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Recurrence time statistics of landslide events simulated by a cellular automaton model

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The recurrence time statistics of a cellular automaton modelling landslide events is analyzed by performing a numerical analysis in the parameter space and estimating Fano factor behaviors. The model is an extended version of the OFC model, which is a paradigm for SOC in non-conserved systems, but it works differently from the original OFC model as a finite value of the driving rate is applied. By driving the system to instability with different rates, the model exhibits a smooth transition from a correlated to an uncorrelated regime as the effect of a change in predominant mechanisms to propagate instability. If the rate at which instability is approached is small, chain processes dominate the landslide dynamics, and power laws govern probability distributions. However, the power-law regime typical of SOC-like systems is found in a range of return intervals that becomes shorter and shorter by increasing the values of the driving rates. Indeed, if the rates at which instability is approached are large, domino processes are no longer active in propagating instability, and large events simply occur because a large number of cells simultaneously reach instability. Such a gradual loss of the effectiveness of the chain propagation mechanism causes the system gradually enter to an uncorrelated regime where recurrence time distributions are characterized by Weibull behaviors.
Simulation results are qualitatively compared with those from a recent analysis performed by Witt et al.(Earth Surf. Process. Landforms, 35, 1138, 2010) for the first complete databases of landslide occurrences over a period as large as fifty years. From the comparison with the extensive landslide data set, the numerical analysis suggests that statistics of such landslide data seem to be described by a crossover region between a correlated regime and an uncorrelated regime, where recurrence time distributions are characterized by power-law and Weibull behaviors for short and long return times, respectively. Finally, in such a region of the parameter space, clear indications of temporal correlations and clustering by the Fano factor behaviors support, at least in part, the analysis performed by Witt et al. (2010).