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The 2014 Napa valley earthquake constrained by InSAR and GNSS observations

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In this work InSAR and GNSS data have been exploited to evaluate the 3D displacement field produced by the Mw 6.0 earthquake occurred on August 24th, 2014, southwest of Napa Valley, California. The earthquake epicenter is located within the San Andreas Fault system, which forms the boundary between the North American and Pacific plates. As the Pacific plate moves to the northwest, relative to North America, deformation occurs between the major faults in the System.
The InSAR data are those of the Sentinel-1 satellite recently launched on April 3rd, 2014. This satellite is capable of acquiring data in several modes such as Interferometric Wide (IW), Extra Wide (EW) swath mode or the Stripmap mode, thus varying area coverage and pixel resolution. Here a pair of SAR images, acquired in Stripmap mode with an incidence angle of about 23° and a pixel resolution of about 4 meters in both directions, covering an area of 70x180 Km have been used. The pre- and post-earthquake images have been acquired on August 7th and August 31st, 2014 respectively. They are characterized by a perpendicular baseline of 2 meters and have been cut around the epicenter and multi-looked by a factor of 15x15 in range and azimuth to obtain a pixel size of about 60x60 m. The Digital Elevation Model (DEM) provided by the SRTM mission has been used to remove the topographic phase. Moreover, the Goldstein filtering and the Minimum Cost Flow (MCF) phase unwrapping algorithm were also applied. The analyzed GNSS dataset, spanning the 1st August 2014 - 2nd September 2014 period, includes 32 stations belonging to the Bay Area Regional Deformation Network and 301 additional continuous stations available from the UNAVCO and the CDDIS archives. The whole network of stations has been organized into seven sub-networks of about 50 sites each. The sub-networks were processed sharing a number of common sites to provide the necessary ties between them. The results of this processing step are daily estimates of loosely constrained station coordinates, and other parameters, along with the associated variance-covariance matrices. These solutions were used as quasi observations in a Kalman filter to estimate a consistent set of daily coordinates (i.e. time-series) for all sites involved. The resulting time-series were aligned to a North American fixed reference frame. The visual inspection of the time-series for the stations closely located to the epicentral area of the seismic event allowed detecting a significant offset related to a coseismic deformation. Both data sets have been integrated to determine the 3D displacement field produced by the earthquake. It shows clear characteristics of a strike slip event with an approximately NW striking fault plane.