



University of
**Southern
Queensland**

Australian Monsoon: Development and Implementation of Operational Services

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(with thanks to Matthew Wheeler², Hanh Nguyen², Andrew Marshall^{1,2},
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²Australian Bureau of Meteorology

30 November 2023



Outline

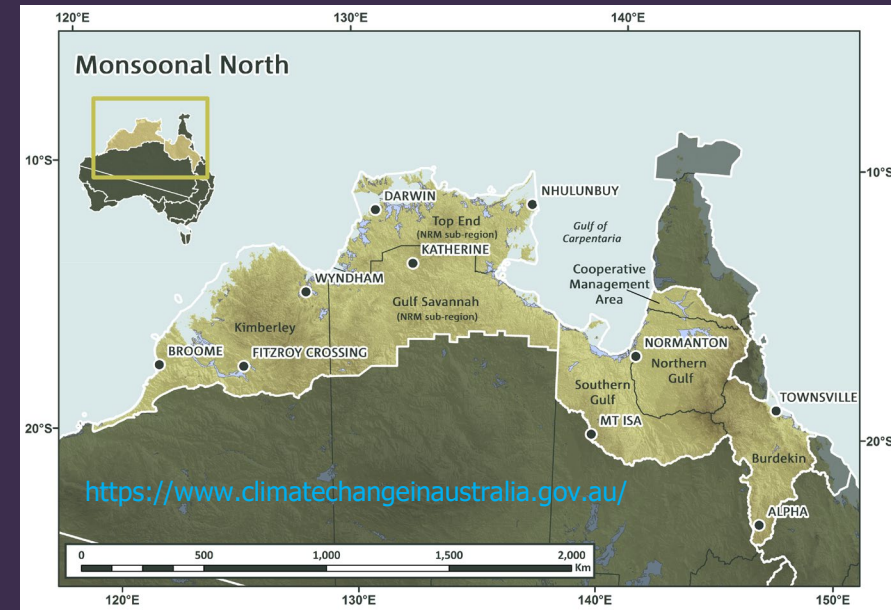
The importance of the Australian summer monsoon (AUSM) to northern regional communities

Defining the AUSM

The Madden Julian Oscillation (MJO) and atmospheric waves

Forecast products related to the AUSM

Monsoon failures (expectation vs outcome)



Cattle prices crash as El Niño is declared and producers prepare 'for the inevitable'

Landline / By Matt Brann

Posted Sat 23 Sep 2023 at 9:56am

NEWS

ABC RURAL

Did Australia's cattle industry have a 'chronic overreaction' to the El Niño forecast?

Landline / By Matt Brann

Posted Yesterday at 8:10am



BOM warns of dry wet season ahead for northern Australia as bushfires rage

ABC Kimberley / By Alys Marshall and Ted O'Connor

Posted Wed 18 Oct 2023 at 11:37am, updated Wed 18 Oct 2023 at 2:49pm

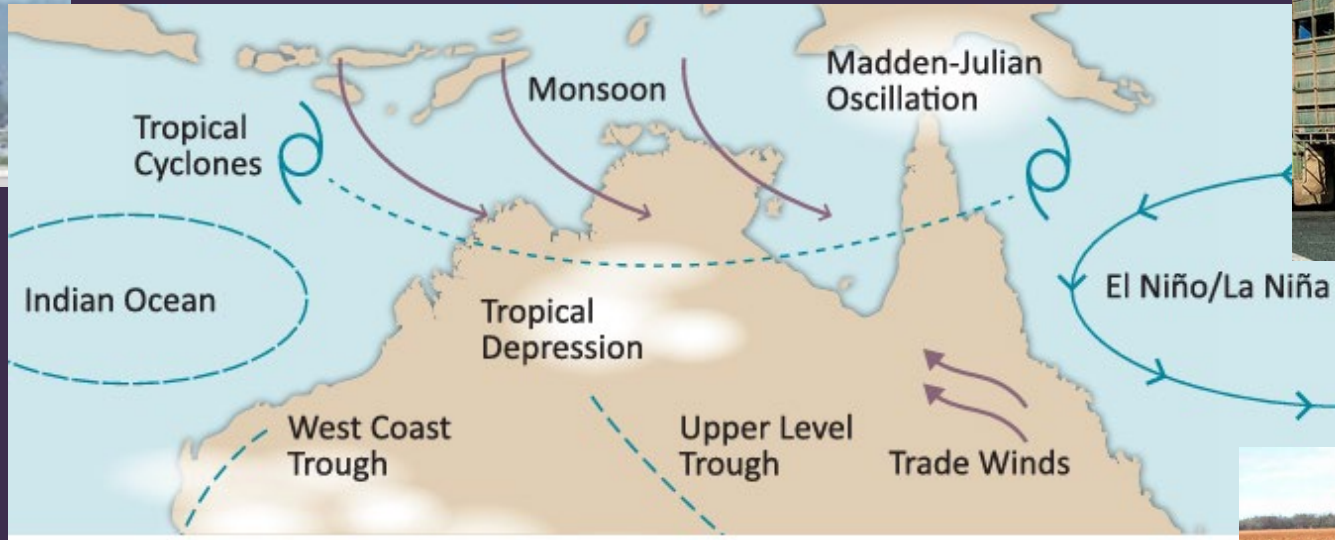


Cattle Australia deputy chair Garry Edwards said cattle prices were undervalued and spending all year talking about El Niño had not helped.

"My personal opinion is that there's been a chronic overreaction to the [weather] bureau announcing El Niño," he said.

The importance of the Australian summer monsoon (AUSM)

Mining accounts for ~10% employment (iron ore, coal, phosphate)



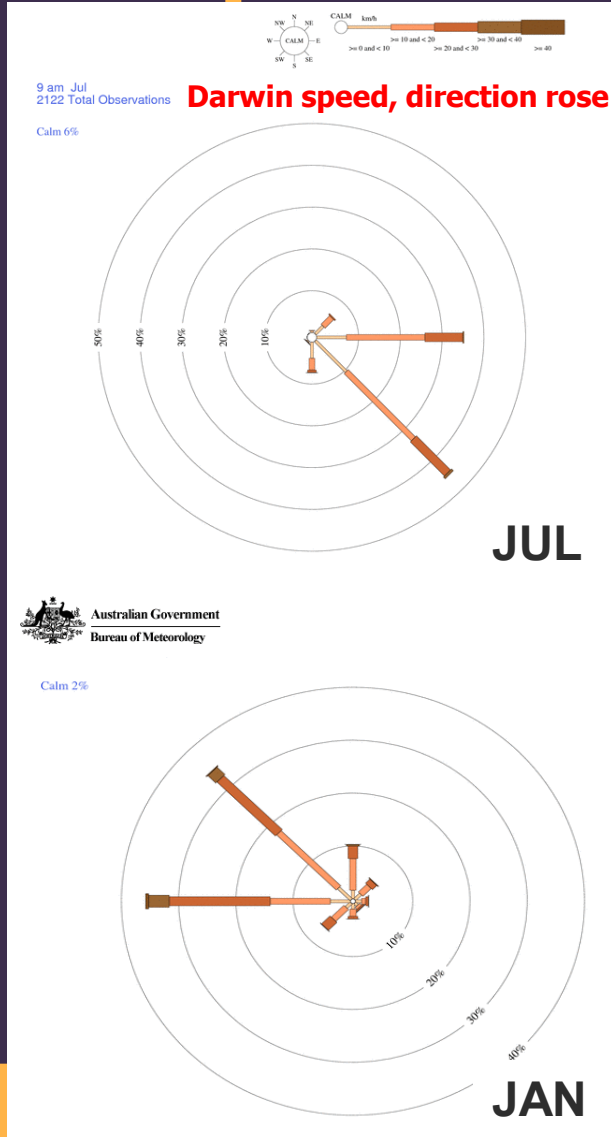
15 million head of cattle in northern Australia



Australian summer monsoon

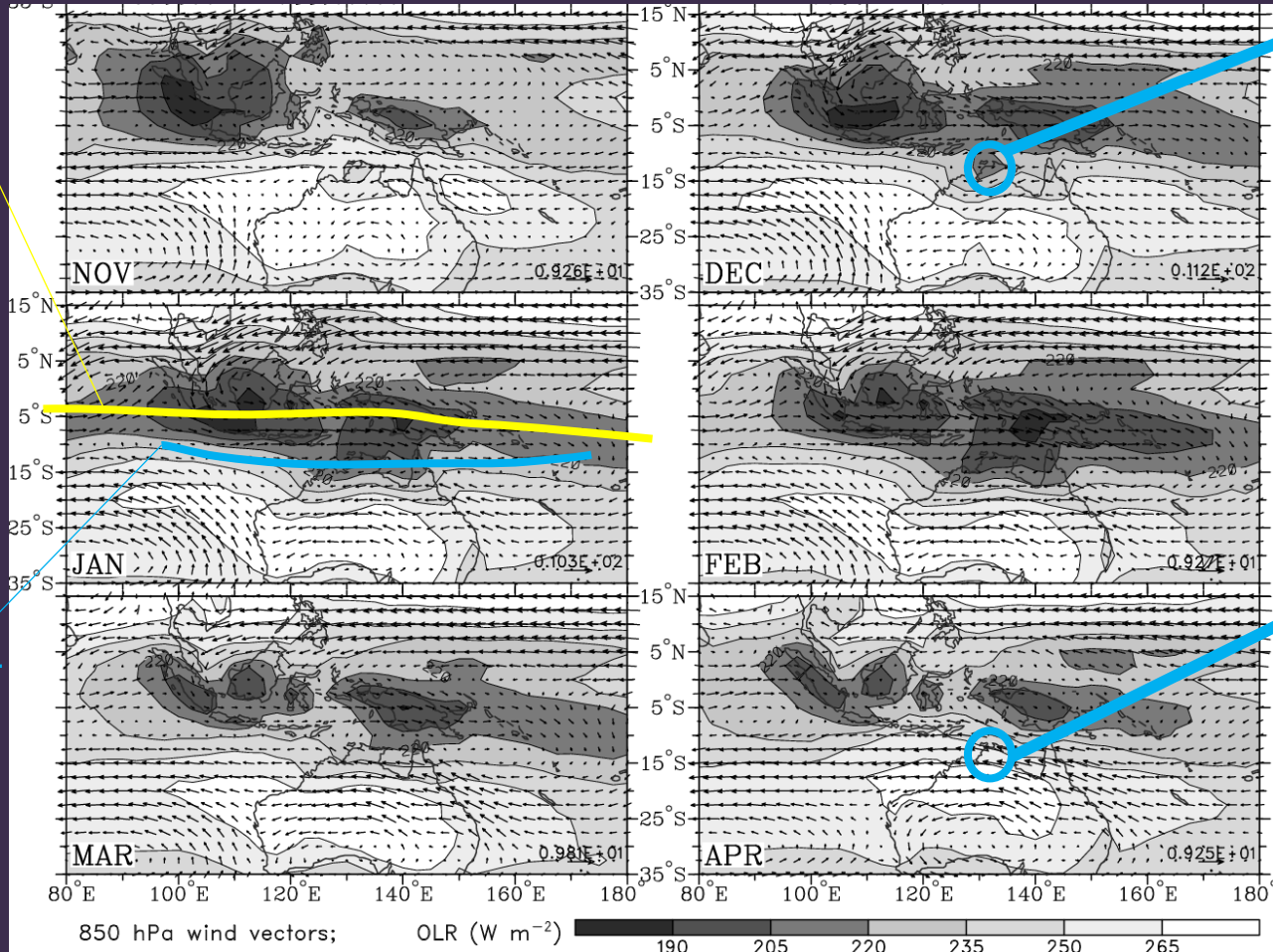
850 hPa winds & OLR

1979-2002 mean conditions from NCEP/NCAR Reanalysis



Strongest convection (ITCZ)

