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Simulating statistics of lightning-induced and man made fires

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The frequency-area distributions of forest fires show power-law behavior with scaling exponents α in a quite narrow range, relating wildfire research to the theoretical framework of self-organized criticality. Examples of self-organized critical behavior can be found in computer simulations of simple cellular automata. The established self-organized critical Drossel-Schwabl forest fire model (DS-FFM) is one of the most widespread models in this context. Despite its qualitative agreement with event-size statistics from nature, its applicability is still questioned. Apart from general concerns that the DS-FFM apparently oversimplifies the complex nature of forest dynamics, it significantly overestimates the frequency of large fires. We present a straightforward modification of the model rules that increases the scaling exponent α by approximately $1/3$ and brings the simulated event-size statistics close to those observed in nature. In addition, combined simulations of both the original and the modified model predict a dependence of the overall distribution on the ratio of lightning induced and man made fires as well as a difference between their respective event-size statistics. The increase of the scaling exponent with decreasing lightning probability as well as the splitting of the partial distributions are confirmed by the analysis of the Canadian Large Fire Database. As a consequence, lightning induced and man made forest fires cannot be treated separately in wildfire modeling, hazard assessment and forest management.