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Multi-week to seasonal fire weather prediction and customer applications for the 2020/21 summer

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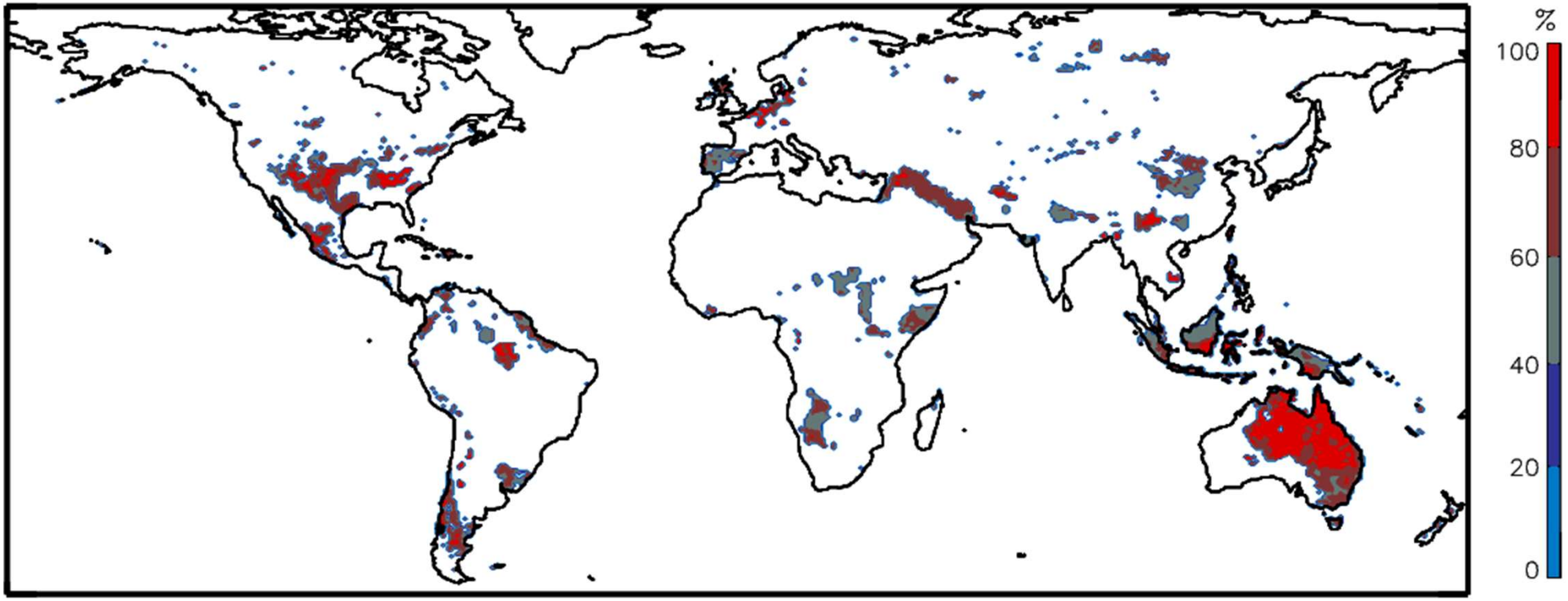
Overview

- New capability for Australia: predicting dangerous bushfire conditions more than one week ahead (weeks, months & seasons).
- Previously, long-range fire outlooks used temperature and rain individually: new modelling system combines humidity, wind, temperature and rain, with observations for fuel moisture.
- This presentation provides predictions for next summer, as well as revisiting those delivered prior to last summer.
- Broader development of 'seamless' predictions over different time scales including future projections.

Predictions of Fire Weather Index (FWI, hindcasts from August)

Accuracy of seasonal prediction of fire weather, for the months September-November.



