Natural Hazards Research Australia

Identifying & defining landscape dryness thresholds for fires

Dr Jane Cawson and Dr Jamie Burton
The University of Melbourne
Natural Hazards Research Australia

We acknowledge the Traditional Owners of the lands on which we work, the Dja Dja Wurrung and Wurundjeri peoples.

Landscape moisture (or dryness)

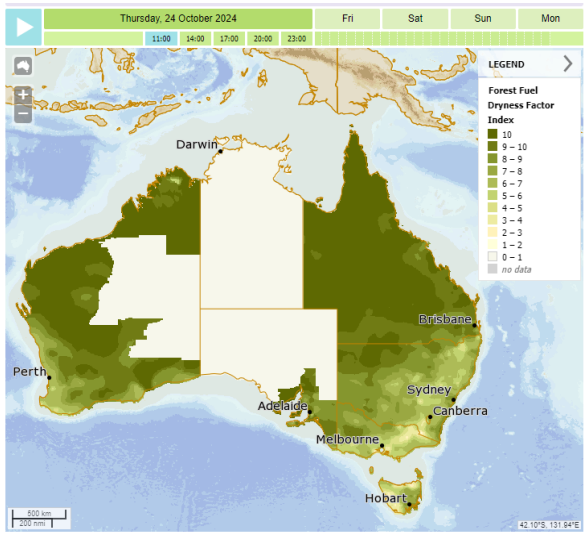
Landscape moisture is the water in the air, soil and vegetation

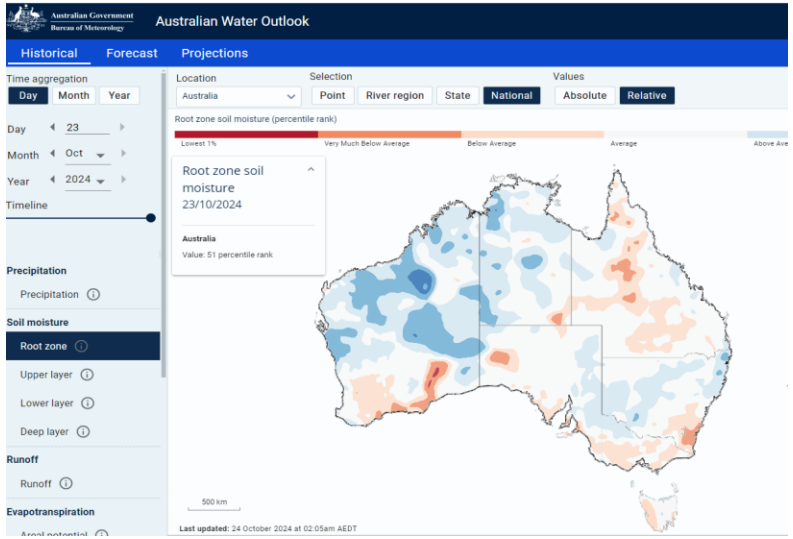
Influences probability of ignition, fire spread, intensity and size across different spatial and temporal scales

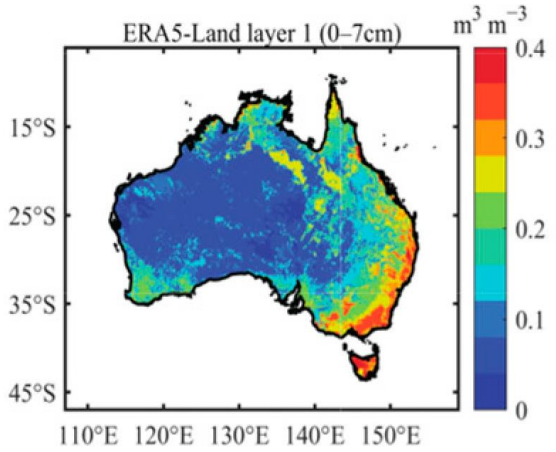
Fire managers need landscape moisture information to make informed decisions at various levels

Not just a matter of having access to moisture datasets, but understanding which metrics are most informative, and defining thresholds for levels of fire activity

