

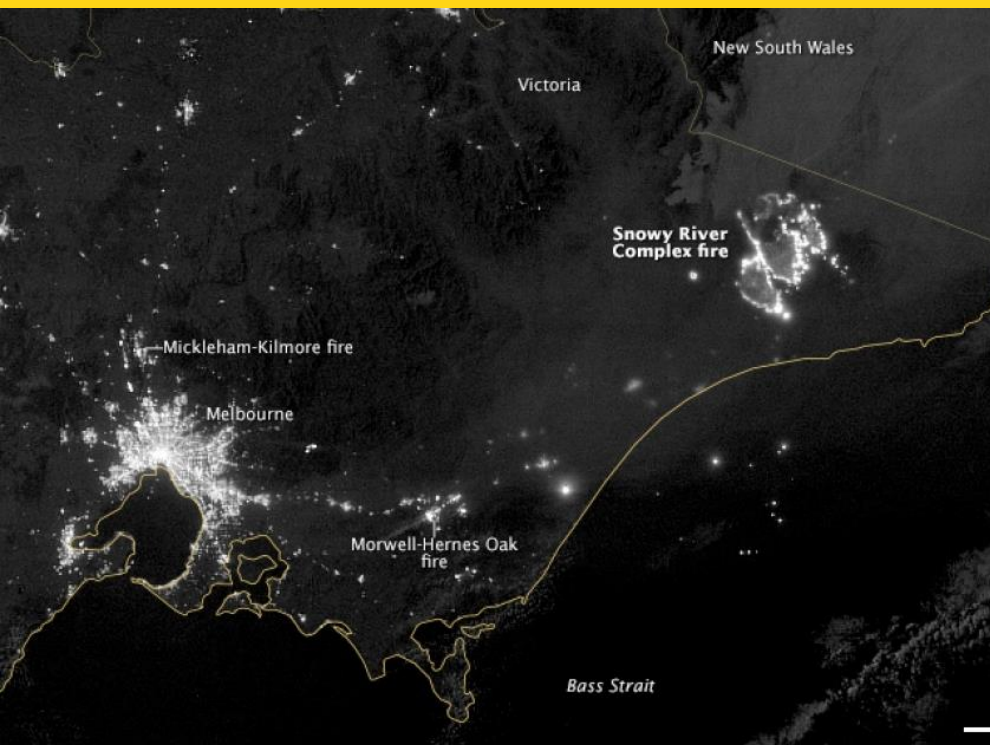


bushfire&natural  
**HAZARDS**CRC

# MORE ACCURATE FIRE DANGER WARNINGS THROUGH THE USE OF NWP SYSTEMS

**Vinodkumar & Imtiaz Dharssi**

Bureau of Meteorology, Melbourne



Picture courtesy: NASA



An Australian Government Initiative



# Fire Danger Rating in Australia

- Forest Fire Danger Index (FFDI; McArthur, 1958).
- No major science update since first design!
- FFDI use a sub-model to estimate cumulative soil moisture deficit.
  - Mount Soil Dryness Index (MSDI; Mount 1972)
  - Keetch-Byram Drought Index (KBDI; Keetch & Byram 1968)
- KBDI / MSDI are:
  - Simple empirical water balance models.
  - Ignores majority of factors affecting soil water dynamics.

