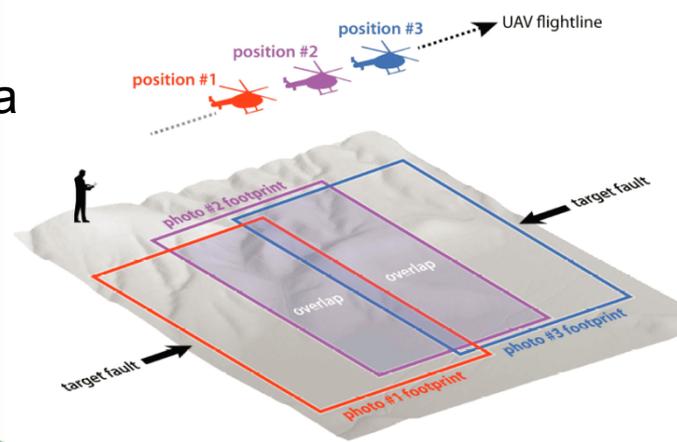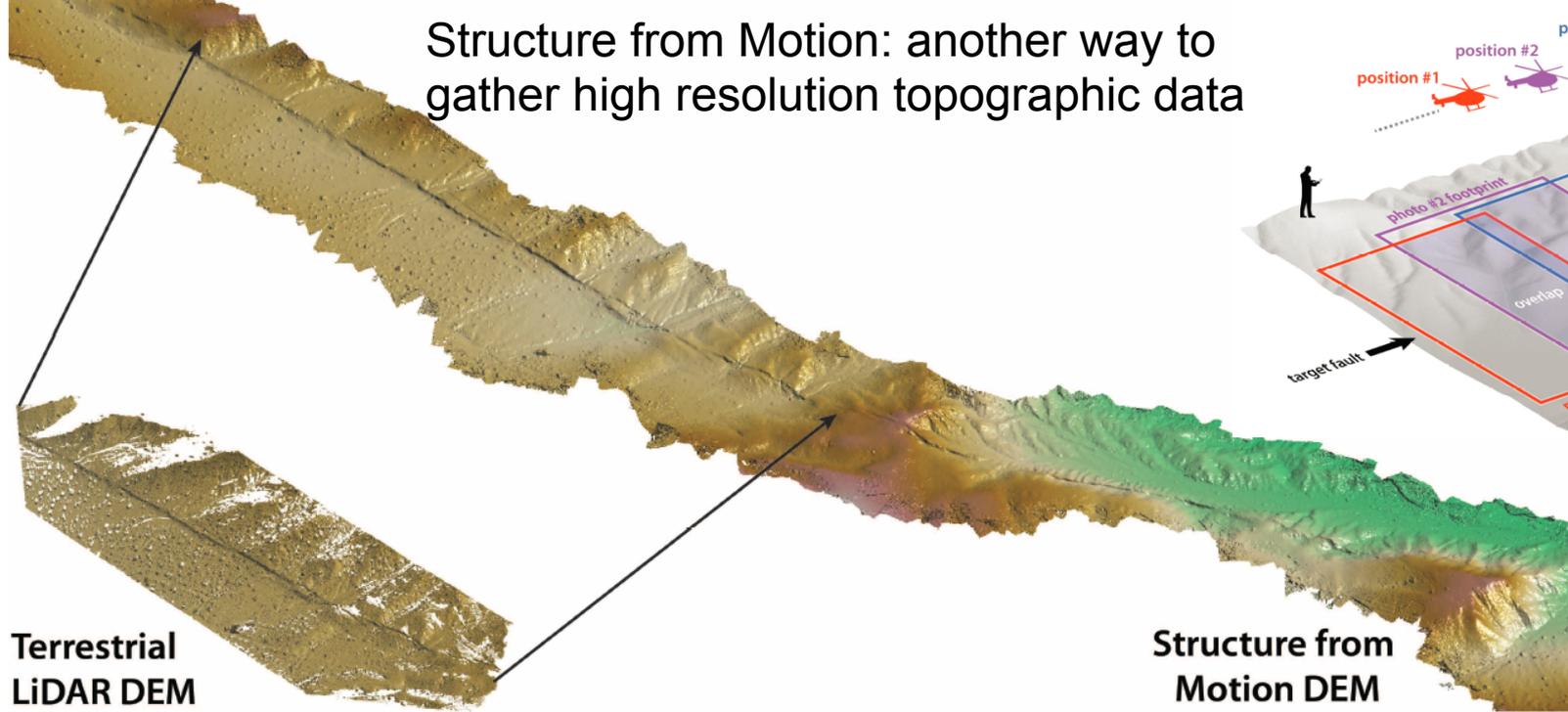features matched in multiple photographs
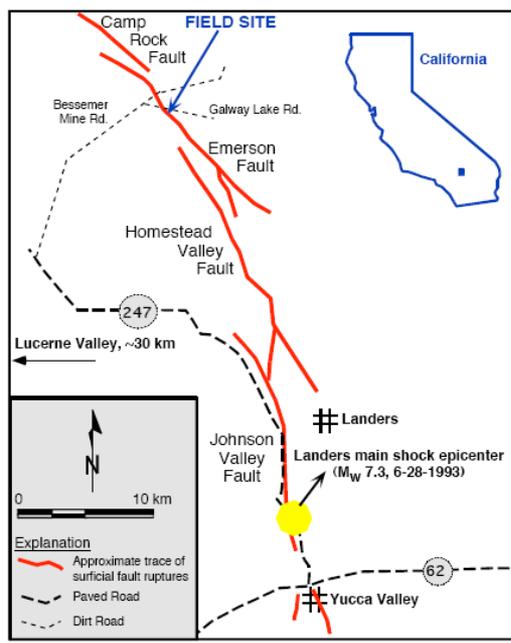
laser pulse