Many moisture metrics







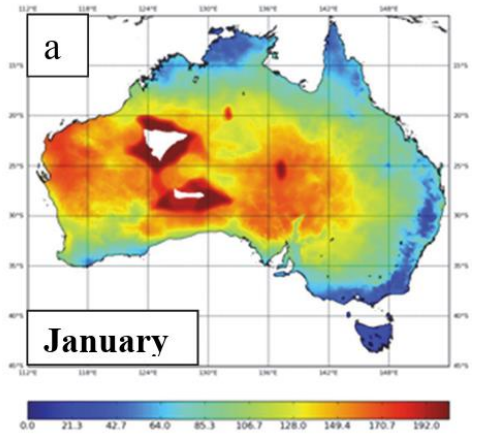
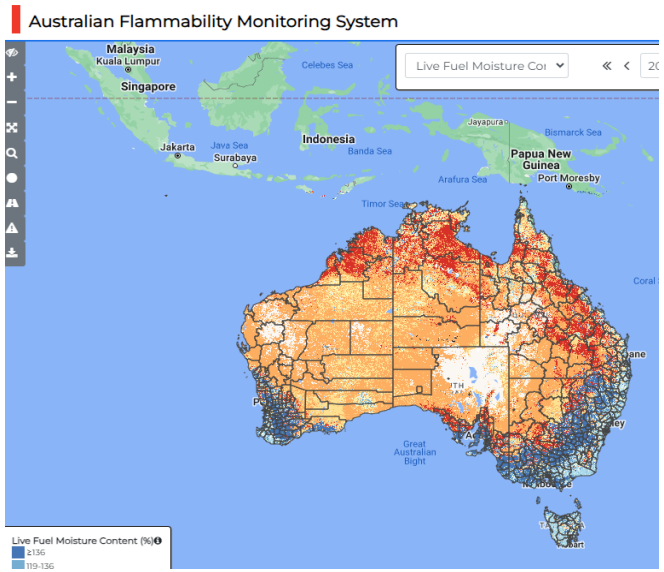
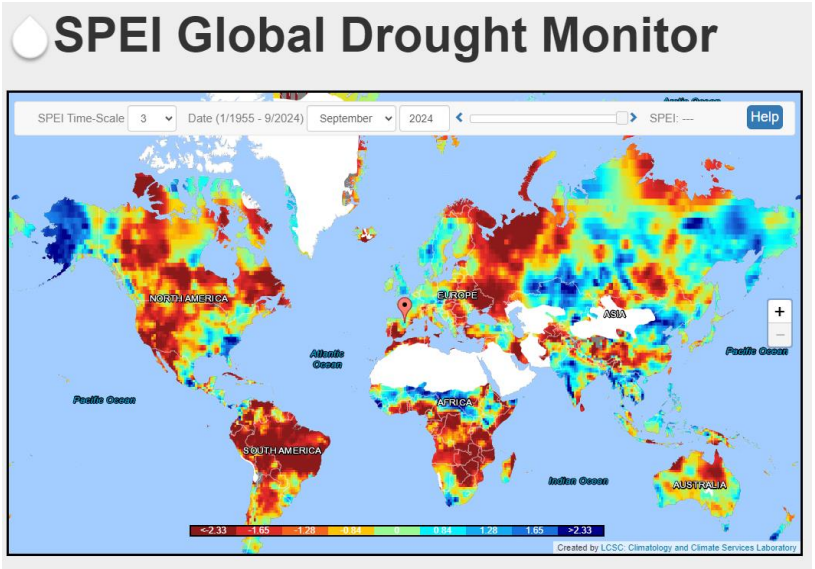
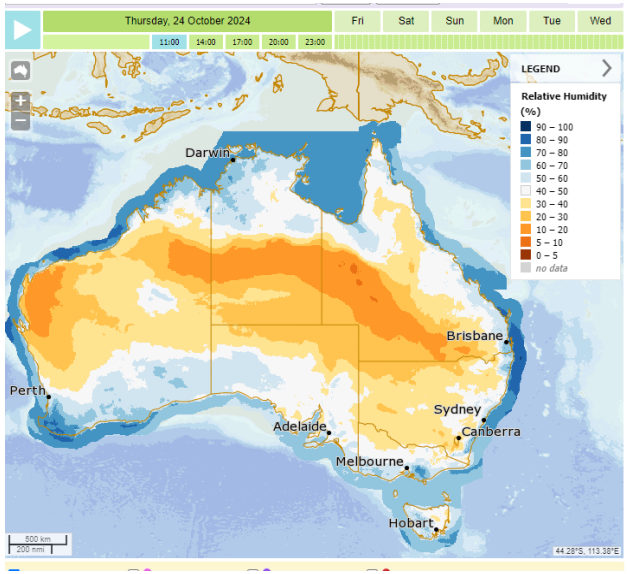


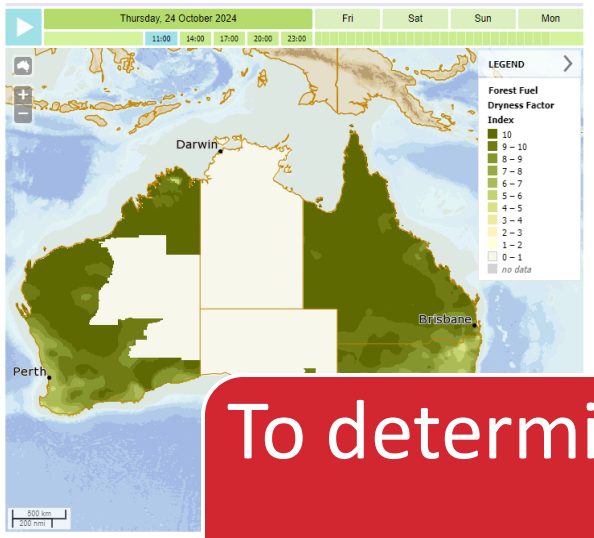
Figure 2 Mean monthly KBDI values for (a) Janu

