



bushfire&natural  
**HAZARDS**CRC

## MITIGATING THE EFFECT OF SEVERE FIRES, FLOODS AND HEATWAVES THROUGH IMPROVEMENT TO LAND DRYNESS MEASURES & FORECASTS

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Bureau of Meteorology



An Australian Government Initiative

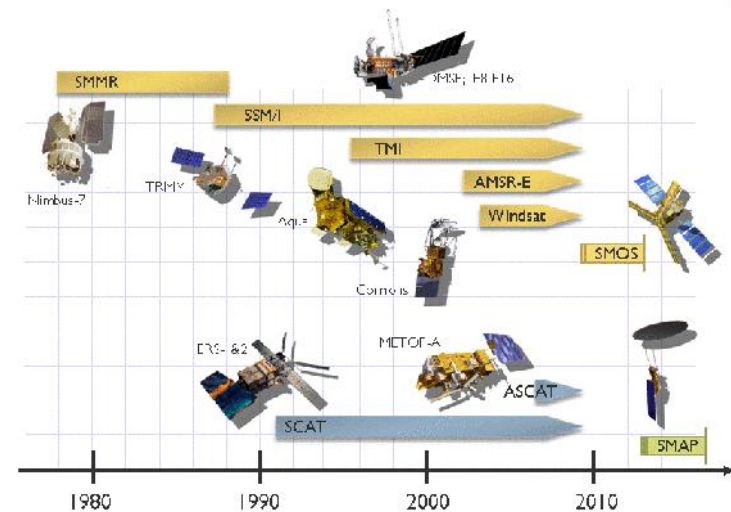
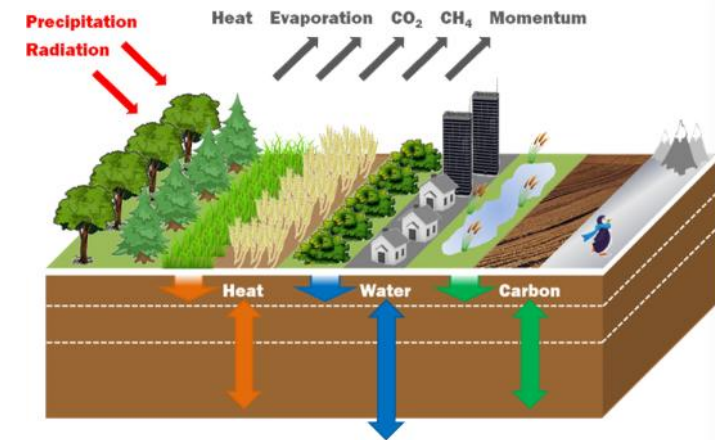


# Background

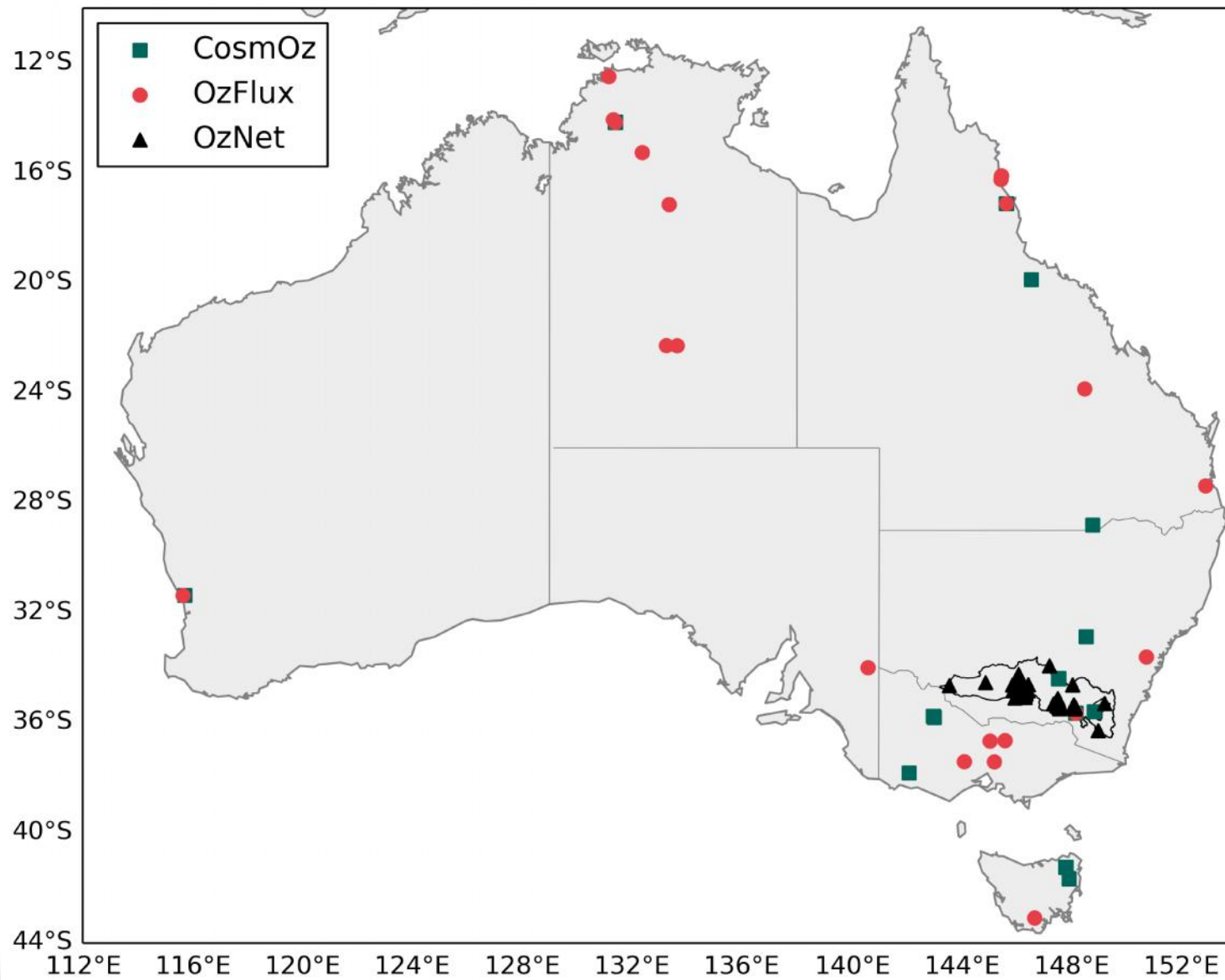
- "From the standpoint of fire control, the **significant moisture relationships** are those which exists in an **upper layer of soil** and a covering layer of duff. ..." (Keetch & Byram, 1968, pp 24.)
- KBDI / SDI
  - >> single soil layer (~1 m)
  - Simple (very simple!) bucket model
  - 60's science to do hand held calculations
- KBDI/SDI used as proxies for both dead and live fuels.
- "... a good system that work **throughout the seasons** should not depend upon a fixed depth of soil horizon to indicate fire danger. A system employing **multi-layer soil** model is desirable..." (Bovio & Camia, 1997).

