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Using MODIS data to identify fuel moisture conditions preceding major wildfires in Australian eucalypt forests

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Fuel moisture content is one of the primary variables that affects ignition and spread of wildfires. Monitoring fuel moisture content over landscape scales is thus critically important for predicting the risk of wildfires. Currently, fuel moisture is commonly estimated from empirical and physical models based on weather observations. However, the spatial resolution of weather data can be coarse, and spatial interpolation can generate uncertainty. In contrast, satellite observations offer a spatially dense means of estimating fuel moisture content. Here, we estimate fuel moisture content from MODIS satellite data in the months prior to the occurrence of wildfire in Victoria, south-eastern Australia, and identify the prerequisite conditions leading to wildfire. Satellite data and fire history data are analysed over 2000-2012.

Live fuel moisture content was estimated using the Normalized Difference Infrared Index (NDIIb6) spectral index. From these estimates we found a significant, positive relationship between the area of a region that contained dry or severely dry live fuel, and the area burned by wildfire on an annual basis (linear regression, r^2 = 0.57). A similar analysis of live fuel moisture content prior to several mega fire events in Victoria found that, for many of the fires, moisture content was normal-wet in the spring preceding fire, followed by normal-severely dry conditions during the summer months immediately prior to the fire.

Dead fuel moisture content prior to major fires will be similarly estimated using MODIS Land Surface Temperature (LST) data. We have found that MODIS LST outperforms MODIS NDIIb6 in estimating dead fuel moisture content, based on empirical observations over a one year period at the Hawkesbury flux tower site in south-eastern Australia (linear regression, r^2 = 0.53).