

STATISTICAL CHARACTERISATION OF WIND FIELDS OVER COMPLEX TERRAIN FOR BUSHFIRE MODELLING



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WITH THE EMERGENCE OF ENSEMBLE-BASED FIRE MODELLING, IT IS NECESSARY TO RECAST WIND FIELDS IN PROBABILISTIC TERMS. THIS PROJECT AIMS TO STATISTICALLY CHARACTERISE WIND FIELDS AND EXPLORE THE ROLE OF PROBABILISTIC WIND MODELLING IN BUSHFIRE PREDICTION.

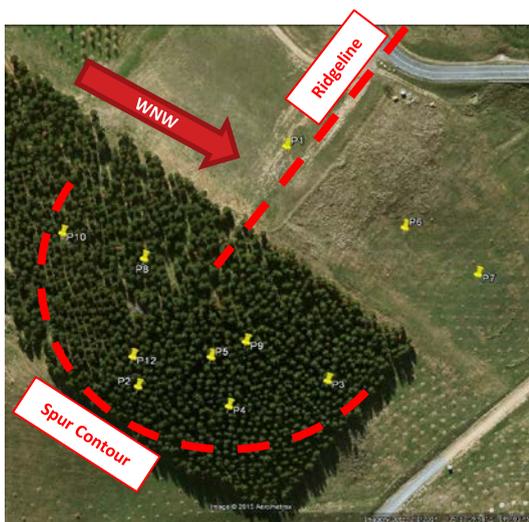


Figure 1: Wind data collection at the NAC.

AIM 1: Contribute a new wind field dataset

- Wind speed and direction data were collected using 5 metre high portable automatic weather stations across complex and undulating terrain.
- In 2007 and 2014, data was collected across Flea Creek Valley, NSW, allowing for analysis of the affects of post-fire vegetation regrowth on wind fields in rugged topography.
- In 2015, data was collected at the National Arboretum Canberra (NAC, Figure 1) with an experimental design enabling more controlled assessment of both vegetation and topographical affects on wind fields.

AIM 2: Recast wind fields in probabilistic terms

- Probabilistic wind direction response distributions were developed using observed wind direction data (Figure 2). These distributions represent how the direction of the prevailing wind responds to changes in topography and vegetation at the surface.
- From these distributions, there are clear thresholds in aspect (or leewardness) and vegetation (or surface roughness) for the production of wind behaviours such as lee-slope eddies.
- Wind behaviours can therefore be characterised in terms of likelihood or probability, with such information used to complement current physical wind modelling techniques.
- The development of probabilistic wind field prediction is better suited for input into emerging ensemble-based fire prediction frameworks which better account for uncertainty in fire spread across the landscape.

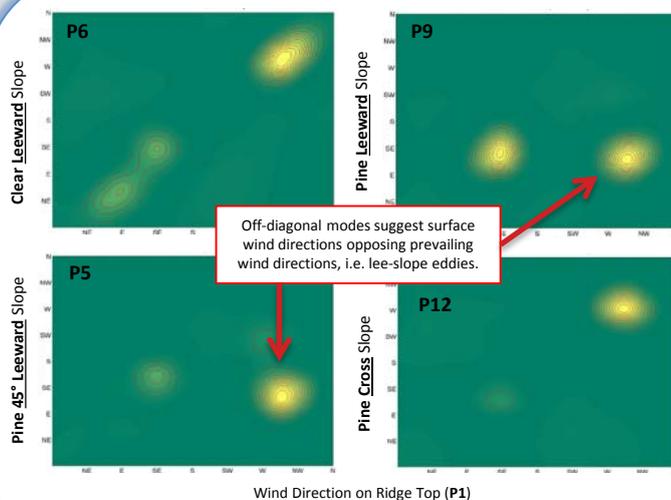


Figure 2: Joint wind direction distributions across the NAC.

AIM 3: Evaluate operational wind models

- Current operational wind models are deterministic in nature, or allow for uncertainty through the use of standard probability distributions.
- Data from this project clearly show that wind fields are inherently probabilistic and adhere to more complex (non-standard) distributional structures that can vary across the landscape (Figure 2).
- Probabilistic application of deterministic models can better capture the spread of wind response across complex landscapes (Figure 3).
- It is possible to predict key wind behaviours that are currently not well captured, such as bimodal distributions or eddies seen on leeward slopes within complex terrain.

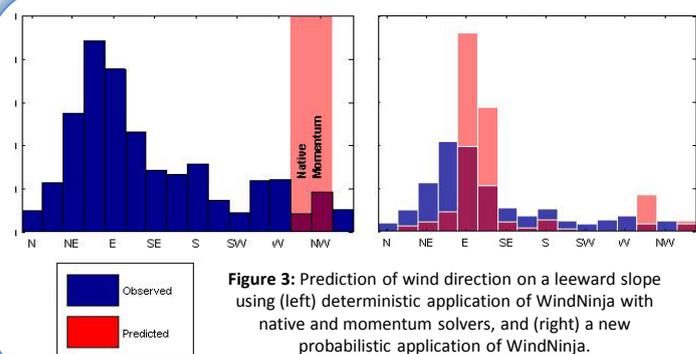


Figure 3: Prediction of wind direction on a leeward slope using (left) deterministic application of WindNinja with native and momentum solvers, and (right) a new probabilistic application of WindNinja.

CONCLUSION

This research highlights the potential for a hybrid approach to wind modelling for fire spread prediction; combining current physics-based models with new probabilistic approaches. With better understanding of wind variability, better analysis of the uncertainty of fire prediction can be made using emerging probabilistic frameworks, leading to more informed bushfire management. For more details, contact rachael.quill@student.adfa.edu.au

