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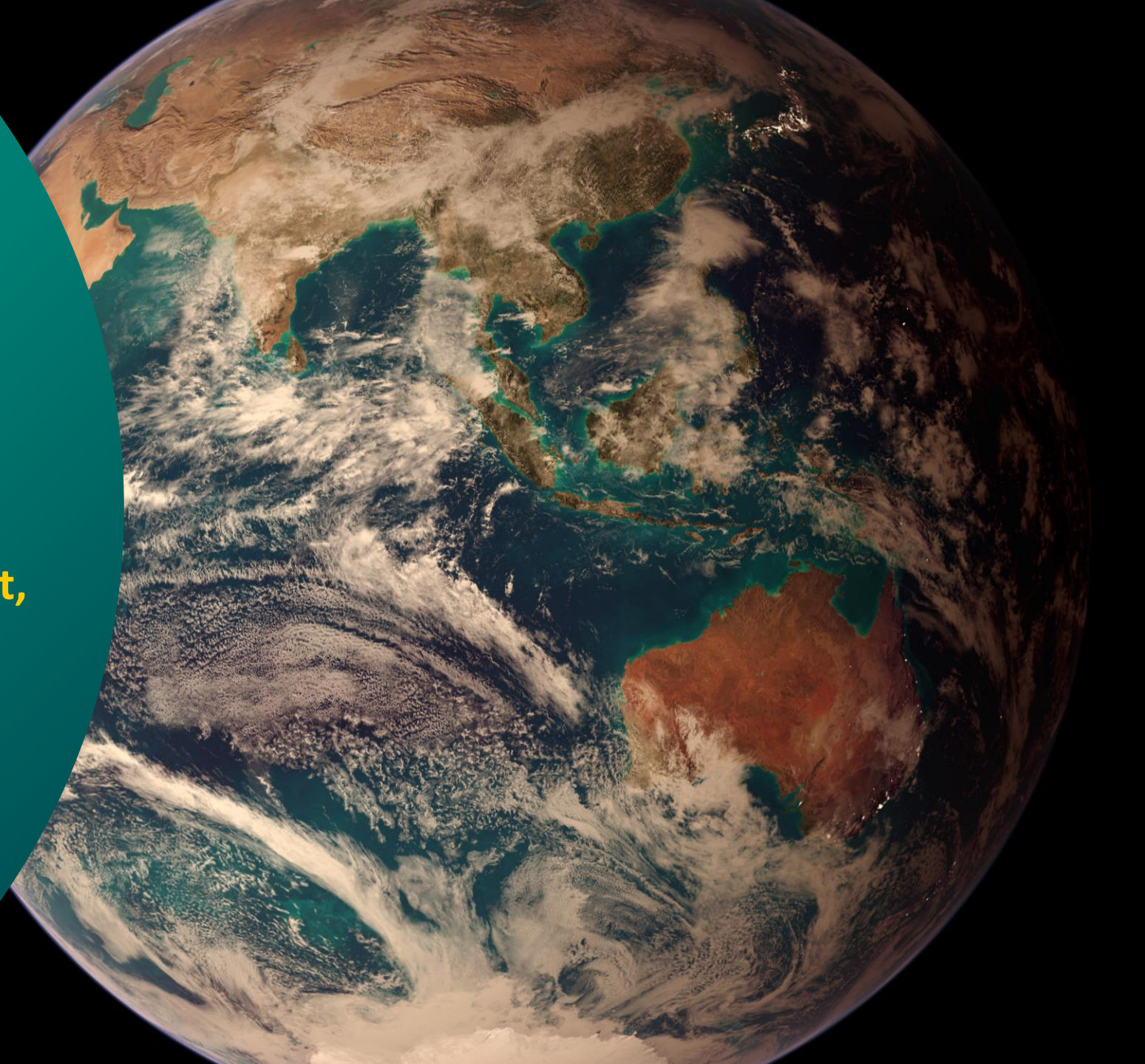
Unlocking Climate Indices

A deep dive into the development, science, and applications in insurance



All Actuaries Summit 2024, Gold Coast

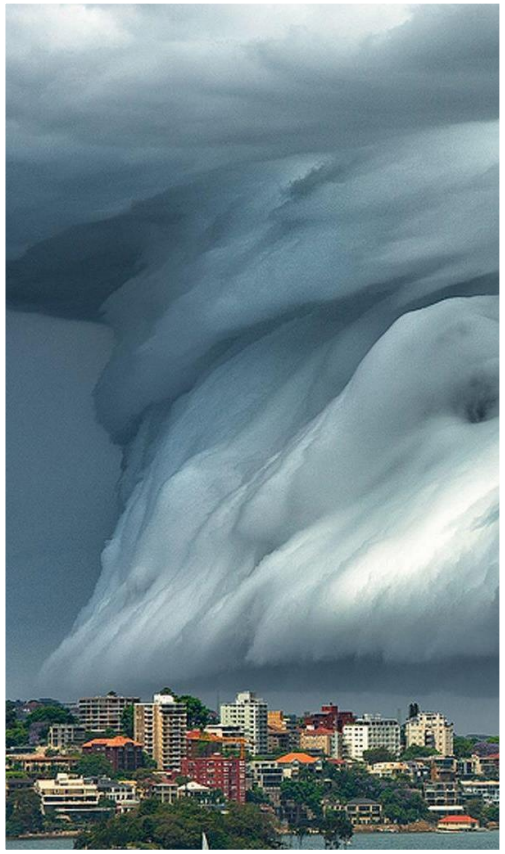
3 May 2024

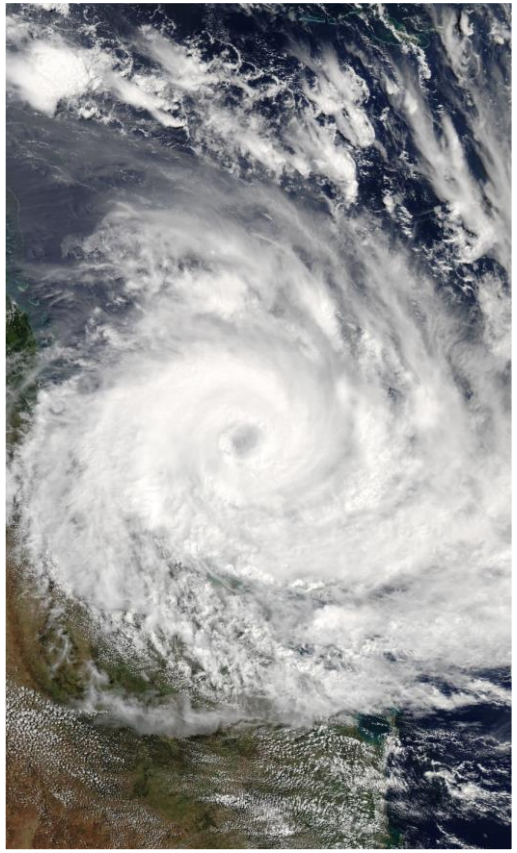
SUNCORP GROUP LIMITED
ABN 66 145 290 124

General Insurance Pricing and Natural Perils Risk

Finding the signal in the chaos







Other **Key Functions**

Atmos. Meas. Tech., 17, 407–422, 2024
https://doi.org/10.5194/amt-17-407-2024

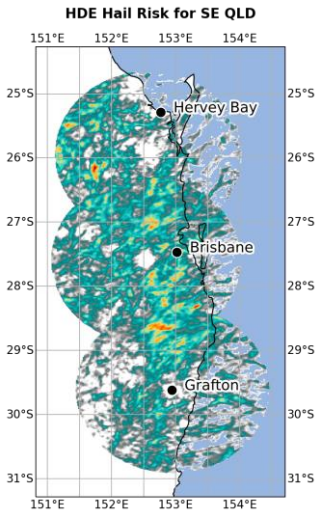
Atmospheric Measurement Techniques Open Access EGU

Radar and environment-based hail damage estimates using machine learning

Luis Ackermann[1], **Joshua Soderholm**[1], **Alain Protat**[1], **Rhys Whitley**[2], **Lisa Ye**[2], **and Nina Ridder**[2]
[1]Australian Bureau of Meteorology, Melbourne, Victoria 3001, Australia
[2]Suncorp Group Limited, Brisbane, Queensland 4000, Australia

Correspondence: Luis Ackermann (luis.ackermann@bom.gov.au)

Received: 27 July 2023 – Discussion started: 31 July 2023
Revised: 3 October 2023 – Accepted: 12 November 2023 – Published: 19 January 2024



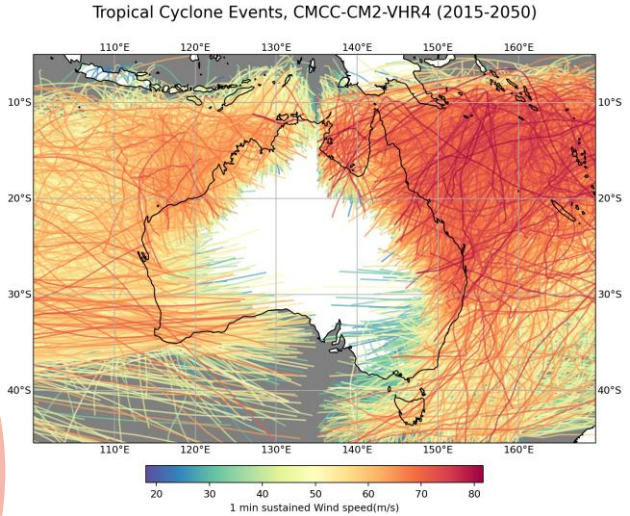
Source of '**truth' on climate** and weather extremes.

Seasonal Outlooks

Weather Monitoring

Supporting **research** and **collaborating** with the scientific community.

