



Quantization of large earthquakes driven by asperities strain concentration patterns

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The role of asperities in fault evolution has been received continuously increasing attention as critical areas where nucleation and cascade like failure may take place. They consist patches where the contact takes place across the fault rough surfaces, accumulating elastic strain during the interseismic period. More than one asperity rupture result to strong and large earthquakes, a phenomenon mostly characterizing large subduction earthquakes. Identification of the factors controlling single or multiple asperities failure and their spatiotemporal behaviour is a key issue in seismic hazard assessment. It is the aim of the present work to explore the role of different spatial patterns of asperities as well as their different strength characteristics by means of simulation experiments via cellular automata models. Initial results show that the earthquake distribution clearly depends on a) the total real contact area of asperities, b) the relative distance between asperity patches and c) the fraction of strain that asperities may sustain in comparison to the corresponding value of the non-asperity sites. There is a definite range of the aforementioned controlling parameters, which result to a non-typical earthquake magnitude distribution and where a clear departure from the classical power law-like Gutenberg – Richter relation is depicted. More specifically, for one (more than one well separated) asperity (-ies) with significant fraction of strain unlocking thresholds a non-typical earthquake size distribution emerges where for low magnitude earthquakes a power law still holds, but for higher earthquake sizes, a quantum like behaviour emerges, i.e. there is one (more than one) certain earthquake sizes that are more probable to occur. This manifests a characteristic earthquake model, which although not adequately supported by observational data, is present in several applications of simulator models.

Keywords:

asperities, large earthquake quantification, characteristic model, cellular automata

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