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A non extensive statistical physics analysis of the Hellenic subduction zone seismicity

F. Vallianatos (1,2), G. Papadakis (2), G. Michas (2), and P. Sammonds (2)

(1) Technological Educational Institute of Crete, Laboratory of Geophysics and Seismology, CHANIA, Greece (fvallian@chania.teicrete.gr), (2) Institute of Risk and Disaster Reduction, Earth Sciences Department, University College London, Gower Street, London, UK

The Hellenic subduction zone is the most seismically active region in Europe [Becker & Meier, 2010]. The spatial and temporal distribution of seismicity as well as the analysis of the magnitude distribution of earthquakes concerning the Hellenic subduction zone, has been studied using the concept of Non-Extensive Statistical Physics (NESP) [Tsallis, 1988 ; Tsallis, 2009]. Non-Extensive Statistical Physics, which is a generalization of Boltzmann-Gibbs statistical physics, seems a suitable framework for studying complex systems (Vallianatos, 2011). Using this concept, Abe & Suzuki (2003;2005) investigated the spatial and temporal properties of the seismicity in California and Japan and recently Darooneh & Dadashinia (2008) in Iran. Furthermore, Telesca (2011) calculated the thermodynamic parameter q of the magnitude distribution of earthquakes of the southern California earthquake catalogue. Using the external seismic zones of 36 seismic sources of shallow earthquakes in the Aegean and the surrounding area [Papazachos, 1990], we formed a dataset concerning the seismicity of shallow earthquakes (focal depth $\leq$ 60km) of the subduction zone, which is based on the instrumental data of the Geodynamic Institute of the National Observatory of Athens (http://www.gein.noa.gr/, period 1990-2011). The catalogue consists of 12800 seismic events which correspond to 15 polygons of the aforementioned external seismic zones. These polygons define the subduction zone, as they are associated with the compressional stress field which characterizes a subducting regime. For each event, moment magnitude was calculated from ML according to the suggestions of Papazachos et al. (1997). The cumulative distribution functions of the inter-event times and the inter-event distances as well as the magnitude distribution for each seismic zone have been estimated, presenting a variation in the q-triplet along the Hellenic subduction zone. The models used, fit rather well to the observed distributions, implying the complexity of the spatiotemporal properties of seismicity and the usefulness of NESP in investigating such phenomena, exhibiting scale-free nature and long range memory effects.

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