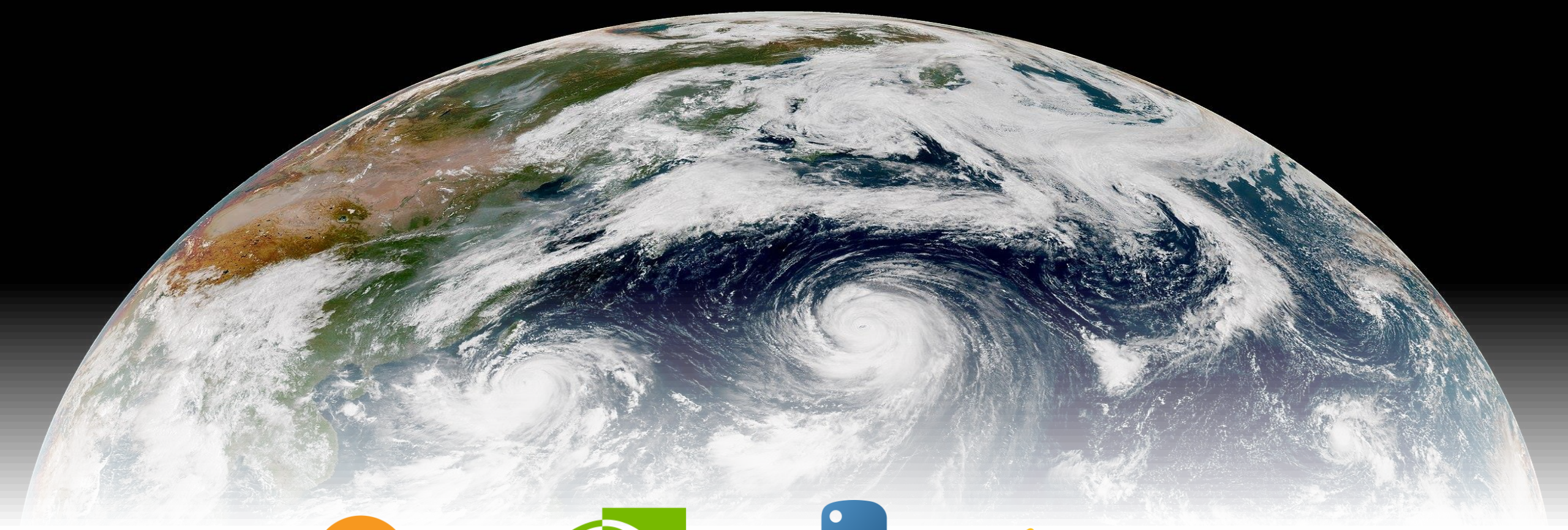
Climate Chance **Scenario Analysis** and **Disclosures.**



Resilience & **Mitigation**

Cost-benefit & affordability Analysis

Scenario Analysis



AWS

NVIDIA

dask

The Bureau of Meteorology

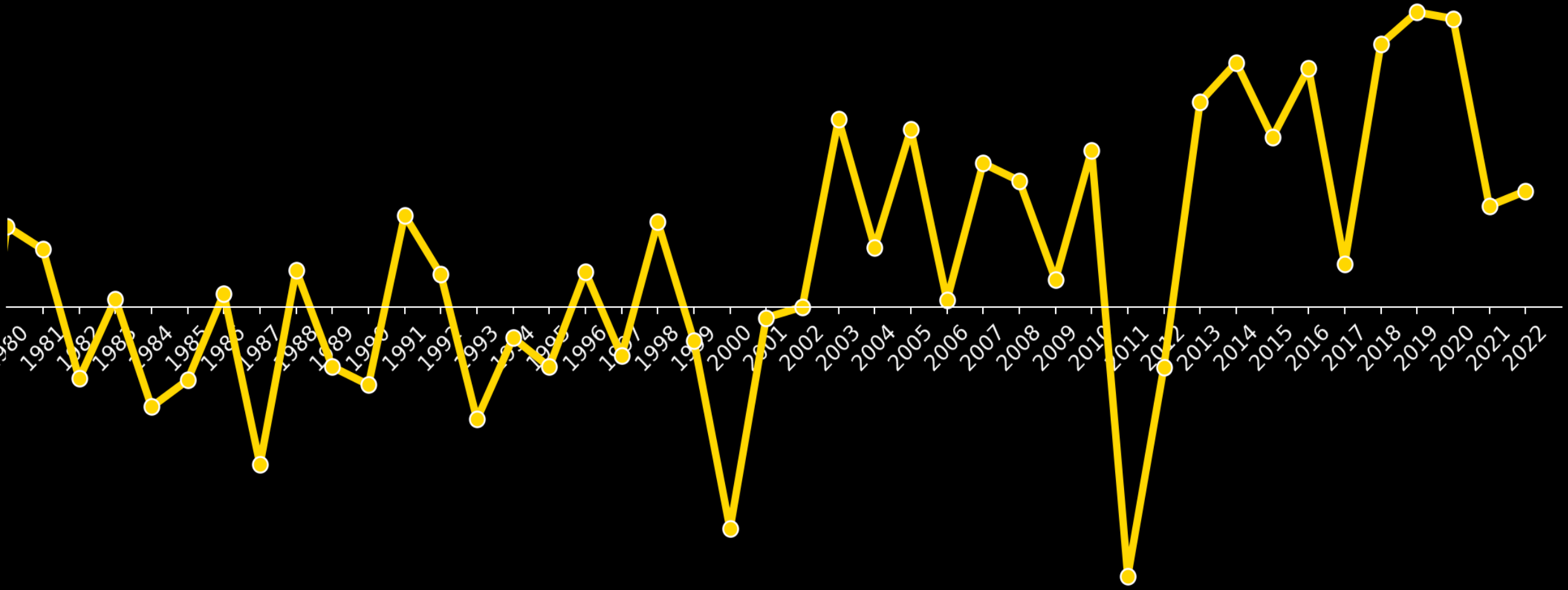
NASA

ECMWF

Japan Weather Association

The Changing Risk Landscape

National Max Temperature
(ERA5 1979-2021)



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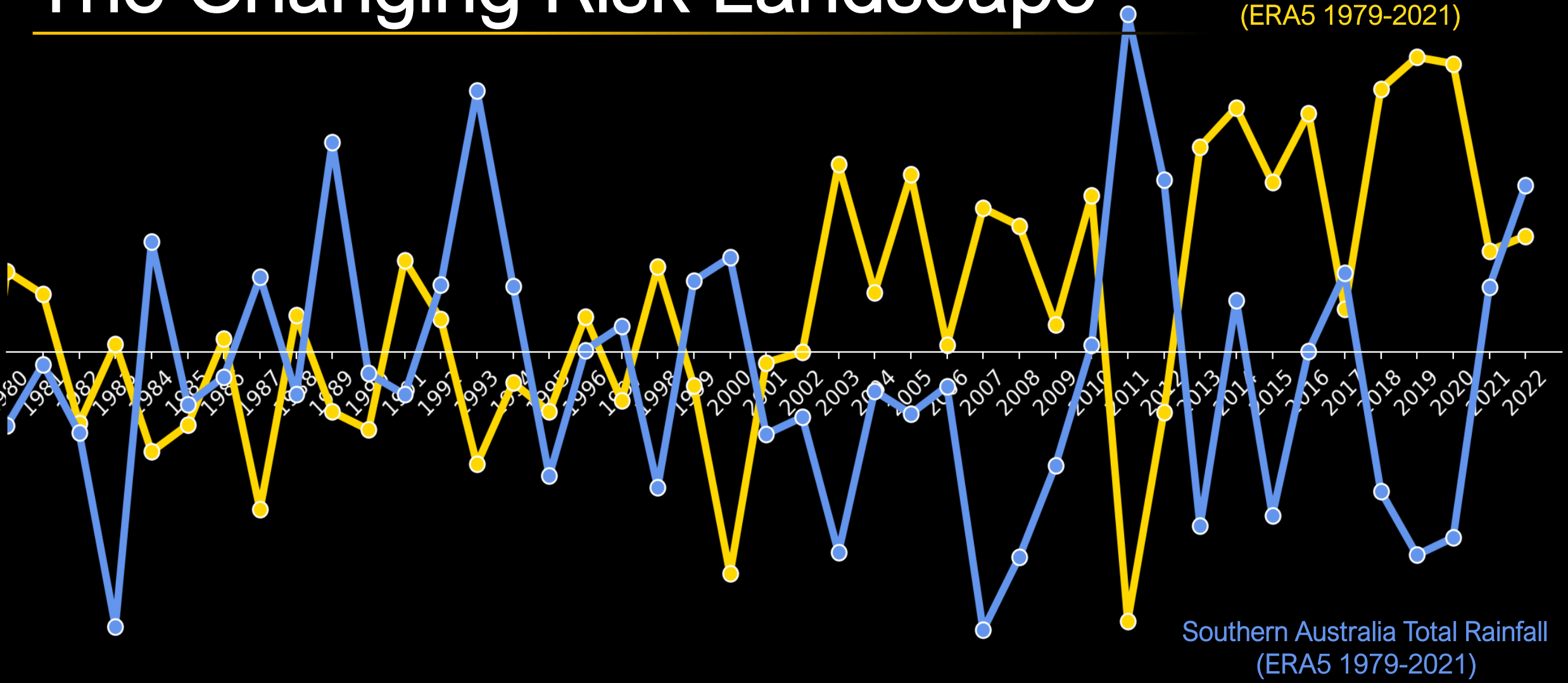
The Changing Risk Landscape



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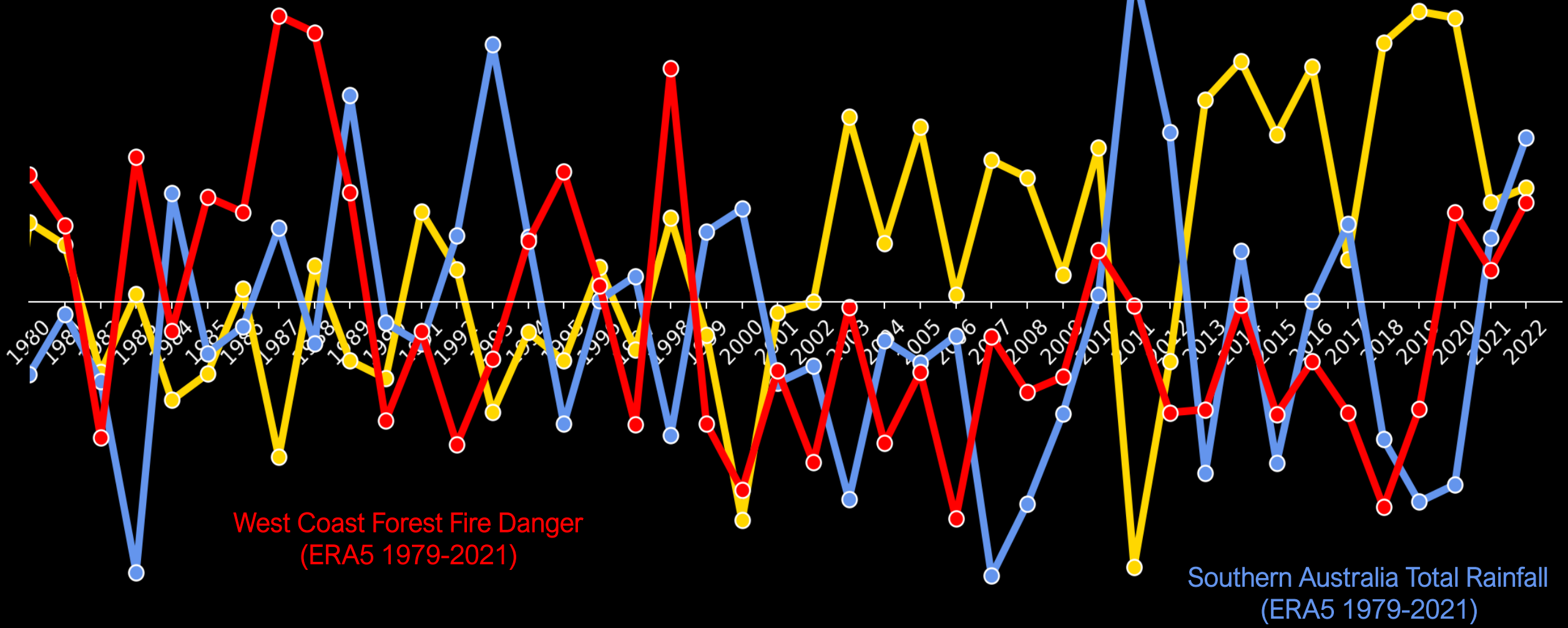
The Changing Risk Landscape