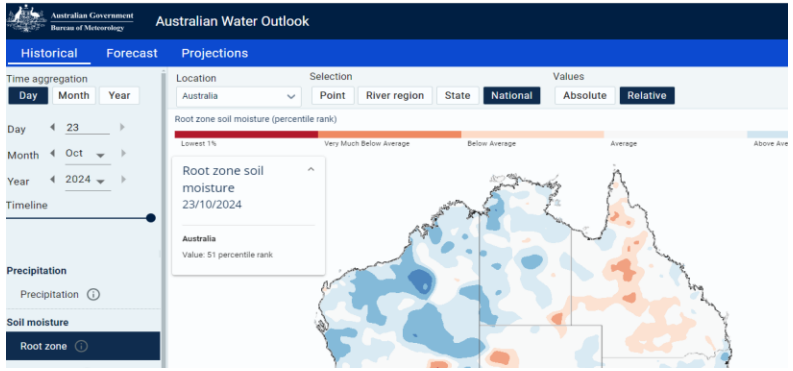


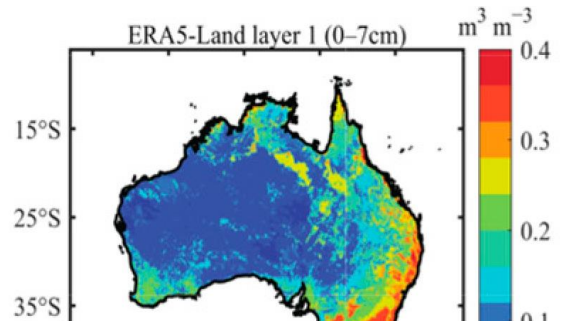


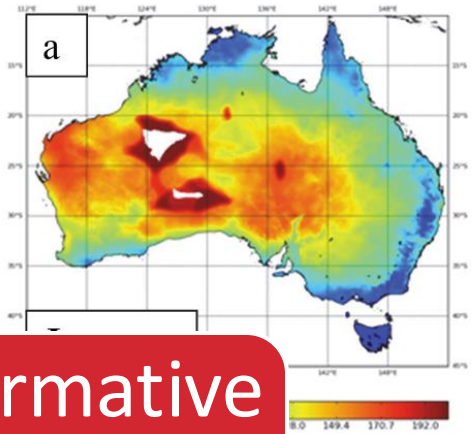


Research Aim



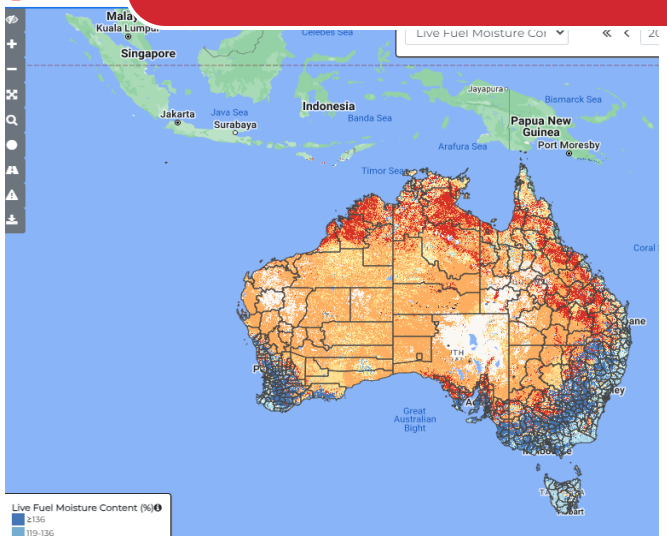


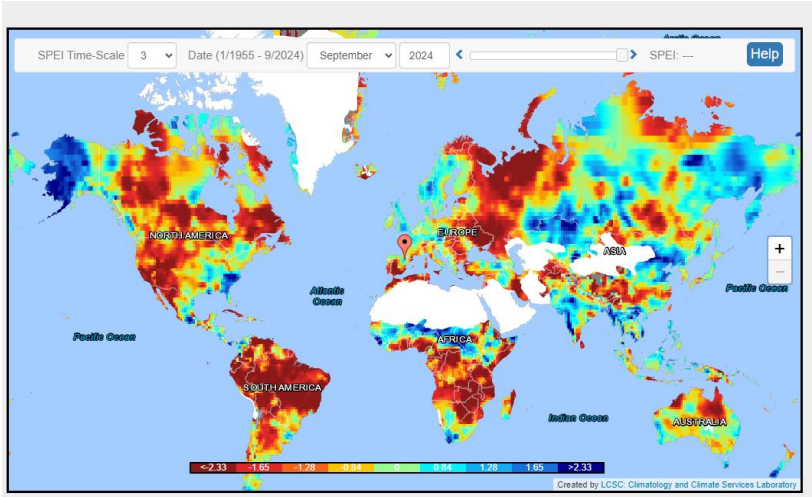


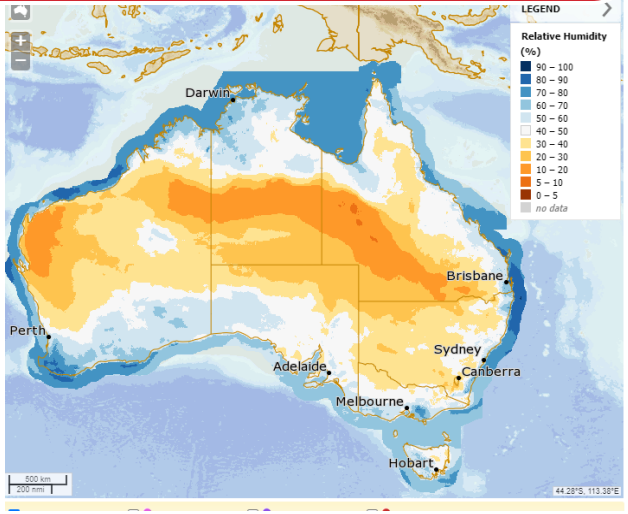


values for (a) Janu

To determine which moisture metrics are most informative for fire agency decision making





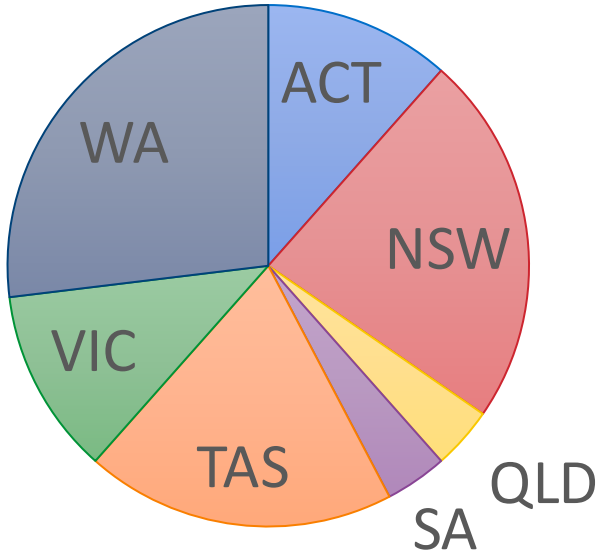


Project stages

1. Workshop with fire decision makers
2. Review of existing moisture metrics
3. Quantitative evaluation of moisture metrics to inform decision making

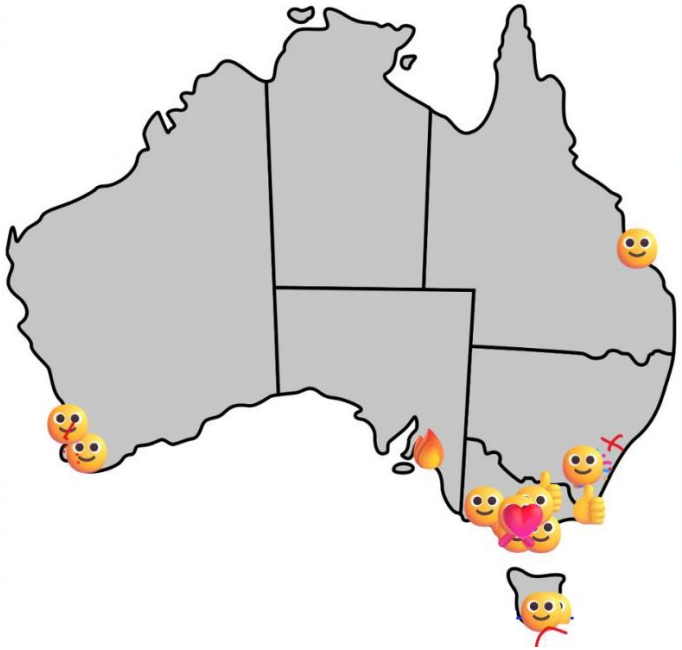
Workshop

- → Online, October 2024
- → 26 participants
- → All States and Territories represented, except NT

