A lumped approach for wildland fire spread modelling

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This work displays the methodology used in the elaboration of a surface fire spread model. The lumped parameter approach is used in the modeling. In this method the thermal domain is divided in a finite number of volumes, supposed isothermal and with homogeneous properties, called nodes. To each node are attributed a temperature, a thermal capacitance and possibly internal heat generation. The nodes interact between themselves and with the environment exchanging heat and the heat exchanges are represented through a matrix of conductances. The convective, radiative and conductive mechanisms into the fuel bed are approximated for a diffusion term and the concept of effective thermal conductivite was utilized. The radiative heat exchanges between the fuel bed and the flames are introduced through the utilization of a solid flame model. If the temperature of a node reaches the ignition temperature the flame element on it is represented geometrically as a parallelepiped whose external surfaces irradiate to the fuel bed. The effects of wind and topography are introduced through empirical correlations for to estimate the height, length and internal angle of the parallelepiped. The temperature of each flame element is represented for a temperature-time profile model. A system of differential equations represents the thermal balance of this heat exchanges for the nodes and the solution of this system represents the temporal evolution of its temperatures.

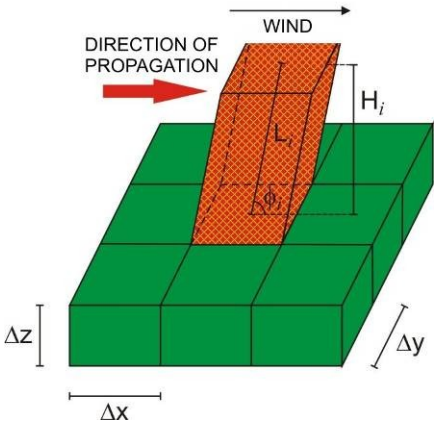

Figure 1: Representation of a flame element over a node which was reached the ignition.

The proposed model can be applied in the wildland fire safety through the estimates of the fire effects over the vegetation mainly caused for the radiant heat flux emitted for the flame front.

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