# Food for thoughts

---

Q. Are the traditional dryness indices accurate?

A. Not sure.

Q. How they stack against the "new generation" products (e.g.: satellite remote sensing, land surface models)?

A. Don't know

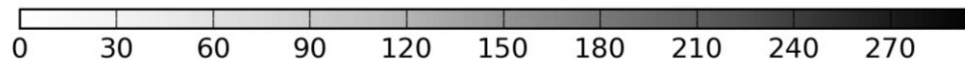
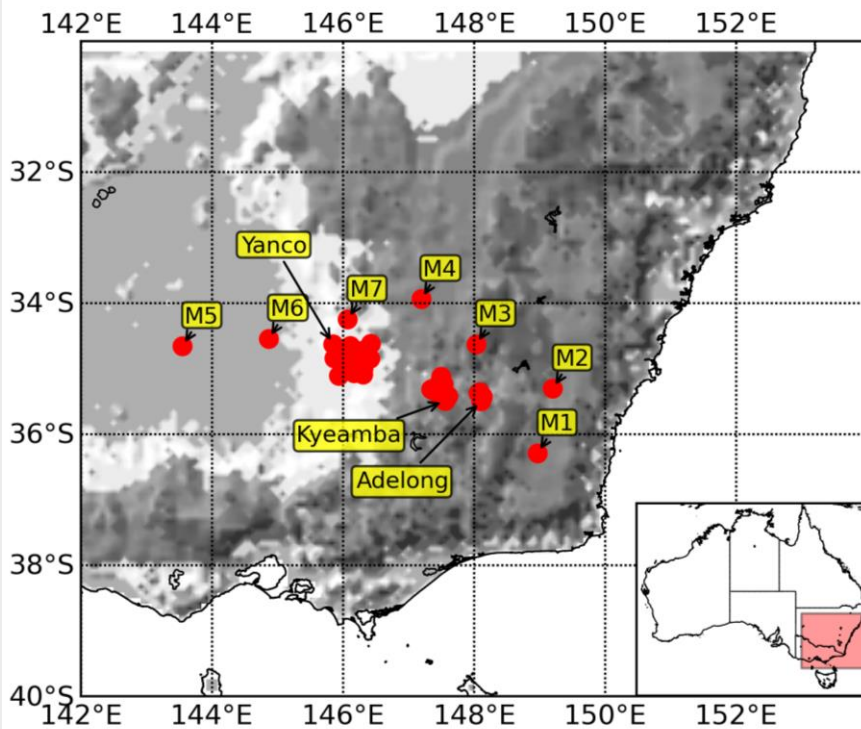
Q. Are there such "new gen" products already available in some form?