Reference: Dowdy et al. 2016, ntrs.nasa.gov/citations/20170003345

Fire weather predictions for 2020/21 summer

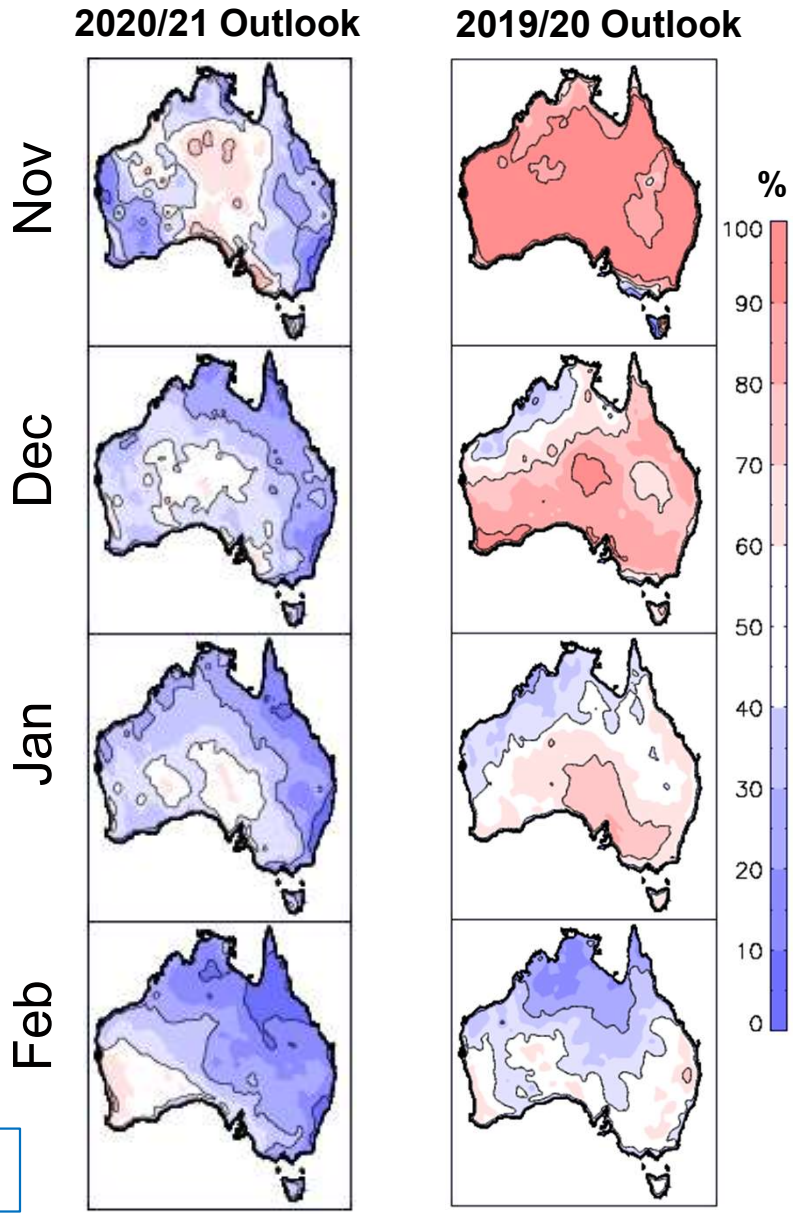
Maps show the probability of FFDI being above average (high probability in Red, low probability in Blue):

- **Less dangerous this summer (for most regions)**
- **Very different to last summer**

Method details:

- Based on daily 5-km grids from ACCESS-S model (run on 1 November, with 50-member ensemble); fuel moisture initialised from observations using Keetch-Byram Drought Index (KBDI).
- Probability based on percentage of model ensemble members that exceed1989-2018 observed mean (doi.org/10.1175/JAMC-D-17-0167.1).
- Intended to be interpreted regionally, with FFDI as a generalised way to combine humidity, wind, rain & temperature.