Terrestrial LiDAR

lines show track of scan across ground
circles show actual ground return footprints
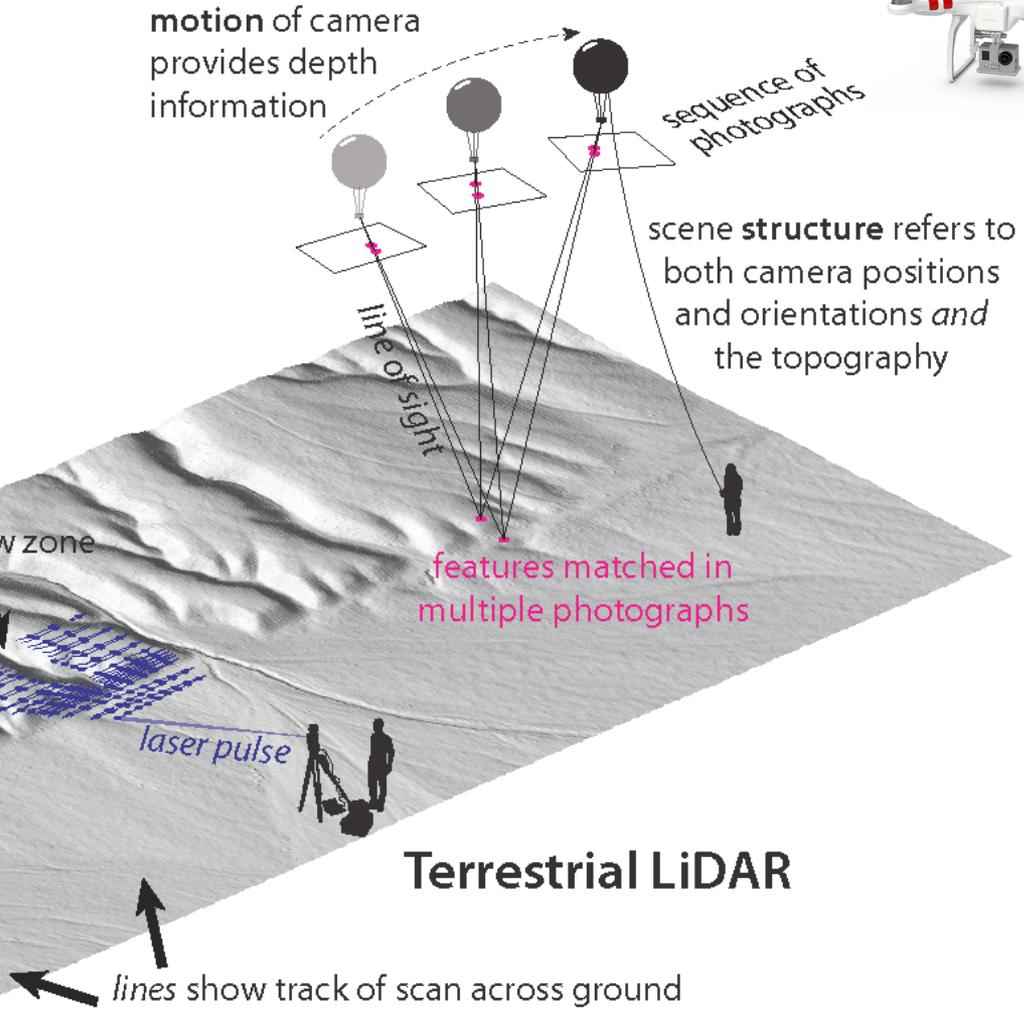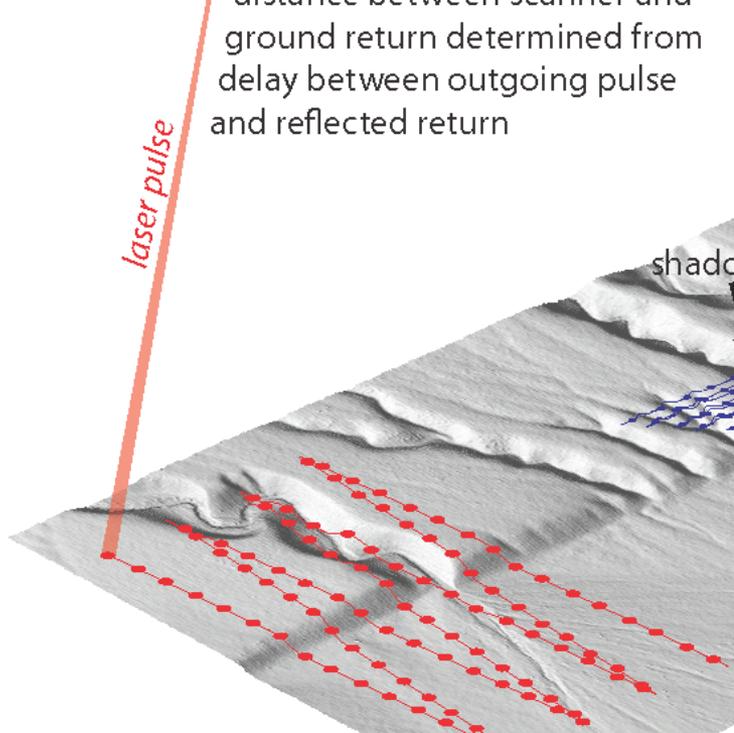
Structure from Motion: another way to gather high resolution topographic data

