Severe Fire Behaviour – Improved Planning Responses

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THIS PROJECT AIMS TO BETTER DESCRIBE THE NATURE OF BUSHFIRES, ESPECIALLY VERY SEVERE ONES, AND THE EFFECT OF LAND-USE PLANNING RESPONSES IN REDUCING BUSHFIRE RISK ACROSS A WIDE RANGE OF VALUES AND ASSETS

This project aims to:

- Develop a better ember transport model.
- Relate the model to ember attack levels on dwellings and spot-fire development; and
- Validate the model against documented fire events.

This project will provide fire and land management agencies with:

- Quantification of convective strength across the landscape, validated against documented fire events
- An algorithm to improve convective updraught strength to calculate maximum local wind strength and potential house loss; and
- Improved PHOENIX RapidFire characterization and improved understanding of bushfire risk and the assessment of treatment options for improved planning responses through the development of specific planning modules.

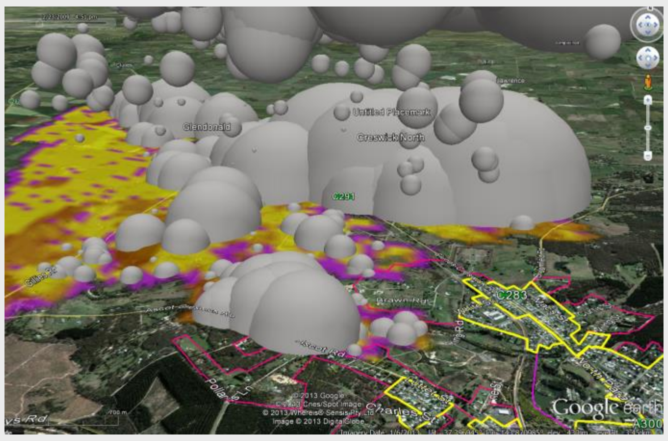


Figure 1. Illustration of a 3D characterization of bushfire in a 2D context using PHOENIX RapidFire

IMPROVED CONVECTION MODELLING

There are no direct measures of convective strength. Tree damage and structural building damage was used as an indicator. The revised method of calculating convective strength showed a stronger correlation to tree damage than the previous model.

Convective strength was used to drive the spotting process. Convective strength was used in the calculation of the amount of ember material launched and the duration of flight, therefore its downwind distribution. Weather radar was used to check convective modelling against observed smoke plumes.

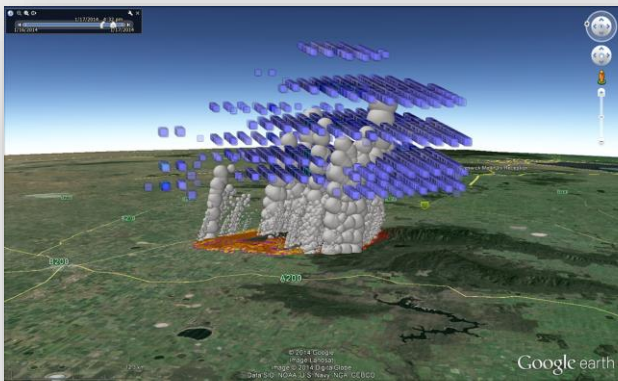


Figure 2. Blue dots from weather radar, white bubbles from PHOENIX RapidFire

9000 houses, affected by bushfires, were used to develop an algorithm to predict the probability of house loss using fire characterizations produced by PHOENIX RapidFire. The new algorithm was a significant improvement on previous attempts:

$$Prob(HouseLoss) = 1-EXP(2.03142 - 0.03239*FlameHt - 0.06737*EmbrDens - 0.000003*Convect)/(1+EXP(2.03142 - 0.03239*FlameHt - 0.06737*EmbrDens - 0.000003*Convect))$$

n=9199, Somers D = 0.58

Where:

FlameHt = flame length (m)

EmbrDens = ember density ($\#/m^2$)

Convect = convective strength (MW)

Statistically, this algorithm should predict house loss with about 80% accuracy.

APPLYING THE IMPROVED SEVERE FIRE CHARACTERIZATION TO RISK ASSESSMENTS

A process has been used in Victoria to develop a fire risk register. Driven by the CFA this process has relied heavily on input from community groups and is known as the VFRR (Victorian Fire Risk Register). This register has identified values and assets of importance to local communities, but also potentially at risk from bushfires.

These values and assets fall into four main classes:

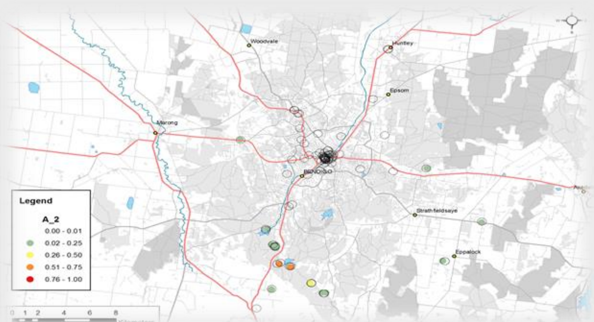
- Human Settlement
- Economic
- Environmental
- Cultural Heritage

However, there are too many individual types to be easily used for consistent, state-wide bushfire risk assessment, so as a part of this project, a process was undertaken to produce a shorter list (19) of asset types with common bushfire vulnerabilities. An example of the list is given below.

Asset Code	Priority	Asset Type	Vulnerability Type	Impact Type	Notes	Fire Hazard Code
1	1	House	Flammable	Destroy	Residential, embers, radiation, convection all contribute	2
12	2	Pump	non-flammable	Disrupt	Critical service dependent on power / communication	4
13	3	Comms	non-flammable	Disrupt	Critical service dependent on power / communication	4
9	4	Hospital	Flammable	Destroy	Residential, smoke could be an issue	2
11	5	Hotel	Flammable	Destroy	Motel / hotel providing overnight accommodation	2
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Large public event with outside people, [illegible]	[illegible]

From the table above, it can be seen that each asset type needs to have a known vulnerability type, a description of what the nature of the bushfire impact is and a link to a table of fire attribute thresholds that need to be passed for an impact to occur (Fire Hazard Code).

The map below shows the location of "Pumps" and the probability of a bushfire impact in the Bendigo area. Such analyses can be done for all 19 asset types to inform a more comprehensive bushfire risk assessment.



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