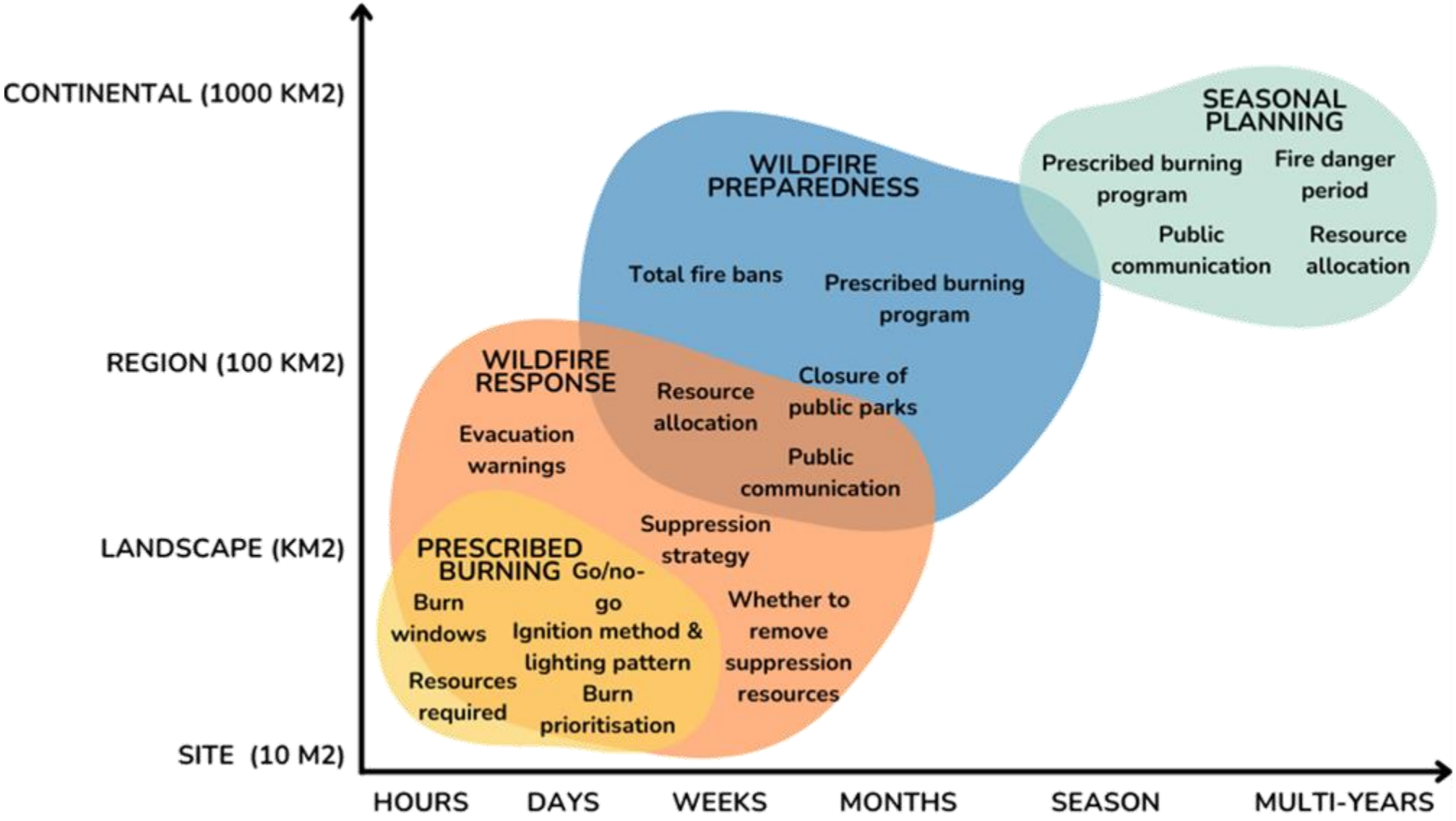


Aims:

- → Document key fire management decisions that depend on moisture information
- → Identify what attributes make a moisture metric useful for different types of decisions



Fire management decisions



Desirable attributes of moisture metrics

Desirable Attributes	Seasonal planning	Wildfire preparedness	Wildfire response	Prescribed burning
Indicator of **hourly** fluctuations in fuel availability			✓	✓
Indicator of **daily** fluctuations in fuel availability		✓		
Leading indicator of fuel availability over **longer timeframes (months)**	✓			
Applicable across many climatic zones / vegetation types	✓	✓	✓	✓
Readily available for use, not reliant on intensive computations or field calibration	✓	✓	✓	✓
Provides up-to-date information	✓	✓	✓	✓
Predicts at a **moderate to coarse spatial resolution**, capturing broad variations in climate	✓	✓		
Predicts at a **fine spatial resolution**, capturing topographic effects on moisture			✓	✓
Forecastable up to a week in advance		✓	✓	✓

Review of existing moisture metrics

5 types of moisture information

Grey and published literature

Applicable to all of Australia

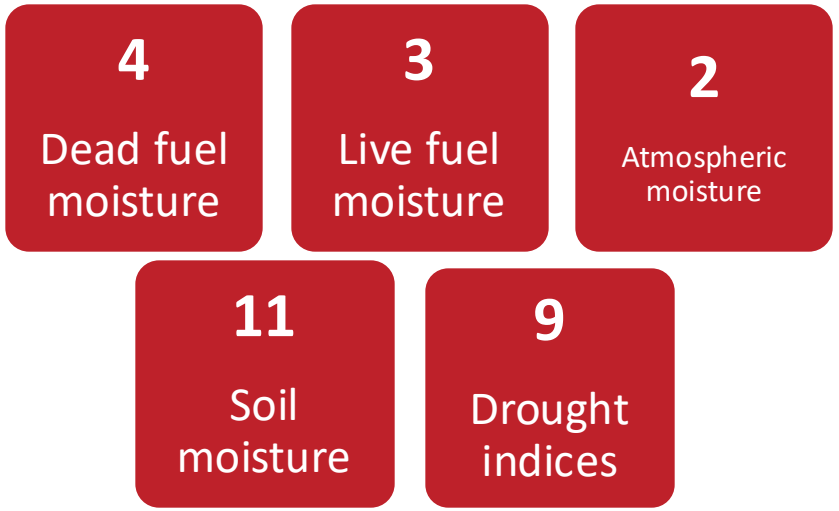
Linked to fire activity previously

Collected information on model type, resolution, forecasting ability, temporal availability

