ELECTRICITY SECTOR CLIMATE INFORMATION PROJECT

Developing extreme/compound weather scenarios for risk assessments – *an example from the electricity sector*

Australian Government
Department of Industry, Science, Energy and Resources

CSIRO

AEMO
AUSTRALIAN ENERGY MARKET OPERATOR

Australian Government
Bureau of Meteorology

The ESCI project:

- The Australian Government is providing $6.1 million over 3 years, to June 2021, to improve climate and extreme weather information for the electricity sector.
- The project is designed to improve the reliability and resilience of the National Electricity Market (NEM) to the risks from climate change and extreme weather.
- The project will tailor climate change data and information to ensure it's usable by the people who need it, to support improved long-term climate risk planning for electricity infrastructure.

Tailored climate information to support industry decision-making

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Hazards:

- Temperature
- Wind
- Bushfire
- Precipitation

1. Trends in key climate variables affecting supply and demand:

Time series with high temporal and spatial resolution.

2. High-impact weather Simulations:

Compound or coincident extreme synoptic weather events.

3. Regional thresholds for key climate variables:

Probability of exceedance for temperature, wind gusts, FFDI

Long-term risk (2030-2060+)

- Reliability
- Resilience
- Operating risk

Standardised approach to developing climate scenarios including understanding of uncertainty and confidence

Constructing **compound** extreme weather scenarios

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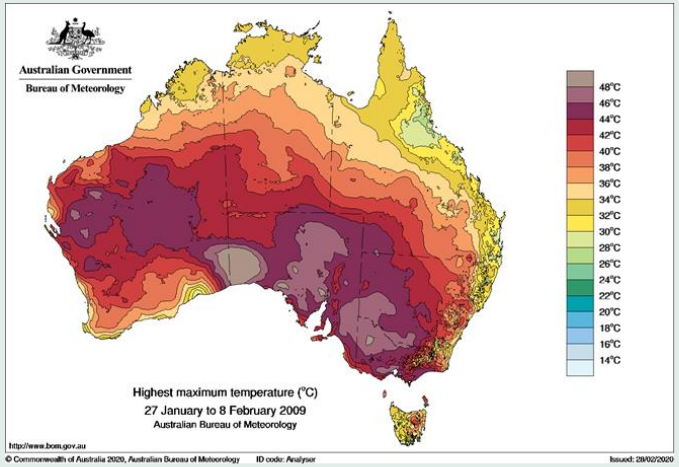
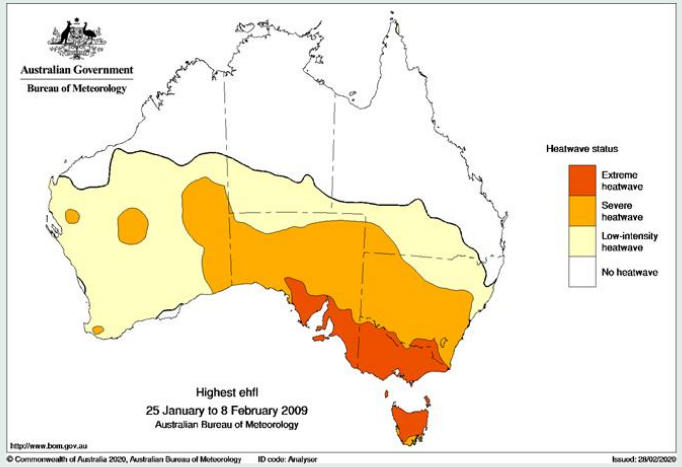
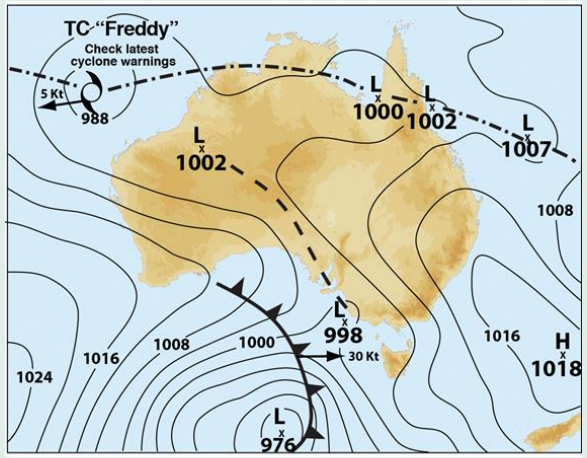
ESCI project consultation identified the key vulnerabilities of the power system to extreme weather events:

