Detection of aseismic creep along the San Andreas fault near Parkfield, California with ERS-1 Radar Interferometry

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Abstract

Parkfield, California lies an area along the San Andreas fault in Southern California that has experienced strong earthquakes at apparently regular intervals in historic t imes. It is a site of intense study in anticipation of a significant earthquake (M >6) that according to predictions is now long overdue. Such an event is expected because the section of the San Andreas Fault northwest of the town has been measured by conventional geodetic methods to be creeping aseismically at a rate consistent with the right lateral secular motion of the plates, whereas the fault segment southeast of Parkfield is locked, accumulating strain. We present in this talk differential interferometric analysis of ERS data that reveals the wide-area distribution of creep along the moving fault segment. ERS-1 images acquired 15 months apart were combined interferometrically. A DEM from the site is used to remove the phase introduced by the interferometric geometry and local surface topography. The residual phase is proportional to the change in propagation path length caused surface deformation and variations in the tropospheric water vapor. A sharp phase discontinuity, visible along the 100 km fault trace, is equivalent to 2.0 cm change in the line of sight. This displacement is consistent with current models of motion along the fault. Of interest are systematic phase signatures near Parkfield that may be related to the strain accumulation in this region. We compare the observed phase signature with a predictions of the differential phase based on a model for deformation developed by Okada. The ERS differential interferometric signature is compared to a result derived from the NASA SIR-C radar operating a L-Band with a 6 month time interval between passes. The shorter time interval reduces the detectability of the fault displacement signature. Further analysis of the SIR-C, and other ERS data is continuing.