# JASMIN [JULES based Australian Soil Moisture Information]

- Joint UK Land Environment Simulator (JULES).
- Physics based land surface model.
  - High resolution (5 km).
  - Hourly time step.
  - Four soil layers, to 3 m deep.
  - 0–10; 10–35; 35–100; 100–300 (in cm)
  - Includes different:
    - land-use / vegetation type
    - soil type
- Can include a data assimilation system that can use satellite information.
- Used in BoM's numerical weather prediction & seasonal forecasting models.
- Data from 2010 onwards.

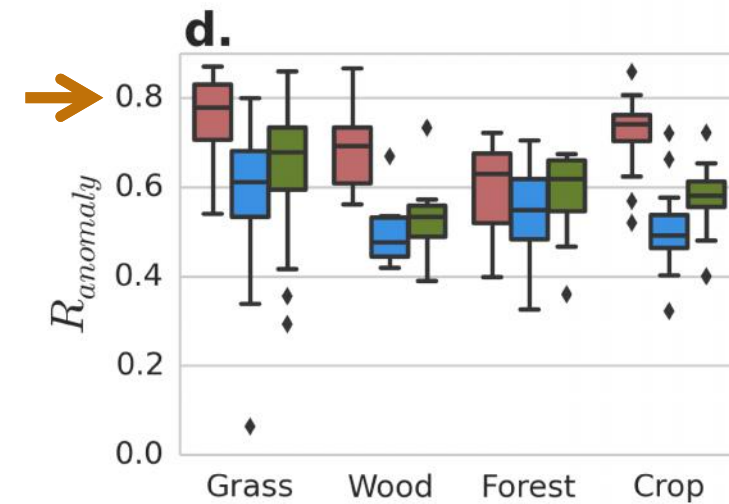
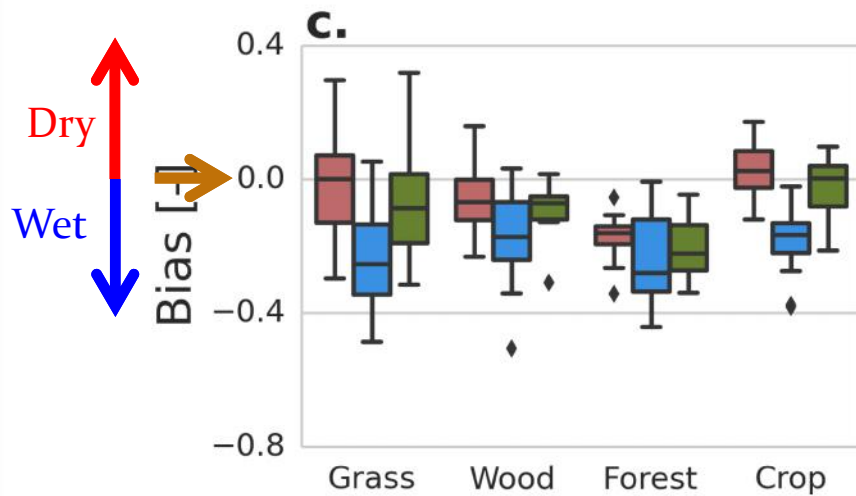
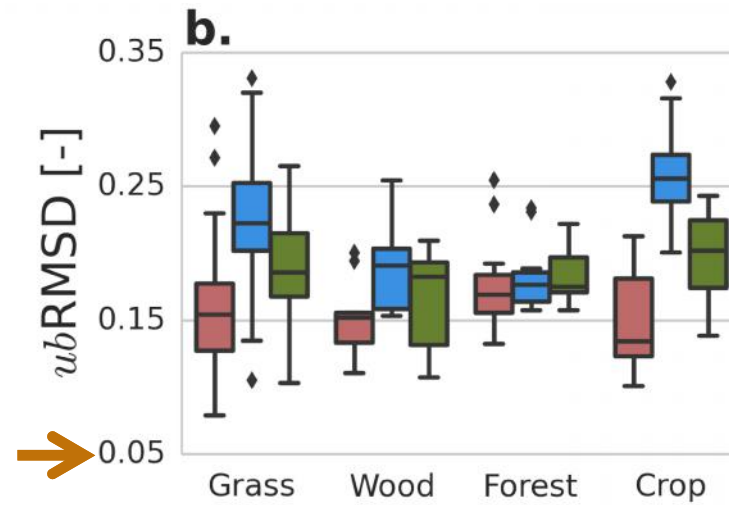
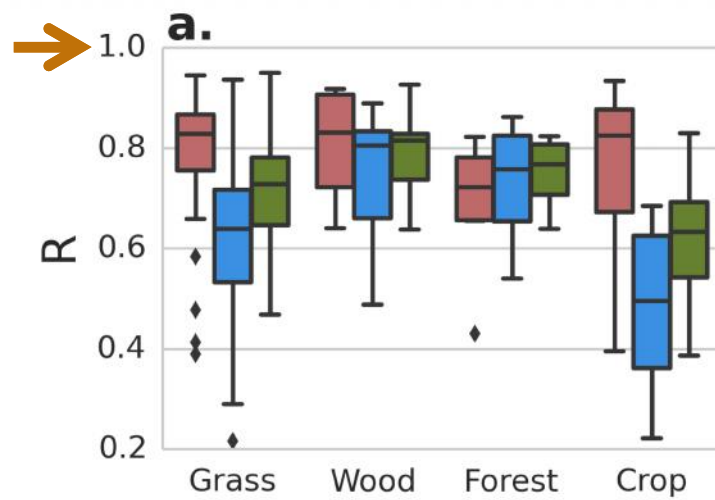


