bushfire&natural HAZARDSCRC

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

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An Australian Government Initiative

CRC AUSTRALIA

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.)**

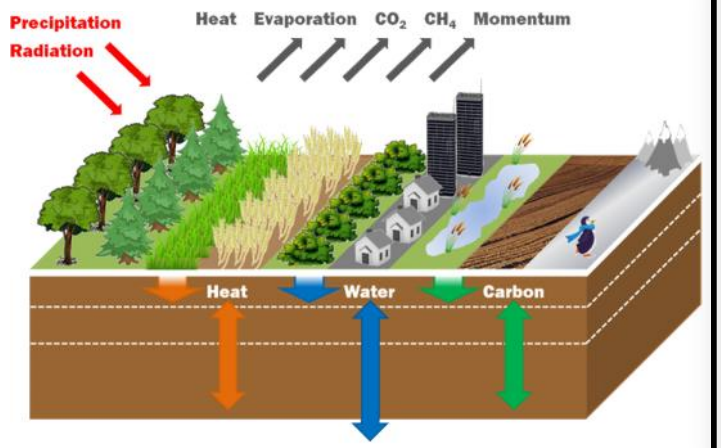
- KBDI / SDI
  - >> single soil layer (~1 m)
  - Simple (very simple!) bucket model
  - 60's science to do hand held calculations

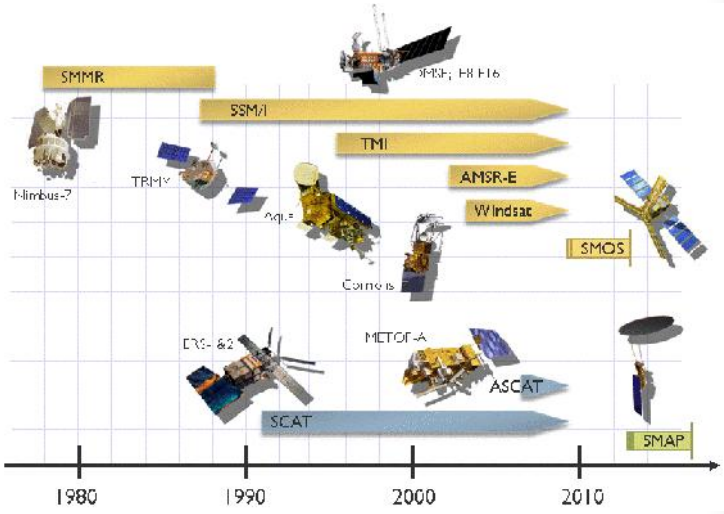
- KBDI/SDI used as proxies for both dead and live fuels.

- *"... **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).**

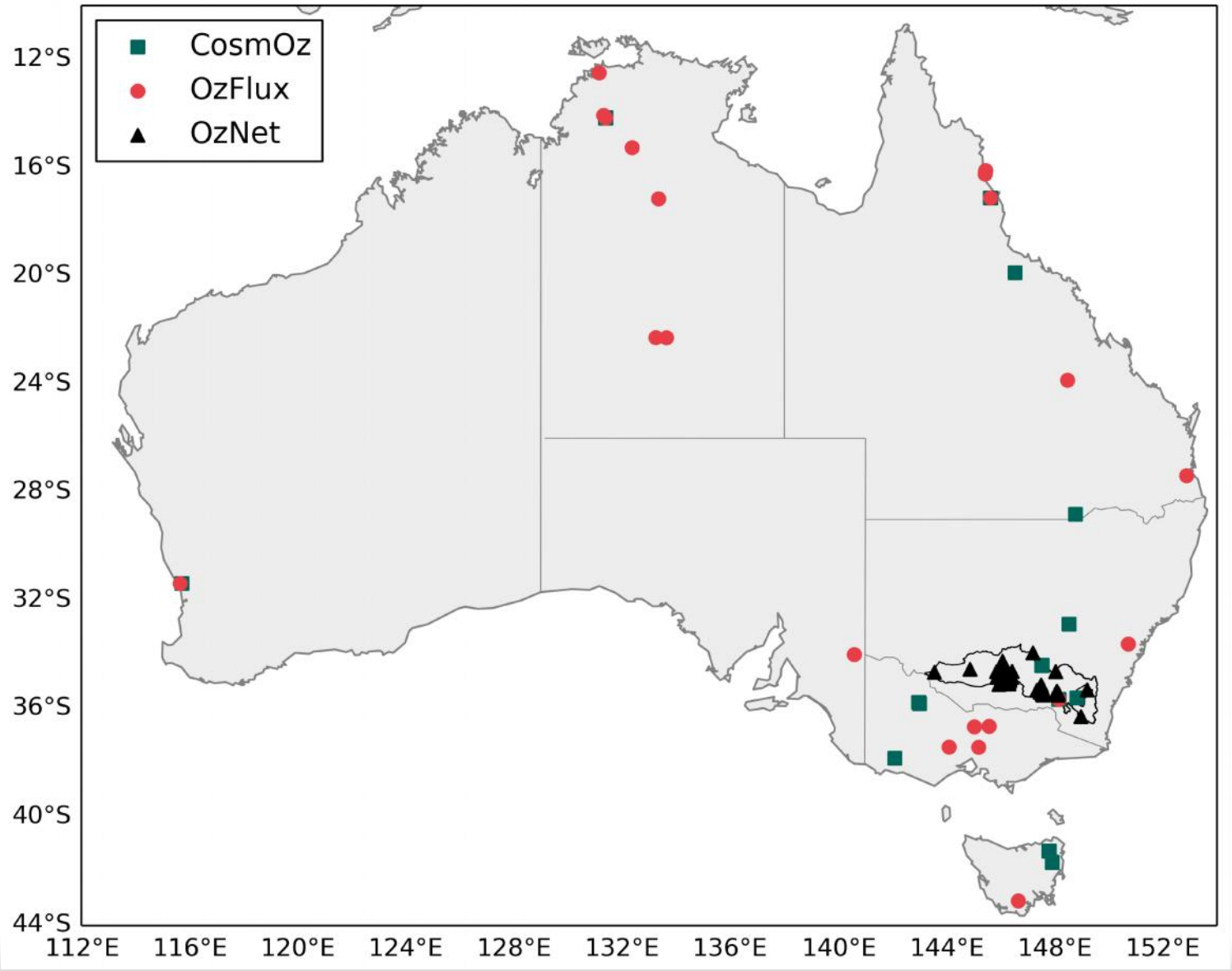
JASMIN [JULES based Australian Soil Moisture Information]

