Terrestrial Laser Scanning Survey Project for a Deflected Stream Channel in the Carrizo Plain, San Andreas Fault

Project completion date: 07/2009

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Scientific Objective

Tectonic geomorphic markers such as deflected and offset stream channels form the basis for paleoseismic studies that aim to understand the spatiotemporal distribution of earthquakes, their magnitudes, and recurrences. The objective of this survey was to scan a deflected stream channel using TLS to create an ultrahigh-resolution digital elevation model of the channel.

TLS System Description and Specifications

The survey was performed using the Zoller and Fröhlich (Z+F) Imager 5006i terrestrial laser scanner:

See http://www.zf-usa.com/ for this scanner's detailed specifications.

Survey Area

The survey was carried out in an area covering ~100 m by ~100 m in the Carrizo Plain section of the San Andreas Fault (Fig. 1), and spanned a low-relief deflected channel.

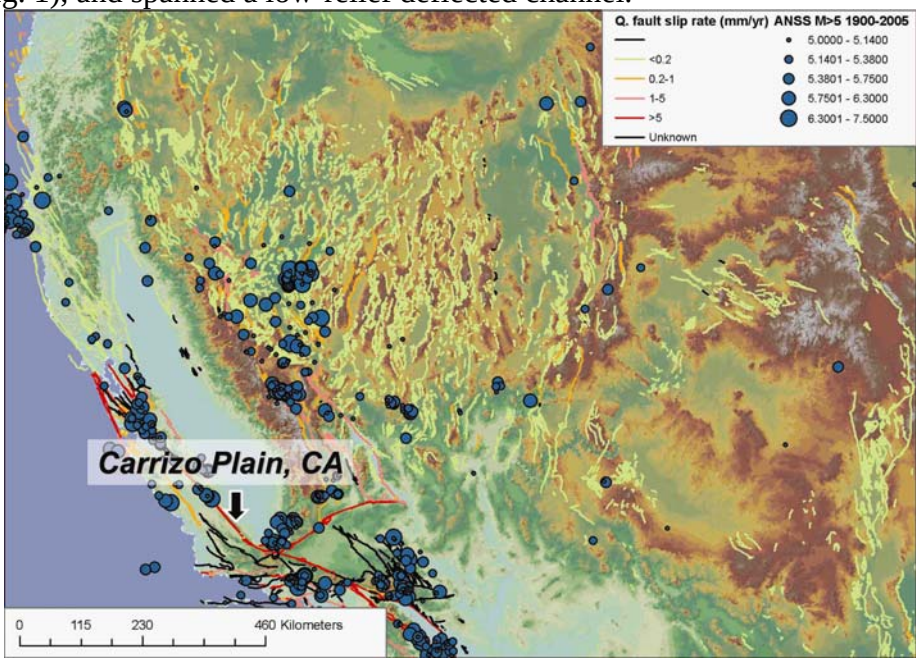

Figure 1. Location map of the TLS survey area. Active faults data from http://geohazards.usgs.gov/qfaults/map.php. Figure modified from Haddad et al. (2010).

Field Procedures

A total of 17 targets were used to align the scans. The targets were uniquely numbered 8 ½" x 11" sheets of paper (Fig. 2) and were taped to flat surfaces. Following target setup, the small deflected channel was scanned from 10 positions (Fig. 3). All scans were aligned in the lab using Z+F LaserControl.

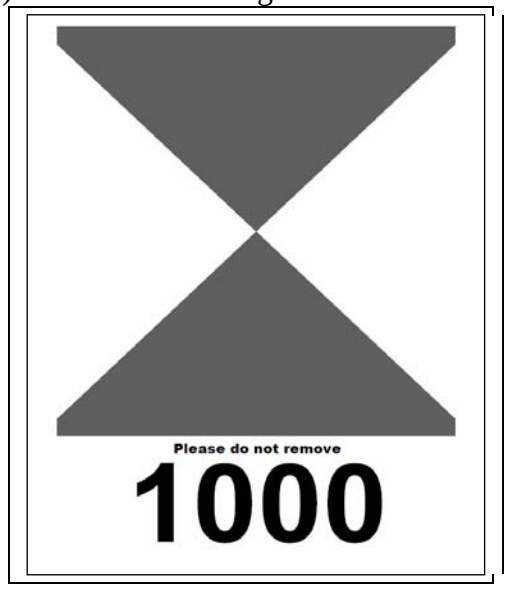

Figure 2. An example of a Z+F target used to align the TLS scans.

