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# Heatwaves in Queensland

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- 2 University of Adelaide
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# background

- The Bureau has experienced a rising demand for HW services in Qld
  - the HW of Feb 2004 resulted in an estimated 75 excess deaths
- The Bureau introduced a pilot HW forecasting service in Jan 2014
  - this pilot service was repeated for the HW season of 2014/2015 and ceased to be a pilot for the HW season of 2015/2016
  - The Heatwave Service project will be fully operational once it uses the official Australian Digital Forecast Database (planned for 2016/17)
  - using the Excess Heat Factor (EHF) metric of HW intensity
- $EHF = EHI_{sig} \times \max(1, EHI_{accl})$ 
  - $EHI_{sig} = T_{3\text{-day}} - T_{95}$
  - $EHI_{accl} = T_{3\text{-day}} - T_{30\text{-day}}$



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# presentation outline

- some significant recent Qld HWs
- a climatology of HWs across Qld using the EHF metric
  - base period (1958-2011) used to construct the EHF *versus* the last 30 years (1986-2015)
- heatwave severity trends
- performance of the Bureau's HW forecasting service across Qld
- where to from here in service development?



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# significant Queensland heatwaves

- December 1972
- February 2004
- New Year 2014
- November 2014

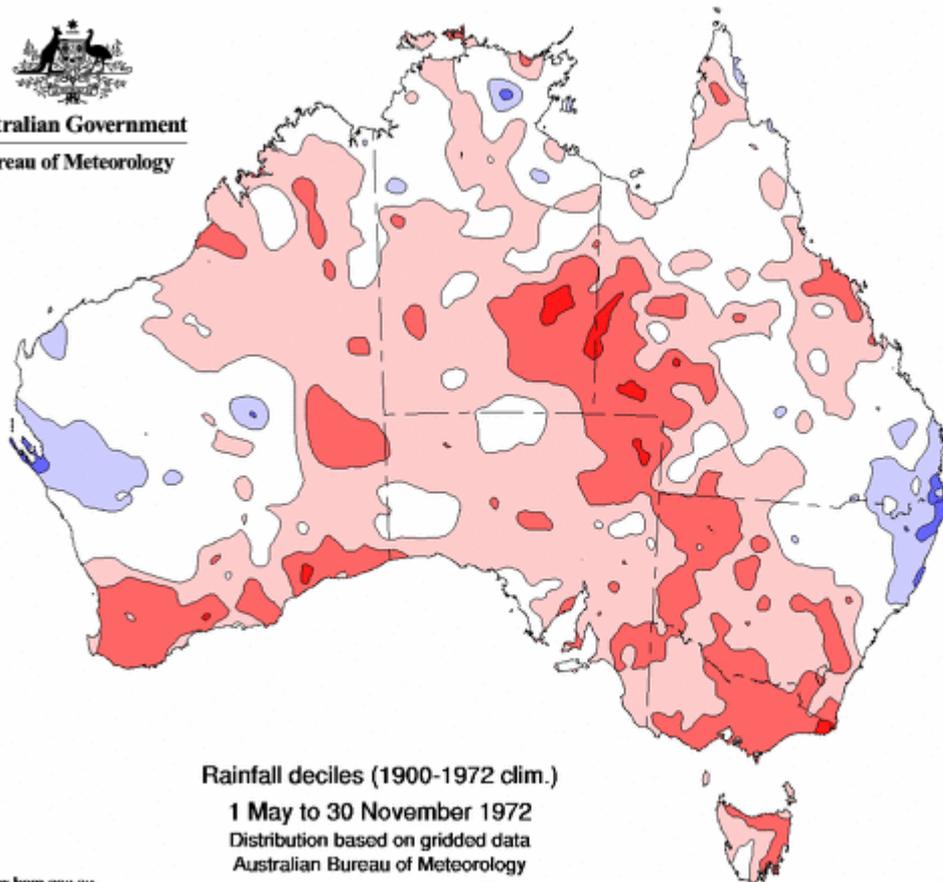


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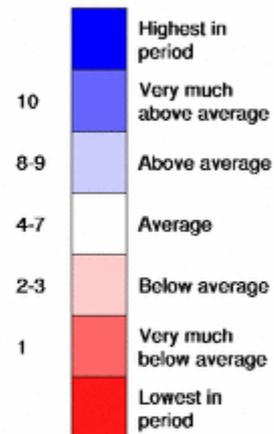
# 6 month rainfall deciles to Nov 1972



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Rainfall decile ranges



Rainfall deciles (1900-1972 clim.)  
1 May to 30 November 1972  
Distribution based on gridded data  
Australian Bureau of Meteorology

<http://www.bom.gov.au>

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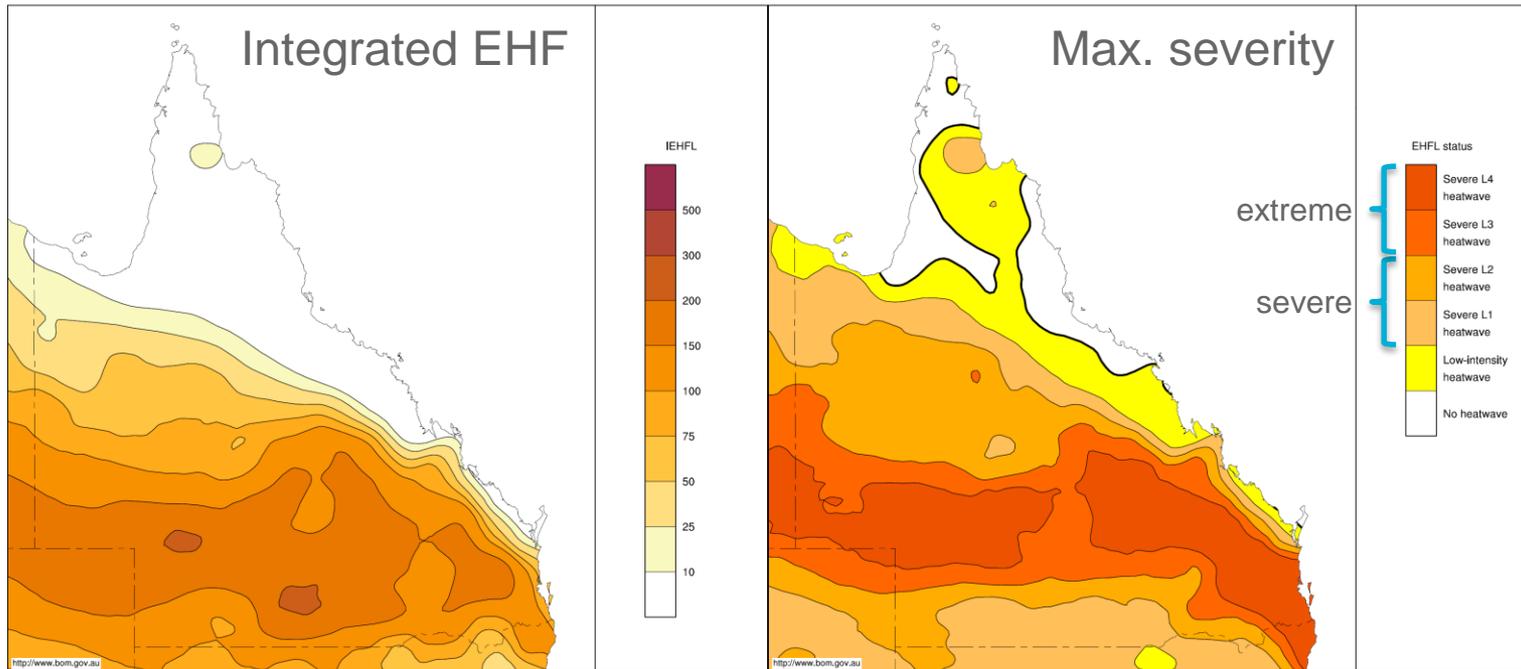