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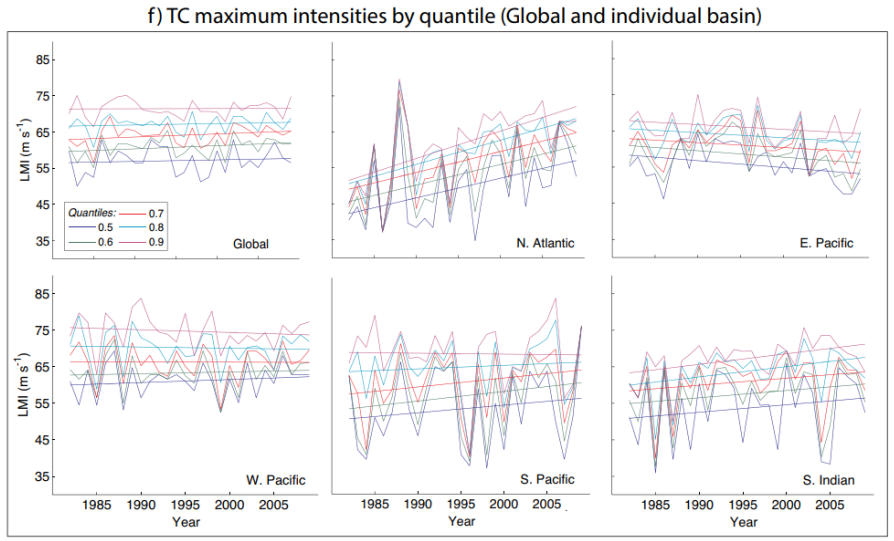
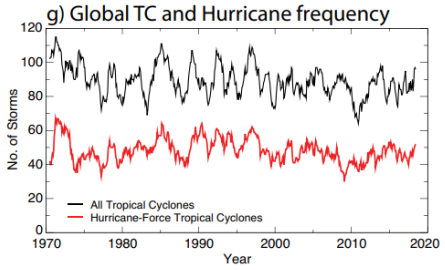
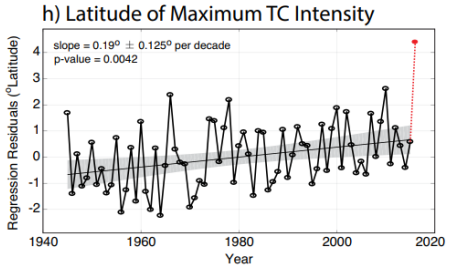
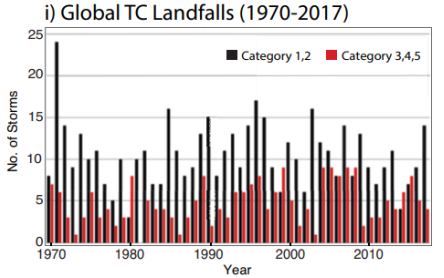
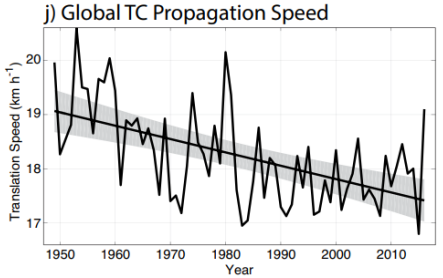
The change is complex // **examples**

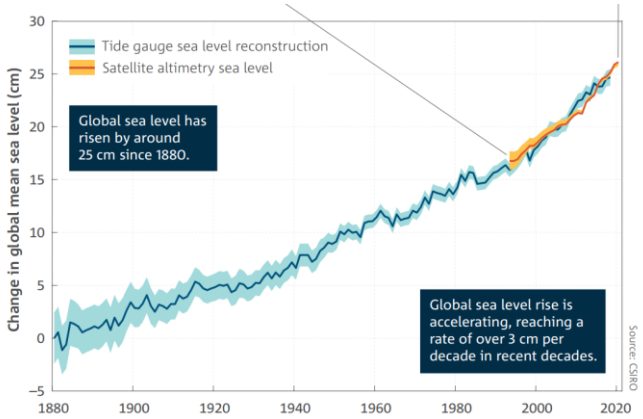




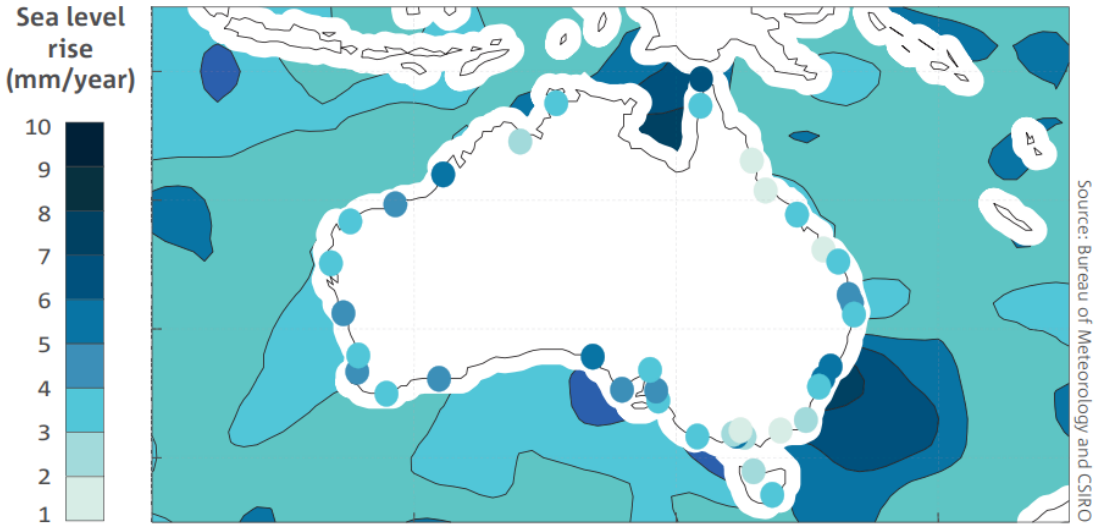








State of the Climate 2022, Bureau of Meteorology, CSIRO, Australia



Knutson, T.R. et al., 2019: Tropical Cyclones and Climate Change Assessment: Part I: Detection and Attribution. Bulletin of the American Meteorological Society, 100(10), 1987–2007, doi:10.1175/bams-d-18-0189.1.

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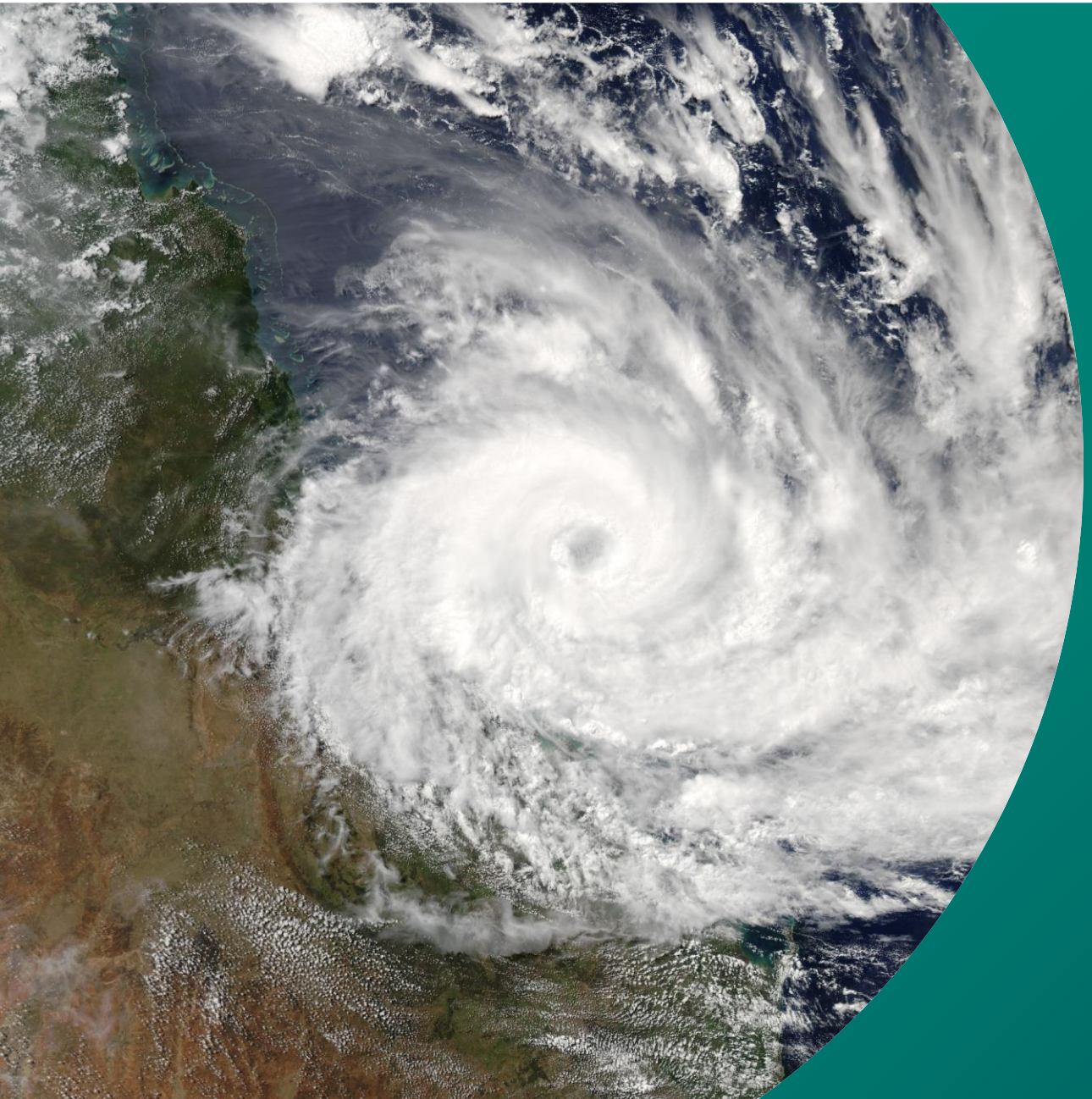
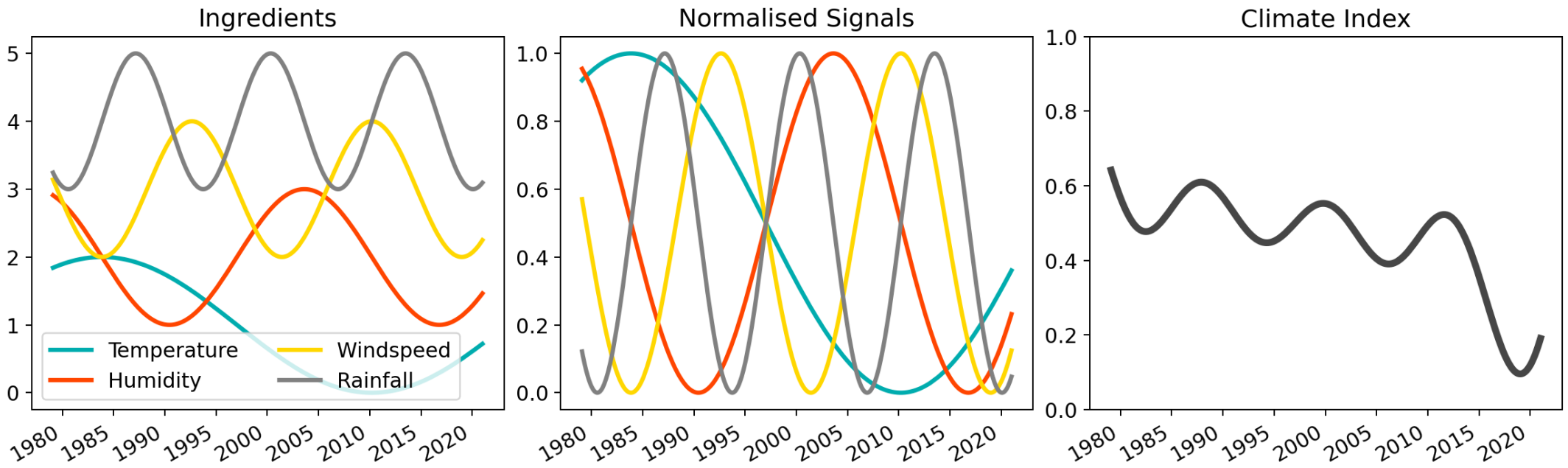


Climate Indices

Building indicators of change in severe weather

Encapsulating climate risk with indices

Producing a standard to which risk can be reasonably measured and assessed.