A. Yes! E.g. – Numerical weather prediction models, ASCAT

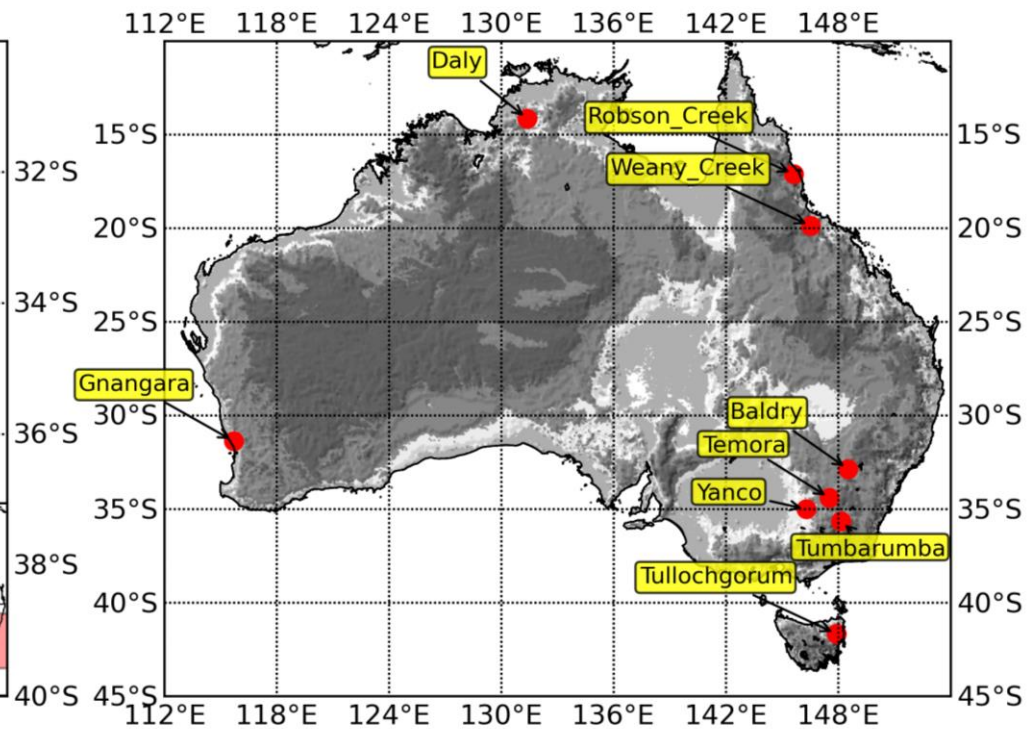
**Well, then lets verify!**

# In-situ observation locations

(a) OzNet



(b) CosmOz



# Skill scores

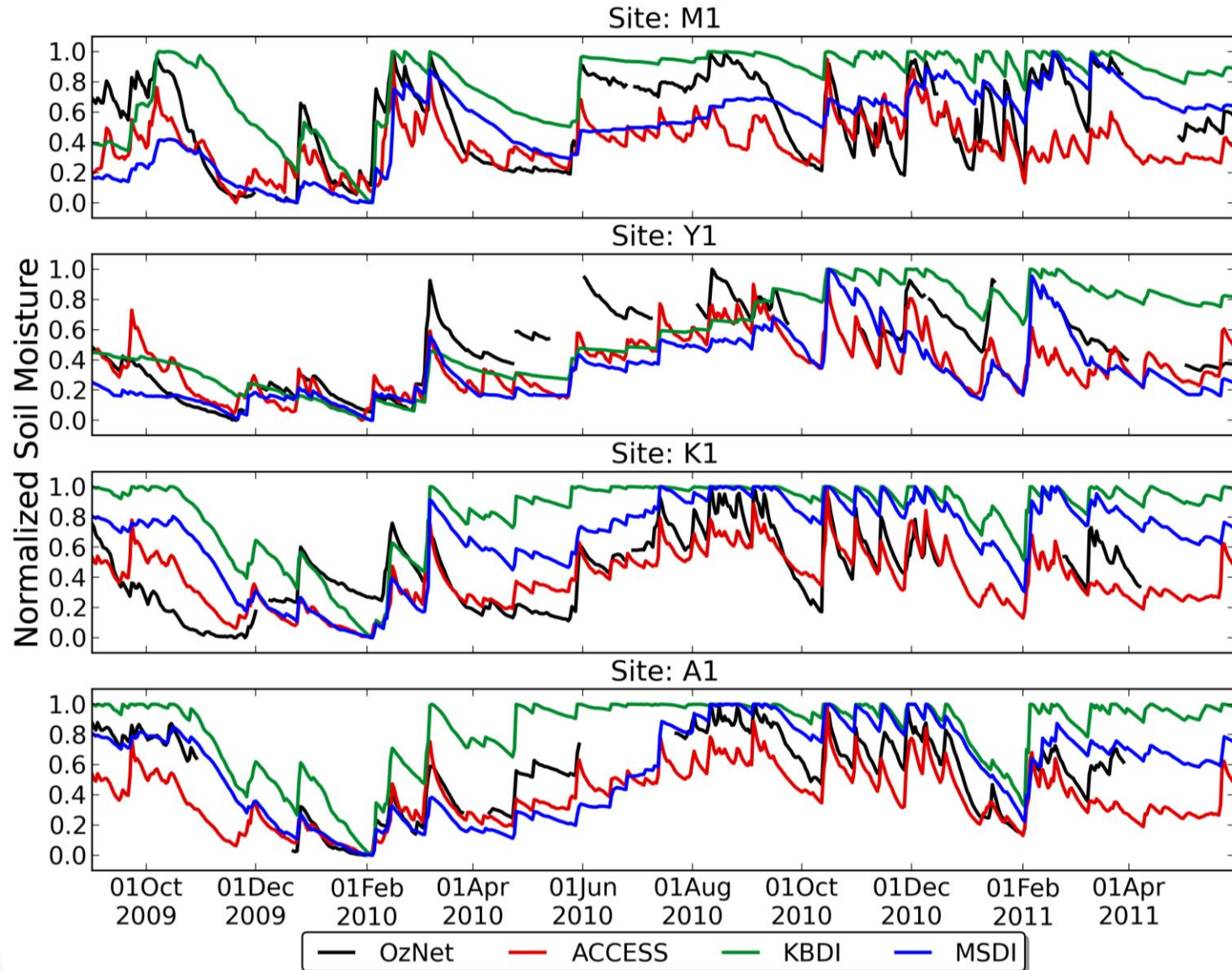
Data Set	Normal time series						Anomaly series	
	Correlation [-]		Bias [-]		RMSD [-]		Correlation [-]	
	<i>OzNet</i>	<i>CosmOz</i>	<i>OzNet</i>	<i>CosmOz</i>	<i>OzNet</i>	<i>CosmOz</i>	<i>OzNet</i>	<i>CosmOz</i>
ACCESS_80km	<b>0.72</b>	—	<b>0.02</b>	—	<b>0.19</b>	—	<b>0.68</b>	—
ACCESS_40km	—	<b>0.81</b>	—	<b>-0.03</b>	—	<b>0.15</b>	—	<b>0.68</b>
KBDI	<b>0.64</b>	<b>0.63</b>	<b>-0.26</b>	<b>-0.22</b>	<b>0.36</b>	<b>0.32</b>	0.72	<b>0.47</b>
MSDI	0.71	0.76	<b>-0.02</b>	-0.07	0.23	0.20	<b>0.75</b>	0.50
ASCAT	—	<b>0.81</b>	—	<b>-0.03</b>	—	0.18	—	0.67

