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Postseismic deformation in the El Asnam fault region (Algeria): Results from merged PS-InSAR and Small Baseline methods

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We investigate the surface displacement along the 36-km-long and NE trending El-Asnam thrust fault (NW Algeria) responsible of two large earthquakes (Ms 6.7 in 1954 and Ms 7.3 in 1980) using Stamps/MTI advanced time series analysis of ERS SAR images acquired between 1997 and 2000. Previous leveling measurements of geodetic benchmarks conducted from 1986 to 1991 show 5.1 $\pm$ 1.9 mm/yr and 9.6 $\pm$ 1.4 mm/yr postseismic uplift rate of the northwestern block. The processed 9 SAR images (ERS1 and ERS2) are based on the combination of PS-SB using Stamps, the 3-arc/sec SRTM topographic data, and filtering in order to remove atmospheric artifacts and control the Doppler centroid difference.The semi-arid landscape of the El Asnam (nowadays Chlef) region provides favorable image coherency for interferometric SAR processing. The application of Persistent Scatterer InSAR (PS) and Small baseline (SB) approaches reveals significant surface changes across the fault zone. The earthquake fault area limits two distinct zones, with LOS values reaching 30.4 mm cumulative displacement corresponding to 16.2 mm(uplift) on the hanging block and -14.2 mm (subsidence) on the footwall block.We then extract the vertical and horizontal components (uplift and NNW-SSE shortening) from the LOS and obtain 0.6 mm/yr and 0.4 mm/yr, respectively. The elastic modeling on the homogeneous 1980 fault rupture illustrates the crustal deformation at depth. The cumulative postseismic and perhaps comparable interseismic deformation across this tectonic boundary may explain the frequent earthquake occurrence in this region. The InSAR Time Series analysis also shows LOS displacement on other parallel active faults (Bou Kadir fault and Tenes fault) NNW of the El Asnam fault. The inferred total rate of shortening across these faults and the Tell Atlas of Algeria reflects the level of active deformation along this section of the plate boundary in North Africa.