

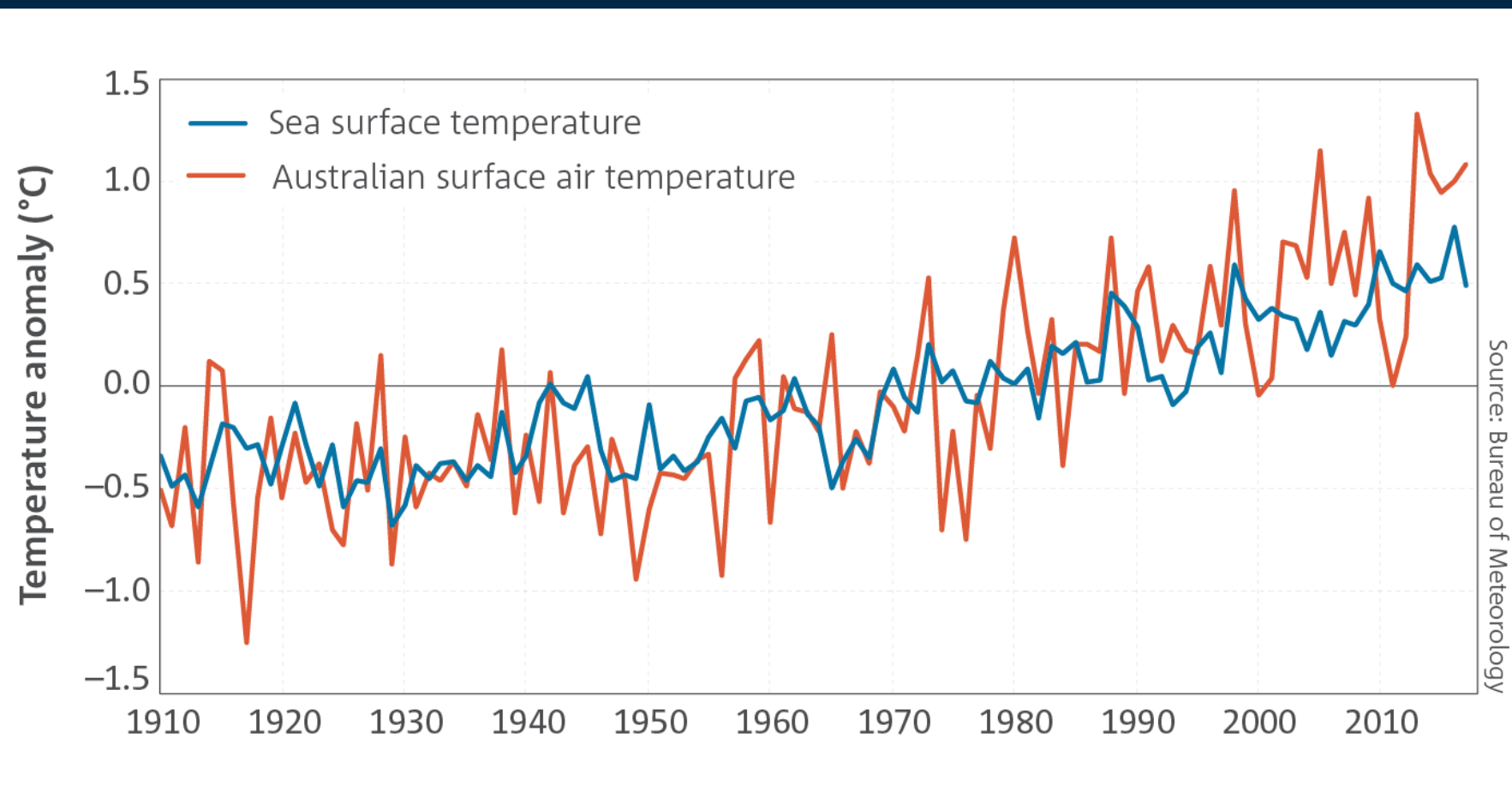
Climate outlook and future scenarios

Shane Kennedy
Bureau of Meteorology
November 2019



A Changing Climate

About a one degree rise in atmosphere and ocean mean temperature





Changes in climate requiring adaptation



Increased frequency of large-scale heatwaves and record-high temperatures



Longer fire season with more extreme fire danger days



Decreased frequency of tropical cyclones but high variability



Prolonged high ocean temperatures, increasing acidity



Reduced average rainfall and more time spent in drought in southern Australia



An increase in heavy rainfall events, wet season variability



Increased frequency of coastal storm surge inundation

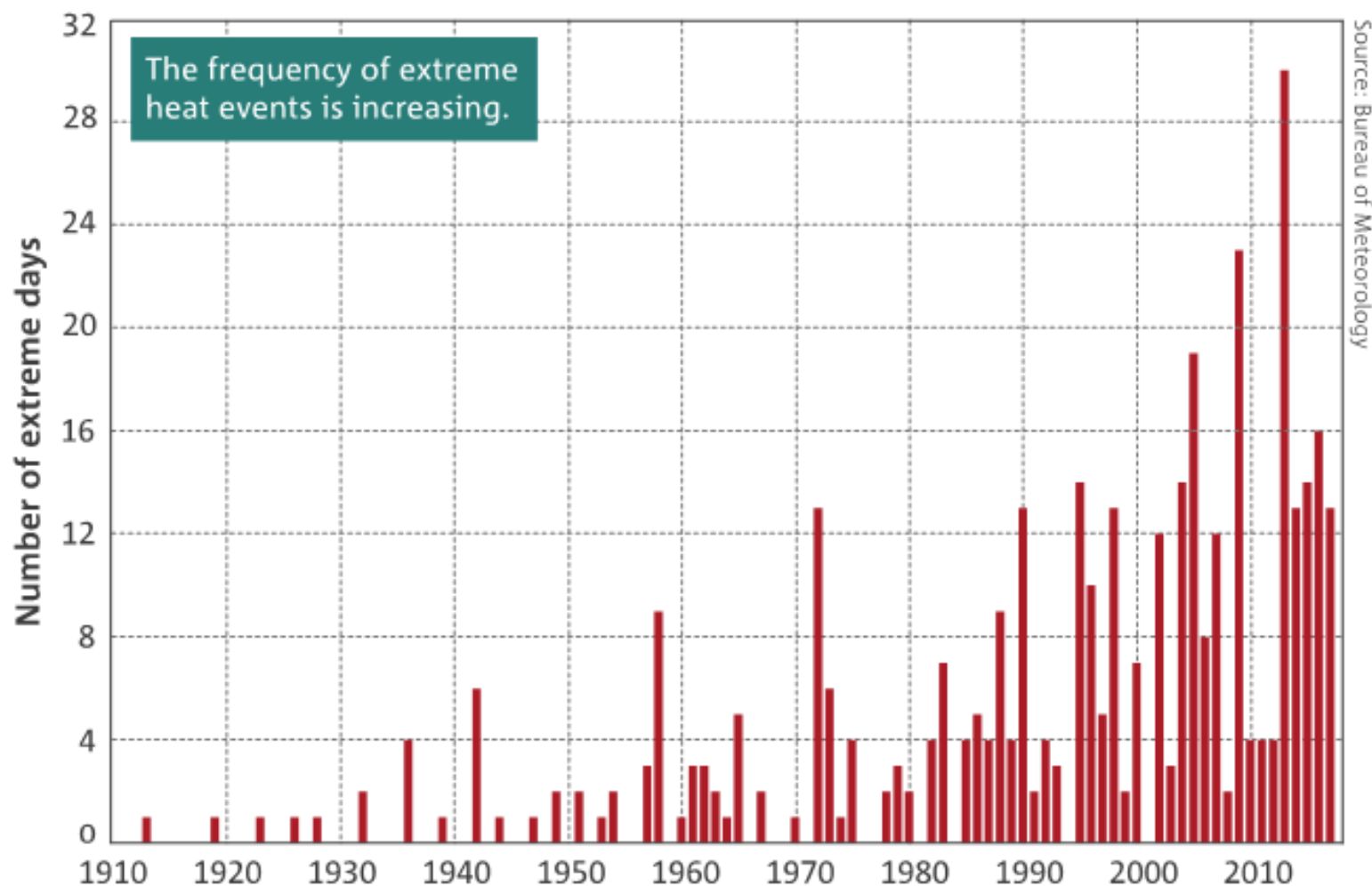
occurring now



emerging threat



Increasing frequency of extreme heat



Heat waves, sustained hot days and warm nights, are particularly dangerous to life, agriculture, infrastructure.