- 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.

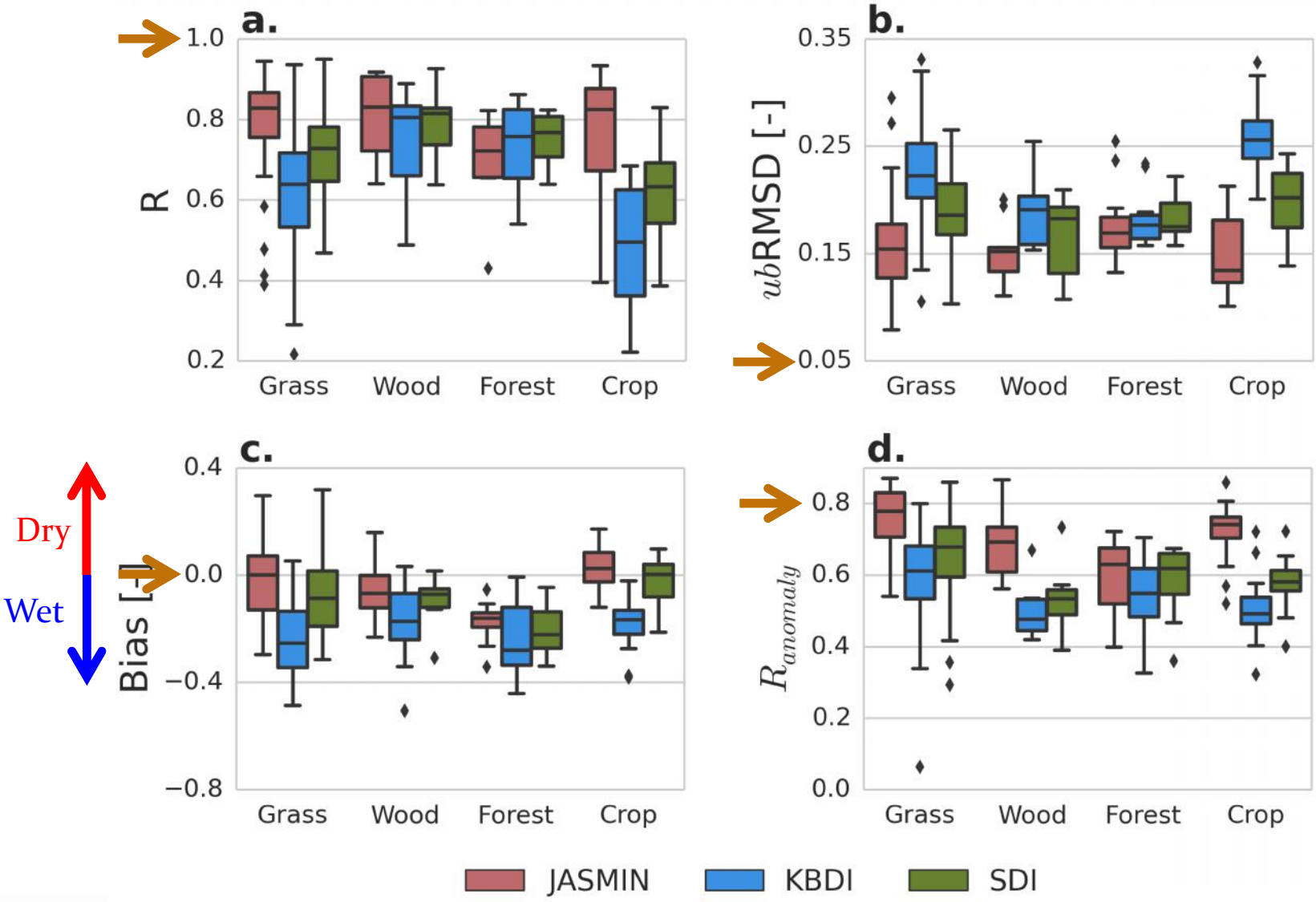




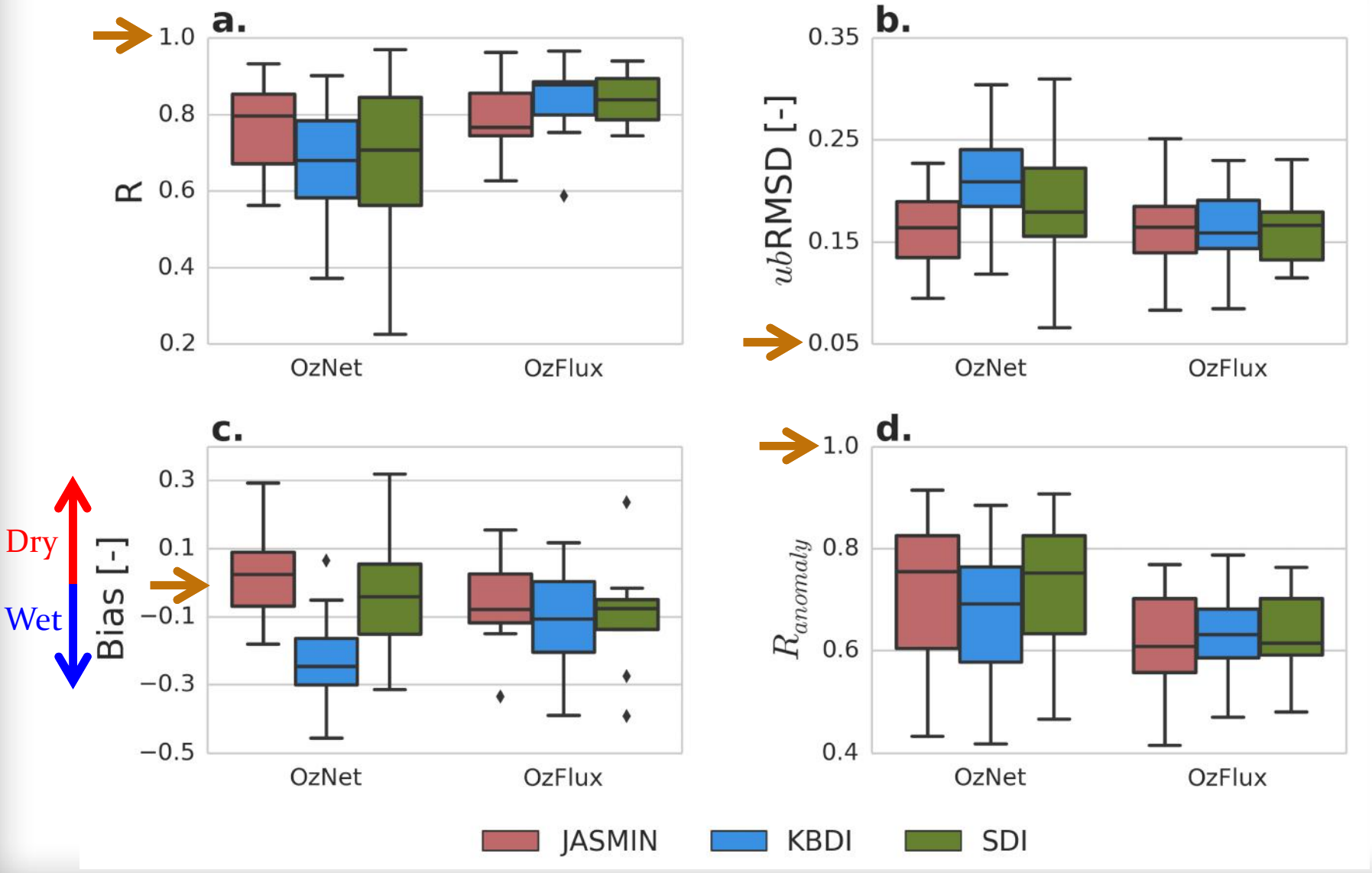
In-situ Observations for Verification



Shallow layers



Deep layers


a.
R
1.0
0.8
0.6
0.4
0.2
OzNet
OzFlux
b.
$ubRMSD$ [-]
0.35
0.25
0.15
0.05
OzNet
OzFlux
c.
Dry
Wet
Bias [-]
0.3
0.1
−0.1
−0.3
−0.5
OzNet
OzFlux
d.
$R_{anomaly}$
1.0
0.8
0.6
0.4
OzNet
OzFlux
JASMIN
KBDI
SDI