Experimental product

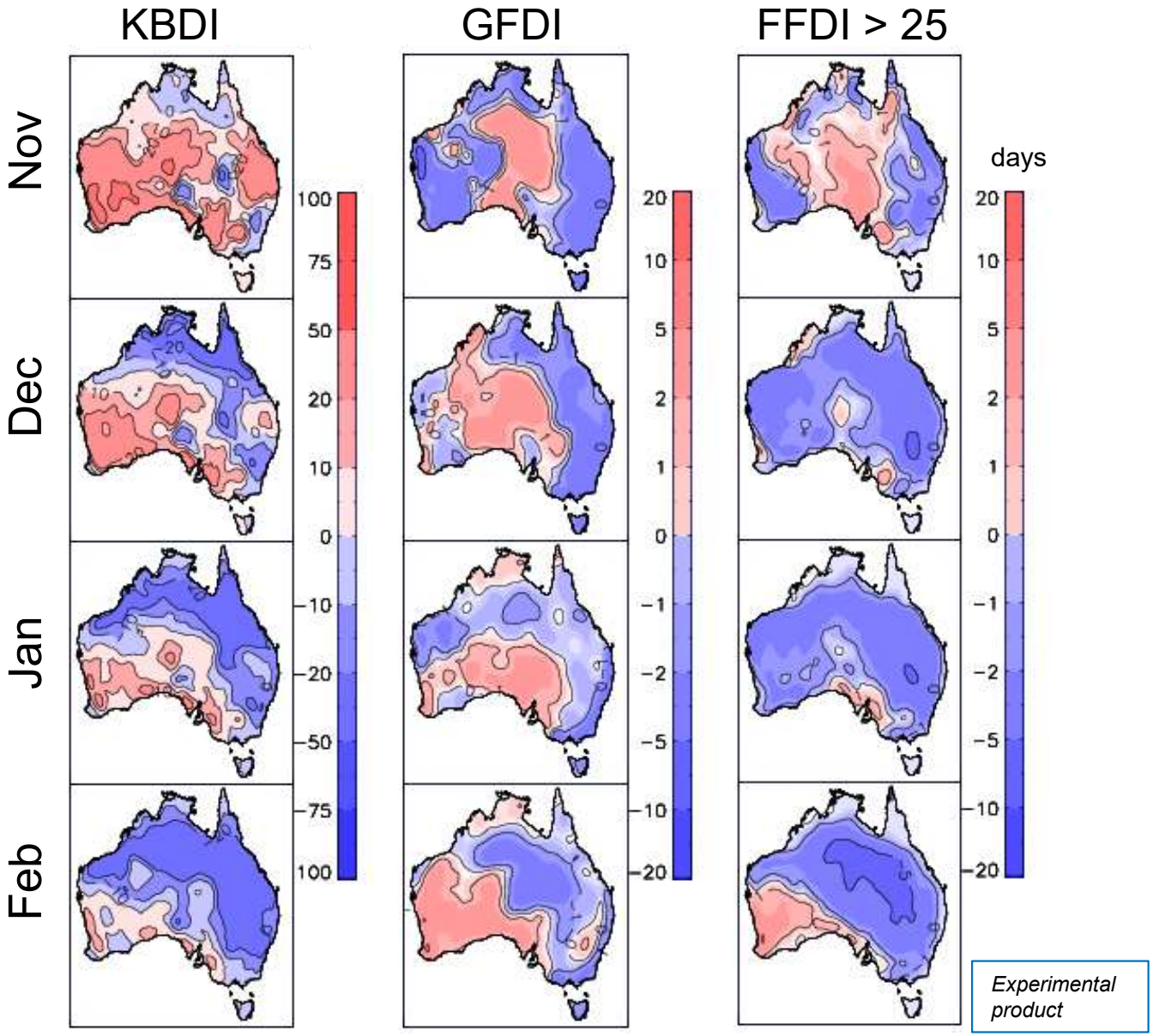


Various measures available

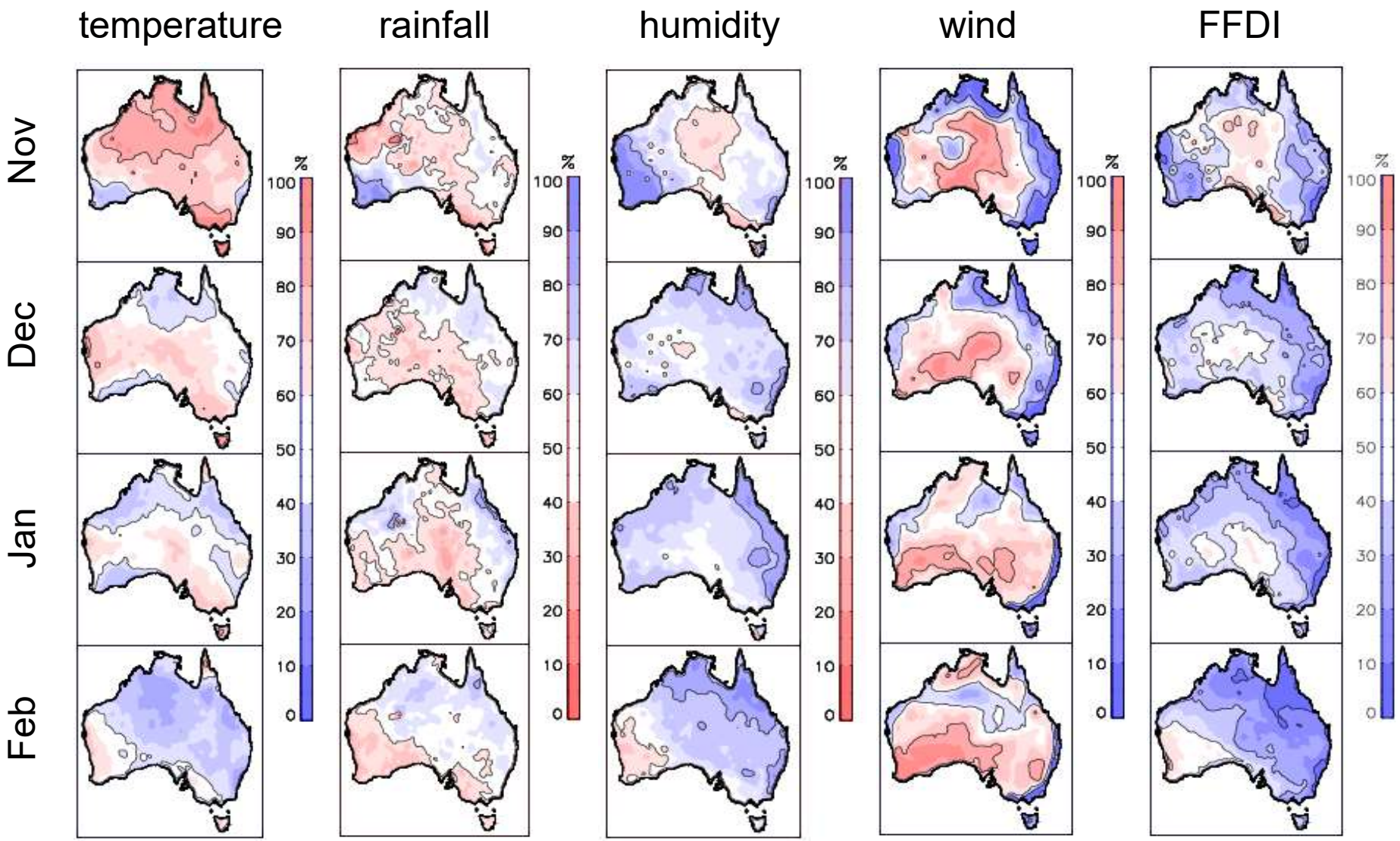
- Soil moisture based on Keetch-Byram Drought Index (KBDI)
- Grassland Fire danger Index (GFDI)
- Days classed as 'Very High' (based on FFDI ≥ 25)

Less severe conditions predicted:

- **particularly for eastern regions**
- **regional exceptions include southwest WA and southern SA**



Why are less severe conditions predicted? Humid, La Niña conditions.