Bega Valley, NSW
15 August 2018
(Source: ABC)

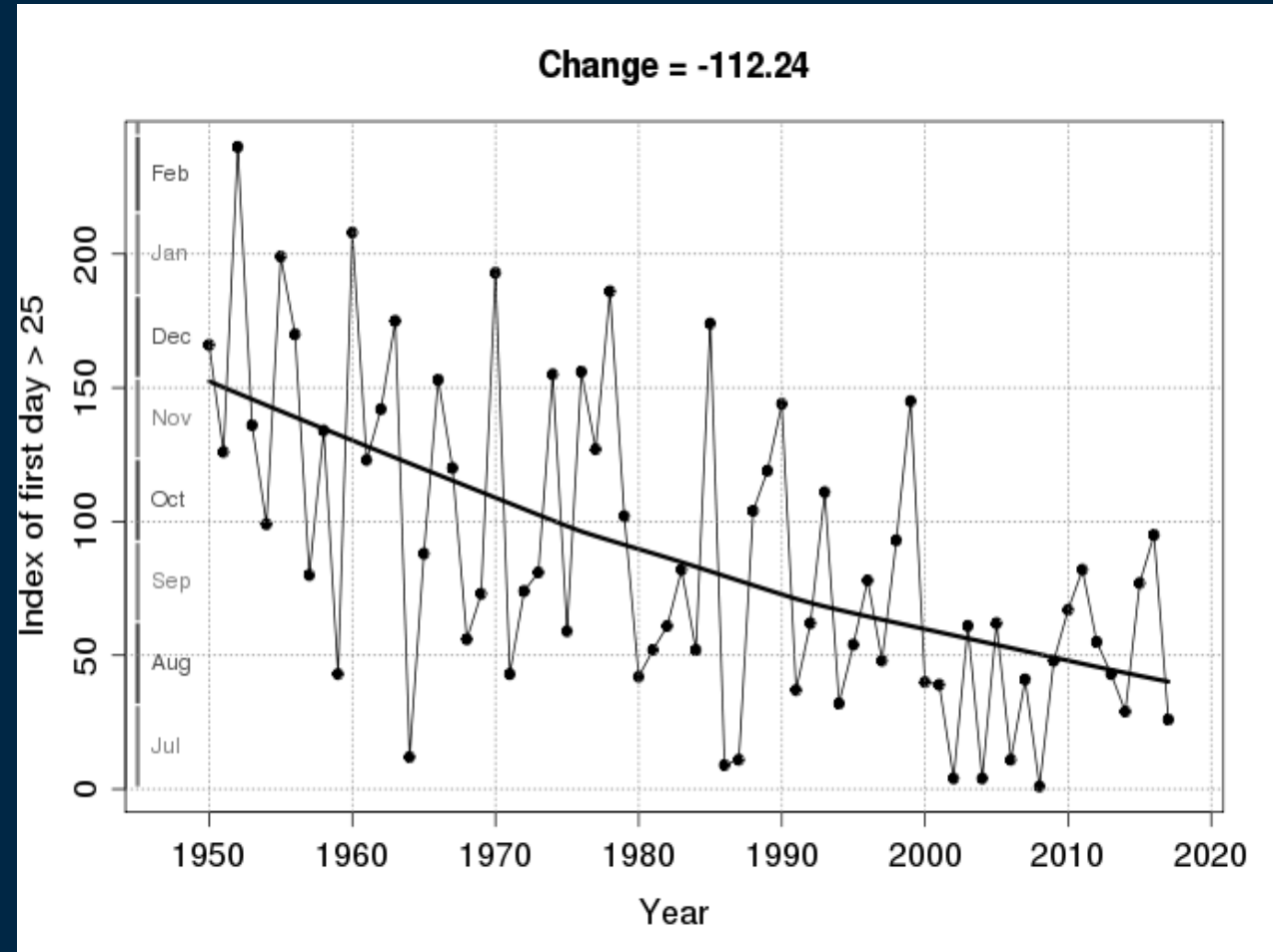


Albany, WA
25 May 2018
(Source: ABC)



Ranch Fire, California
August 2018 (Source: SFGate)

Worsening fire seasons

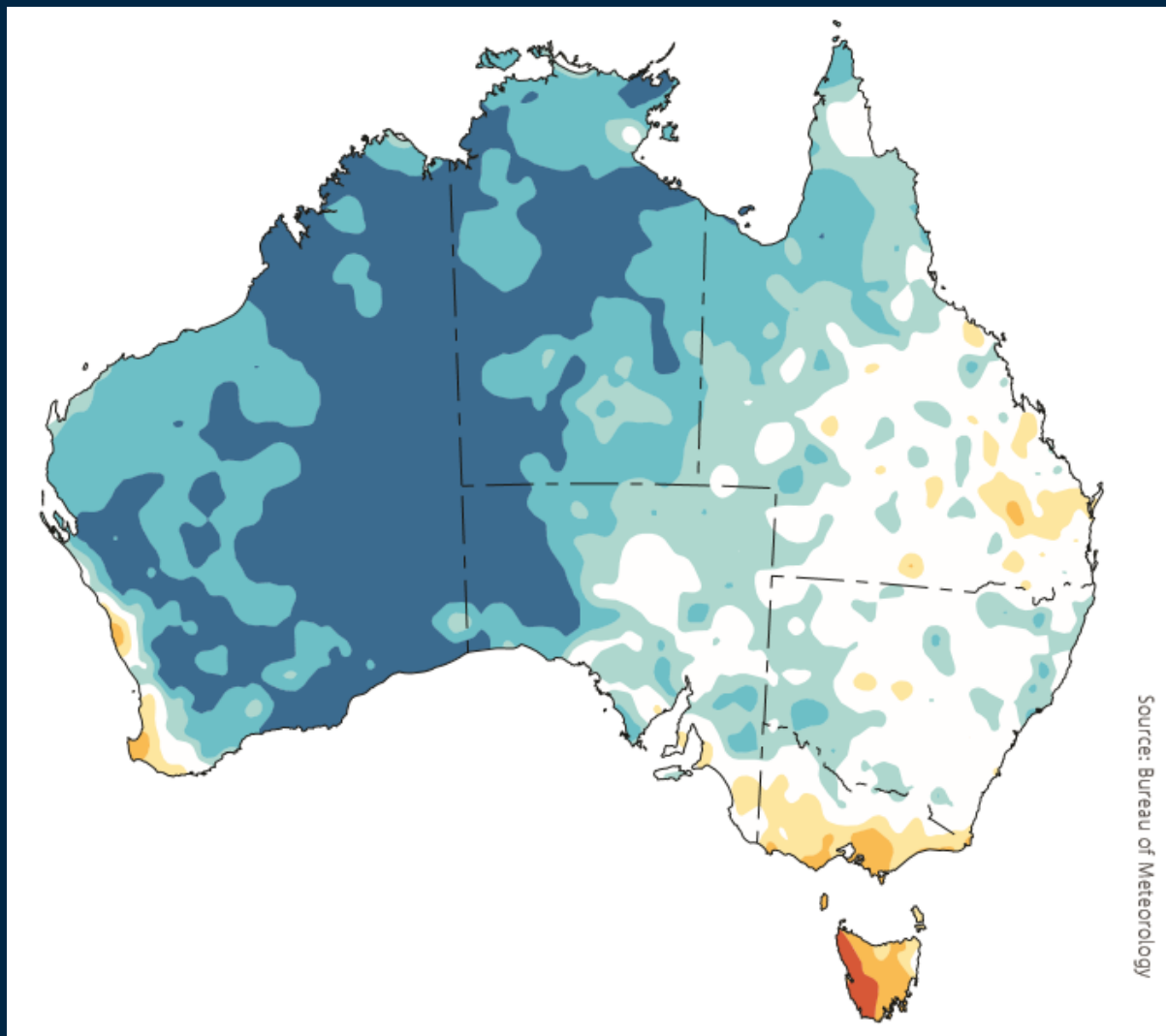


Earliest day with south-coastal NSW daily FFDI > 25



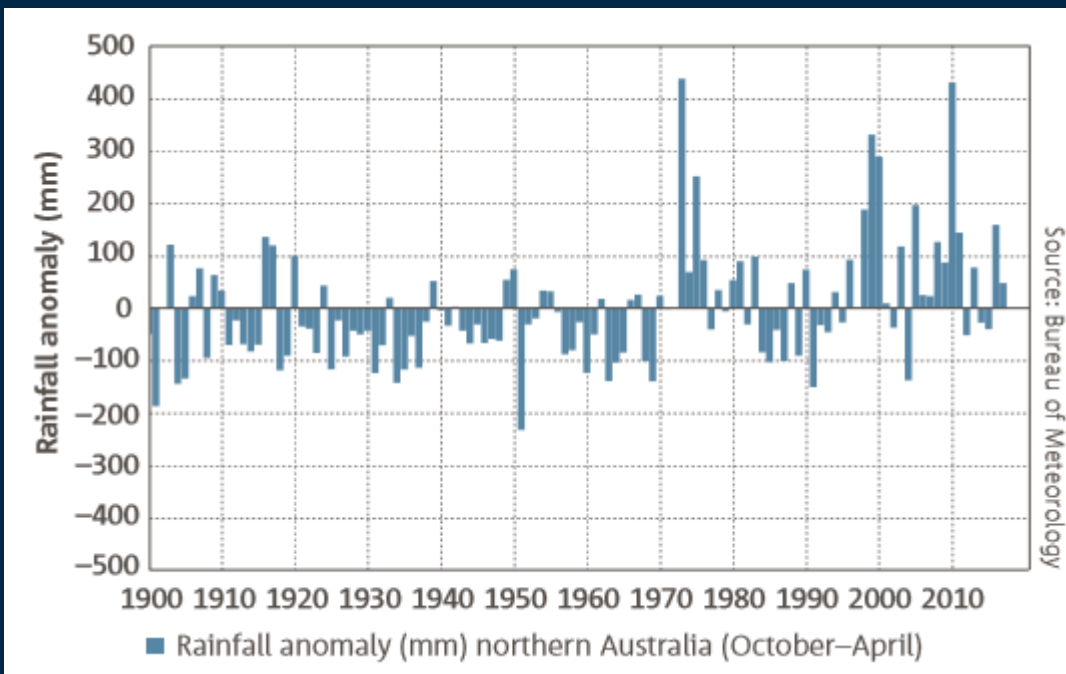
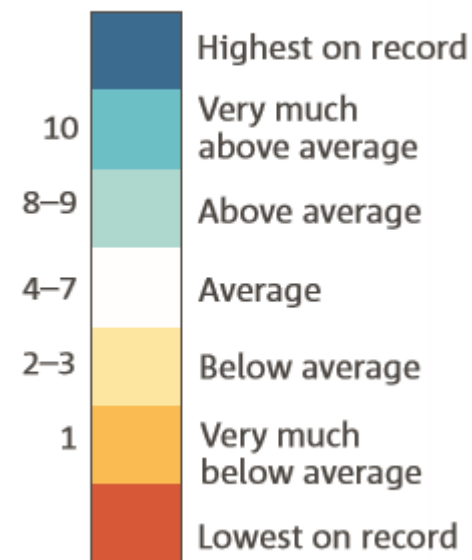
Australian Government
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Increasing Northern Rainfall