# December 1972 heatwave

- 99 excess deaths across SA + NSW + Qld
- Towards the end of a major El Niño

Integrated EHFL  
December 1972  
Australian Bureau of Meteorology

Maximum Severity  
December 1972  
Australian Bureau of Meteorology

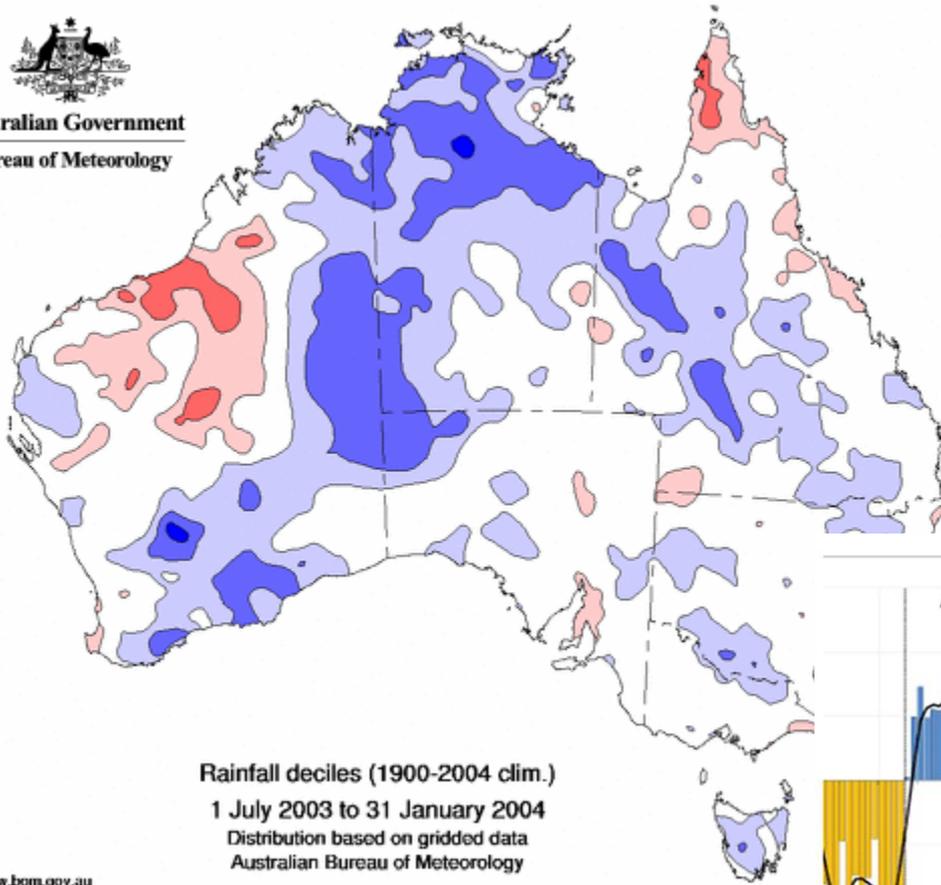




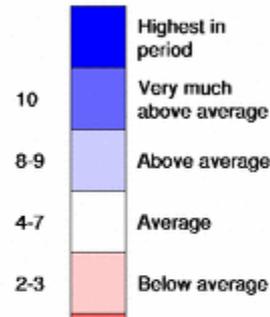
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# 6 month rainfall deciles to January 2004

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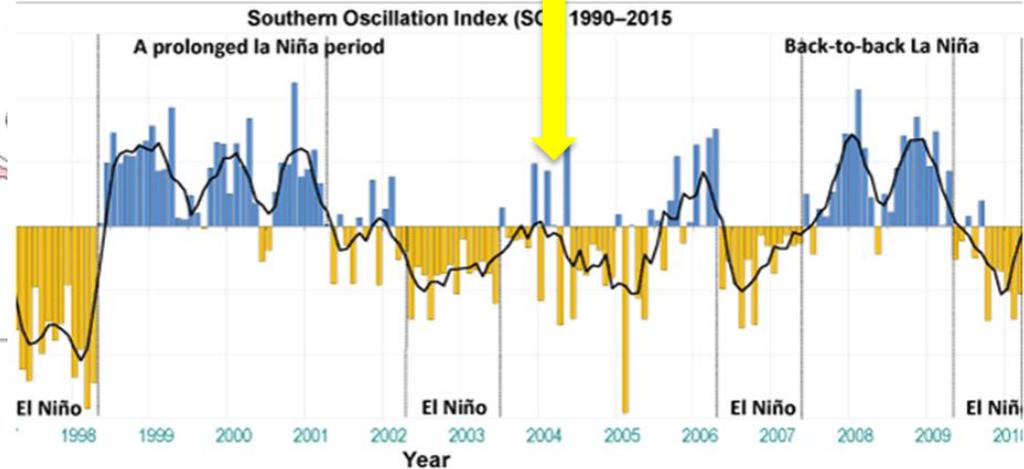
Rainfall decile ranges



Rainfall deciles (1900-2004 clim.)  
1 July 2003 to 31 January 2004  
Distribution based on gridded data  
Australian Bureau of Meteorology

<http://www.bom.gov.au>

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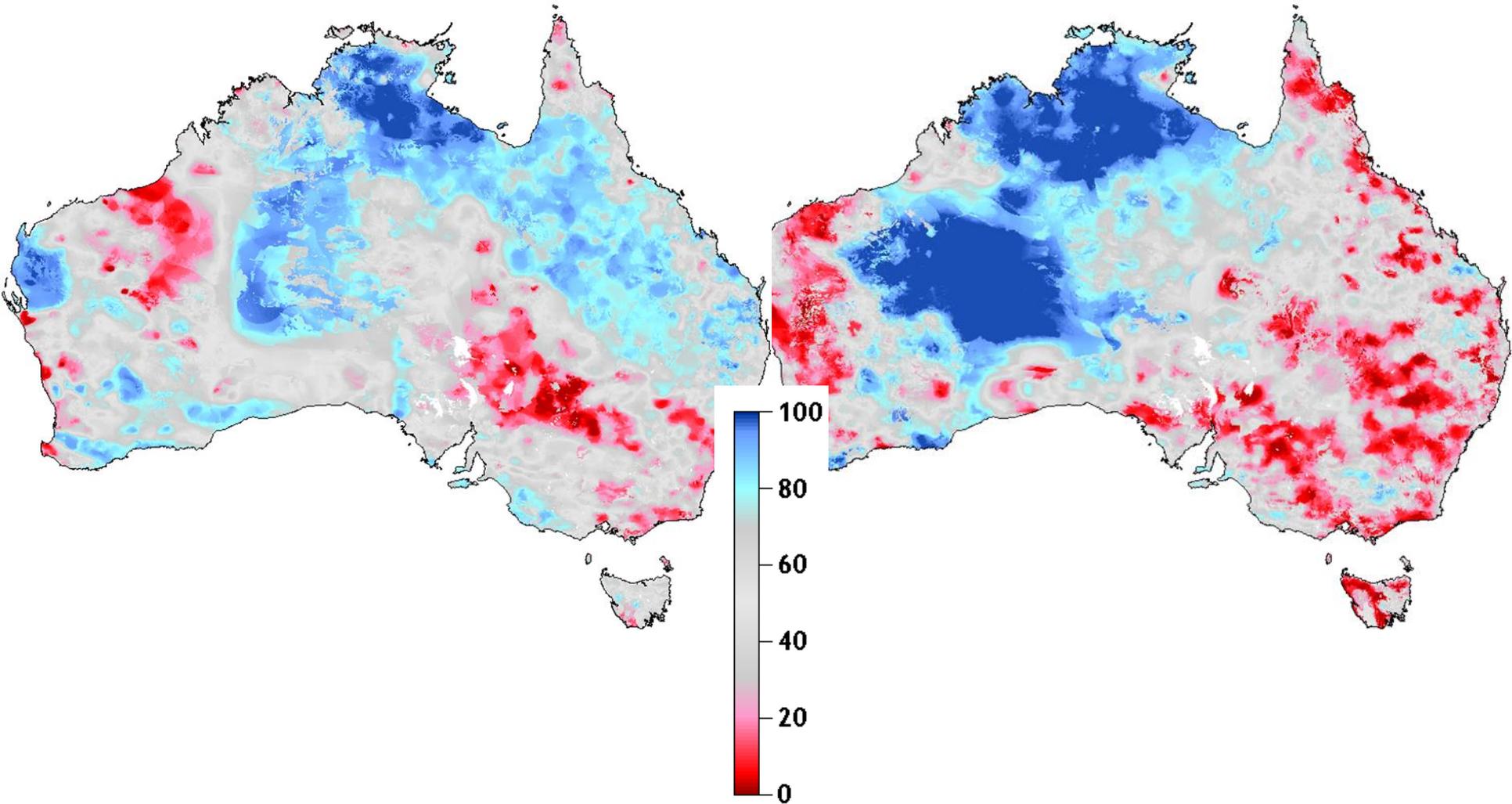
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# January 2004 percent rank soil moisture upper & lower layers

Percent Rank Relative Soil Moisture (Upper Layer) [%]

2004/01/01 to 2004/01/31ent Rank Relative Soil Moisture (Lower Layer) [%]

