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THE FIRST VERY-SMALL-APERTURE SEISMIC ARRAY IN IRAN FOR MONITORING EARTHQUAKES AND VOLCANIC ACTIVITIES IN DAMAVAND REGION; A PRELUDE TO AN EARLY WARNING SYSTEM FOR METROPOLITAN TEHRAN

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To monitor possible seismic activities related to Damavand Volcano and earthquakes associated with Mosha Fault Zone, a very small aperture seismic array was deployed to the foot of the Damavand Volcano. The array proved to be capable of detecting small events which otherwise were not reported by permanent networks due to their sparse distribution of stations in the region. There were also tremor like phenomena observed which might be related to Damavand volcano, a dormant volcano which constantly emits fumarolic gases and hosts a number of hot springs on its flank. The array boosted by installation of a high accuracy GPS station for future seismogeodetic measurement may be seen as a prelude for an early warning system for metropolitan Tehran.

Seismic arrays since the start of their deployment in 1950's (have undergone continuous improvement both in configuration and instrumentation to meet various needs from monitoring nuclear explosions to detection of earthquakes and microtremors. Array seismology has therefore played a major role for monitoring local regional and teleseismic events. What differentiates a modern seismic array from traditional networks is not its configuration or equipment but rather the methods used in analysis of their data.

In order to test the capability of a very small aperture seismic array which is easier to deploy than other alternatives, a site close to Damavand volcano which is in fact the abandoned construction camp of Lar water dam, around 70 km northeast of Tehran was chosen (Figure 1).

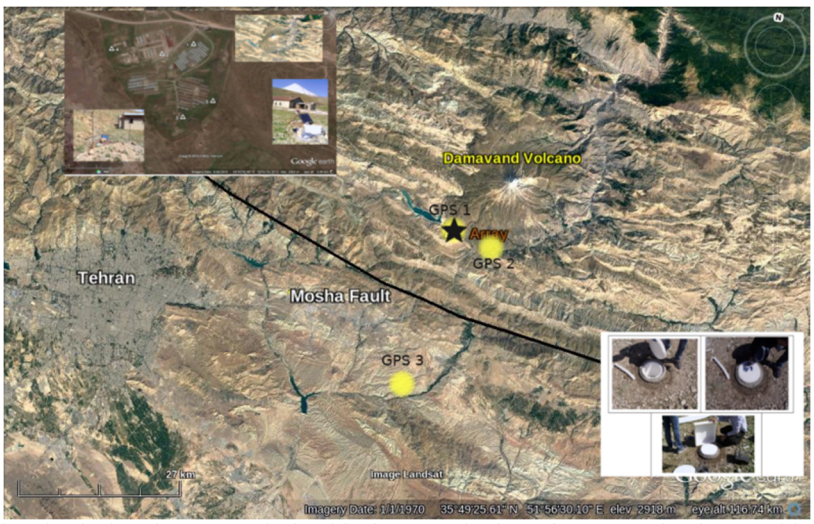

Figure 1. The location map showing the deployed array marked as black star at the foot of Damavand Volcano, with three GPS stations designated as yellow circles. The location of GPS 1 station is at the array site and the GPS 3 station was installed at IIEES permanent seismological station, DAMV. The station GPS 2 is the location of GNSS permanent GPS station LAR. The Mosha fault is also shown as the black line, northeast of metropolitan Tehran. The upper-left inset is the actual configuration of the array and the bottom-right inset the construction and insulation of sensor vault.

The installation of a tripartite array in winter of 2014 at the first stage of the deployment was later strengthened by installation of two more stations in spring of 2015. The array which enjoyed 38 days of continuous operation in spite of a series of technical problems. It has restressed the effectiveness of a very-small-aperture seismic array for detection of seismic activities while such deployment is logistically and practically more feasible than installation of network of stations for detection and localization of seismic events. With thought of an early warning system and prospect of a seismogeodesic network on mind, collaboration with National Cartographic Center of Iran was made and two high accuracy GPS stations were installed, one in the array site north of the Mosha fault and the other south of it at the site of DAMV permanent seismic station of IIEES, augmenting the already operational GPS station at lower camp of Lar water dam, the permanent GNSS station LAR.

The rather short operation of the array was luckily coincided with the occurrence of a moderate earthquake of Ml=3.2, ca. 20 km southwest of the array which was detected by the array (Figure 2-a). This event which had been located by Iran Seismological Center was preceded by another event which went undetected (Figure 2-b).

The array was also able to detect tremors believed to be related to Damavand volcano activities (Figure 3).

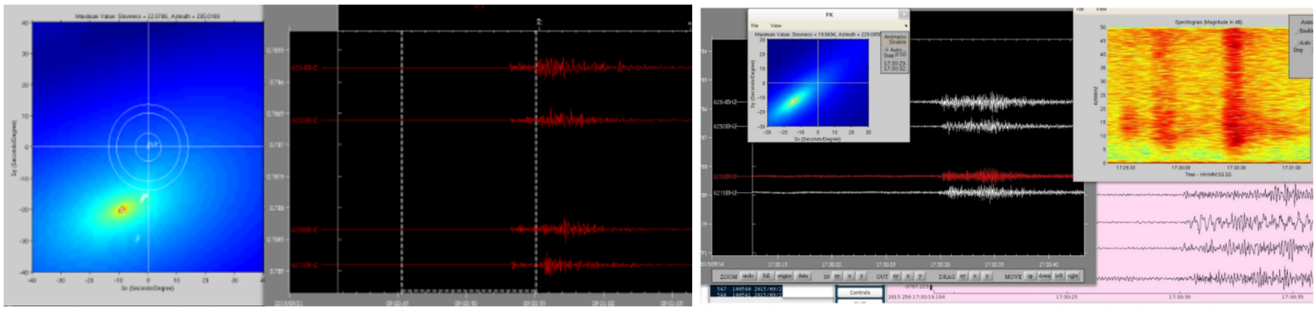

Figure 2. (a) A magnitude 3.2 event detected by the array and FK analysis shows the energy coming from 205 azimuth, (b) Another event, much smaller preceded this event on 16.09.2015 which went unnoticed by permanent networks but detected by the array. It must be located in the neighborhood of the main event.

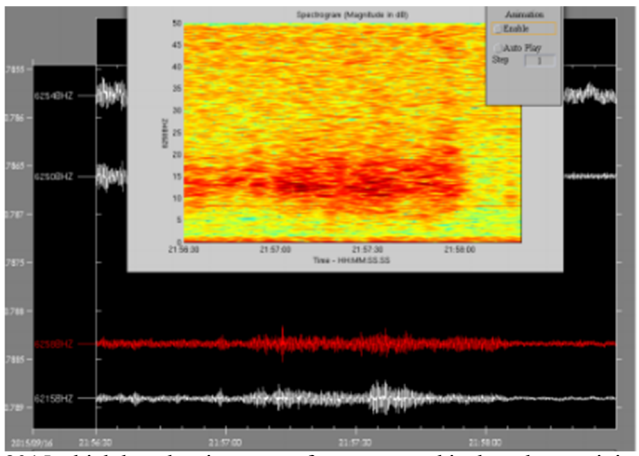

Figure 3. A signal on 16.09.2015 which has the signature of a tremor and is thought to originate from Damavand Volcano.

The continuation of the project is underway by reinstalling the array in the same location. It is planned to parallel the development of software and hardware tools for both seismological and seismogeodetic analyses as tools for an early warning system based on seismic arrays.

REFERENCES

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