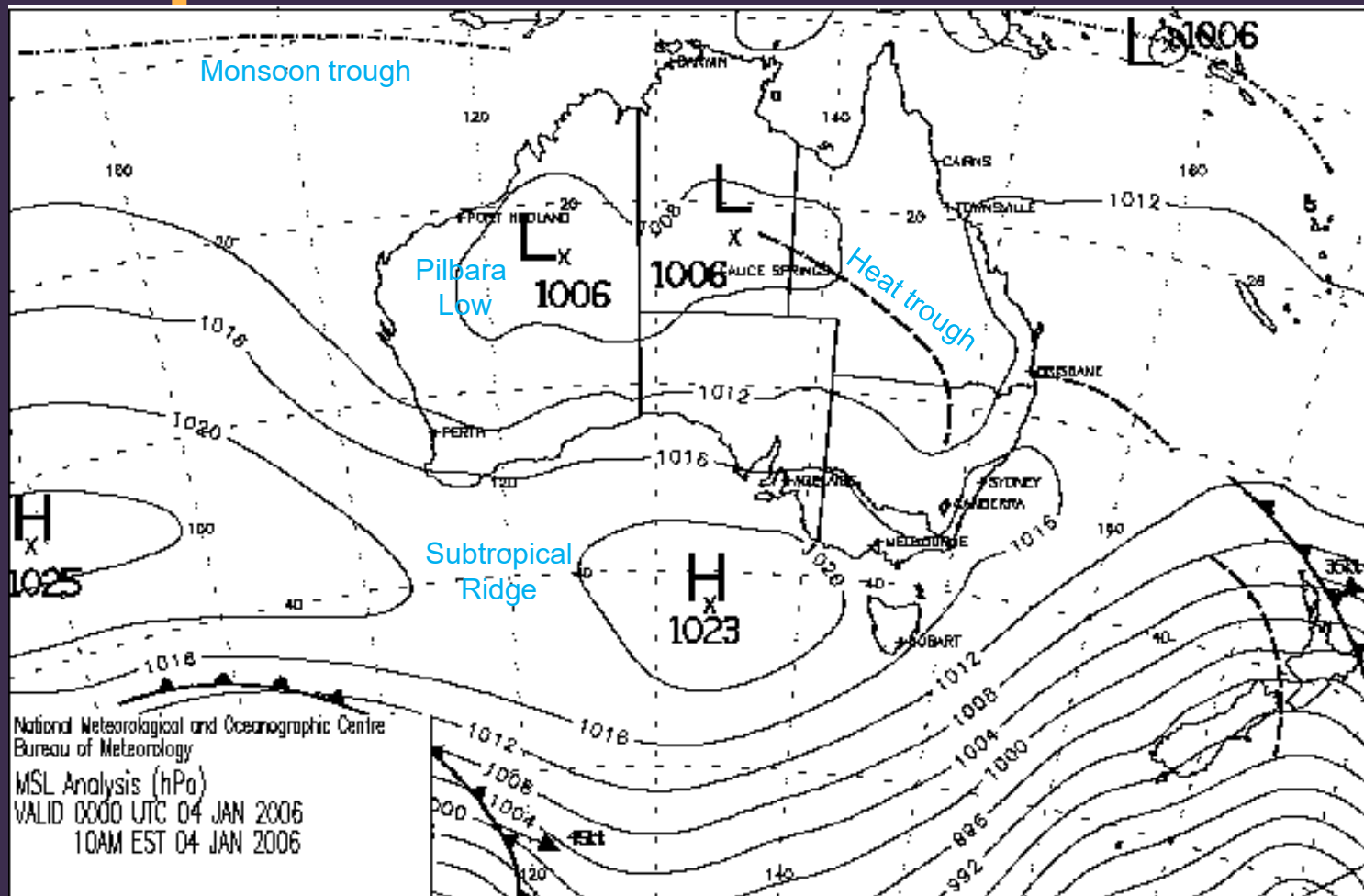
Monsoon shear line (monsoon trough)



Monsoon onset occurs over Darwin in December

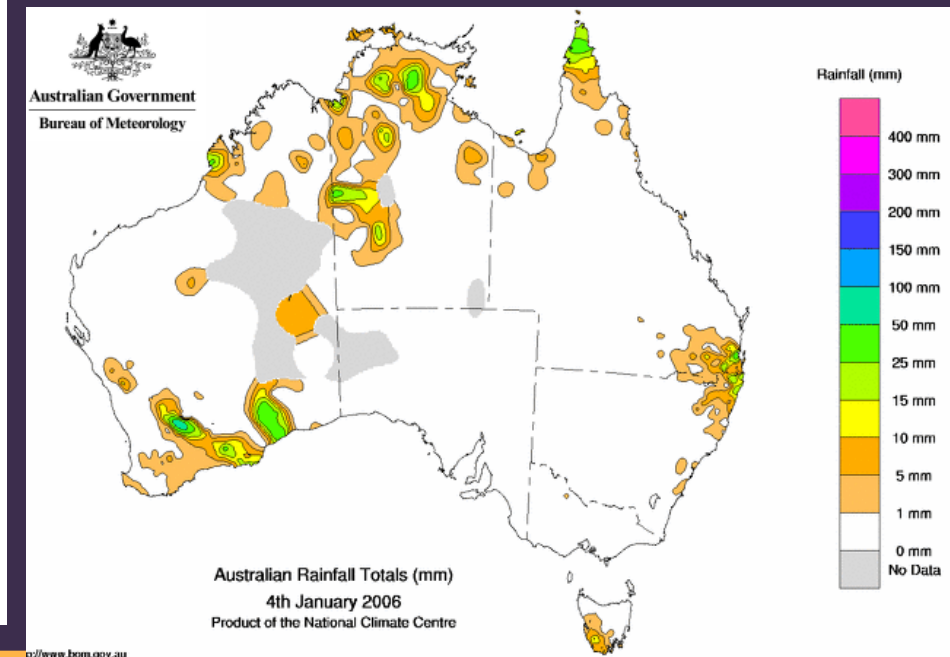
Monsoon retreat occurs in March or April

Stationary heat lows and troughs

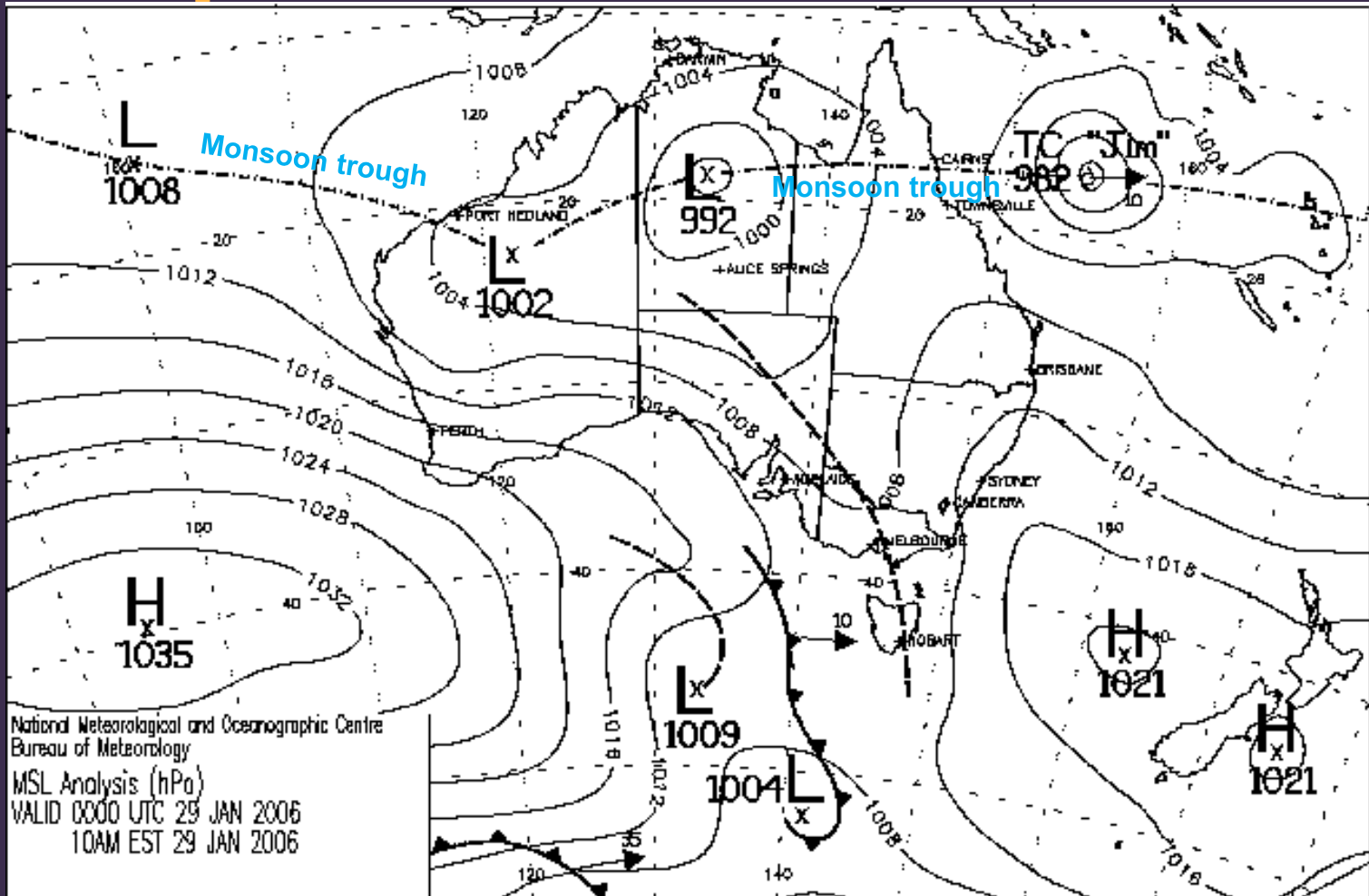


Heat lows and heat troughs are quite shallow, usually extending only 1-2 km above the surface. Typically associated with isolated thunderstorm activity.