2004/01/01 to 2004/01/31



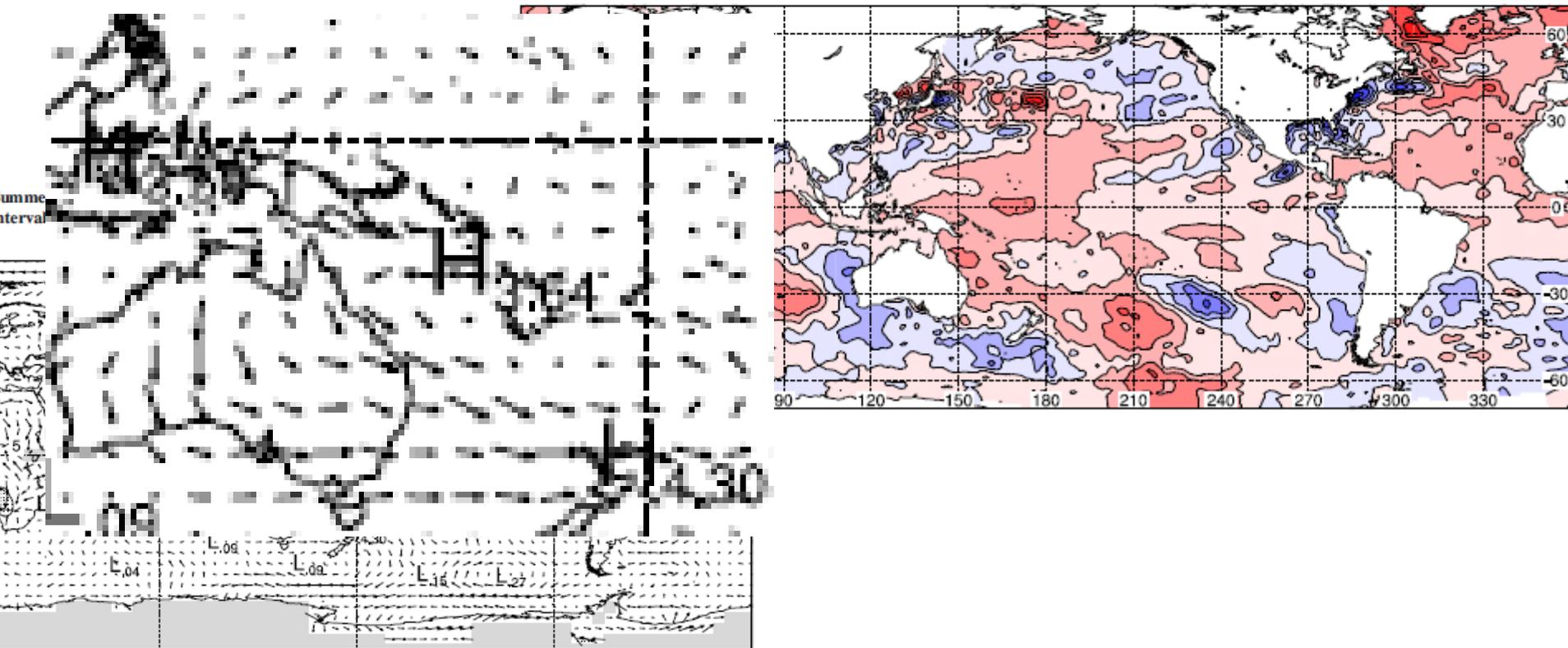


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# Aust. Met. Mag. 53 (2004) 305-317

## R.J.B. Fawcett

Fig. 4 Anomalies of sea-surface temperature for summer 2003/04 ( $^{\circ}\text{C}$ ). Positive anomalies are shown in red and negative anomalies are shown in blue. Contour interval is  $0.5^{\circ}\text{C}$ .



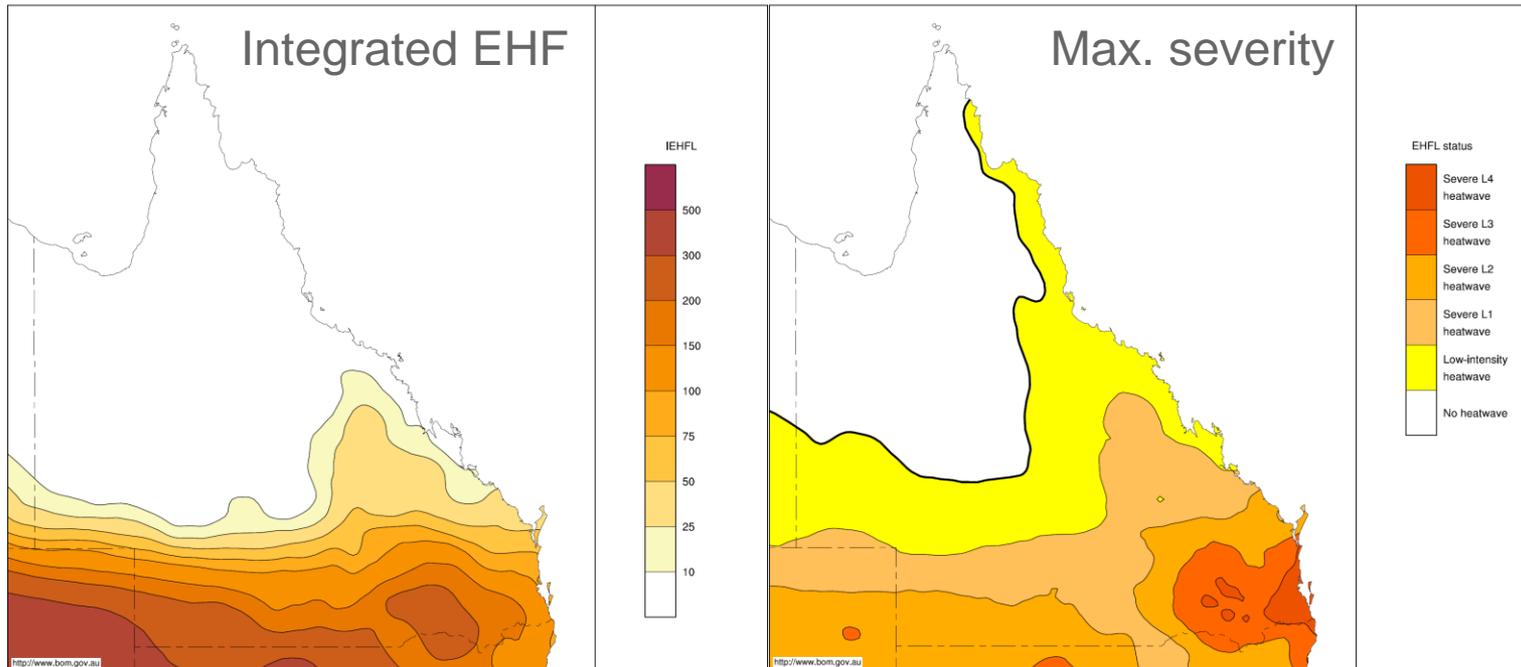


# February 2004 heatwave

- 116 excess deaths in Brisbane

Integrated EHFL February 2004  
Australian Bureau of Meteorology

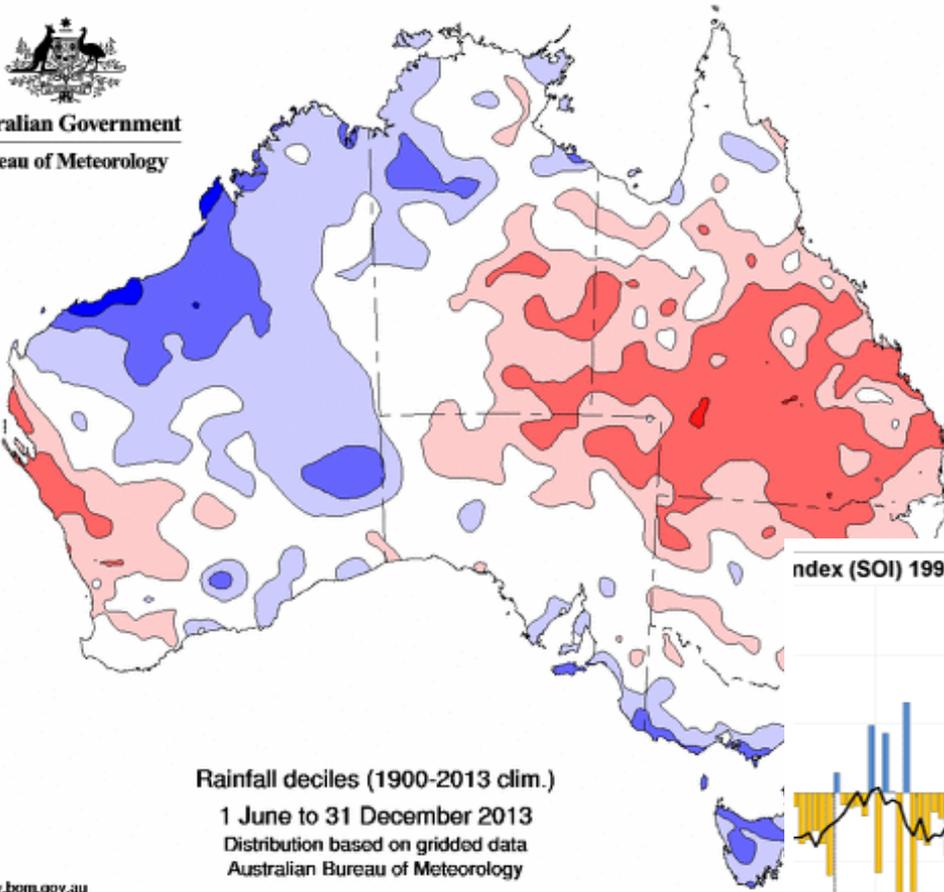
Maximum Severity February 2004  
Australian Bureau of Meteorology



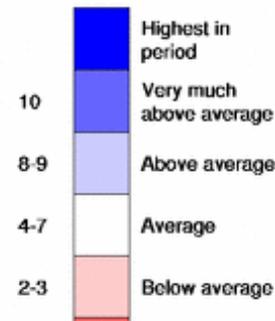


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# 6 month rainfall deciles to December 2013

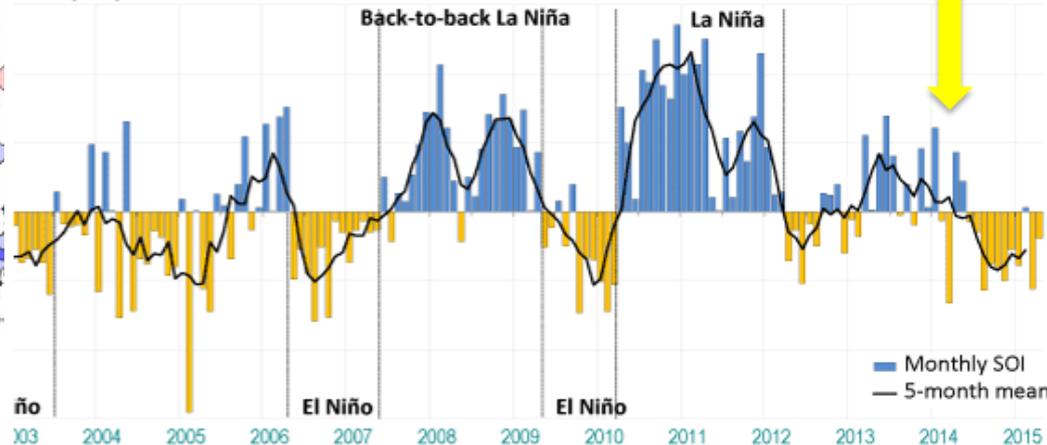


Rainfall decile ranges



Rainfall deciles (1900-2013 clim.)  
1 June to 31 December 2013  
Distribution based on gridded data  
Australian Bureau of Meteorology

