

Tectonic geomorphology and earthquake geology of the 1857 reach of the San Andreas Fault: a new look from Airborne Laser Swath Mapping

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Important information about paleoearthquakes is recorded in the meter-scale tectonic geomorphology of fault zones. Such information is available from both the records of offset and from paleoseismic sites which are better understood with enhanced knowledge of geomorphic context. The B4 airborne laser swath mapping dataset of the topography along the San Andreas Fault (SAF) zone has enabled a spectacular new look at the 10s-of-meter scale tectonic geomorphology and is a powerful complement to field survey. We explored the applicability of these data to several aspects of the tectonic geomorphology of the SAF. This exploration has included significant data-processing assessment with application to fault trace mapping and offset stream channel study. We analyzed the point cloud itself, as well as several methods of filtering and gridding the data to produce digital elevation models (DEMs). Shot densities are typically 5-10 and as high as 33 per square meter with swath overlap. 1 m resolution DEMs show the topography well with few artifacts. Swath to swath position errors induce decimeter errors in adjacent scan lines from different swaths. The scan lines can be separated by 30-100 cm, so with DEM resolutions lower than that separation (e.g., 25 cm), decimeter high swath normal ridges ("corduroy") are notable artifacts. We have interpolated the data using kriging and spline methods and use local binning of the maximum, mean, and minimum elevation within a specified search radius (usually the DEM resolution). The minimum method removes some low vegetation (sagebrush) in the data that obscures landforms. The data are unprecedented in their power to quantitatively depict the tectonic landforms along the SAF. We closely examined several reaches of the fault in the Carrizo Plain, including that part covered by our pilot B4 dataset. We compared our estimates of 1857 and earlier offset from the field and from the B4-derived DEMs (where available) to the estimates from Sieh, 1978. We found that combinations of field and virtual examination provided our most confident estimates. In addition, a quantitative offset estimation using SAF spanning and parallel profiles was possible in places with higher quality obvious offsets. Broad (>several m) and shallow channels (<1 m) were difficult to confidently match with this semi-automated approach.

Web site: <http://activetectonics.asu.edu/1857/>

Presentations:

Arrowsmith, J R., Campbell, B., Crosby, C., Raleigh, D., [Tectonic geomorphology and earthquake geology of the 1857 reach of the San Andreas Fault: a new look from Airborne Laser Swath Mapping](#), *Eos Trans. AGU*, 87(52), Fall Meet. Suppl., Abstract G53C-0916, 2006.

Also colloquium at University of Texas at Dallas and participation at the 2006 SCEC meeting and the SoSAFE workshop and 1857 earthquake sesquicentennial.

SCEC Intern This work also included the involvement of SCEC intern Brian Campbell from Elizabeth City State University in North Carolina with Arrowsmith as the mentor.

Figure 1. High resolution B4 topography along the San Andreas Fault in the northwestern Carrizo Plain. Strip at right is a 1 m DEM from B4 data computed using Geon LiDAR Workflow (Crosby, et al., 2006). It dramatically shows the tectonic geomorphology along the fault zone. Red lines are active fault traces from Vedder and Wallace, 1970. Yellow numbers indicate the offset locations compiled from Sieh, 1978. Liu, et al.'s study was at site 25. The Bidart site is bounded by channels 32 and 33. Detailed map below shows the topographic slope computed from the 1 m B4 DEM semi transparent over the hillshade at the Bidart site. The subtle slope changes indicate the SAF zone which offsets the two channels. White trenches are from Grant and Sieh, 1994 and blue ones are from Akciz et al. in prep.

