IMPROVING FIRE RISK ESTIMATION THROUGH INVESTIGATING FIRE INTENSITY, MOISTURE AND TEMPERATURE ANOMALIES

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THE ACCURACY OF FDI'S ARE LARGELY DEPENDENT ON THEIR INPUT VARIABLES AND ADVANCEMENTS IN REMOTE SENSING ARE YET TO BE UTILIZED TO IMPROVE ACCURACY AND SCALABILITY. THIS STUDY AIMS TO ADDRESS THIS THROUGH THE USE OF REMOTELY SENSED DATA OF SOIL MOISTURE, FIRE RADIATIVE POWER, TEMPERATURE AND PRECIPITATION. IN DOING SO, COMBINING RISK WITH LIKELY FIRE INTENSITY.

INTRODUCTION

Understanding the mechanisms behind forest fires and quantifying their risk and scale are essential for mitigating their potential socioeconomic damage. Forest fires are often linked to precipitation (P) deficits, extreme temperature (T) and low fuel moisture, however, soil moisture (SM) is yet to be investigated. Hirschi et al (2010) indicated a link between soil moisture deficits and hot extremes which is particularly strong in temperate climates leading to ample conditions for severe fire. Fire Radiative Power (FRP) can be a useful tool to quantify the impact and severity of fires and is directly affected by temperature, moisture and vegetation conditions (Kaufman et al, 1998). Through these relations, fire risk and likely intensity (from FRP) will be combined updating the currently used FDI in South Eastern Australia.

LIMITATIONS OF CURRENT FDI'S

- No universally used FDI and definition for risk.
- Fire risk does not quantify the potential intensity or spread of a fire.
- Data used as input is not always accessible at a high spatial and temporal resolution.
- Uses many variables as input: temperature, precipitation, humidity, wind speed, fuel etc.

AIMS

- Quantify a link between SM, T, P and FRP.
- Use SM, T, P and FRP to simplify the current FDI and use remotely sensed data to improve accuracy.
- Explore the change in fire risk in response to climate change using CMIP-5 projections

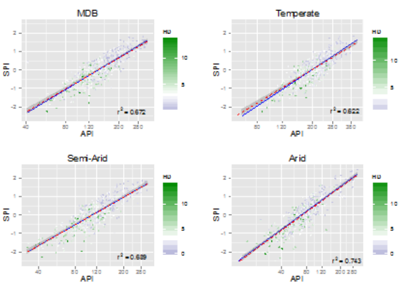

Figure 1. SPI versus API (log scale) plotted against the number of hot days (color gradient). The median and mean regression is fitted to each plot with the correlation coefficient inlayed. Each panel represents a different climate regime within the MDB.

DATA

Table1. Overview of data products used.

Name	Data	Resolution	Period
AWAP	P, T	0.05°	1900-2014
MODIS – MYD14A1	Fire Pixel, FRP	0.0045°	2000-2014
ESA-CCI SM	SM	0.1°	1979-2010
CMIP-5	Multi-Model Archive	Native to Model	Model Dependent

RESULTS

(A) API, SPI, HD

- 3 Month / 14 Day API and SPI best correlate to soil moisture.
- Distinct relationship between SPI and the log of API with correlation coefficients > 0.6
- Clear gradient of increasing hot days (number of days with temperature exceeding the 90th percentile) and moisture deficits (Figure 1).

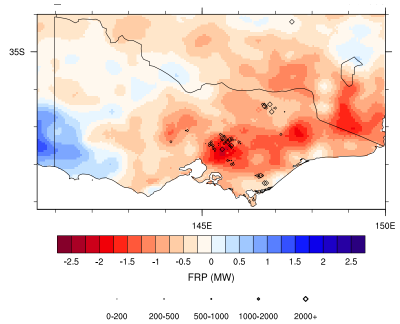

Figure 2. Map of 3-Month SPI (dry is negative, wet is positive) with the relative fire intensity overlaid for the black Saturday fires (Feb 2009).

(B) FRP

Fire locations are associated with regions in moisture deficit. i.e. negative SPI and low API (Figure 2) particularly in South Eastern Australia in the summer months (DJF). This is linked to the stronger relationship between moisture deficits and temperature anomalies in the temperate and semi-arid climate regimes. (i.e. the transitional zone). This is also more noticeable during large fire events such as the black Saturday fires in February 2009. Here, a strong negative SPI was linked to an increase in the number of outbreaks and their relative intensity (e.g. Figure3; Temperate and Figure 4).

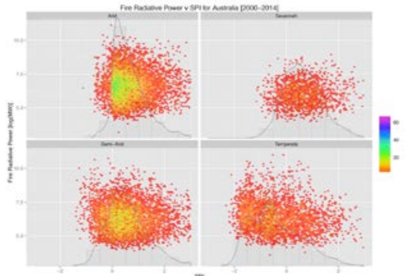

Figure 3. Density scatter plot for each climate regime of SPI versus FRP (log scale). Data are binned and ranked by number of occurrences. Overlaid in gray are the histograms of SPI occurrences for fire and non fire pixels.

FUTURE WORK

- Quantify the relationship between moisture deficits and FRP
- Develop risk maps using FRP and test their accuracy
- Produce FDI using an updated drought factor calculated using API and SPI.

END USER COMMENT

"Significant improvements in the spatial and temporal resolution of remotely sensed data have stimulated this novel approach to estimating and displaying fire danger on regional and wider scales"

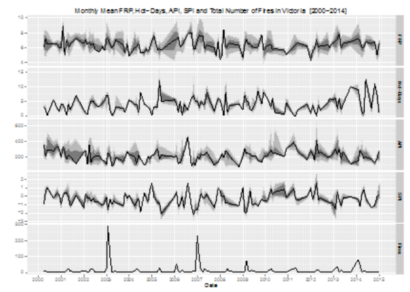

Figure 4. Time series of mean FRP, Hot days, API, SPI and the total number of fires for each month between 2000-2014 in Victoria. Median and quantiles are calculated from the number of fires per month.

REFERENCES

Hirschi, M., et al., 2010: Observational evidence for soil-moisture impact on hot extremes in south-eastern Europe. Nature Geoscience, 3, 1–5.

Kaufman, Y. J., et al., 1998: Potential global fire monitoring from eos-modis. Journal of Geophysical Research, 103, 215–238.

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