1. Direct (destructive) physical **threats to critical infrastructure**
2. **Loss of generation** due to impact of weather on both renewable generation and other generation sources
3. **Reduction in electricity supply** due to impact of weather on power distribution and transmission assets
4. **Increase in customer demand** due to extreme heatwave conditions

Qualitative scenario: developed based on lived experiences (e.g., "*like Black Saturday but hotter again*")



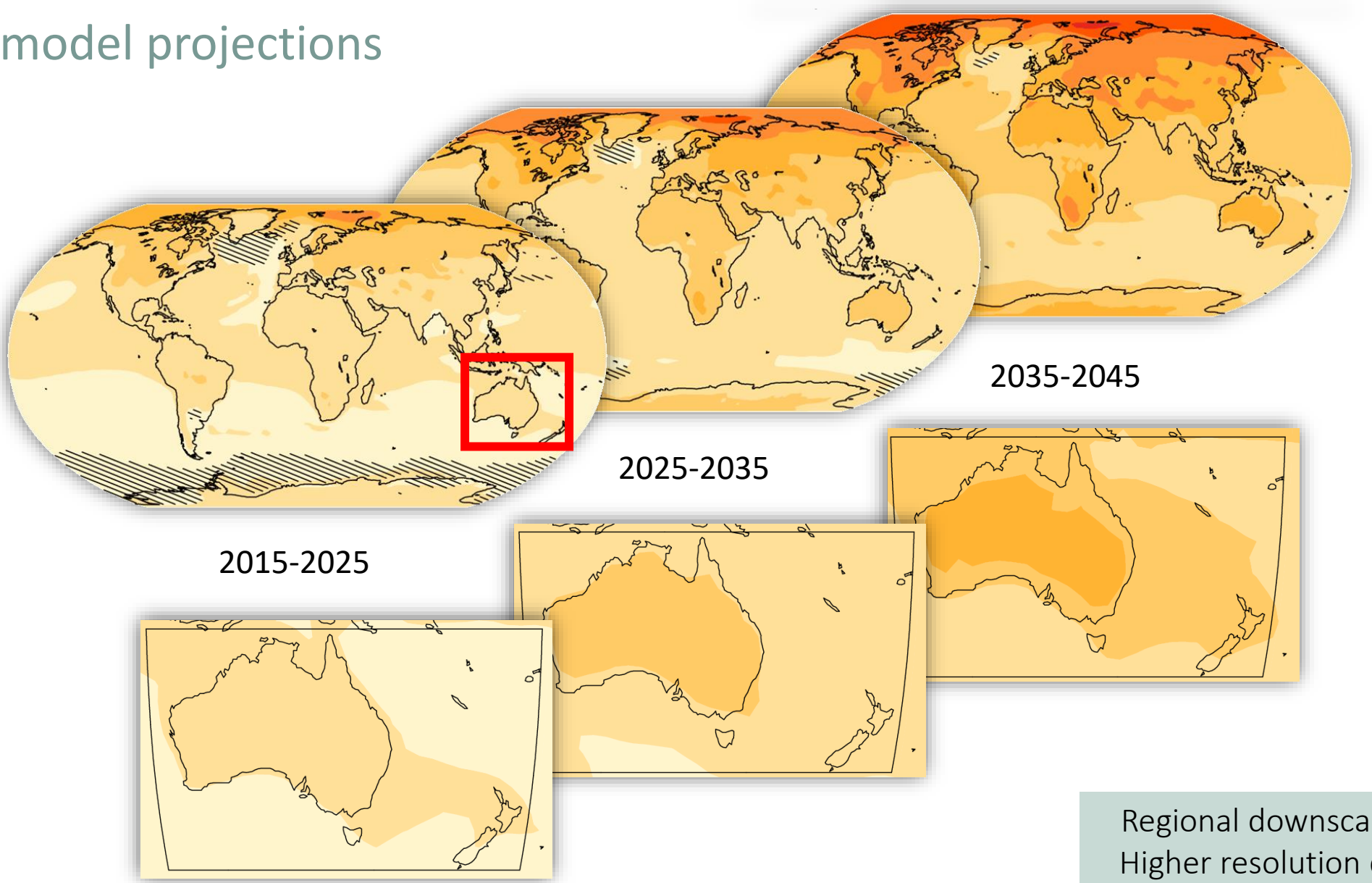




Persistent heat over large parts of SE Australia …

… followed by a strong cold front

Climate model projections



Regional downscaling:
Higher resolution data
(spatial and temporal)

