PROGRAM A - Bushfire Risk Management Model

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Incorporating the effect of spotting into fire behaviour spread prediction using PHOENIX-Rapidfire

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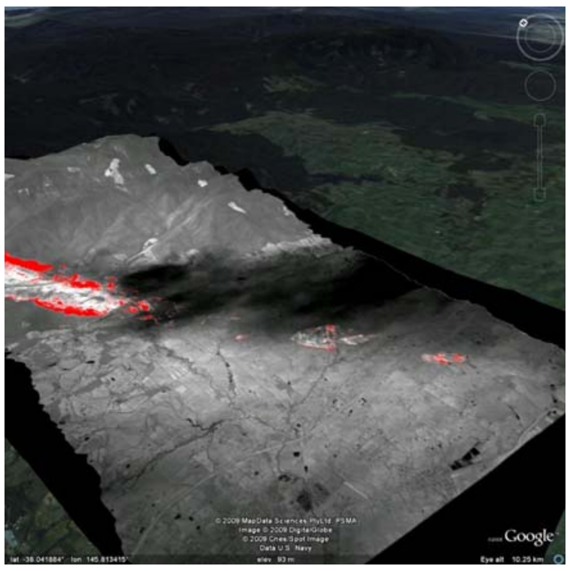
WHAT WE KNOW

- Spotting is pronounced in eucalypt forest fires.
- The phenomenon of spotting is more important in eucalypt forests fires than any other vegetation type in the world.
- Most spotfires are caused by burning fragments of tree bark. Therefore, the abundance of spotting is strongly dependent on the amount and type of bark on the trees.
- The effect of spotting can double or even triple the effective spread rate of a fire.

Spotfires on the forward flank of the Combienbar fire in Gippsland Victoria, 1982.
(Photo: Ross Runnalls)

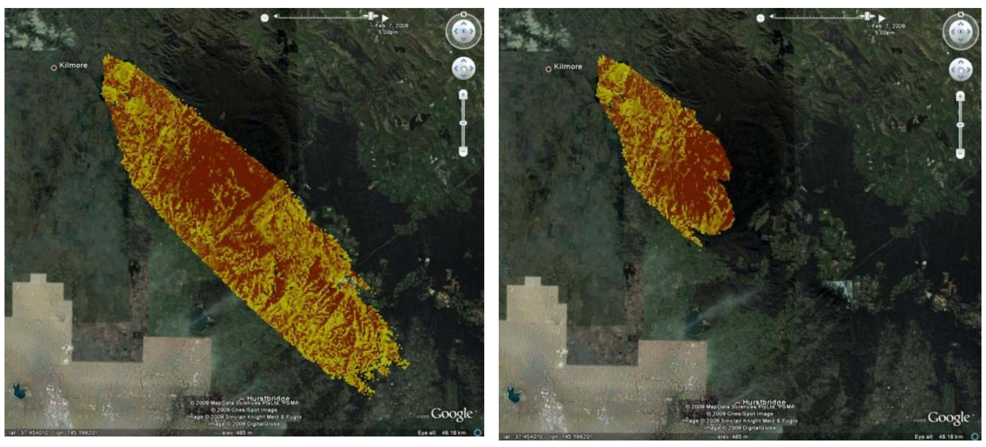
Thousands of spotfires can be produced ahead of a fire. Spotfires increase the rate of fire advance in three ways:
1. prefrontal burnout, burning out area before the main front gets to it
2. by crossing over breaks in fuel that may otherwise slow or stop a fire
3. by adding to the total heat output from the burning area increasing the updraught and hence the indraught.



Spotfires ahead of the Kilmore East fire on Black Saturday, 2009 in Victoria. Some were up to 35km ahead of the main fire area.
(Image: DSE Victoria)

HOW HAS SPOTTING BEEN DEALT WITH?

- Australian grassland fire behaviour models don't consider the effect of spotting since grass fuels only spot enough to cross small fuel barriers.
- McArthur's fire spread model does not include the effect of spotting, but it estimates the maximum likely extent of spotting.
- The Vesta fire spread model has confounded the effects of spotting into the overall spread rate, but does not deal with variations in spotting likelihood. It too estimates the maximum likely extent of spotting from stringybark firebrands.



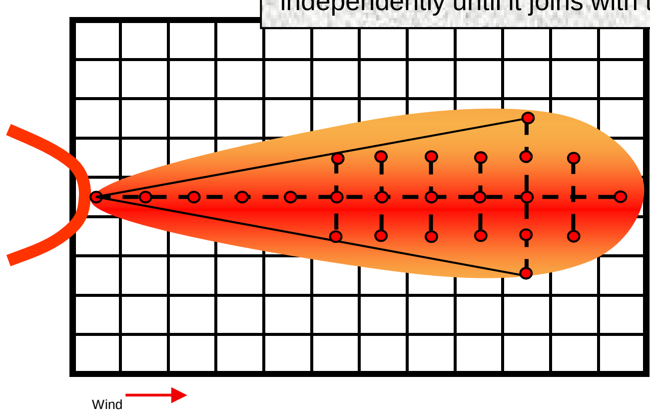
Left: PHOENIX simulation including spotting component. Right: no spotting included.
(Kilmore East fire, Victoria, Black Saturday, 2009)

HOW DOES PHOENIX MODEL SPOTFIRES?

- PHOENIX uses a deterministic spotting model.
- The model is empirical and cellular based.
- The number of embers launched from a cell is calculated based on the amount of bark fuel, the intensity of the fire, and the convective updraught force.
- Embers are dispersed in a 28º arc from the cell, with a density pattern falling logarithmically with the distance from the cell and normally distributed across the centreline, up to the maximum distance predicted by the fire spread model.
- The path of the centreline is determined by the wind speed and direction for the time of ember flight.
- Spotfires are initiated if the fuel quantity and moisture conditions are suitable in the receiving cell and enough embers land in that cell to pass an ignition threshold.
- The spotfire is then initiated as a new fire and modelled independently until it joins with the main or other fires.

CONCLUSIONS?

- The effect of spotting is included in a dynamic way, only being included if there are the right type of ember fuels, the receiving fuels are in a flammable state.
- PHOENIX can (and often does) start spotfires in grassland fuels from fires burning in forests, so it is not restricted to any particular fuel type.
- Because the Vesta model already includes a fixed effect from spotfires, it is not suitable to use in a dynamic modelling environment where spotting is modelled explicitly.



Spread pattern of embers launched from just one of many cells at the fire front. The spread arc is 28º.

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