



Interdecadal climate variability and climate change

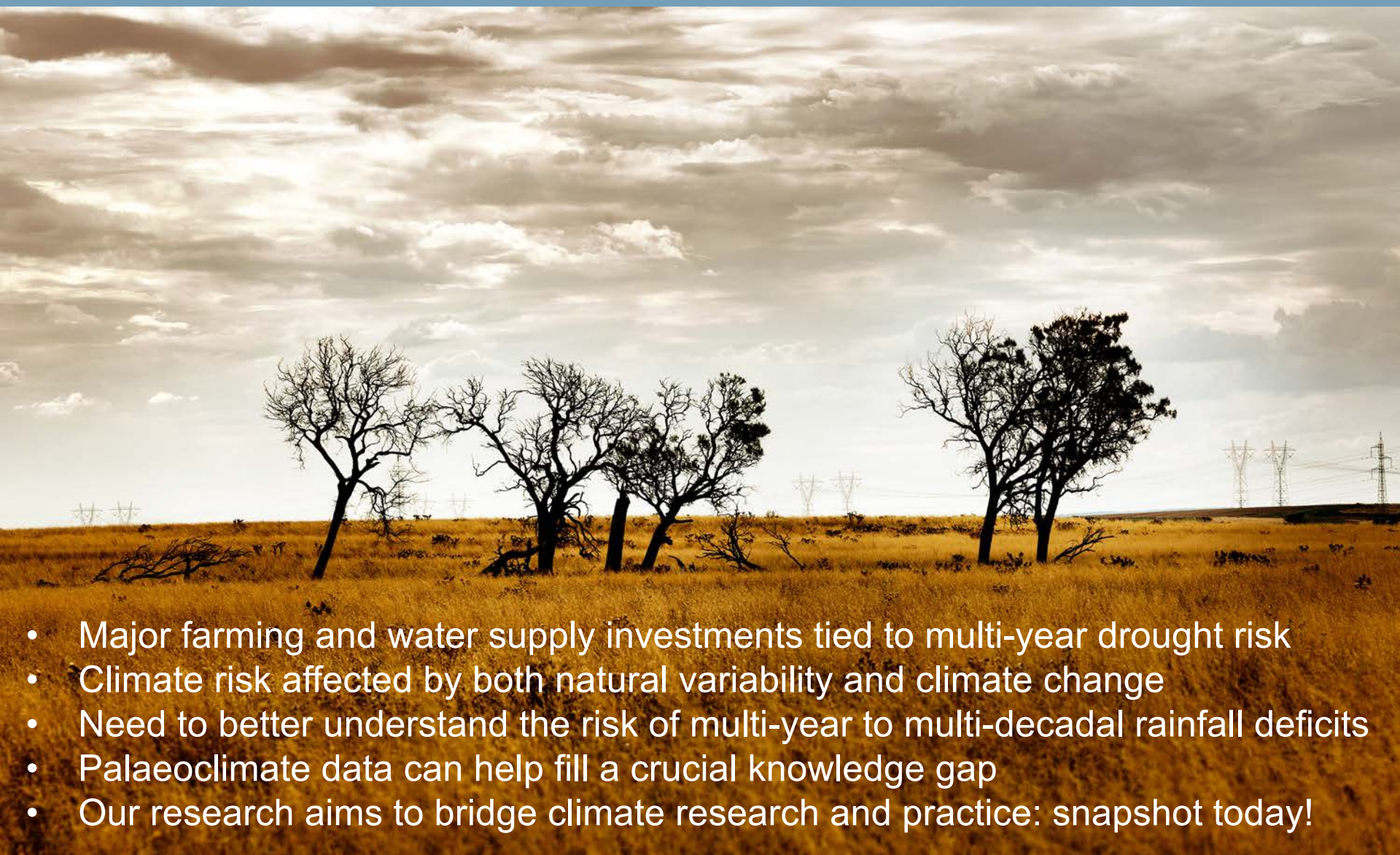
Impacts on Australian rainfall

Dr Ben Henley

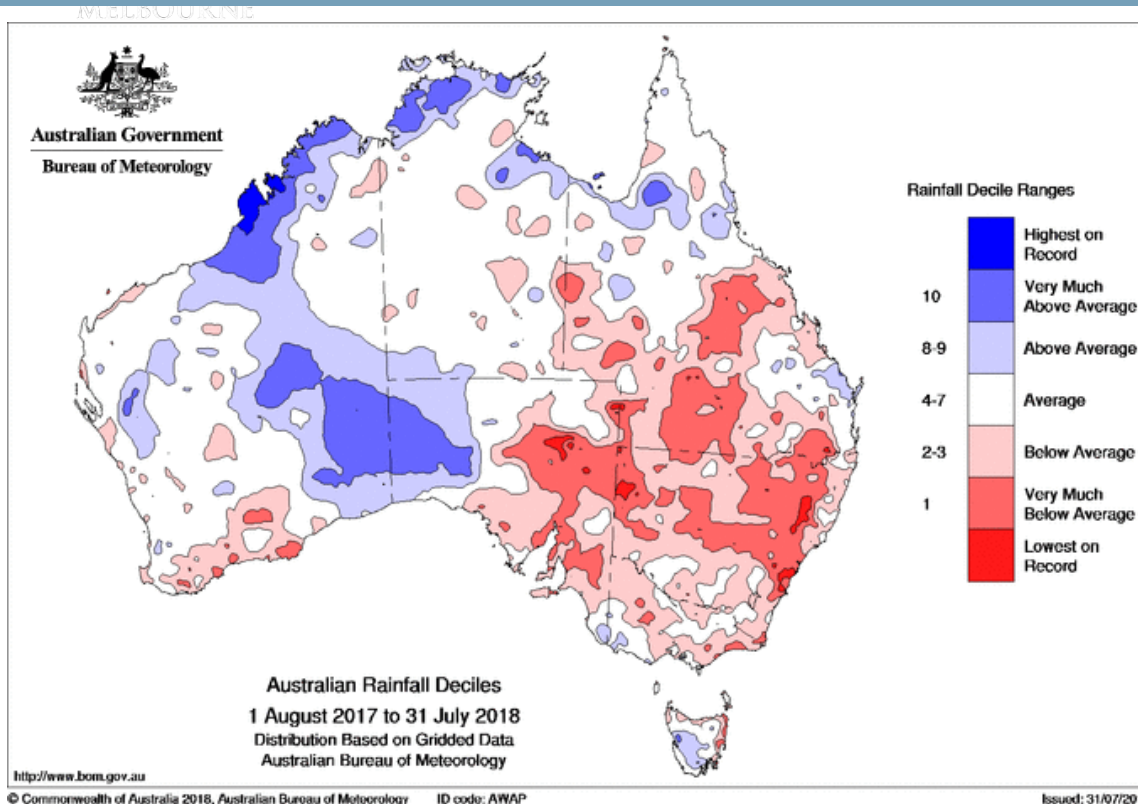
bhenley@unimelb.edu.au



Farmers understand climate variability



- Major farming and water supply investments tied to multi-year drought risk
- Climate risk affected by both natural variability and climate change
- Need to better understand the risk of multi-year to multi-decadal rainfall deficits