Hail Example

FEBRUARY 2023 RAUPACH ET AL. 545

An Improved Instability–Shear Hail Proxy for Australia

TIMOTHY H. RAUPACH,[a,b] JOSHUA SODERHOLM,[c] ALAIN PROTAT,[c] AND STEVEN C. SHERWOOD[a,b]

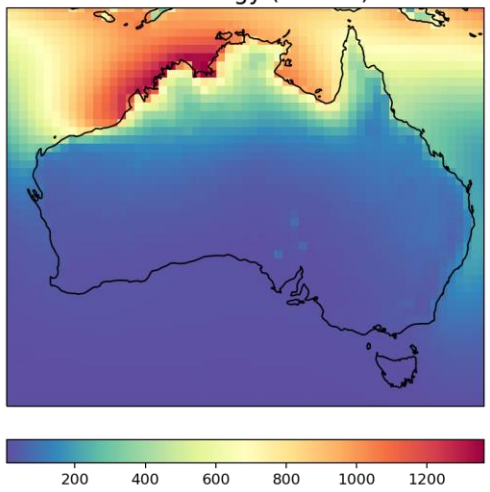
[a] *Climate Change Research Centre, University of New South Wales, Sydney, New South Wales, Australia*
[b] *ARC Centre of Excellence for Climate Extremes, University of New South Wales, Sydney, New South Wales, Australia*
[c] *Science and Innovation Group, Bureau of Meteorology, Melbourne, Victoria, Australia*

(Manuscript received 29 April 2022, in final form 14 September 2022)

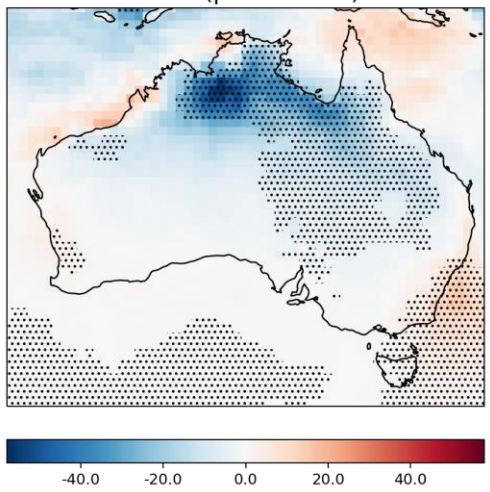
$$\mathrm{MLCAPE}_{100} \times \mathrm{S06}^{\alpha} \geq \beta$$

Atmospheric Instability (J/kg)

Climatology (annual)

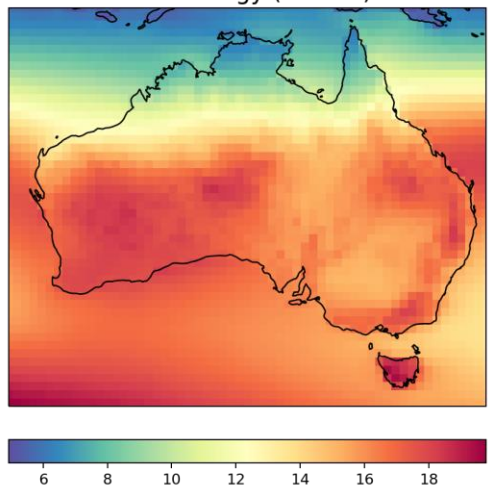


Trend (per Decade)

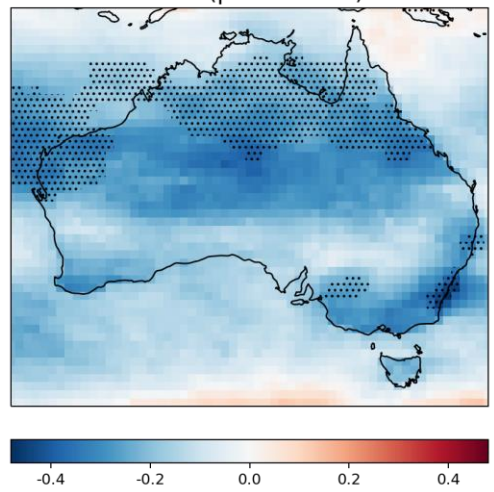


Wind Shear (m/s)

Climatology (annual)

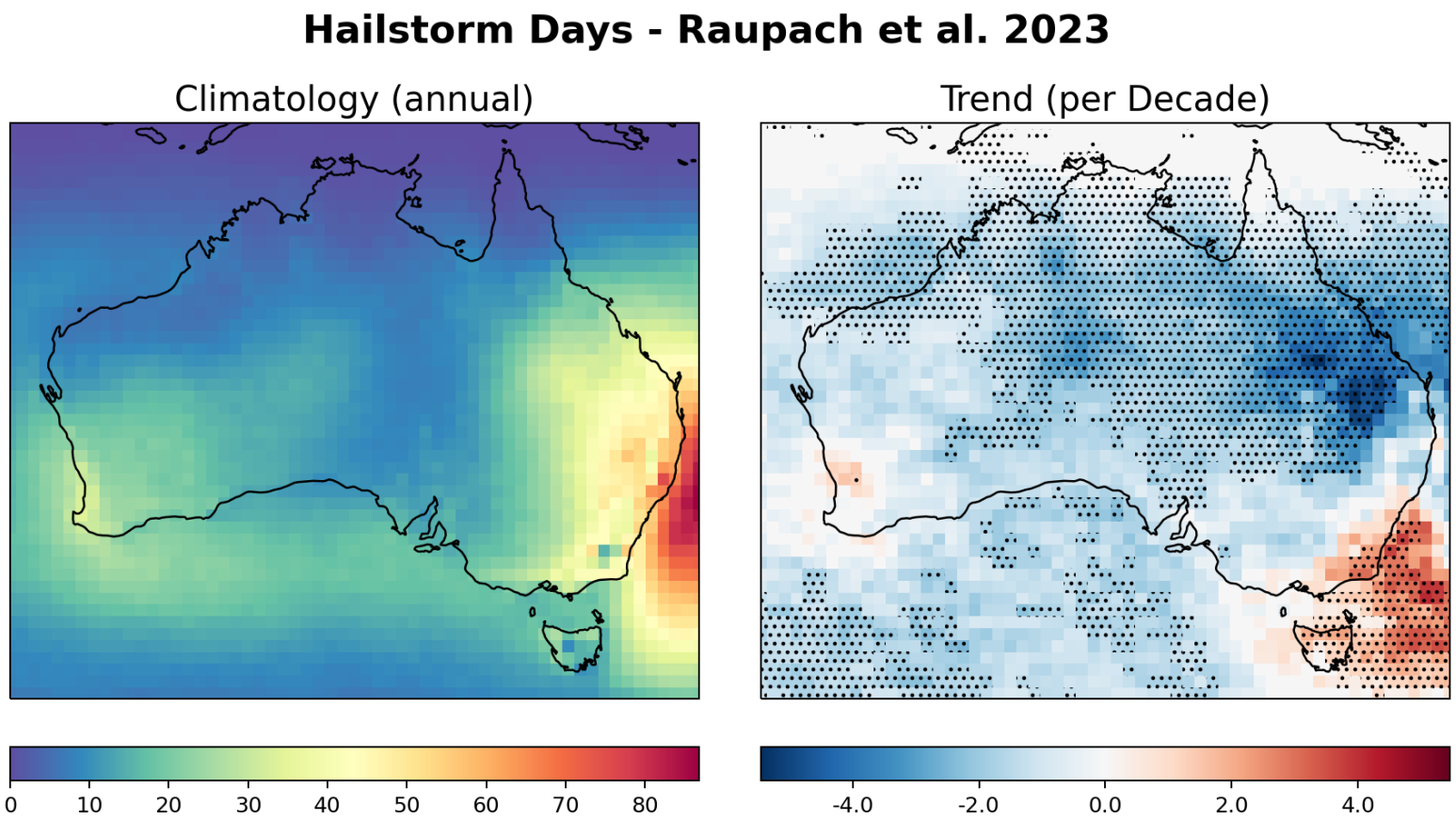


Trend (per Decade)



Hail Example

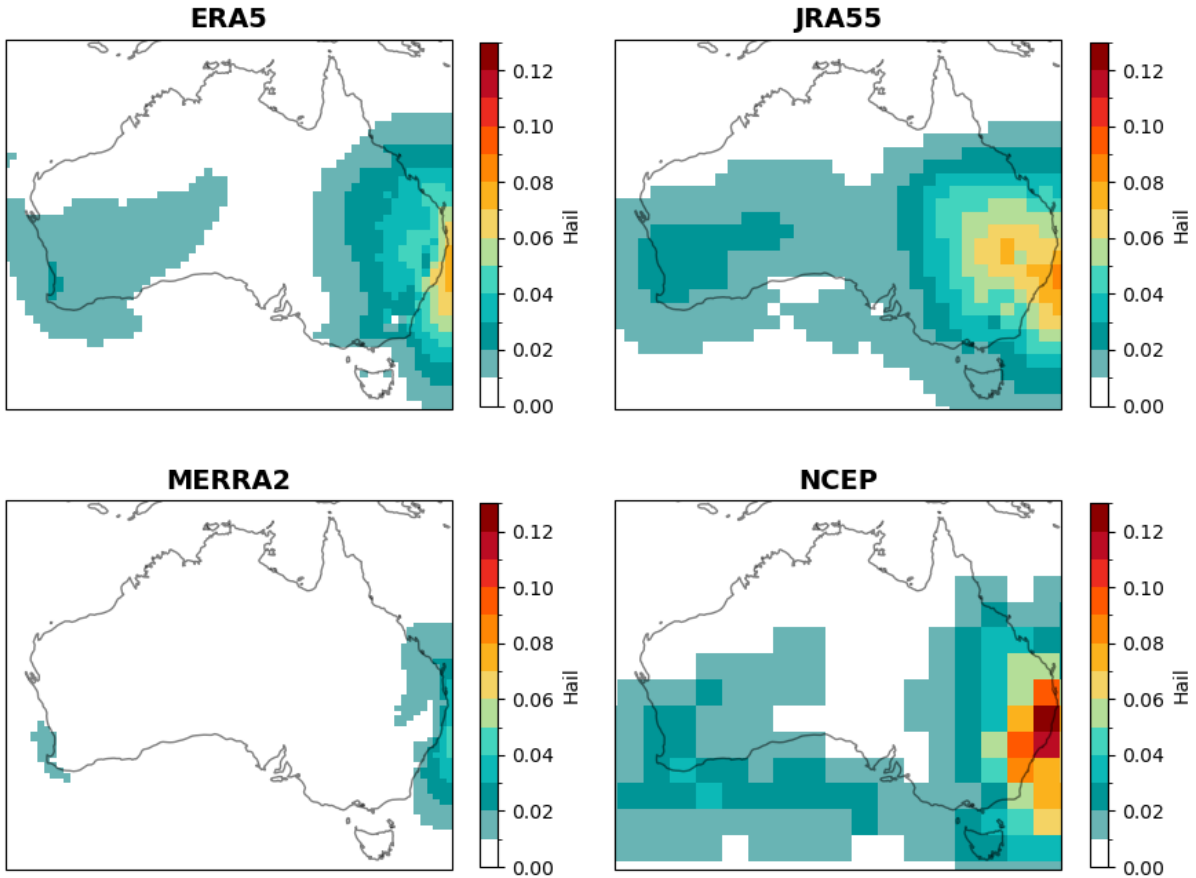
Index highlights regionally where hail risk is the most likely in Australia and how this has changed since 1979.



