ALOS Cal/Val Support at SIO, University of California San Diego: Radar Corner Reflectors

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Background

The San Andreas Fault zone is a transform fault connecting the seafloor spreading ridges in the Gulf of California to the seafloor spreading on the Juan de Fuca Ridge off the Coast of Oregon. The metropolitan areas of San Francisco and Los Angeles lie along this transform fault and thus are at risk of a destructive Earthquake. Major earthquakes have occurred in 1906 in San Francisco and 1857 north of Los Angeles but a long section of the southern San Andreas Fault has remained locked for over 330 years so there is a concern that this will be the site of the next major rupture (Figure 1).

PALSAR aboard ALOS will provide the first L-band radar interferograms of this tectonic area beginning in 2006. We have proposed to participate in the ALOS calibration/validation phase of the mission by installing three radar corner reflectors at the Pinon Flat geodetic observatory (PFO) (http://pfostrain.ucsd.edu/pfo/index.htm). The Pinon Flat Observatory (PFO) is operated by the Institute of Geophysics and Planetary Physics of the University of California, San Diego (IGPP-UCSD), and is used for geodetic and seismic instrumentation. The objectives of this lab are to measure, as accurately as possible, crustal deformation in a tectonically active area, so as to improve our understanding of the earthquake cycle, and so improve estimates of the earthquake hazard throughout southern California. The lab also served as a testing ground for new geophysical instrumentation. Investigators from throughout the world operate instruments at this site.

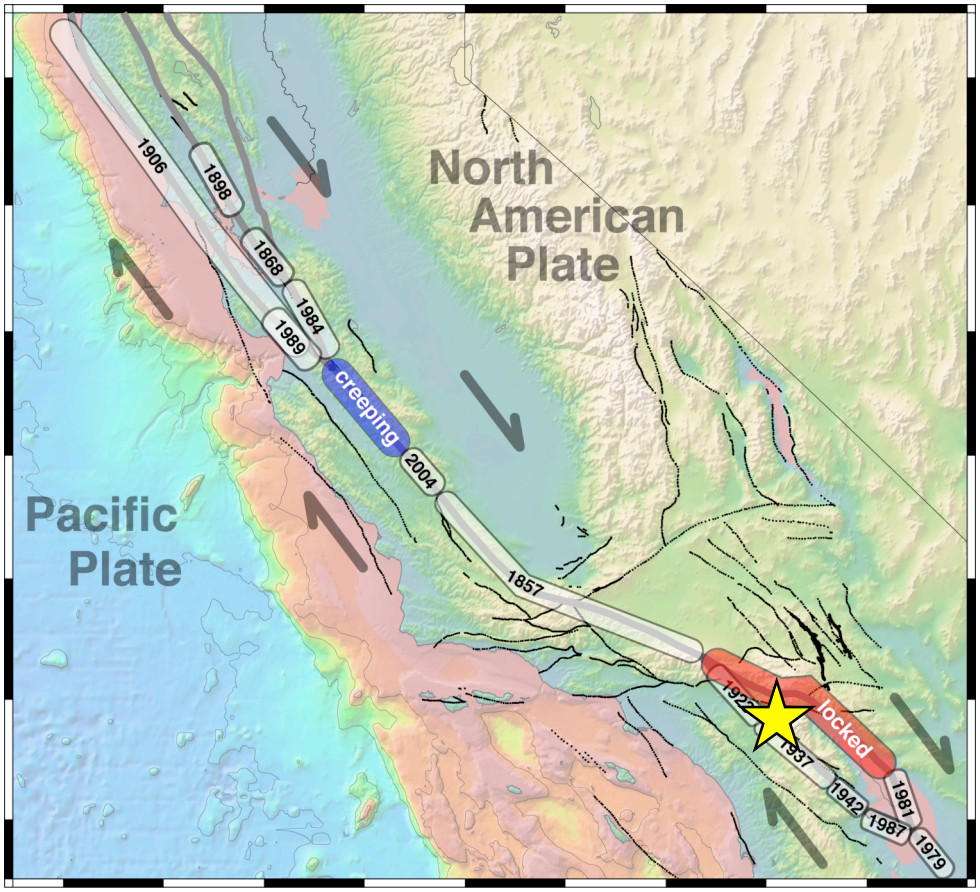

Figure 1. The major sections of the San Andreas Fault zone undergo repeated earthquake activity except along the *creeping* section where the plates slide smoothly at all depths. Recent major earthquakes are dominated by the 1857 Fort Tejon Earthquake (M7.9) and the 1906 San Francisco Earthquake (M8.3). The southernmost *locked* section of the San Andreas Fault has not experienced a major earthquake in at least 330 years. The next event along this section should release more than 8 m of accumulated slip; typically large California earthquakes have a maximum slip of 6 m. Pinon Flat Observatory (yellow star) lies hosts a wide array of geodetic and seismic instrumentation including three large radar corner reflectors.