- Palaeoclimate data can help fill a crucial knowledge gap
- Our research aims to bridge climate research and practice: snapshot today!

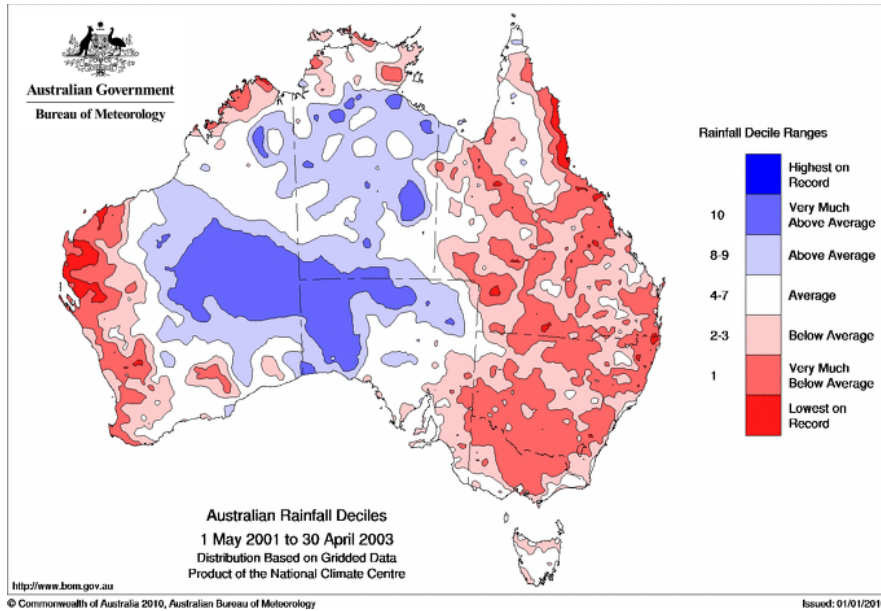


50% chance of El Niño this year

Motivating questions:

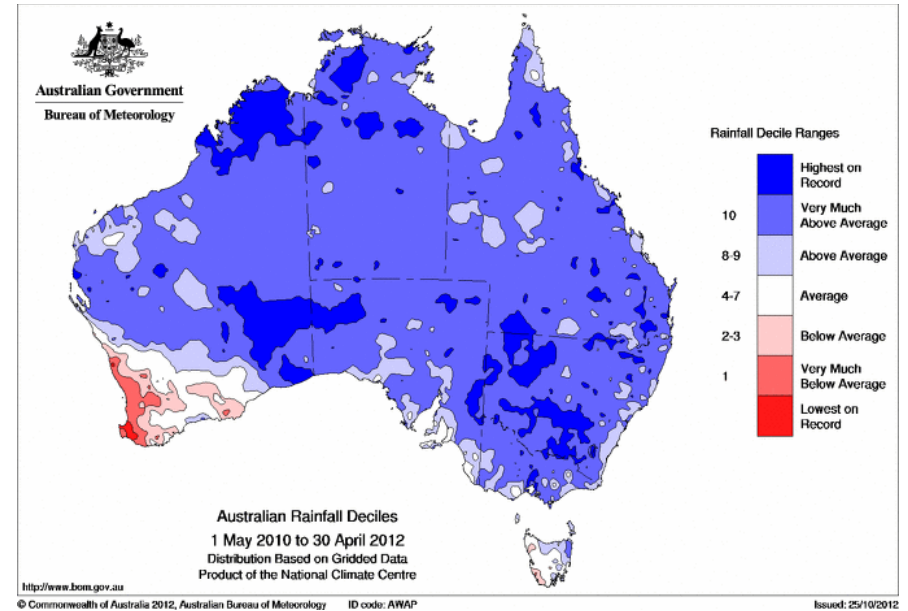
- What are the drivers of our current climate?
- What is the likely range of natural drought variability?
- What additional challenges does climate change pose?

