



## Savanna fire simulations using cellular automata: benefits and limitations

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**ABSTRACT** – Modelling and computer simulations have been used to manage and fight wildfires for many years. The primary goal of these numerical models is to predict fire spread and behaviour under various scenarios – i.e. weather, vegetation and topography. The advantage of cellular automata resides primarily in proposing a fire propagation model which attempts to simplify tremendously the physical model of known fire dynamics. Therefore, the model should be defined by a relatively small and simple set of rules that apply locally as to reduce the problem complexity while not sacrificing the model explanatory power at larger scale. The objective of our work is to test the suitability of the continuous cellular automata approach to model grass fire behaviour in highly heterogeneous landscapes. After reviewing and testing previous works (Karafyllidis and Thanailakis 1997, Berjak and Hearne 2002, Hernández Encinas et al. 2007), we derive a generalized CA ruleset that eschews most physical considerations in favour of the conservation of large scale fire properties in simplified landscapes, such as fire front shapes, area burned and behaviour in the presence of rate of spread heterogeneities. The ruleset is then incorporated into a GIS based model where each cell holds properties derived from discretised landscape features. With this approach, the landscape becomes a lattice of cells in the cellular automaton domain where the state of a cell is represented by its percentage of ‘area burned’ and where the local fire front behaviour is influenced by terrain, wind and vegetation cover at a given cell. The fire spread model is then tested for north Australia savannas where the vegetation cover is dominated by open forests and woodlands with a grassy understorey. The results of the simulations are used to create fire extent ‘risk maps’ centred on known points/zones of ignition, typically defence bombing range and defence training areas. A better validation of the model would be to compare the simulation results to historical fires. However, some challenges remain in integrating detailed vegetation cover, fine grained grass curing maps and weather data.

**Keywords:** Fire behavior; propagation model; tropical savannas; cellular automata; GIS landscape

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