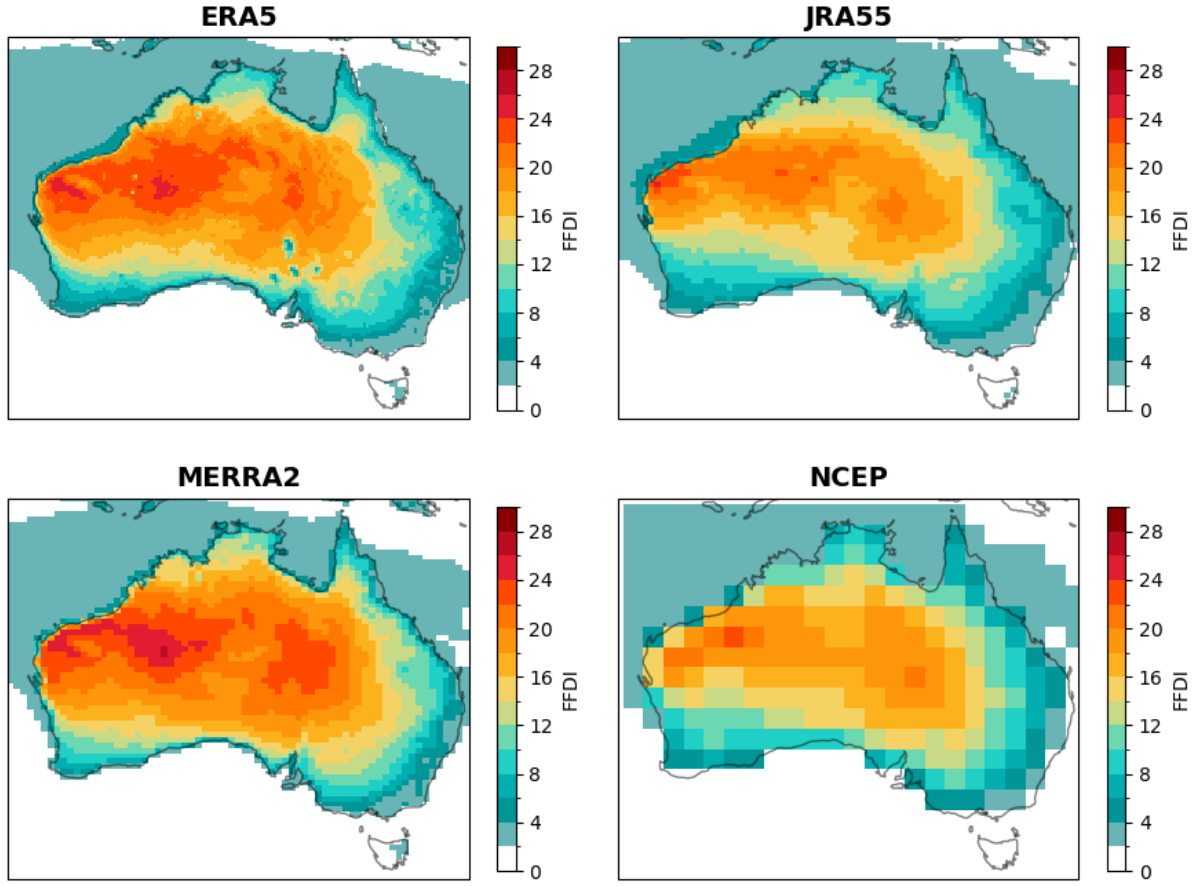
The scale and quality of information matters

Views of climate risk will be dependent on how well the reanalysis can resolve climate dynamics.

Hail Risk

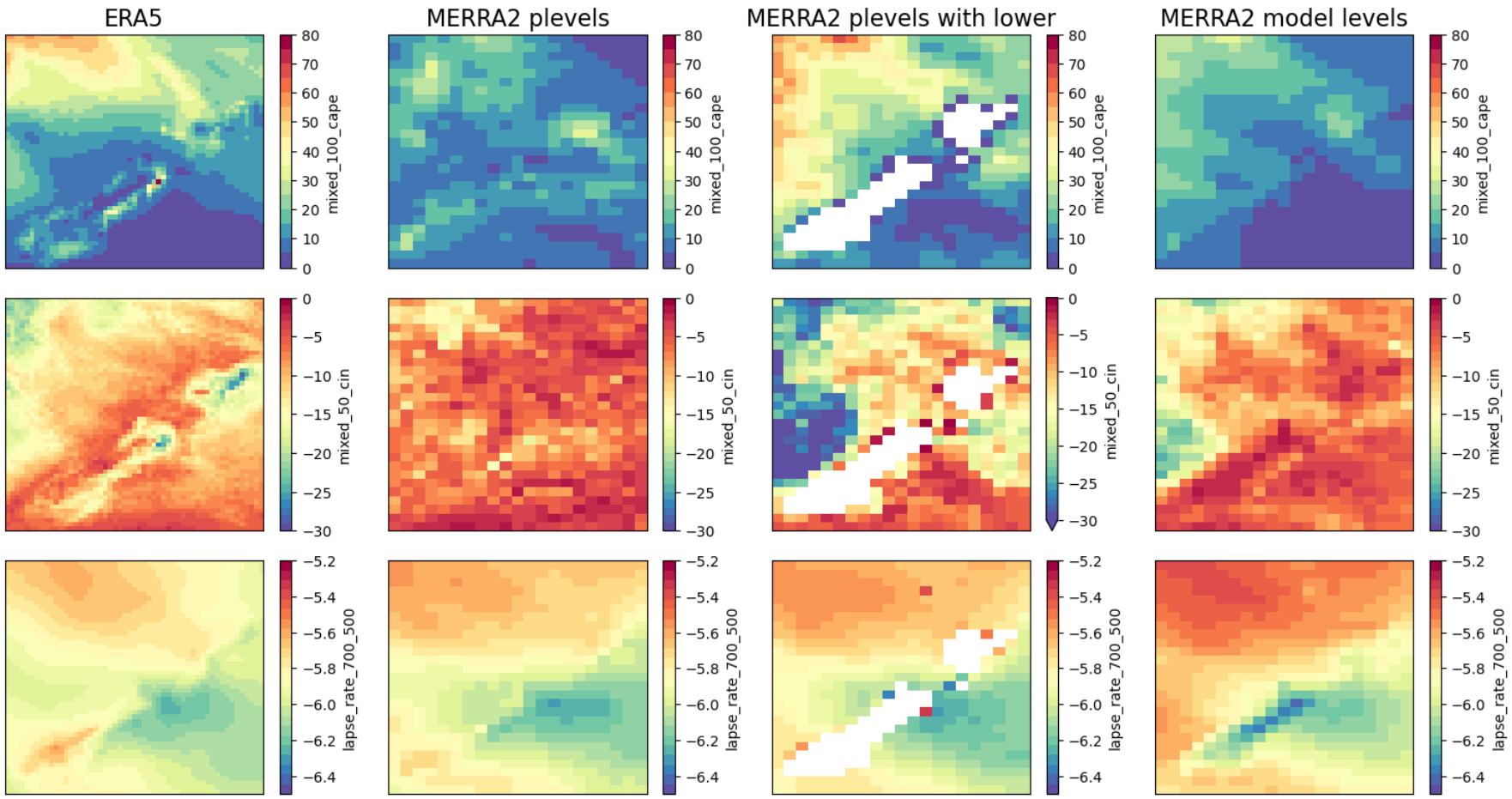


Bushfire Risk



While simple in design, complex to implement

Processing +20TB of gridded climate information is fraught with problems to the uninitiated

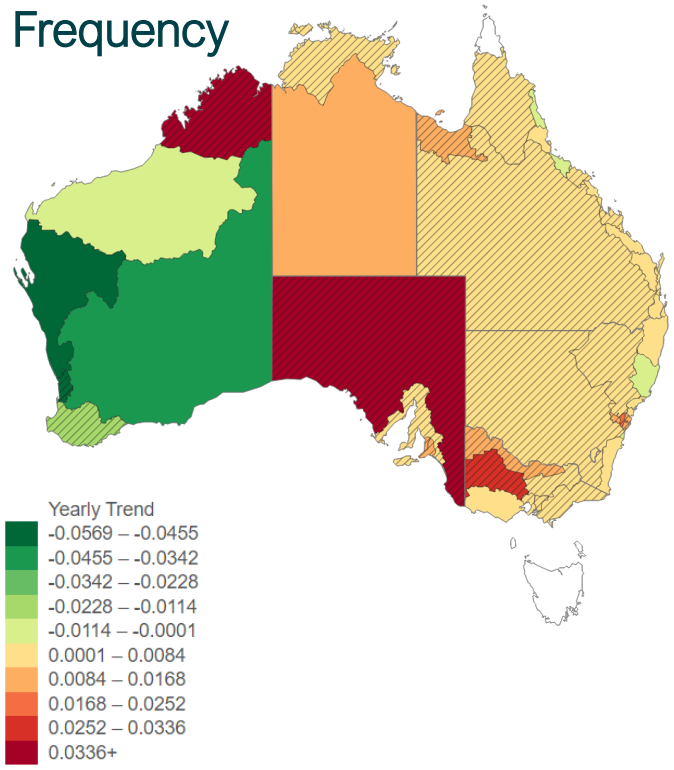


Developing a catalogue of climate risk indicators

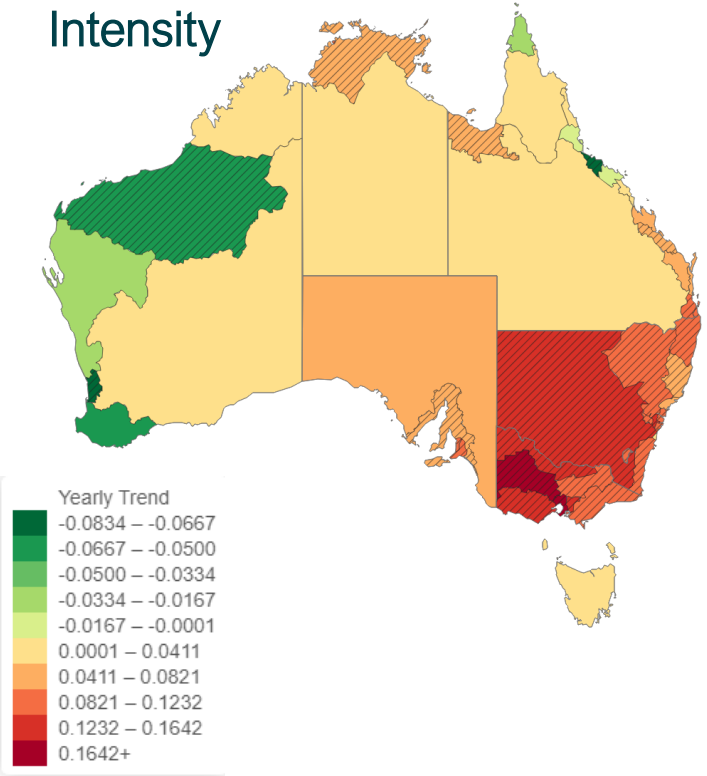
We have over **52 completes** views on changes in the **frequency, intensity and severity** for **bushfire**, **extreme rainfall and flood**, **tropical cyclone**, **synoptic storms**, **severe thunderstorms and hail**, **and extreme heat.**