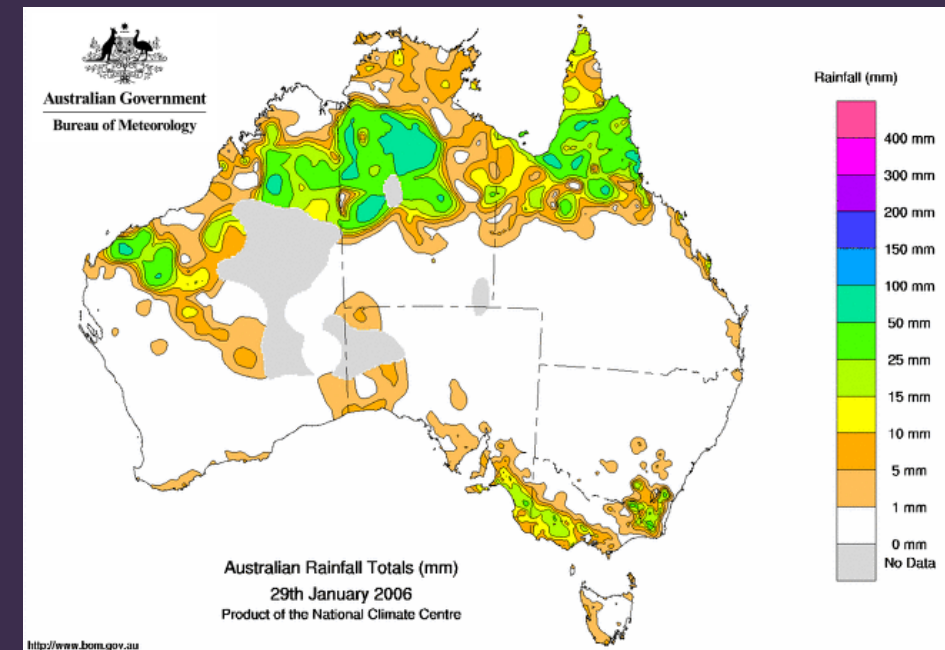
Heat lows are most common just prior to monsoon onset.



Southward shift in monsoon trough



During the monsoon months, the trough can move quite far south. The monsoon lows tend to be deeper and lead to widespread rainfall.



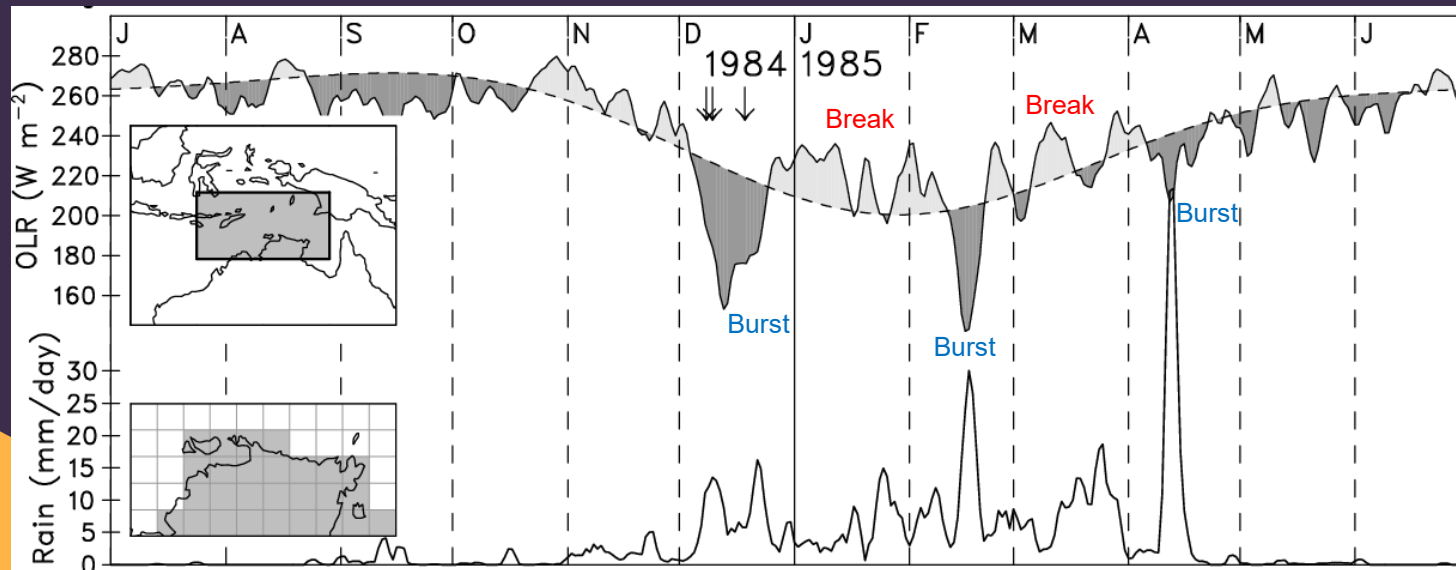
AUSM definitions

Defined as a deep layer mean westerly flow in the lower atmosphere (surface to 500 hPa) overlain by strong upper-level easterlies. Westerly winds need to be established for at least two consecutive days to be considered an active monsoon period (Drosowsky 1996)
→ **Deep-layer mean zonal wind**

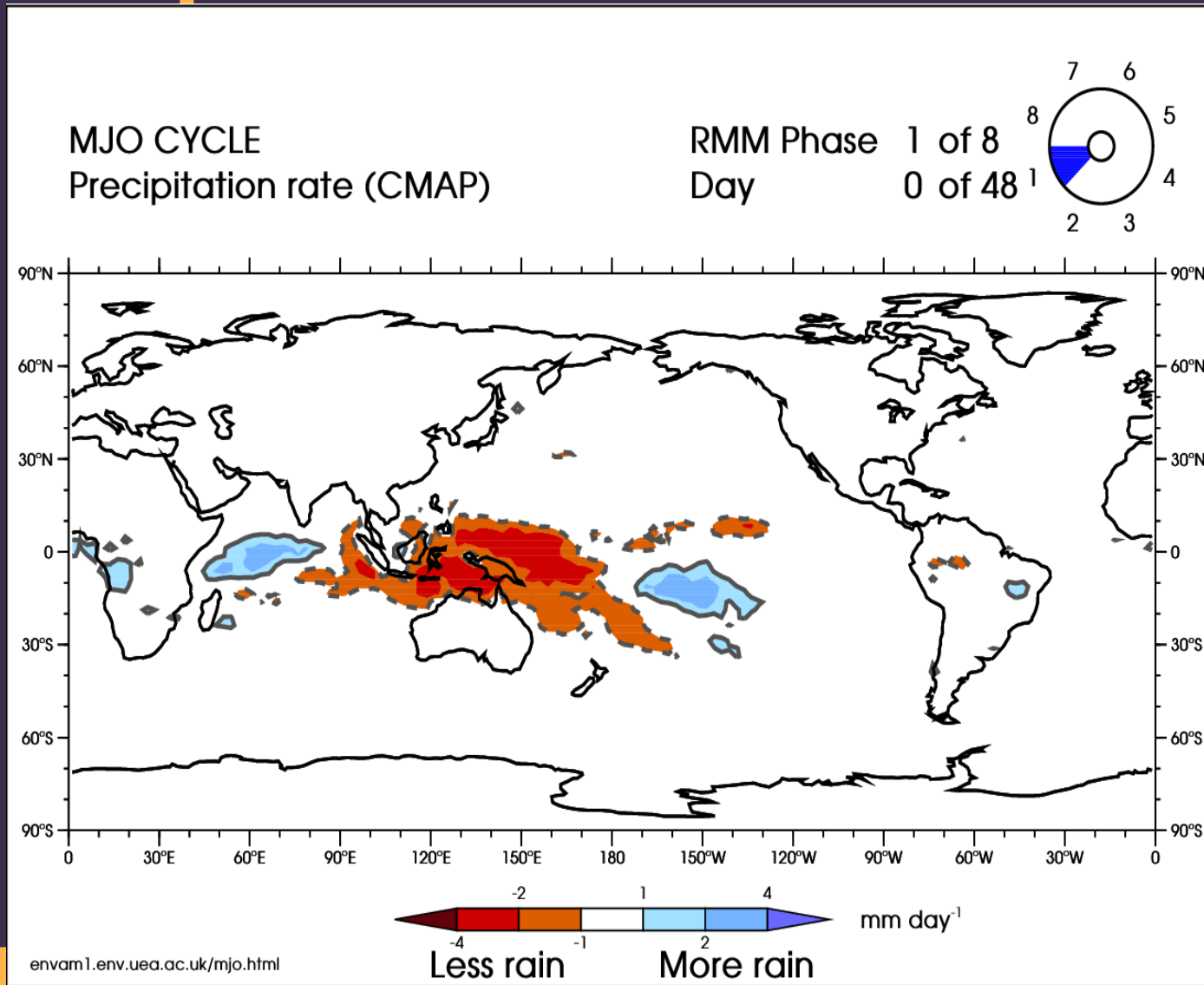
3-10 spells
per wet season 3.3 day
average length

For a location (e.g., Darwin), monsoon defined when 5-day running mean daily rainfall exceeds 150% of the long-term daily mean (Shaik & Cleland 2010)
→ **Australian Monsoon Rainfall Index**

1-6 spells
per wet season 4 day
average length

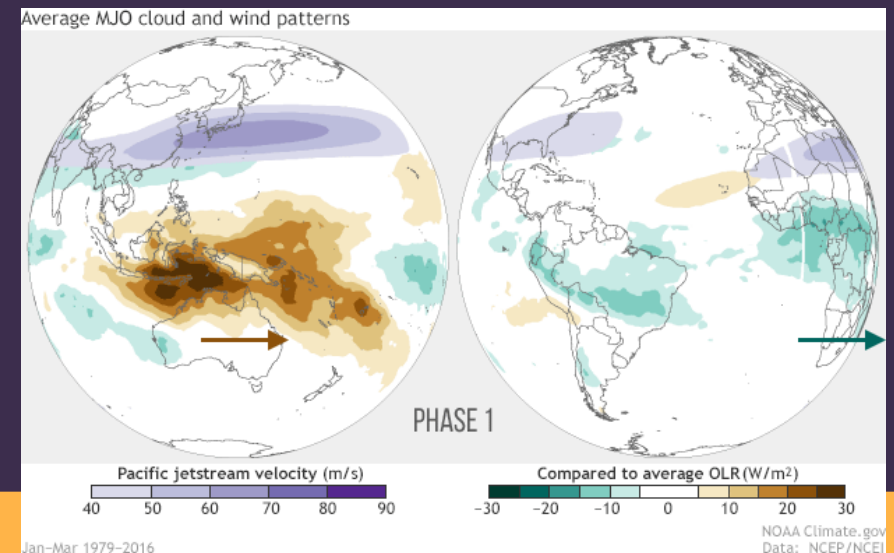


The MJO and the AUSM



The MJO can impact:

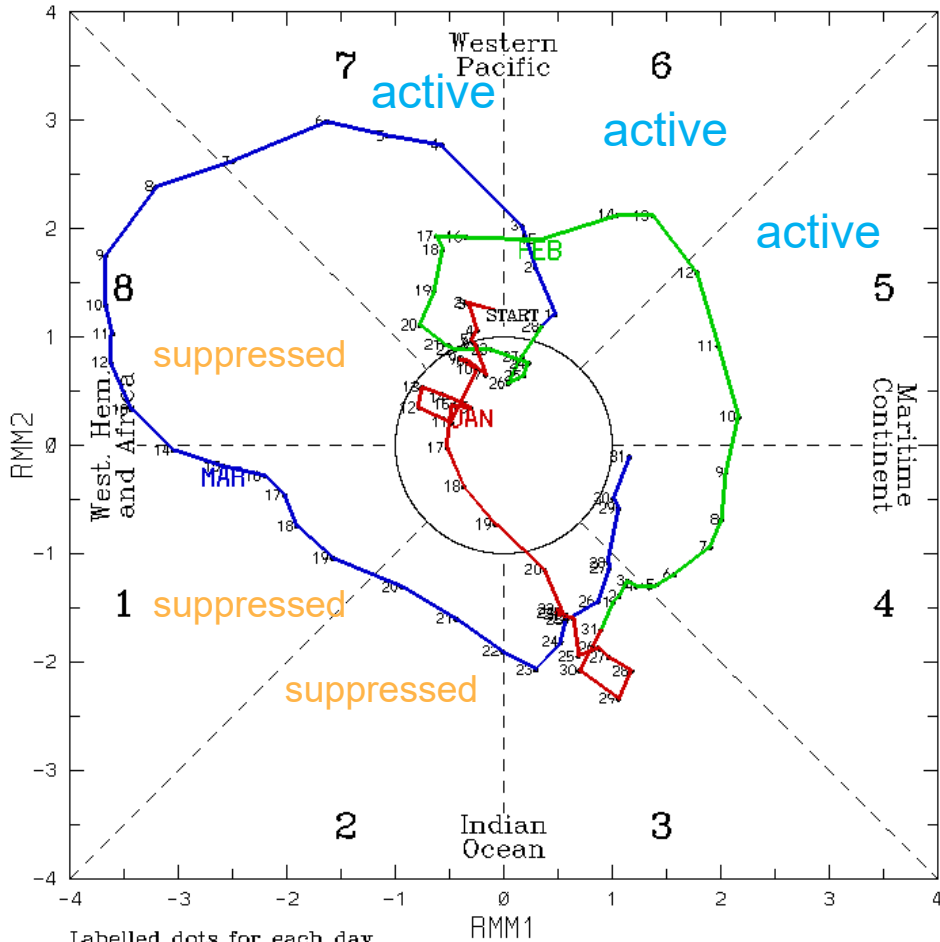
- Tropical cyclones and depressions
- "Bursts" and "breaks" of the AUSM
- Rainfall in most parts of the tropics
- Weather outside the tropics
- The underlying ocean (e.g., accelerate development of ENSO event).



The MJO and AUSM rainfall

MJO evolution, Jan-Mar 2023

(RMM1, RMM2) phase space for 1-Jan-2023 to 31-Mar-2023



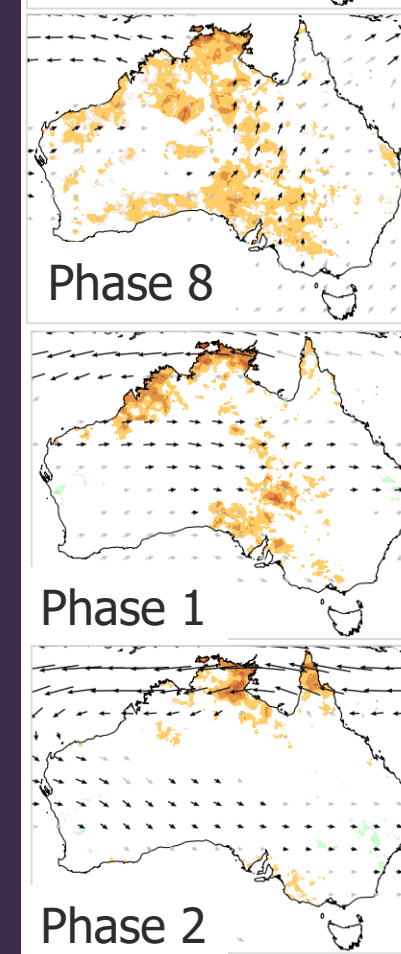
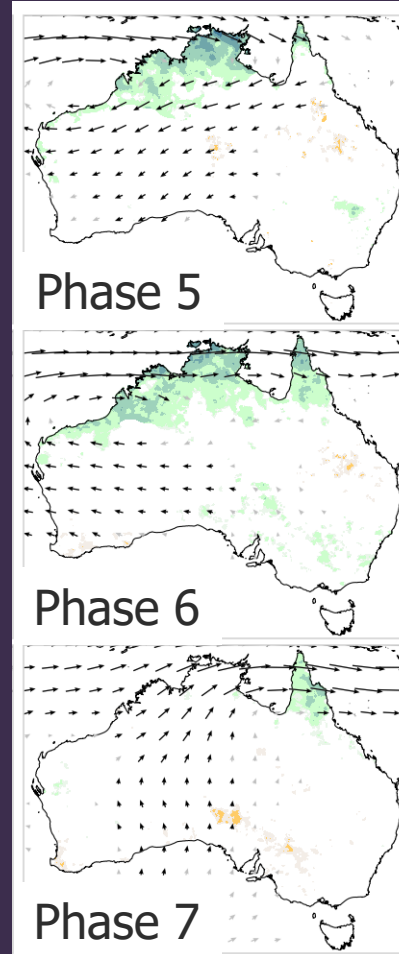
Labeled dots for each day.

Blue line is for Mar, green line is for Feb, red line is for Jan.

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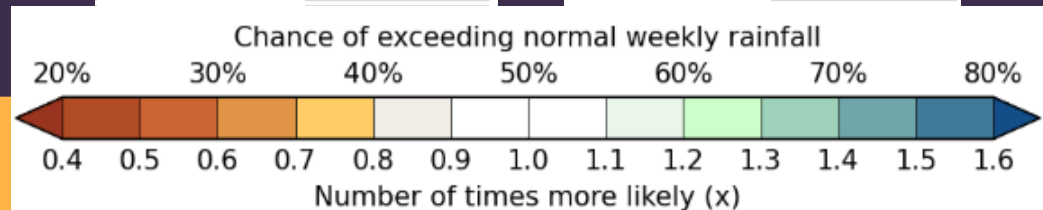
Active composites

Suppressed composites



Dec-Feb
(1974-2021)

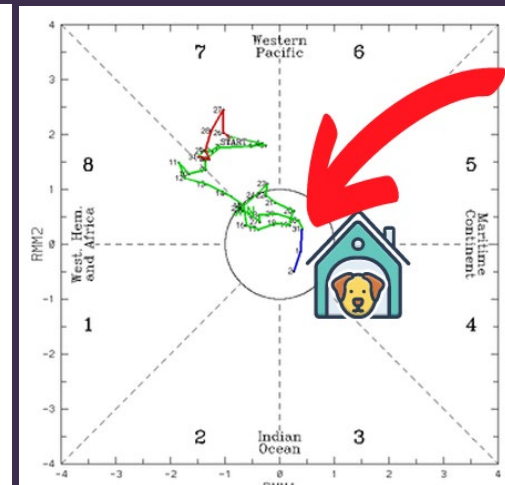
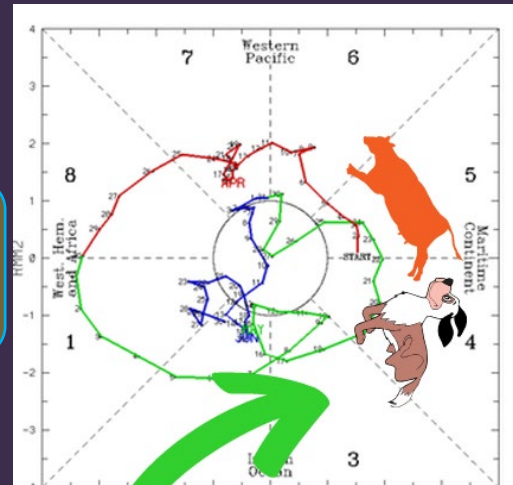
<http://www.bom.gov.au/climate/enso/#tabs=Tropics&tropics=Averages>



Customer engagement

The MJO's been strange in the past two years. Is this normal or have there been other climate drivers influencing the MJO?

Which phase of the MJO might bring me rainfall in the Gascoyne (West Australia)?

