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Modling of Fault Directivity of 2012 Ahar-Varzaghan Earthquake with Aftershocks Data

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Abstract:*On the11st of August 2012 northwestern Ahar and northeastern Varzaghan, eastern Azarbayjan province in Iran,were struck by two major earthquakes which measured firstM_w =6.4 (6.4onthe moment magnitude scale) at 12:23:15 UTC time and second M_w= 6.2 at 12:34:33 UTC time. Several aftershocks occurred in the cities, the biggest one of which (M_W=5.5) happened on the 7th of November 2012 at 6:26:31 local time 9 kilometers away from Varzaghan. In the present article, this area was considered the main earthquake focus along with the two major earthquakes. We attempt to develop determine aftershock trends of the area based on aftershocks. After drawing diagrams and maps, we discover that aftershocks crack at the bottom of the plane in the three main focuses. This means that earthquake activity starts in the west and stops in the east with lower speed and velocity. As a result, earthquakes are more active in the west. In addition, is using surfer, Arc GIS.*
Keywords:*Ahar-Varzghanearthquake,modling , aftershock*

I. Introduction

Increasing human dependence on the nature along with growing economic activities necessitates a noticeable amount of investment. The investment should be done with sufficient assurance in order to guarantee human survival. Natural disasters such as earthquakes have always occurred on the Earth throughout man's history [1,2].

In spite of technological advances, the occurrence of earthquake can't be controlled yet, thereby incurring huge costs of human society. Over the last few decades, studies conducted on earthquakes and possible prediction of temporal and partial distribution of earthquakes have focused on the transmission of released tension during big earthquakes in the areas surrounding rupture. These studies have also concentrated on interaction phenomenon in those events. Consequently, considerable breakthroughs have achieved in this field[3, 4, 5].

The geo-structural position of Iran plateau in Himalayan- Alps belt caused numerous earthquakes in Iran as Arabic plane moving towards the north converged Asia-Europe plane. In this relation, Iran is the fourth earthquake-stricken country in Asia. Given the time of the occurrence of earthquakes over the past years, on average an earthquake measured 6-7 on Richter scale happened every 10 years in Iran plateau[6, 7]. About 9 years after an earthquake in Bam in the year 2003,an earthquake measured 6.2-6.4 on Richter scale shook Ahar-Varzegan. Ahar-Varzegan earthquakes in 2012 occurred in Alborz-Azarbaijan structures and have eastern-western trend. The existence of movement and Quaternary basic faults made the area become the most seismically active sheet in Iran [8, 9, 10].Other papers on this subjectinclude [11-18].

The present article is arranged as ensued: In part 1, we introduce the issue. In part 2, we demonstrate the methodology. In part 3, we accomplish the results and discussion. For part 4, a brief conclusion is given.

II. Methodology

In the present paper, we study two main earthquakes measured 6.2 and 6.3 on Richter scale on the eleventh of August 2012 as well as the biggest aftershock measured 5.5 on Richter scale on the seventh of November 2012. The epicenter map of these three earthquakes along with 498 aftershocks in a 12-month time period is shown[10].

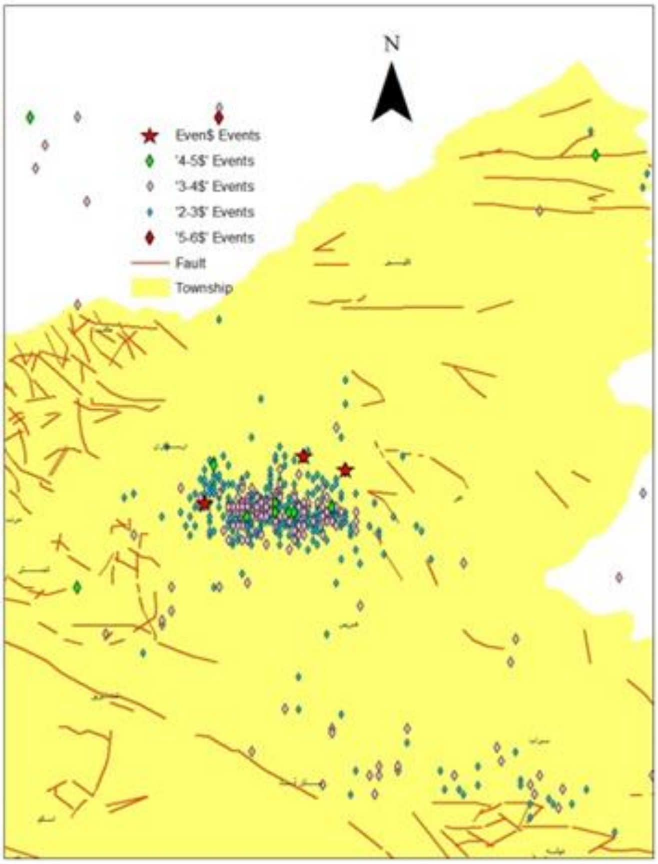

Fig.1: Three main earthquakes with aftershocks in a 12-month time period using ArcGISsoftware

