Forecasting of extreme weather events from sub-seasonal to decadal timescales

Dr Paul Gregory
Bureau of Meteorology (BoM)

With
Dr David Jones, Dr Karl Braganza
Climate Services (BoM)
Dr Debbie Hudson, Dr Andrew Dowdy
Science and Innovation (BoM)

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25 Aug 2018 Sheep on a drought affected farm near the NSW town of Bigga. Source ABC News Franklin Hood

Overview

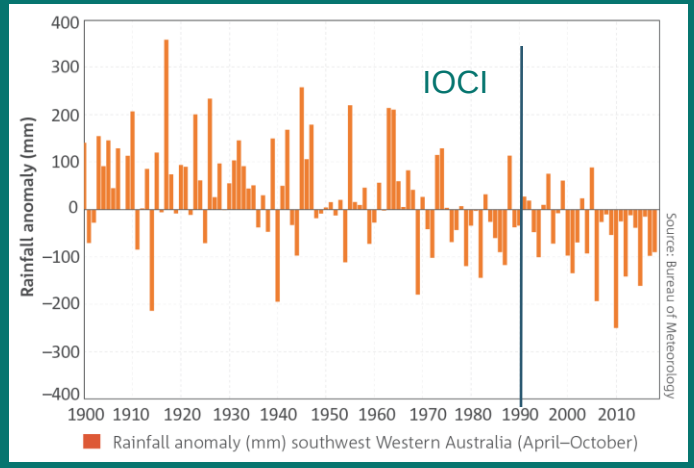
Setting the scene – current trends and emerging climate impacts in Australia

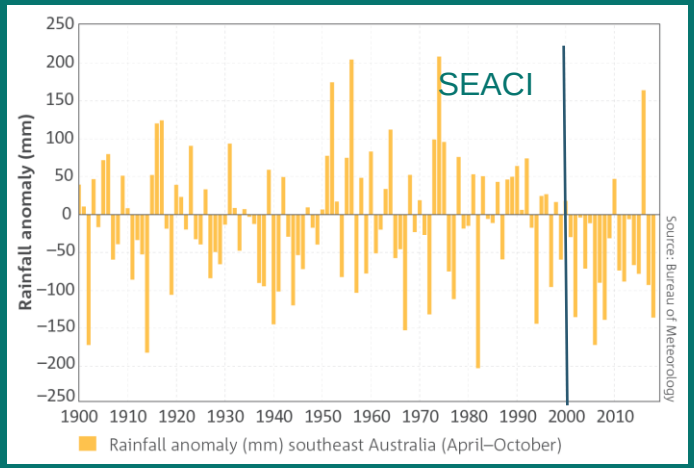
Existing seasonal climate products and services

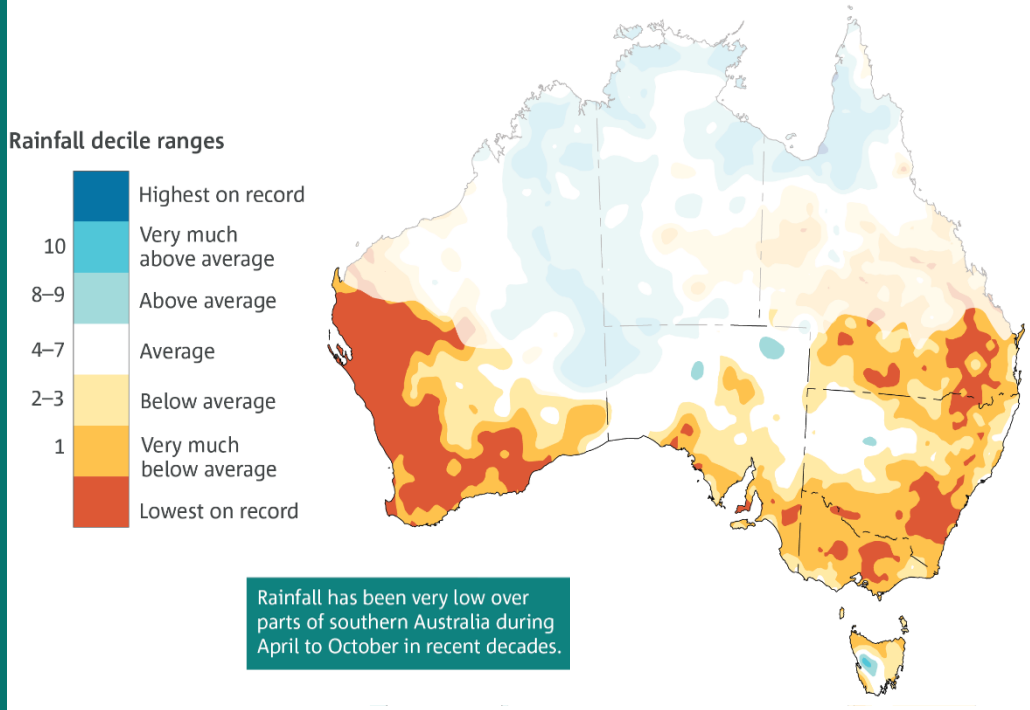
New products forecasting seasonal and sub-seasonal climate extremes

Planned products for forecasts of extremes at decadal timescales

Drying over southern Australia







Rainfall has been very low over parts of southern Australia during April to October in recent decades.

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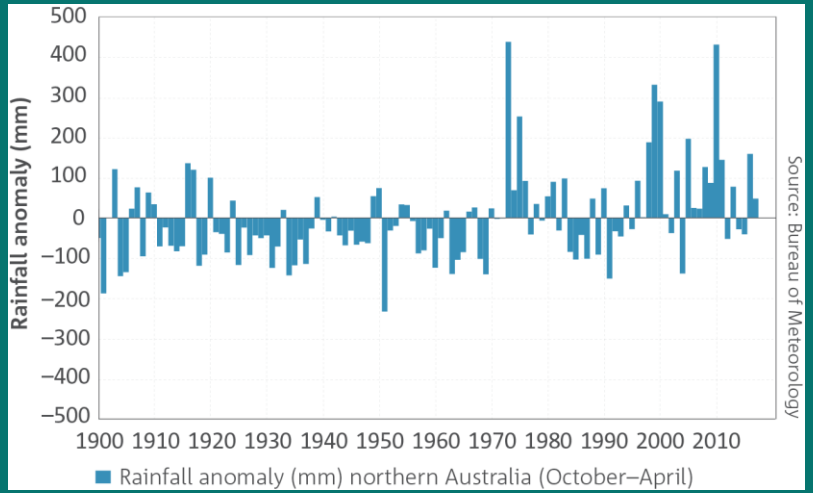
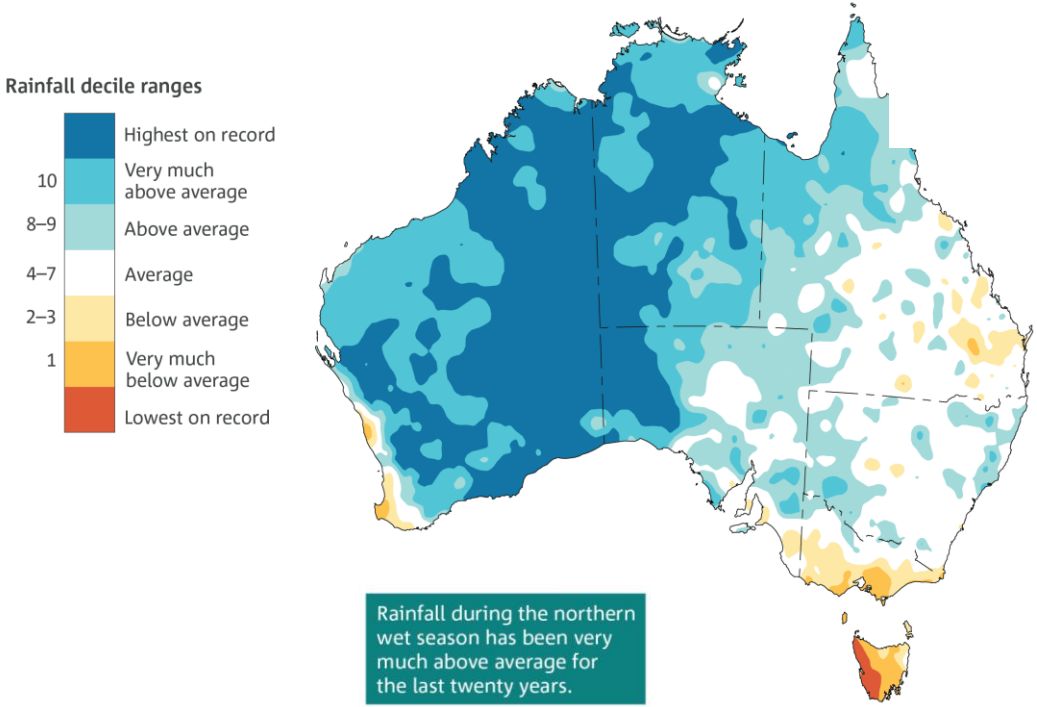
Bureau of Meteorology

Heavier rainfall over northern Australia





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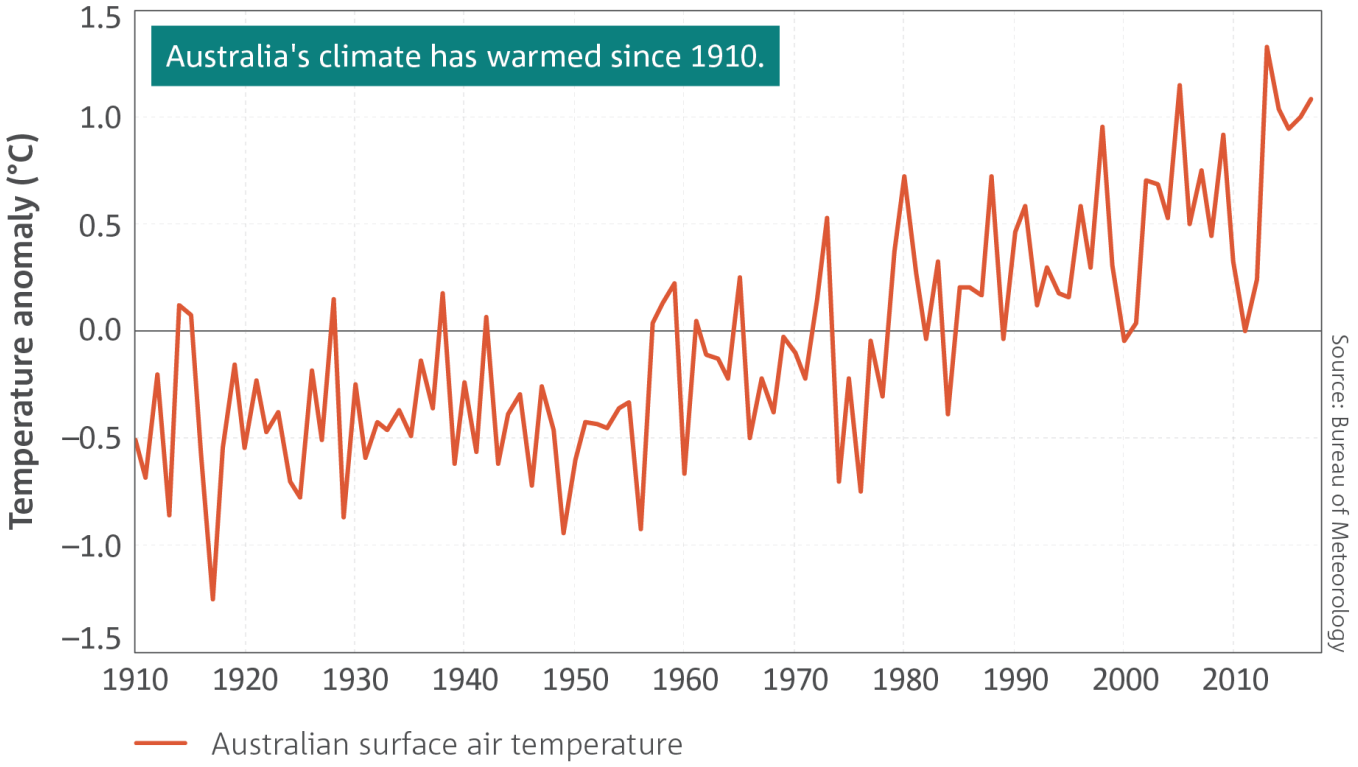
Australia's changing climate