Drought



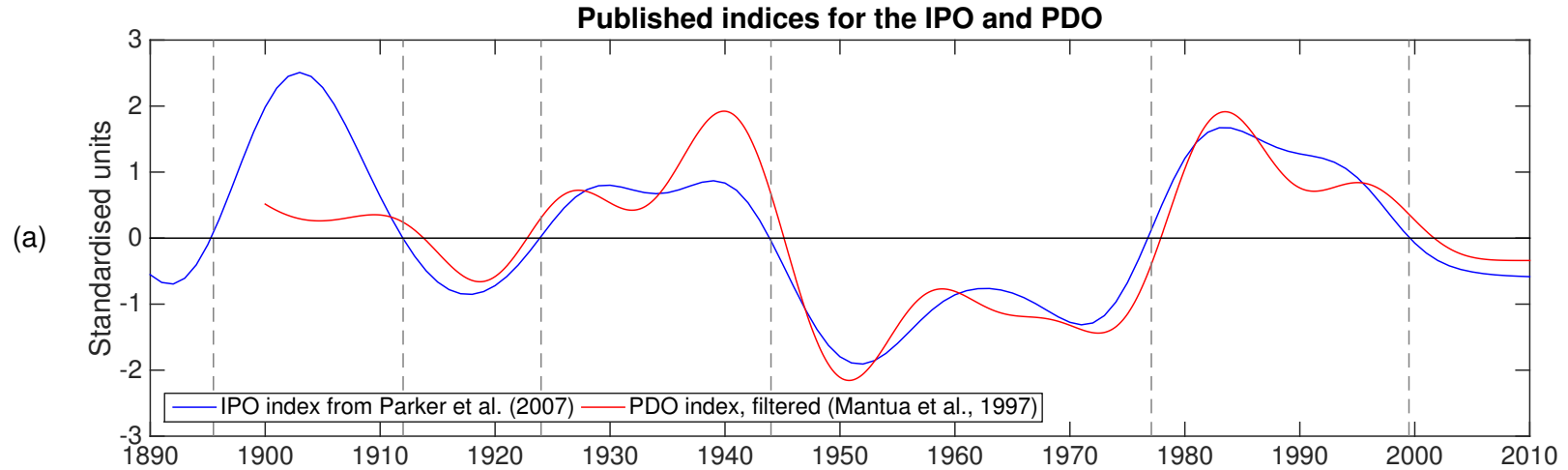
2002-2003
El Niño

Floods

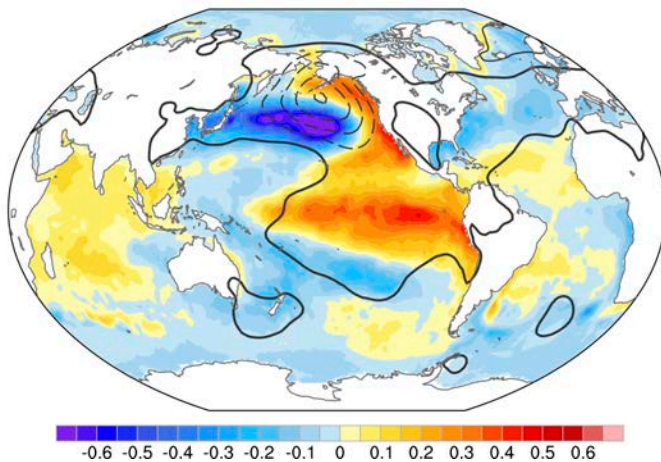


2010-2011
La Niña

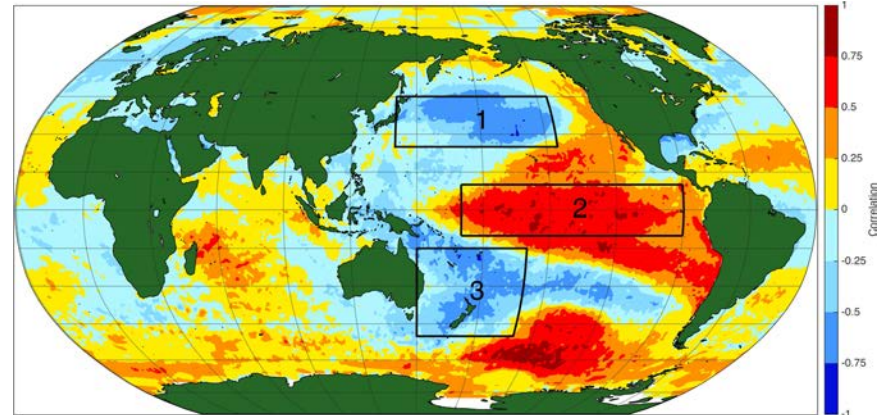
Pacific Decadal Variability



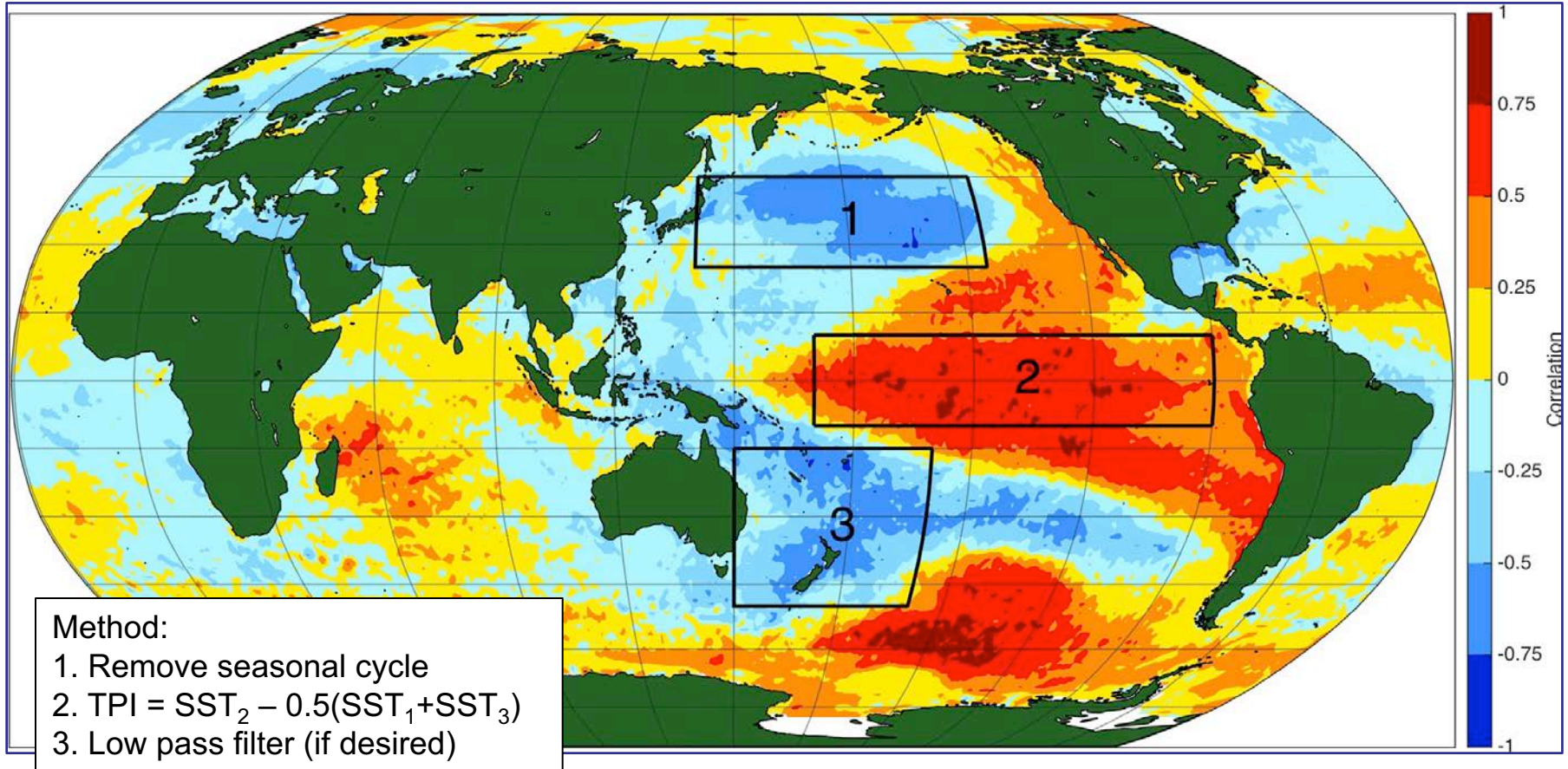
