Time-dependent vs stationary seismic hazard assessment: an application to Mt. Etna volcano (Southern Italy)

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Hazard estimations based on the characteristic earthquake model and time-dependent renewal process are applied to the seismogenic faults at Mt. Etna volcano. Most of them are characterised by a long record of historically well-documented earthquakes occurred in the last 200 years (CMTE catalogue, Azzaro et al., 2000), often associated with coseismic surface faulting. We analyse the main seismic sequences associated to the seismotectonic domain of the Timpe system, in the eastern flank of the volcano (Azzaro, 2004). Intertimes computed for all the events which have occurred in this sector, with an epicentral intensity Io ≥ VIII EMS, show an aperiodicity coefficient (standard deviation over mean value) near to the one, typical of a stationary process; the mean recurrence time is about 17.2 years. The same analysis is also applied to a declustered catalogue, obtaining a recurrence time of 19.6 years, consistent with the value obtained by the historical rate from the catalogue. Conversely, by calculating the intertimes for each individual fault, the aperiodicity coefficient falls at ca. 0.33, depicting a quasi-periodic behaviour. For these reasons, a time-dependent approach to seismic hazard assessment by using a renewal model based on the Brownian Passage Time (BPT) distribution, is applied. Mean recurrence time of major events is calibrated by merging the inter-event times observed at each fault; aperiodicity is tuned on b-values from instrumental data, according to the approach proposed by Zoeller et al. (2008). Finally we compare these mean recurrence times with the values obtained by using only geometrical and kinematic information, as defined in Peruzza et al. (2008) for faults in Italy. Time-dependent hazard assessment is compared with the stationary assumption of seismicity, and validated in a retrospective forward model. Seismic hazard estimates is given in terms of earthquake rupture forecast: impending events are expected on the S. Tecla Fault and, secondly, on the Moscarello Fault, both involved in the highly active geodynamic processes affecting the eastern flank of Mt. Etna. References Azzaro R. (2004): Seismicity and active tectonics in the Etna region: constraints for a seismotectonic model. In: Bonaccorso A., Calvari S., Coltelli M., Del Negro C. and Falsaperla S. (Eds), “Mt. Etna: volcano laboratory”, American Geophysical Union, Geophysical monograph, 143, 205-220. Azzaro R., Barbano M.S., Antichi B. and Rigano R. (2000): Macroseismic catalogue of Mt. Etna earthquakes from 1832 to 1998. Acta Volcanol., 12 (1/2), 3-36 with CD-ROM. Upgrade to 2008 available on the web at http://www.ct.ingv.it/Sismologia/macro. Peruzza L., Pace B. and Cavallini F. (2008): Error propagation in time-dependent probability of occurrence for characteristic earthquakes in Italy. Journal of Seismology, DOI 10.1007/s10950-008-9131-1. Zöller G., Hainzl S., and Holschneider M. (2008): Recurrent Large Earthquakes in a Fault Region: What Can Be Inferred from Small and Intermediate Events? Bulletin of the Seismological Society of America, Vol. 98, No. 6, pp. 2641-2651, December 2008, doi: 10.1785/0120080146.

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