Index (SOI) 1990-2015



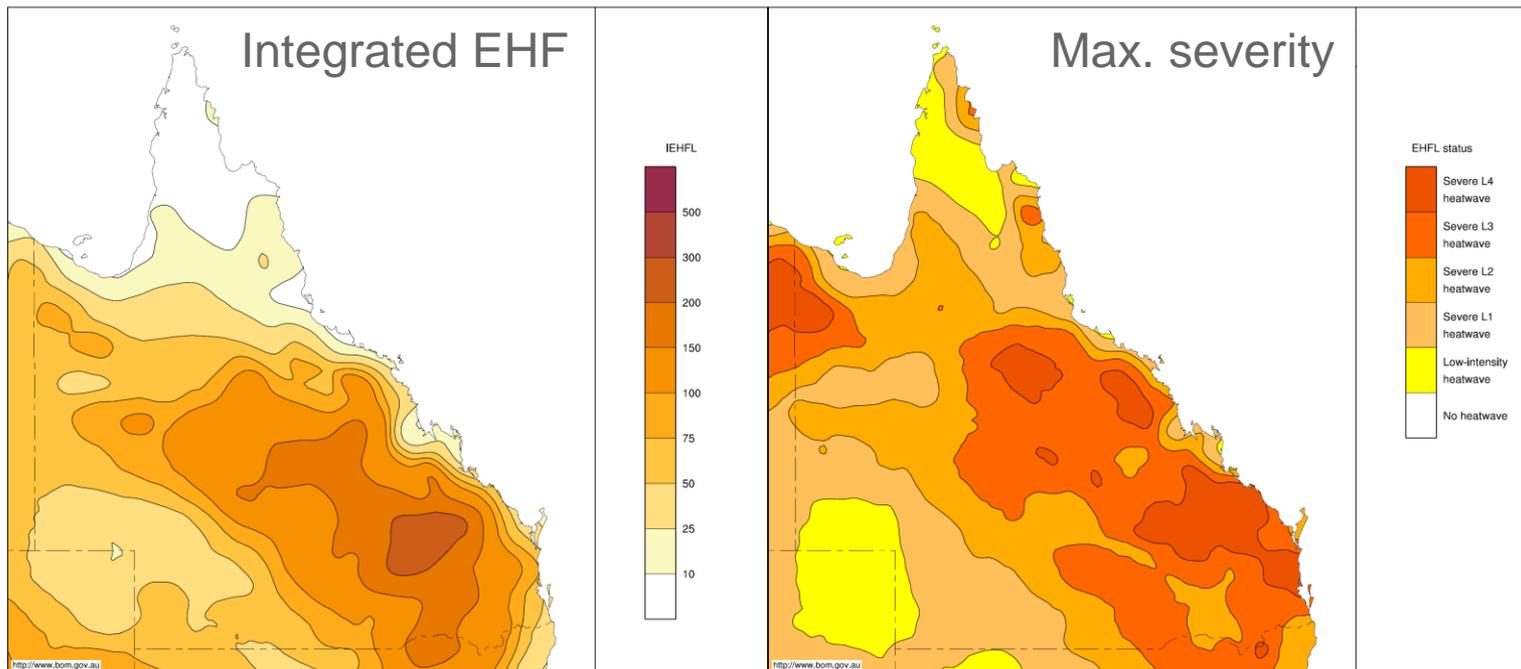


# New Year 2014 heatwave

- 43.5 °C at Archerfield (040211) on 2014-01-04 !
- > 45,000 flying foxes thought to have died

Integrated EHFL 16 December 2013 to 12 January 2014  
Australian Bureau of Meteorology

Maximum Severity 16 December 2013 to 12 January 2014  
Australian Bureau of Meteorology



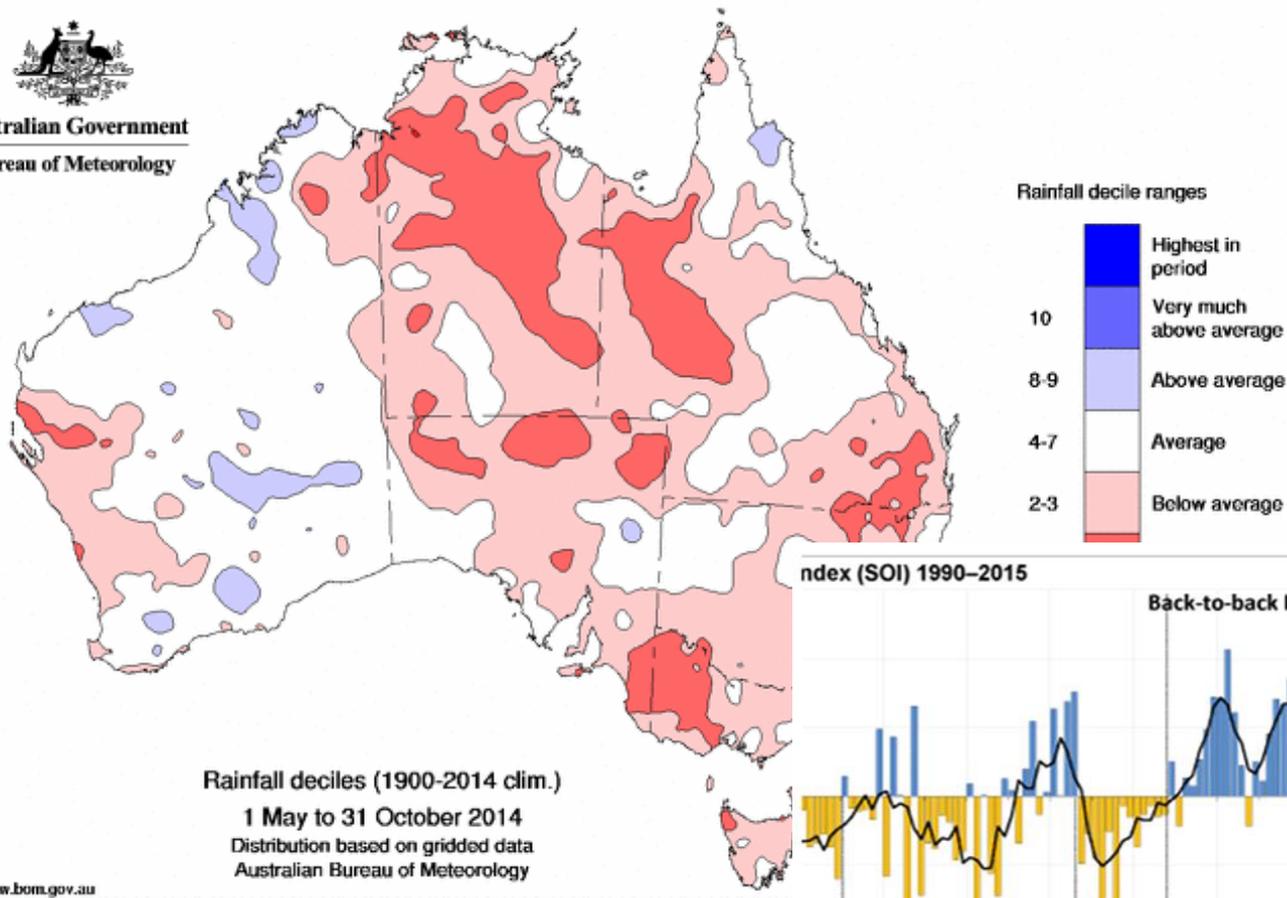


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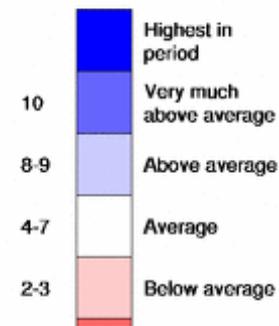
# 6 month rainfall deciles to October 2014



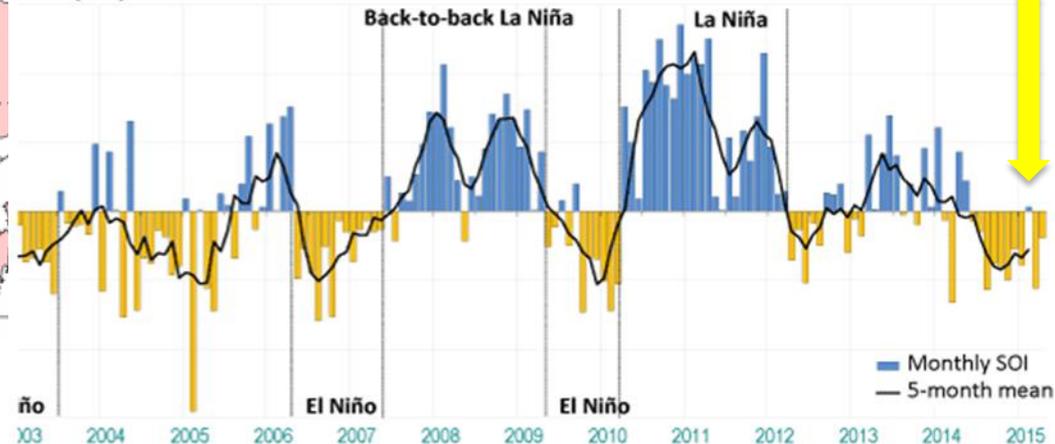
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Rainfall decile ranges