PDO



IPO



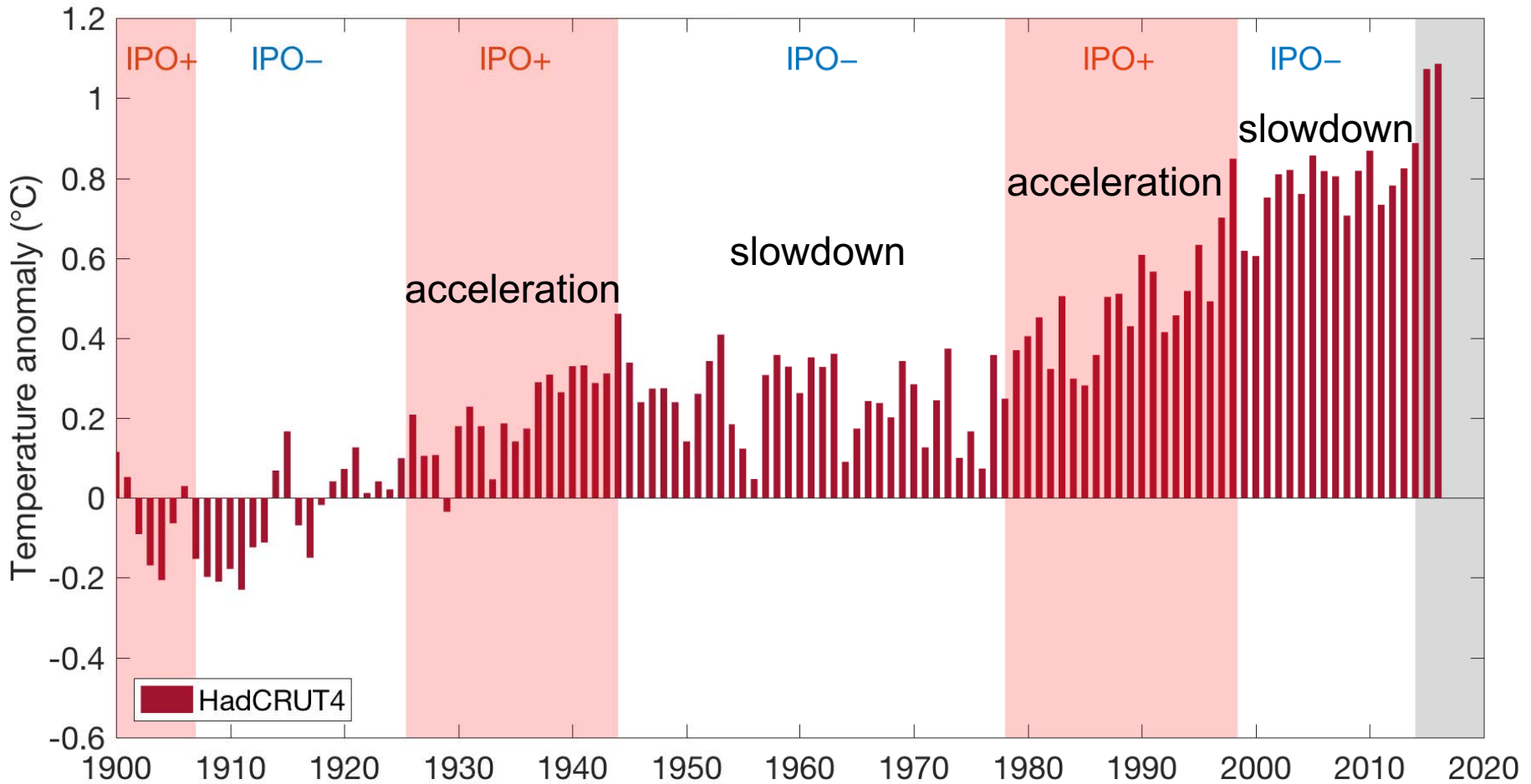
A Tripole Index for the IPO: a new index



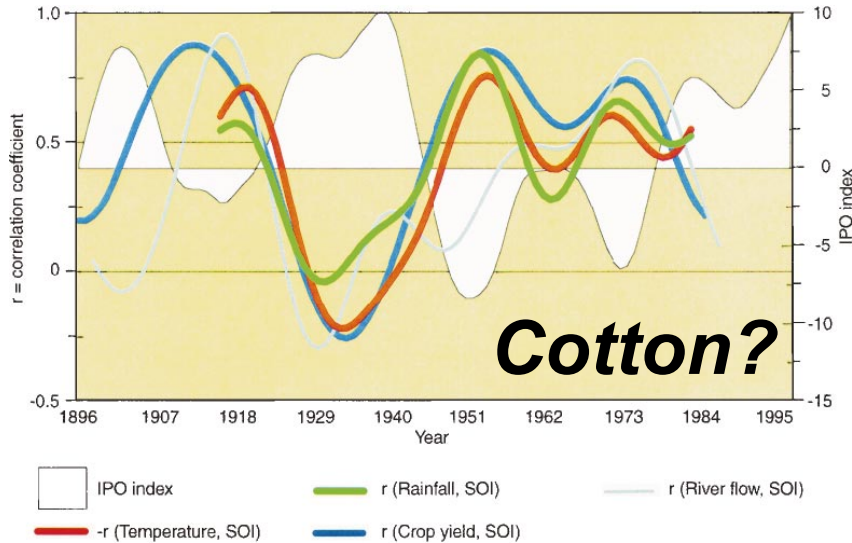
- The index tracks sea surface temperatures in three large regions
- Data now published regularly and available from NOAA



The influence of El Niño's "cranky uncle" *El Tio* on Global Temperatures



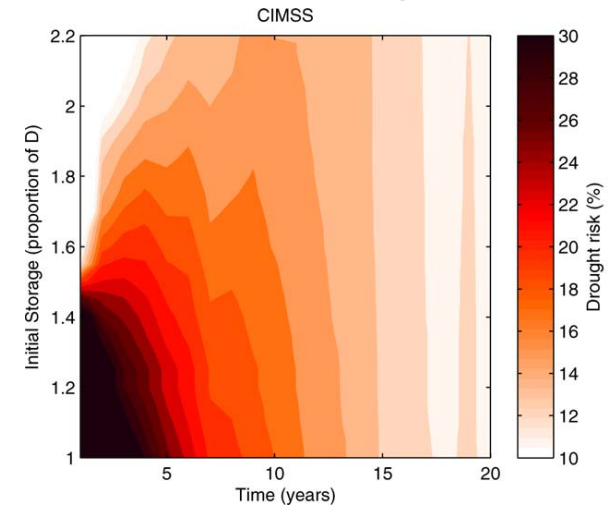
Correlation between SOI and T, P, wheat yields varies on decadal timescales:



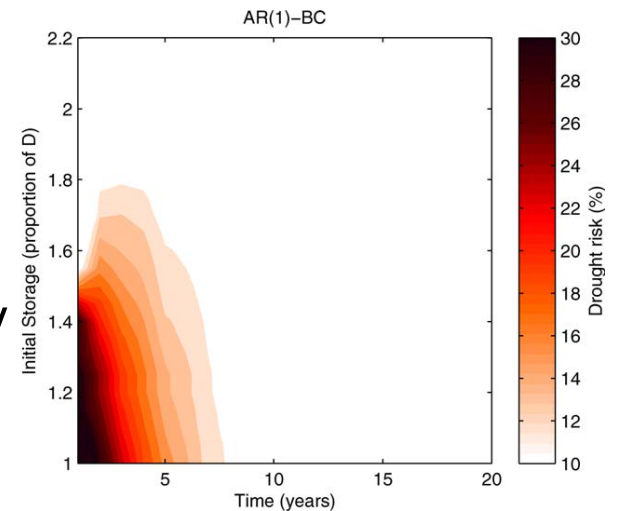
New research proposal to better understand PDV (currently under review)

PDV and drought risk

Including Pacific Decadal Variability

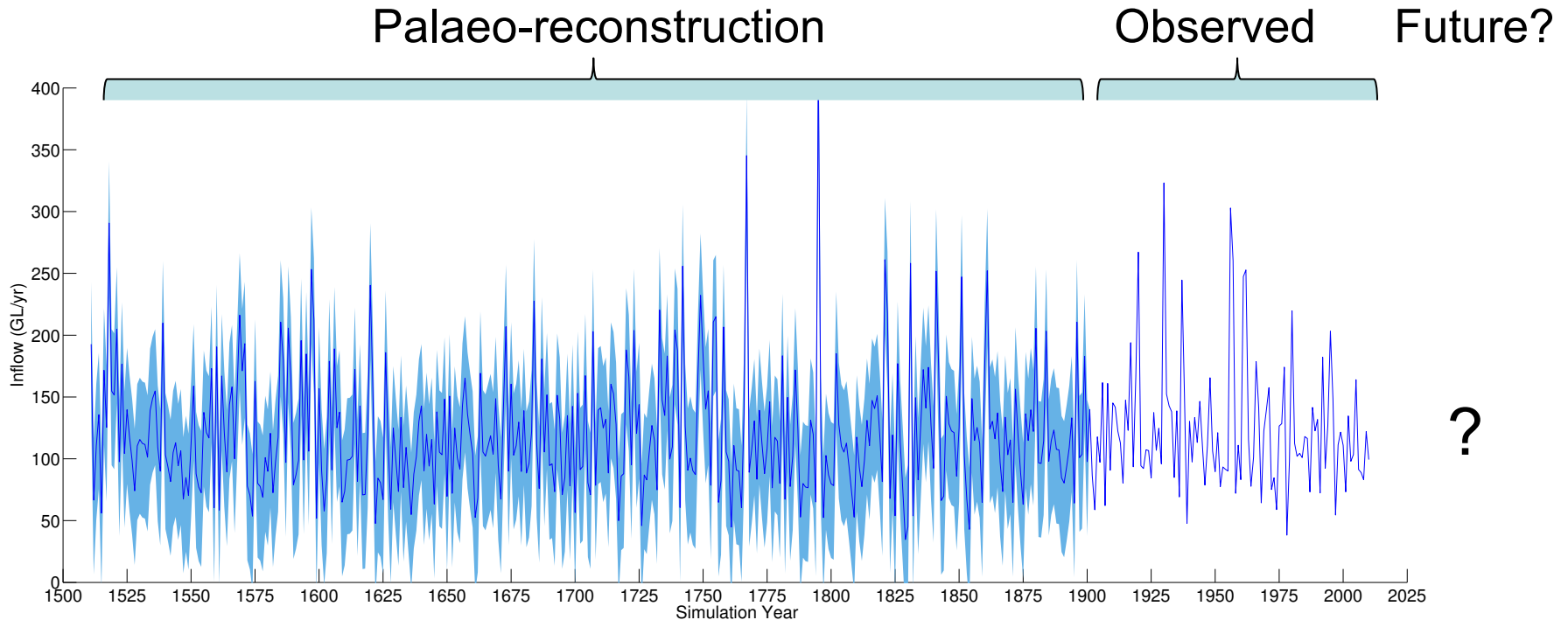


Ignoring Pacific Decadal Variability





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VicDRIP Victorian Drought Risk Inference Project
vicdrip.org