# In-situ Observations for Verification



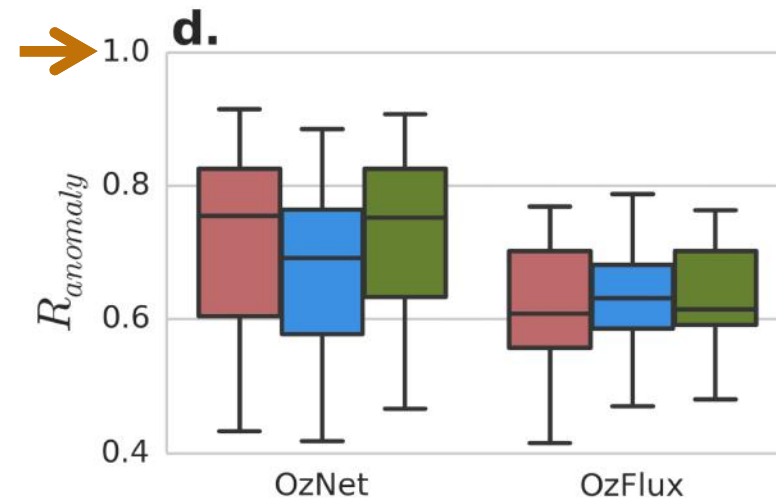
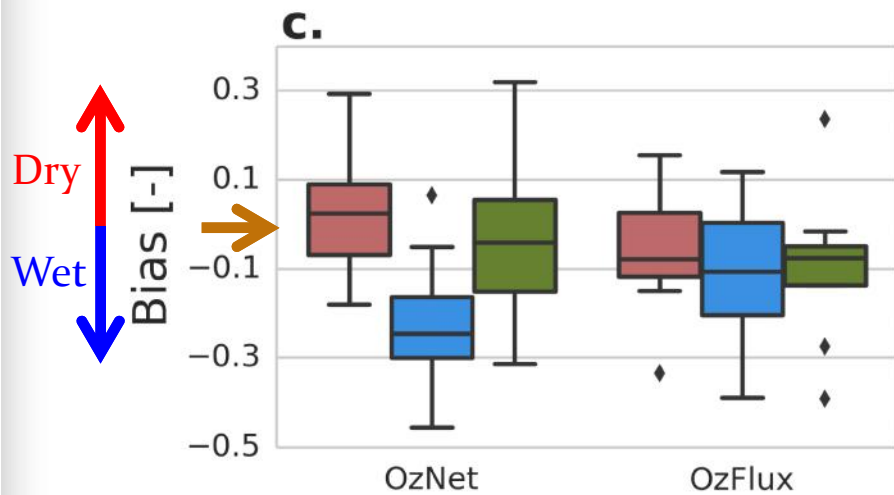
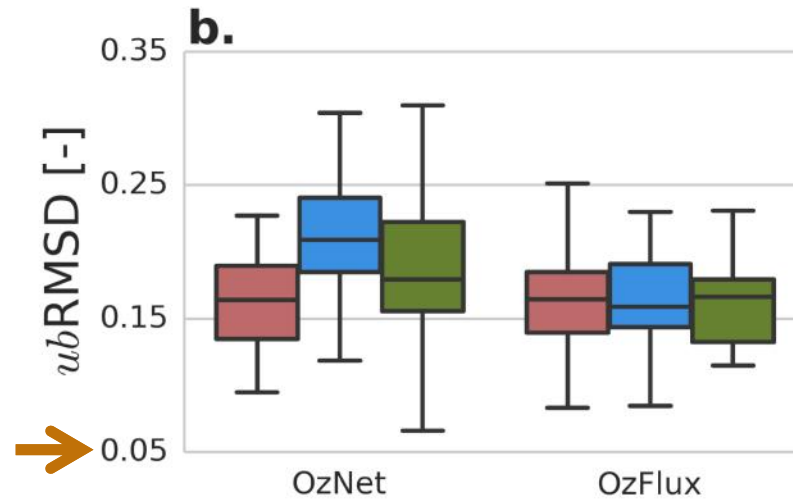
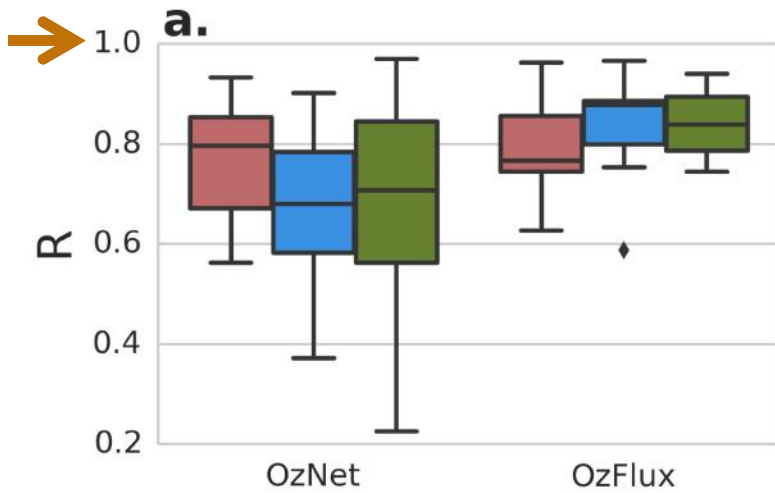