Rescaling: A short-term utilization strategy

- JASMIN output is in Kg/m². KBDI/SDI range from 0 – 200 mm.
- Various rescaling methods.
  - Minimum-Maximum (MM) matching
  - Mean-Std. dev (μ–σ) 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

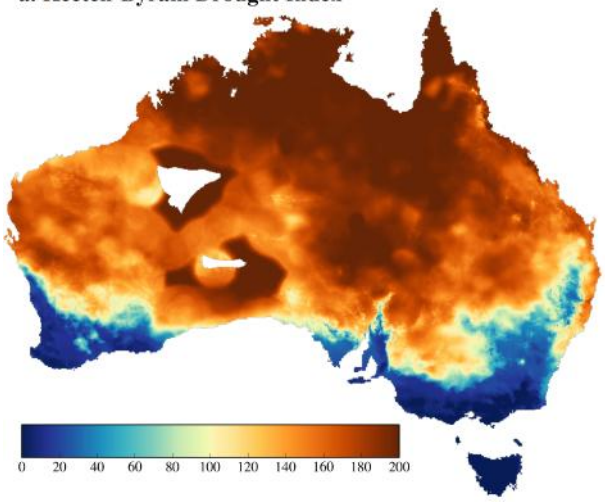
State Mine Fire, NSW, Oct 2013; Dunalley Fire, TAS, Jan 2013; Wuthering Heights Fire, TAS, Jan 2016; Lake Mackenzie fire, TAS, Jan 2016; Ballandean fire, QLD, Oct 2014