Index (SOI) 1990-2015



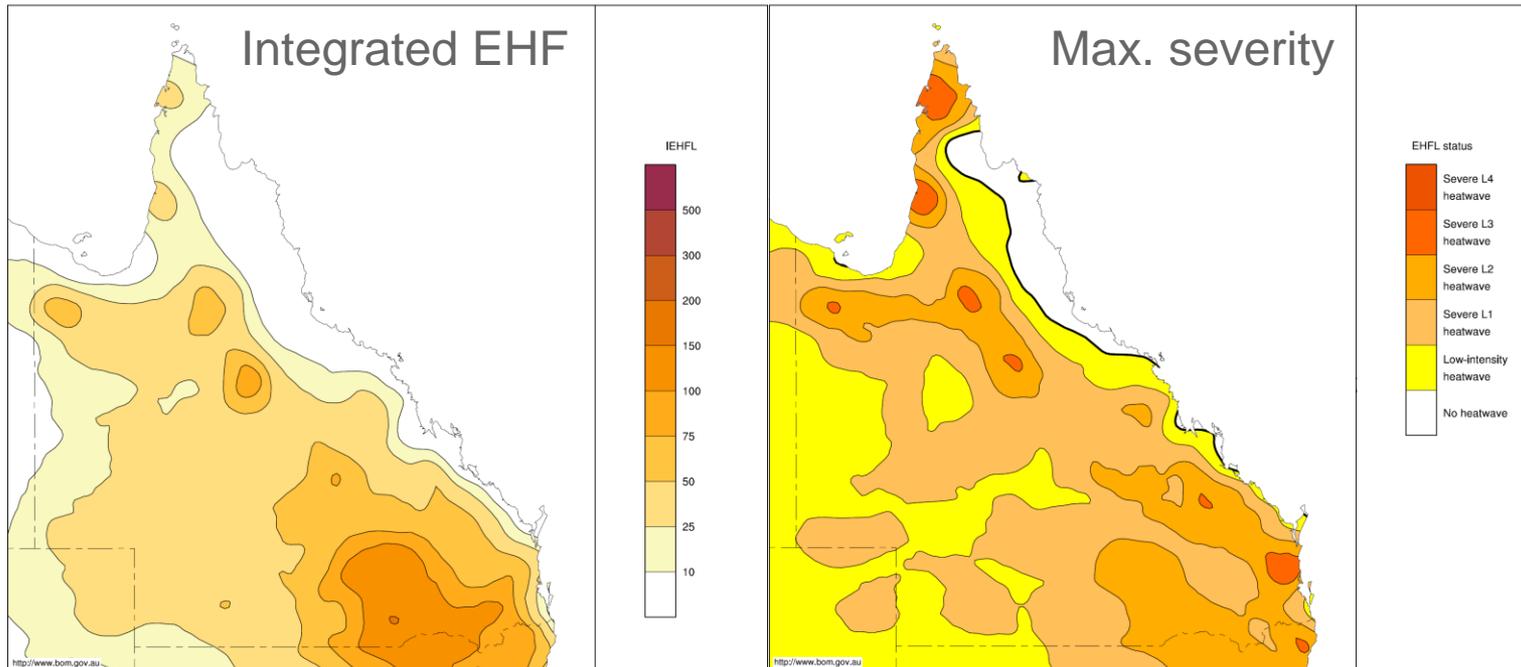


# November 2014 heatwave

- 42.1 °C at Archerfield (040211) on 2014-11-16 !

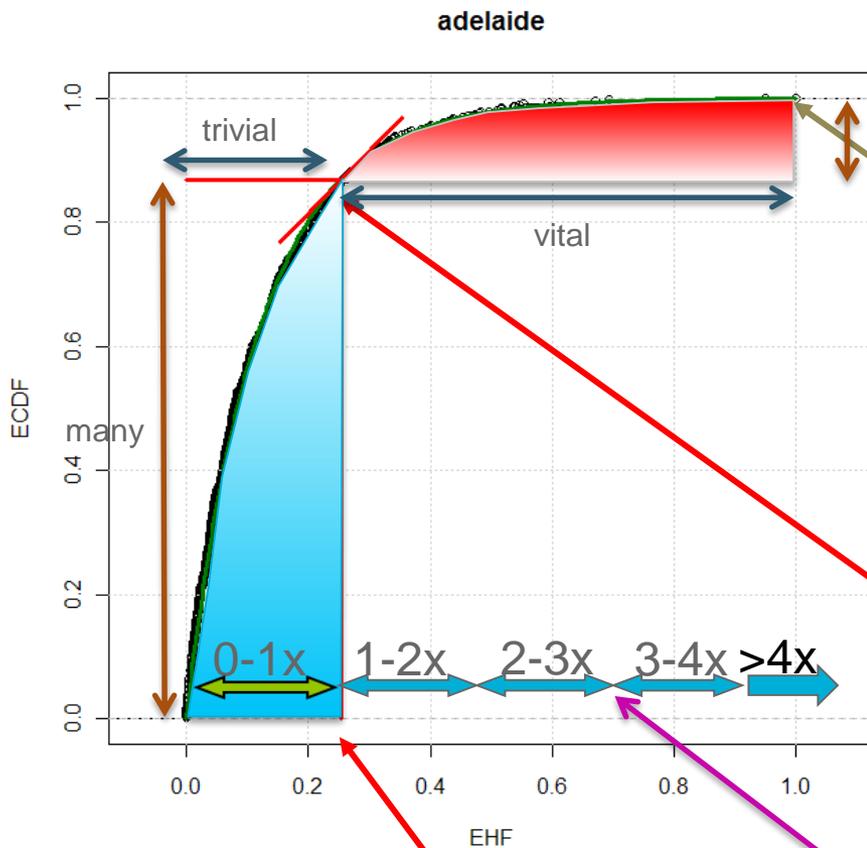
Integrated EHFL  
November 2014  
Australian Bureau of Meteorology