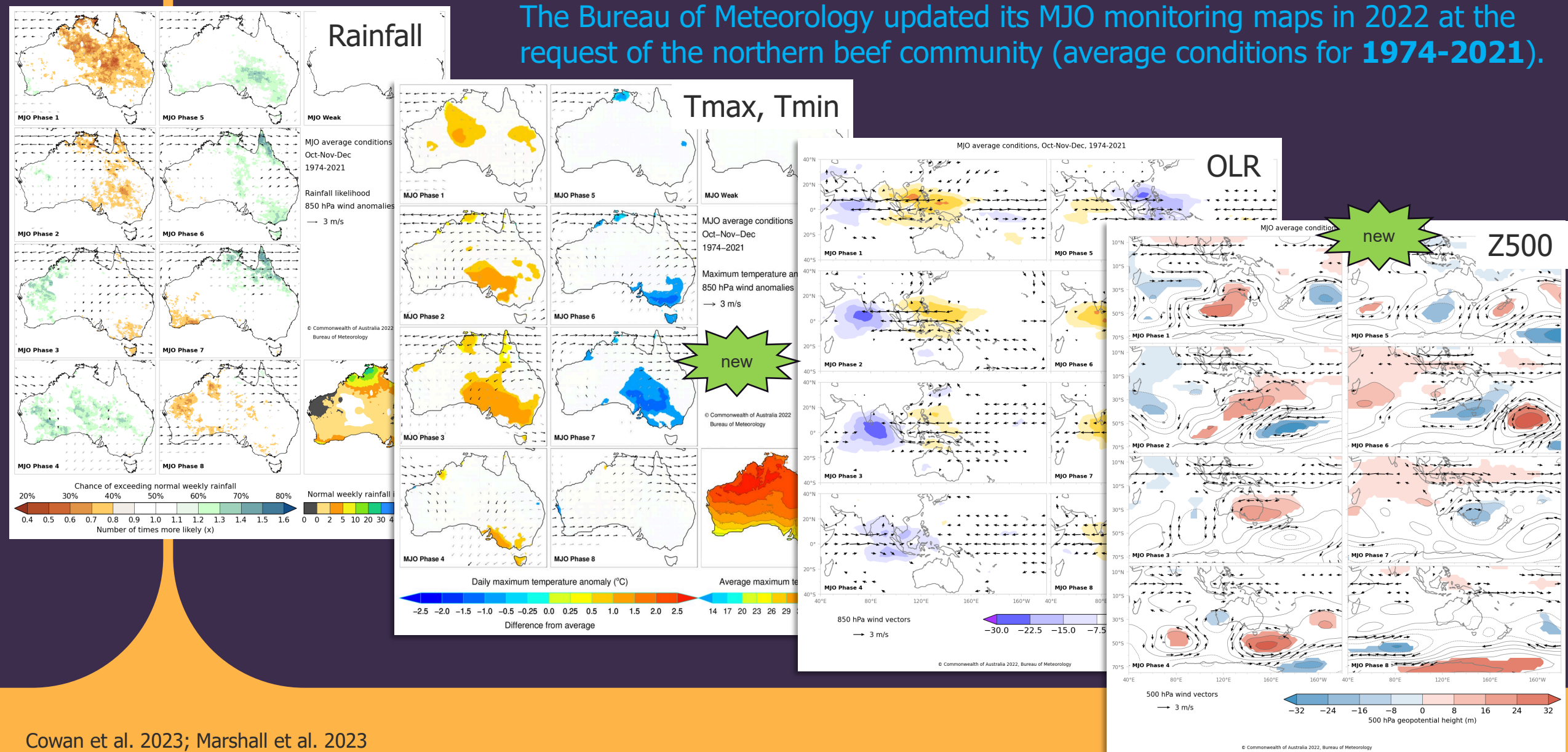


- Our customers (e.g., graziers) are really interested in "better understanding what drives their weather"
- They want to know what causes extreme conditions (usually floods or severe wet seasons).

Northern Australia Climate Program

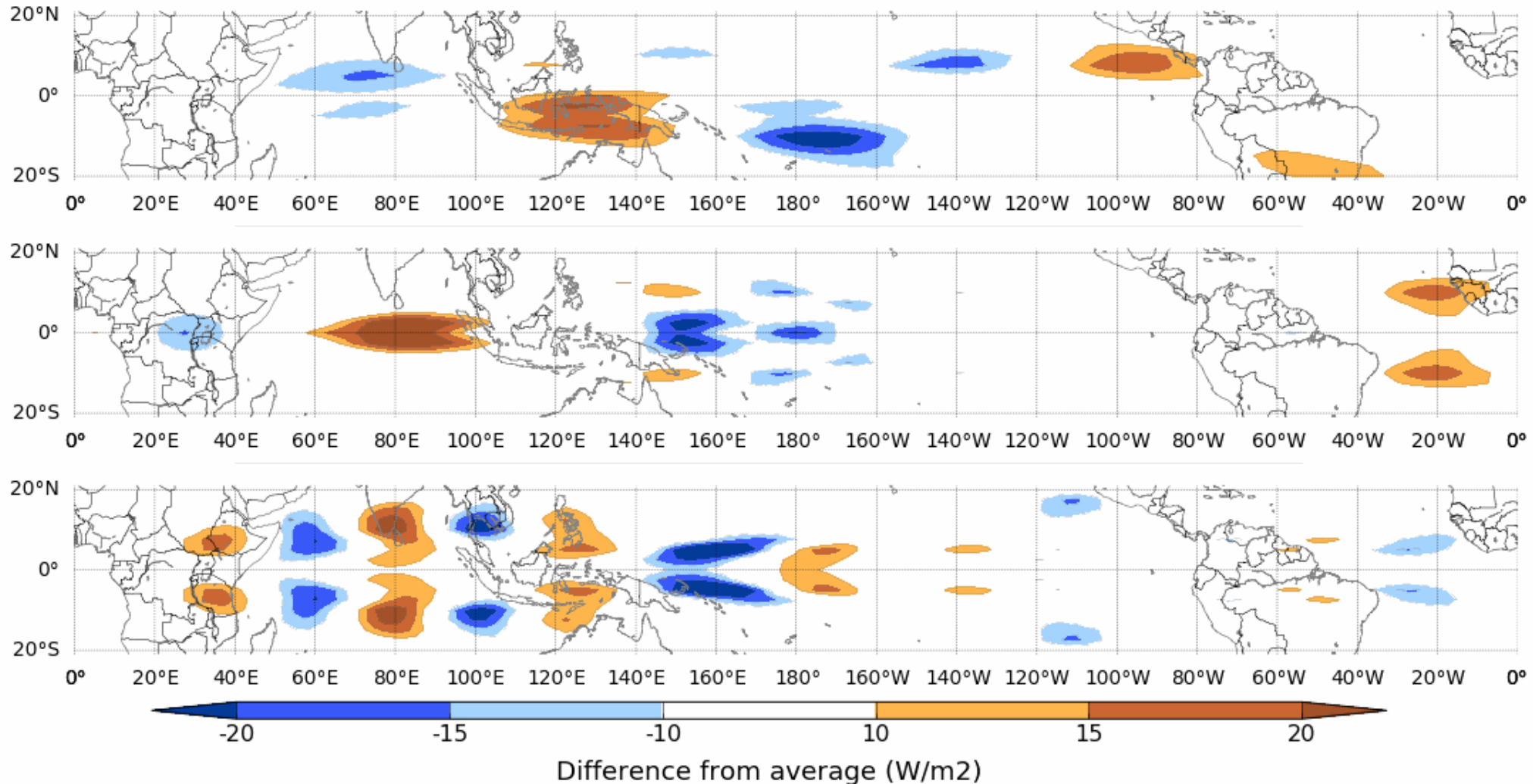
Monitoring the MJO at the Bureau

The Bureau of Meteorology updated its MJO monitoring maps in 2022 at the request of the northern beef community (average conditions for **1974-2021**).



Tropical atmospheric waves

Mix of analysis (bright colours) and forecasts (dull colours) from ACCESS-S2



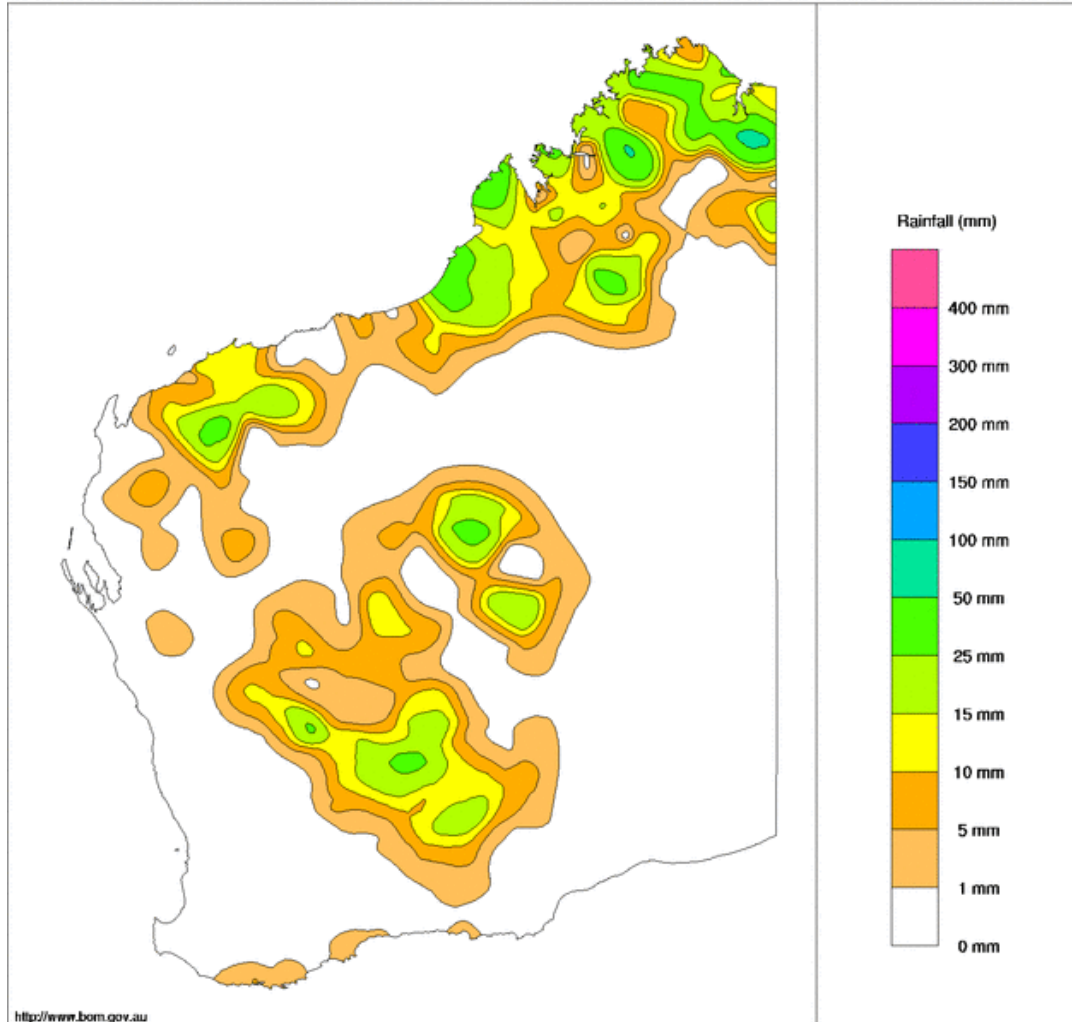
MJO
(30-60 d)

Kelvin
(12-25 m/s)
2-3x faster than MJO

Eq. Rossby
(5-7 m/s)
Precursor to TCs

Why atmospheric waves matter

Western Australian Rainfall Totals (mm) 23rd February 2023
Australian Bureau of Meteorology