## ■ Verification periods:

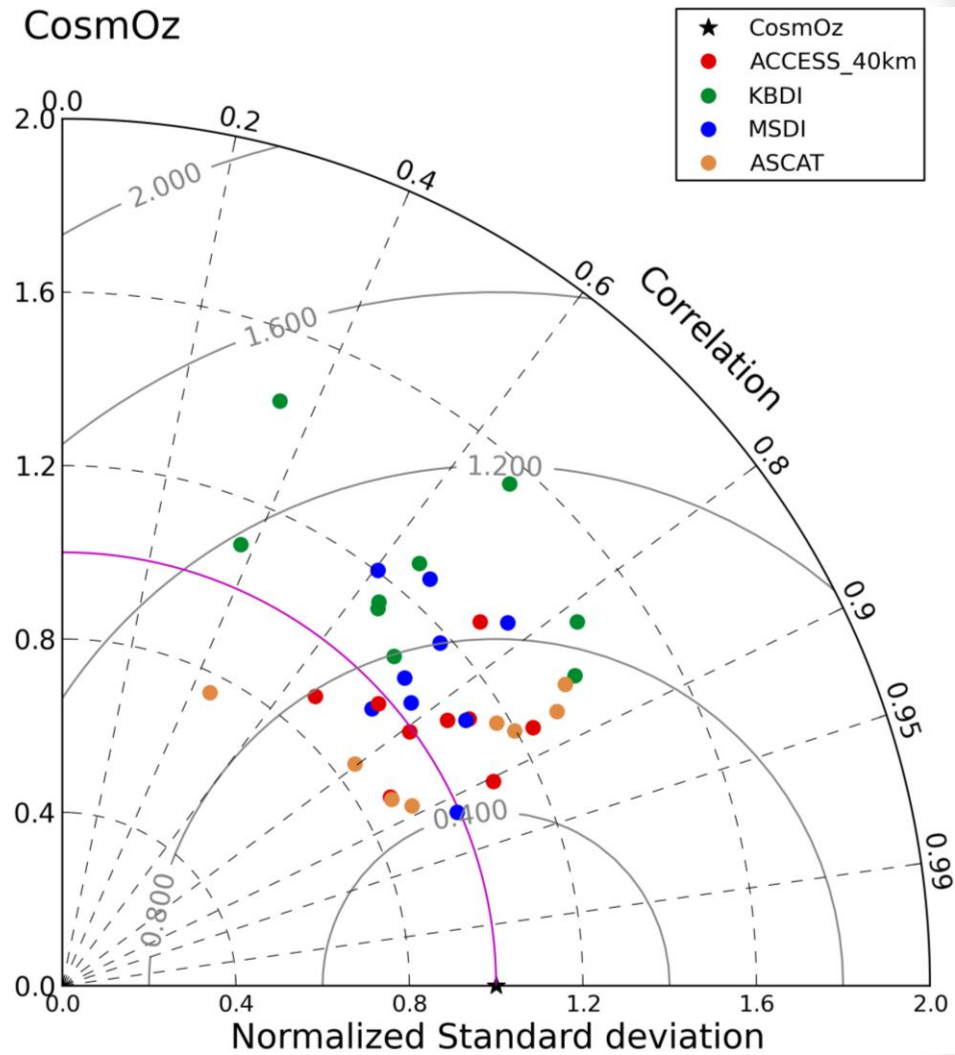
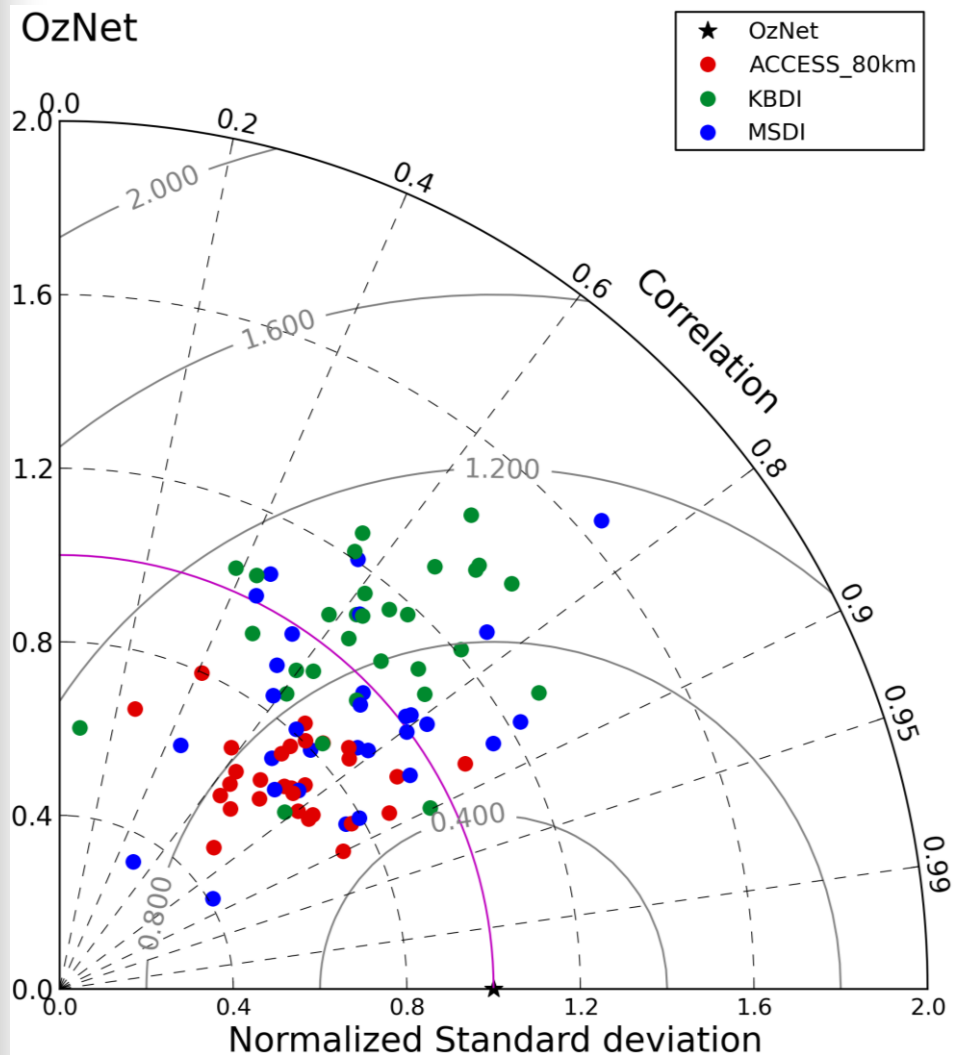
- OzNet — 01 September 2009 to 31 May 2011 (21 months)
- CosmOz — 01 May 2012 to 31 December 2014 (32 months)



