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THE DOUBLE DIFFERENCE RELOCATION OF AFTERSHOCK SEQUENCE OF 2017 EZGELEH EARTHQUAKE

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On November 12, 2017, an earthquake with moment magnitude of 7.3 occurred in vicinity of Sarpol-e Zahab town, Kermanshah, Iran. The main earthquake of November 12 has been proceeded by a large number of aftershocks; from that date until January 2019, 5078 earthquakes have been recorded by Iranian Seismological Center (IRSC). This earthquake has been the largest event in this region in the last hundred years, the previous largest event in the area had occurred in 1909 AD in Silakhor with magnitude of 7.4. In this study in order to relocate 2017-2019 earthquakes in the region, double difference earthquake location method of Waldhauser and Ellsworth (2000) is applied. The double-difference algorithm minimizes errors due to unmodeled velocity structure without the use of station corrections. The method incorporates ordinary absolute travel-time measurements and/or cross-correlation *P*-and *S*-wave differential travel-time measurements. Two waveforms recorded at the same station are considered similar when half of the squared coherency value, in a specified frequency range and time window is exceeding the chosen correlation coefficient (Waldhauser and Ellsworth, 2002). Residuals between observed and theoretical travel-time differences are minimized for pairs of earthquakes at each station while linking together all observed event-station pairs. Using the cross correlation method on similar seismograms to obtain accurate phase arrivals, could reduce the location uncertainty that will lead to more efficient detection of waveforms that are more similar to already known events (Ottemö ller and Thomas, 2007). In this study, In order to improve the image of the seismogenic features, relocation has been done with both catalog data (P and S phases) and cross correlations data (P phases) combined, for simultaneous relocation for all events. Using Cross Correlation has improved the accuracy of the phase picking (Figure 1).

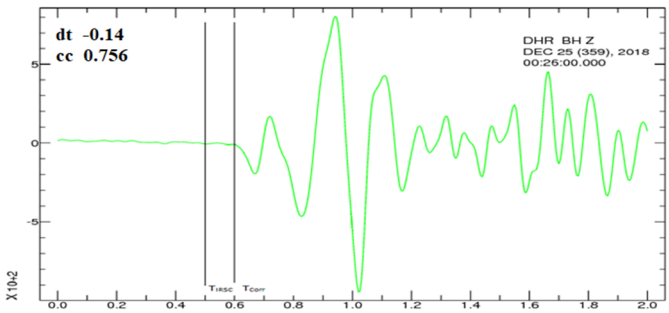

Figure 1. Improved phase picking using Cross Correlation method (T_{IRSC} shows initial phase picking and T_{Corr} shows phase picking using Cross Correlation method).

Figure 2-a illustrates IRSC locations; as it can be seen, the events near MFF fault (Ezgeleh earthquakes) show high scattering; Figure 2-b shows the relocated events derived with the combined set of catalog and Cross Correletion data; the relocation results reveal a more focused picture of seismicity. The cross sections from different points of view are shown

in Figure 3, the comparison between upper (IRSC data) and lower (relocation data) panel shows considerable improvement in depth distribution of events in the study region. Looking at the earthquakes from AA' point of view (Figure 3-a) shows no special trend; also there is high scattering in the distributions of earthquakes, this scattering is due to these possible reasons: 1. improper data quality, 2. The aftershocks are not occurred in simple and only one plane, 3. The low dip causative fault. From BB' point of view (figure 3-b) a low slope can be seen from E-W direction, the events scattering increases towards MFF fault. A slope towards NW can be seen in Figure 3-c, which is in good agreement with the focal mechanism shown in Figure 2-a. DD' cross section in Figure 2-d illustrates Tazeabad events that coincided with the Ezgeleh aftershocks. They show high slope towards North; events in this direction are highly concentrated that is possibly because of a high angle fault. Furthermore, there are no known faults in the area. It must be added that the aftershocks distributions are in agreement with the fault plane solutions in this region.

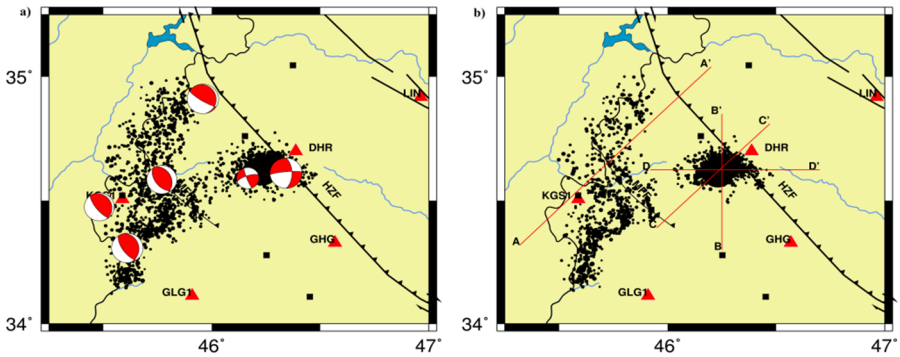

Figure 2. The comparison between IRSC locations and relocated data: a. IRSC Locations and the focal mechanism of some events, b. Relocated events and the direction of the cross sections.

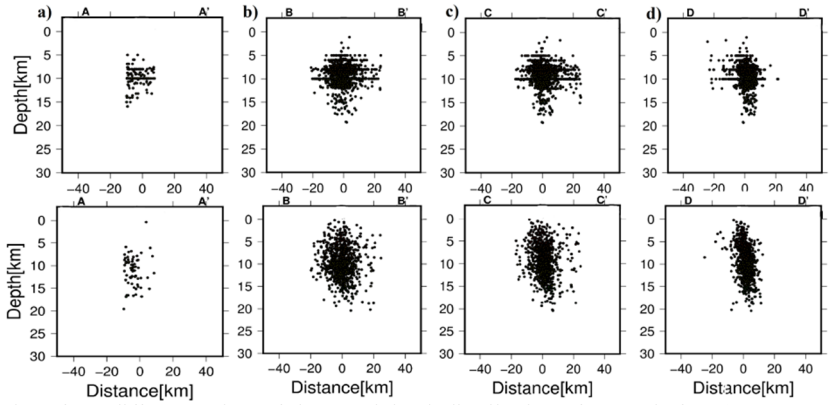

Figure 3. Cross sections from different points of view, and depth distribution of events before (upper panel) and after (lower panel) relocation a. AA'. b. BB'. c. CC'. d. DD'.

This method has been successfully applied in the study area. The results show that the average of RMS has decreased from 360 ms to 28 ms for catalog date and 5 ms for Cross Correlation data. The results show that the Ezgeleh earthquakes hypocenters in the discussed time-space interval has a slope towards NW direction; also the Tazeabad earthquake sequence shows a clear slope towards NW direction.

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