# Shallow layers



JASMIN KBDI SDI

# Deep layers



JASMIN KBDI SDI

# Rescaling: A short-term utilization strategy

- ❑ JASMIN output is in Kg/m<sup>2</sup>. KBDI/SDI range from 0 – 200 mm.
- ❑ Various rescaling methods.
  - ❑ Minimum-Maximum (MM) matching
  - ❑ Mean-Std. dev ( $\mu$ - $\sigma$ ) matching
  - ❑ CDF matching: Spatial & Temporal
- ❑ Routine display of images on website.
- ❑ Case studies:
  - ❑ Past bush fire occurrences and fuel reduction burns. These cases are selected and evaluated with the help of end users.
  - ❑ All case studies will be documented and could be used as training documentation by fire agencies.
  - ❑ Cases identified so far:

## Bushfire cases

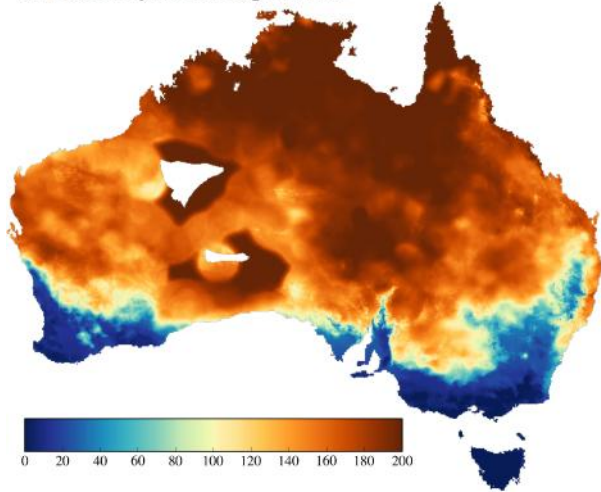
State Mine Fire, NSW, Oct 2013; Dunalley Fire, TAS, Jan 2013; Wuthering Heights Fire, TAS, Jan 2016; Lake Mackenzie fire, TAS, Jan 2016; Ballandean fire, QLD, Oct 2014

## Fuel reduction burns

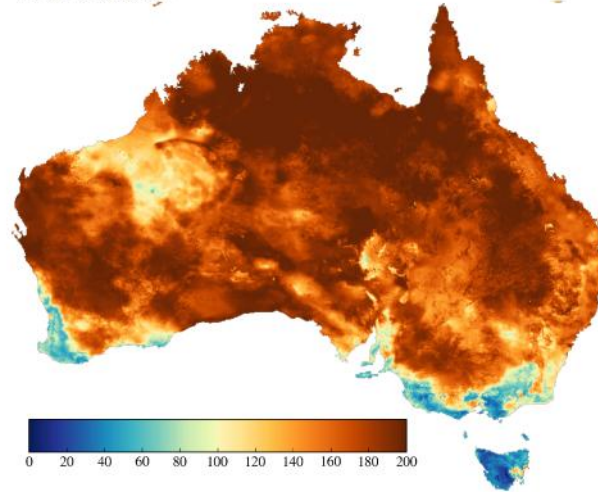
Lancefield, VIC, Sep 2015; NE Victoria, Mar 2017; Orbost, VIC, Mar 2017.