# Time series - OzNet



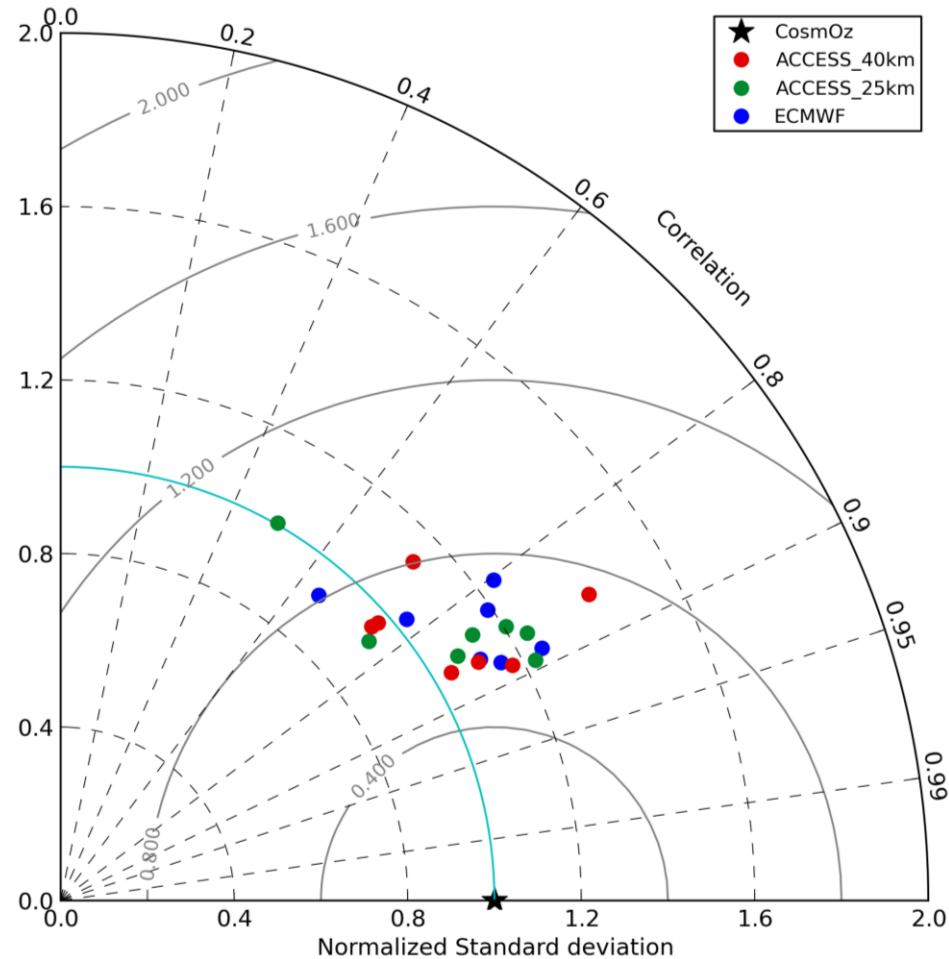
# Taylor diagrams



# ACCESS vs. ECMWF\*

Verification Period – 1 Dec 2013 to 28 Feb 2015 (14 months).