Identifying an extreme event from model projections

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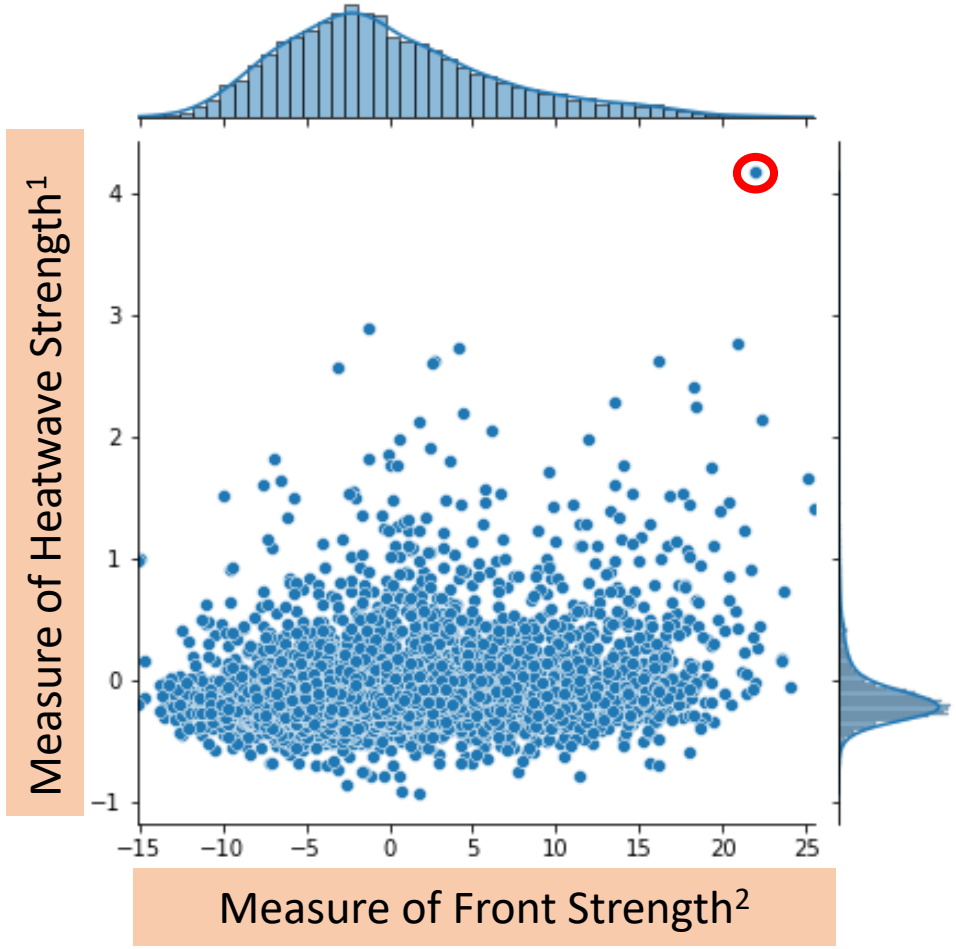

1. Excess Heat Factor – Adapted from: Nairn and Fawcett 2015. The Excess Heat Factor: a metric for heatwave intensity and its use in classifying heatwave severity. *Int. J. Environ. Res. Public Health*.
2. Delta-Tmax - Adapted from: Reeder et al. 2015. Rossby waves, extreme fronts and wildfires in southeastern Australia. *Geophys. Res. Lett.*