Increasing Extreme heat



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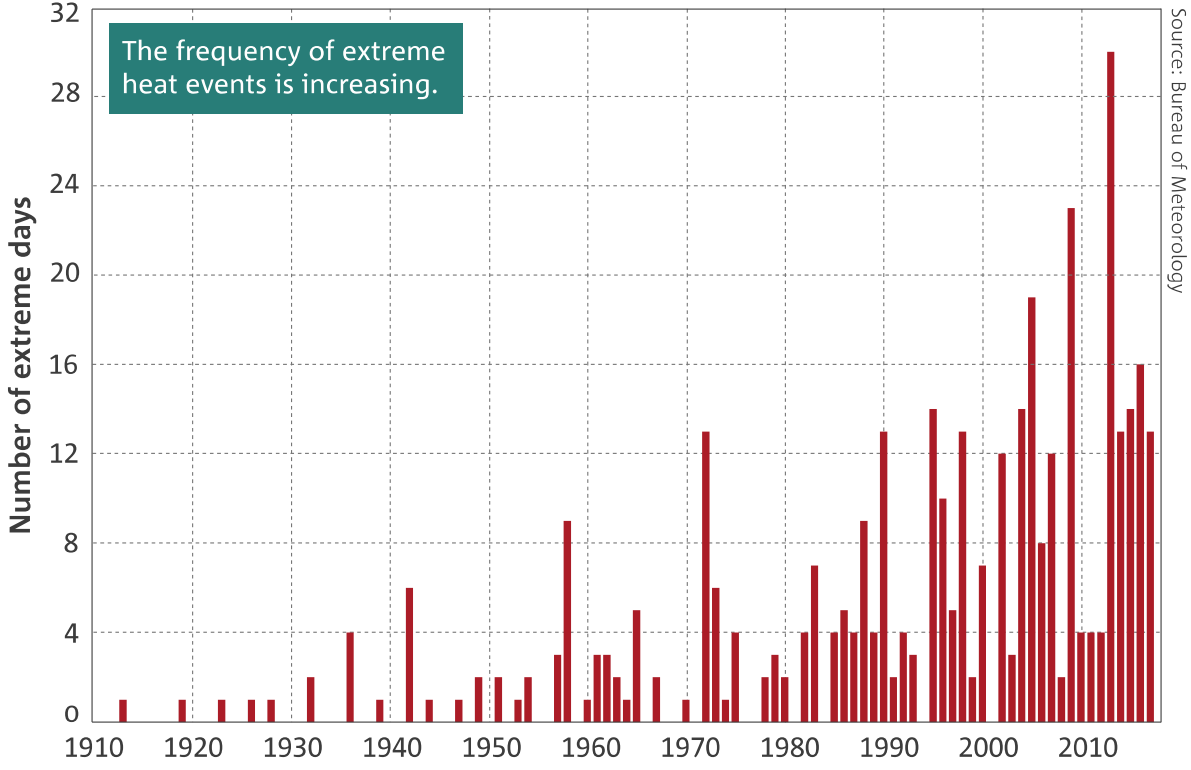

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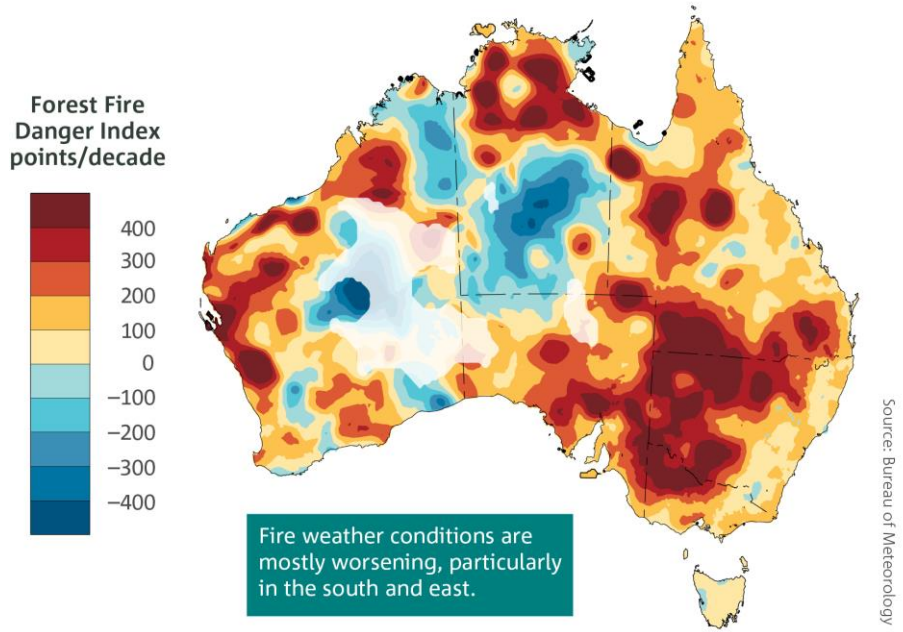
Worsening fire seasons

Escaped control burn, October 2015, Lancefield, Victoria.



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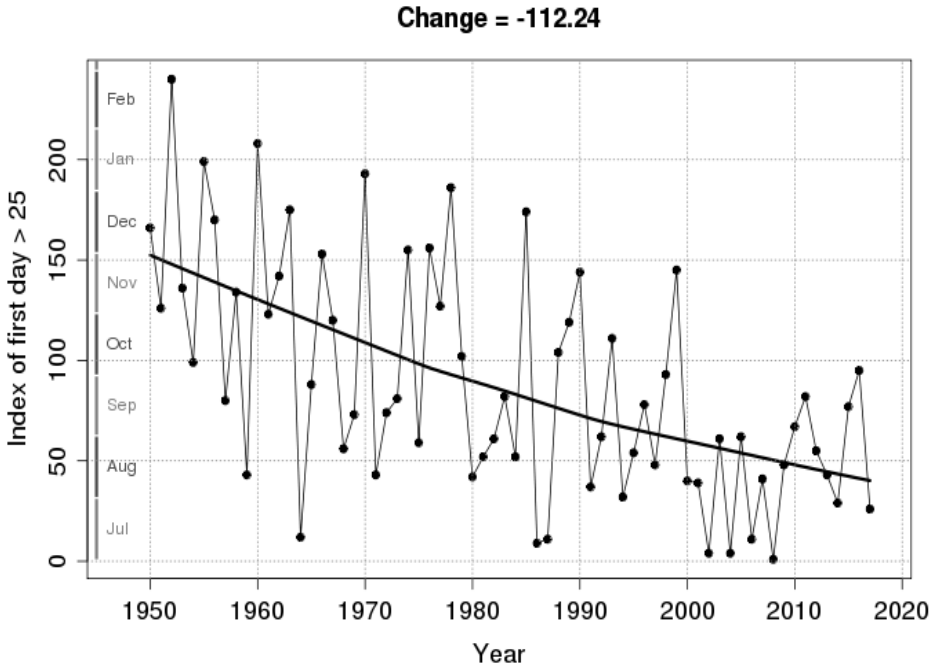
Bega Valley, NSW
15 August 2018
(Source: ABC)

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

Oceans

Collaroy Beach, 2016

Altona Beach, 2014

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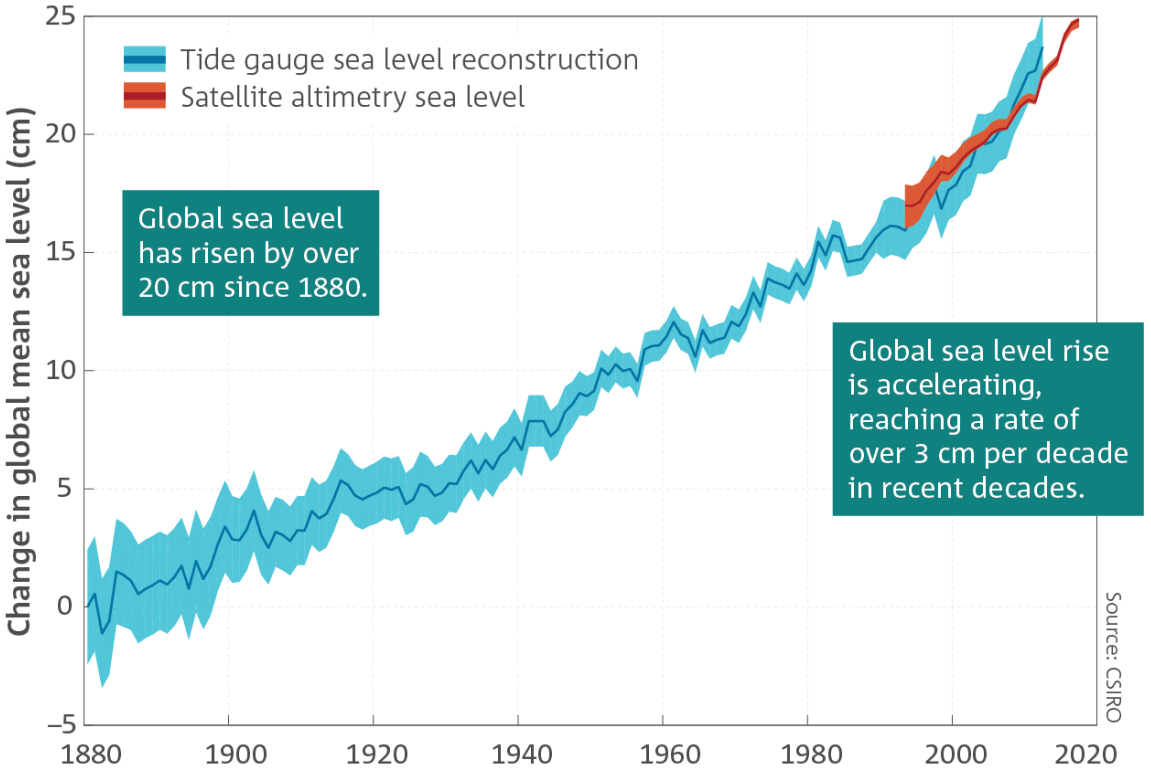
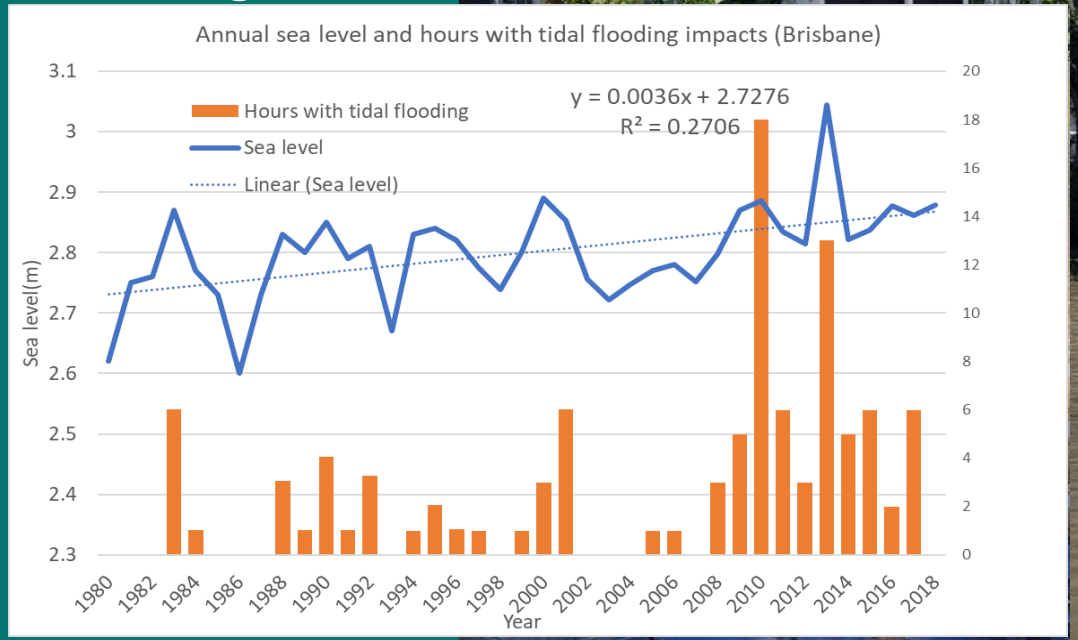
Sea level



Evidence of increasing coastal flooding



Number of hours per year when tidal flooding effects are likely in Brisbane

Brisbane Street flooding (Clark 2018)

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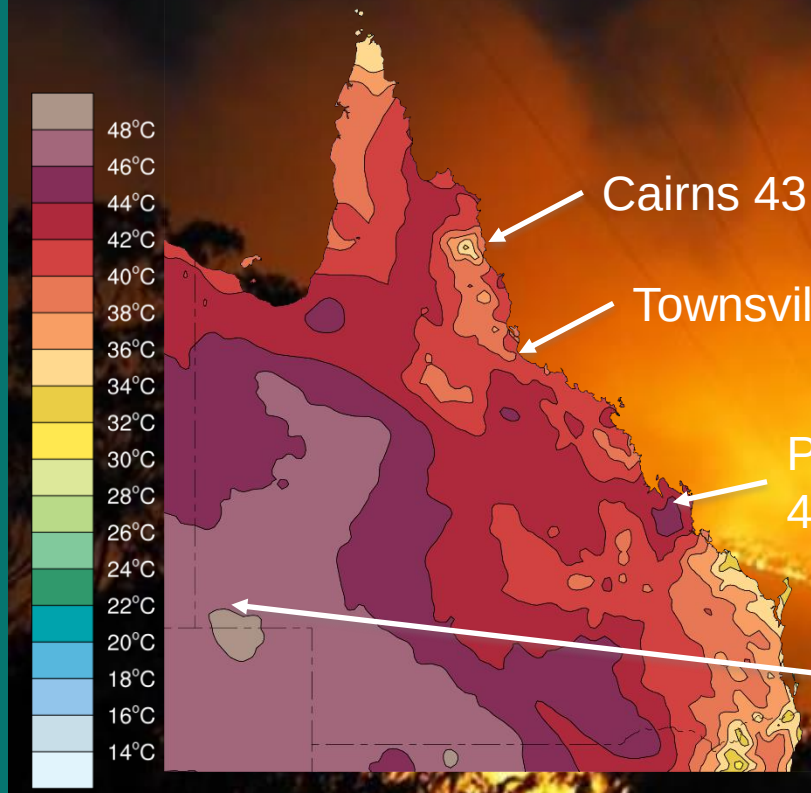
Bureau of Meteorology

Record-breaking heat and fire weather: the new normal?