# JASMIN rescaled to KBDI on 18<sup>th</sup> Oct 2013

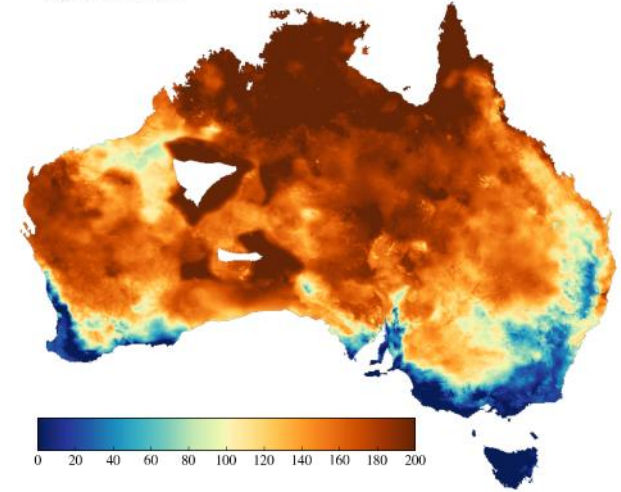
a. Keetch-Byram Drought Index



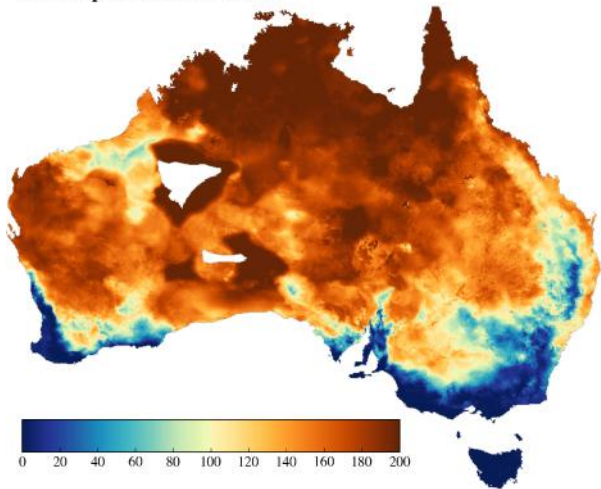
b. MM method



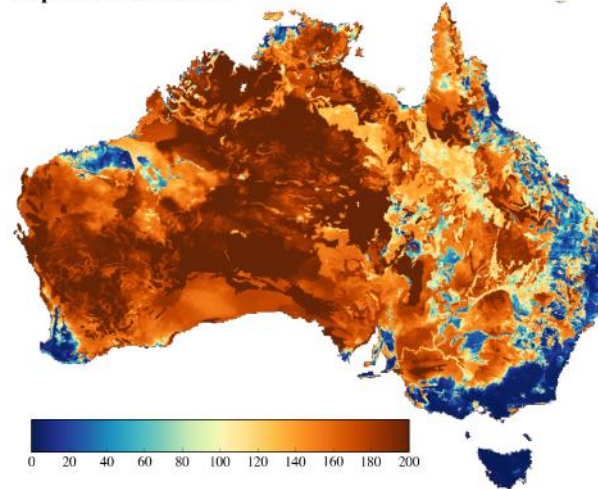
c.  $\mu-\sigma$  method



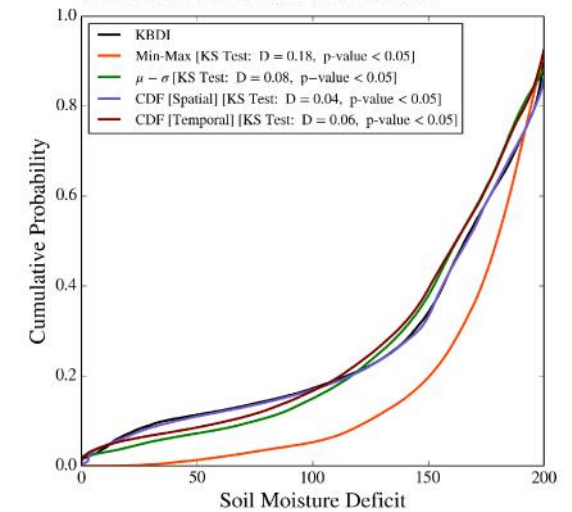
d. Temporal CDF method



e. Spatial CDF method



f. Cumulative distribution function



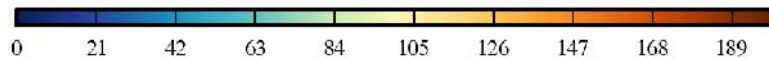


# State Mine Fire: JASMIN rescaled to KBDI on 18<sup>th</sup> Oct 2013

JASMIN scaled to KBDI for 18/Oct/2013

Using Minimum-Maximum Matching on first 3 soil layers

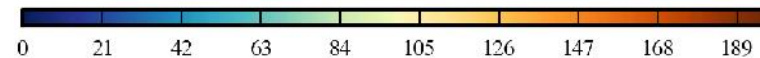
State Mine Fire Complex



Keetch-Byram Drought Index

Calculated for 18/Oct/2013

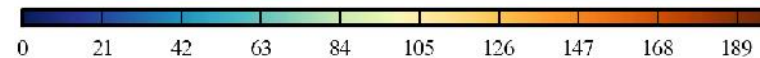
State Mine Fire Complex



JASMIN scaled to KBDI for 18/Oct/2013

Using Mean-Variance Matching on first 3 soil layers

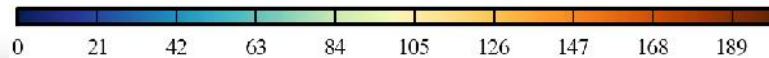
