Understanding junction fire physics and scaling laws in order to mitigate the consequences of this severe wildfire event

Mr Ahmad Hassan[1,2], Prof Khalid Moinudin[2] and Prof Gilbert Accary[3]

[1] Natural Hazard Research Australia, Melbourne, Vic, 8001
[2] Institute for Sustainable Industries and Liveable Cities, Victoria University, Melbourne, Vic, 8001
[3] School of Engineering, Lebanese American University, Byblos, Lebanon

Physical modelling of junction fire behaviour: Underlying physics, fire regime, and scaling laws

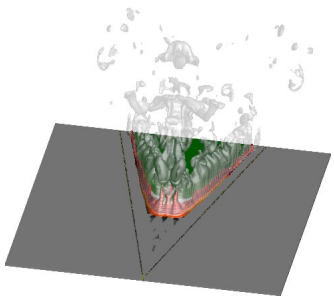
Extreme bushfires present severe threats globally. Junction fires stand out for their intense and unpredictable behaviour, requiring comprehensive understanding. This study delves into the physics governing junction fires to better understand their complex dynamics and to establish scaling laws describing their behaviour.

Objectives

- Have a better understanding of the complex dynamics of junction fires.
- Understand the effects of slope angles, junction angles and wind speed on junction fire behaviour.
- Conduct a dimensional analysis of the problem based on Byram's convective number.
- Bring together all scale experiments and simulations into one scaling law.

Methodology and Numerical Modelling

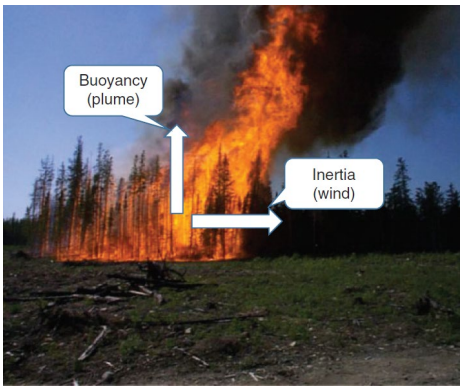
- Use of FIRESTAR3D, a physics-based model developed collaboratively by multiple universities.
- Conducting numerical simulations replicating laboratory and field-scale experiments.
- Explored the effects of parameters such as slope angles, junction angles, wind speed, fuel moisture content …



Preliminary Results and Discussion

- FIRESTAR3D effectively reproduced experimental results, demonstrating its capability in simulating junction fire propagation.
- Ongoing research aims to further explore the interplay between slope, junction angle, and wind speed.

The research boundaries are pushed using dimensional analysis in order to establish a similarity between real-world wildfire scenarios and scaled-down experimental or numerical models. Using Byram's convective number, we strive to characterise the balance between buoyancy and wind effects on flame trajectory and spread. And through the formulation of scaling laws, this work aims to provide valuable insights into the behaviour of junction fires at different scales. This would help in developing effective wildfire management strategies, ultimately contributing to the protection of lives, property, and ecosystems form wildfires.



For additional information scan the QR code or contact:
Ahmad Hassan, PhD student, Victoria University
ahmad.hassan6@live.vu.edu.au

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