Source: Bureau of Meteorology

Rainfall decile ranges

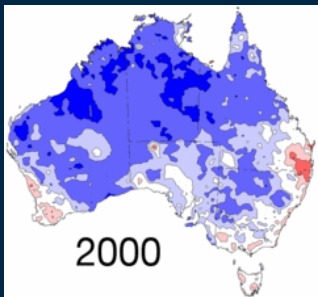


October–April rainfall from 1998–99 to 2017–18.

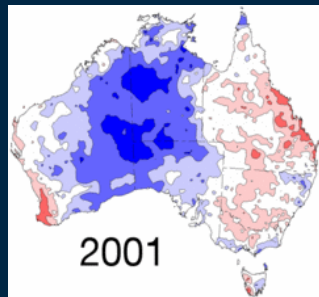


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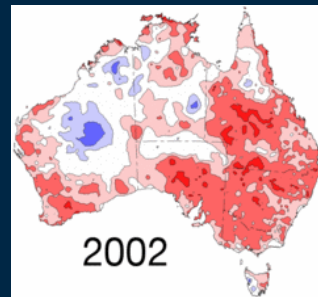
Yearly rainfall this century



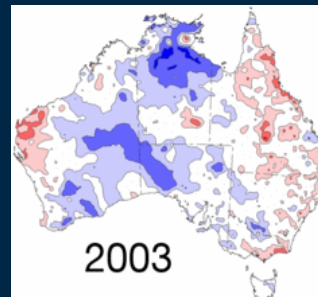
2000



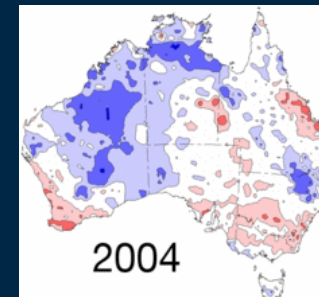
2001



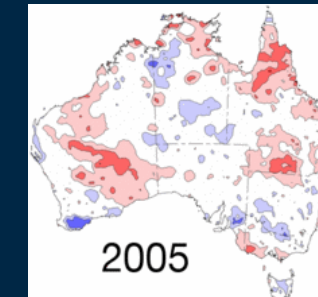
2002



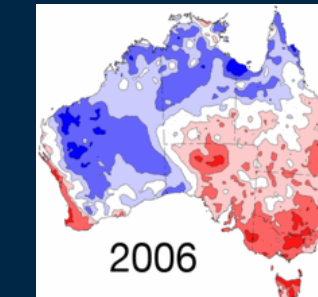
2003



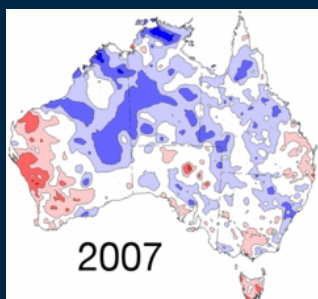
2004



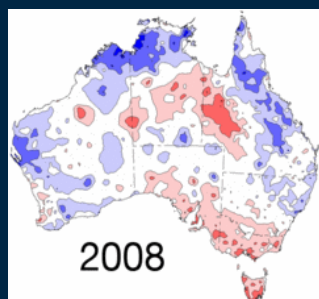
2005



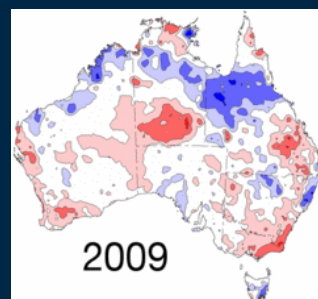
2006



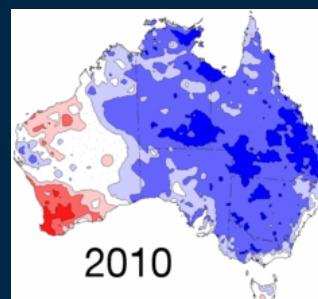
2007



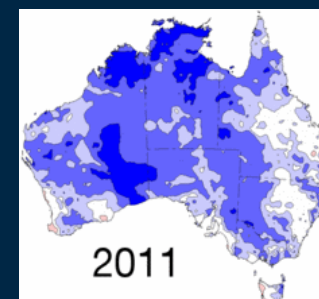
2008



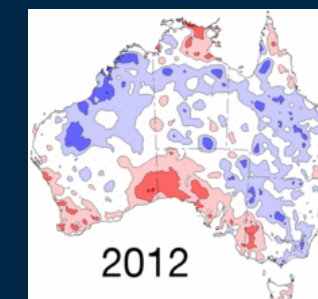
2009



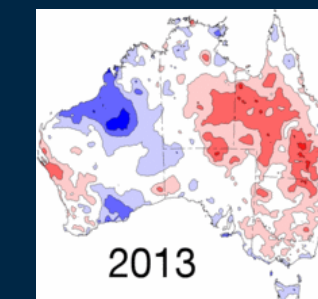
2010



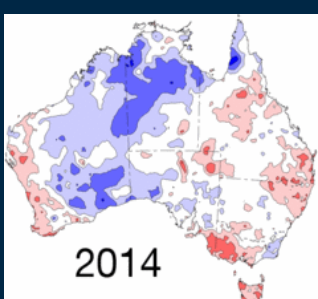
2011