Fuel reduction burns

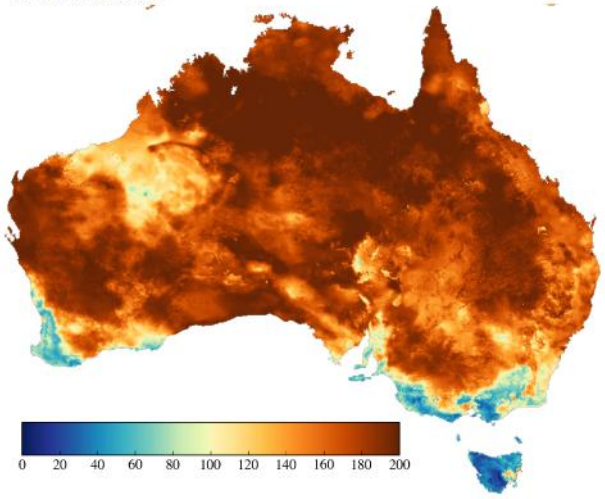
Lancefield, VIC, Sep 2015; NE Victoria, Mar 2017; Orbost, VIC, Mar 2017.

JASMIN rescaled to KBDI on 18th Oct 2013

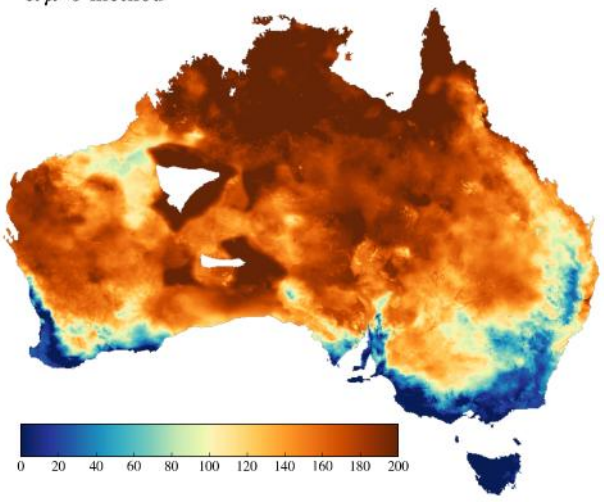
a. Keetch-Byram Drought Index



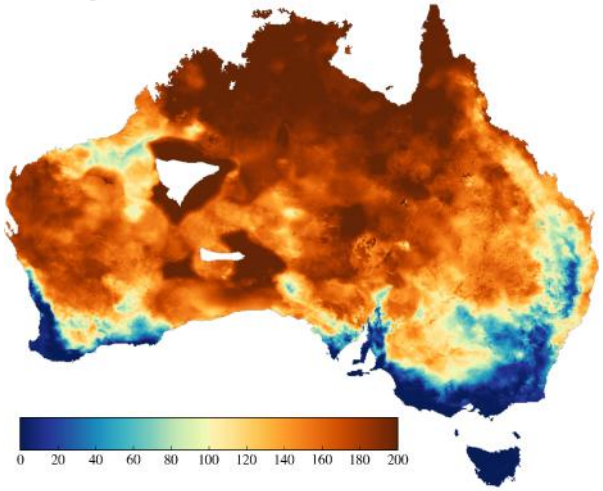
b. MM method



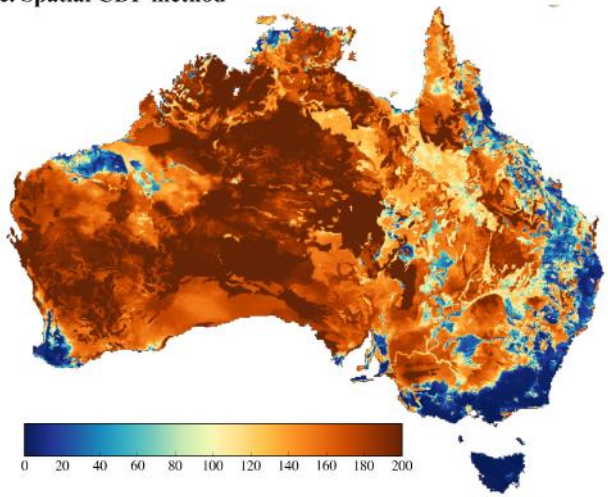
c. μ–σ method



