Using advancements in technology for better understanding of fire behaviour and decision making

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Accurate detection and tracking of fire front propagation and its properties has been a challenging task for both operational and research purposes. In recent years, remote sensing technologies have come along way in terms of capability and accessibility. The application of these technologies has great potential in furthering our understanding of fire behaviour and extreme fire events.

INTRODUCTION

Extreme fires are usually a result of extreme fire behaviours. Although some of these behaviours have been described and investigated, others require further study. Fire coalescence and junction fires are particular cases of merging fire fronts and common phenomena observed during bushfires but are poorly studied. They are important as they can cause eruptive fire behaviour and be dangerous for ground-based emergency personnel.

Despite the investigation of merging fires there is no clear answer as to what are the mechanisms that drive them. In order to understand this phenomenon more clearly and better evaluate risks during bushfires and prescribed burnings, there is a need for high temporal and spatial measurements of fire behaviour.

Merging fire fronts

METHODS

Several preliminary small and medium scale field experiments were conducted during March 2018 and April 2019 to test

1. emerging technologies for measuring fire behaviour; and
2. are existing models developed from small-scale laboratory experiments appropriate at the landscape scale.

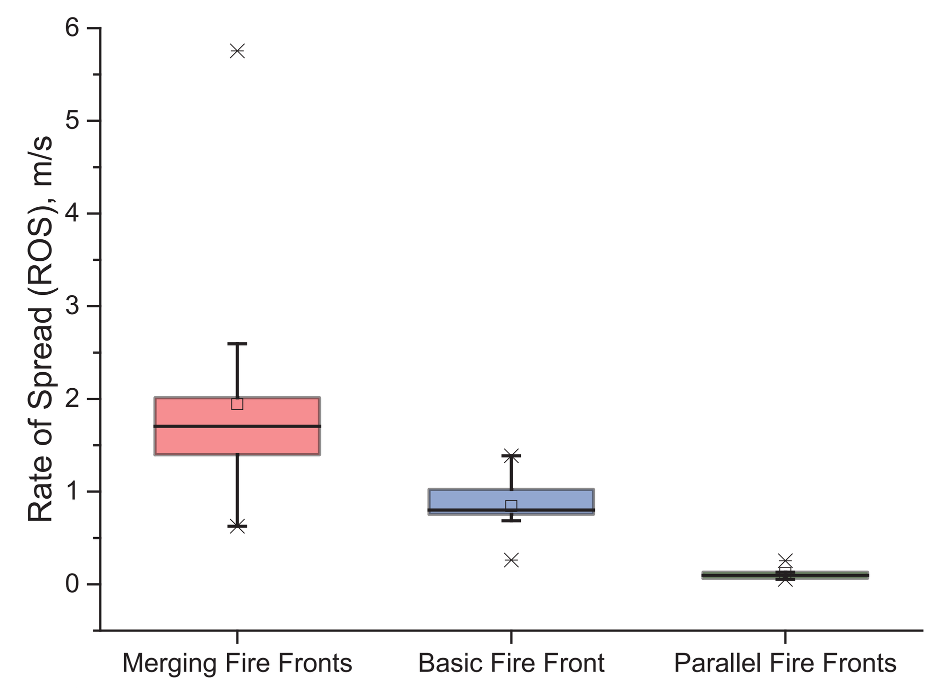
Study area and equipment

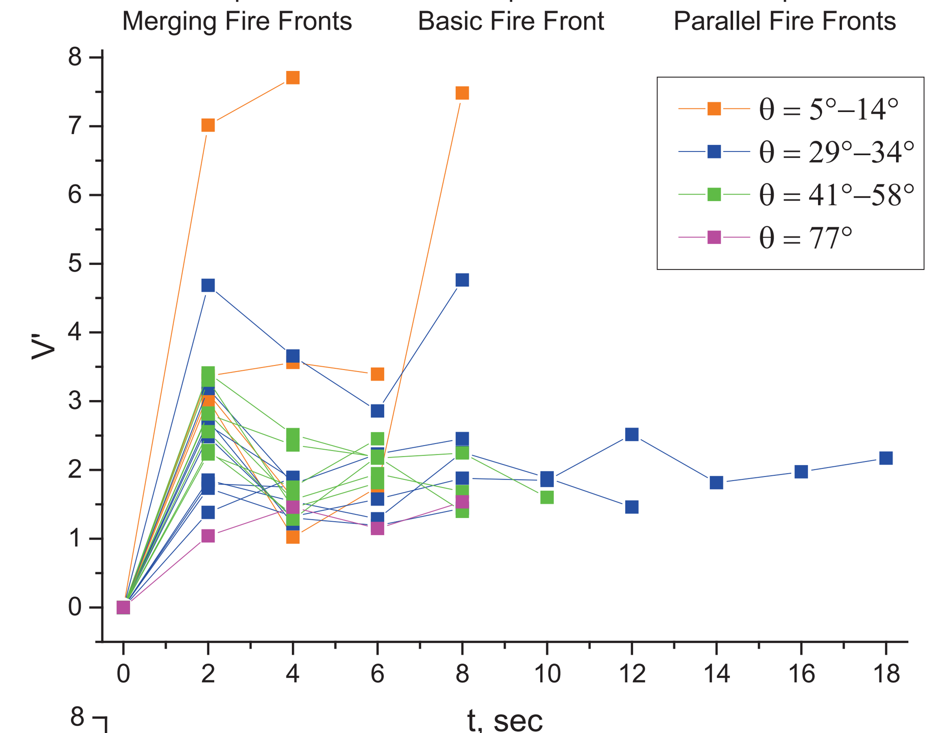
The study was conducted on farmlands in Victoria. Harvested crop fields were used as experimental plots, as they form homogeneous fuel beds. Fuel height was varied from 18 to 40 cm. Fuel load and moisture content were 0.1 kg/m^2 and 11.9% respectively. Wind speed varied in the range of 1.5-6.5 m/s. An Unmanned Aerial System (UAS) was used to capture high definition video imagery of fire propagation. Different configurations of ignition lines were tested during the experiments.

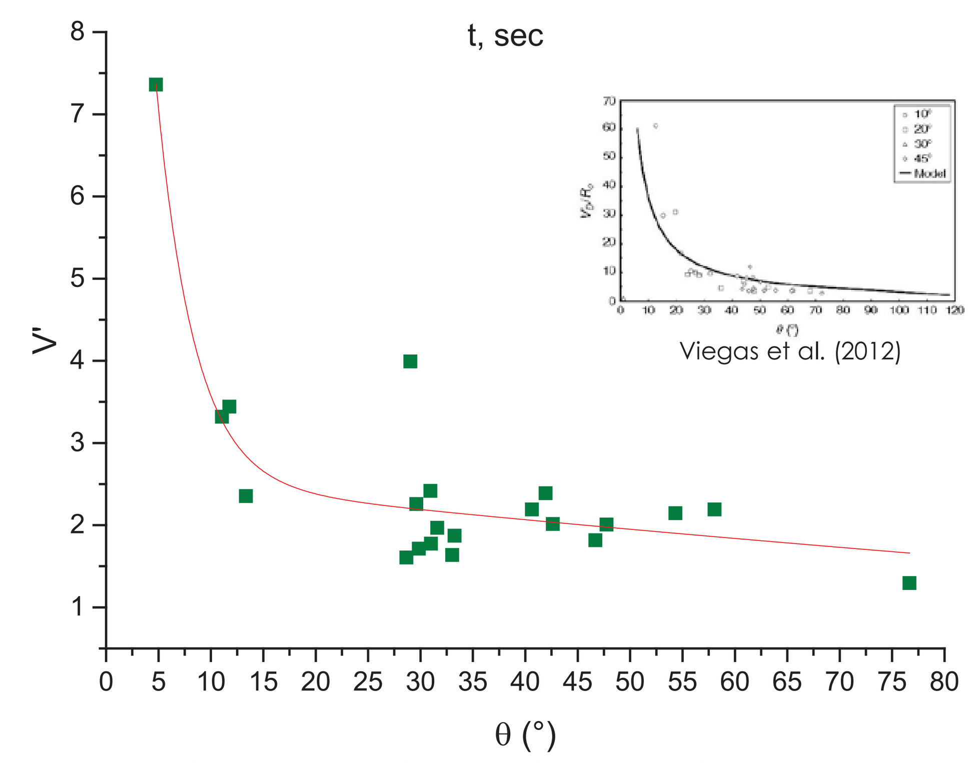
Data processing

The UAS was used to capture video imagery in synchronisation with sensor data from the on-board Global Positioning System (GPS) and Inertial Measurement Unit (IMU). These sensors enabled the platform/camera orientation and position in space to be multiplexed with the video footage of fire propagation georeferenced in GIS software.

RESULTS







V'=Merging ROS/Basic ROS ($V'=V_D/R_0$)

θ is the angle between merging fire fronts in degrees

CONCLUSION

Preliminary results showed a deep flaming and significant convective effects for merging fire fronts, and as a consequence the acceleration of fire front propagation. Future study will be focused on fire front details and larger scale experiments.

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