Some analysis of seismicity in the Sumatra area

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Abstract: *Investigating both aftershock behaviour and a wide spectrum of parameters may find the key to better explain the mechanism of seismicity as a whole. In particular the purpose of this work is to apply some different statistical approaches related to the seismicity of "Sumatra area" (Indonesia). We focalised our attention on the seismicity from 1973 to 2004 and on different seismic sequences happened in this area. We estimated the variation of p-value, b-value, the energy involved into the decay process and the fractal dimensions D_0 and D_2 to highlight the clustering of events in time.*

1. Introduction

The earthquakes are natural phenomena that occur in particular zones of the Earth's surface. They are related to complex processes. One of the classic problems in global seismology has been the mapping of earthquake distribution. This mapping has played a key role in the evolution of the theory of plate tectonics, which describes the large-scale relative motion of a mosaic of lithosferic plates on the Earth's surface. Usually the energy during an earthquake is released from the mainshock. It could be preceded by foreshocks and follows by a lot of aftershocks. Statistical studies related to the seismicity and occurrence of earthquakes could give us useful interpretation to better explain the mechanism of seismicity.

2. Data and analysis

In particular the purpose of this work is to apply some different statistical approach related to the seismicity of "Sumatra zone". We analysed also three different seismic sequence happened in this area on 13 February 2001, 2 November 2002 and 26 December 2004 having the magnitude of the mainshock respectively M=7.4, M=7.6 and M=9. We evaluated in this case also the *b*-value, *p*-value, cumulative energy, and the fractal dimensions D_0 and D_2 to highlight the clustering in time of events; everything is related to some anomalies in the temporal decay. We consider an anomaly when, during the aftershock decay, the absolute values of differences between the observed and the theoretical temporal trend are greater than 2.5σ quantity being σ the standard deviation (Caccamo et al., 2005a,b; D'Amico et al. 2005, Parrillo et al.,2005). Data used in this study come from NEIC-USGS data bank (http://neic.usgs.gov/neis/epic/). A large earthquake cause a lot of damages. Certainly it will likely be followed by several aftershocks of considerable size in a short time span. Earthquakes located within a characteristic distance from the main event can be considered aftershock. Regarding to the seismicity of the area and the behaviour of aftershocks we are trying to use other statistic methods like the un-parameter procedure "NPC Ranking" and the Cox-Stuart's approach. The first one is a statistic method that consent to draw up some classifications. With this method it is possible draw up some classifications concerning every observation. His peculiarity is that it to consent and pass easily from a partial classification to a general. This peculiarity has an important statistical interest because it summarizes the effects of single observations . In order to estimate temporal aspects of the seismicity we used un-parameter text because his use permit to establish phenomenon's trend in a given period.

Cox and Stuart's test permit to verify, for the variable that was considered into different methods, if exist a monotonous trend at the increase or at the decrease of the central trend or of variability.

3. Discussion

Some analysis were focalised on different seismic sequence happened in this area on 13 February 2001 (Lat_{main}=–4.68N; Lon_{main}=102.56E), 2 November 2002 (Lat_{main}=2.82N; Lon_{main}=96.08E) and 26 December 2004 (lat_{main}=3.3N; lon_{main}=95.98E) having the magnitude of the mainshock respectively M=7.4, M=7.6 and M=9. To define in space a sequence we calculated "a priori" the dimension of the involved area using the Utsu's (1969) empirical relation. We calculated the "barycentre" of the aftershock sequence, too (D'Amico et al.,2004). The completeness threshold was made using the Gutenberg- Richter's relation (1954). Typically, the frequency of occurrence of aftershock decays rapidly. For the temporal duration d of a seismic sequence we empirically considered d=n_1+n_2 where n_1 is the number of days equals to the number of aftershock in the 24 hours starting from the occurrence of the mainshock and n_2 the number of days, after n_1, that reach and include 10 days in which there are not earthquakes. Time clustering of seismic activity are investigated by fractal dimensions. Here we used the fractal method based on the estimation of the box- counting dimension and the correlation dimension related to the seismic sequences located in the Sumatra area. The analysis are made before large aftershocks with M>5.5 occurred in the time sequence. In the analysed sequence we can notice a clustering in time of box- counting dimension and of the correlation dimension. They have values very close to zero. Relating to the NPC Ranking, in order to classify the earthquakes, that were registered in the investigated area, we individuated the magnitude, M, in four intervals (5<M<6, 6<M<7, 7<M<8 e 8<M<9) during the period 1973-2004. The Cox-Stuart's test was applied on our data. In our investigation we want inquire into possible monotonous trend to the increase or decrease of the seismic events with 5<M<9, in the geographic region regarding to Indonesia in the period of time 1973-2004. In a first moment this test was applied for all the shocks included between 5<M<9. In a second moment this test was developed on the shocks number included to 5<M<6, 6<M<7 e 7<M<9.

4. Conclusion

Concerning to the aftershock sequences we notice that there are some anomalies in the temporal decay before the occurrence of large aftershock. These anomalies are related to the variations, in a   short period, of the parameters above mentioned.

5. Acknowledgement

6. References

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