Scenario A: multi-jurisdictional heatwave and elevated fire danger

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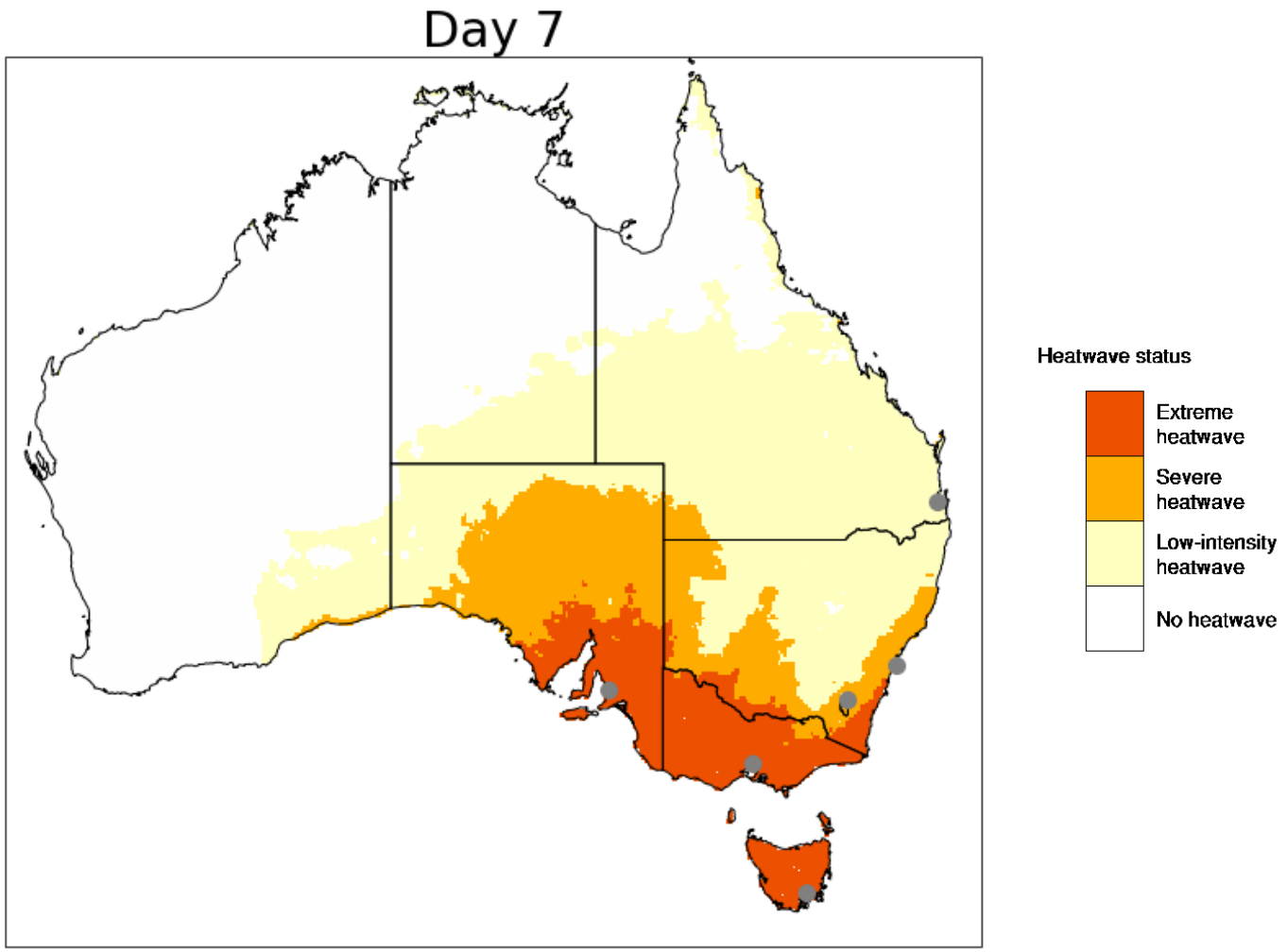
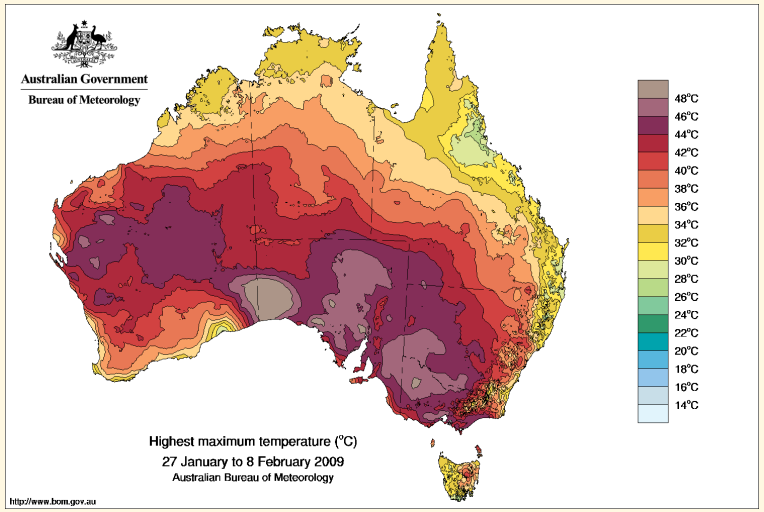
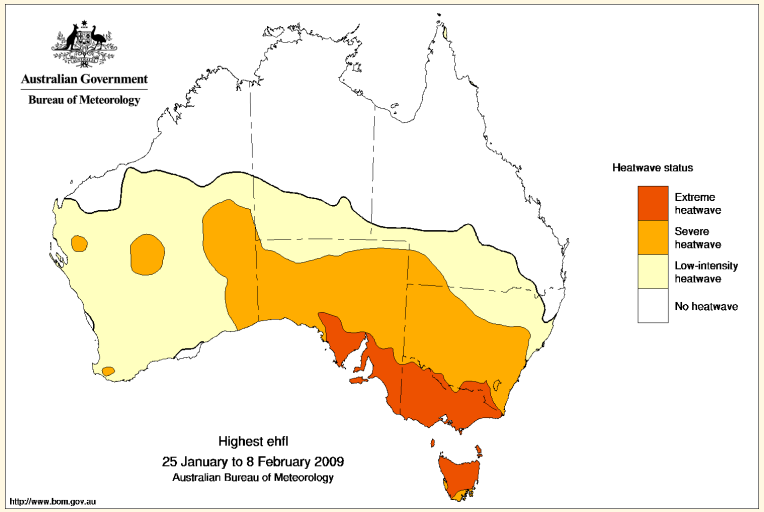
Heatwave status	
Melbourne	*Extreme*
Adelaide	*Extreme*
Sydney	*Extreme*
Hobart	*Extreme*
Canberra	*Severe*

