Modeling of flame spread in engineered cardboard fuelbeds

A 3D finite volume model named "FireStar3D" has been developed in order to predict fire propagation in natural environment (Fig. 1); it consists briefly in solving the conservation equations of the coupled system consisting of the vegetation and the surrounding gaseous medium. The model takes into account the phenomena of vegetation degradation (drying, pyrolysis, combustion), the interaction between an atmospheric boundary layer and a canopy (aerodynamic drag, heat transfer by convection and radiation, and mass transfer), and the transport within the fluid phase (convection, turbulence, gas-phase combustion).

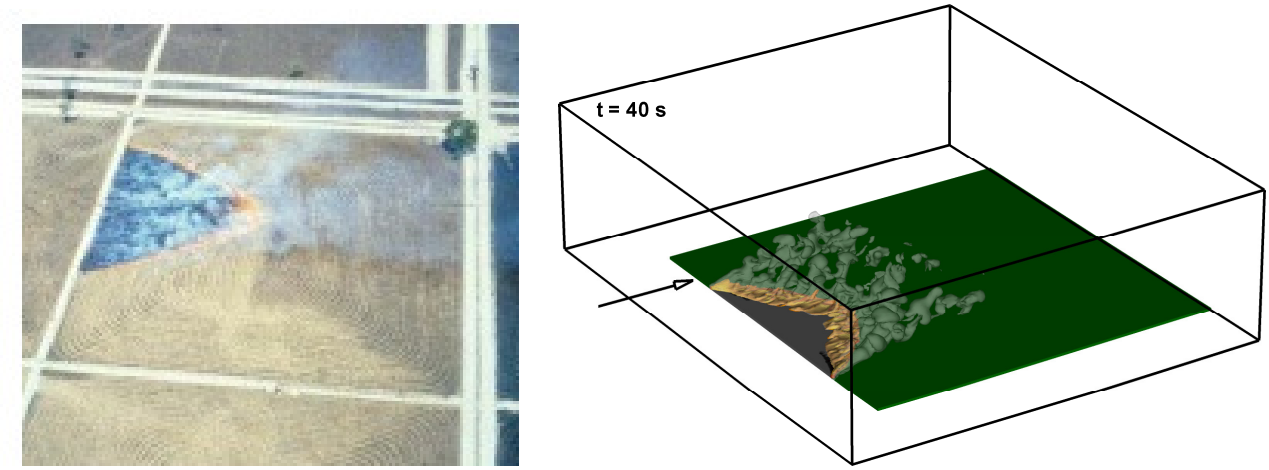

Fig. 1. Left: Photo of experiment 'C064 - AU Grassland Fire' carried out in Australia by Cheney et al. Right: Numerical simulation of fire propagation corresponding to experiment C064 carried out using FireStar3D.

The objective of this study to validate this 3D model in the case of fire propagation in confined environment, by reproducing experiments of flame spread in engineered cardboard fuelbeds in a wind tunnel carried out by Finney et al. in 2013 at Missoula Fire Sciences Lab. in the US (Fig. 2). The comparison between the simulations and the experimental data will be mainly based on the rate of spread of fire or ROS (velocity of the fire front), and a study of the dependence of the rate of spread on the wind speed and on the fuel bed characteristics will be carried out.

Fig. 2. Left: Picture of laser-cut cardboard laboratory fuel bed. Right: Flame structure normal to spread direction showing rotation of flame eddies.