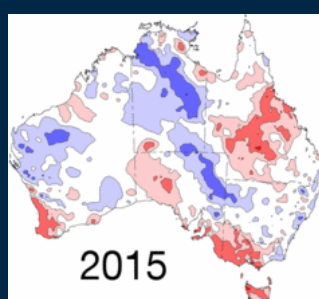
2012



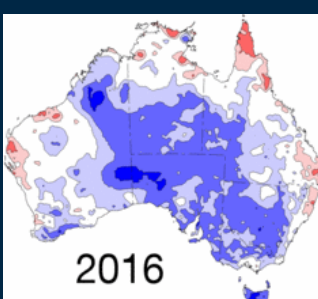
2013



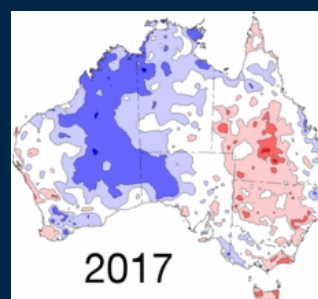
2014



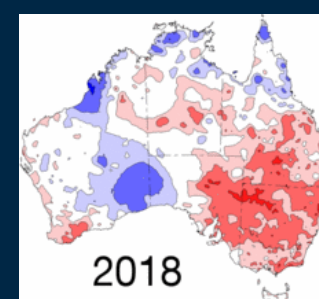
2015



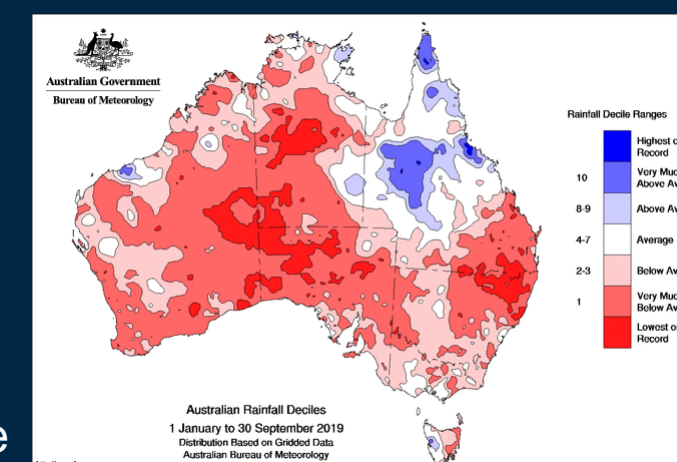
2016



2017



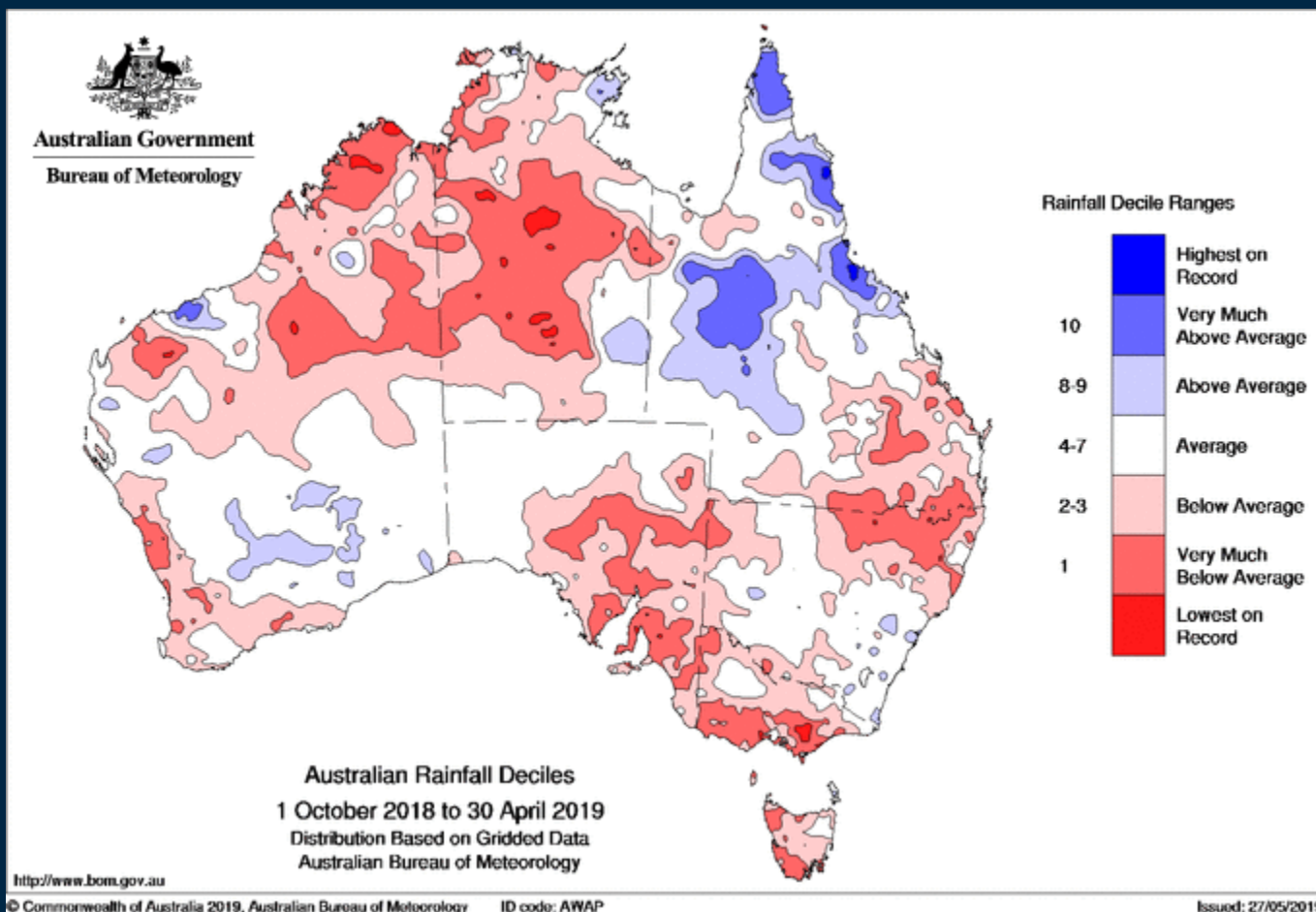
2018



2019 to date



Rainfall variability – poor wet season



- 2018/19 hottest wet season on record
- Driest wet season since 1992
- Rainfall 34% below average Territory wide
- Late monsoon onset at Darwin on 23 January



Rainfall variability – poor wet season



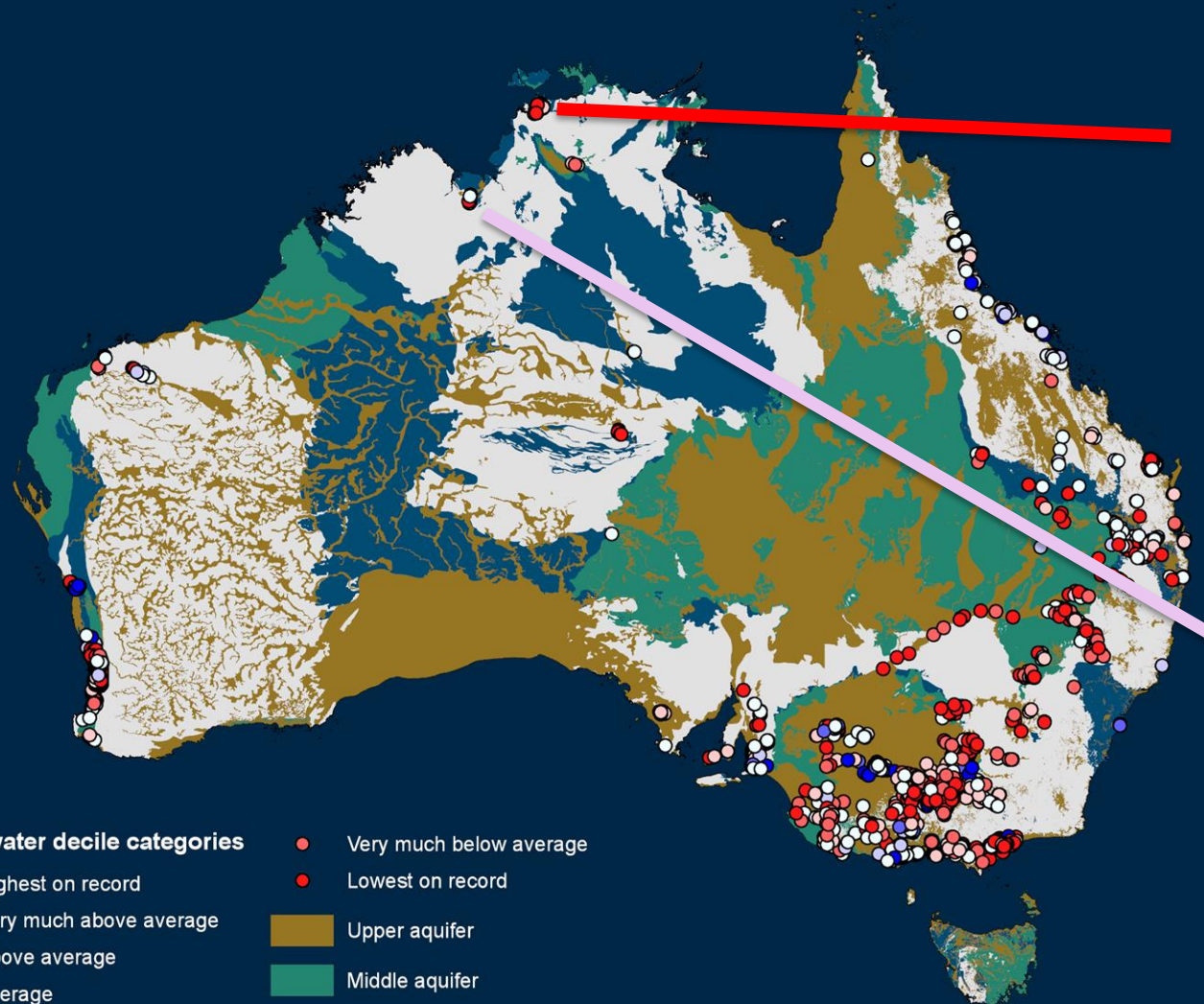
1 Mar 2019 Drought in the Barkly Tablelands NT.

Source: ABC News Carmen Brown

- Many sites with lowest October to April rainfall on record, or lowest in 25 years.
- Elliott 157.6 mm (average 575.0 mm).
- Tennant Creek Airport 79.2 mm (average 437.4 mm).
- Territory Grape Farm 26.0 mm (average 237.4 mm).

