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Project Title: Refinement and validation of the pyrolysis and firebrand transport sub-models for a physics based bushfire prediction model

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Firebrands during bushfires are the root cause of spotfire which increases the rate of spread of fire. Firebrands constitutes of varied species like barks, twigs, leaves, etc. The flow of firebrands in the wind has not been studied in details, and the existing physics-based model to describe the flow and aerodynamics of firebrand does not incorporate the effect shape & size of the firebrand. The Lagrangian particle model (tracks the flow pattern of an individual particle in the fluid flow) which is used for the firebrand aerodynamics is applicable only when the particles are small in comparison to the scale of flow.

We are studying the transport of firebrands experimentally using a firebrand generator constructed at the CESARE facilities and compare the experimental results with the existing computational Lagrangian particle model. The objective is to incorporate the effect of the shape & size of a firebrand. We are measuring the velocity of a firebrand, their scattering pattern and the probability that a firebrand ignites a fuel bed.

The effect of passive firebrands shape on the transport of firebrand using firebrand generator prototype is studied (December–March 2015-16). A qualitative agreement is observed with CFD simulation on the transport of firebrands using Fire Dynamic simulator. Results have been submitted as a poster in AFAC, 2016. Laboratory-scale firebrand generator with variable flow speed is constructed (October-February 2015-16). The equipment is ready to use for passive firebrands (both flaming and non-flaming) with minor modifications.

To study the ignition of fuel bed from firebrand it is important to estimate the thermo-physical and kinetic properties of the fuel bed to improve the pyrolysis sub-model. The kinetic properties of forest litters are significantly different than the timber material of the same species which is observed through Fourier transform infra-red spectroscopy (FTIR) and Thermo-gravimetric analyser (TGA). Kinetic parameters of forest litter fuels i.e. barks, twigs, leaves, etc. of pine and eucalyptus and grass are being estimated in the inert atmosphere of nitrogen, the results are due for submission in 'Thermochimica Acta' Journal (April-June 2016). These parameters in oxidative environment will be measured soon. Furthermore thermo-physical properties and flammability parameters will be measured with Hot Disc Analyser and Cone calorimeter, respectively.