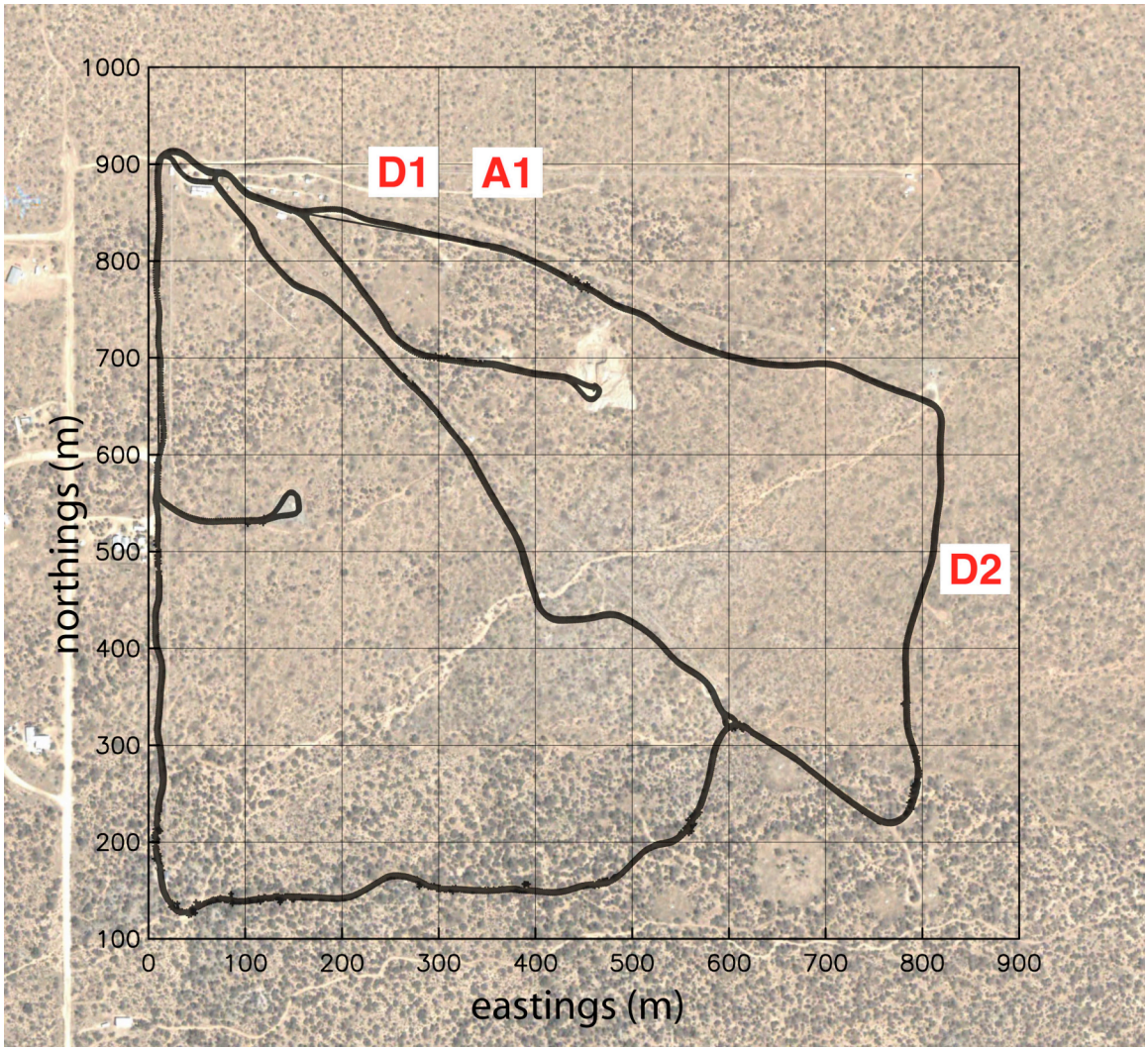

Figure 2. Satellite image of the Pinon Flat Observatory. This arid region at an elevation of 1200 m is relatively flat with a surface of decomposed granite sparsely covered by bush and grass. Three radar corner reflectors are oriented to reflect energy from ascending (A1) and descending (D1 and D2) passes of ALOS. In addition to the known GPS positions of the radar reflectors, we have a 10-cm accuracy 3-D survey (black lines) of the dirt roads in the area to serve as calibration for both optical (e.g., PRISM) and radar instruments (e.g. PALSAR).