State Mine Fire Complex



JASMIN scaled to KBDI for 18/Oct/2013

Using CDF Matching [Temporal] on first 3 soil layers

State Mine Fire Complex



JASMIN scaled to KBDI for 18/Oct/2013

Using CDF Matching [Spatial] on first 3 soil layers

State Mine Fire Complex



# Rescaling: Pearson's correlations

## 0–35 cm model soil profile

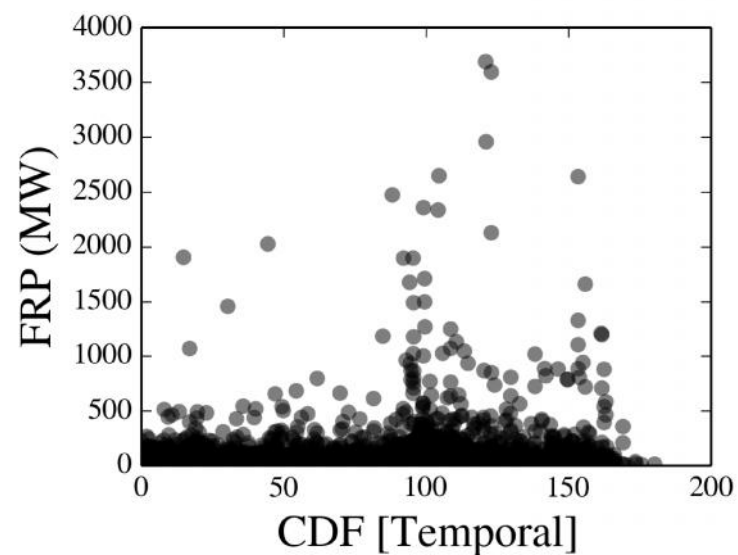
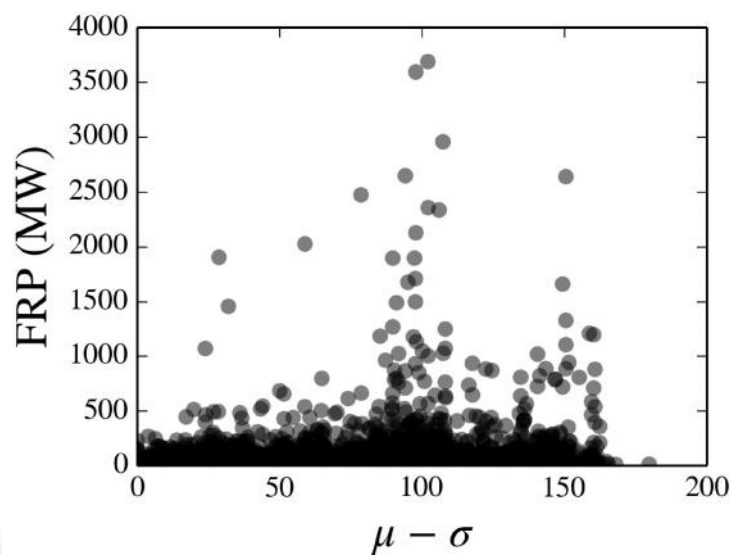
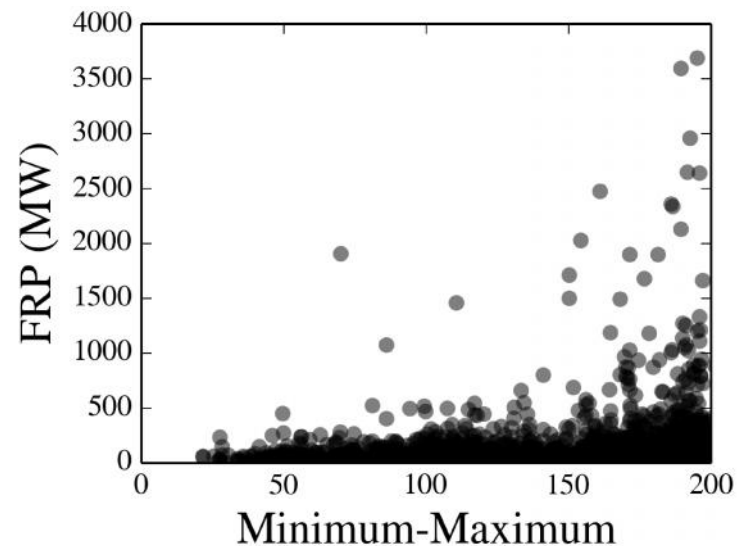
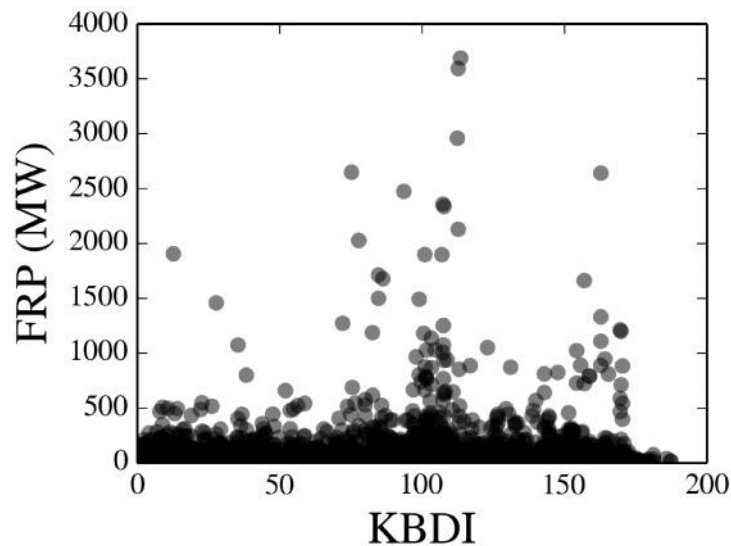
In situ network	Correlation					Anomaly correlation				
	KBDI	MM	$\mu - \sigma$	CDF		KBDI	MM	$\mu - \sigma$	CDF	
				Spatial	Temporal				Spatial	Temporal
CosmOz (surface)	-0.69	-0.84	-0.82	-0.76	-0.79	-0.47	-0.65	-0.61	-0.50	-0.59
OzFlux (surface)	-0.75	-0.80	-0.80	-0.73	-0.79	-0.58	-0.70	-0.68	-0.57	-0.66
OzFlux (root zone)	-0.86	-0.84	-0.85	-0.78	-0.85	-0.65	-0.63	-0.63	-0.49	-0.62