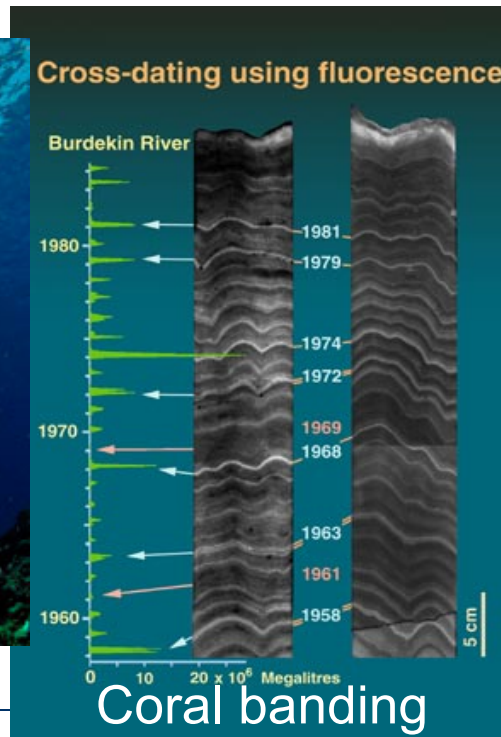


Tree rings

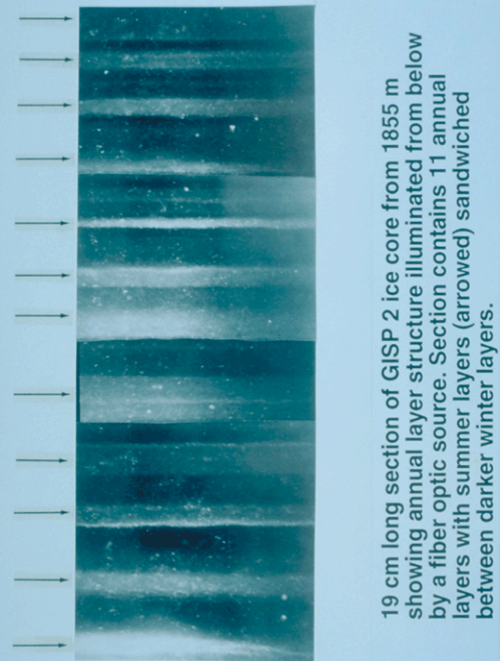
- Biological and geological indicators of pre-instrumental climate variability on seasonal–centennial timescales. e.g. tree rings, corals, ice cores, lake and cave sediments
- Best records for understanding rainfall variability are high temporal resolution i.e. seasonally–annually resolved palaeoclimate records to extend the instrumental climate record centuries into the past



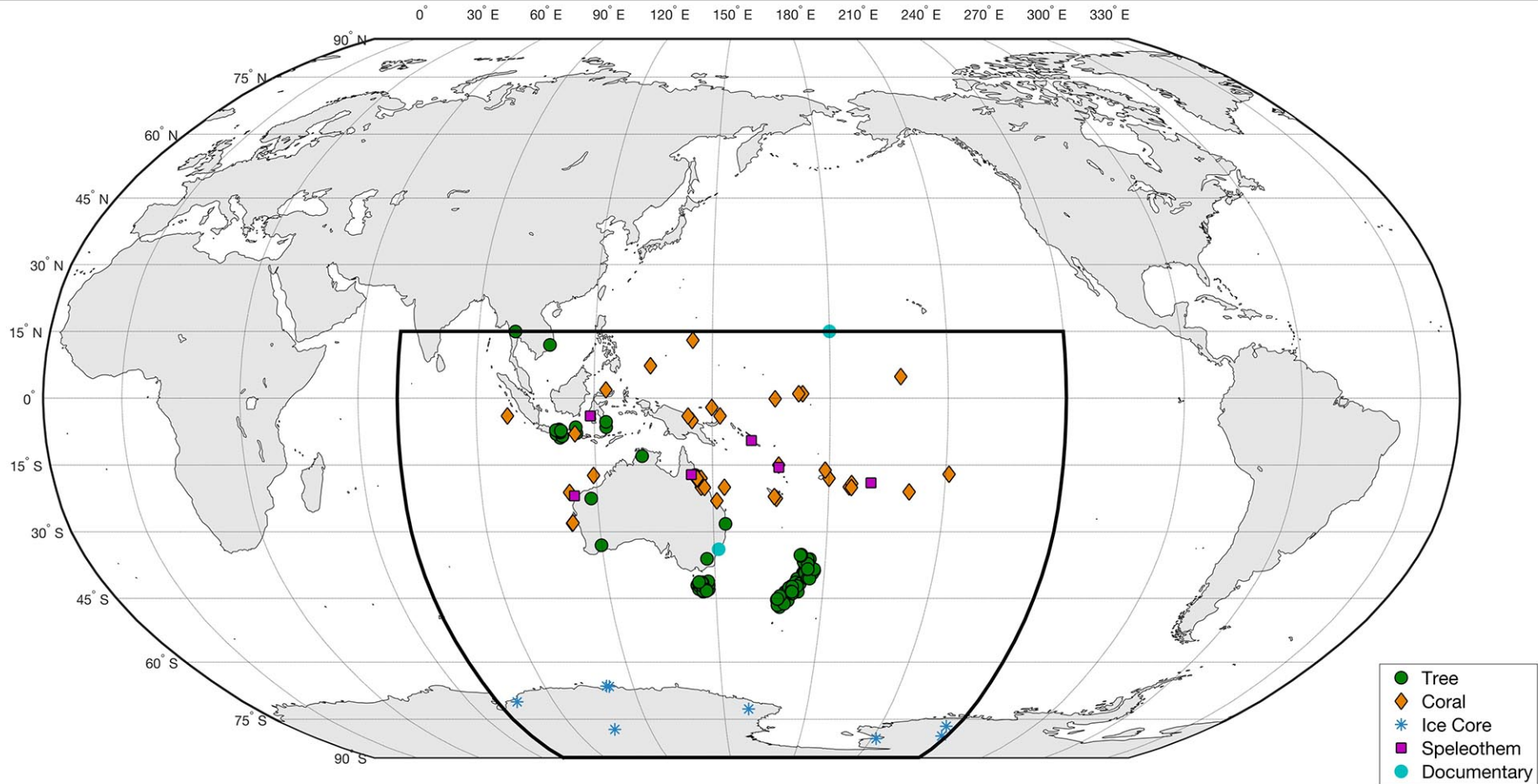
Drilling *Porites* sp.



