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InSAR analysis of the coseismic deformation of the August 11th, 2012 Ahar-Varzaghan (NW Iran) earthquakes (Mw 6.4 and 6.3)

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Northwestern Iran is part of a 2-km high plateau that results from the continental collision between the Arabian and Eurasian plates. The convergence is partitioned between thrust and strike-slip faults in the region (Copley and Jackson, 2006) like the right lateral North Tabriz Fault. On August 11, 2012, two earthquakes of magnitudes 6.4 and 6.3, causing a loss of 300 lives, occurred 10 minutes apart near the city of Ahar and about 40 km NE of Tabriz, which with 1.4 million inhabitants, is the 4th largest city of Iran. The locations and focal mechanism solutions of the shocks showed that at least the first shock with pure right lateral mechanism ruptured part of the Ahar fault, a prominent and major structure with a clear morphological expression in the topography. Our field observations revealed a surface rupture of $\sim$11 km with a right lateral sense of displacement of up to 50 cm along the Ahar fault. However, a rupture length of 11 km is rather short to account for two earthquakes of magnitude 6.4 and 6.3 (Wells and Coppersmith, 1994). Thus, it is not clear whether this surface rupture was created by the first event only or partly by both since the sparse distribution of the regional seismic network does not allow a precise estimation of the earthquake epicenters. The second shock has a significant reverse component and a change in strike of nodal planes. However, no significant reverse slip was observed in the field. The second shock might therefore not have ruptured the surface or even taken place on its left lateral conjugate at depth. To resolve these issues and produce a detailed map of the corresponding surface deformation we use high-resolution scenes acquired from the Multi-Look Fine Beam mode of RADARSAT-2 which is the only SAR satellite that has gathered information over the epicentral region before and after the earthquakes. In the ascending coseismic interferogram more than 16 fringes are visible to the south of the fault zone indicating a line-of-sight displacement of over 45 cm towards the satellite. The total rupture length is around 15 kilometers. Our preliminary analysis, utilizing the synthetic aperture radar interferometry (InSAR), suggests that the two shocks could have broken different along-dip portions of the same fault instead of the two adjacent segments of the Ahar fault.