MM: Minimum-Maximum

## 0–100 cm model soil profile

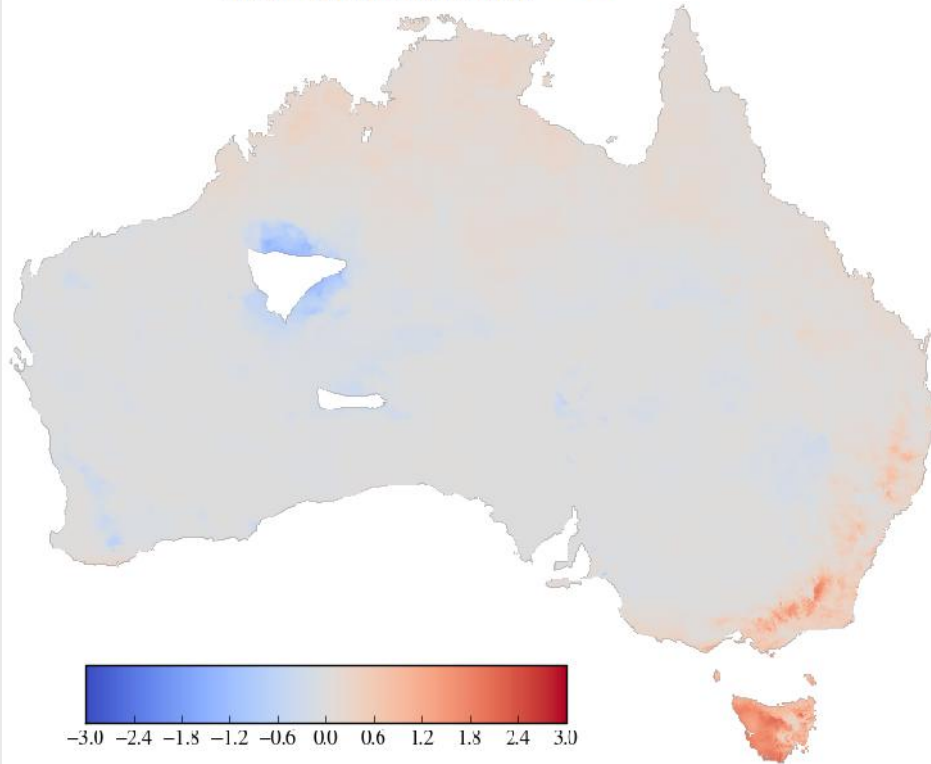
In situ network	Correlation					Anomaly correlation				
	KBDI	MM	$\mu - \sigma$	CDF		KBDI	MM	$\mu - \sigma$	CDF	
				Spatial	Temporal				Spatial	Temporal
CosmOz (surface)	-0.69	-0.72	-0.70	-0.65	-0.67	-0.47	-0.57	-0.55	-0.48	-0.54
OzFlux (surface)	-0.75	-0.74	-0.73	-0.60	-0.71	-0.58	-0.64	-0.61	-0.51	-0.60
OzFlux (root zone)	-0.86	-0.82	-0.82	-0.65	-0.82	-0.65	-0.63	-0.62	-0.48	-0.60