Highest temperature observed in November-December 2018



Cairns 43.6C

Townsville 41.7C

Proserpine 44.9C

Birdsville 10 days above 45C

Bushfire at Agnes Water on Monday 26 Nov. Source ABC Supplied: Benjamin Potts

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Record-breaking heat and fire weather: the new normal?

Bushfire plumes from Himawari 8 Japanese weather satellite; 7:30am on 29 November 2018

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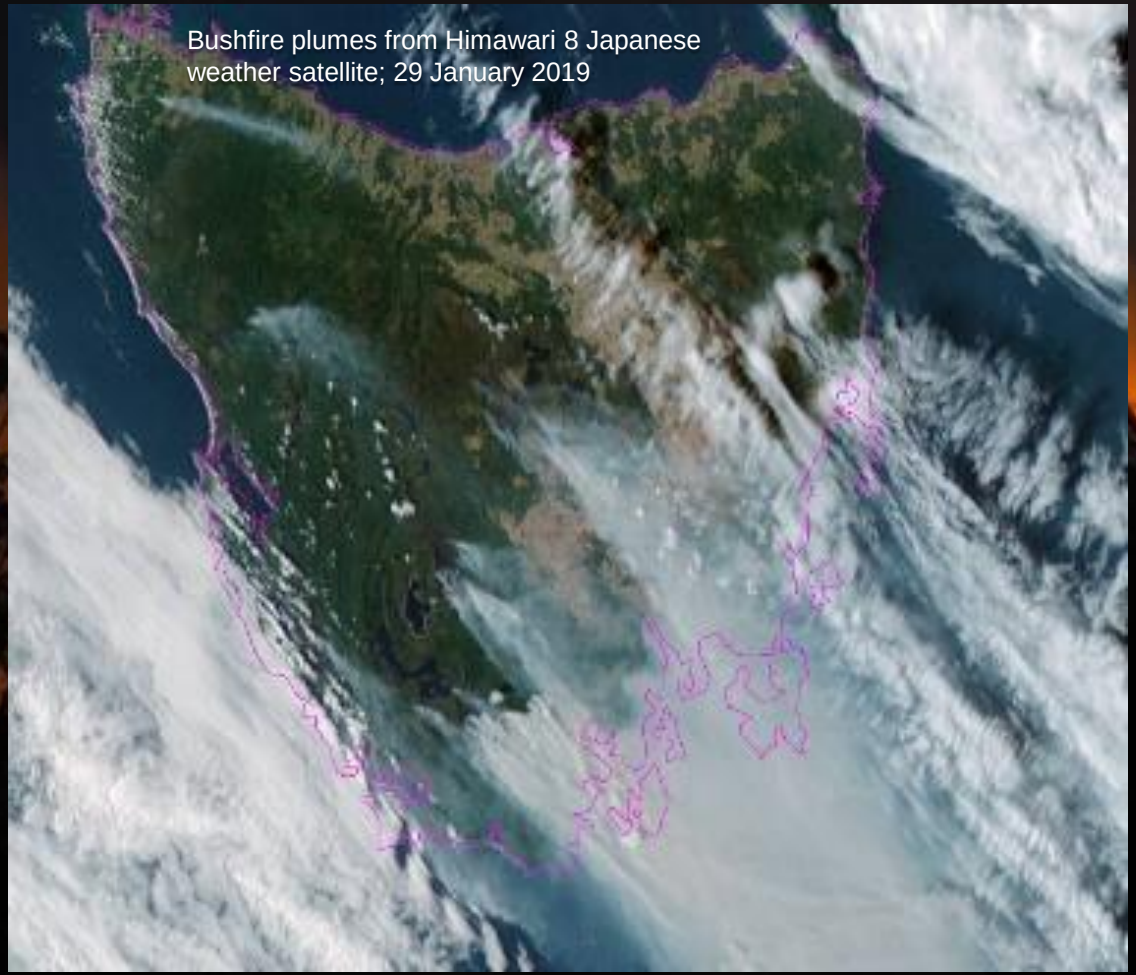
Record-breaking heat and fire weather: the new normal?



Bushfire plumes from Himawari 8 Japanese weather satellite; 29 January 2019

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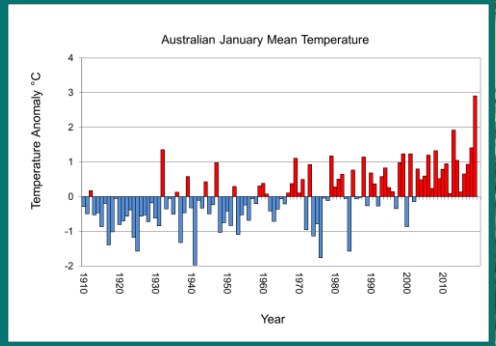
January 2019: Australia's hottest month on record



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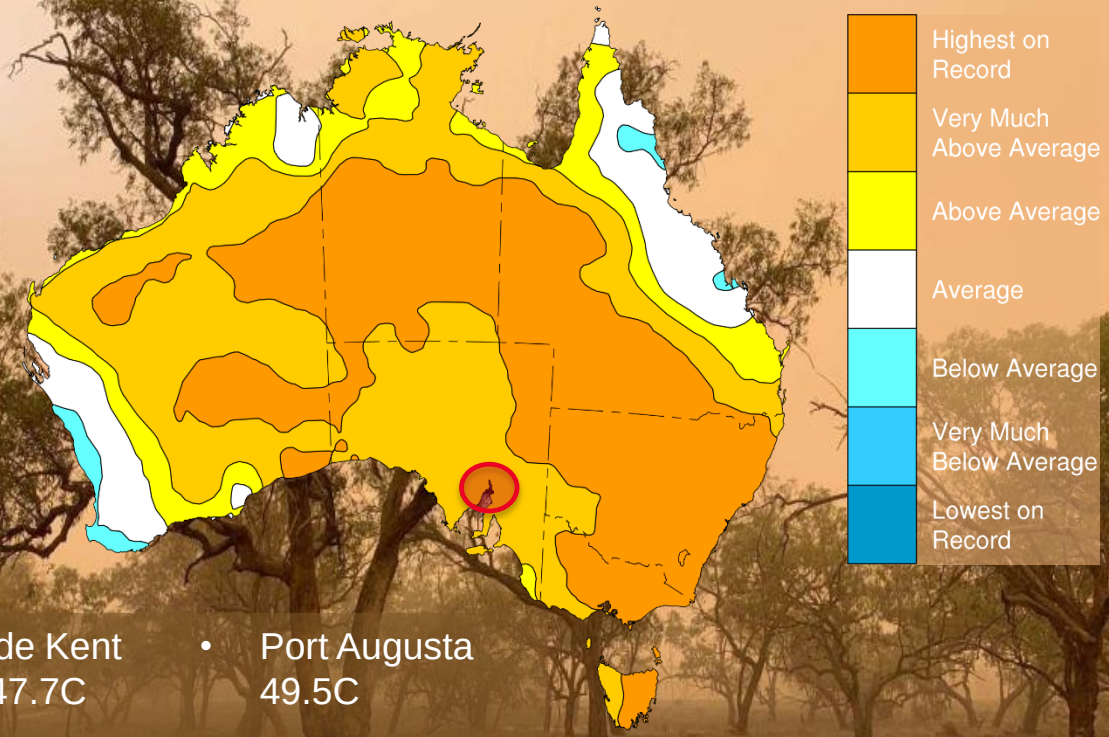
Averaged across the country, 8 of the 10 warmest days on record occurred during January 2019



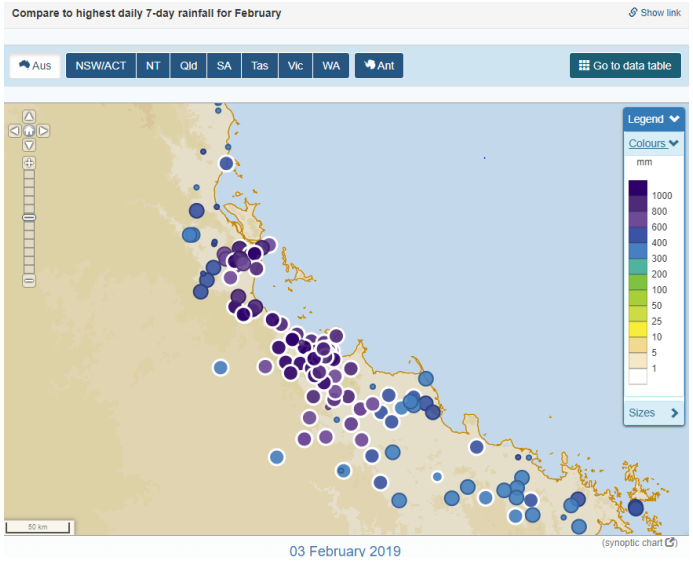
- Adelaide Kent Town 47.7C
- Port Augusta 49.5C
- Hobart six days above 30C
- Borrona Downs 36.6C (minimum)

ABC News, NSW Dust Storm

Record flooding in coastal Queensland

Monsoon low over Queensland, 4 February 2019

Record high multi-day rainfall widespread



03 February 2019

Flooding in Townsville and Mt Isa

ABC News

http://www.bom.gov.au/climate/ahead

- **Monthly and seasonal outlooks**

  Probability of above/below median rainfall/Tmax/Tmin and POE for rainfall

- **Northern rainfall onset**
- **Sea surface temperature forecasts**
- **Forecasts of ENSO & IOD**
- **Seasonal streamflow forecasts**
- **Seasonal Tropical cyclone outlook**

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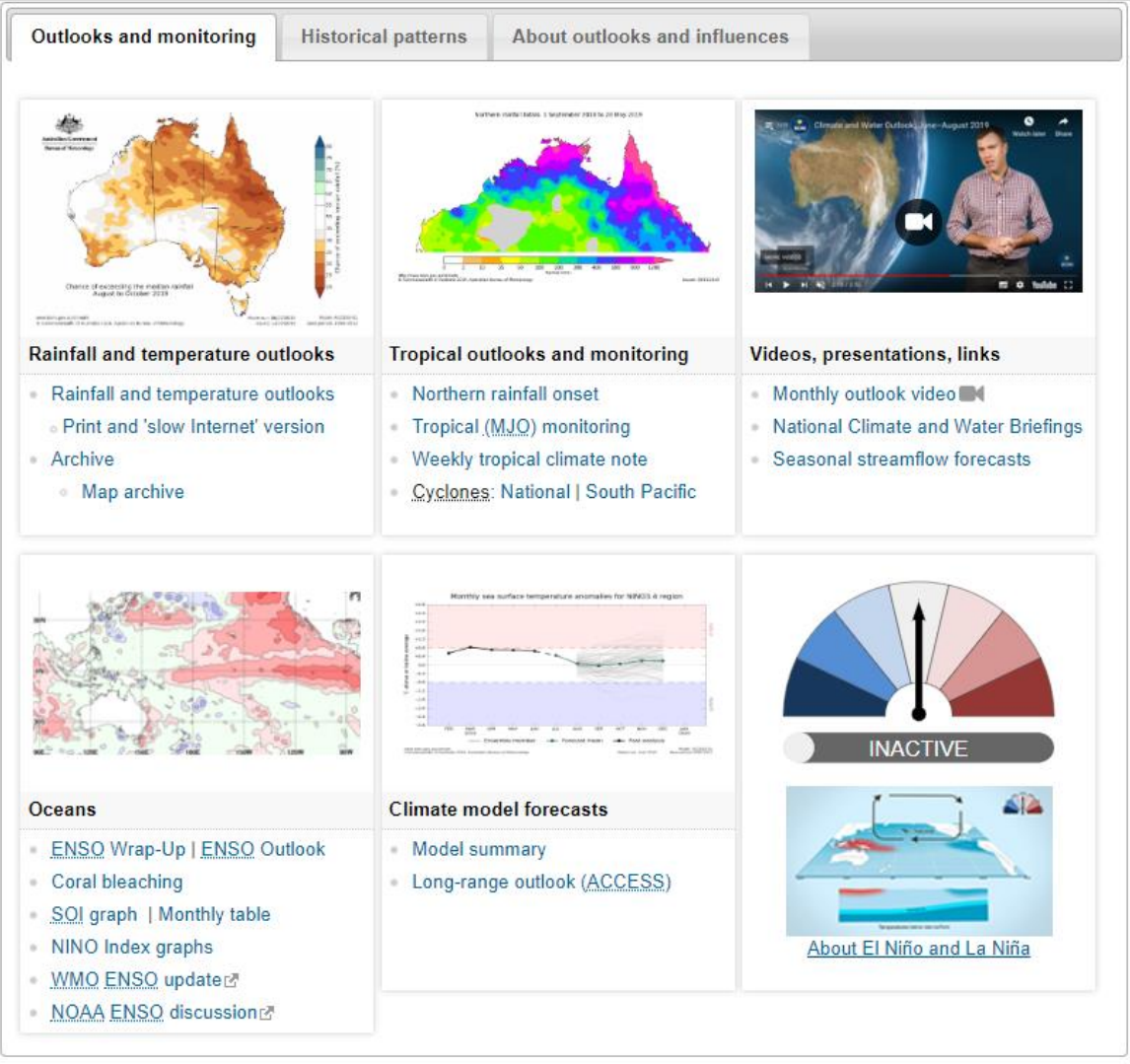