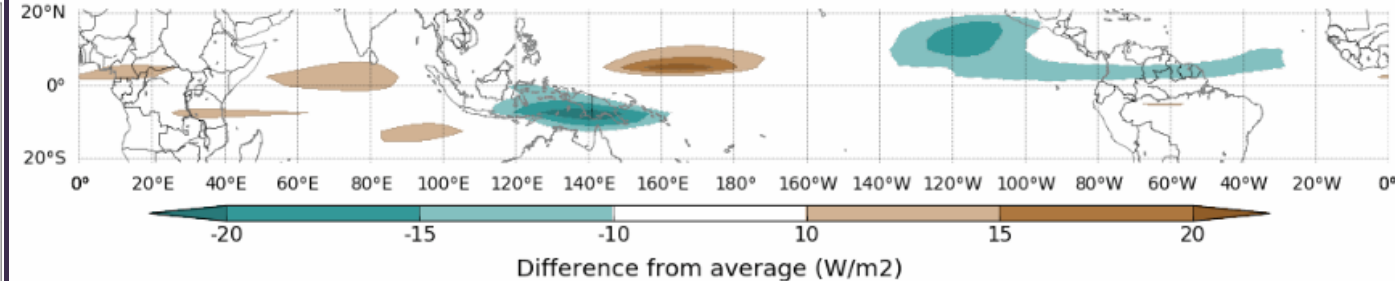


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2023

Issued: 21/08/2023

MJO forecast

24 February 2023 Daily Madden-Julian Oscillation

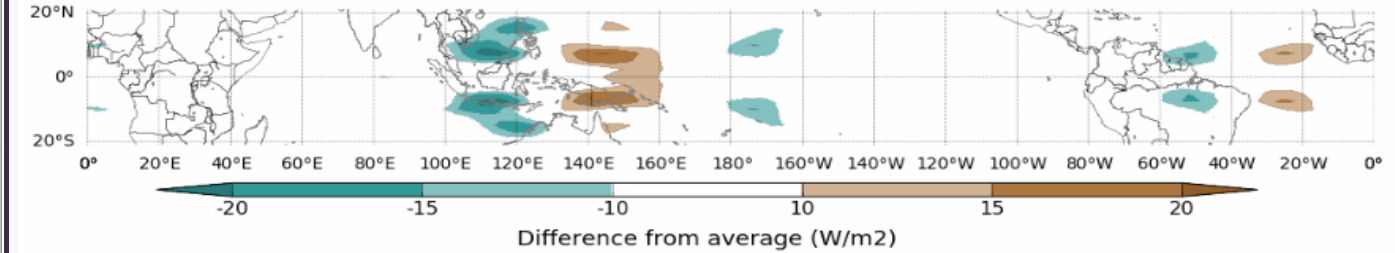


www.bom.gov.au/climate
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Model: ACCESS-S2 Forecast date: 24/02/2023
Base period: 1981-2018 Model run date: 18/02/2023

ER wave forecast

23 February 2023 Daily Equatorial Rossby wave



www.bom.gov.au/climate
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Model: ACCESS-S2 Forecast date: 23/02/2023
Base period: 1981-2018 Model run date: 18/02/2023

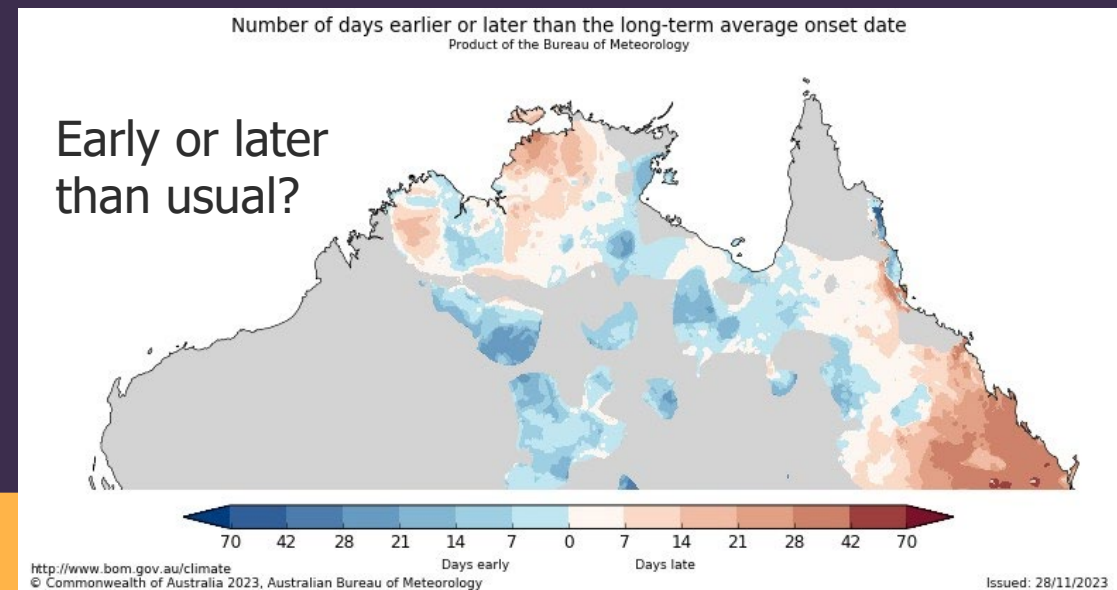
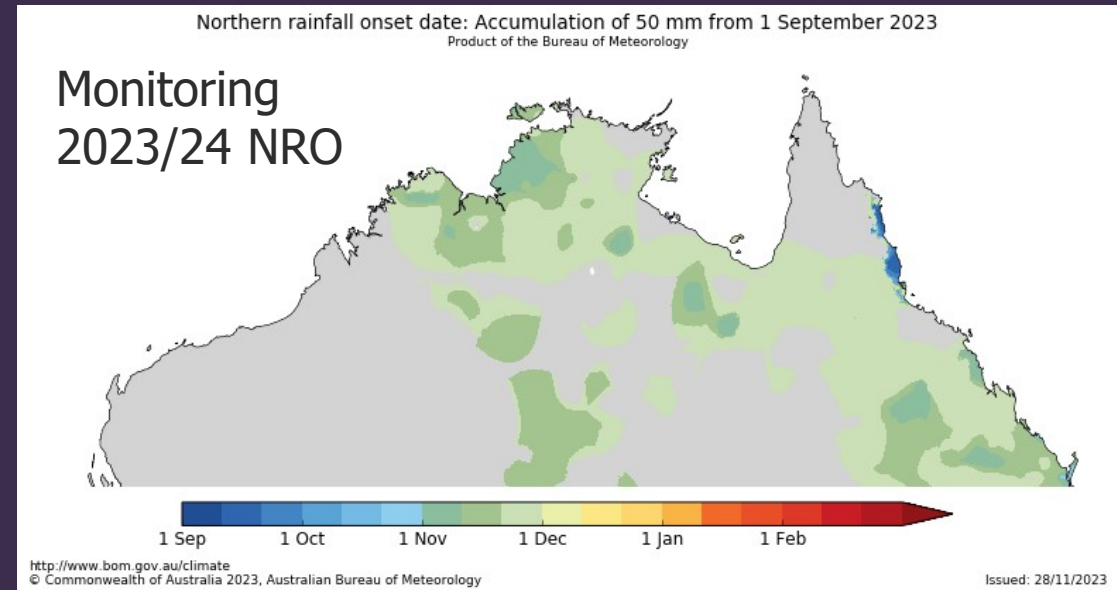
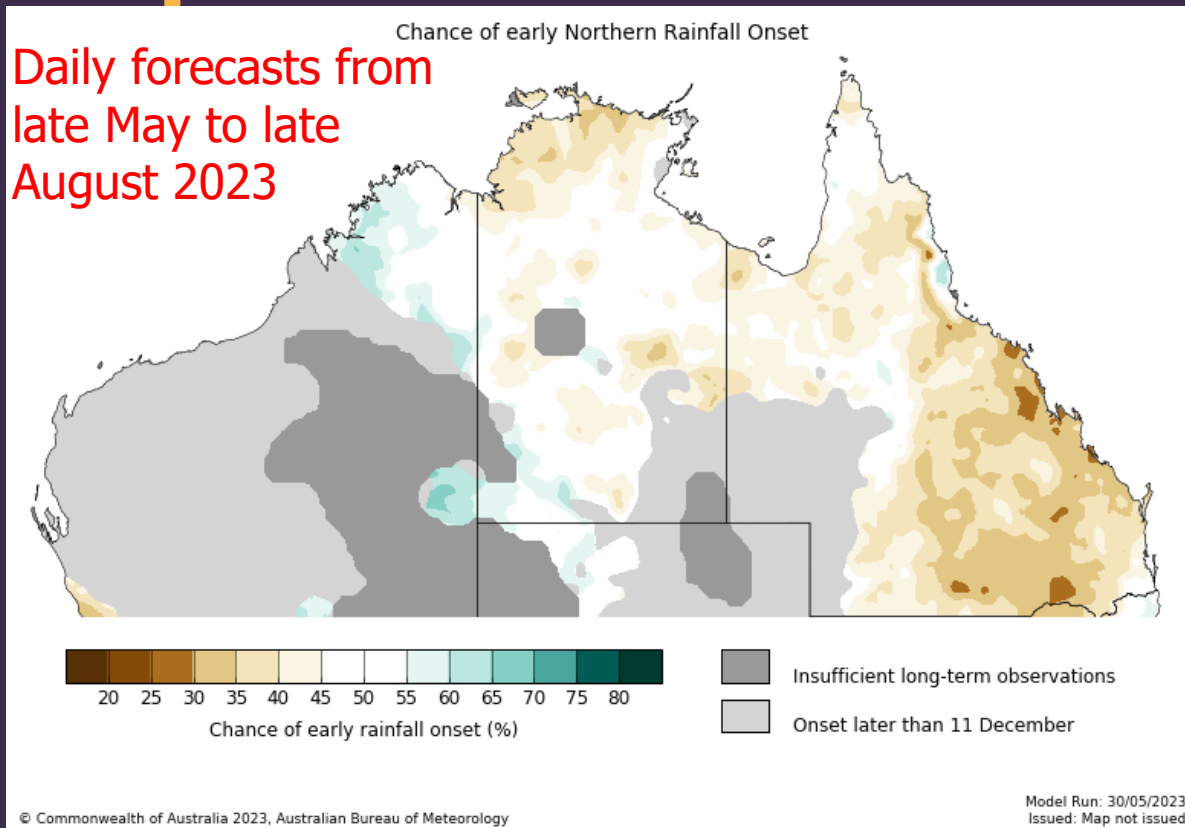
23-24 February 2023

Northern rainfall onset (NRO)

The **NRO** is defined as the date when rainfall over a location accumulates 50 mm rain after 1 September. It is a proxy for pasture growth.