Example: Bushfire Risk 1960 - 2022

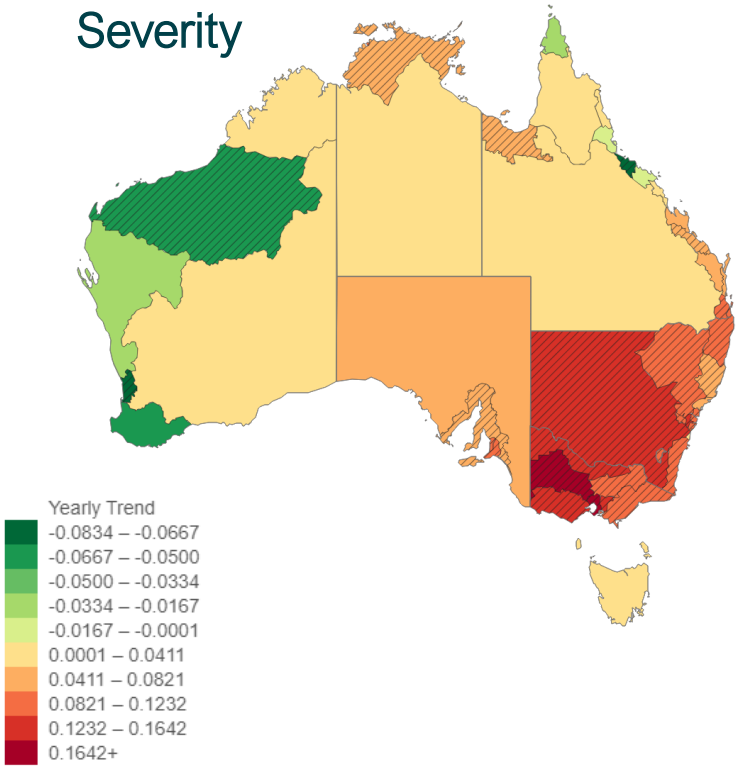
Frequency



Intensity

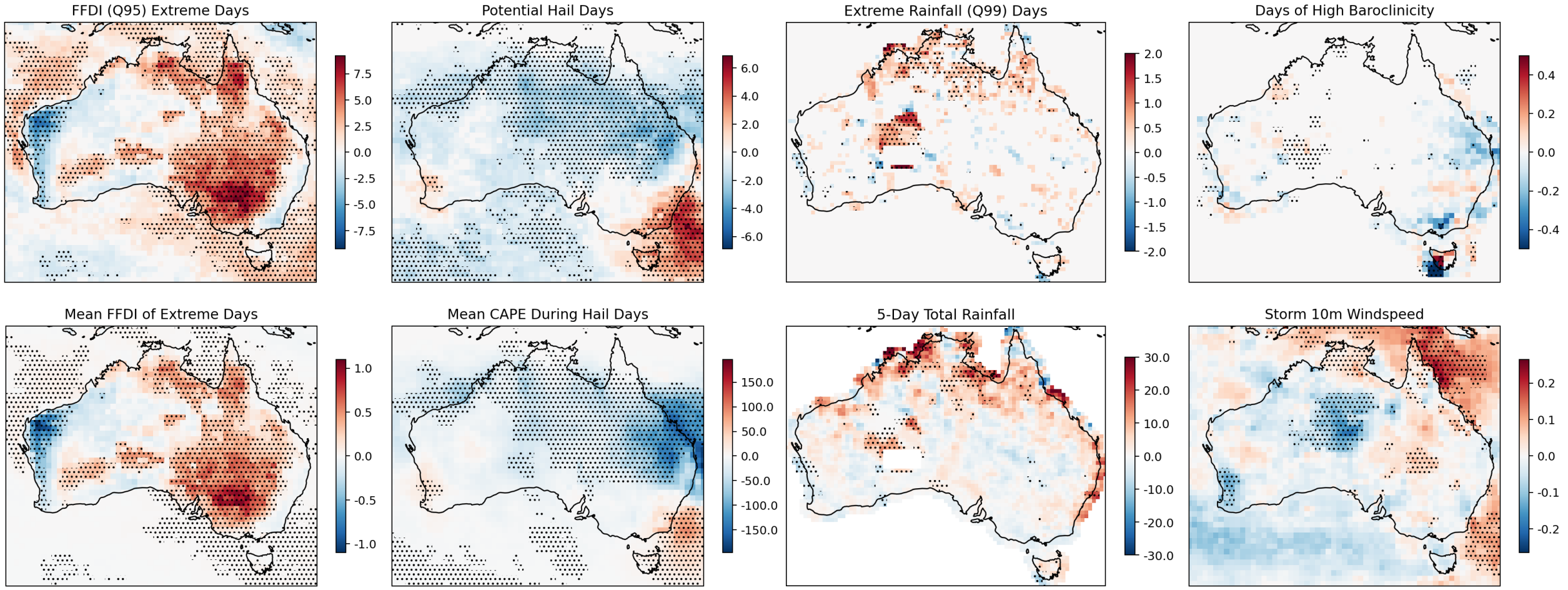


Severity



Trends in climate risks

There is an observable change in peril-related risks, but it is small, geographically different, and not always significant.

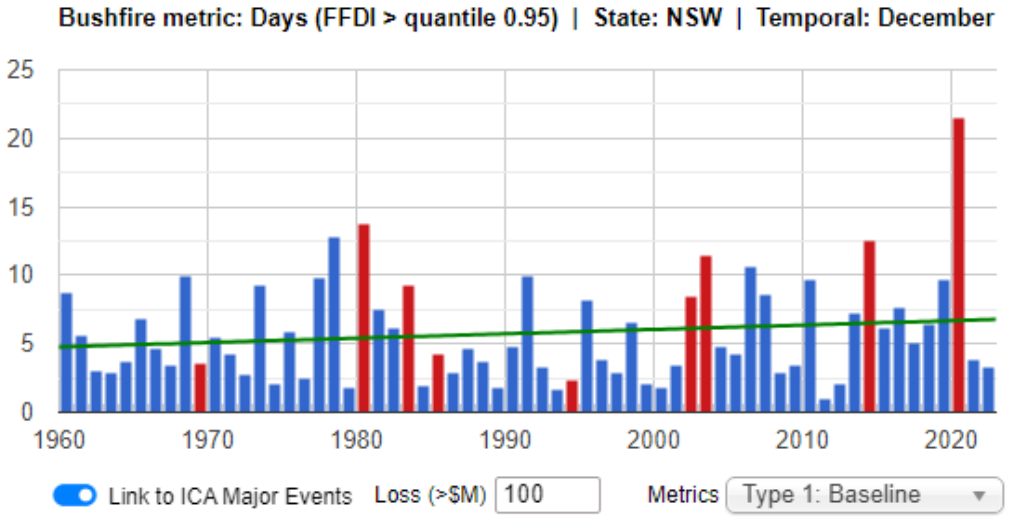


AI-driven climate loss modelling

Relating climate to industry losses

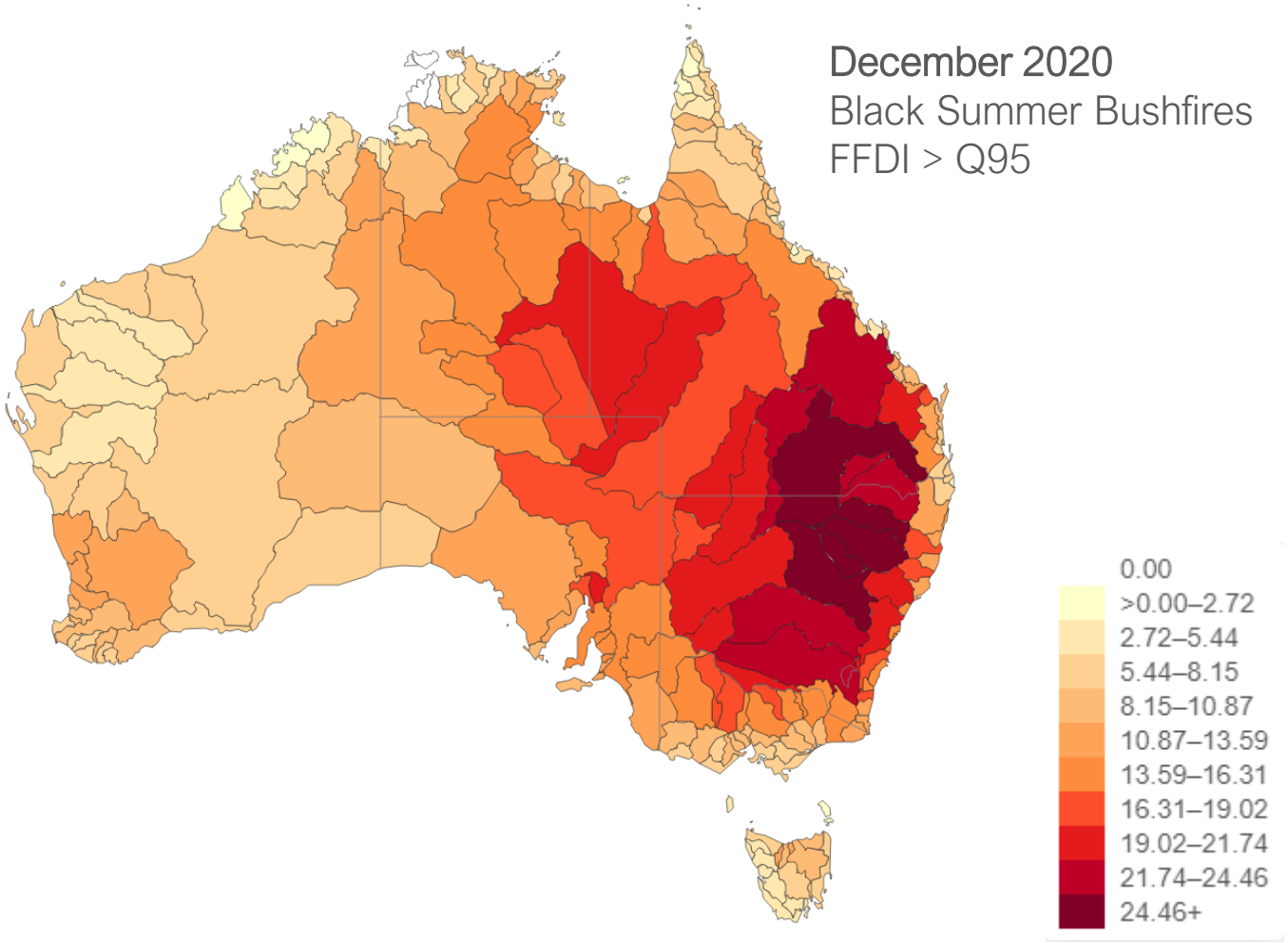
Correlation between conditions and insurance events