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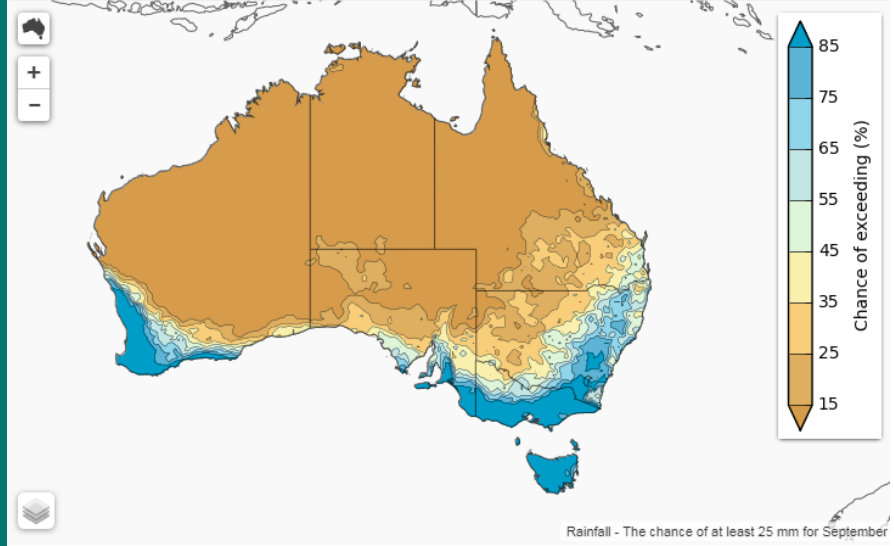

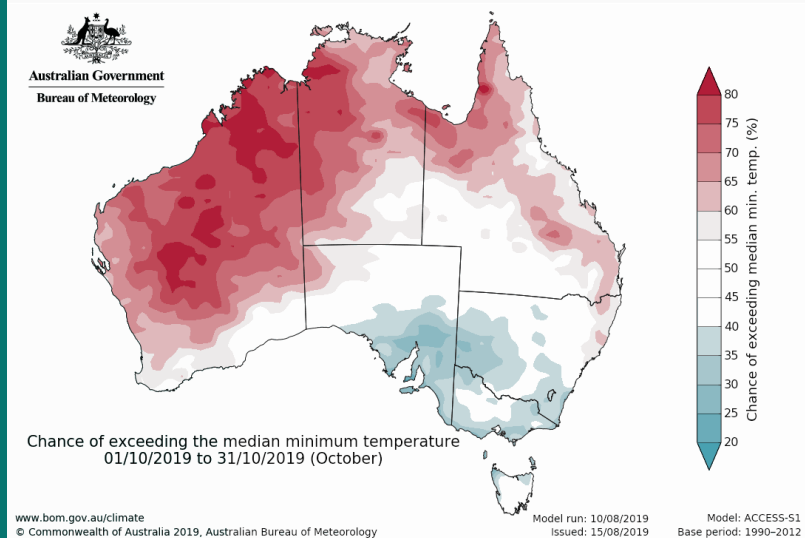

Australian Government
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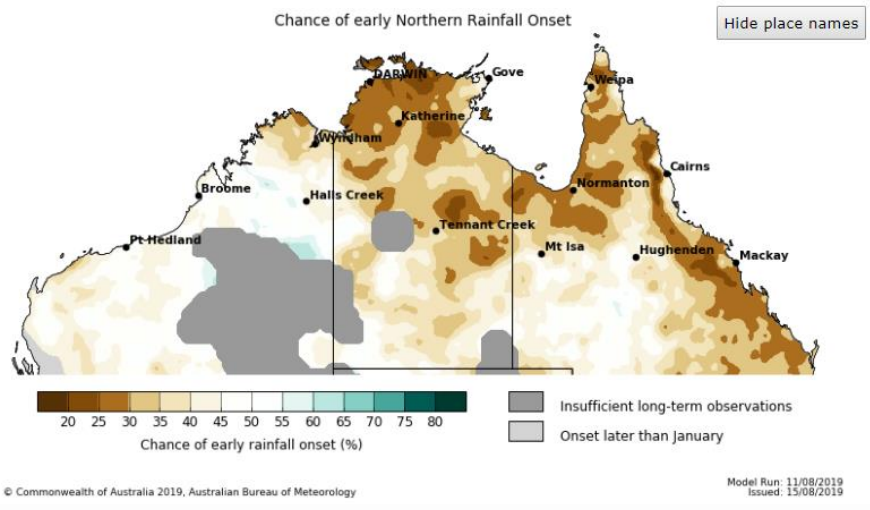
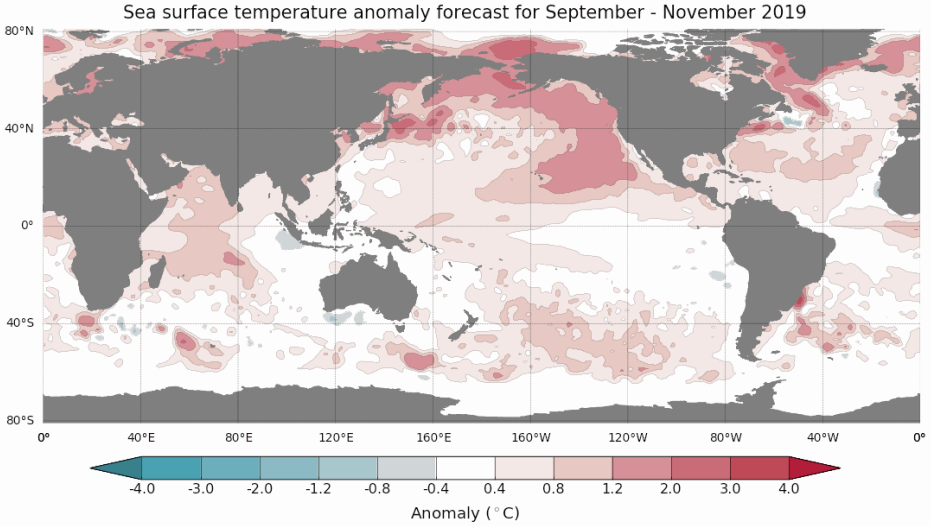
http://www.bom.gov.au/climate/ahead

- **Northern rainfall onset**
- **Sea surface temperature forecasts**





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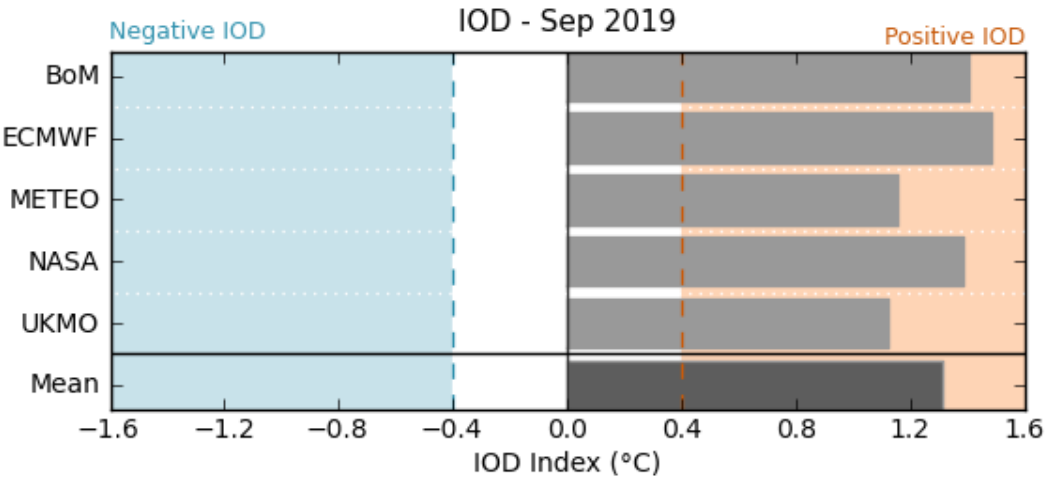
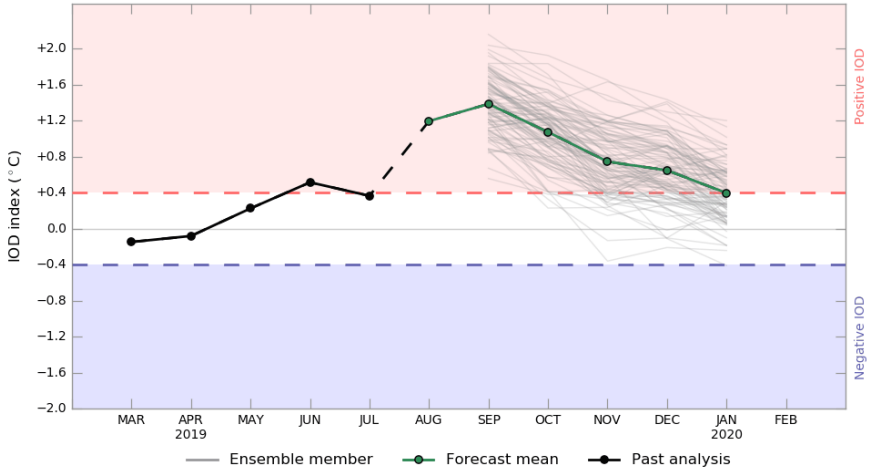
http://www.bom.gov.au/climate/ahead

- **Forecasts of ENSO & IOD**



Monthly sea surface temperature anomalies for IOD region



www.bom.gov.au/climate
Commonwealth of Australia 2019, Australian Bureau of Meteorology

Model run: 3 Aug 2019

Model: ACCESS-S1
Base period 1990-2012

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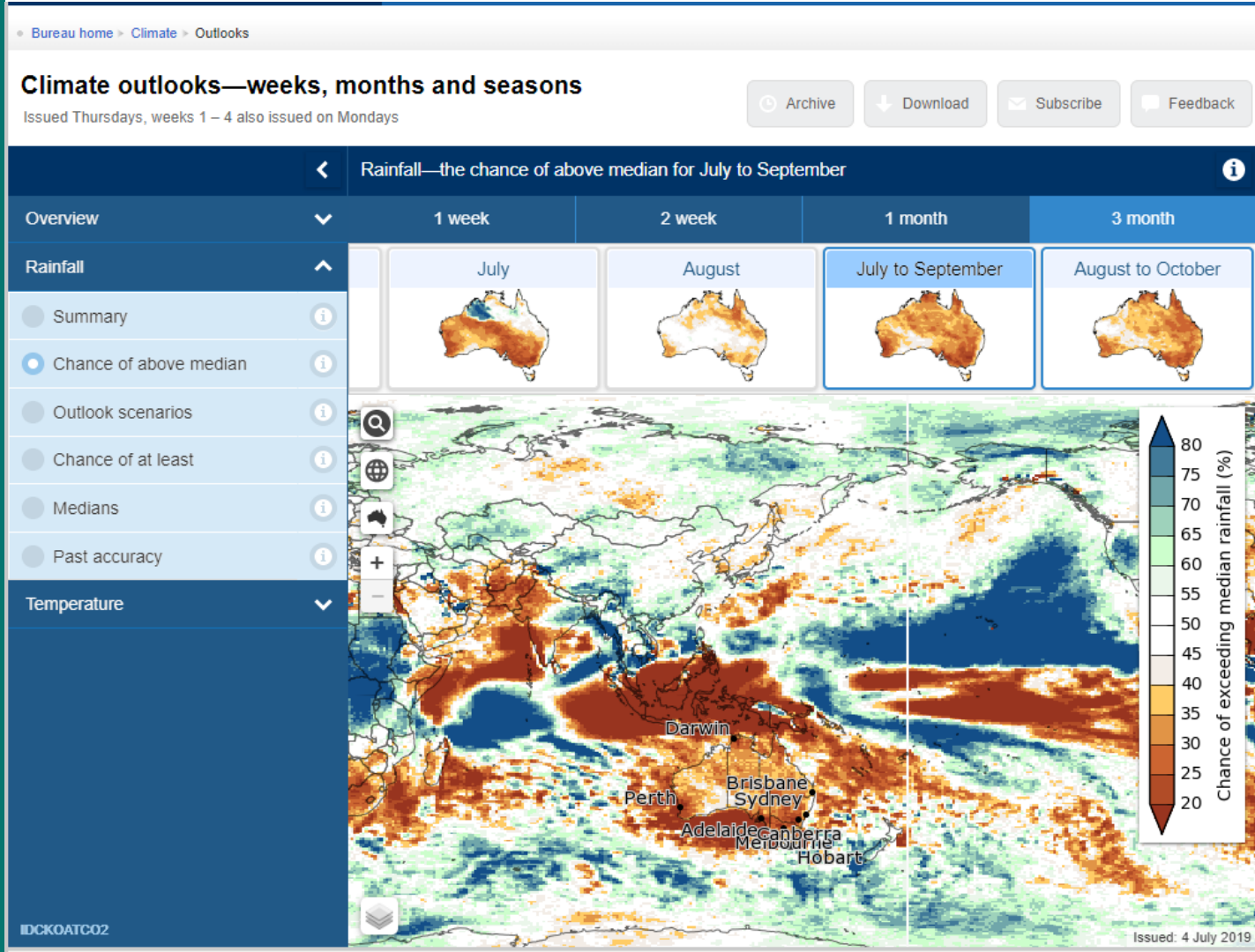
Bureau of Meteorology