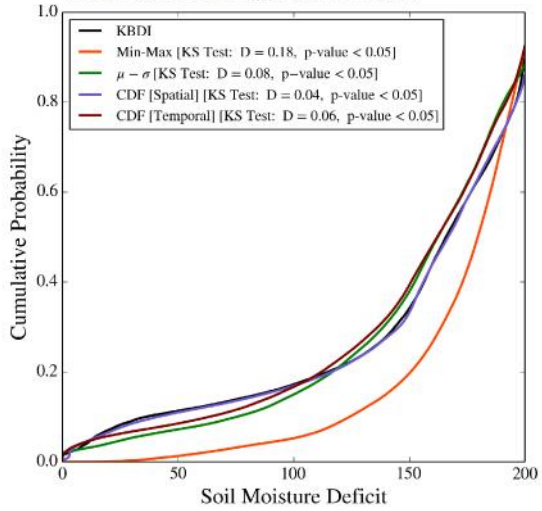
d. Temporal CDF method



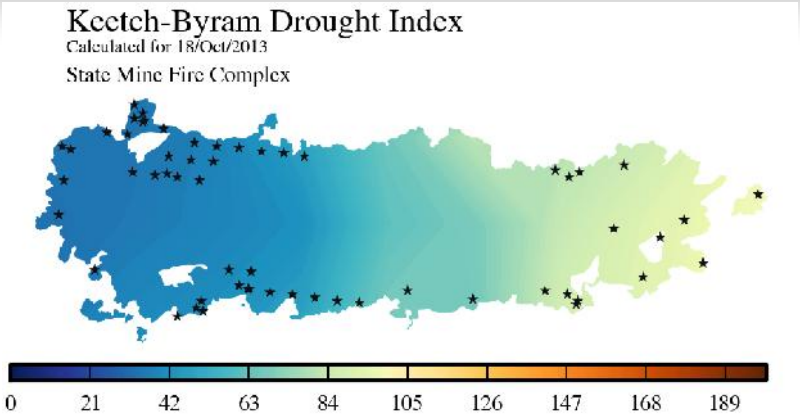
e. Spatial CDF method

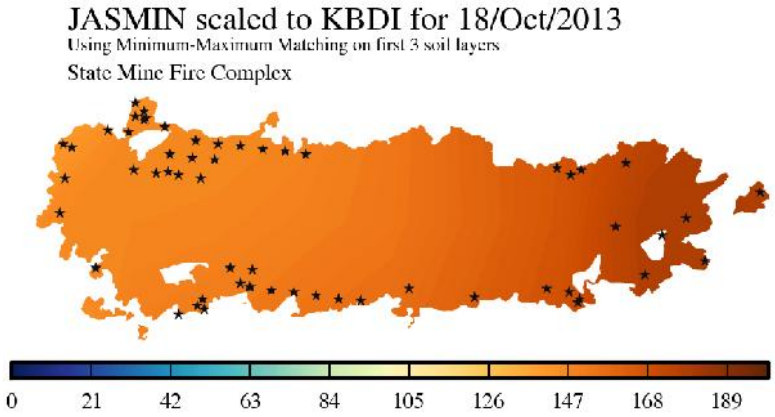


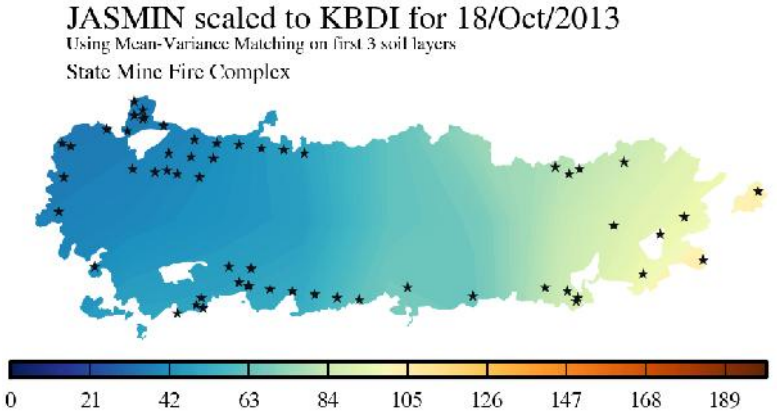
f. Cumulative distribution function

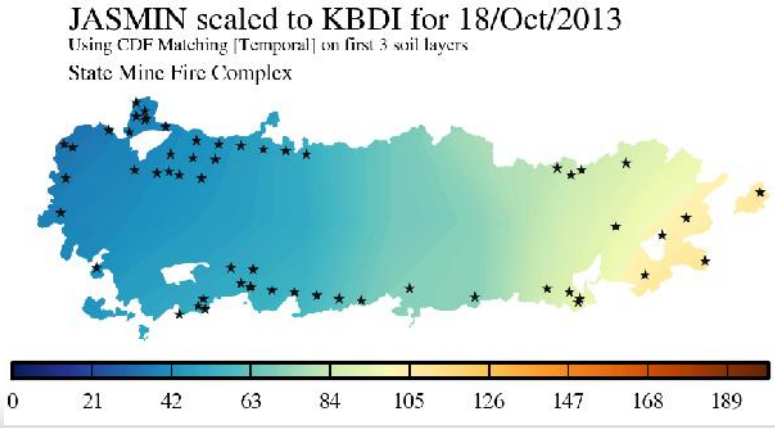


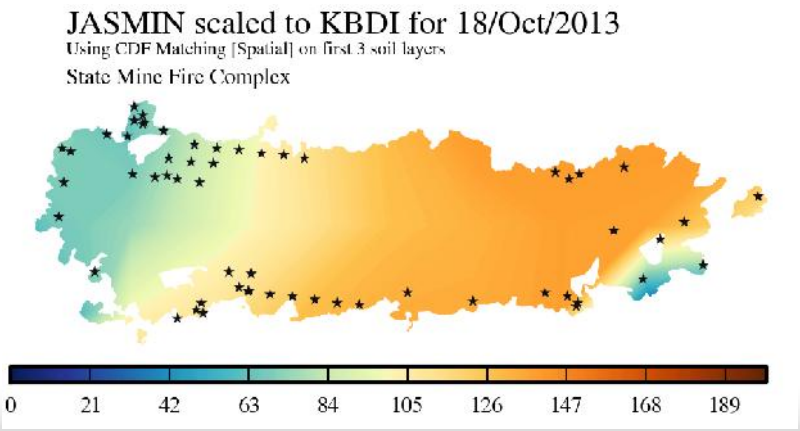
State Mine Fire: JASMIN rescaled to KBDI on 18th Oct 2013











