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Post-seismic surface deformation in central Taiwan from SAR interferometry time series analysis

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The Chi-Chi earthquake struck the central Taiwan and caused widespread damages on 21 September 1999. A distinctly north-south trending rupture appeared along the previously recognized Chelungpu Fault. The main goal of the study is to understand the space-time distribution of post-seismic deformation in the central Taiwan. In this aim, we analyze the SAR interferometry time series analysis and C-band radar images acquired by the European radar satellites ERS-2 and ENVISAT from October of 1999 to September of 2008.

Post-seismic deformation pattern inferred from the interferometry appears to be different along the strike of the Chelungpu Fault. The displacement rates are larger to the south near the main shock than in the north where the greatest coseismic displacement occurred. The discrepancy between both parts of the fault is gradually decreasing with time. A slight displacement is undergoing in the Puli Basin where coseismic subsidence associated with the Chi-Chi earthquake occurred. Comparing the deformation rates between the hanging wall and footwall blocks shows that the former still record more rapid subsidence than the latter. In addition, the maximum deformation rate reaches nearly 5 cm/yr along the radar line-of-sight direction in the area of the Choushui River Alluvial Fan. The comparison between InSAR results, precise leveling data and continuous GPS data not only reveal that the displacement rate is consistent with the long-term geodetic measurement, but also illustrate the similar deformation trend within the region. Displacement rates are generally high in the footwall of the Chelungpu Thrust and gradually decrease eastward. Post-seismic deformation is currently focusing to the west, in the vicinity of the Changhua Fault, revealing a component of aseismic thrust propagation.

SAR interferometry time series analysis provides a snapshot of the spatial and temporal deformation pattern in the central Taiwan after the Chi-Chi earthquake, and allows inferences on the mechanisms of thrust propagation in an active collisional orogen.