Multi-week forecasts

Available in September

Global in scope



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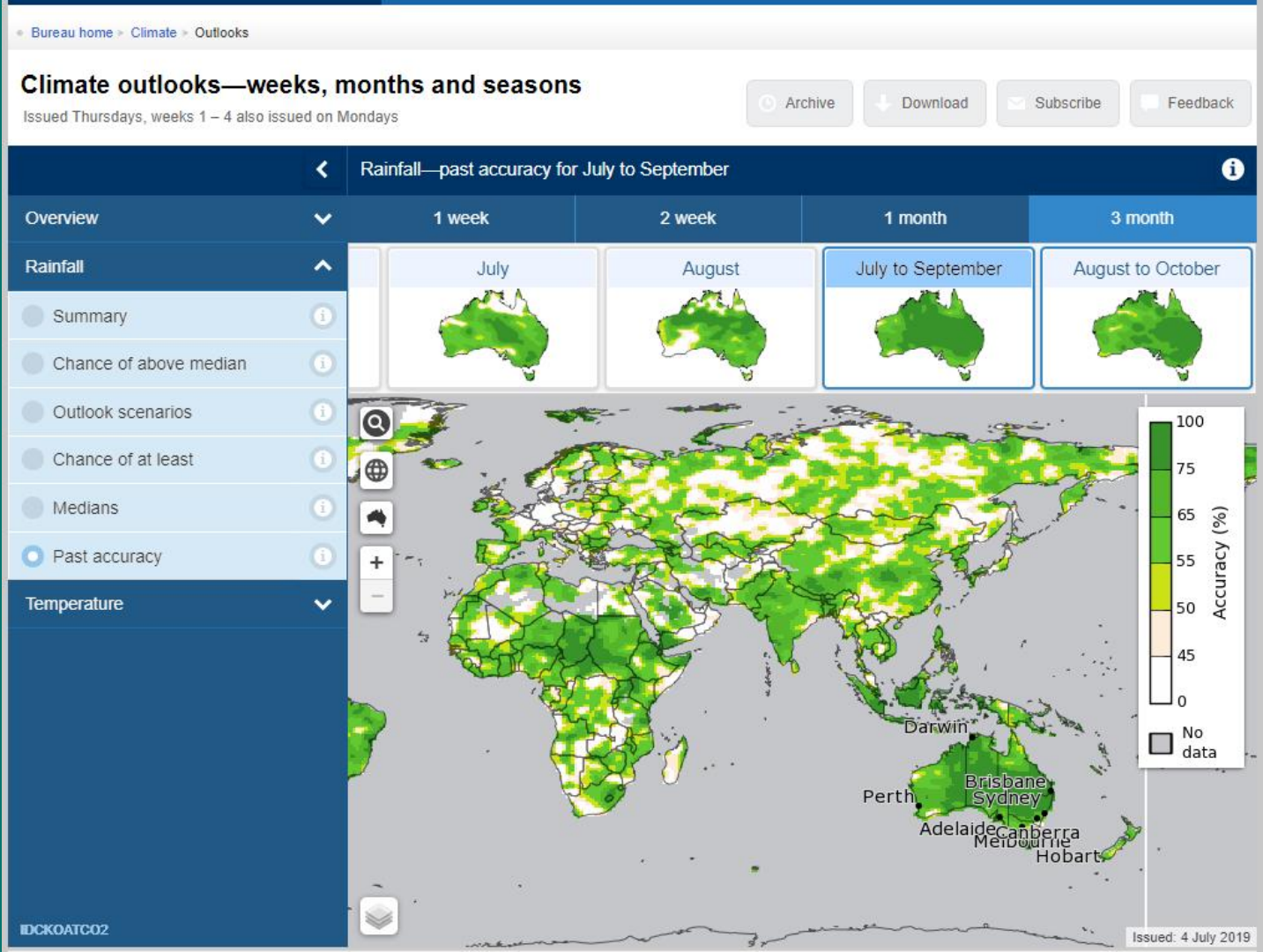
Multi-week forecasts

Available in September

Including global skill maps



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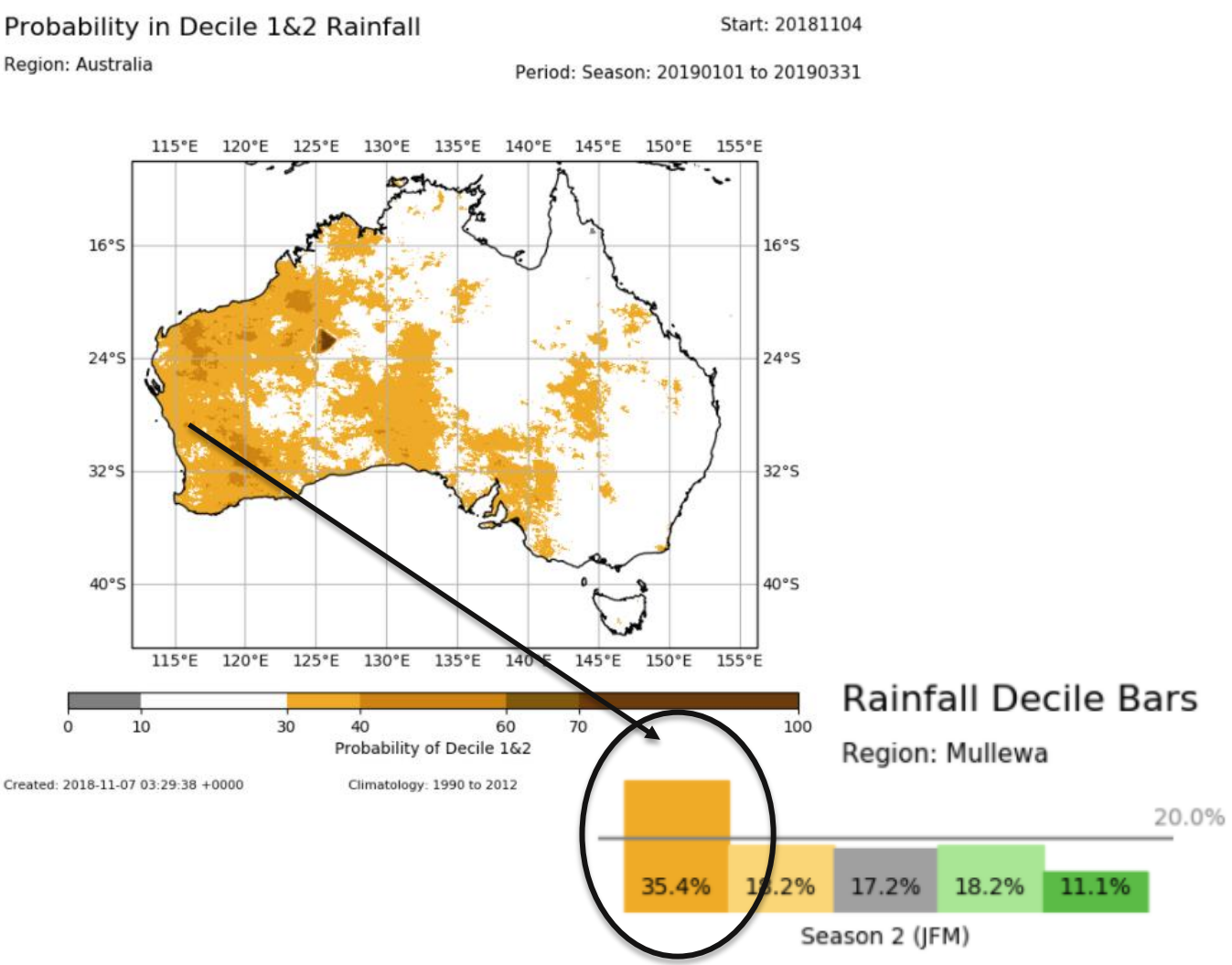
Seasonal forecasts of extremes: Chance of being in outer deciles (e.g., very dry)

Increased likelihood of having Decile 1&2 (i.e. of being amongst the driest fifth of JFM seasons



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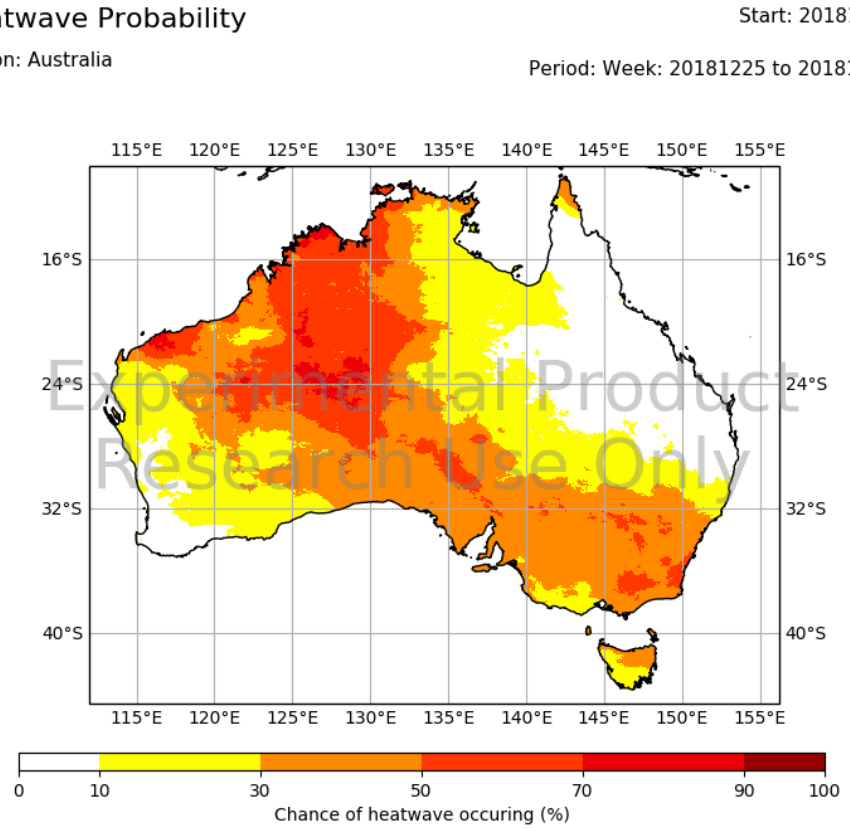
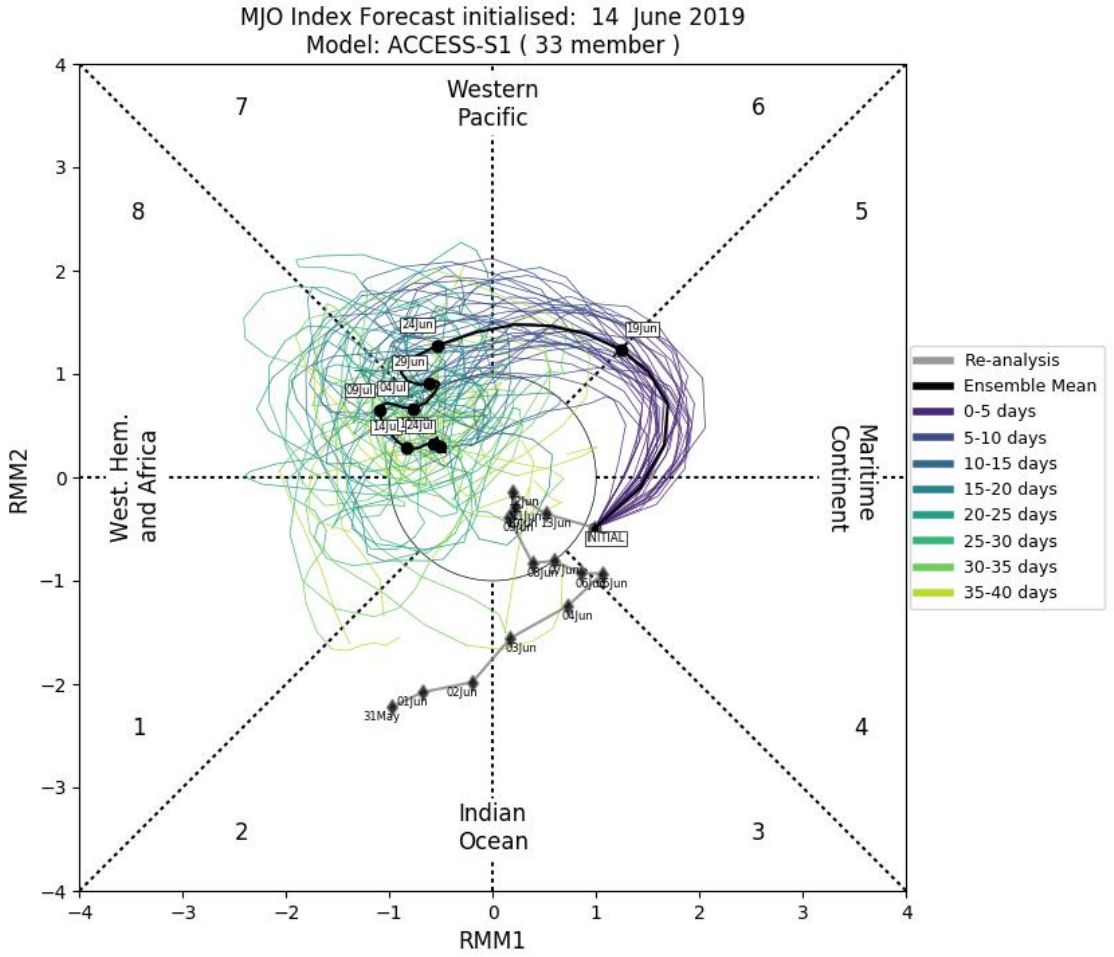
Sub-seasonal (week 2) forecasts of extremes: Heatwave

