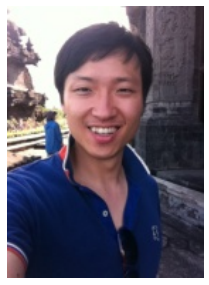
RELATING VERTICAL WIND PROFILES TO VEGETATION STRUCTURE FOR FIRE BEHAVIOUR PREDICTION



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Background

Wind is a key driver of fire behaviour. In forests, the free flow of wind is impeded and consequently rates of air movement are slower than in open areas. In open areas wind speeds typically increase with height from ground, however in forests vegetation structure can greatly influence patterns of wind flow. Current fire spread models assign a single value wind reduction factor (WRF) to each forest type, encompassing all heights and vegetation structures. However, there may be gains in predictive performance if such models were to incorporate wind profiles based on height and vegetation structure.

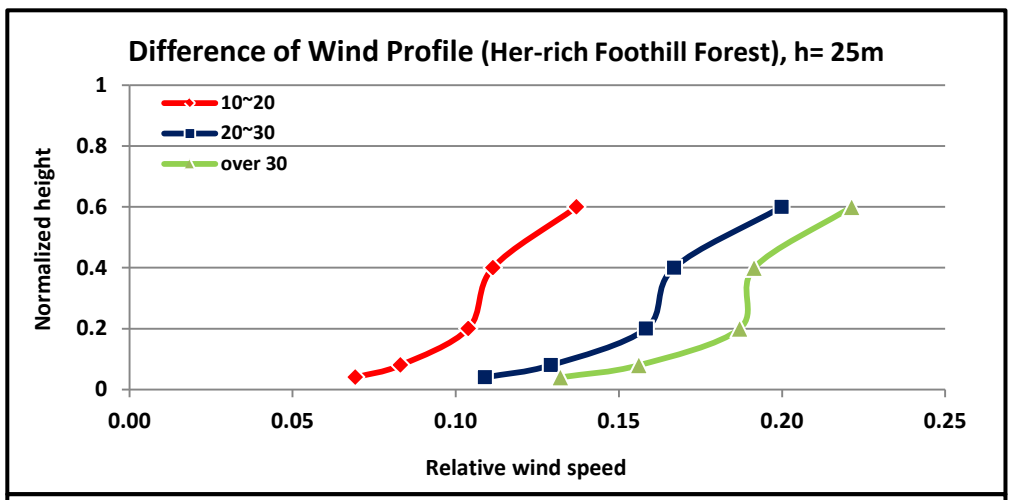
Research Questions

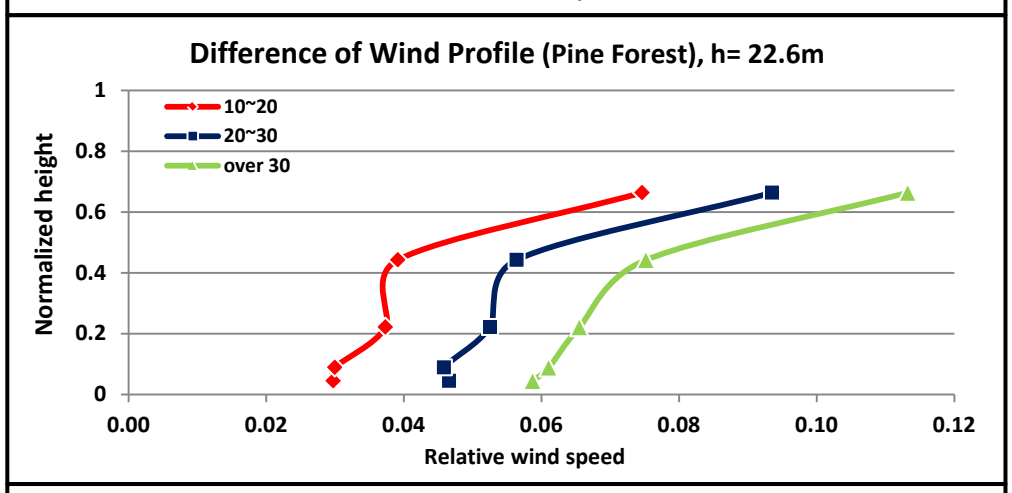
- Can wind speed at different heights above the ground within forests be predicted from wind speed measured at 10m in the open and vegetation structure?
- Is there a consistent relationship between the vertical and horizontal structure of vegetation and wind?
- Can the aspects of vegetation structure important to forest winds be characterised at a landscape level?
- Can more accurate predictions of fire spread be achieved through dynamic representation of winds in forests linked to vegetation structure?

Wind measurement

Figure 1. measurement of both horizontal and vertical winds in different vegetation types and open areas at multiple heights

Results





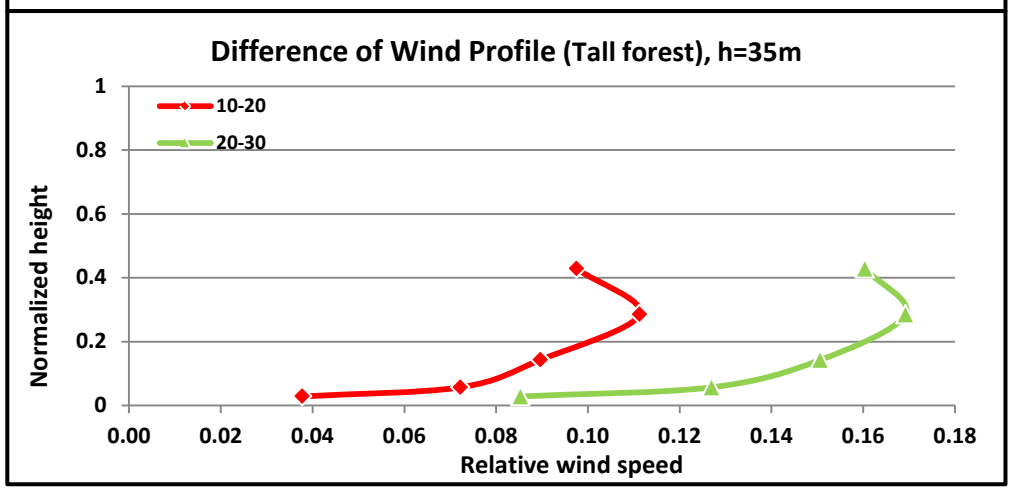


Figure 2. Difference of wind profiles in three forest types with height and open area wind speeds (10-20 km, 20-30 km and over 30 km). Heights and forest winds were normalized by tree height in each forest type and open area winds respectively. Three figures indicate that there is large variation of wind profiles in forests. Therefore, there is potential to have more dynamic application of WRFs, which may result in more accurate predictions of winds in vegetation.

What's next?

- Detailed survey of vegetation structure at wind measurement sites including ground-based LiDAR
- Develop wind profile models to predict wind patterns in various vegetation type
- Incorporation of the wind profile model into the fire spread model PHOENIX RapidFire. Results will be evaluated to determine whether predicted spread patterns are more accurate than those using a single wind reduction factor.

Lead End-User Comment (**David Youssef**: Deputy Chief Officer, Metropolitan Fire and Emergency Services Board): The ability to better understand factors which influence fire behaviour has the potential to improve understanding of risk and support better incident management decision making. This project will hopefully enhance and support existing models, therefore assisting in further safeguarding both community and firefighter safety

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