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Simulating the effect of ignition source type on forest fire statistics

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Forest fires belong to the most frightening natural hazards, and have long-term ecological and economic effects on the regions involved. It was found that their frequency-area distributions show power-law behaviour under a wide variety of conditions, interpreting them as a self-organised critical phenomenon. Using computer simulations, self-organised critical behaviour manifests in simple cellular automaton models. With respect to ignition source, forest fires can be categorised as lightning-induced or as a result of human activity. Lightning fires are considered to be natural, whereas “man made” fires are frequently caused by some sort of technological disaster, such as sparks from wheels of trains, the rupture of overhead electrical lines, the misuse of electrical or mechanical devices and so on. Taking into account that such events rarely occur deep in the woods, man made fires should start preferably on the edge of a forest or where the forest is not very dense. We present a modification in the self-organised critical Drossel-Schwabl forest fire model that takes these two different triggering mechanisms into account and increases the scaling exponent of the frequency-area distribution by ca. 1/3. Combined simulations further predict a dependence of the overall event-size distribution on the ratio of lightning-induced and man made fires as well as a splitting of their partial distributions. Lightning is identified as the dominant mechanism in the regime of the largest fires. The results are confirmed by the analysis of the Canadian Large Fire Database and suggest that lightning-induced and man made forest fires cannot be treated separately in wildfire modelling, hazard assessment and forest management.