Metrics	ACCESS_40 km	ACCESS_ 25km	ECMWF (25km)
Correlation [-]	0.82	0.80	0.81
Anomaly Correlation [-]	0.49	0.56	0.58
Bias [-]	-0.04	-0.06	-0.04
RMSD [-]	0.16	0.17	0.17



\* European Centre for Medium Range Weather Forecasting



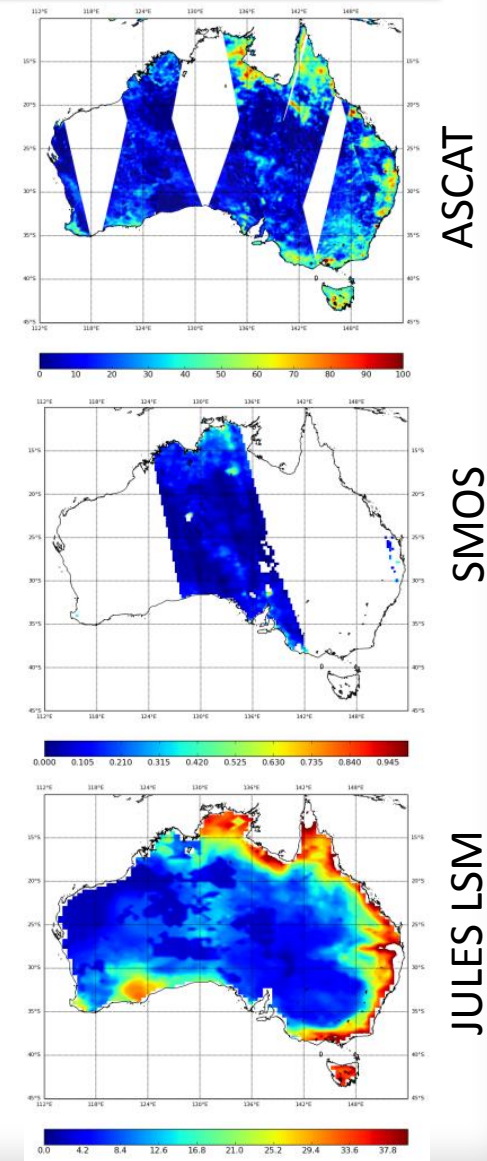
# Conclusions

- ACCESS soil moisture has better skills than the currently used traditional indices in fire danger ratings.
- Low skills of traditional dryness indices means they could undermine the fire danger ratings.
- ACCESS can thus provide the fire community with soil moisture estimates that is superior to what they currently have.
- ACCESS & ECMWF model soil moisture has similar skills.

# Future work: Land Data Assimilation System

- Extended Kalman Filter
- Offline soil moisture analyses at 5 km horizontal resolution.
- Initialise high resolution regional NWP systems.
- Used for fire danger warnings.
- Used in research mode, in operational use ~2016.
- Built around the JULES land surface model.
- Observation types and status:

Platform	Observation Type	Status
Screen-level	2 m Temperature	Yes (Research)
Screen-level	2 m Humidity	Yes (Research)
ASCAT	Soil Moisture	Yes (Research)
SMOS	Soil Moisture	No (Planned)
Himawari-8	Land Surface Temperature	No (Mid-term)
MODIS etc.	NDVI/LAI	No (Long-term)



# Publication

---

Vinodkumar, Dharssi, I., Bally, J., Steinle, P., McJannet, D., Walker, J., 2015: Verification of soil moisture from multiple models over Australia for fire danger rating application. *Water Resources Research (Under review)*.

# Acknowledgments

---

- BNHCRC.
- John Bally, Paul Fox-Hughes, Peter Steinle, Jeff Keppert, David McJannet, Jeff Walker, Adam Smith.
- Monash & Uni. Melbourne for OzNet.
- CSIRO for CosmOz.
- ESA, TU Wien / CATDS for ASCAT / SMOS.

# THANK YOU

Vinodkumar

Bureau of Meteorology

[v.kumar2@bom.gov.au](mailto:v.kumar2@bom.gov.au)

+61 3 9616 8448