ALOS-2 observation of the 2017 Sefidsang earthquake, northeastern Iran: a blind shallow-dipping thrust event near the Eastern Kopeh Dagh

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The Iranian plateau is deformed between the converging Arabian and Eurasian plates. Their convergence is principally taken up by the active Makran subduction zone to the South, in addition to shortening and strike-slip faulting accommodated by crustal structures, which are non-uniformly distributed in several continental deformation domains such as the Zagros, Alborz and Kopeh Dagh mountain ranges. During the last decade, several studies carried out in the Zagros, Alborz and central Iran have produced a better understanding of active deformation in these zones. Conversely, such detailed studies are less common in northeast Iran.
Indeed, despite all the efforts made by previous workers to shed light on active tectonics in northeast Iran, this region still suffers from a lack of detailed structural and kinematics data and should be considered as a concealed segment in the geodynamic puzzle of the Arabia-Eurasia collision. This matter is made worse by the facts that northeast Iran is the second populated region and one of the most seismically active deformation domains in the country that has experienced at least nine large earthquakes (M >= 7) during the last six centuries (Tchalenko, 1975; Ambraseys and Melville, 1982; Berberian and Yeats, 1999, 2001).
On 5 April 2017, an Mw 6.1 earthquake occurred in the northeastern region of Iran, about 90 km southeast of the city of Mashhad, the second most populous city in Iran with a population of over 3 million people. The epicenter (35.776 N, 60.436 E, USGS) was at a remote mountainous area, about 30 km northeast of the Sefidsang district where approximately 5000 people live, and the depth was about 13 km. This earthquake raised an opportunity to study the deformation pattern in the SE of the Kopeh Dagh Mountains.
Space geodetic observations of ground deformation provide important data to investigate the seismogenic fault and the subsurface deformation mechanics. Here we used ALOS-2 synthetic aperture radar data to produce SAR interferograms using the GMTSAR software (Sandwell et al., 2010) to investigate coseismic and postseismic deformation associated with the 2017 Sefidsang earthquake. The ascending and descending interferograms were produced and both indicate thrust-dominated slip that is consistent with seismic data sets, with the maximum line-of-sight coseismic displacement of 9.9 and 13 cm, respectively. The obtained coseismic deformation maps have good consistency with Sentinel-1 interferograms that showed maximum line-of-sight displacement of 10.5 and 13.7 cm for ascending and descending interferograms, respectively (Xu et al., 2018).
We also used ascending SAR data acquired on 2017/06/24 to 2018/12/22 for evaluating the postseismic deformation caused by this earthquake. The produced interferogram does not show any displacement more than the noise level (~1 cm).

Keywords: InSAR, Northeastern Iran, Kopeh Dagh, Sefidsang earthquake