UAV flightline

position #1   position #2   position #3

target fault

photo #2 footprint
photo #1 footprint
photo #3 footprint
overlap
overlap

target fault

Terrestrial LiDAR DEM

Structure from Motion DEM

Nissen, et al. in prep.

Camp Rock Fault

FIELD SITE

California

Bessemer Mine Rd.   Galway Lake Rd.

Emerson Fault

Homestead Valley Fault

247

Lucerne Valley, ~30 km

Landers

Johnson Valley Fault

Landers main shock epicenter
(M_W 7.3, 6-28-1993)

0   10 km

Explanation

Approximate trace of surficial fault ruptures

Paved Road

Dirt Road

62

Yucca Valley

Principal trace of surface rupture

6-30-1992: U S Geological Survey

STRUCTURE FROM MOTION: PHOTOGRAMMETRIC HIGH RESOLUTION TOPOGRAPHIC DATA
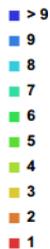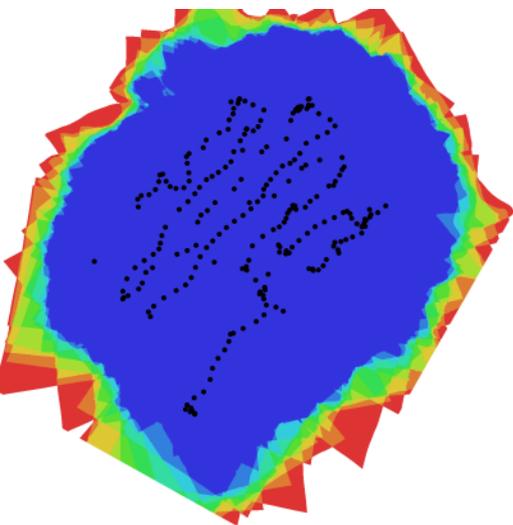
Fig. 1. Camera locations and image overlap.

> 9
9
8
7
6
5
4
3
2
1

Nissen, et al. in prep.

5 cm/pixel orthophoto

5 cm/pixel DEM

130 m

1 m/pixel B4 DEM