Space geodetic investigation of the coseismic deformation associated with 12 December 2017 Mw 6.2 Hojdek and 12 November 2017 Mw 7.3 Sarpol-e Zahab Iran earthquakes

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Abstract

Study of the crustal deformation field induced by earthquakes and determining the fault geometry is essential for a better understanding of seismic hazard and geologic evolution. In this study, we focus on two intracontinental earthquakes occurred in south and west of Iran in 2017. The deformation in the Iranian plateau is the result of the convergence between Arabian-Eurasian plates at a rate of 25-30mm/yr. This convergence energy is accommodated by a mixture of thrust and strike-slip faulting in the Zagros, Alborz and Kopeh Dagh mountain ranges. Consequently, most of the earthquakes inside Iran are related to localised deformation in these zones. We investigate the geometric and kinematic characteristics of the seismogenic faults of 12 December 2017 (MW 6.2) Hojdek earthquake in the south of Iran and the 12 November 2017 (Mw 7.3) Sarpol-e Zahab earthquake in Zagros, west of Iran using geodetic data. The first event is related to Lakar Kuh fault located between roughly north-south trending Kuhbanan and Nayband faults. These North-South trending faults are accommodating part of North-South shear between Central Iran and Helmand block as a part of the Eurasian plate. The second one is associated with the deep basement oblique thrusting occurred in northwestern of Zagros. We take advantage of satellite interferometry method to measure coseismic deformation associated with the above earthquakes. Sentine1-1 TOPS and ALOS-2 ScanSAR data are processed interferometrically to constrain coseismic deformation field. We use a combination of burst overlap interferometry and offset tracking method to resolve deformation in near field and areas affected by rockslides and landslides. We then invert the across track and along track displacement field derived by the combination of interferometry and offset SAR methods to infer the fault geometry, location and distribution of slip on the fault plane. Fault location, geometry and uniform slip on it, are resolved by applying Bayesian inversion on the measured coseismic displacement. Our results suggest that the main deformation related to 12 December 2017 Hojedk earthquake occurred as a result of WNW-ESE thrusting faulting as a termination of Lakar Kuh fault. The main rupture is concentrated at a depth between 8 and 10 km, characterised by a shallow rupture reaching the surface. For the second event, the 12 November 2017 Sarpol-e Zahab earthquake, our results indicate the mainshock was generated by a blind ENE oblique

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overthrust faulting with an average slip of 5 m at a depth between 14 and 20 km. The results are further interpreted against existing geological and morphological structures for a better understanding of the tectonic deformation and seismic hazard in the regions affected by the two earthquakes.