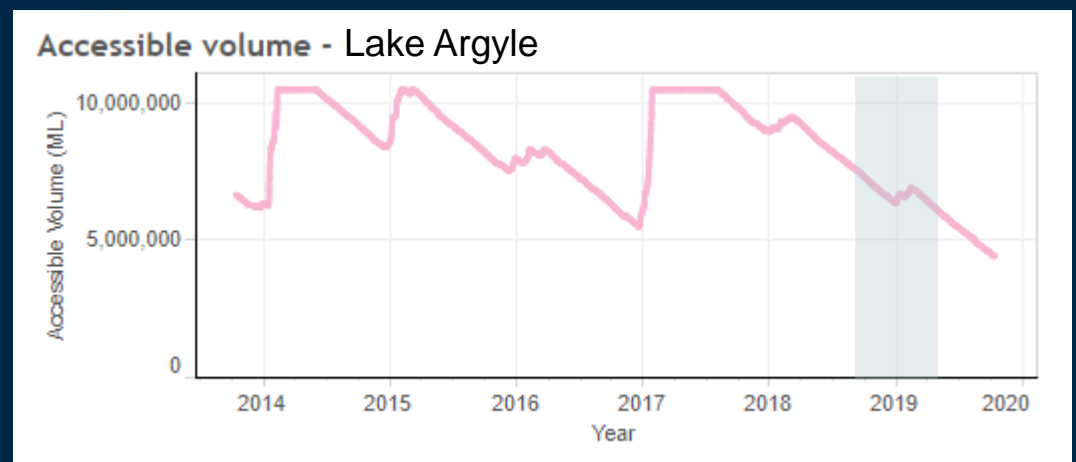
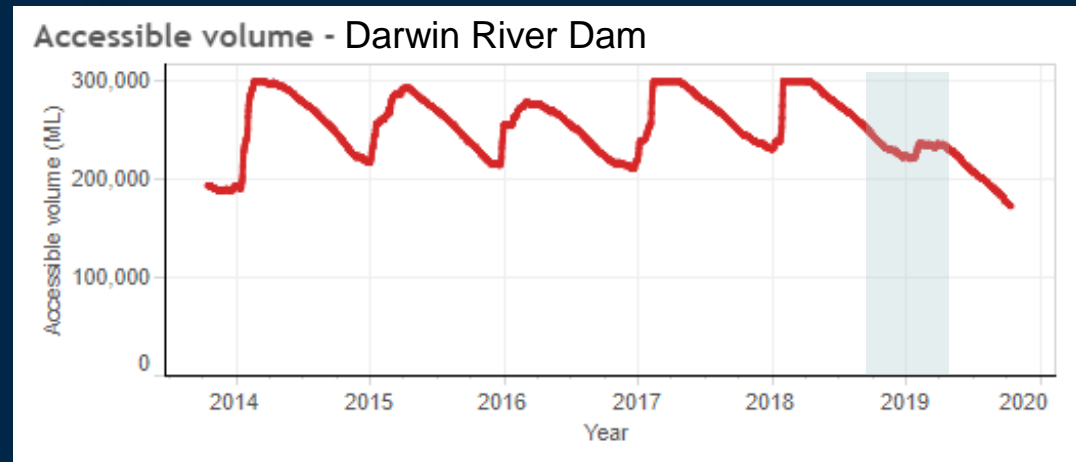


Rainfall variability – poor wet season



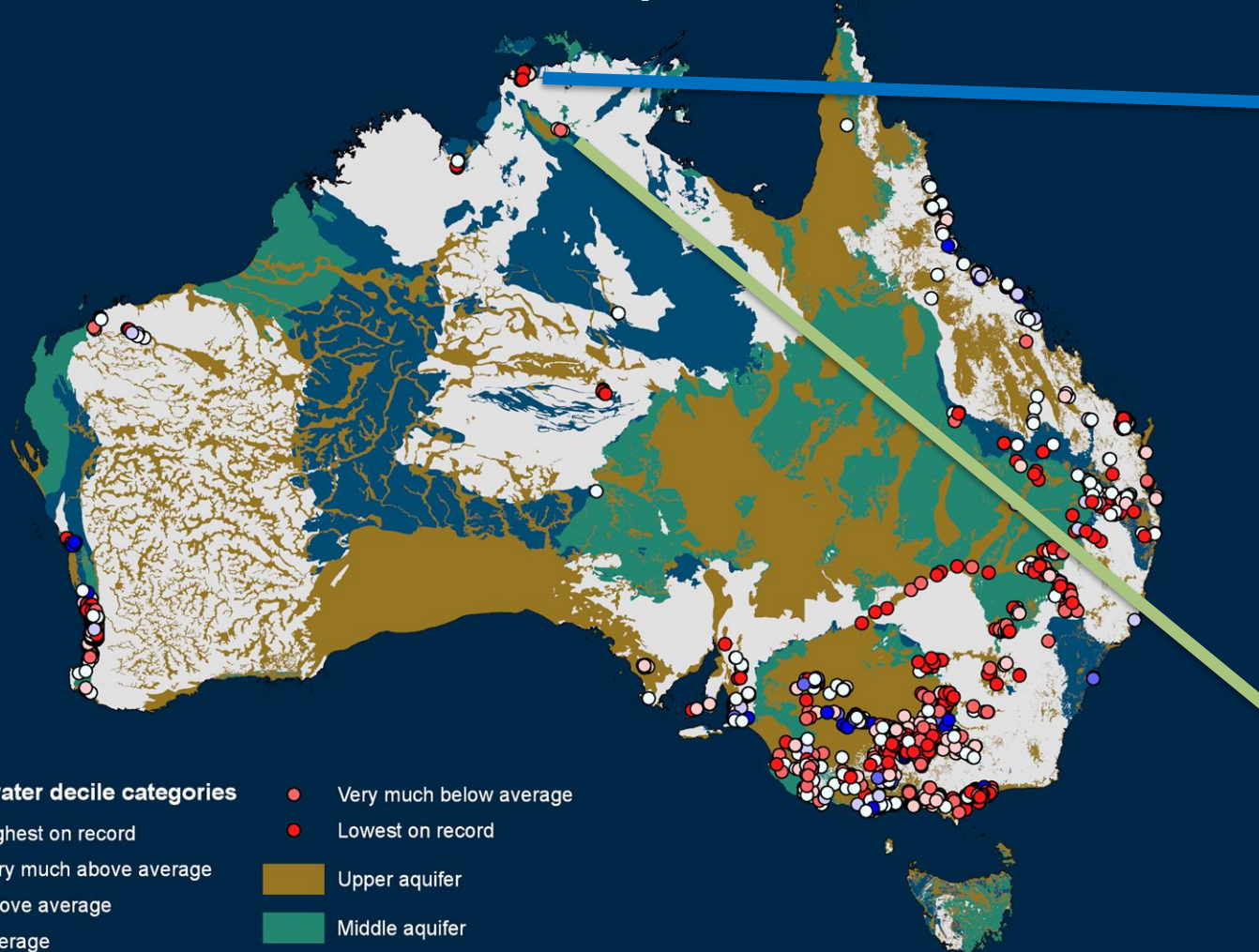
- Groundwater decile categories**
- Highest on record
 - Very much above average
 - Above average
 - Average
 - Below average
 - Very much below average
 - Lowest on record
- Aquifer types**
- Upper aquifer
 - Middle aquifer
 - Lower aquifer

2018-19 FY





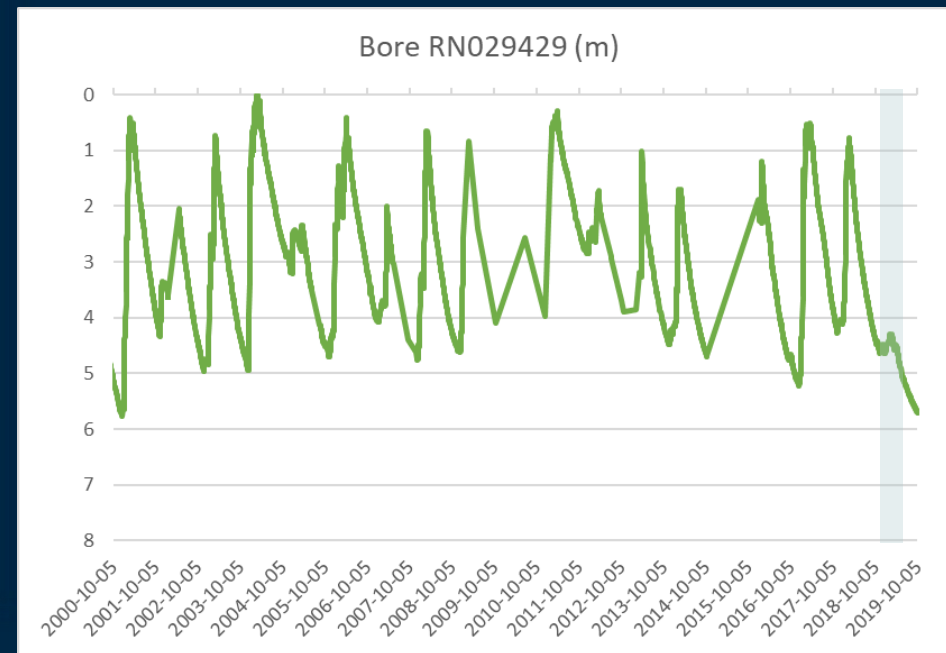
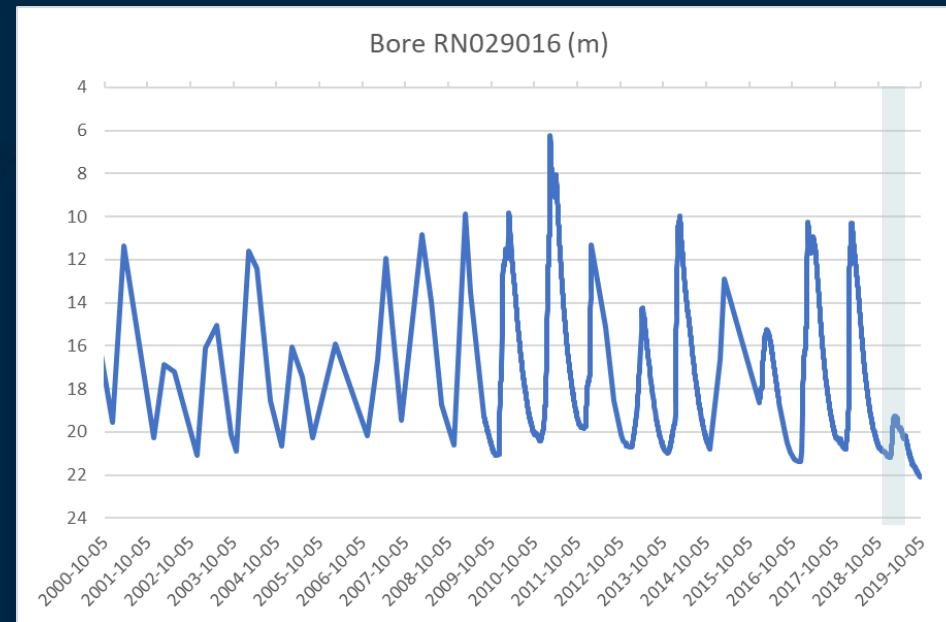
Rainfall variability – poor wet season



