

# A COMPARISON OF SOIL MOISTURE PROXIES ACROSS AUSTRALIA



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**EXTREME TEMPERATURE AND DEFICITS IN SOIL MOISTURE PROVIDE AMPLE CONDITIONS FOR BUSHFIRES. MEASUREMENTS FOR SOIL MOISTURE ARE OFTEN ONLY AVAILABLE AT LOW TEMPORAL AND SPATIAL RESOLUTION. THIS STUDY AIMS TO COMPARE VARIOUS PROXIES OF SOIL MOISTURE AGAINST EACH OTHER FOR BOTH MODELED DATA AND STATION DATA ACROSS AUSTRALIA.**

## Introduction

- ▶ Extreme temperature and deficits in soil moisture provide ample conditions for bushfires. Methods to quantify fire risk using these variables are of particular importance.
- ▶ The Forest Fire Danger Indices (FFDI) is primarily used in Australia and currently uses the Keetch-Bryam Drought Index (KBDI) to quantify soil moisture/dryness within the FFDI. However, KBDI is based on various assumptions and with advances in remote sensing, it may not be the best method for quantifying soil moisture.

## Aims

- ▶ Compare KBDI, MSDI (Mount's Soil Dryness Index), SPI (Standardized Precipitation Index) and API (Antecedent Precipitation Index) against soil moisture across Australia and at various insitu stations.
- ▶ Compare various soil moisture depths with these proxies as well as at various temporal ranges.
- ▶ Calculate FFDI using these various proxies in place of the KBDI and compare the accuracy against remotely sensed fire hot spots

## Data

- ▶ ESACCI, Soil moisture at 0.25 °. 1979-current.
- ▶ AWAP, Precipitation, Temperature, Evapotranspiration, at 0.05° 1900-current
- ▶ OzNet sm, p station sites ~2001-current.
- ▶ CosmOz sm, p station sites ~2006-current

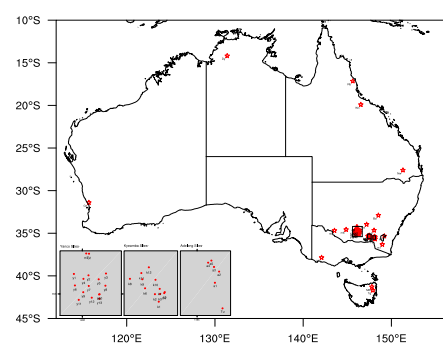


Figure 1. Location of soil moisture stations from the OzNet and CosmOz networks. Inlaid are zoomed in maps of the Yanco, Kyeamba and Adelong regions.

## Results

### (A) Station Data

- ▶ Figure 2 shows the initial results using 47 (35 OzNet and 11 CosmOz) sites. KBDI, MSDI and API are produced for daily values whereas SPI uses a 30 day soil moisture memory. There is a large standard deviation in the results as well as a large variation in the correlation coefficients seen. This is particularly seen in sites located in the Northern Territory and WA.

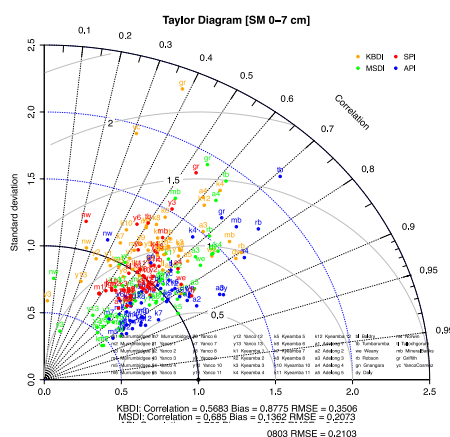


Figure 2. Taylor plot displaying the correlation coefficient, standard deviation and error between soil moisture and KBDI, MSDI, API and SPI for 22 of the station sites across Australia.

- ▶ Generally MSDI and API correlate much better than KBDI and SPI at the surface soil moisture (top 7cm). This is possibly due to the more direct relationship with precipitation than the other methods.
- ▶ There is a very large bias in KBDI and tends to be far too wet. API and SPI show a slight dry bias. MSDI has the smallest bias or RMSE.

Table1. Summary of results of KBDI, MSDI, SPI and API for station sites

| Data | Correlation |      | Bias  |       | RMSE |      |
|------|-------------|------|-------|-------|------|------|
|      | Oz          | Cos  | Oz    | Cos   | Oz   | Cos  |
| KBDI | 0.55        | 0.61 | 0.68  | 1.44  | 0.32 | 0.41 |
| MSDI | 0.70        | 0.64 | 0.05  | 0.39  | 0.20 | 0.27 |
| SPI  | 0.62        | 0.55 | -0.19 | 0.24  | 0.21 | 0.20 |
| API  | 0.78        | 0.72 | -0.42 | -0.14 | 0.21 | 0.20 |

## Results

### (B) Australia

- ▶ ESACCI SM represents a shallow layer of only up to 2 cm compared to station data of up to 7cm. API, KBDI and MSDI all show low correlation coefficients in regions with extremely low to no precipitation such as central W.A. Similarly to the station data, API appears to have a much more direct relationship with precipitation.

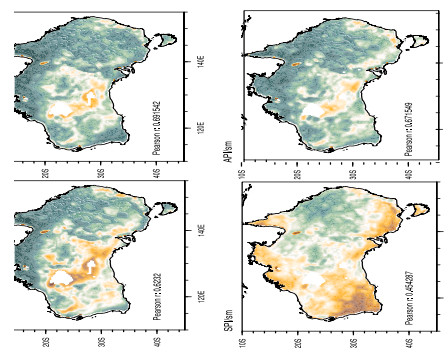


Figure 3 Correlation coefficients between ESACCI soil moisture and AWAP derived KBDI, MSDI, SPI and API for Australia between 1979 and 2013. Regions with zero precipitation between this period are masked.

## Conclusions

- ▶ MSDI/API perform the best at the surface soil layer.
- ▶ Large error and bias in KBDI and API. Wet bias in KBDI.
- ▶ SPI appears to perform very poorly in WA and most coastal regions.
- ▶ Results of API differ depending on the filtration limit used.

## Future Work & Comments

- ▶ Apply an exponential filter to SM to represent deeper soil layers.
- ▶ Calculate FFD using KBDI, MSDI, SPI and API for specific fires.
- ▶ For further information on how KBDI, MSDI, SPI and API are calculated please contact me via email.

