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GROUND DEFORMATION OF THE 2017 MW6.1 FARIMAN EARTHQUAKE-NE IRAN USING SENTINEL-1A INTERFEROMETRY

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Northeastern Iran is one of the seismically active zones and has suffered a lot of devastating earthquakes over its history, some of which have been accompanied by considerable losses (Berberian and Yeats, 1999). The northeastern Iranian Plateau, which is situated at the eastern most penetration corner of the Arabia-Eurasia plate-collision zone (Jackson, 1992), is experiencing north-south crustal shortening between seismotectonics proviences of Central Iran and Lut Block and the Turan platform. Previous studies have shown that the northward-moving of Arabia with respect to Eurasia is accommodated at a rate of 22 ± 2 mm/a at the longitude of Bahrain (Reilinger et al., 2006) and about 4 to 10 mm/a in northeast of Iran (Shabanian et al., 2009). Most of the north-south convergence has been absorbed by crustal compressing normal to a series of NW–SE-striking mountain ranges, such as the Kuh-E Sorkh, Binalud and Kopeh Dagh Mountains (Su et al, 2018).

First, the northward motion of the Lut zone and central Iran with respect to Afghanistan should be taken up between the Doruneh Fault and the Kopeh Dagh Mountains with trivial absorption across the northern part of central Iran. Second, part of this motion have to be transferred between the Binalud and Kopeh Dagh mountain ranges, as strike-slip motion along localized major fault systems or in form of distributed deformation (on several faults with comparable slip rates).

Interferometry using InSAR (Interferometric Synthetic Aperture Radar) is the precise method based on the use of at least two SAR images from a special location and is able to discover the changes in vertical displacement accurately at large scale over different time intervals in accuracy of millimetre level (Tang et al., 2016). InSAR has been broadly utilized for surveying the deformation of the earth's surface induced by seismic activities (Amighpey et al., 2009; Feng et al., 2017).

The Sentinel-1A sensor have been routinely sensing over the plateau of Iran with minimum orbit repeat cycle of 6 days since 2014 at both descending and ascending modes. Specifically, all the accessible descending VV co-polarized C-band images with an interval of 12 days at path 93 and frame 472 have been considered for our research from 2017-03-18 to 2017-05-05. These Single Look Complex (SLC) data, available from ESA data hub in the Interferometric Wide (IW) swath mode, have pixel spacing of about 20 m by 5 m in azimuth and range components, respectively. The incidence angle of scene center is about 34 degrees.

The detected differences of ground deformation of the co-seismic DInSAR pair could generally be attributed to the cumulative energy release by the aftershock sequence. The surface coseismic displacement showed an upward with a minor left ward slip of hanging wall in the eastern side of a fault plane, with a peak uplifting of ~12 cm along the line-of-sight direction (Figure 1). These data indicate that strike-slip faulting also plays a critical role in the slip partitioning of NE Iran. Based on Descending path data, we detect an oval-shaped area in 20 km length and 10 km width far about less than 5 km southwest of the epicenter, with largest LOS displacement of 12 cm. Our results show that how the Kopeh Dagh region has been accommodating the deformation due to the collision between Arabia and Eurasia. Also reactivation of this part of Kopeh Dagh should be considered for reassessing the earthquake hazards of this area and shows the importance of geodetic researches beside of seismic studies.

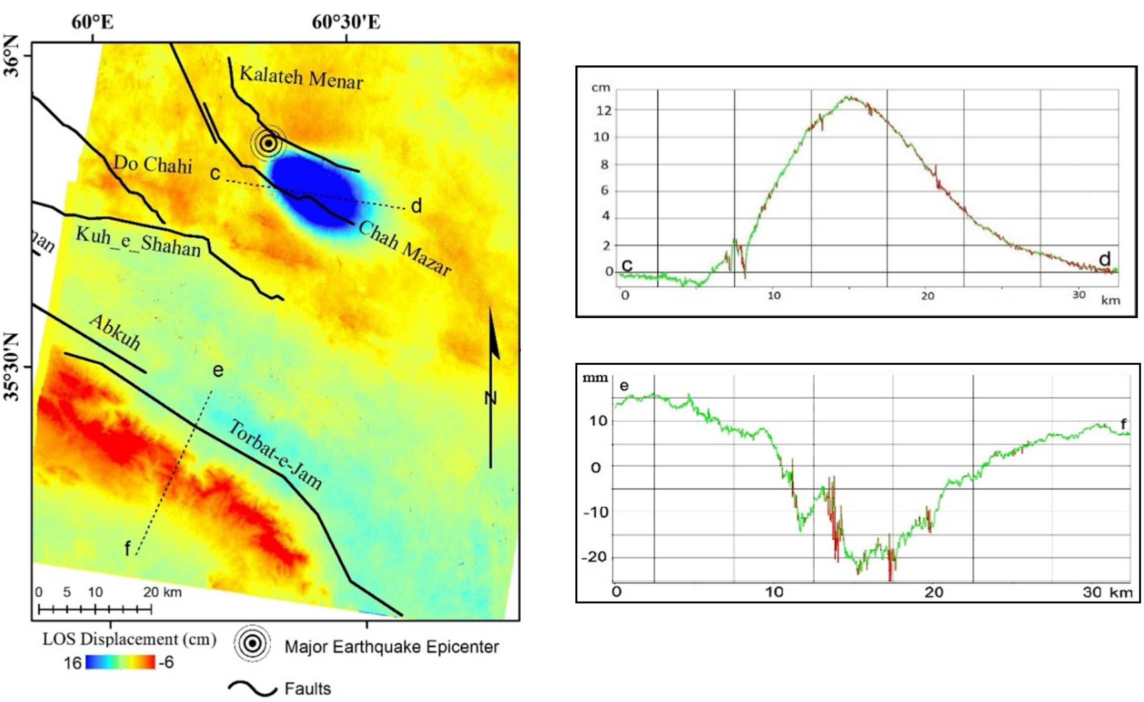

Figure 1. Coseismic deformation velocity obtained from Sentinel-1A InSAR processing and Displacement profiles.

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