Three or more consecutive days of Tmean > 90th percentile



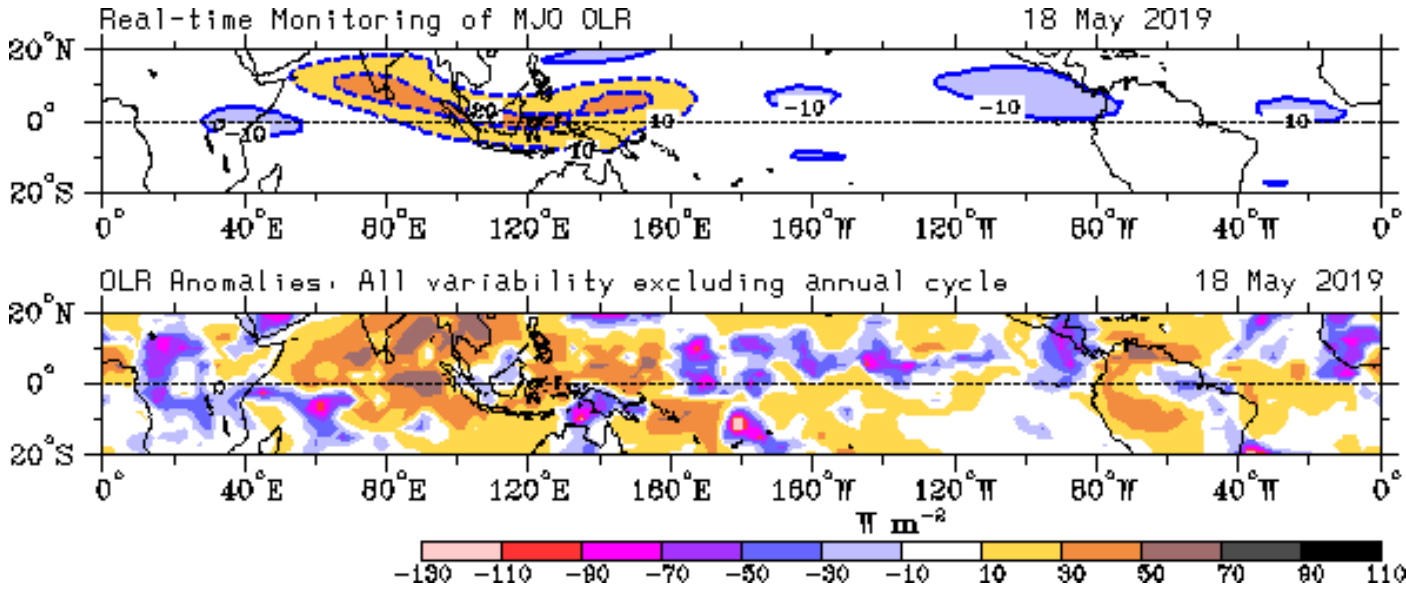
Sub-seasonal forecasts of extremes: Tropical Weather

Realtime MJO forecasts
RMM forecasts



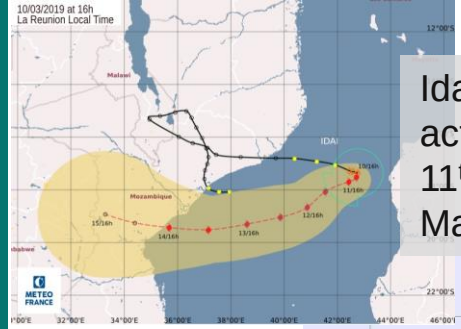
Sub-seasonal forecasts of extremes: Tropical Weather

Realtime MJO forecasts
Filtered OLR plots



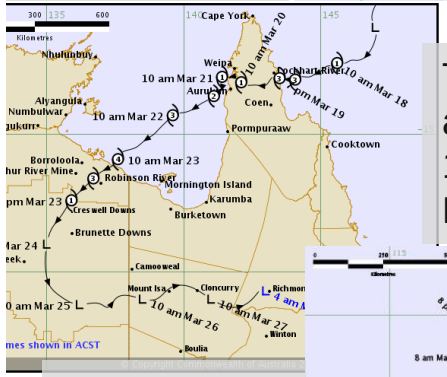
Sub-seasonal forecasts of extremes: Tropical Weather

Week two forecasts of cyclone activity
Forecast initialised March 4th 2019

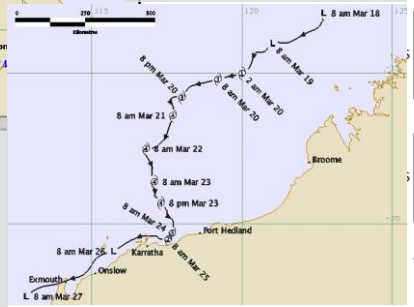


Idai was active from 11th-16th March 2019

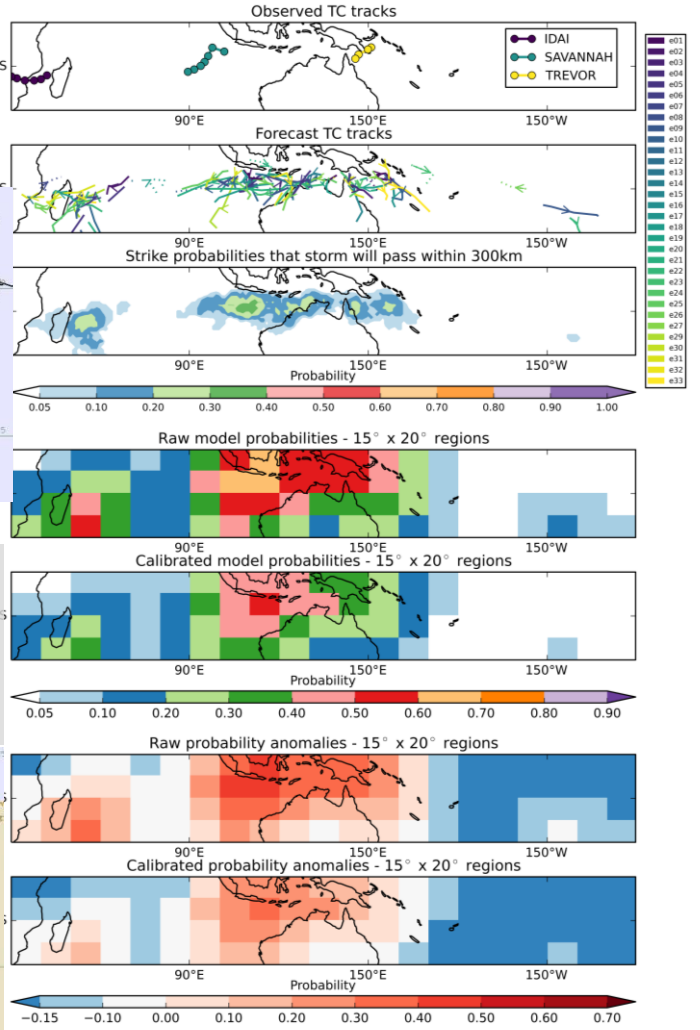
Savannah was active from 13th-20th March 2019



Trevor was active from 18th-23rd March 2019



Veronica was active from 20th-25th March 2019



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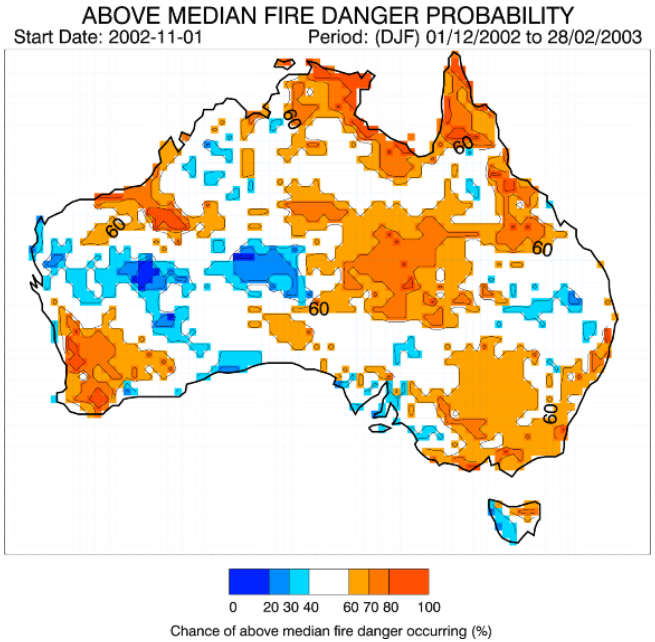
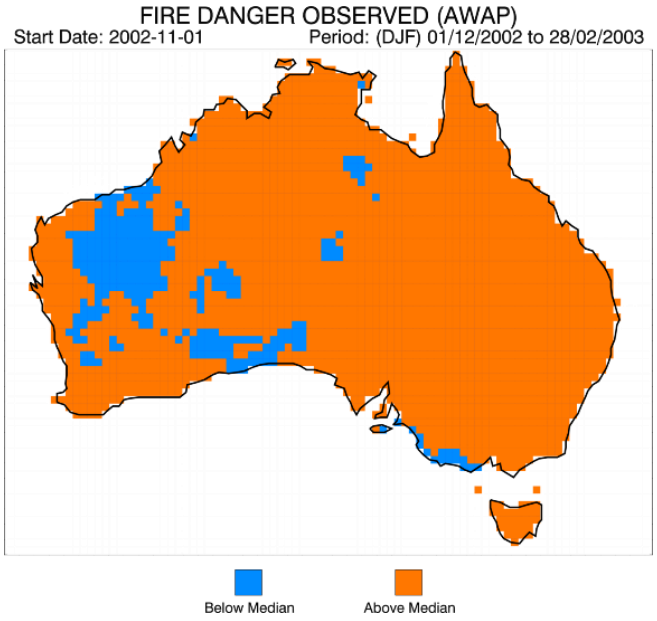
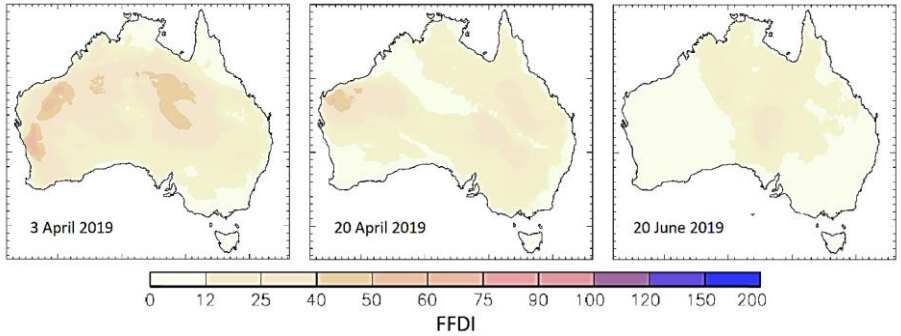
Seasonal and sub-seasonal forecasts of extremes: Fire Weather

Chance of above median Fire Danger (top)
Seasonal forecasts of Forest Fire Danger Index (FFDI) - bottom







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Changes in climate requiring adaptation

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

Longer fire season with more extreme fire danger days

Prolonged high ocean temperatures

Reduced average rainfall and more time spent in drought

An increase in heavy rainfall

Increased frequency of coastal storm surge inundation

occurring now ⬇ ⬇ ⬇ ⬇ emerging threat

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Changing paradigms

Future planning, resilience and disaster mitigation

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Record-breaking heat and fire weather: the new normal?