Groundwater decile categories

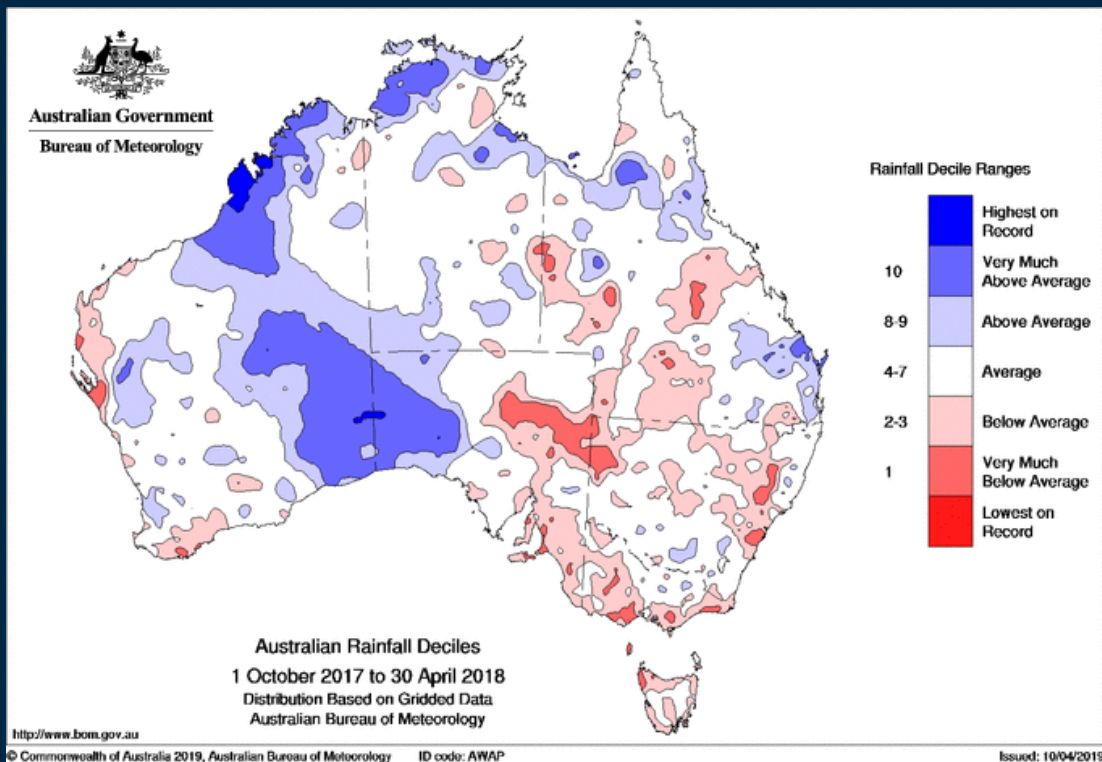
- Highest on record
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2018-19 FY

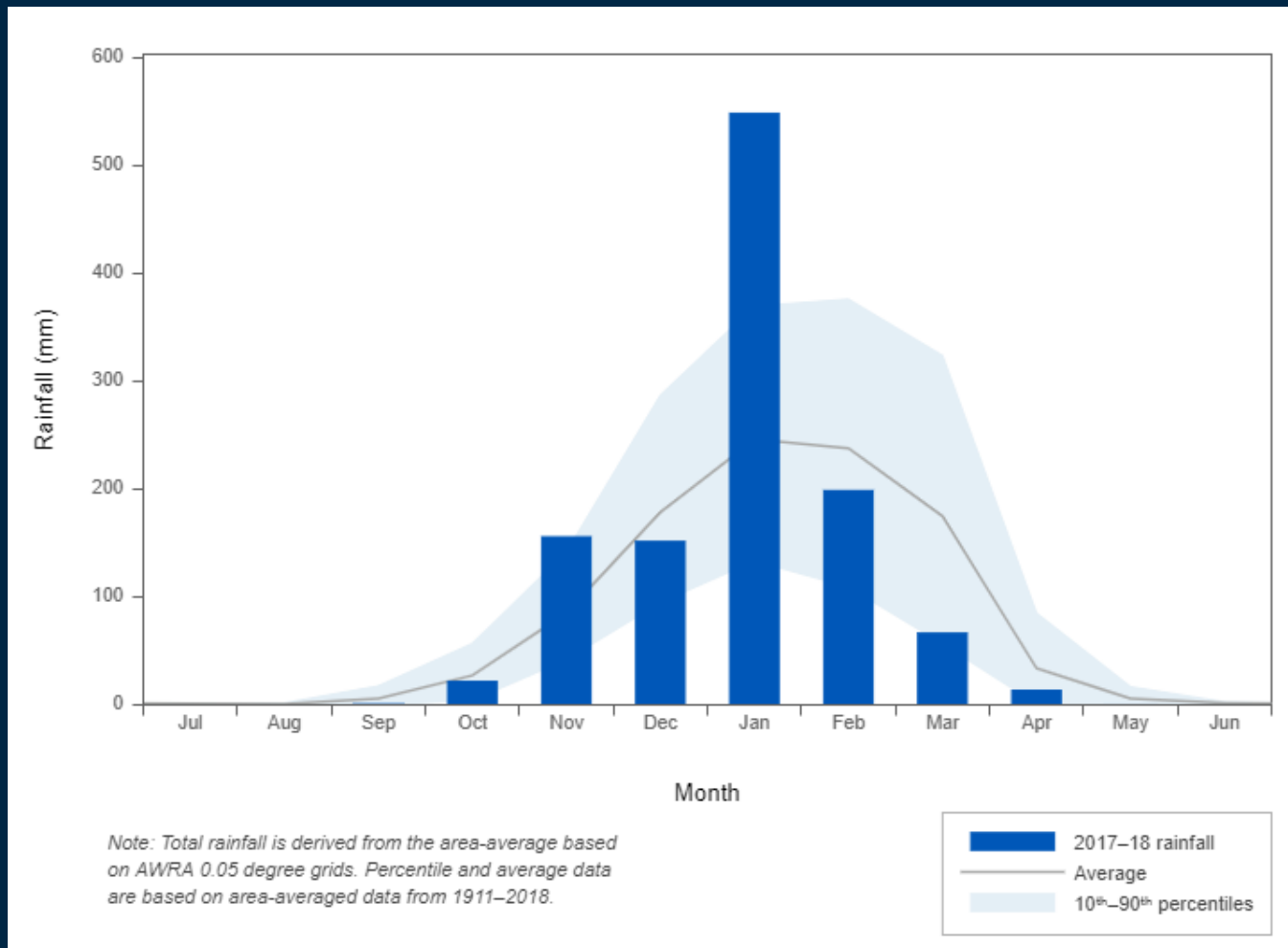




Intense rainfall – 2017/18 wet season



Major flooding in the Daly District, wettest January on record for the Top End.