Using ICA historical loss data



3.0 Major Historical Events (Source: ICA / Combus / Suncorp)

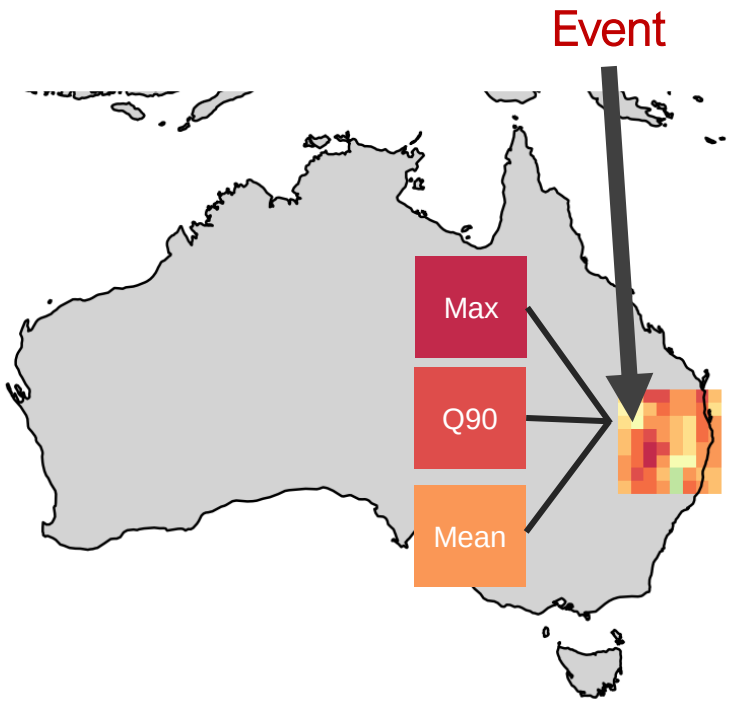
	Type	Start	Event	State	Loss 2022 ($)
1	Bushfire	2019-12-30	Black Summer Nationwide	NSW | VIC | SA | ACT | WA	1,604,000,000
2	Bushfire	2019-12-15	Widespread NSW fires	NSW	449,000,000
3	Bushfire	2019-11-12	East Coast Fires NSW QLD	NSW | QLD	646,000,000
4	Bushfire	2013-10-22	NSW Bushfires	NSW	323,000,000
5	Bushfire	2003-01-18	Canberra Bushfire	ACT | NSW	1,370,000,000
6	Bushfire	2001-12-25	Bushfire	NSW	251,000,000
7	Bushfire	1994-01-16	Eastern Seaboard	QLD | NSW | VIC	385,000,000
8	Bushfire	1984-12-25	Central Southern NSW	NSW	365,000,000
9	Bushfire	1983-01-09	Bushfire Ash Wednesday (Not its real name)	NSW	211,000,000
10	Bushfire	1979-12-04	Sydney NSW	NSW	260,000,000
11	Bushfire	1968-12-03	Blue Mountains Bushfire	NSW	163,000,000



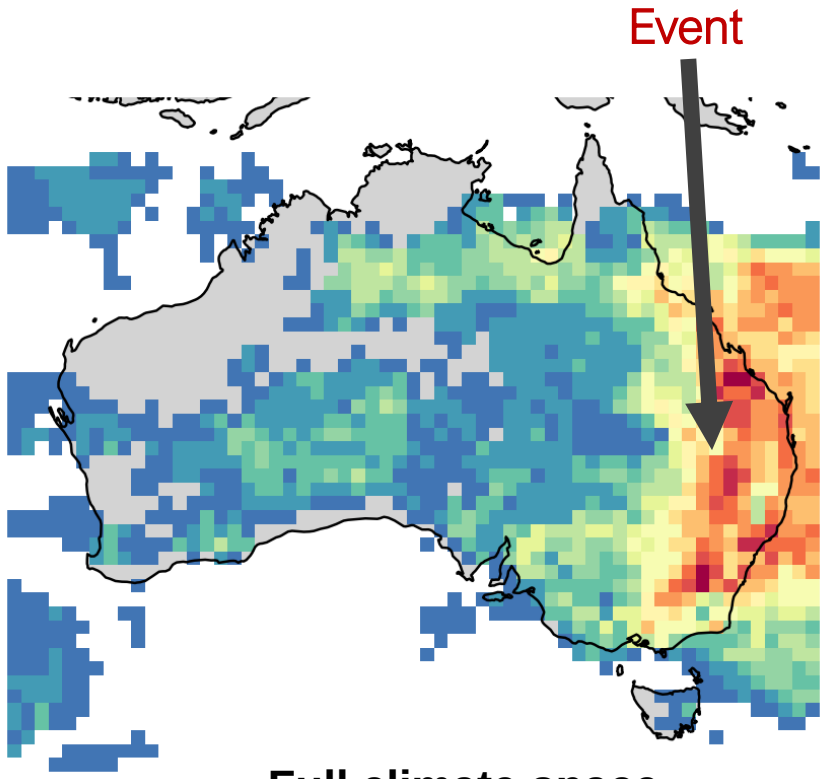
Utilising the full climate space in model learning

Climate information needs to be correctly utilised to extract its full potential

Point value ‘associated‘ with event.

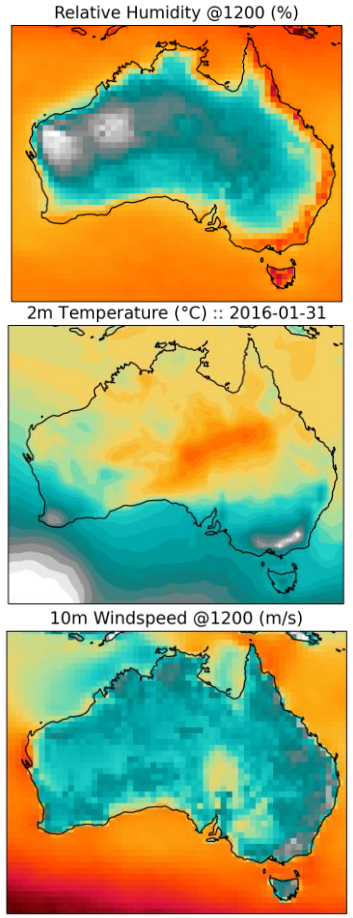


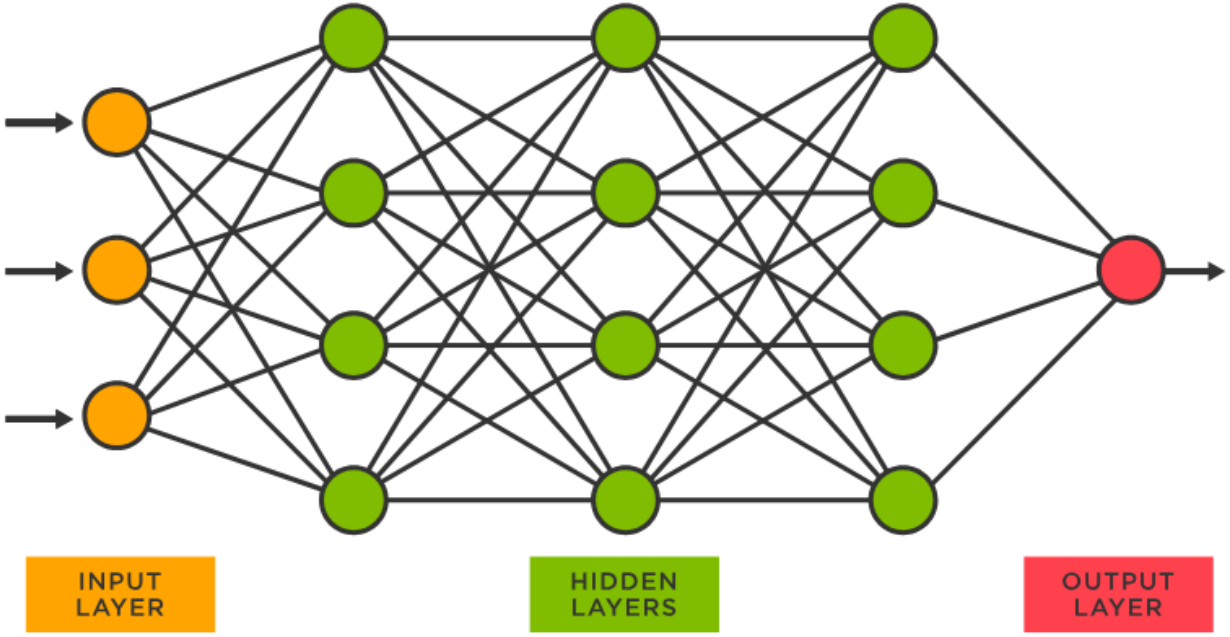
Summarised, broader conditions around event.

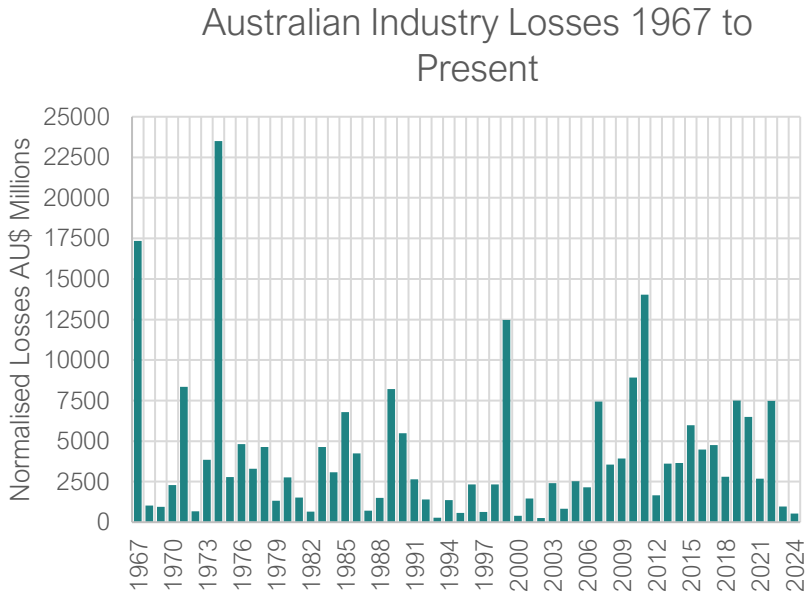


Full climate space around the event.

