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InSAR time series analysis for southern California: Constraints on transient deformation and fault mechanics

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Plate boundary processes are moving from a time invariant to a time variable paradigm. In these processes short and long-term fault and stress interactions couple through the mechanical properties of the fault to modulate earthquake occurrence and long-term plate deformation. We analyze ERS, Radarsat, and Envisat SAR interferometric data to compute InSAR time series of deformation across the southern San Andreas fault system of southern California from its intersection with the Garlock fault to Mexico. SAR data from the WInSAR archive - ERS-1, ERS-2, and Envisat from the European Space Agency (ESA) - as well as Radarsat-1 data from the Canadian Space Agency through the Alaska Satellite Facility (ASF) are analyzed, collectively spanning the period 1992 to 2007. We use the ROI_PAC InSAR processing software package to process these data and use a variation on the IREA-CNR developed SBAS algorithm for the time series computation. We discuss some of the challenges and limitations in computing InSAR time series over swaths several hundred kilometers in length. InSAR transient deformation is observed during the 2002-2005 time period that in some cases is completely new relative to the ERS data from the 1992-2000 period. These data we compare to continuous GPS data from the SCIGN network to separate localized hydrologic or anthropogenic sources from potential tectonic/fault transient deformation. We present some preliminary numerical models linking both the time variable and longer-term deformation rates to fault and crustal mechanics.