Probability > mean

Red is more dangerous

Blue is less dangerous

Experimental product

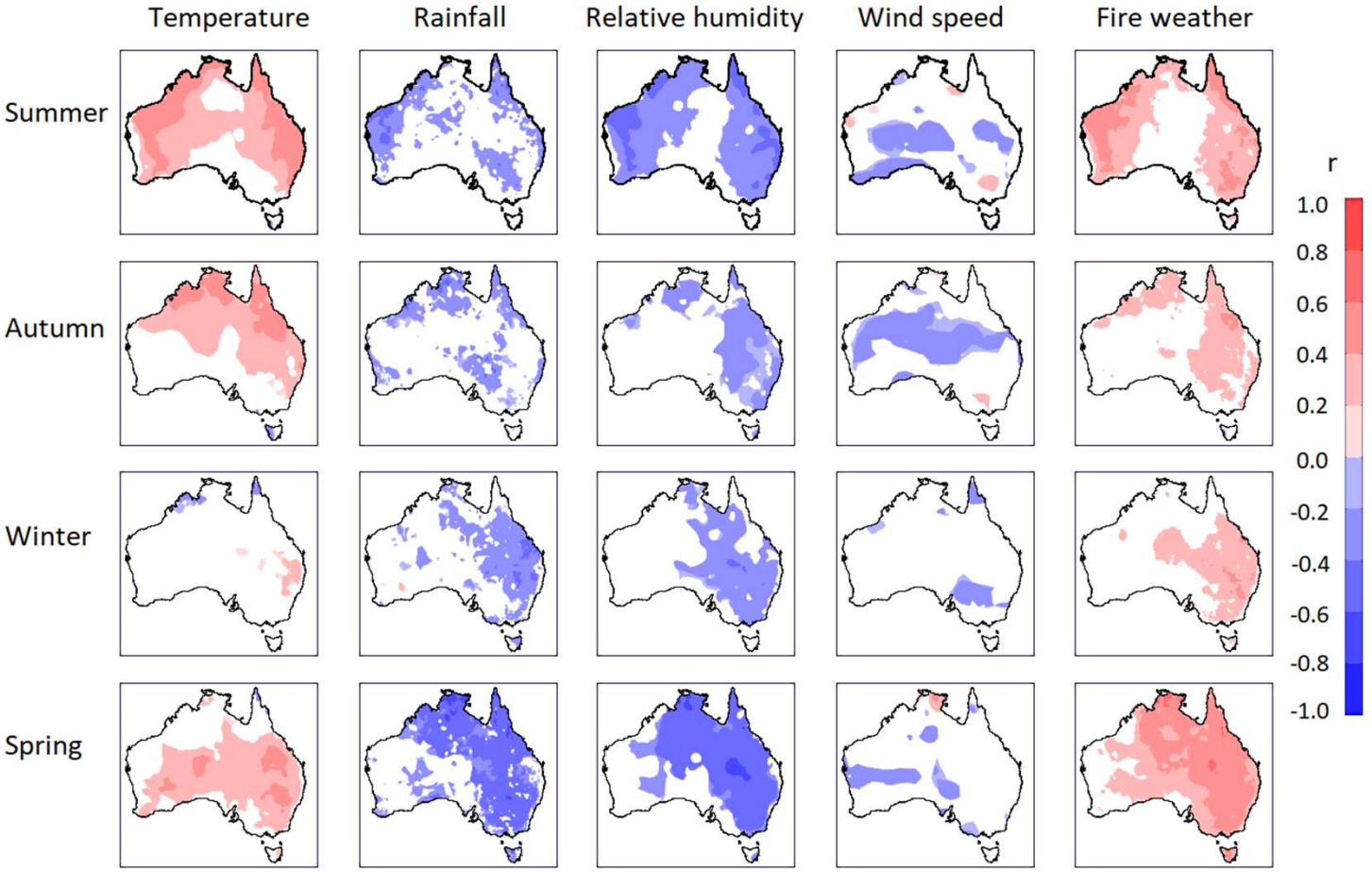
Fire weather conditions and ENSO relationships

Large-scale atmospheric and oceanic modes of variability (El Niño/Southern Oscillation, Indian Ocean Dipole, stratwarms, etc.)

Figure shows correlation with NINO34 index:

Red = lower values in La Niña and higher values in El Niño

Blue = higher values in La Niña and lower values in El Niño



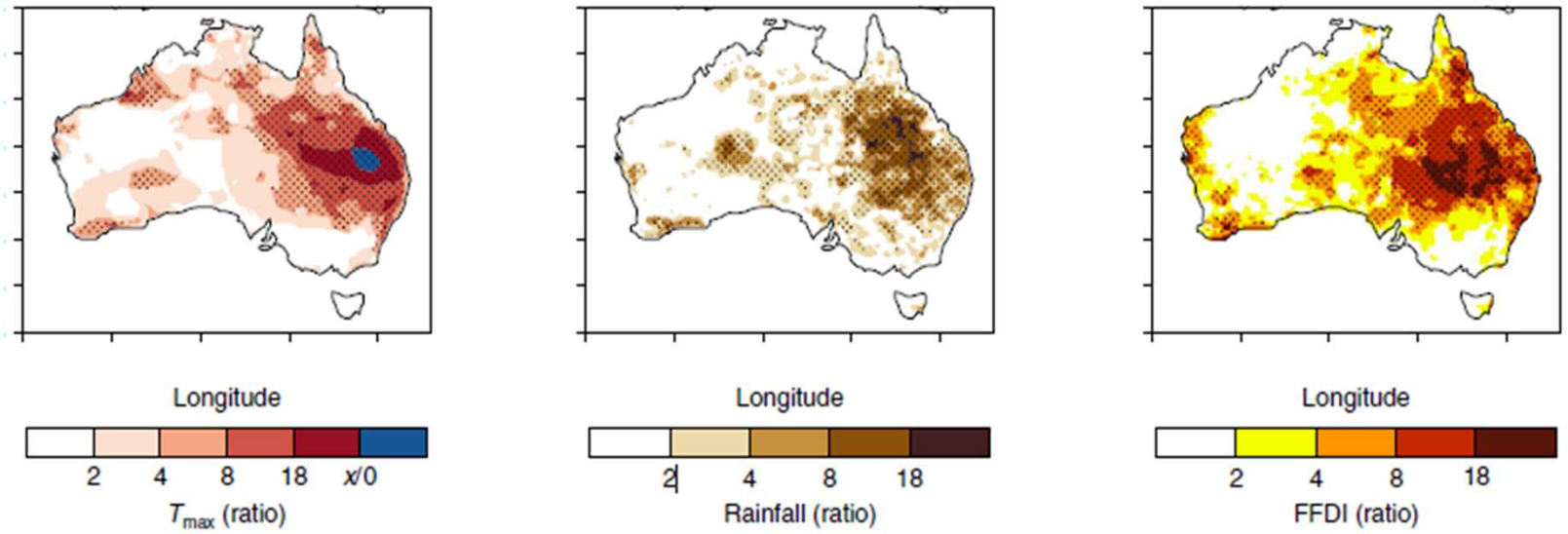
Fire weather indices such as Forest Fire Danger Index (FFDI) combine these factors.

Why was last summer predicted to be so severe?

Stratospheric polar vortex

- major contributor to severity of last summer's fire conditions, together with positive Indian Ocean Dipole (IOD) and climate change
- provides long-range predictability (vortex close to average this year)

Changes in the likelihood of extreme high T_{max}, low rainfall and high wildfire danger during polar vortex weakening years

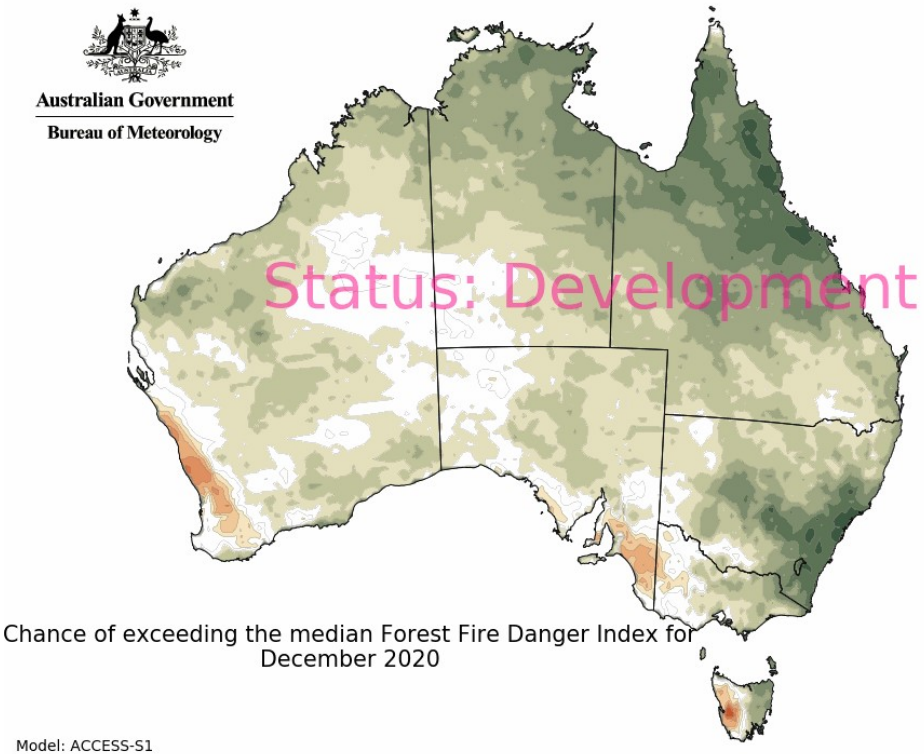


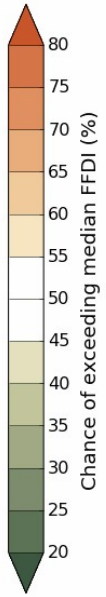
Reference:
Lim et al. 2019
Nature Geoscience.