- Dead fuel moisture
- Live fuel moisture
- Atmospheric moisture
- Soil moisture
- Drought indices

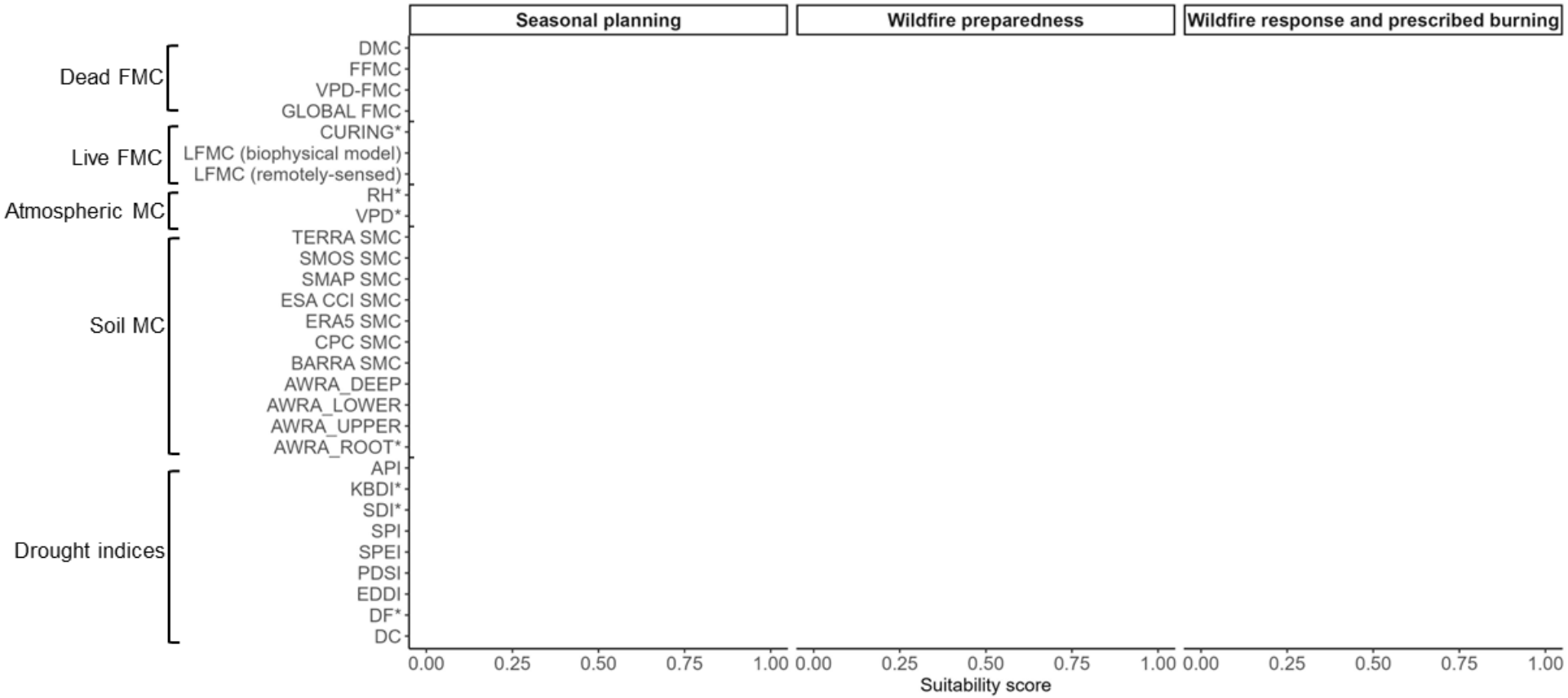
Group	Metric/Model	Description	Type	Spatial, temporal resolution	Forecastable	Reference
Dead fuel moisture	Global FMC	Dead FMC of 1, 10, 100 and 1000 h fuel	Physical	9km, Daily	Yes	(McNorton and Di Giuseppe 2024)
	Fine fuel moisture code (FFMC)	FMC of litter and other cured fine fuels	Book-keeping	Various, Daily	No	(Van Wagner 1987)
	Duff moisture code (DMC)	FMC of loosely compacted, decomposing organic matter	Book-keeping	Various, Daily	No	(Van Wagner 1987)
	VPD-FMC	FMC of litter and other dead fine fuel	Empirical	Various, Daily	Yes	(Resco de Dios *et al.* 2015; Rodrigues *et al.* 2024)
Live fuel moisture	LFMC (remotely sensed)	Moisture content of live fine, fuels	Empirical and physical (remotely-sensed)	Various, but commonly 500 m, daily	No	(Quan *et al.* 2024; Yebra *et al.* 2018)
	LFMC (biophysical)	Moisture content of live fine, fuels	Empirical and physical (biophysical)	~ 5km, daily	Yes	(Vinodkumar *et al.* 2021)
	Grassland curing	Proportion of dead to live grass	Empirical (remotely sensed)	500 m, daily	No	(Wright and Majewski 2023)
Atmospheric moisture	Vapour pressure deficit	Difference (deficit) between the amount of moisture in the air and how much moisture the air can hold when it is saturated	Empirical	Various, various	Yes	(Monteith and Unsworth 2013; Potter 2012)
	Relative humidity	The amount of water vapour present in air expressed as a percentage of the amount needed for saturation at the same temperature	Empirical	Various, various	Yes	(Potter 2012)