Rescaling: Pearson's correlations

0–35 cm model soil profile

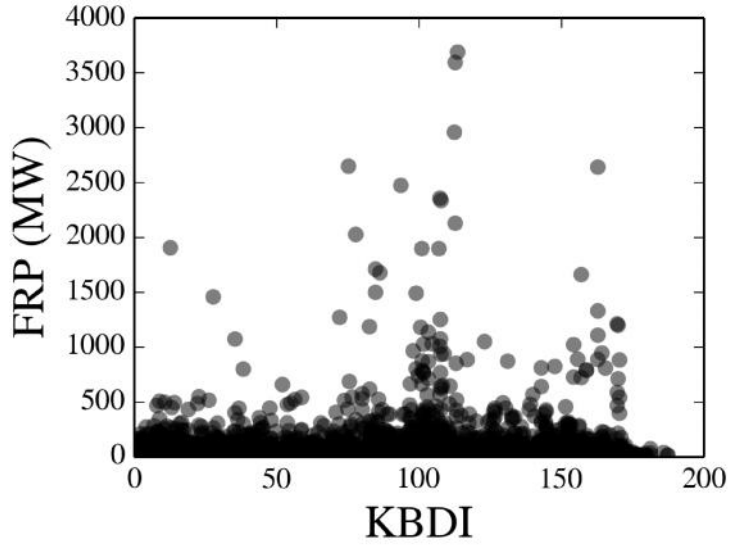
In situ network	Correlation					Anomaly correlation				
	KBDI	MM	μ – σ	CDF		KBDI	MM	μ – σ	CDF	
				Spatial	Temporal				Spatial	Temporal
CosmOz (surface)	-0.69	-0.84	-0.82	-0.76	-0.79	-0.47	-0.65	-0.61	-0.50	-0.59
OzFlux (surface)	-0.75	-0.80	-0.80	-0.73	-0.79	-0.58	-0.70	-0.68	-0.57	-0.66
OzFlux (root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