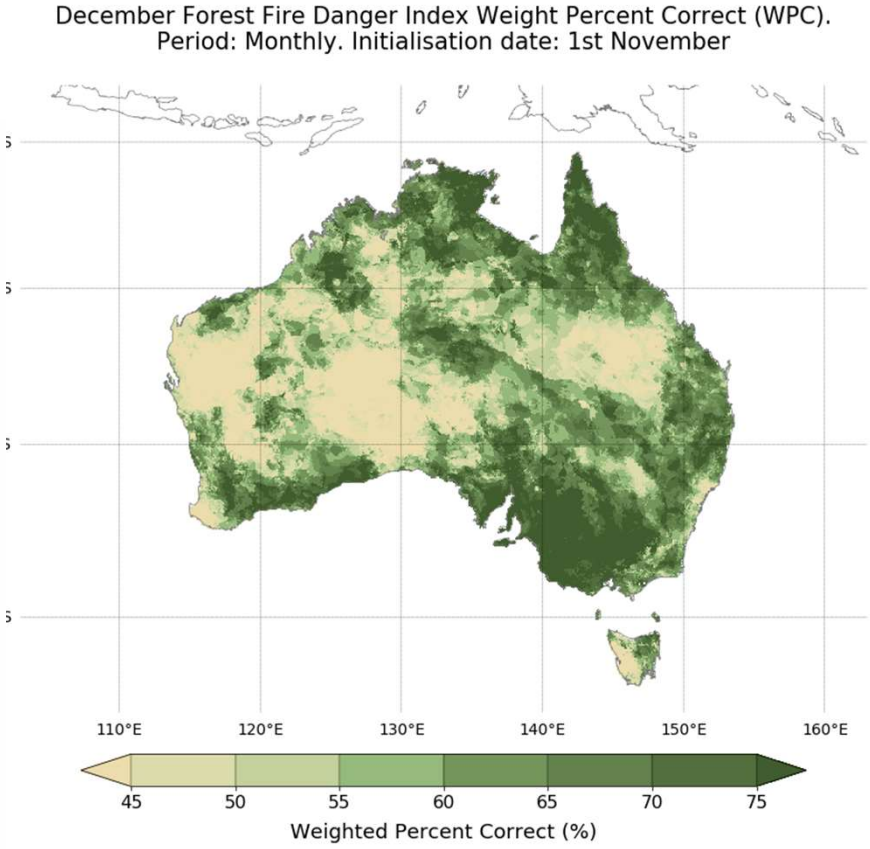
Automated project outputs

Consistent style with BoM operational products (foundation for future operationalisation/AFDRS)

- Predictions (left); Verification (right)







Broader capability: predicting hazards over different time scales

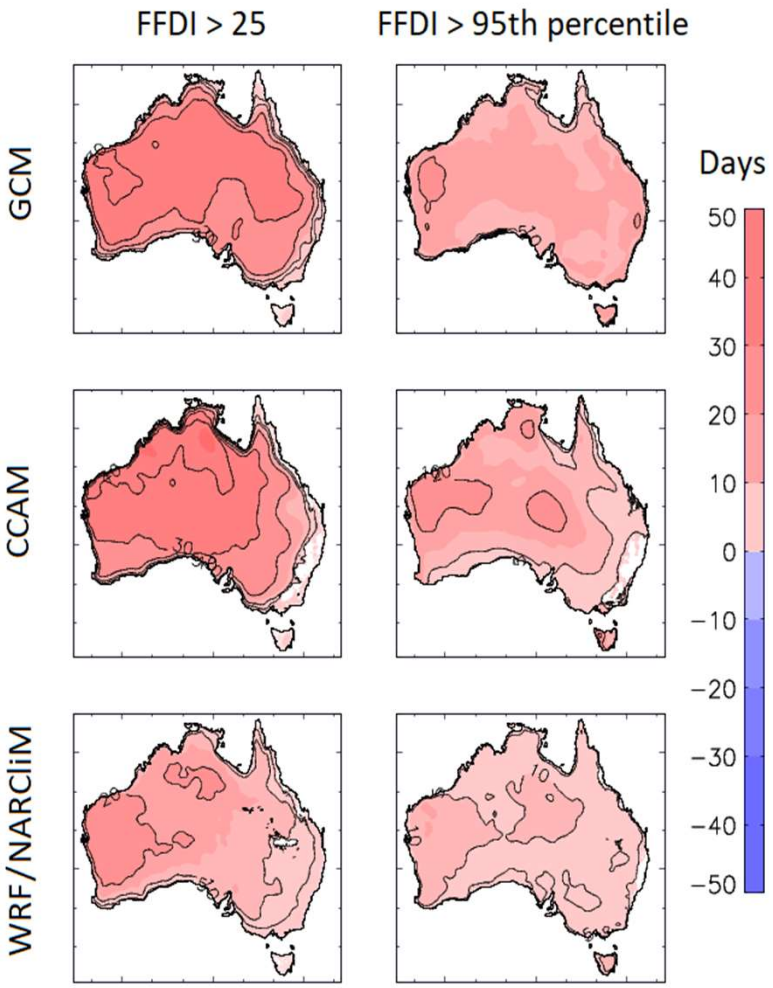
Fire weather data available for each day (5 km grid)