Assessing metric suitability



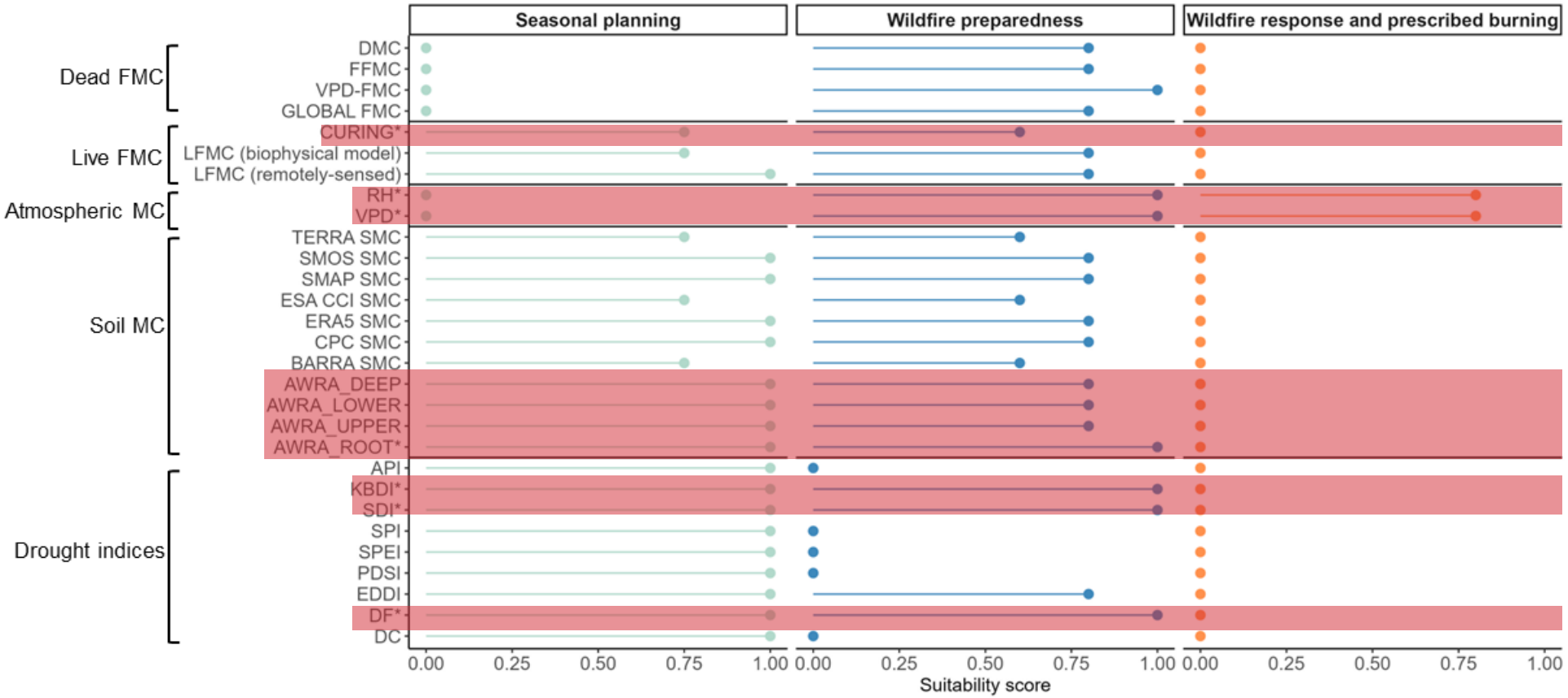
Desirable Attributes	Seasonal planning	Wildfire preparedness	Wildfire response	Prescribed burning
Indicator of **hourly** fluctuations in fuel availability			✓	✓
Indicator of **daily** fluctuations in fuel availability		✓		
Leading indicator of fuel availability over **longer timeframes (months)**	✓			
Applicable across many climatic zones / vegetation types	✓	✓	✓	✓
Readily available for use, not reliant on intensive computations or field calibration	✓	✓	✓	✓
Provides up-to-date information	✓	✓	✓	✓
Predicts at a **moderate to coarse spatial resolution**, capturing broad variations in climate	✓	✓		
Predicts at a **fine spatial resolution**, capturing topographic effects on moisture			✓	✓
Forecastable up to a week in advance		✓	✓	✓

