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SOURCE INVERSION OF M7.3 12 NOV. 2017 SARPOL-E ZAHAB EARTHQUAKE USING FUZZY INVERSION METHOD

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On 12 Nov. 2017 an M7.3 earthquake shook Sarpol-e Zahab city in north-western Zagros seismogenic area, near Iran-Iraq border line. The earthquake killed more than 600 people and the strong motion was widely felt in Kermanshah and Kurdistan provinces of Iran as well as major city of Sulaymanieh in Iraq. Before this earthquake, no high-magnitude (>7.0Mw) earthquake was recorded in this area (Nissen et al., 2019), and the causative fault was not completely known before (Gombert et al., 2019) while the epicentral region is surrounded by a complex set of faults. In order to study the co-seismic displacement within the rupture of this earthquake, a kinematic source model is found by fuzzy inversion method (FIM) (Navid Kheirdast et al., n.d.) using geodetic satellite data (InSAR) from Sentinel-1 and strong-motion recordings of BHRC in the frequency domain. The fuzzy inversion method helps to decrease the effect of ill-posedness in the source inversion problems, where the effect of non-uniqueness and instability will be controlled which results in a more reliable dislocation model. FIM helps in determining the ruptured area by distinguishing it within the inversion process.

In this study, the revised hypocenter from IIEES which is solved with nonlinear location algorithm (Lomax et al., 2000) is used. This location is in good agreement with S-P phase in the recorded data. This location is in good agreement with S-P phase in the recorded data. We used 28 strong motion recordings within 200 km of Since the strong motion dataset does not contain the timing information, we corrected the arrival phases by simulating Green functions considering the resolved hypocenter as the origin, then aligning the synthetic P- phase with observed one. In this work, we used CRUST1.0 velocity-density structure (Laske et al., n.d.) for the region of study for synthetic wave field calculation.

The size of ruptured area is determined by inverting the InSAR data. The abundant number of observation points that represents the 3-dimensional permanent displacement (zero frequency) of the Earth surface, calculated from interferometry analysis, is then inverted to recover the final slip of the fault plane. The problem in zero-frequency is over determined. By means of fuzzy inversion method, we selected the most important part of the fault which has the most contribution in the rupture, then by means of hybrid learning method (Jang and Chuen-Tsai Sun, 1995), we improve the resolved slip iteratively. After finding the rupture area, higher frequency (<1.0 Hz.) component of the slip function is found by inverting the strong motion data.

The obtained kinematic model (Figure 1) shows a 36 km (along strike) by 22 km (along dip) fault where the rupture was starting from ~45 km north to the Sarpol-e Zahab city. A rupture velocity of ~5 km/s was recognized. There is only one asperity revealed by the inversion with the maximum slip of 4.0 m, 25 km north to the Sarpol-e Zahab city.

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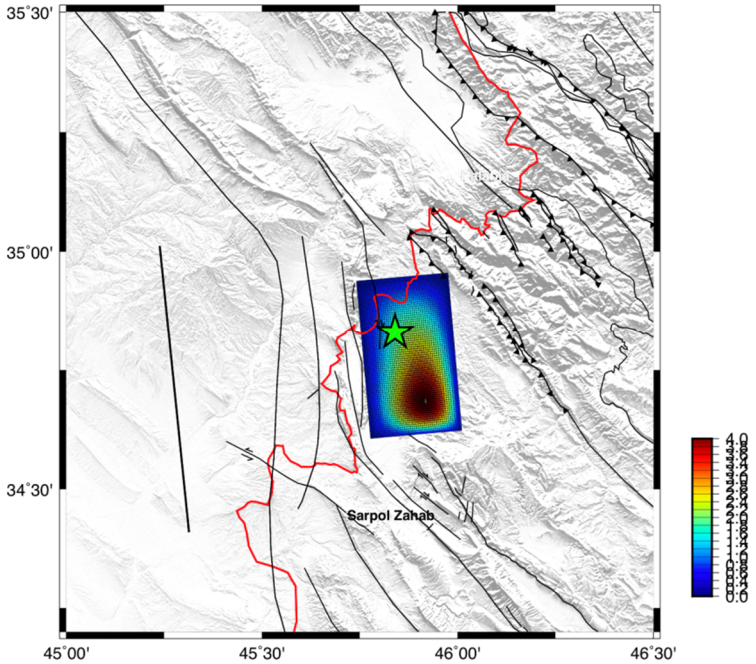

Figure 1. The final slip of M7.3 2017 Sarpol-e Zahab from fuzzy inversion method.