Firstly, we locate 498 aftershocks of three earthquakes in geo-structural seismic map of the area[17]. As can be seen in both geological and geo-structural seismic maps, there are two faults and most aftershocks occurred beyond the area. This condition can be attributed to the tectonics of the area. Thus, aftershocks trend shows a broken plane. We drew these faults using geological evidence, geological and geo-structural maps. Later, we located all aftershocks of the main earthquakes in different time periods and realized that no aftershocks occurred on active and well-known faults. In other words, there are no clear faults but instead active latent faults. A modeling map of the location of aftershocksis shown in the following:

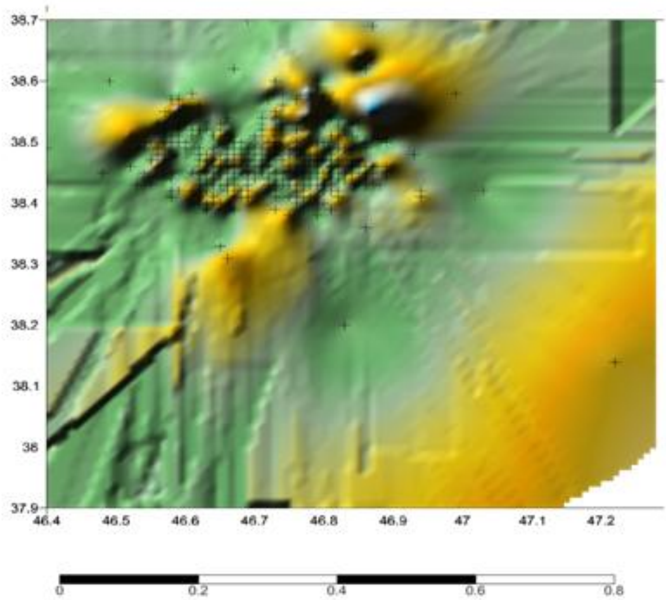

Fig.2: A modeling map of the location of Ahar-Varzegan aftershocks using surfer software

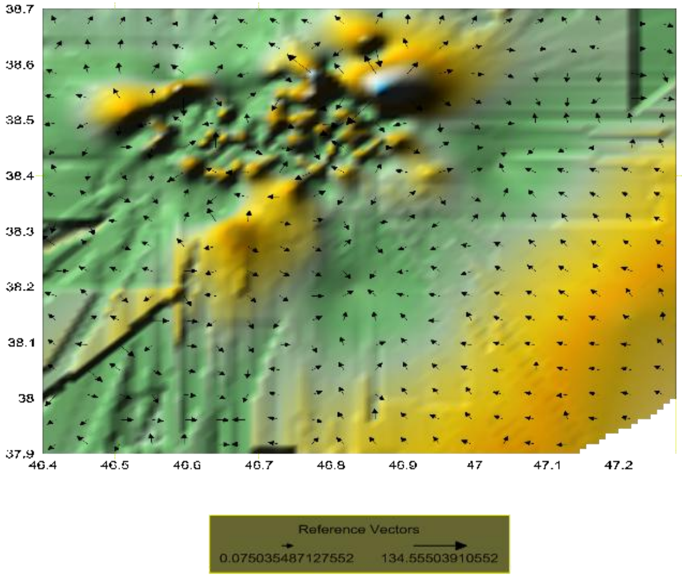

Fig.3:A modeling map of the location of Ahar-Varzegan aftershocks along with their movement directions using surfer softwareAs can be seen in the two-dimensional modeling map, aftershocks are concentrated in the North.