Deep Learning methods unlock the potential of climate data



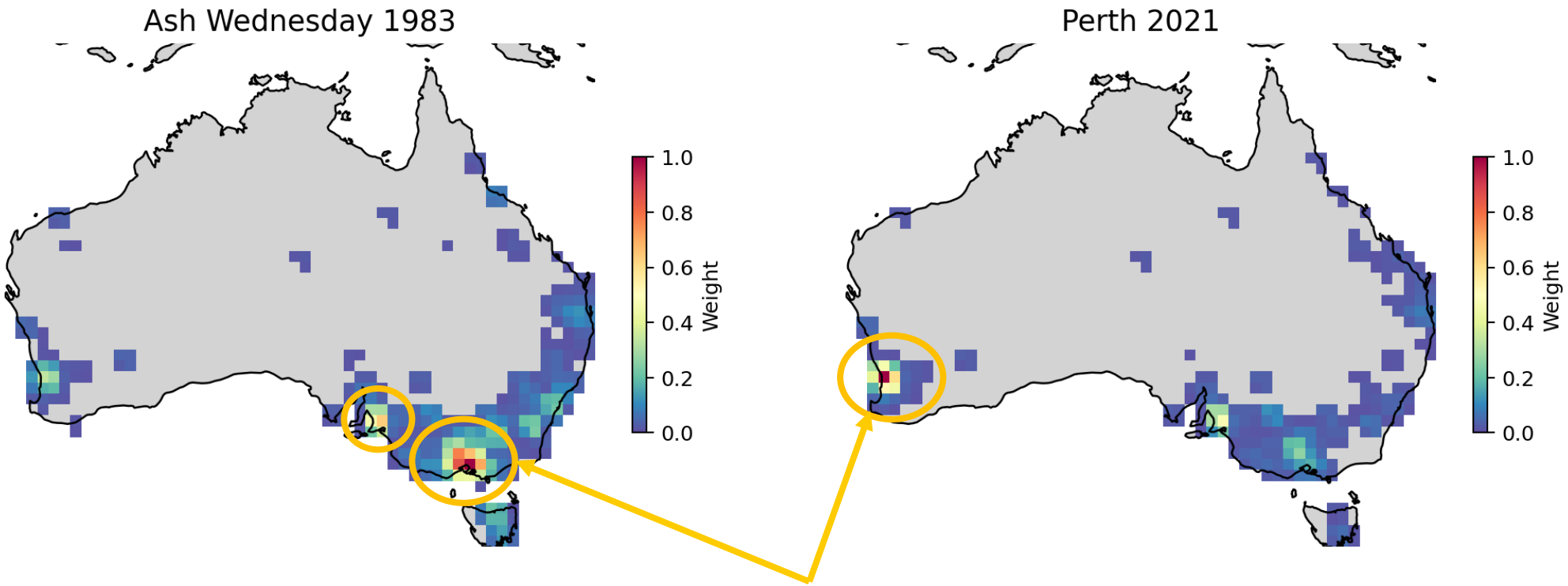




Inputs | **Neural Network** | **Output**

Why retaining spatial information matters

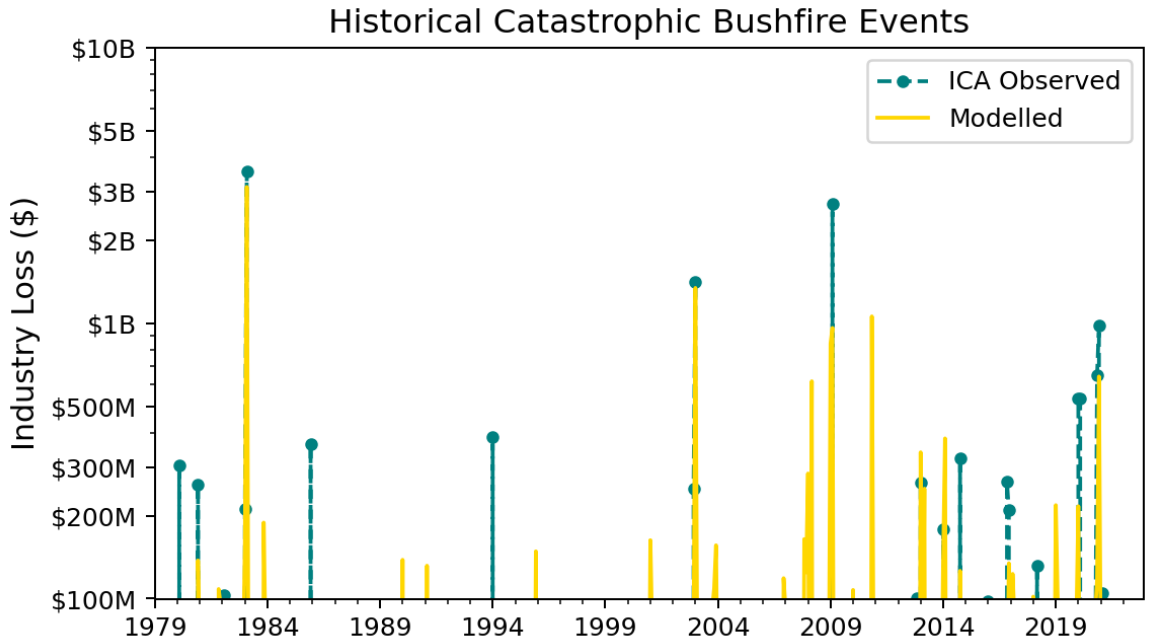
Example activation maps from a CNN modelling historic bushfire events

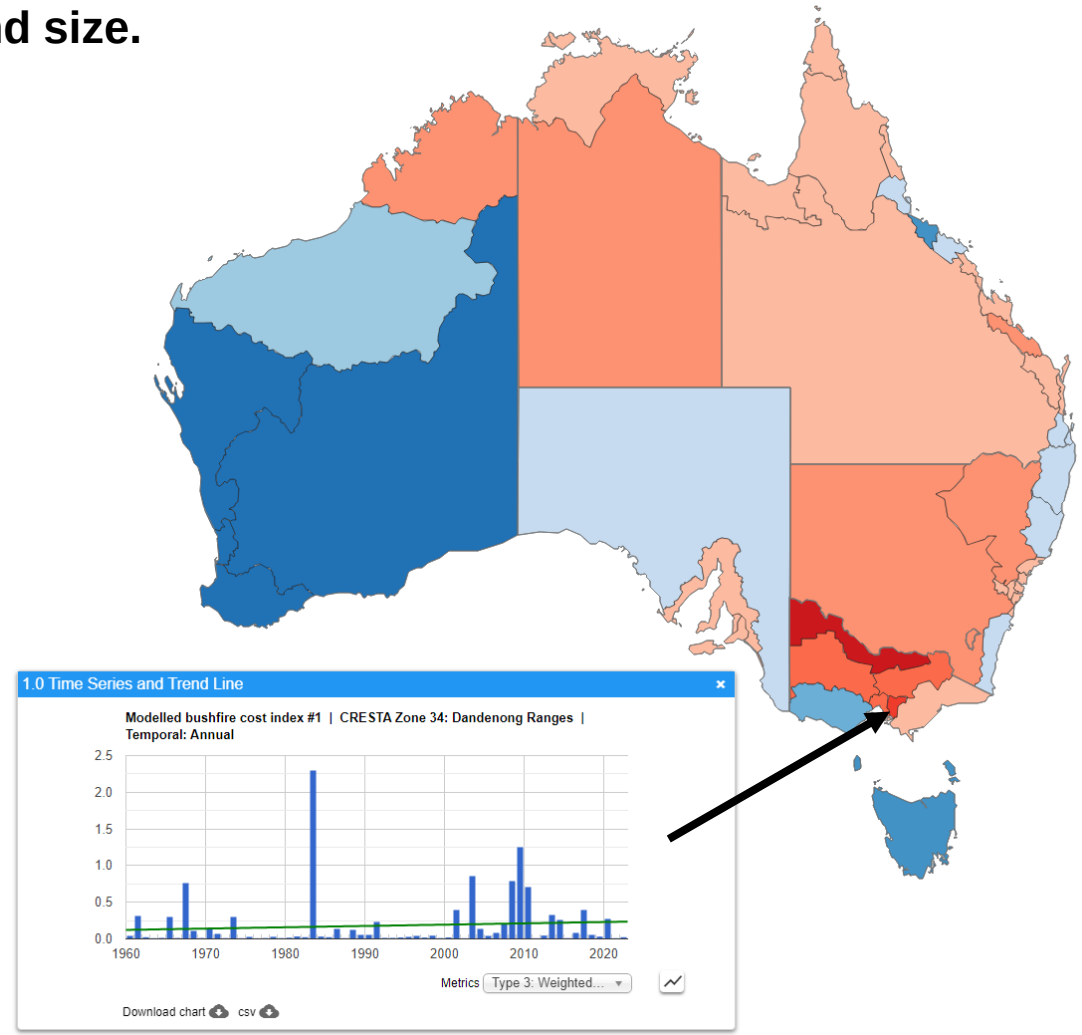


Pixels with what are deemed the most relevant information are activated by the neural network. These activation maps line up well with historical events.

Expressing risk in terms of ‘cost’

Defining an insurance-related index in terms of **frequency and size.**





Future developments

Daily time-scale	Seek a high temporal resolution by modelling at a daily scale.
Higher resolution	Move to higher resolution grids that can better resolve the climate space at more local scale – BARRA2, ERA5LAND, etc.
Include Suncorp Claims	Expand the training to include the claims history of Suncorp, retaining the ICA data in a pre-training context.
Deeper Networks	Transfer learning, more effective transformers, segmentation and object detection.

Concluding Remarks

Climate indices offer a powerful way of **quantifying climate risk** that are shown to be related to historical severe weather events.

This information is generally free and widely available, but **requires significant investment in skills and resources** to properly develop.

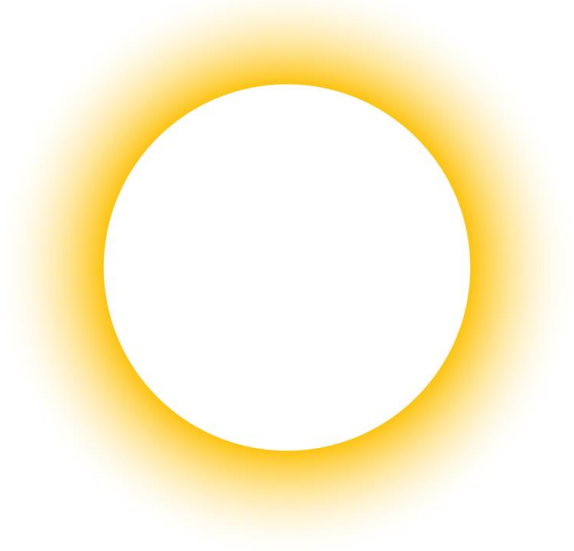
There is a **measurable amount of predictive power in climate indices** to be able to draw skilled relationships between climate conditions and the frequency and size of insurance events.

Capturing the 'climate space' is key to successfully finding these relationships, but further development in this space (particularly using neural networks) is required to maximise its potential.

Live Demo @ https://riskmapping.int.corp.sun/climateindex

Q&A

Disclaimer



All views presented are to convey general information only and do not express the complete view of natural perils and climate risk held by Suncorp.

All sources of information contained within this presentation are considered to be factual and reliable, but there is no guarantee that this information is without error. All information has been referenced to its original source where mentioned. We make no claim to original works by government sources or partner investigators.

Any questions please contact the author of this presentation.