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The Surface Deformation and Source Parameters of the October 23rd, 2011, Mw 7.1 Van (Turkey) Earthquake from InSAR, GPS and Field Observations

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A Mw 7.1 earthquake struck the Van Province (population > 1 million) in eastern Turkey on October 23rd, 2011, causing over 600 fatalities and extensive damage mainly in the Van city center and in the northern town of Erciş. Various focal mechanism solutions imply that reverse faulting took place on a ENE-WSW striking fault located to the north of the city center. Extensive field investigations failed to reveal a clear prominent surface rupture and therefore do not provide unambiguous information about the dip direction for this blind fault rupture. Analysis of coseismic interferograms from the descending orbits of Cosmo-SkyMed and Envisat satellites show that faulting occurred on a northerly dipping blind thrust fault with an uplift over 100 cm. The interferograms also revealed two zones of phase discontinuities indicating surface movement along two main fault splays running between Lake Van to the west and Lake Erçek to the east, one of which runs through the city center. Preliminary modelling of the interferograms using elastic dislocations on rectangular faults reveals a fault slip asperity at depths between 5 to 15 km and coseismic reverse faulting of over 2.5 m on a $\sim$45° north-dipping fault between the two lakes. Analysis of post-earthquake InSAR data with 11-day intervals from the TerraSAR-X satellite reveals rapid postseismic uplift of the hanging wall block of up to 4.5 cm in the first 19 days, suggesting that afterslip is the main mechanism causing the early postseismic deformation. GPS benchmarks established in the nearfield after the earthquake will be used in combination with the InSAR data to get more information about the spatiotemporal variation of the postseismic deformation. In addition to the hanging wall uplift, the TerraSAR-X data show postseismic motion along the fault splays mentioned above and additional deformation to the south of Van city, which we interpret as surface movement due to the Mw 5.6 aftershock of November 09th. Preliminary modelling of the aftershock suggests an E-W trending rupture.