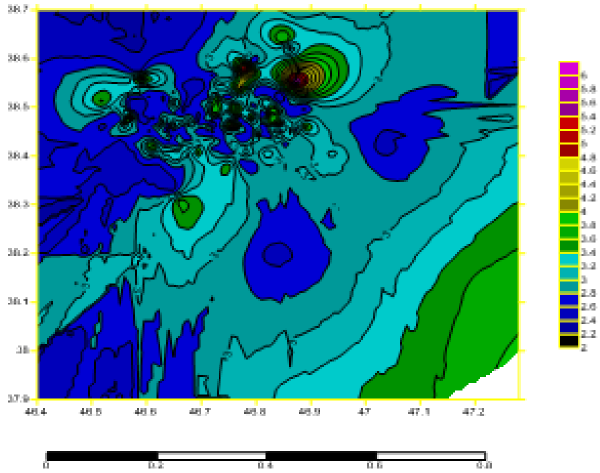

Fig.4:A tow-dimensional map of Ahar-Varzegan aftershock modeling using Surfer softwareIn the following maps,the fusiform indicates the magnitude of earthquakes. The sharp edges suggest that bigger earthquakes happen less frequently and extend from the east to the west.

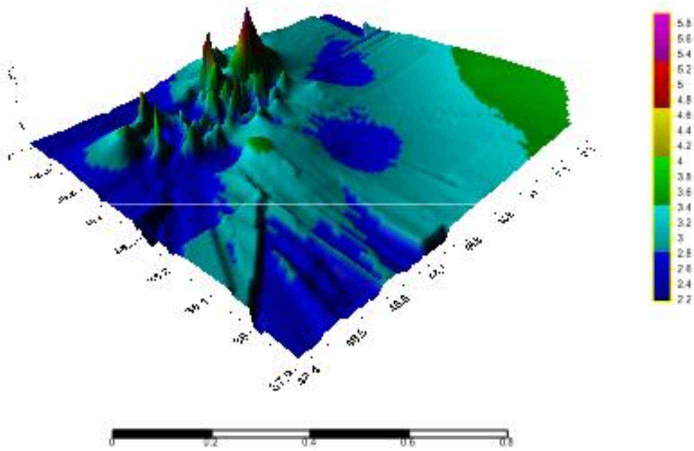

Fig.5:A three-dimensional map of Ahar-Varzegan aftershock modeling using Surfer software.

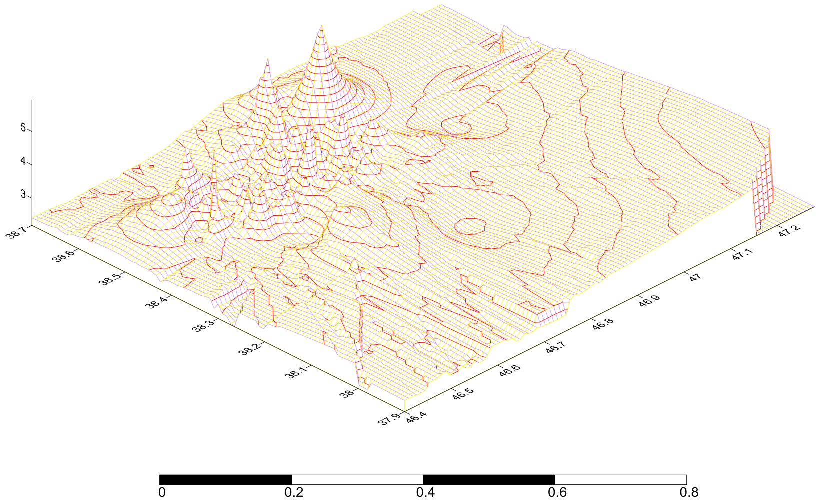

Fig.6:A three-dimensional map of Ahar-Varzegan aftershock modeling using Surfersoftware

III. Results and Discussion

The difference of seismicity and energy release in different parts of Iran shows that physical properties and fault systems are different in different parts of the country. Additionally, the structure of the Earth is considerably heterogeneous in different areas. It should be noted that the occurrence of aftershocks depends on the study of physical phenomena. Therefore, it's essential to identify aftershocks better. It's possible to identify the active fault involved in the earthquake after determining the protraction of activated latent faults and aftershocks migration trend by temporal and spatial distribution of aftershocks.

IV. Conclusion

After having determined the location of all aftershocks in the area, we discovered a movement trend from the east to the west. This, in turn, indicates the movement of latent fault under study.Fusiformaftershocks suggest that the movement started from the west and finished in the east with lower speed and intensity. This finding suggests the importance of earthquake activity in the west of the area under study.We can conclude that there is a latent active fault with eastern-western trend. This information can be used for studying other earthquakes and /or construction activities in the area. We need to strengthen construction or establish construction in other places.

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