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A Design for a Coupled Fire Spread, Fire Regime, and Urban Growth Model

ABSTRACT

As urban America spreads, the urban-wildland interface grows with it. This is notable in the American West, where the risk increases for urban areas to be endangered by wildfires. In the year 2000, millions of dollars were spent to control wildfires, yet thousands of homes were destroyed. As cities grow there is a greater need for planning tools that can both model where a city may grow and account for potential fire risk. We present the framework to couple an urban growth model with a fire regime and fire spread model as a platform for fire disaster mitigation.

The urban component of the model is a modified cellular automaton (CA) that has local rules applied across a landscape. Input data to the model are slope, road networks, present and historical urban extents and areas excluded from growth. The fire model is also a modified CA, which has rules on how the fire responds to wind, slope, fuel load, and moisture content of the fuels, all triggered by an ignition point.

In this framework, a randomly chosen ignition point from the fire regime model initializes the fire-spread model. Once a fire is triggered, it runs until extinction. The results of the fire spread are then relayed back to the urban growth model which transitions burned urban pixels from an "urban" state to an "excluded" state for one time step (one year). In addition, the fire regime map and the fuel map are continuously being updated as the city grows.

Keyword: urban growth, fire modeling, coupled modeling.