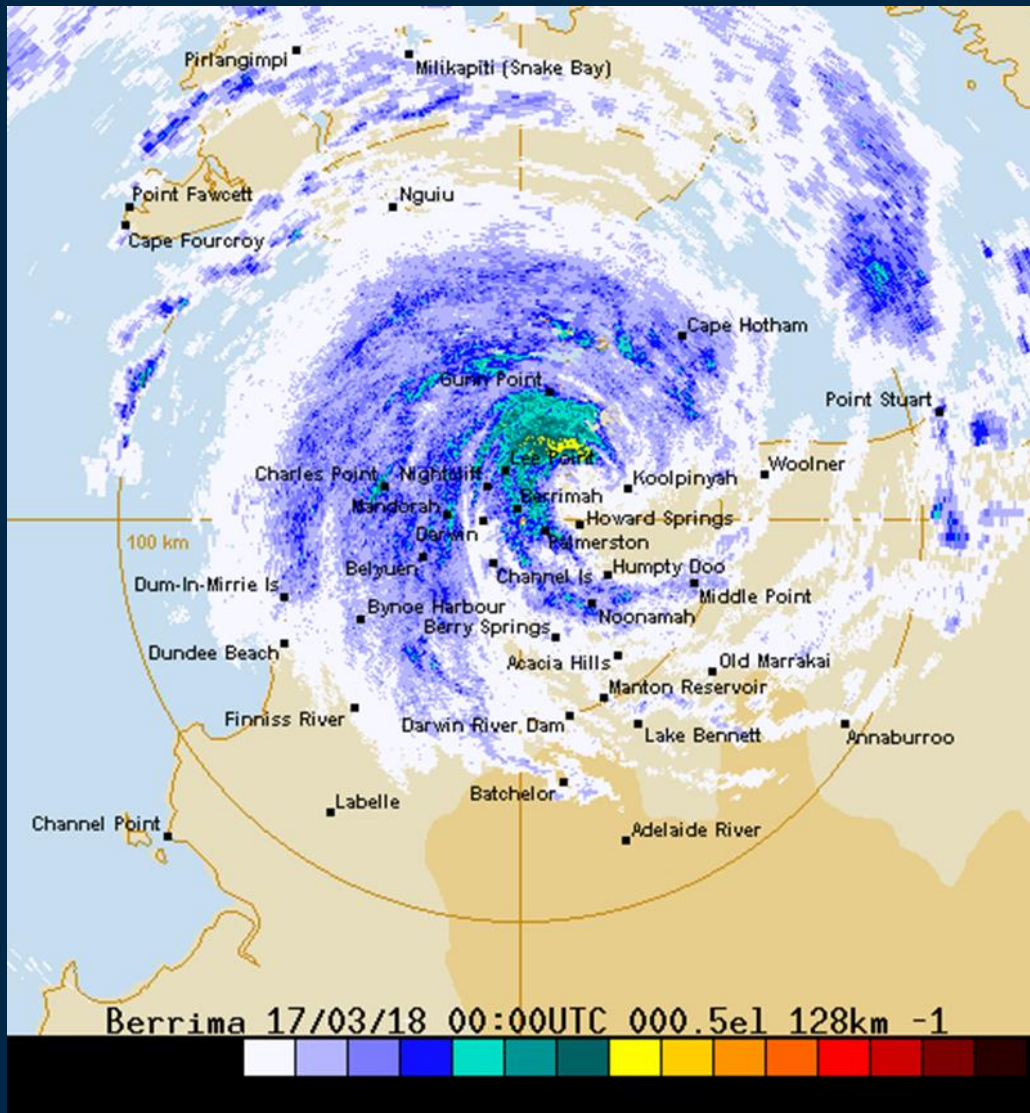


Daly District 2017/18 rainfall by month



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Tropical cyclones



Source:
ABC News



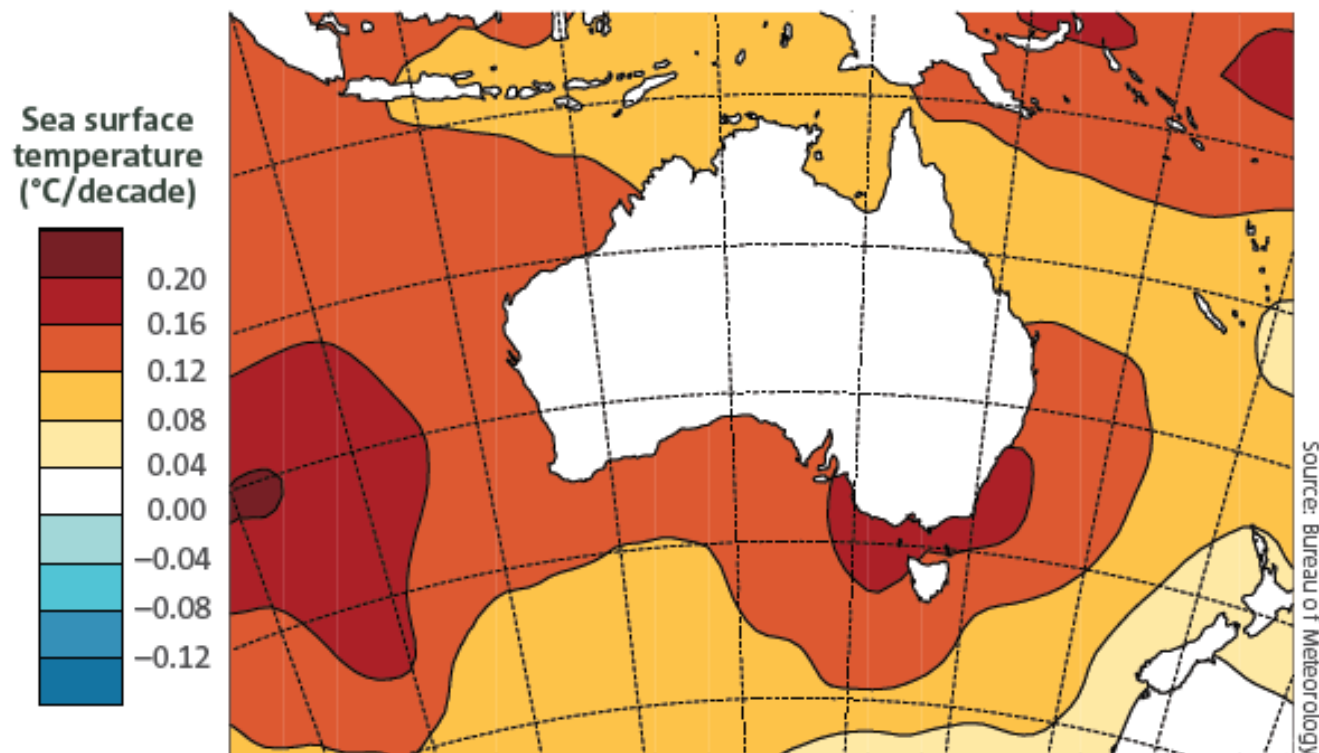


Australian Government

Bureau of Meteorology

Marine heatwaves and acidification

The ocean surface around Australia has warmed, especially to the southeast.

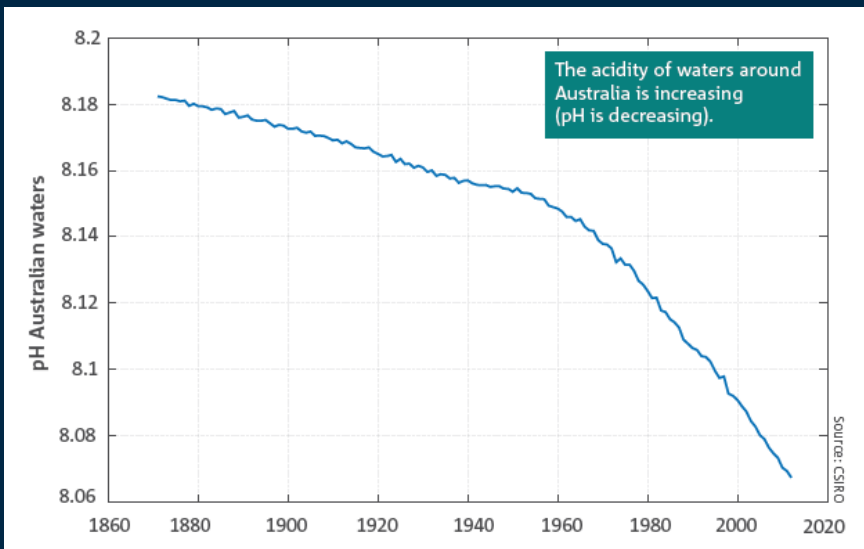


Trends in sea surface temperatures in the Australian region from 1950 to 2017
(data source: ERSST v5, www.esrl.noaa.gov/psd/).

