PROGRAM B - Project B6.3

WIND-TERRAIN EFFECTS ON RUGGED LANDSCAPE FIRE PROPAGATION: LEE-SLOPE CHANNELLING

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Background

Analyses of line-scan data collected during the 2003 fires have shown that some interesting and unusual fire behaviour can occur along incised valleys and steep lee slopes that are aligned almost perpendicular to the wind. In particular, a number of significant events west of Canberra on the 18th of January have been noted. Typically, and with reference to Figure 1, these types of events are characterised by:

1. Rapid lateral propagation of the flank along the valley or slope
2. Downwind extension of the flaming zone of 3-5 km with uniform spectral signature in the imagery
3. The upwind edge of the flaming zone is constrained by a major break in topographic slope
4. One edge of the flaming zone is aligned with the main wind direction and is comprised of many spot fires

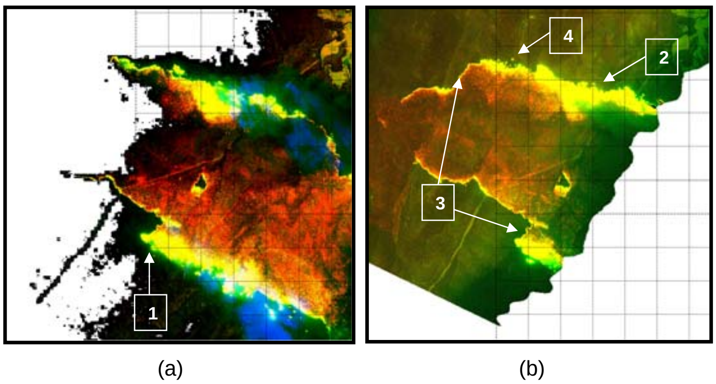

Figure 1. Consecutive (partially overlapping) line scan images of the Broken Cart Fire taken at 15:04 (panel a) and 15:09 (panel b) on the 18th of January 2003. North is to the top of the figures and the main wind direction is from the NW approximately. The grid is 1km x 1km.

Lee-slope Channelling : Conceptual Model

Figure 2 illustrates a conceptual model developed to account for the type of fire behaviour seen in figure 1. In this model, strong winds separate from the surface in the lee of a prominent ridge leading to the formation of a lee-slope, or separation, eddy. This turbulent flow exacerbates the production of embers which are circulated within the eddy or 'peeled-off' by the strong winds flowing above and deposited downwind where spot fires form. The turbulent flow moves along the slope, channelling the fire in that direction. We use the term 'lee-slope channelling' to describe the process.

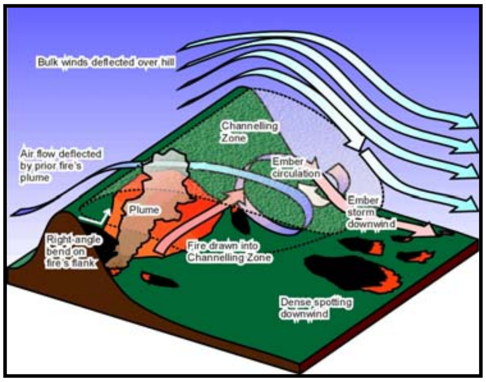

Figure 2. Illustration of a conceptual model for lee-slope channelling

Analysis of Field Data

Portable automatic weather stations have been deployed in complex terrain to test the validity of the proposed model. Figure 3 shows a joint wind direction distribution for two stations in Tidbinbilla, ACT; one on a ridge-top and one approx. 200m down a steep lee slope. The dominant mode (circled in red) suggests that eddy-like structures are a common feature of the wind regime in complex terrain.

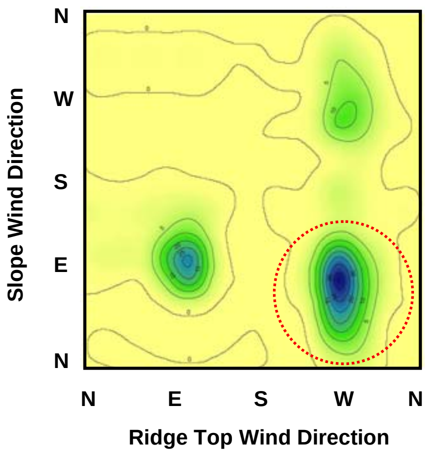

Figure 3.

Joint wind direction distribution for two stations deployed in steep terrain in Tidbinbilla, ACT.

All wind speeds are present in the figure, but the circled mode is more pronounced for higher wind speeds.

Conclusions

Our research has indicated that it is possible to identify terrain characteristics that are necessary for channelling-like processes to occur. Further work will continue to refine and map these terrain features.