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Evaluating the role of seismic energy on the behaviour of a Cellular Automata model for real earthquake processes

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Cellular Automata (CA), characterised by their massive parallelism, constitute a powerful tool for modelling and simulating complex natural phenomena, which are represented by complicated non-linear differential equations and can hardly be approached by standard numerical methods. A two-dimensional CA dynamic system comprised of cells-charges was recently proposed for the simulation of the earthquake process. In this paper, the study has been focused on a seismic energy based estimation of the initial conditions as well as on the enrichment of the recorded data that is used in order to test the model. Applying a retrospective approach as far as it concerns the validation of the Gutenberg – Richter relation of the recorded number of earthquakes at a certain region, the initial values of the CA cells play a significant role. Using the recorded data, the seismic energy that has been released during a certain time period is being evaluated for each cell. This value acts as a weight factor either enforcing or weakening the initial condition of the corresponding cell. Furthermore, the data that is used concern an area of moderate seismicity, namely the region of Macedonia and Thrace. A satisfactory number of strong ($M \geq 6$) earthquakes are included, thus increasing the credibility of the conclusions about the seismic properties of the area. The model optimizes the simulation results, which are compared with the Gutenberg – Richter scaling relations derived by the use of real data, as well as it expands its validity in broader and different regions of increased hazard. Finally, the user-friendly interface of the model has been enriched to further enhance its prominent features of low storage requirements, small processing time and extended parameterisation.