USING SATELLITE IMAGERY AND FLUX TOWER MEASUREMENTS TO MONITOR FUEL MOISTURE CONTENT

2009 BLACK SATURDAY AND OTHER LARGE FIRE EVENTS – MOISTURE CONDITIONS PROJECT

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1. INTRODUCTION and AIMS

Fire is a global phenomenon that affects most terrestrial biomes (Figure 1). Fuel moisture content (FMC) represents a critical factor influencing fire danger. Monitoring FMC is important because moisture is inversely related to fuel flammability and acts as a heat sink during the burning process, affecting fire propagation. Remote sensing provides valuable information for spatially explicit monitoring of FMC at regular time intervals and over extended areas. The aim of this project is to develop a spatially explicit approach to monitor spatio-temporal variations in FMC of live and dead fuels in south-eastern Australia using satellite imagery and flux tower measurements.

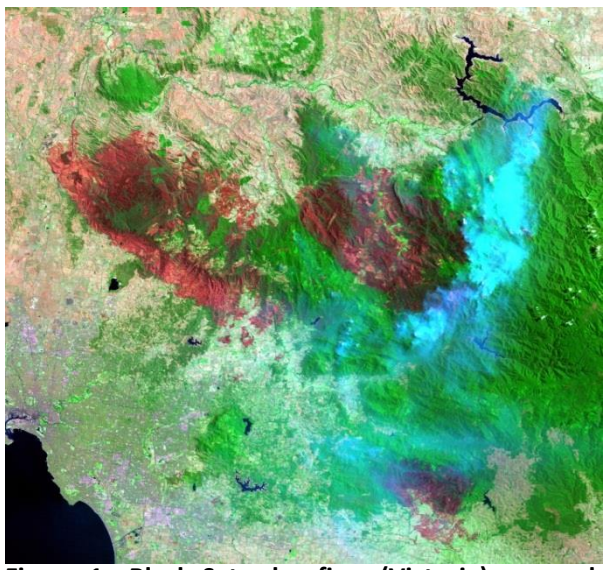

Figure 1 –Black Saturday fires (Victoria) mapped using a combination of shortwave and near infrared bands from Landsat 5TM (16/02/2009) data.

2. DATA and METHODS

Live and dead FMC samples are collected from different sites across News South Wales and Victoria (Figure 2a). The sites are covered by a range of different eucalypt forest types (e.g., dry sclerophyl forest and wet sclerophyl forest). Live samples are collected from both overstorey and understorey layers (i.e., shrubs and ground cover). Dead samples include both surface and suspended fuels. FMC is calculated as the percentage of water weight over dry fuel weight

Two types of remotely-sensed information are used in this study: satellite data and flux tower measurements. Satellite data are acquired by different missions (e.g., MODIS, NOAA and Landsat) at different spatial and temporal resolution. Those data are pre-processed to remove low quality pixels (e.g., cloud contamination) and geo-processed to derive a range of spectral and thermal indices (Figure 2b). Flux tower measurements are acquired from the following sites (Figure 2a): Tumbarumba, Wombat and University of Western Sydney (Figure 2c). Information about energy fluxes (e.g., sensible heat and latent heat) are used to derive energy balance indices. Satellite-derived and energy balance indices are integrated to investigate the potential of remotely-sensed information for monitoring variations in moisture levels in live and dead layers.