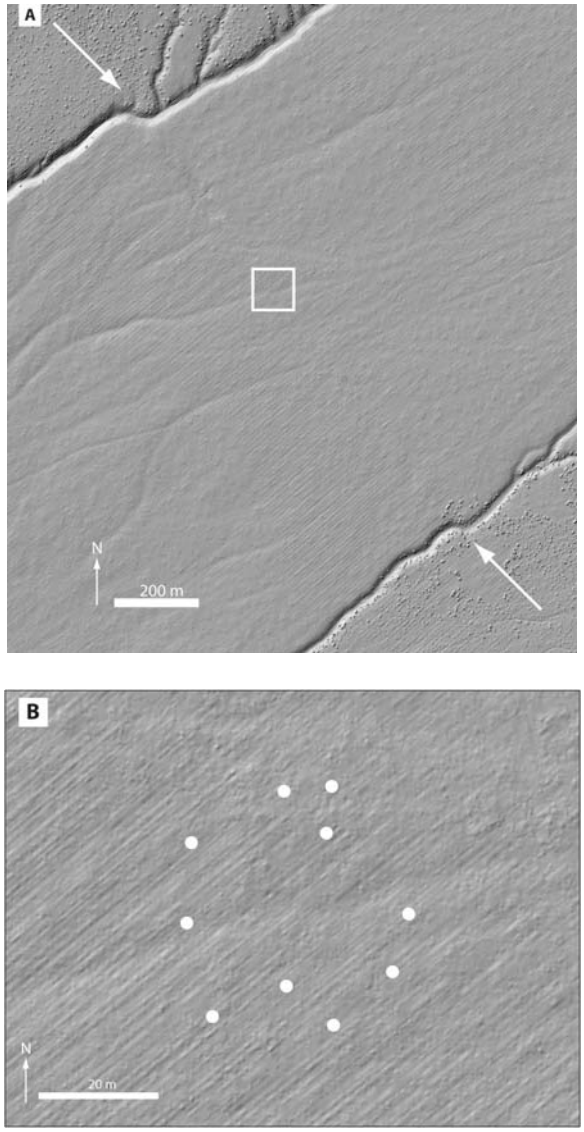

Figure 3. Location map of the TLS scanner positions. (**A**) Overview 0.25 m hillshade created from the B4 airborne laser scanning (ALS) digital elevation model (DEM). White box outlines the TLS survey area. White arrows show trace of the San Andreas Fault. (**B**) Location map of the 10 TLS scanner setups used in this survey.

Data Processing and File Formats

The final point cloud totaled 130 M points and was exported from Z+F LaserControl in ASCII format. Since no GPS control was available to georeference the point cloud, a complete 3D translation and rotation from the survey coordinate system into the UTM Zone 11 reference frame was performed using *xyzRotatorDH* (available from the OpenTopography Tool Repository). This process involved translating the TLS point cloud to an ALS point cloud using a common point, and performing a rigid-body rotation about this point to place the TLS point cloud in the ALS reference frame as follows:

$$x = x'\cos\theta - y'\sin\theta$$
$$y = x'\sin\theta + y'\cos\theta$$

Gridded Digital Topographic Products

The high-resolution DEMs were generated using a Linux version of the GEON LiDAR Workflow's Points2Grid utility (http://lidar.asu.edu; Fig. 4). The opportunity to process these data using the OpenTopography custom DEM and point cloud processing system will be available soon.

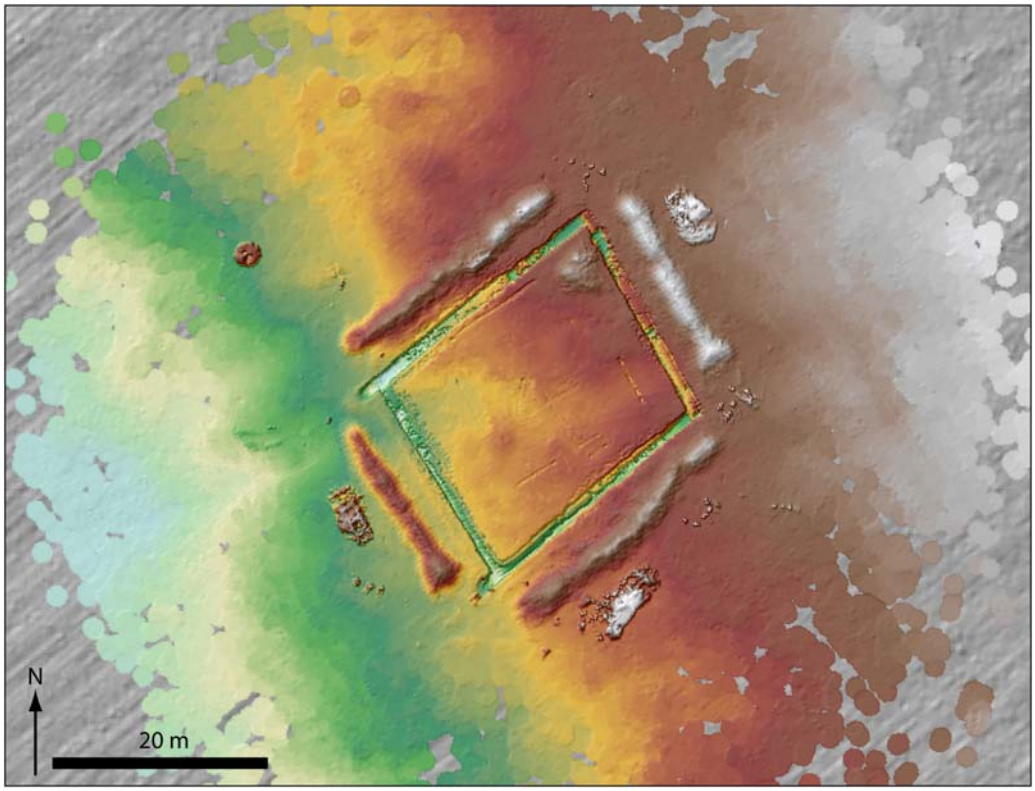

Figure 4. A 0.05 m DEM of the TLS survey area nested in a 0.25 m ALS-generated DEM. Modified from Haddad et al. (2010).

References

Haddad, D. E., Arrowsmith, J R., Akçiz, S. O., and Mauer, J., 2010. Applications of airborne and terrestrial LiDAR to paleoseismology: *GSA Abstracts with Programs*, 42(5).

Acknowledgements

This effort was supported partially by National Science Foundation (NSF) grants (EAR-0651098, EAR-0711282, and EAR-0930643), the US Geological Survey (USGS), and the Southern California Earthquake Center (SCEC).