Maximum Severity  
November 2014  
Australian Bureau of Meteorology





# Severe & Extreme heatwave threshold



Generalized Extreme Value theory  
utilizing Peaks over Threshold

Generalized Pareto distribution function  
– suited to fat tail distributions

80:20 rule for rareness or severity of  
heatwave intensity

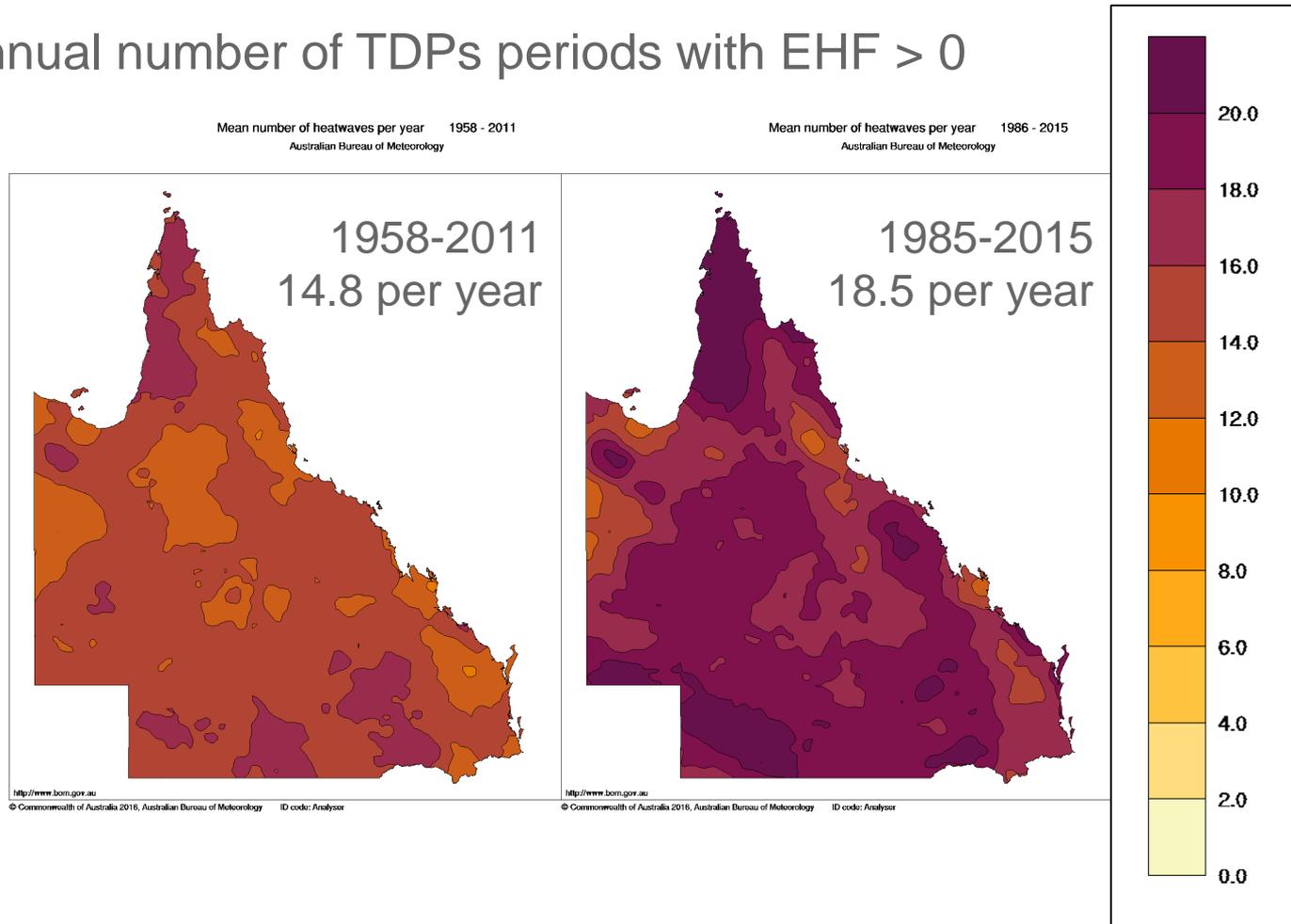
Severe threshold

Extreme threshold



# heatwave climatology in Queensland

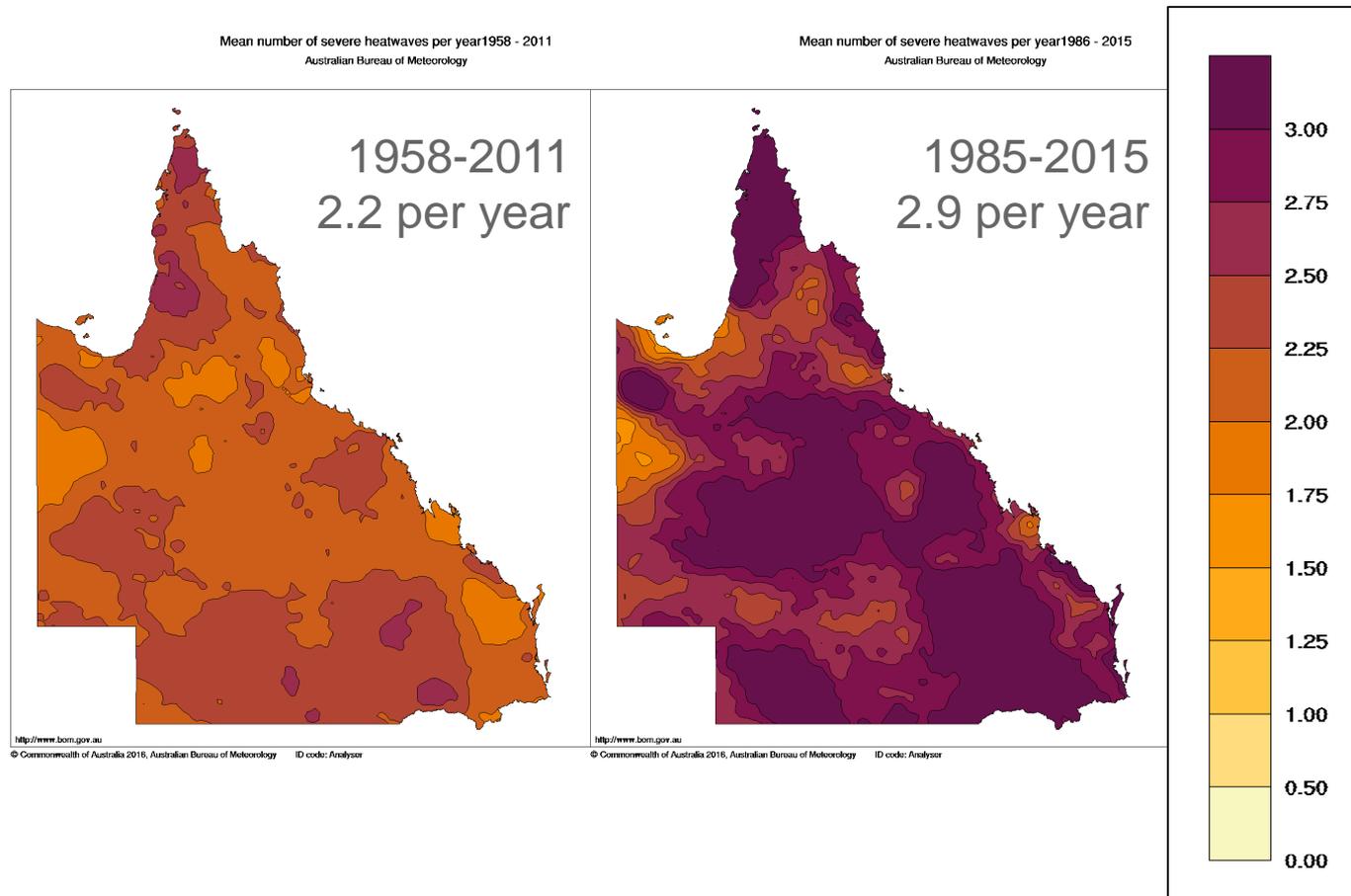
- Average annual number of TDPs periods with EHF > 0





# severe heatwave climatology in Queensland

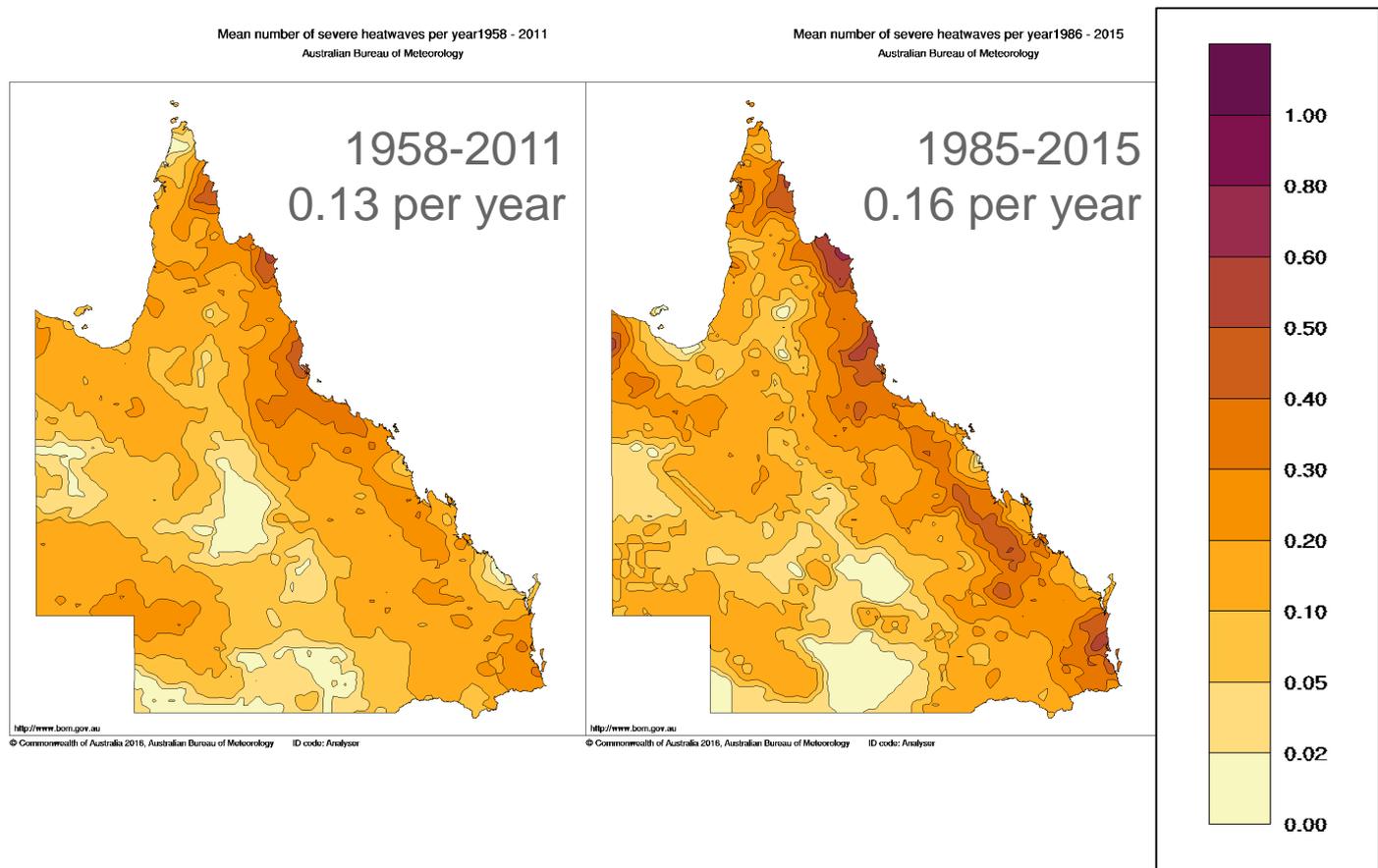
- Average annual number of TDPs periods with  $EHF > EHF_{85}$