Our proposed investigation with PALSAR data is to contribute to the calibration of SAR imagery as well as interferometric phase. The reflectors have 2.4 m openings and are oriented at azimuths and elevations to provide optimal reflections of PALSAR on both descending and ascending tracks (Figure 3 and Table 1.).

Figure 3. Photographs of the 3 radar reflectors. Reflectors D1 and D2 were installed at Pinon in 1997 were originally oriented to reflect radar from ERS-1 and ERS-2 having incidence angles of 23˚ and azimith of 102.5˚. In July of 2004 the reflectors D1 and D2 were adjusted to optimally reflect ALOS data with incidence angles between 34˚ and 43˚. In November of 2005 the ascending reflector was installed to reflector radar waves having an azimuth of 257.5˚ to reflect ALOS data along ascending passes.

Coordinates of Radar Reflectors

	position			orientation	
	lat	lon	height	elevation	azimuth
A1	33.612246	-116.456768	1258.990	39˚	257.5˚
D1	33.612253	-116.457893	1257.544	39˚	102.5˚
D2	33.607373	-116.451836	1254.537	39˚	102.5˚

Latitude and longitude in decimal degrees and elevation in meters relative to the WGS-84 co-ordinate system and ellipsoid.
The survey point is the apex (lowest corner) of each reflector. There should be a correction for the offset between the phase center of the reflector and the apex.

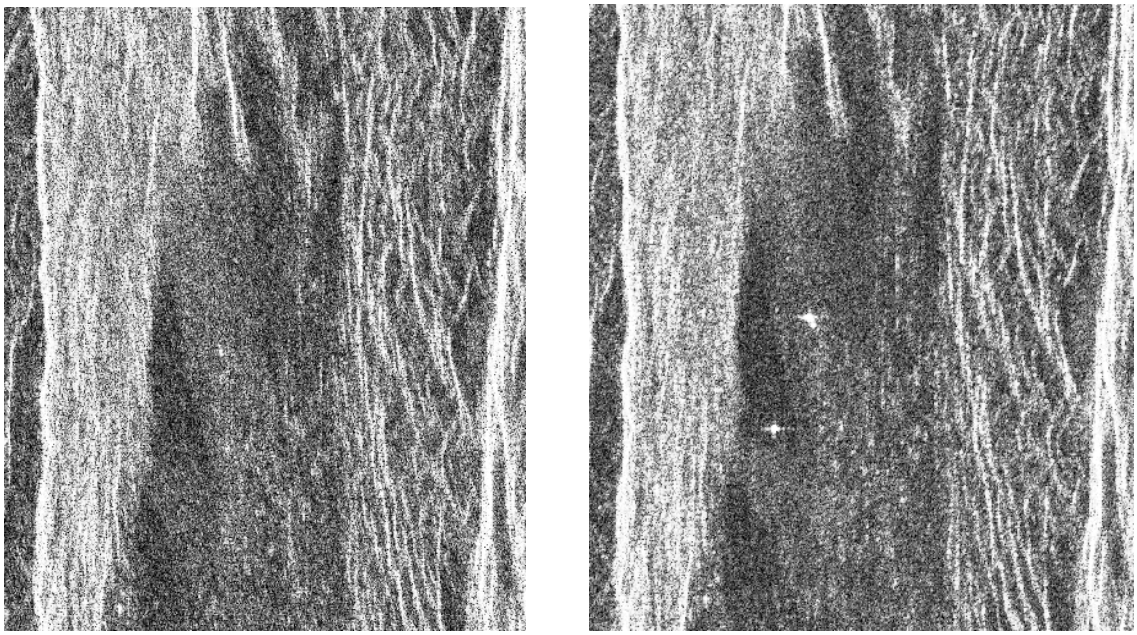

Figure 5. (left) ERS SAR amplitude image of Piñon Flat before installation of radar reflectors D1 and D2. This is the sum of two images collected on 12/20/95 and 12/19/95. (right) ERS SAR amplitude image of Piñon Flat after installation of radar reflectors. This is the sum of three images collected on 5/28/97, 4/23/97, and 3/19/97. Grid spacing is 1 pixel (7.9 meters in ground range, 4 meters in azimuth).