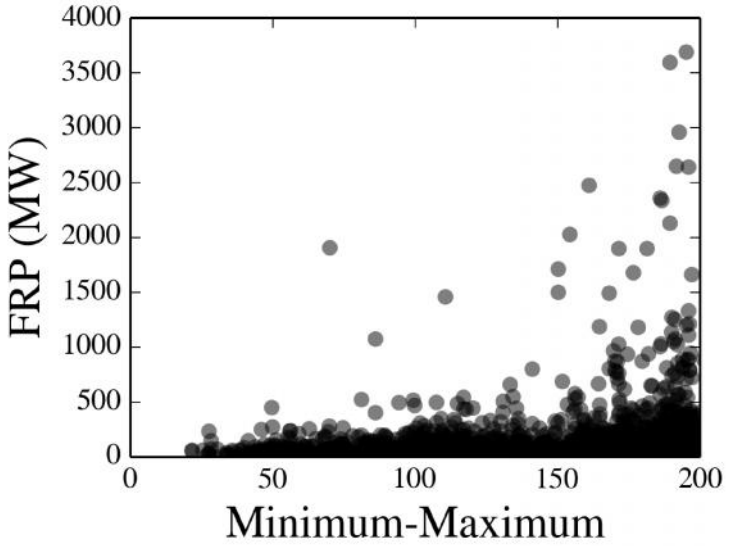
MM: Minimum-Maximum

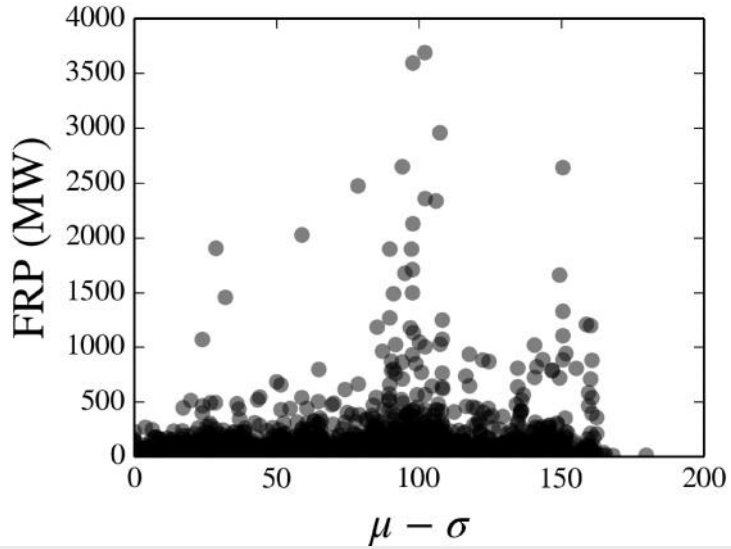
0–100 cm model soil profile

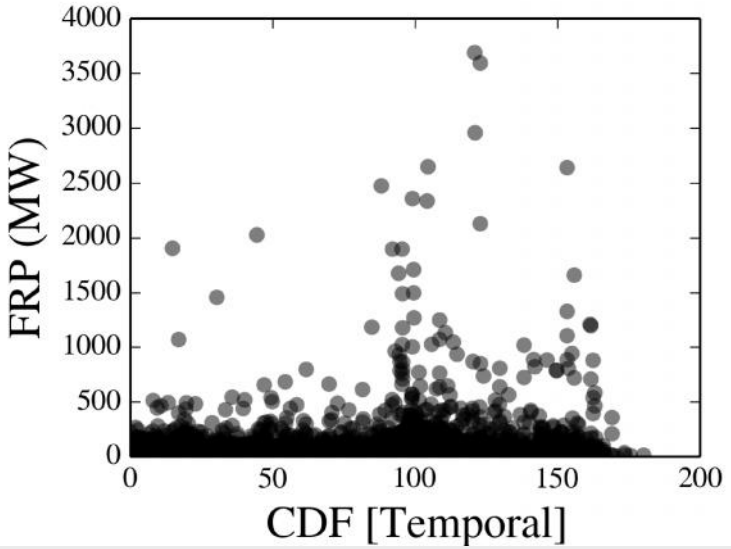
In situ network	Correlation					Anomaly correlation				
	KBDI	MM	μ – σ	CDF		KBDI	MM	μ – σ	CDF	
				Spatial	Temporal				Spatial	Temporal
CosmOz (surface)	-0.69	-0.72	-0.70	-0.65	-0.67	-0.47	-0.57	-0.55	-0.48	-0.54
OzFlux (surface)	-0.75	-0.74	-0.73	-0.60	-0.71	-0.58	-0.64	-0.61	-0.51	-0.60
OzFlux (root 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