- back to 1950 based on observations
- multi-week to seasonal predictions (from this project)
- climate predictions throughout this century (see Figure)

Predictions calibrated to observations (quantile matching)

- to be consistent for 'seamless' user applications.

Range of different hazards considered.



Future change in the number of days with dangerous conditions (2060:2079 - 1990:2009, for high emissions)

Projections for three different ensembles (using different downscaling approaches) and two measures of severity.

Reference: **https://www.nature.com/articles/s41598-019-46362-x**

Climate hazards – from research to outcomes

Climate research on fires, ECLs, TCs, thunderstorms and associated extremes (wind, heat, rainfall):

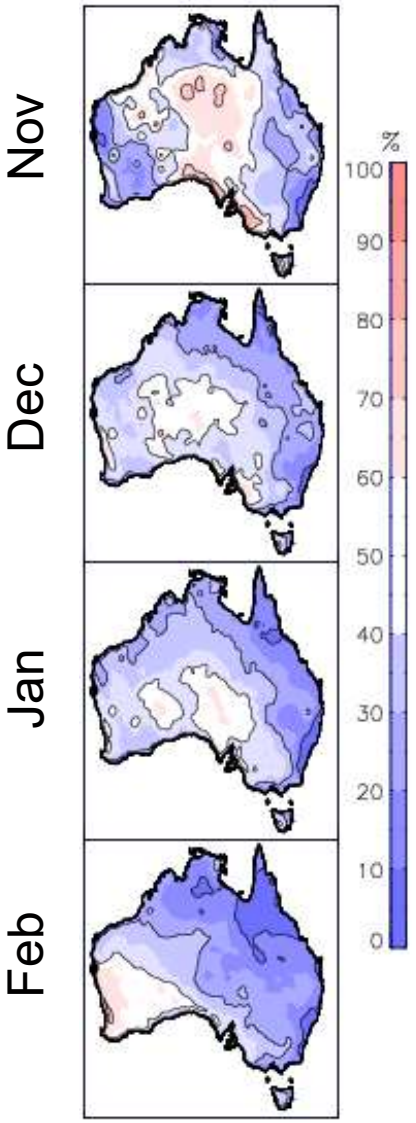
- Used for AFAC's Discussion Paper on climate hazards and now producing on the ground changes in practises (enhanced resilience and adaptation efforts).
- Used for Royal Commission and State inquiries, State of the Climate, IPCC and sectors such as energy (ElectraNet, AEMO), environment (GBRMPA, World Heritage, threatened species), health sector (fire/smoke, lightning, asthma), finance sector (CMSI), planning (Standards Australia), state/federal Gov. (PM briefings, Senate, QoN), …
- Series of brochures distributed to wide range of stakeholders: http://nespclimate.com.au/new-information-on-extreme-weather-and-natural-hazards-in-our-changing-climate/

Summary

- **New capability delivered for long-range fire prediction tools, provided a step change in capability.**

- **Less dangerous fire weather conditions indicated in coming months for most regions, with high confidence:**
  - Consistent signal from different methods (probability > mean; difference to mean; FFDI > 25; automated & manual systems)
  - Good physical process understanding (strong influence from humid conditions consistent with La Niña; normal polar vortex)

- **Broader set of seamless products and tools now produced:**
  - Multi-week to seasonal predictions consistent with observations, as well as climate change projections.



Experimental product

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Thank you

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