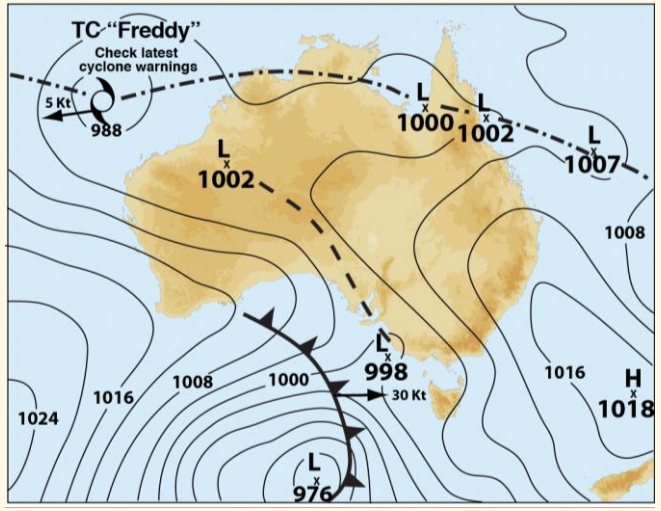
Passage of strong frontal system in late afternoon – elevated fire danger

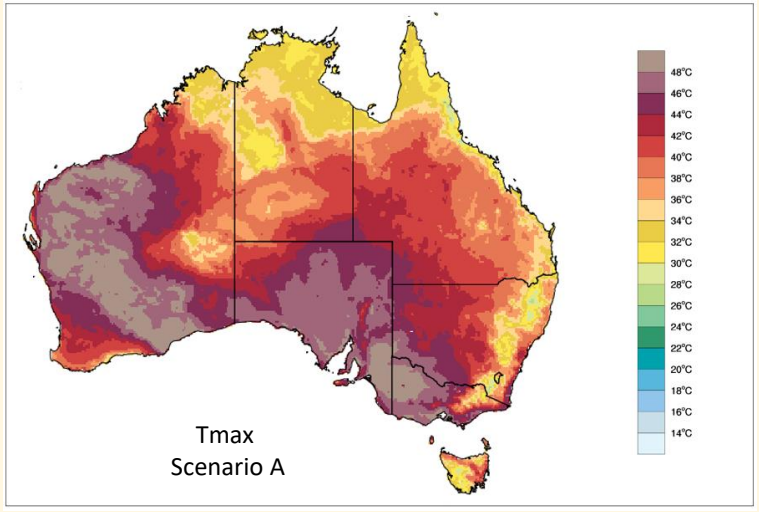


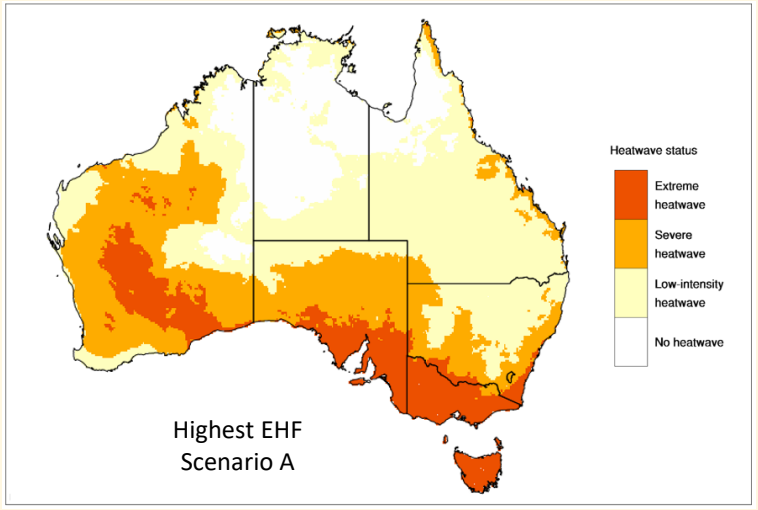
Comparison: Black Saturday and Scenario A

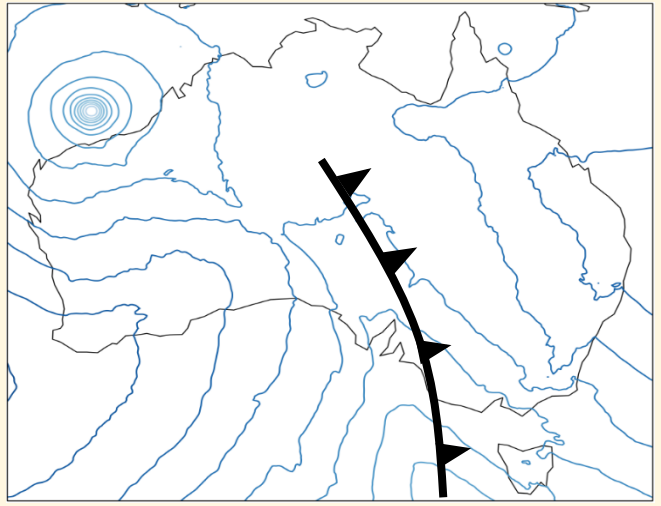












Testing the resilience of the electricity grid

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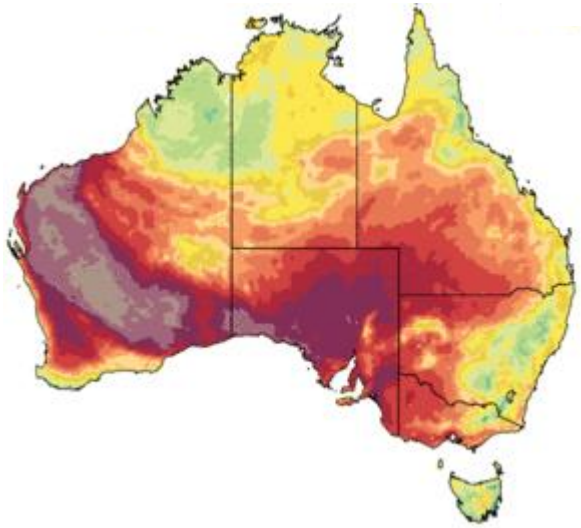

Climate risk planning for electricity infrastructure

This information can be used by the sector to estimate the cost and consequence of extreme events as an input to investment planning decisions.

Summary

The ESCI team has demonstrated a methodology for identifying extreme and compound events in the climate projections and provided the sector with a quantitative case study of a compound weather event based on the weather *signature* of "Black Saturday" in February 2009.

- Ideally the electricity sector needs a suite of compound extreme case studies for stress testing the infrastructure.
- Producing a suite of quantitative case studies from the climate projections is a very resource intensive exercise.
- The innovative approach piloted by the project has demonstrated that it can be done, however scaling this up to sample the full range of possible events (with likelihood estimates), requires a large ensemble of climate projections and significant scientific resources.
- This is beyond the resources of the ESCI project but is likely to be of broad benefit to many sectors, including the emergency management sector, but in particular the electricity sector.

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