Black Saturday 2009

Record preceding heatwave across southeastern Australia

Prolonged drought (record breaking in some aspects)

Record daytime and overnight temperatures

Record fire danger Black Saturday

173 deaths, 414 serious injuries, total cost of ~$5 billion

~500 excess deaths from extreme heat

Kinglake Fire. Source:, CSIRO Science Image, Nick Pitsas, February 25 2009

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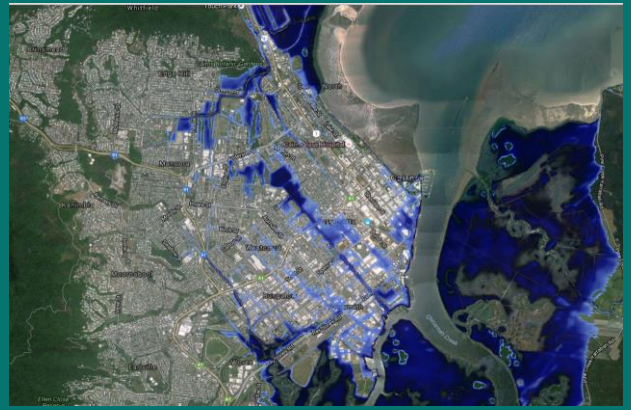
Future sea level



Cairns projected storm tide inundation

Inundation from storm tide under a business-as-usual median-estimate sea level rise by 2050

(1-in-100 year storm tide ~2.32 metres)

Inundation from storm tide under a business-as-usual high-estimate sea level rise by 2100

(1-in-100 year storm tide ~3.08 metres)

Data sources: http://www.climatechangeinaustralia.gov.au/en/ McInnes et al, (2009; 2015)

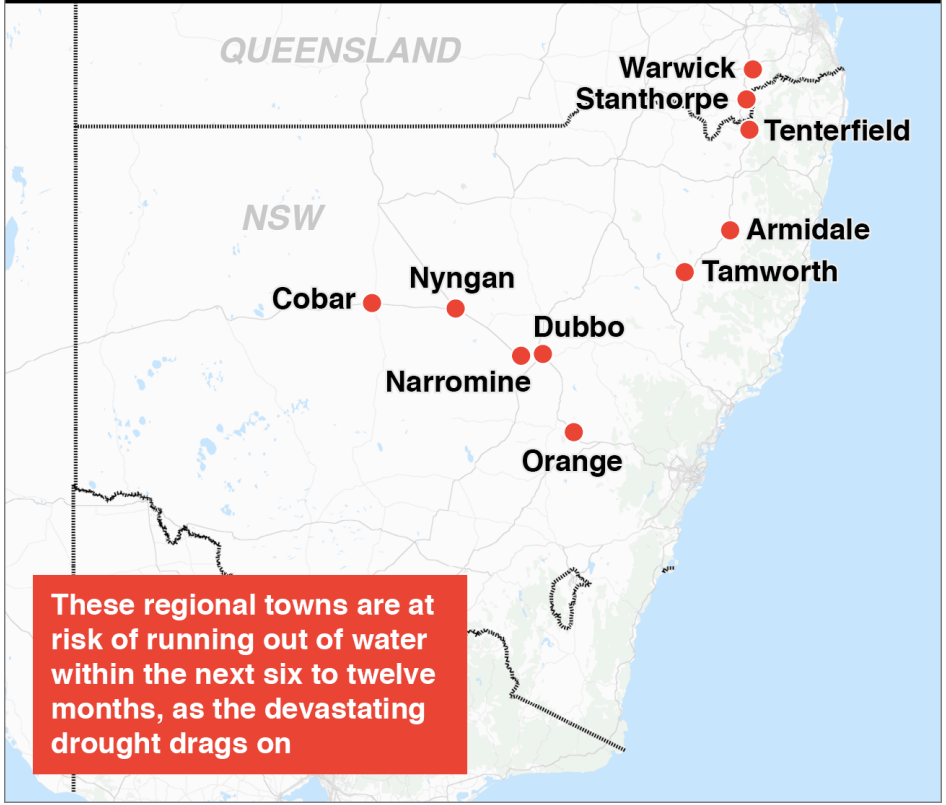
http://coastalrisk.com.au/viewer

Cost of desalination plants

Melbourne	$3.5bn
Sydney	$2.4bn
Adelaide	$1.83bn
Gold Coast	$1.2bn
Perth	$955m

Wonthaggi Desalination Plant, Victoria

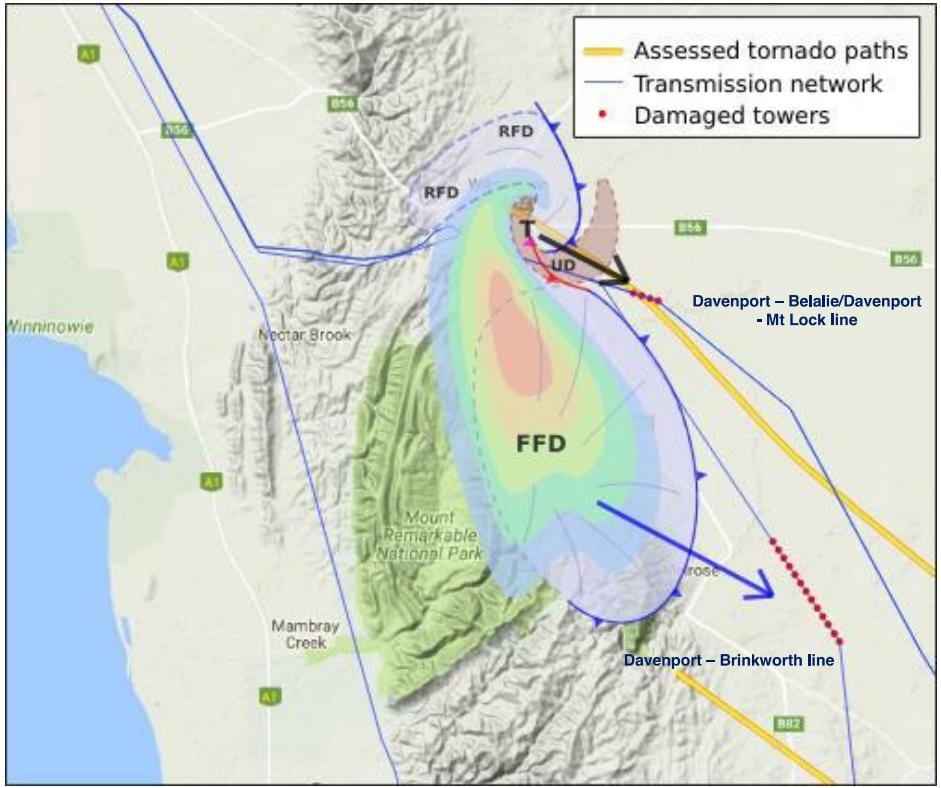
Drought seeing towns run dry



South Australian System Blackout 2016

Adelaide blacked out: Wed 28 Sept 2016 Source: Guardian

Downed transmission lines Sept 2016 Source: ABC



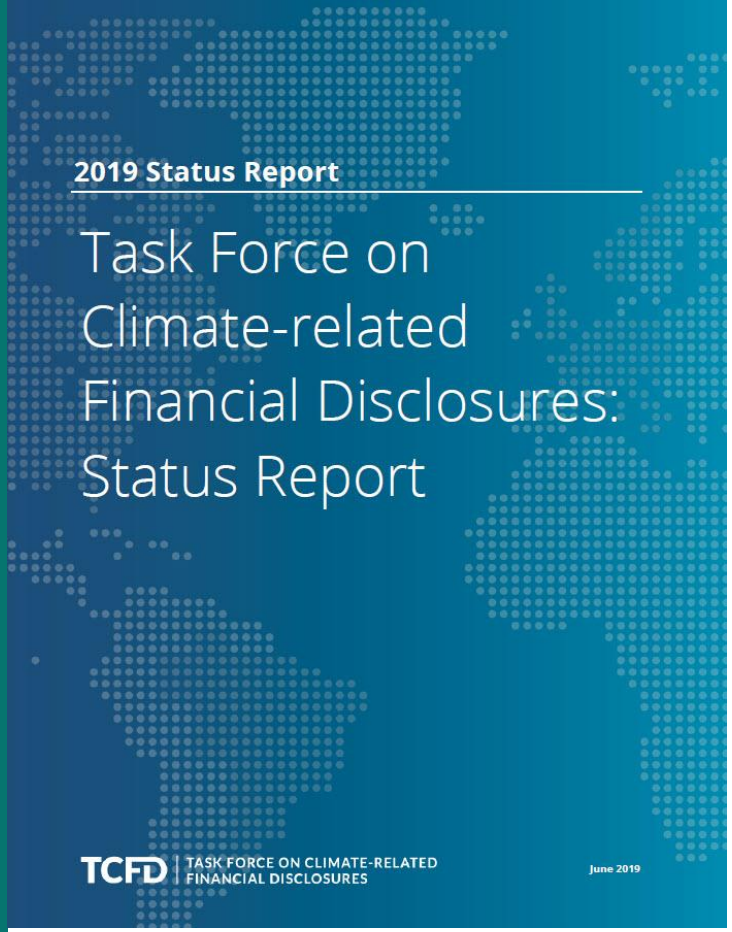
Managing physical climate risk:

What do we need for scenario planning?

Australian Government
Bureau of Meteorology

Managing climate risk:

The regulatory environment is changing



Managing climate risk:

The regulatory environment is changing

Australian Prudential Regulation Authority

APRA to step up scrutiny of climate risks after releasing survey results

Geoff Summerhayes :"A critical implication…. is the importance of considering, and modelling, the potential impact of climate-related risks under different scenarios and over different time horizons."

Managing climate risk:

The regulatory environment is changing

Climate Change and the Economy

RESERVE BANK OF AUSTRALIA

Guy Debelle [*]
Deputy Governor

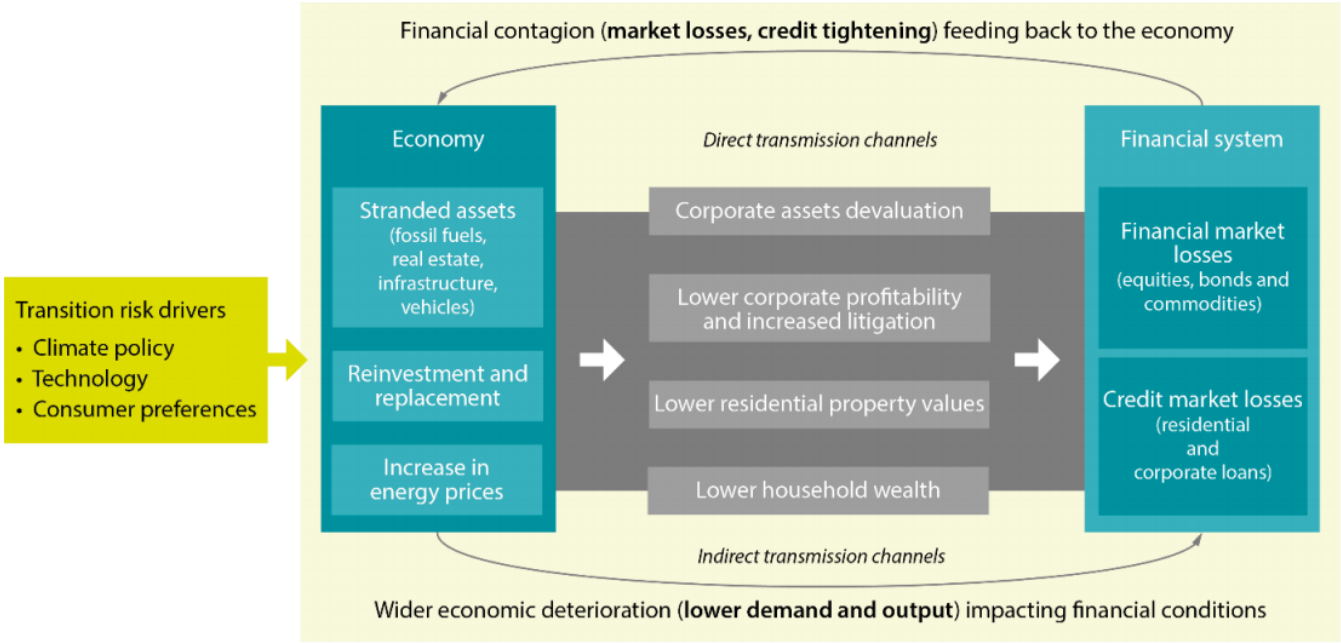
Public Forum hosted by the Centre for Policy Development
Sydney – 12 March 2019

"You should all be aware of the recommendations of the recent report of the Task Force on Climate-related Financial Disclosures (TCFD)….. Risk management under uncertainty is always challenging, but the challenge can be reduced with better and consistent information both in terms of the data inputs and the consistency of the scenarios considered. "

Managing climate risk:

Mechanisms for loss are being identified

Figure 1 **Relationships between transition risk, the economy and financial system**



Managing climate risk:

Costs for inaction are being priced

Property Residential Property market Print article

Climate change predicted to wipe $571 billion off property values

Tim Boyd
Reporter

May 9, 2019 — 12.01am

Save Share

The property market is predicted to have $571 billion wiped from it by 2030 as a result of climate change and extreme weather events if a business as usual approach is taken, according to a new report released by the Climate Council.

Damage related loss of value would rise to $611 billion by 2050 and $770 billion by 2100 if the modelling in a report titled Compound Costs: How Climate Change is Damaging Australia's Economy comes true.

Integrated risks are now well-recognised

Who is talking to the Bureau about climate risk?