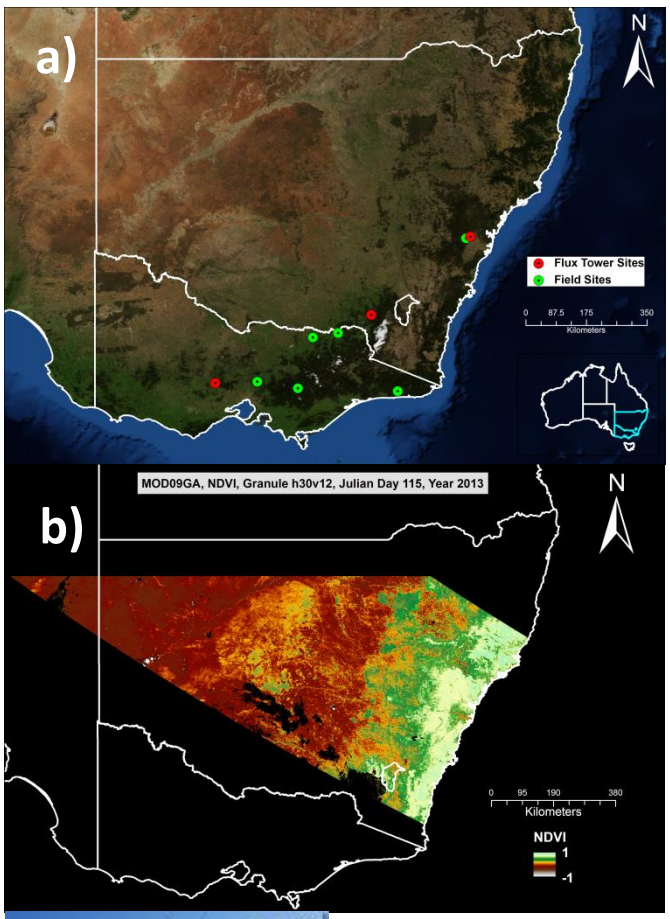

Figure 2 – (a) Map of the field sites and flux tower sites used in this project; (b)Normalized Difference Vegetation Index (NDVI) derived from MODIS TERRA (MOD09GA) data; (c) Picture of the University of Western Sydney flux tower in New South Wales.

3. RESULTS and CONCLUSION

Preliminary results indicate that both satellite-derived information and flux tower measurements are linked to temporal variations in FMC of live and dead fuels in Australian eucalypt forests (Figure 3a to c). Significant ($p<0.01$) relationships were found for MODIS-derived Normalized Difference Vegetation Index (NDVI), Land Surface Temperature (LST) data and energy balance indices derived from flux tower observations. We are currently comparing the performance of data acquired by different sensors (e.g., MODIS TERRA and AQUA) to define the most suitable source of thermal and reflective information. We are also developing more advanced energy balance models integrating both satellite data and flux tower measurements.

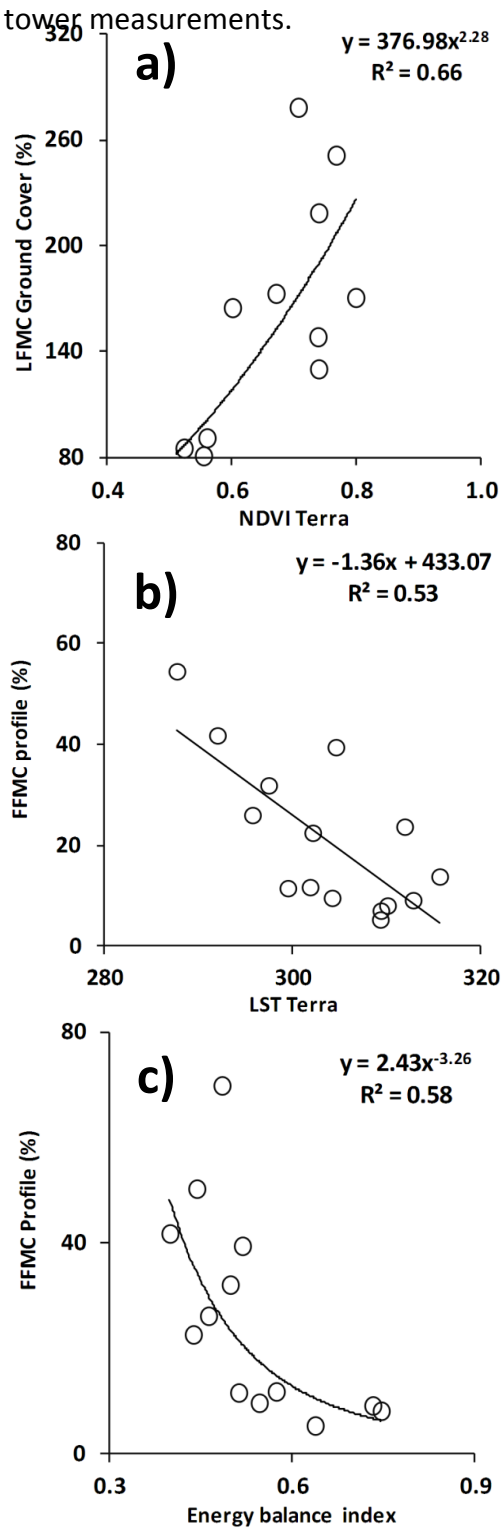

Figure 3 – (a) Scatterplot of Normalized Difference Vegetation Index (NDVI) derived from MODIS Terra (MOD09GA) regressed on live fuel moisture content (LFMC) data collected at University of Western Sydney flux tower; (b) Scatterplot of Land Surface Temperature (LST) Derived from MODIS Terra (MOD11A1) regressed on dead fuel moisture content (FFMC) data collected at University of Western Sydney flux tower; (c) Scatterplot of Energy balance index derived from flux tower measurements regressed on dead fuel moisture content (FFMC) data collected at University of Western Sydney flux tower.

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