# extreme heatwave climatology in Queensland

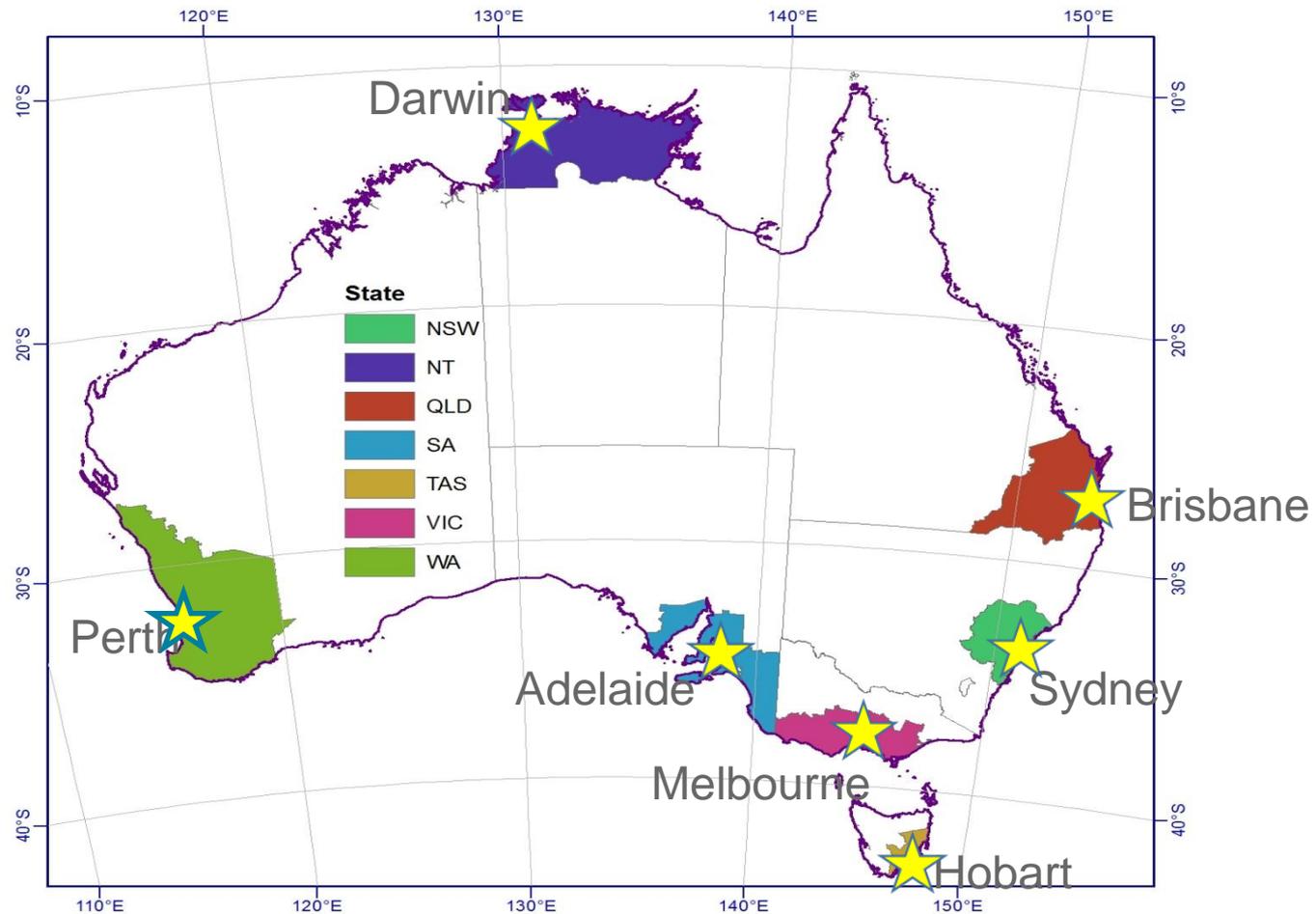
- Average annual number of TDPs periods with  $\text{EHF} > 3 \text{ EHF}_{85}$





# heatwave severity trends

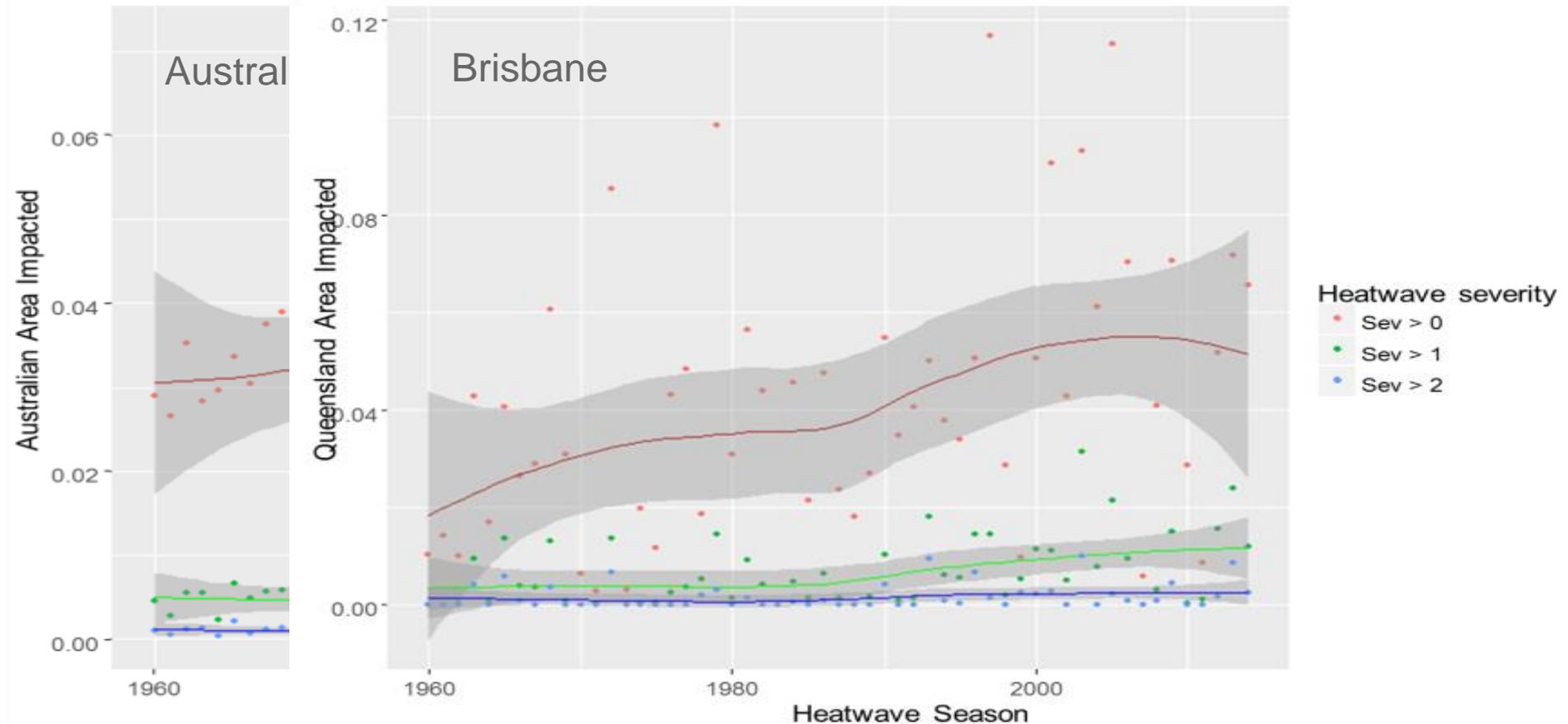
- Capital city region trends





# heatwave severity trends

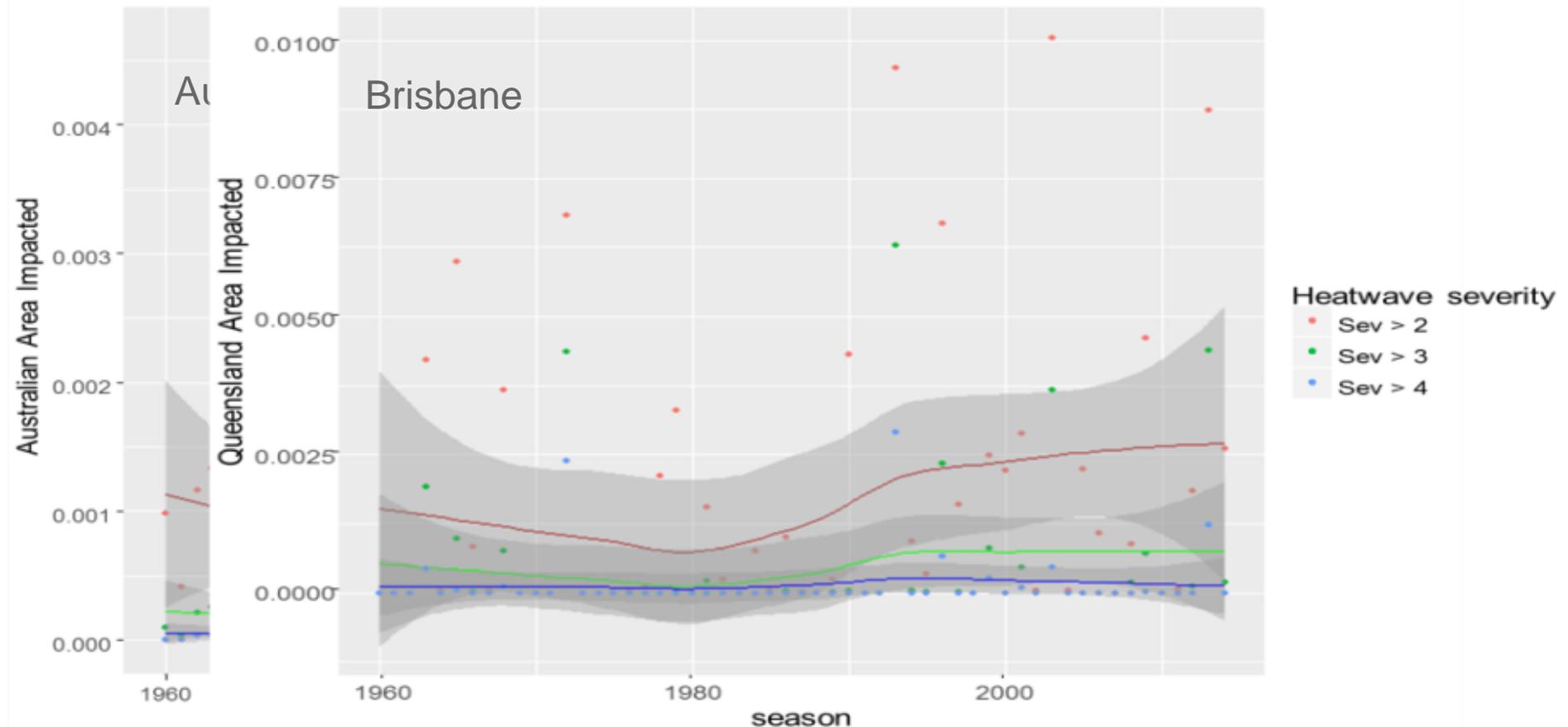
- proportion of region by financial year for severity levels 0, 1 and 2