# Comparison against MODIS FRP: Victoria

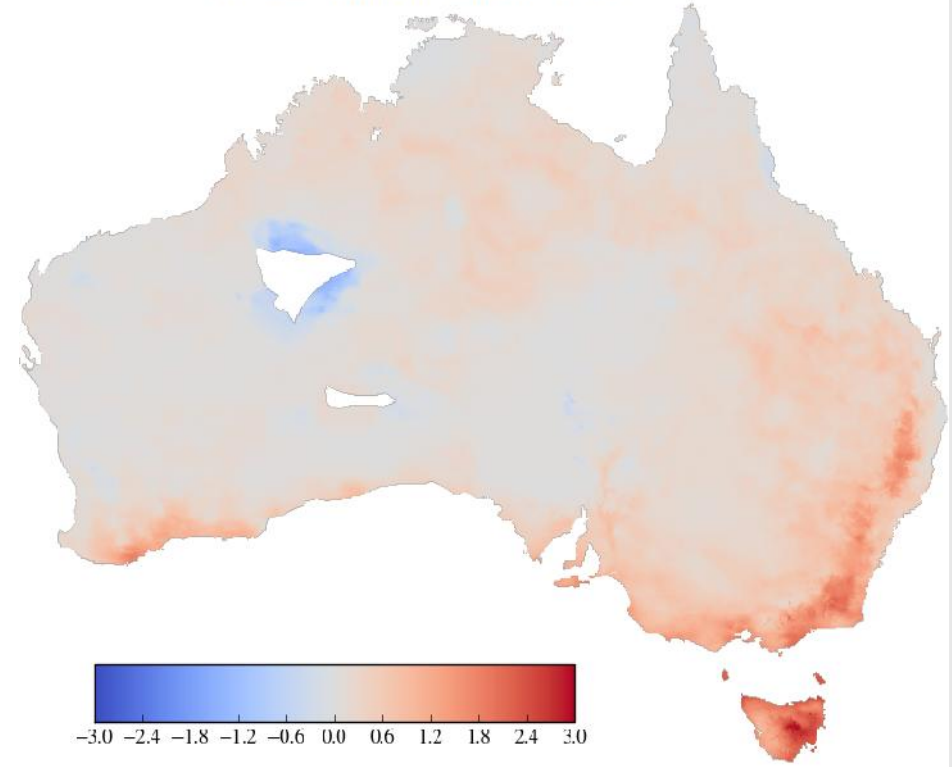


# Drought Factor (?)

Drought Factor: Difference for the month of January  
JASMIN [MM matching] – SDI



Drought Factor: Difference for the month of January  
JASMIN [MM matching] – KBDI





# Internal web-page

File Edit View History Bookmarks Tools Help

http://logan.bo...in.sdi/jrs.html

logan.bom.gov.au/~vinodk/Products/JASMIN/jasmin.sdi/jrs.html

## JASMIN rescaled to SDI

**About JASMIN**

The plots available here are generated as part of the project "Mitigating the effects of severe fires, floods and heatwaves through the improvements of land dryness measures and forecasts" funded by the Bushfire and Natural Hazards Cooperative Research Centre, Australia. The JASMIN outputs are at a 5 km resolution.

Select Date  
2 Oct 2017

Select Method  
Minimum-Maximum Matching

Select Layer  
0-35 cm layer

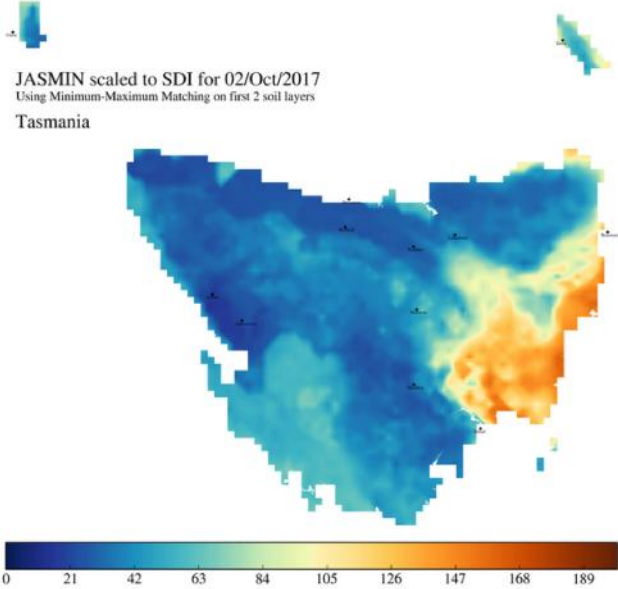
Select Region  
Tasmania

Download Data

Contact


Home

JASMIN scaled to SDI for 02/Oct/2017  
Using Minimum-Maximum Matching on first 2 soil layers  
Tasmania




0 21 42 63 84 105 126 147 168 189

Partner Organizations



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Australian Government  
Bureau of Meteorology

Disclaimer: These plots are experimental. The Bureau of Meteorology accepts no responsibility for actions taken on the basis of these plots.

<http://logan.bom.gov.au/~vinodk/index.html>

# Conclusions & future work

- An accurate, high resolution 5+ years soil moisture dataset for Australia has been developed.
  - Jules based **A**ustralian **S**oil **M**oisture **I**Nformation system

## JASMIN

- Verification shows that the JASMIN has good skill.
- Calibration work in progress.
- Raw soil moisture data can also be made available.
- We will downscale soil moisture to a higher resolution (~ 1km).
- We will assimilate satellite based soil moisture and land temperature using the NASA Land Information System (LIS) framework.

## Acknowledgments

- BNHCRC
- All end-users
- Peter Steinle, Jeff Kepert, David McJannet, Jeff Walker, Adam Smith, Chun-Hsu Su
- Monash University & University of Melbourne for OzNet
- CSIRO for CosmOz
- OzFlux team

**THANKS,  
ANY QUESTIONS?**

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