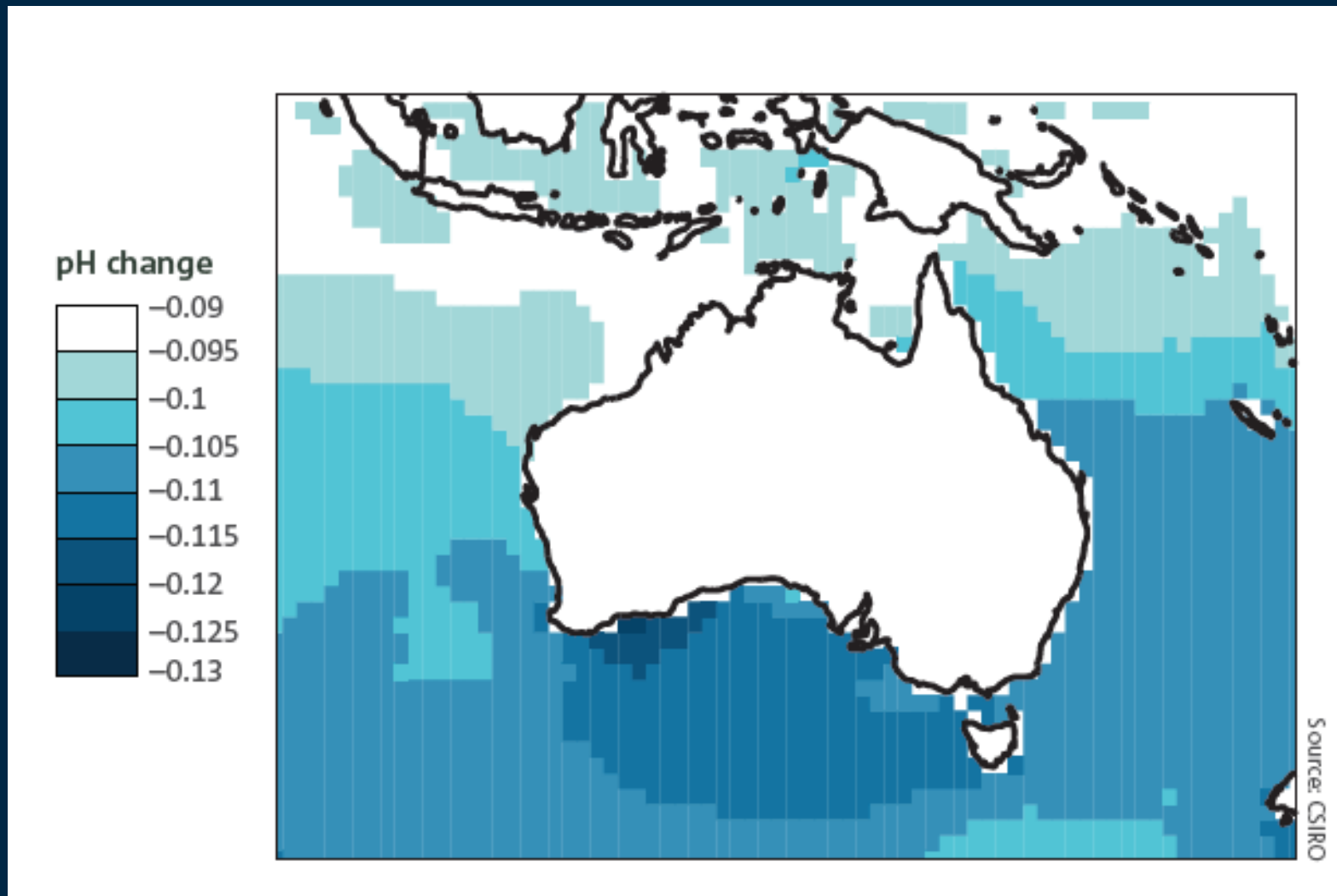
- Oceans around Australia have warmed by around one degree since 1910.
- Contributed to longer and more frequent marine heat waves.



Marine heatwaves and acidification



Ocean absorbing more carbon dioxide, becoming less alkaline, affecting sea life.





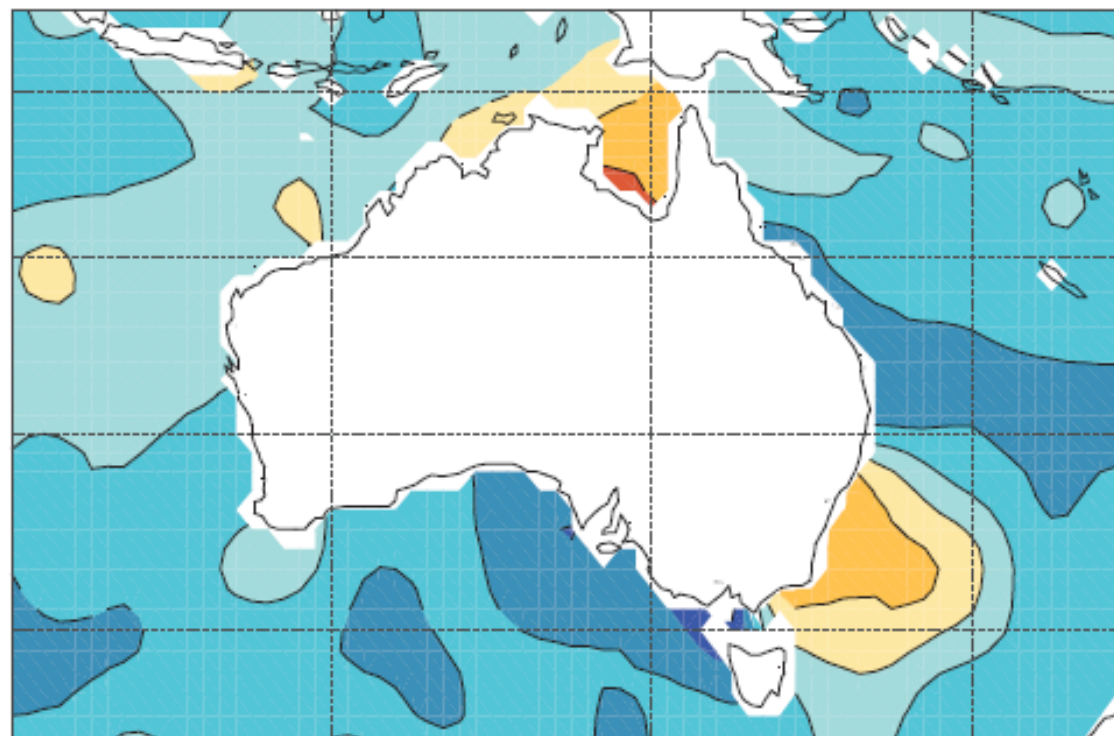
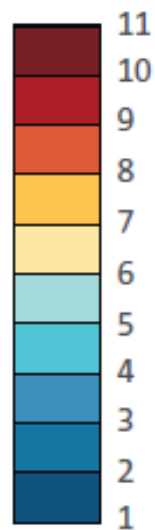
Sea level rise

Global sea level has risen by over 20 cm since 1880.

Since 1993 sea level has been rising at 3.2 cm per decade.

Sea levels have risen around Australia.

Sea level rise
(cm/decade)

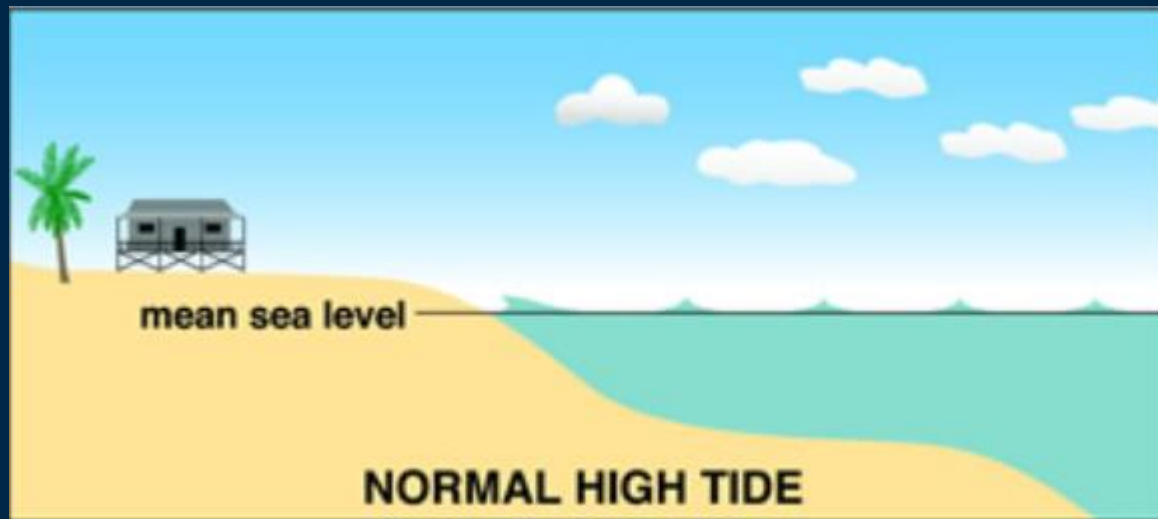


Source: CSIRO

The rate of sea level rise around Australia by satellite observations from 1993 to 2017.
Source: CSIRO, update from White et al. (2014).



Sea level rise – increased risk of storm surge



Storm Surge + Normal (astronomical) Tide = Storm Tide



Changes in climate requiring adaptation



Increased frequency of large-scale heatwaves and record-high temperatures



Longer fire season with more extreme fire danger days



Decreased frequency of tropical cyclones but high variability



Prolonged high ocean temperatures, increasing acidity



Reduced average rainfall and more time spent in drought in southern Australia



An increase in heavy rainfall events, wet season variability



Increased frequency of coastal storm surge inundation

occurring now



emerging threat

Summary

- Impacts of a changing climate being experienced now.
- Expected to have a range of impacts, including an increase in the frequency and severity of extreme weather.