# heatwave severity trends

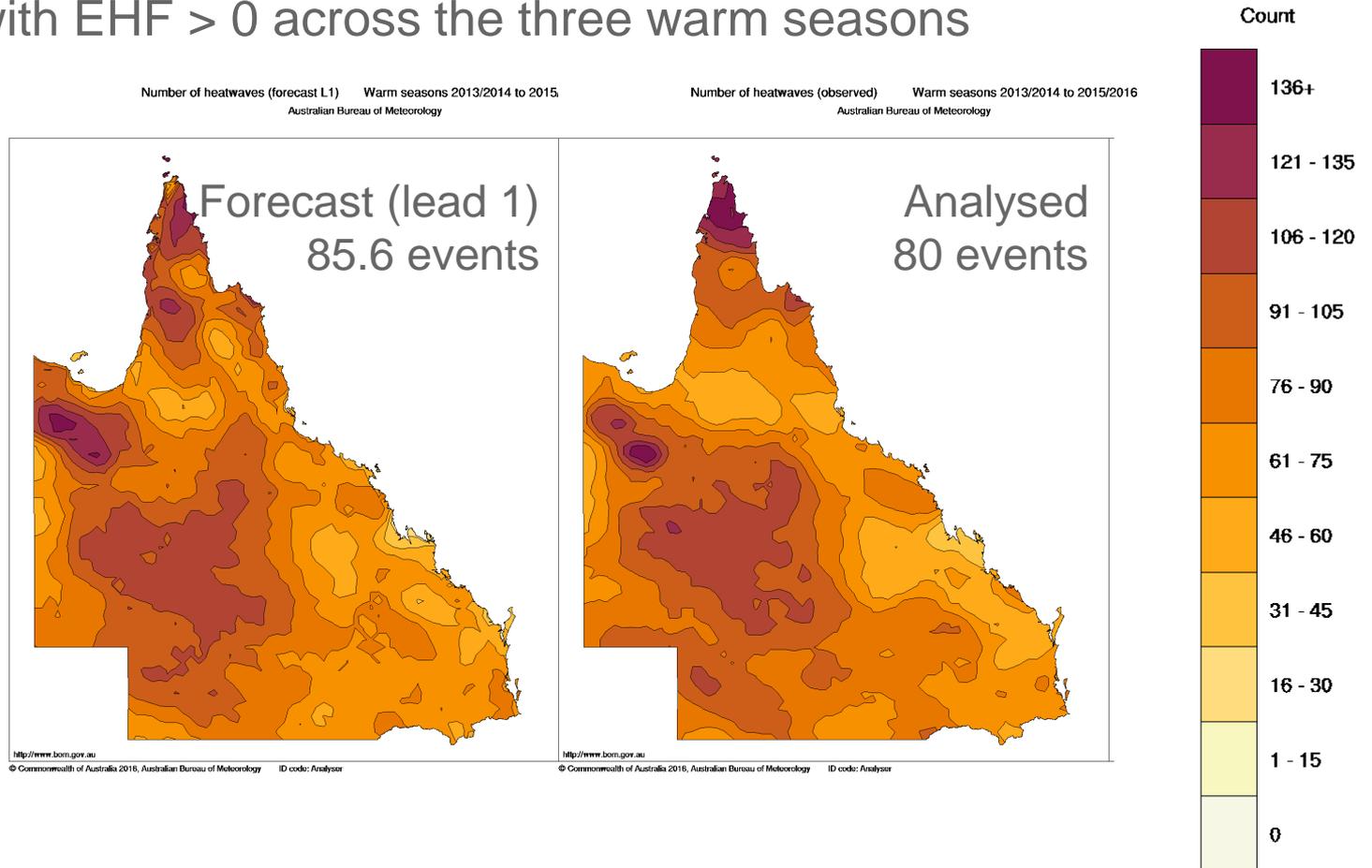
- proportion of region by financial year for severity levels 2, 3 and 4





# forecast heatwave performance

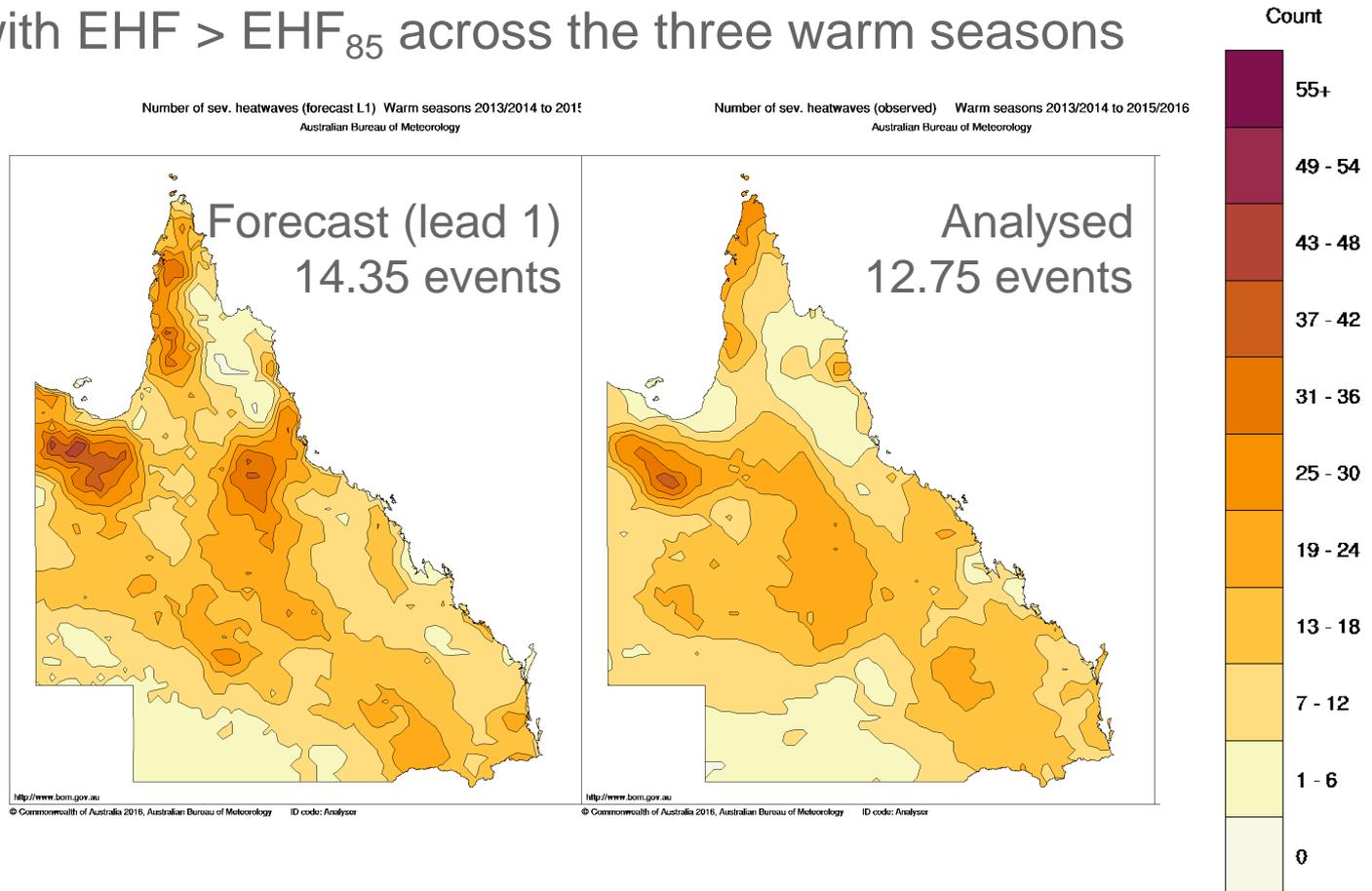
- TDPs with EHF > 0 across the three warm seasons





# forecast severe heatwave performance

- TDPs with  $EHF > EHF_{85}$  across the three warm seasons





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# summary points

- Queensland has experienced a significant rise in severe heatwaves since the 1980s
- Contemporary Queensland heat health exposure/response studies are encouraged to further test the utility of the Bureau's heatwave intensity/severity system. (NB. WA, NSW & SA studies in prep) SA Health, SA Ambulance pubs.
- International collaborations in America (projections for 209 US cities), France (1970-2015) and the UK (Global Hazard Map)
- The Bureau of Meteorology's Heatwave Service is gaining support as an alerting indicator for health and emergency management sectors



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# additional points

- ANZEMC's Hazard Services Forum has endorsed the formation of a heatwave warning working group
- A national workshop on a heatwave warning framework is planned for mid to late (19) October 2016 in Adelaide



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Thank you...

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