Metric suitability



Metric suitability

Currently used in fire management



Curing

RH, VPD

AWRA soil moisture

KBDI

SDI

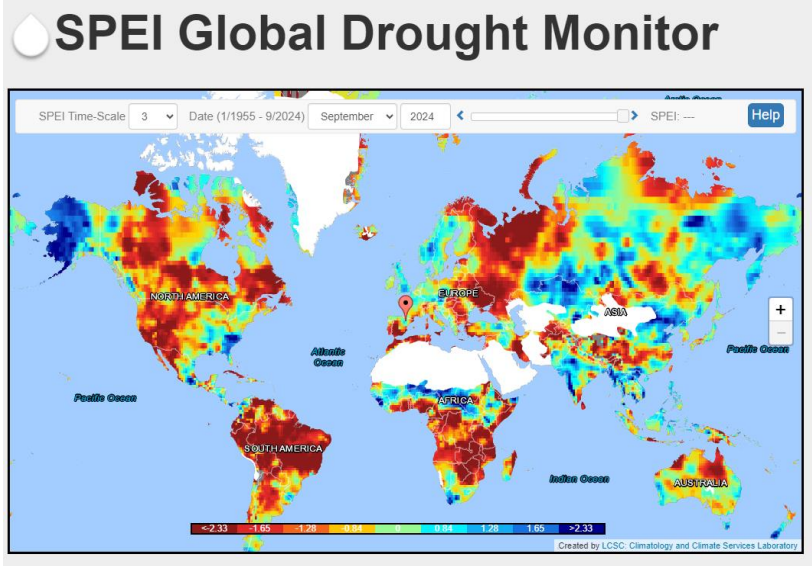
DF

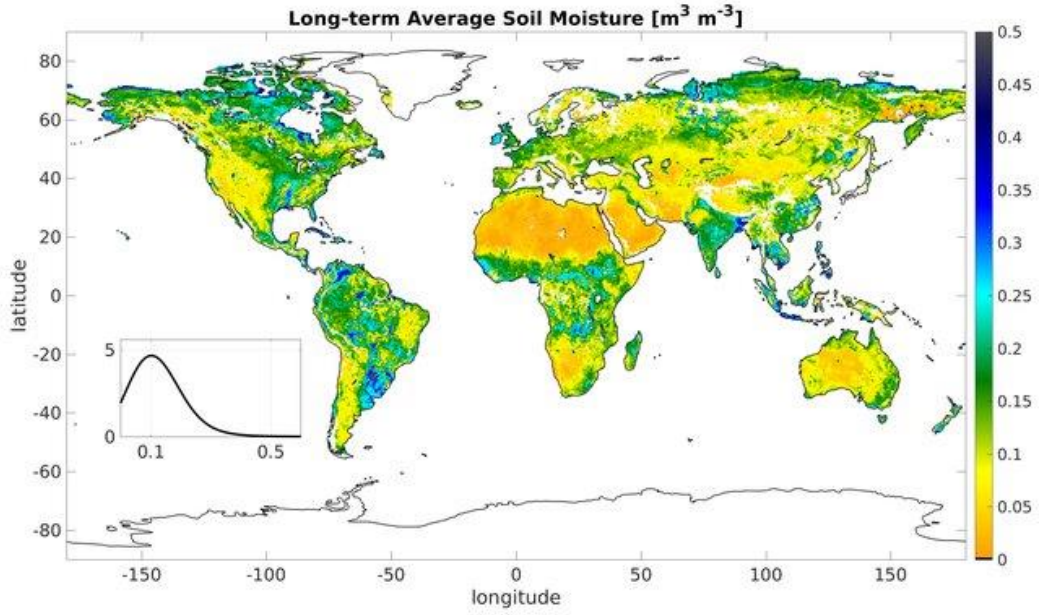
Key findings

→ Many metrics have potential

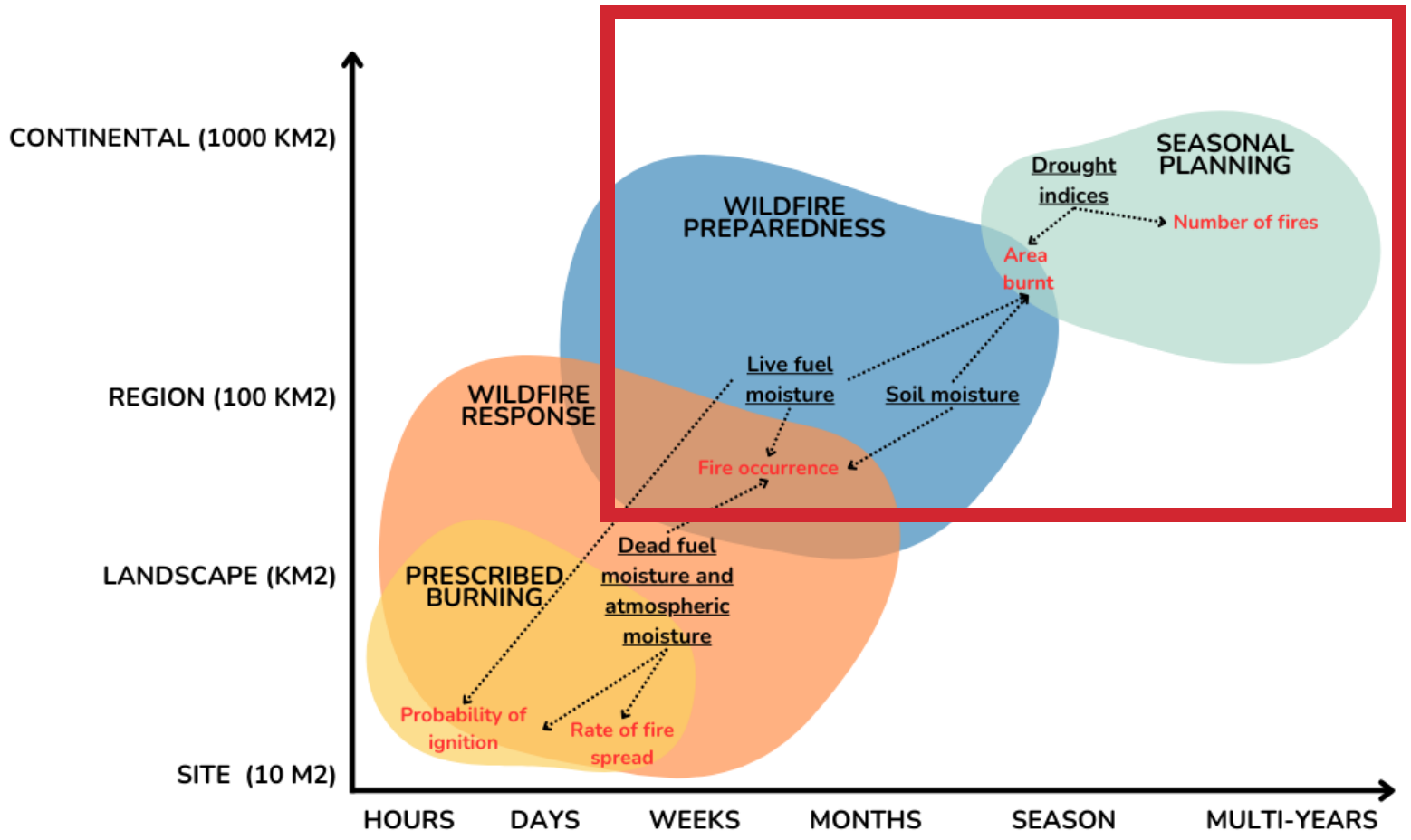
→ One size does not fit all - different metrics suitable for different scales of decision-making

→ Newer soil moisture and drought indices available (e.g. SPEI – multiscalar drought)