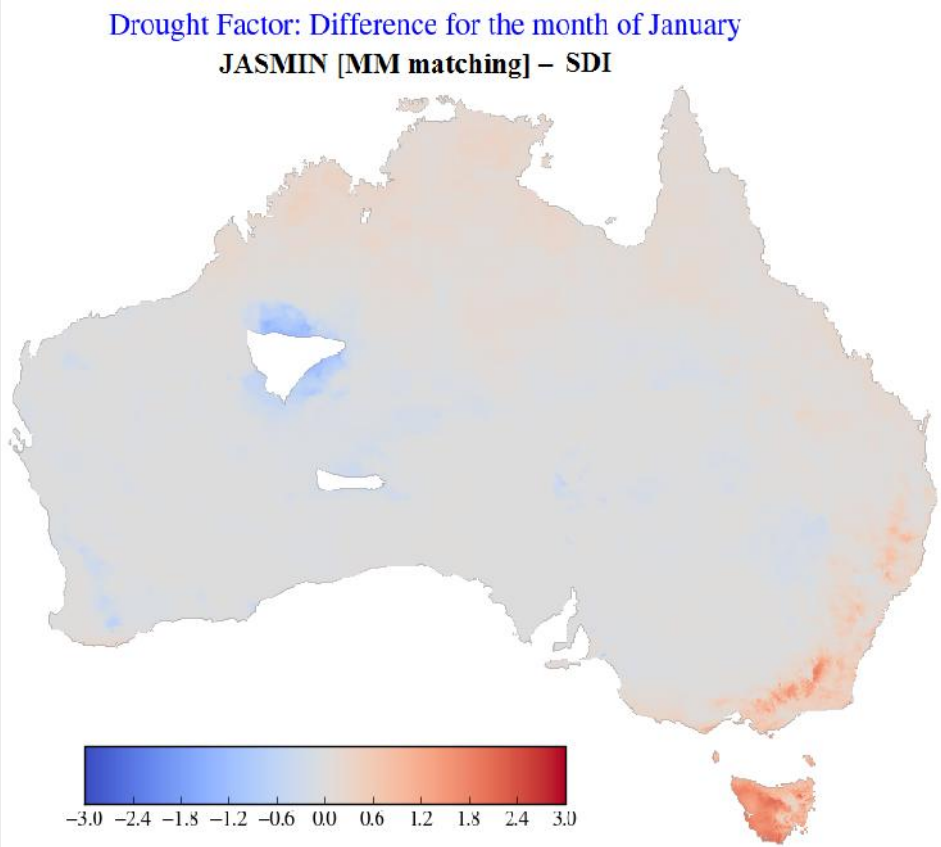


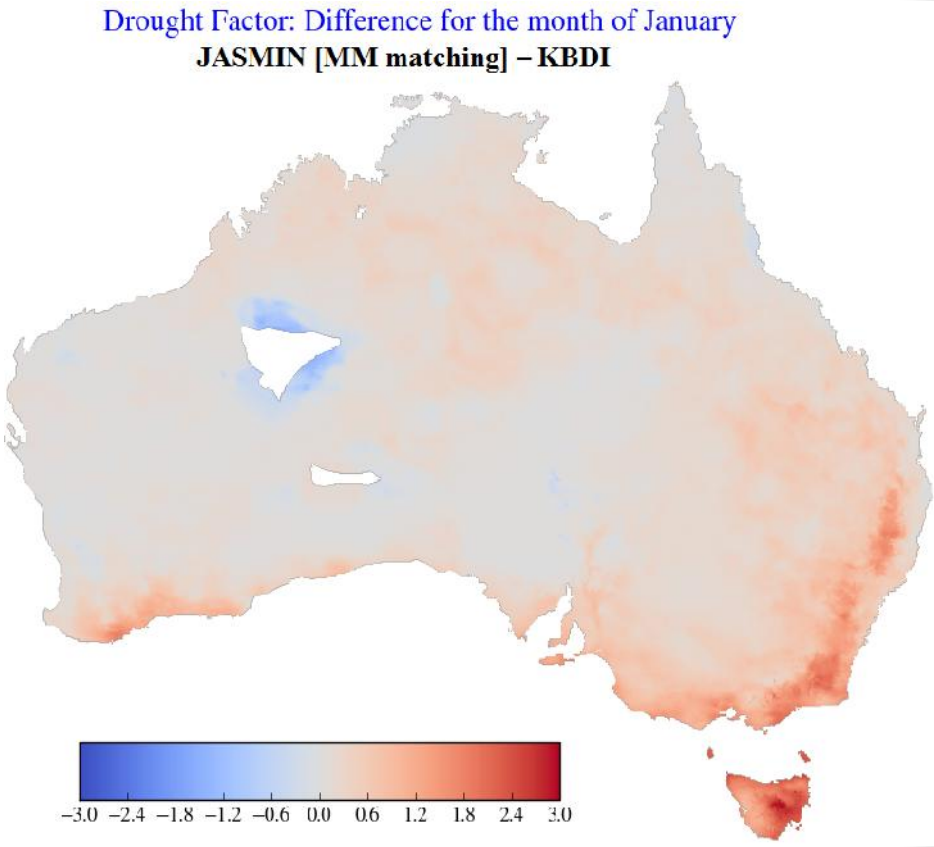




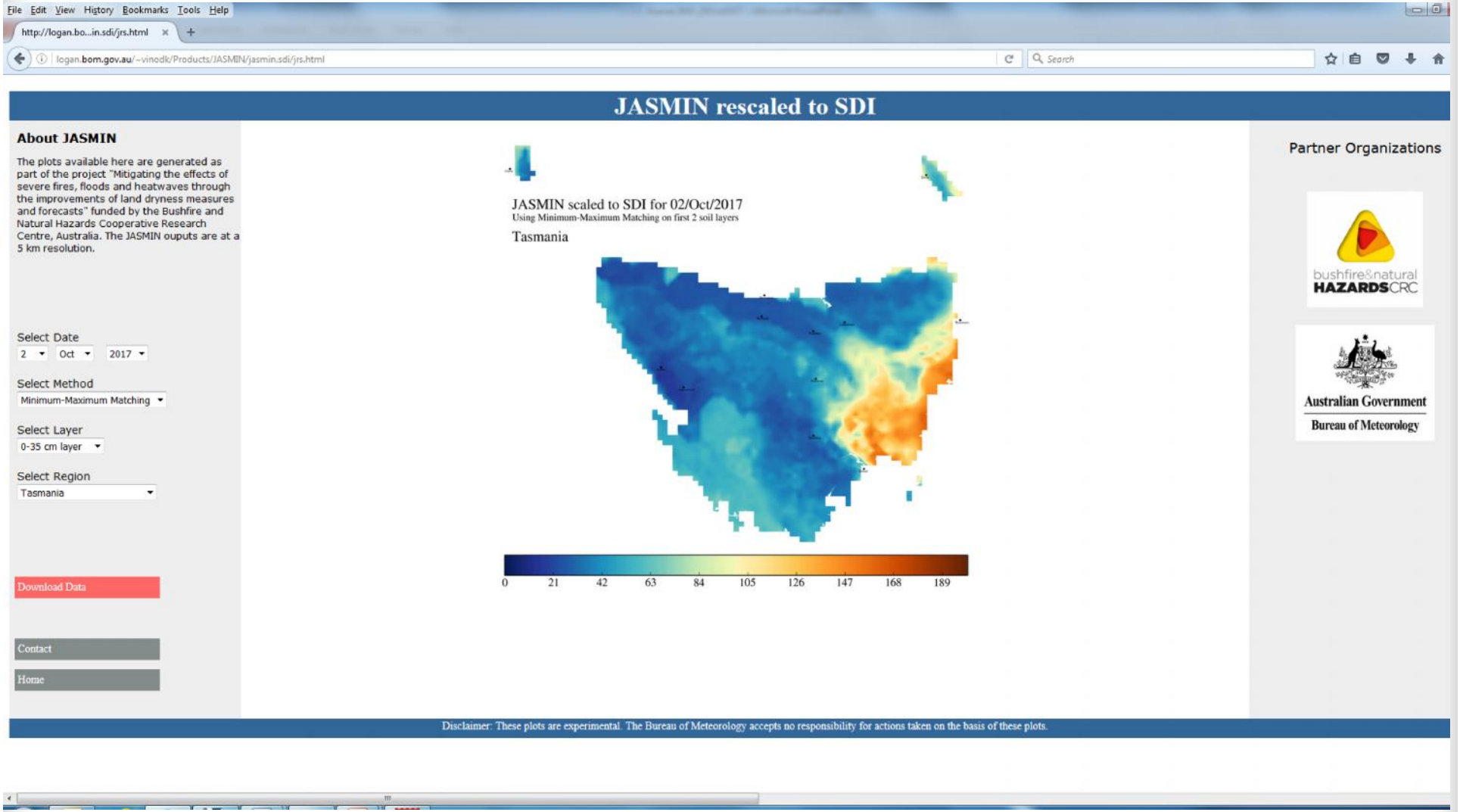


Drought Factor (?)





Internal web-page



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.
  - **J**ules based **A**ustralian **S**oil **M**oisture **IN**formation 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
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- OzFlux team

THANKS, ANY QUESTIONS?

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