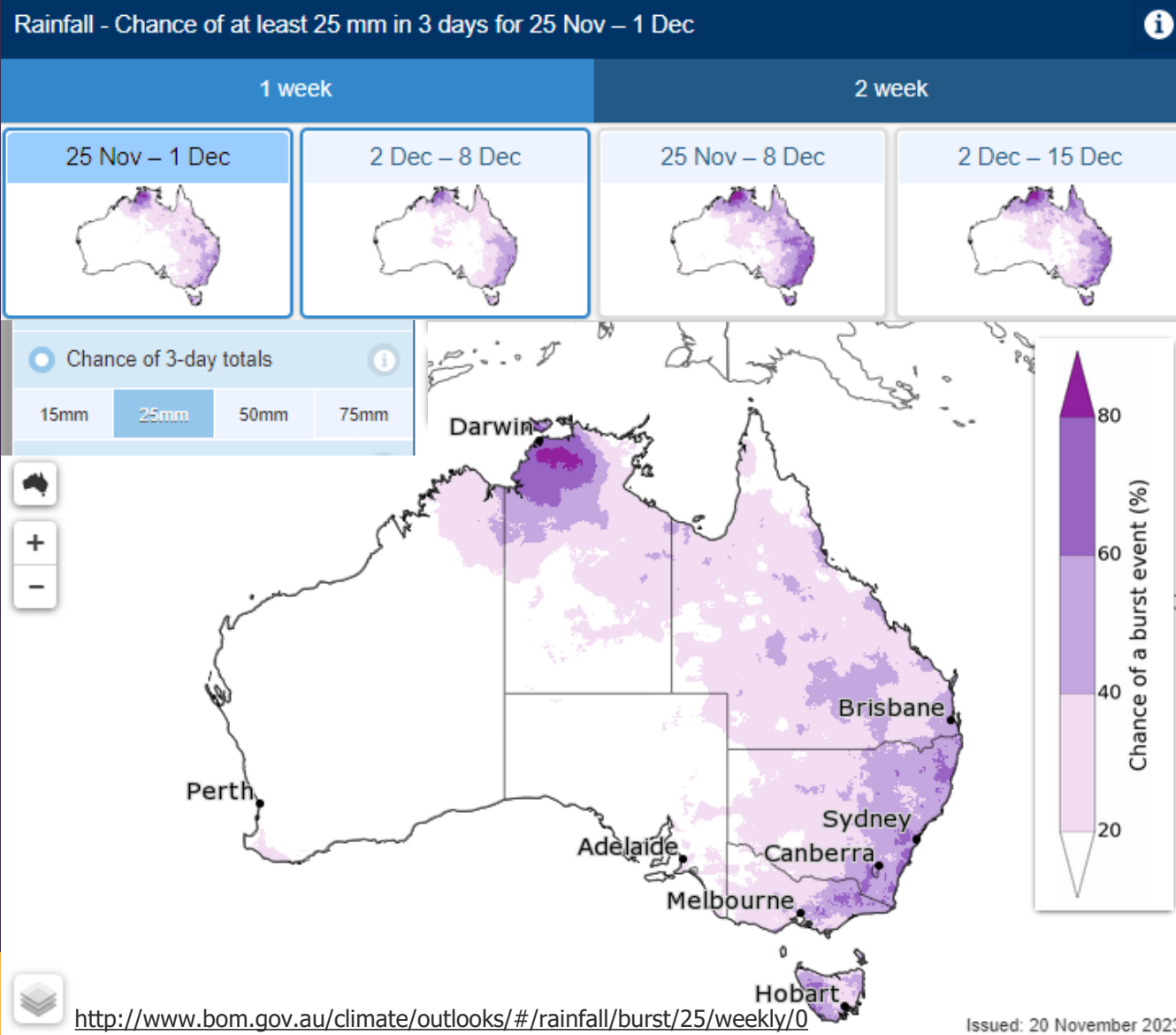
The Bureau issue five forecasts (per year) from June to August, showing the chance of early onset.

Daily forecasts from late May to late August 2023

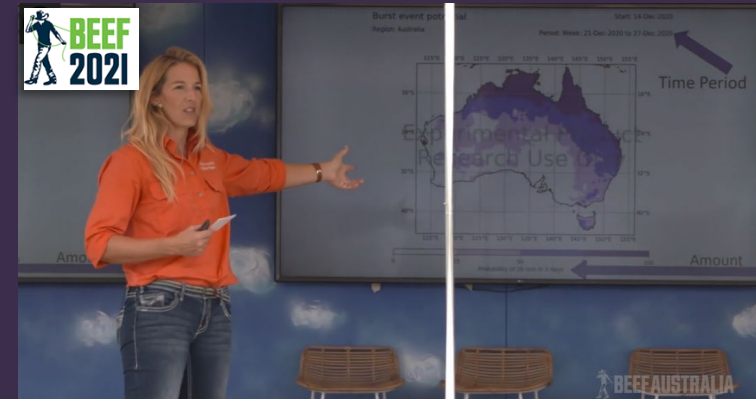


3-day rainfall burst product

Northern Australia
Climate Program



'Three Day Burst' outlook maps for upcoming weeks (do not provide months/seasons outlook)



Dr Chelsea Jarvis (UniSQ) presenting @ Beef2021 in May 2021

Tropical cyclone forecast

7 day forecast map

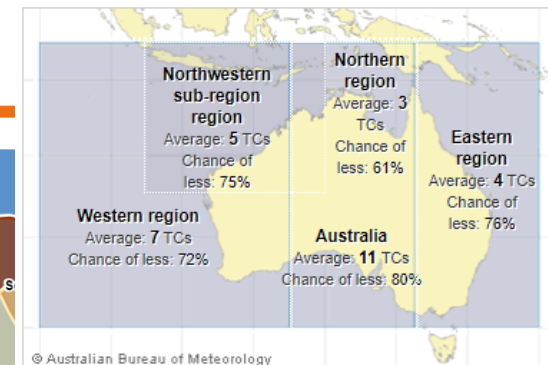
Chance of tropical cyclone



Tropical Cyclone Seroja 22U

100% (High) chance of tropical cyclone strength on Sunday 11 April at 10:00am AEST.

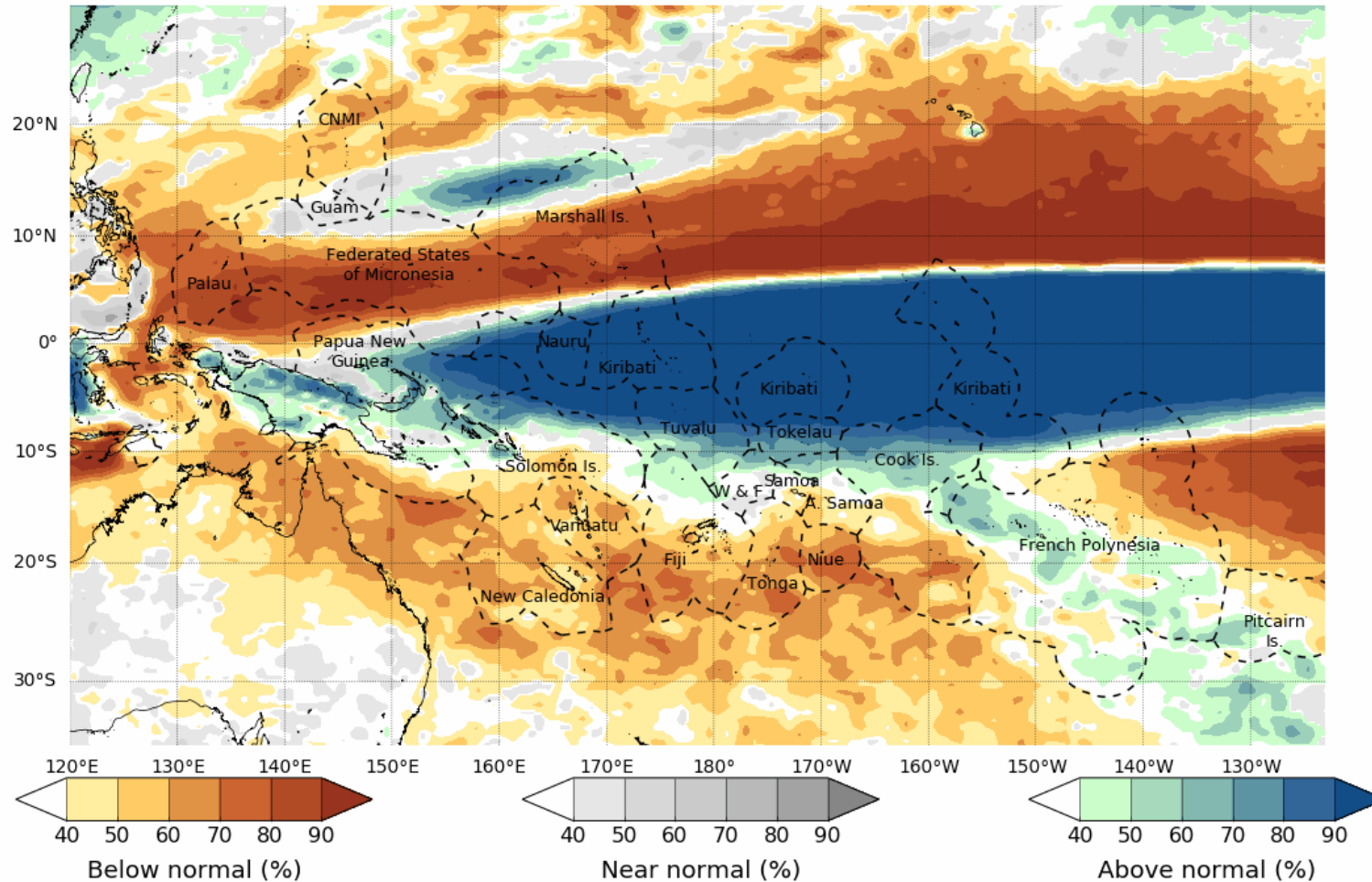
- Tropical Cyclone Advice →
- Forecast Track Map (WA) →
- Ocean Wind Warning →
- Tropical Cyclone Technical Bulletin →