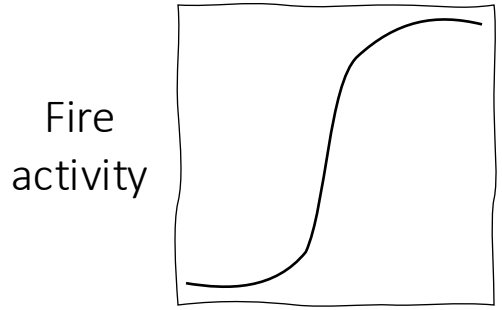
Linking moisture metrics to fire



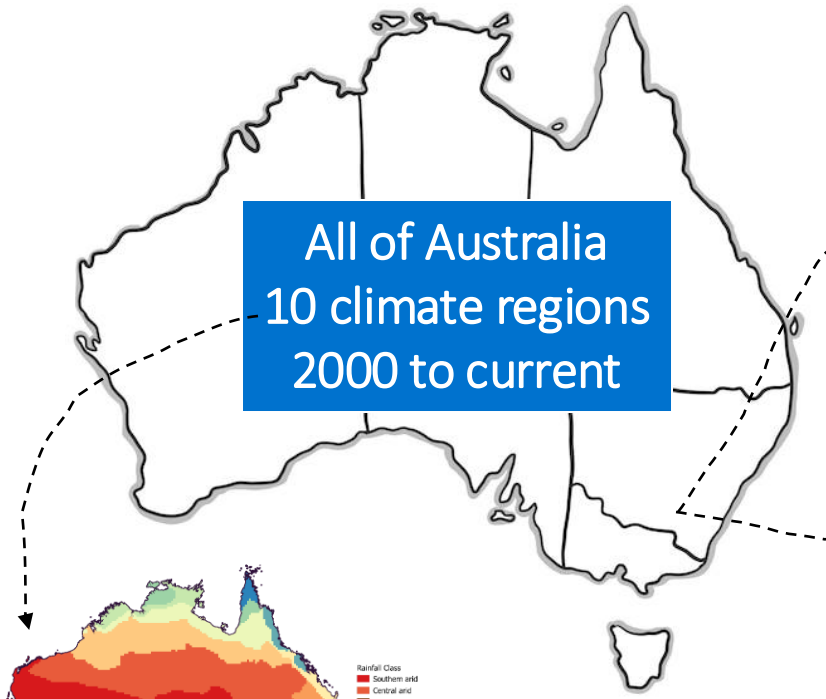
Next steps: quantitative analysis

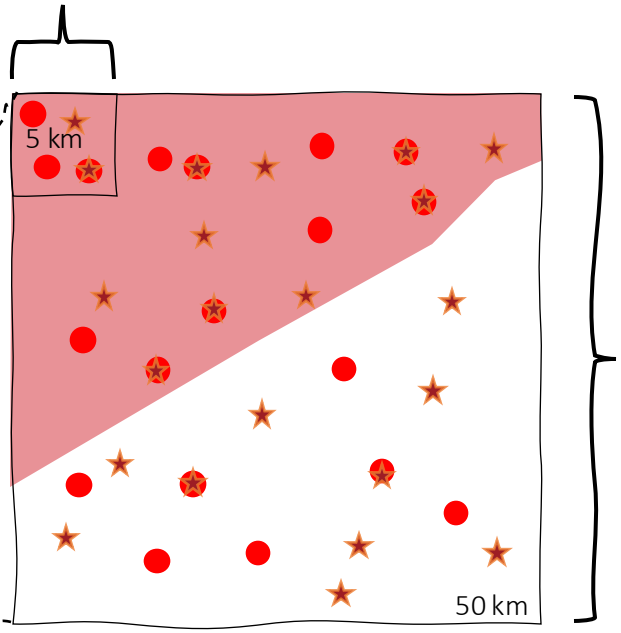
Wildfire preparedness (daily)

- Fire occurrence
- MODIS Hotspots/AIRS Database



All of Australia
10 climate regions
2000 to current





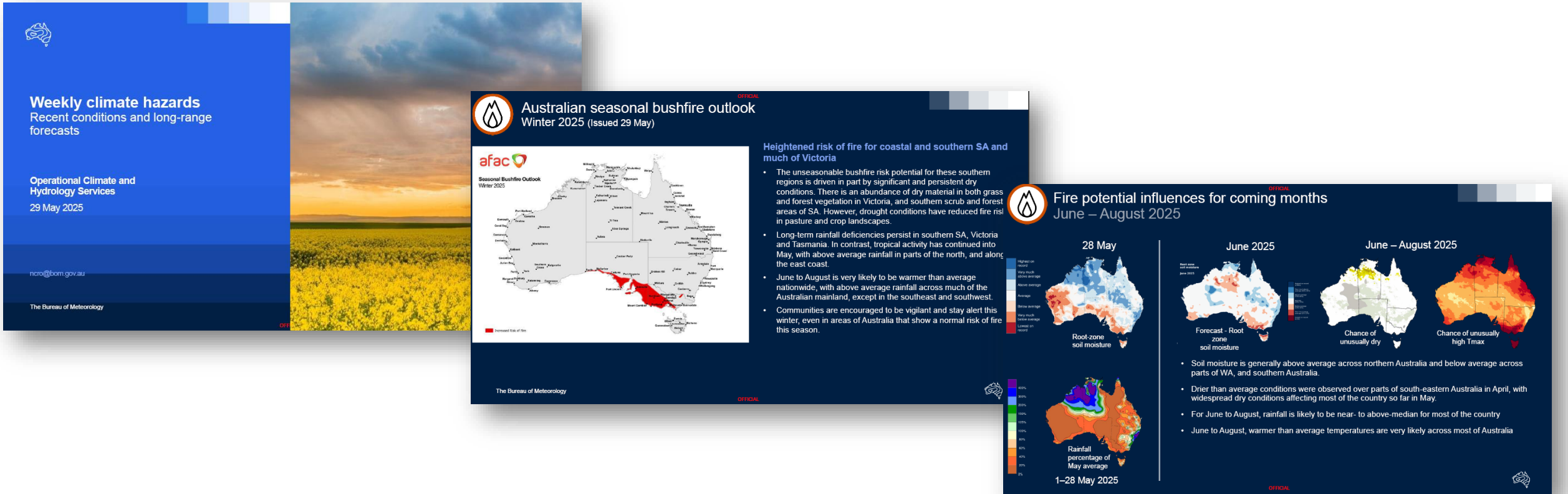
Seasonal planning (multi-months)

- Area burnt
- Number of fires
- NBED

★AIRS Database
●MODIS Hotspots
National Bushfire Extents Database

Applications

- → Understanding fire risk dynamics across Australia: when and where fires more likely to occur
- → Guide wildfire preparedness activities
- → Improve seasonal outlooks



Natural Hazards Research Australia

Thank you

Jane Cawson and Jamie Burton
The University of Melbourne
Natural Hazards Research Australia