

A Small-Scale Study of Fire Whirls and Investigation of the Effects of Near-Ground Height on the Behavior of Fire Whirls

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Abstract : In this work, small-scale experiments of fire whirl were conducted to study the spinning fire phenomenon and to gain comprehensive understandings of fire tornadoes and the factors that affect their behavior. High speed imaging was used to track the flames at both temporal and spatial scales. This allowed us to better understand the role of the near-ground height in creating a boundary layer flow profile that, in turn contributes to formation of vortices around the fire, and consequent fire whirls. Based on the results obtained from these observations, we were able to spot the differences in the fuel burning rate of the fire itself as a function of a newly defined specific non-dimensional near-ground height. Based on our observations, there is a cutoff non-dimensional height, beyond which a normal fire can be turned into a fire whirl. Additionally, the results showed that the fire burning rate decreases by moving the fire to a height higher than the ground level. These effects were justified by the interactions between vortices formed by, the back pressure and the boundary layer velocity profile, and the vortices generated by the fire itself.

Keywords : boundary layer profile, fire whirls, near-ground height, vortex interactions

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