Chance of less than average number of tropical cyclones

Providing a service for the Pacific

Tercile rainfall probabilities for December 2023 to February 2024

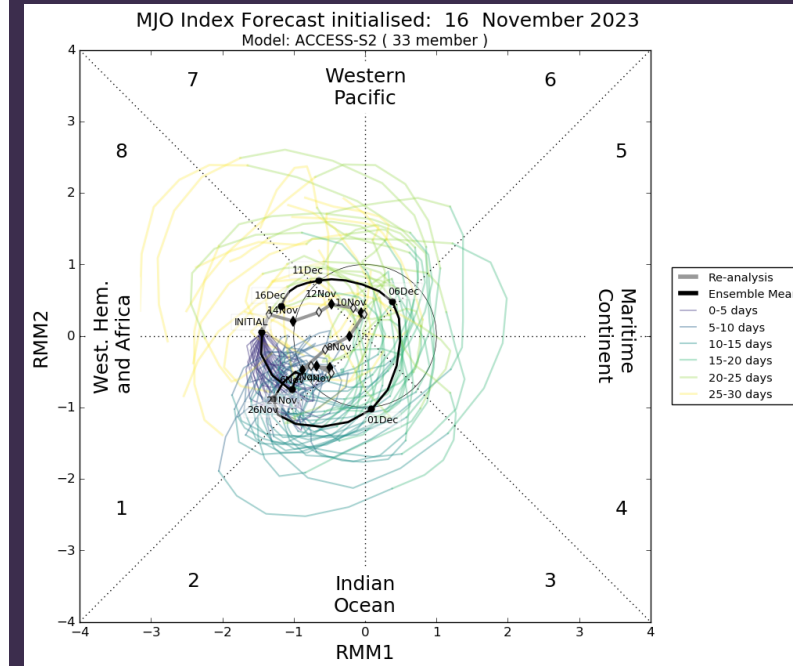


Base period: 1981-2018
 Model: ACCESS-S2
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Model run: 13/11/2023
 Issued: 15/11/2023

Shapefile data extracted from Flanders Marine Institute (2019), Maritime Boundaries Geodatabase: Maritime Boundaries and Exclusive Economic Zones (200NM), version 11. Available online at <http://www.marinerregions.org/>.

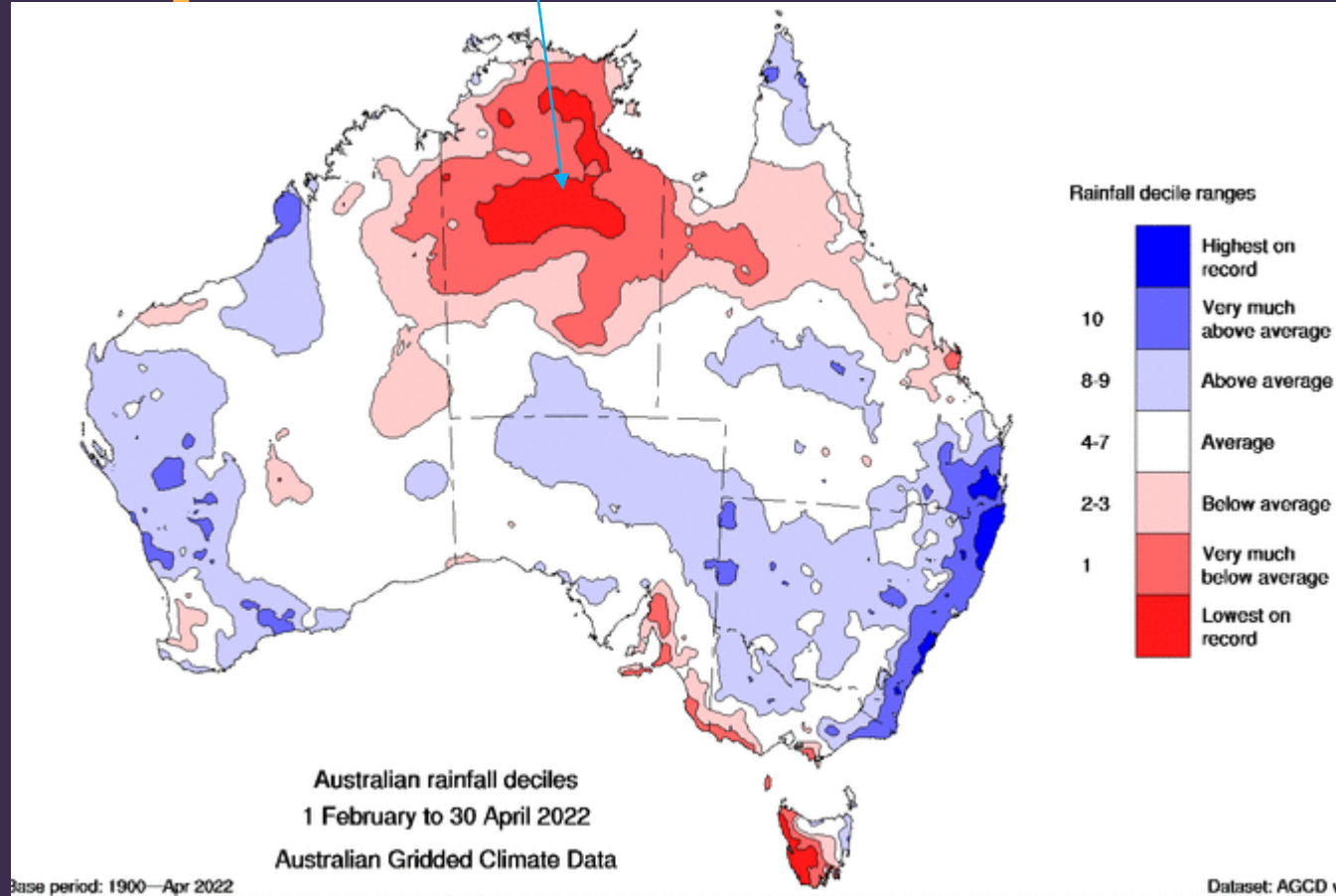
99-member probabilistic ACCESS-S2 forecast



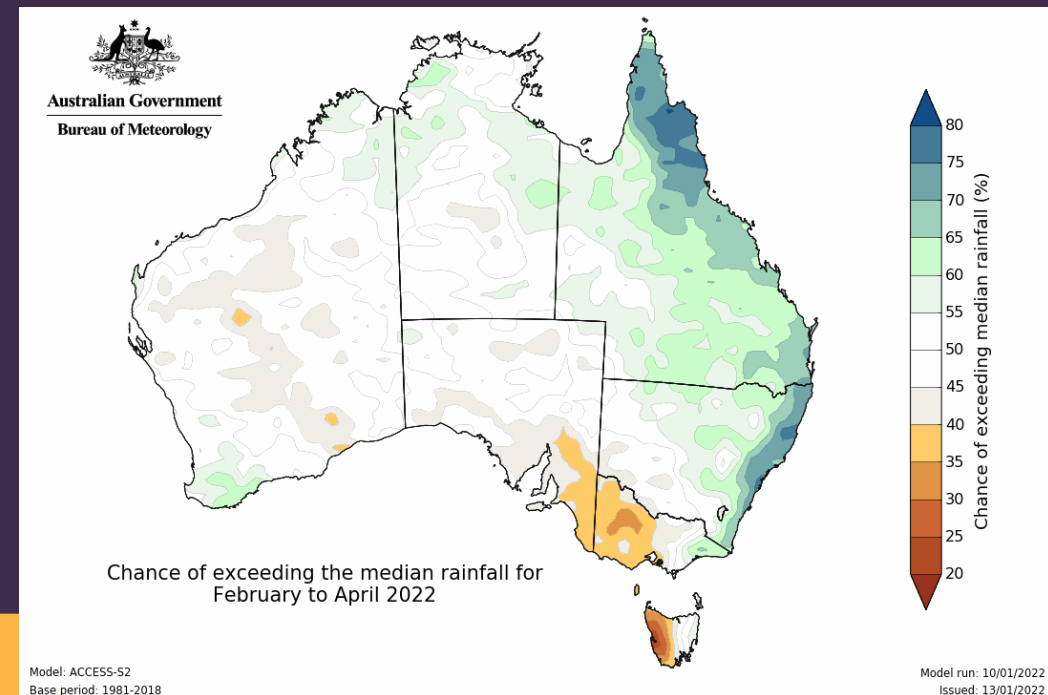
Failed wet seasons

Hunga Tonga-Hunga Ha'apai volcano erupted on 15 January 2022, produced a significant water vapor cloud, circling the globe every 18 days

Northern Territory received < 50 mm from Feb-Apr 2022
(usually receives ~150-300 mm)

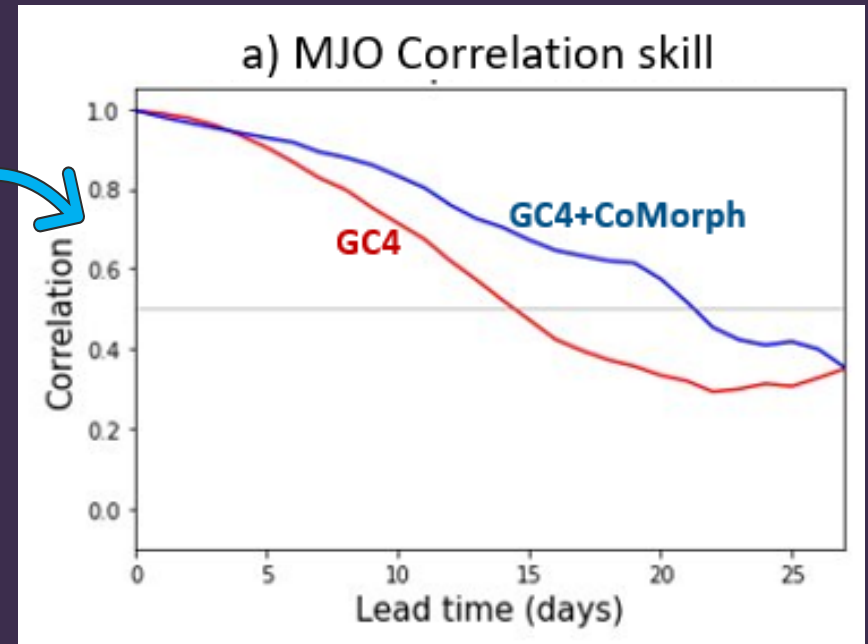


Forecast for Feb-Apr 2022 (10 Jan init.)



AUSM challenges: prediction

- Somewhat poor skill in predicting AUSM rainfall.
- Skill in predicting the MJO has improved, however issues remain in the model depiction of MJO's convective phases as they shift south over Aust.
- **Messaging to customers (expectation vs outcome)**



Cattle prices crash as El Niño is declared and producers prepare 'for the inevitable'

Landline / By Matt Brann
Posted Sat 23 Sep 2023 at 9:56am

9NEWS

Heavy rainfalls in Queensland bring cattle prices back up to 'expected' levels

The Guardian
A decade of making a difference

'The dry weather probably panicked a lot of people who flooded the markets with cattle, but now things are changing,' says one breeder



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