Crustal Deformation in Southern California Using SAR Interferometry

G. Peltzer — Jet Propulsion Laboratory, California Institute of Technology, Pasadena, CA 91109, gilles@altyn.jpl.nasa.gov

F. Rogez — Jet Propulsion Laboratory, California Institute of Technology, Pasadena, CA 91109, rogez@lor.jpl.nasa.gov

P. Rosen — Jet Propulsion Laboratory, California Institute of Technology, Pasadena, CA 91109, par@parsar.jpl.nasa.gov

K. Hudnut — US Geological Survey, Pasadena, CA 91125, hudnut@seismo.gps.caltech.edu

Abstract

By combining pairs of ERS-1/2 SAR images of Southern California spanning long time intervals (1-4 years), we were able to measure the rate of slow deformation processes along faults activated during the Landers 1992 earthquake. Interferograms revealed several centimeters of post-seismic rebound in step-overs of the 1992 break, with a characteristic decay rate of ~280 days. We interpreted this process as due to pore fluid flow as pore pressure gradients caused by coseismic stress changes dissipate. The data also revealed evidence of after-slip on different sections of the fault. The southern branches of the 1992 break experienced surface creep producing sharp phase cuts in the interferometric maps. Creep along a 10-km long section of the Eureka Peak fault occurred on a ~3 km deep patch at a rate of ~3.3 cm/yr resulting in ~14 cm of right lateral surface slip in 3 years. Creep on the Burnt Mountain fault appears to have produced up to 17 cm of surface slip in the three months following the earthquake. After-slip also occurred on the Emerson fault, below the depth of ~1.5 km. The same approach was used in the Los Angeles basin, which is currently undergoing NS shortening at a rate of ~8 mm/yr. Time series analysis of interferometric maps was used to distinguish the long-term tectonic signal from phase patterns due to ground subsidence caused by oil and water withdrawal, or tropospheric phase propagation delay.

Keywords: post-seismic deformation, California, SAR interferometry