- Finance and Insurance Sector
- Energy Sector
- Agriculture
- Private Asset Managers

- Listed Companies (regulatory requirements for climate risk disclosure)
- Global Auditing/Accounting/Rating Agencies
- Banks
- AEMO
- Major Insurers
- Engineering and consulting firms
- Medium sized businesses exposed to climate risk

- Federal Government Departments
- State Government Departments
- Emergency Management Sector
- Public Asset Managers, including Critical Infrastructure
- Defence
- Water Resource Sector
- Regulators (APRA, ASIC, RBA, Treasury)
- Natural Resource Managers (eg. GBRMPA)

Integrated risks are now well-recognised

Financial impacts from 2018-2019 Summer

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Business | Banking And Finance | Extreme weather | Print article

Sydney hail storm, Townsville flood cost insurers $2.4 billion

James Fernyhough
Reporter

Apr 18, 2019 — 3.04pm

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Two freak weather events in Sydney and Townsville over the summer cost the Australian insurance industry a total of $2.4 billion in claims, the Insurance Council of Australia has revealed.

A severe hailstorm in Sydney on December, which prompted the Insurance Council to declare a catastrophe, prompted $1.271 billion worth of claims.

The devastating February floods in Townsville, meanwhile, have so far resulted in 27,355 claims worth $1.132 billion, the Insurance Council said, bringing total losses from both events to $2.4 billion.

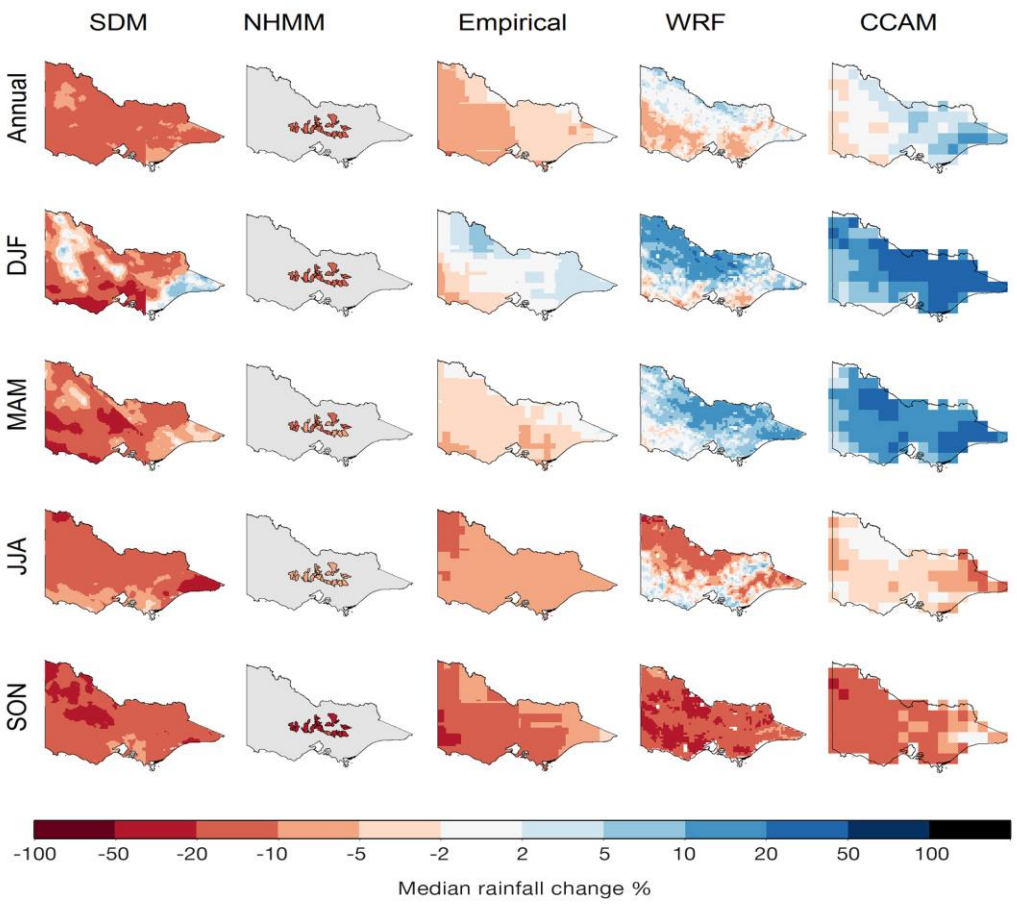
- Australia comprises 2% of the global insurance market and accounts 8% of its losses.
- What happens if the global insurers walk away from Australia?

Australian Government
Bureau of Meteorology

Managing physical climate risk:

What do we need for scenario planning?

High resolution climate projections (downscaling)



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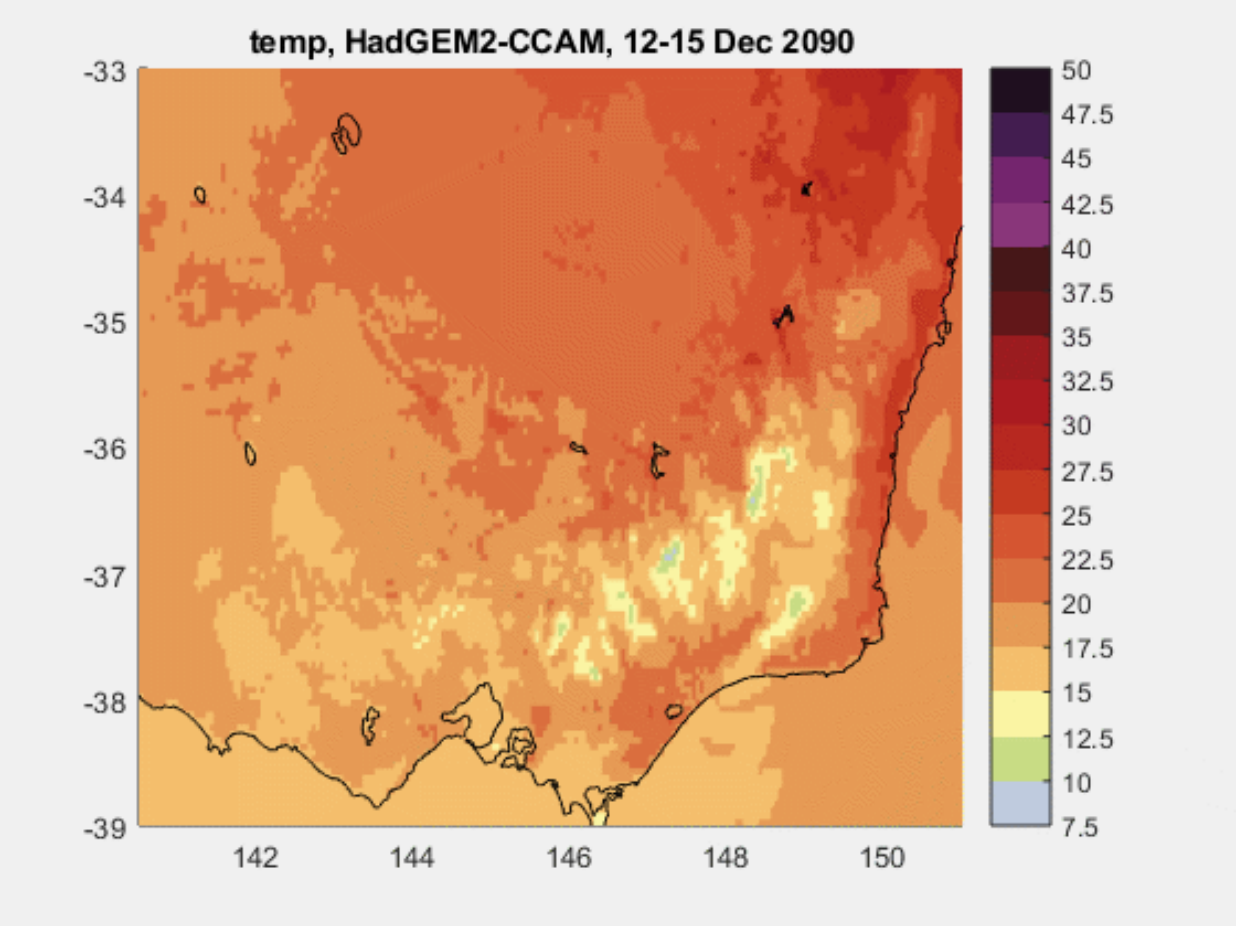
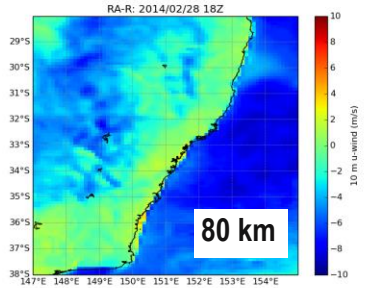


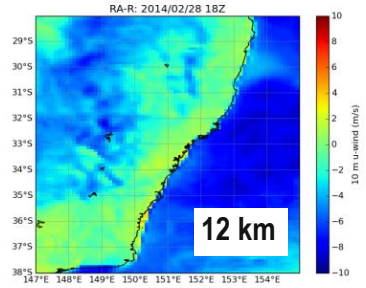
Managing physical climate risk:

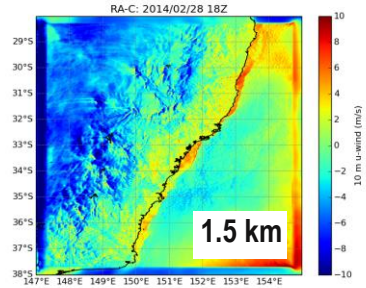
What do we need for scenario planning?

- High resolution historical weather data.
- Vulnerability, impact and exposure data.
- Future scenarios and projections.
- Knowledge brokers.
- Standardised methods.

28 February 2014 — surface wind

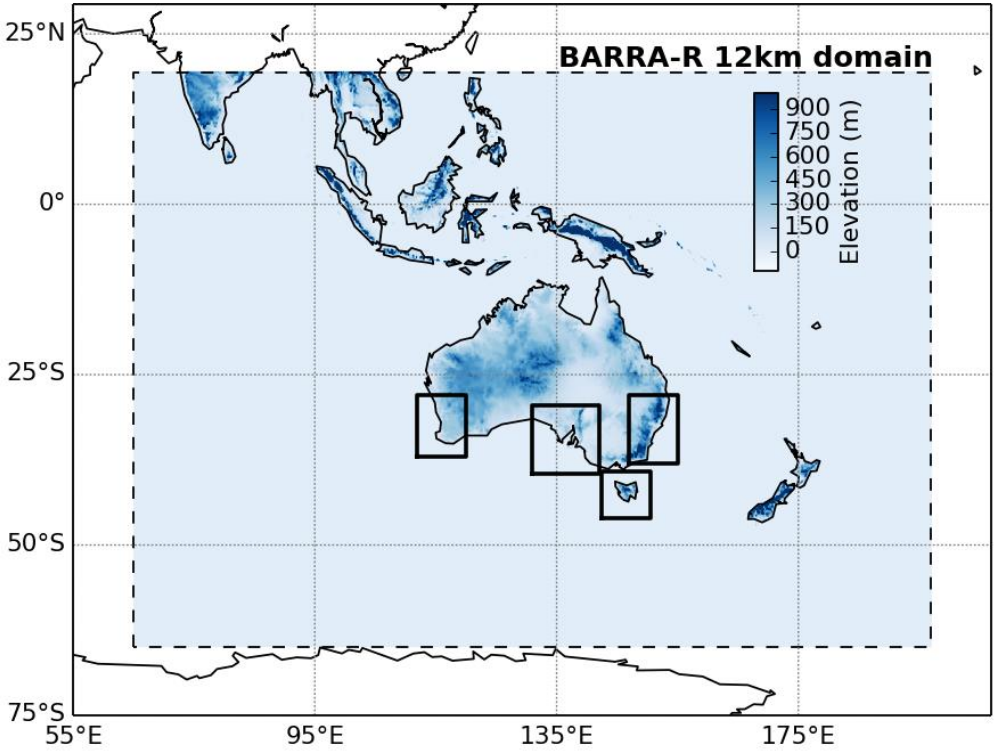




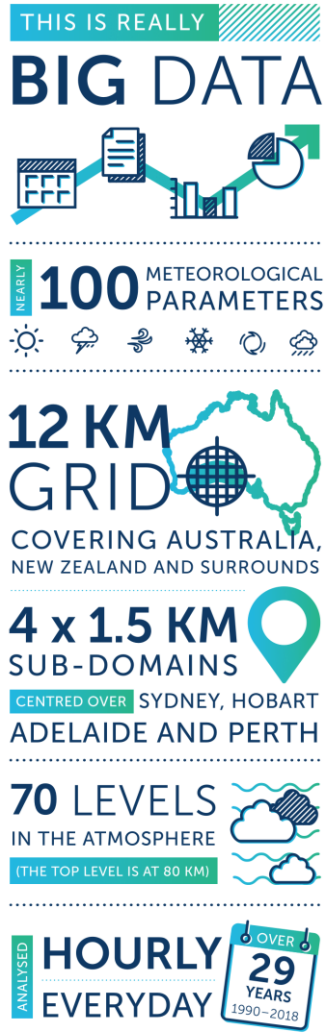


Bureau analysis products:

BARRA and BARPA



- **BARRA is an NWP re-analysis from 1990-2018**
- **BARPA will be the equivalent for future climate scenarios**



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Summary

Setting the scene – current trends and emerging climate impacts in Australia

Existing seasonal climate products and services

New products forecasting seasonal and sub-seasonal climate extremes

Planned products for forecasts of extremes at decadal timescales

Thank you

CSIRO

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