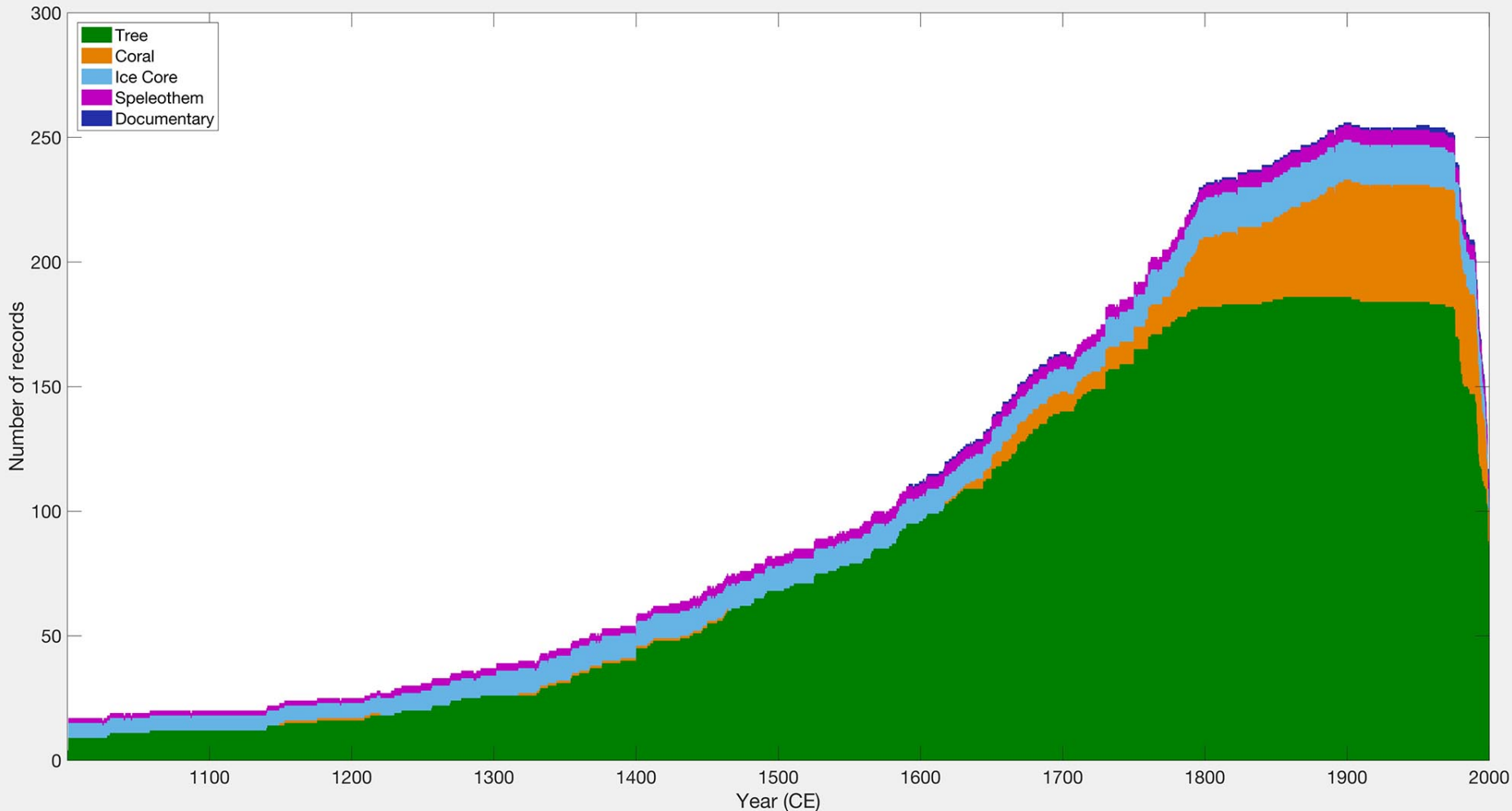
Ice cores



Sources: NOAA World Data Center –Palaeoclimatology;
Eric Matson, Australian Institute of Marine Science

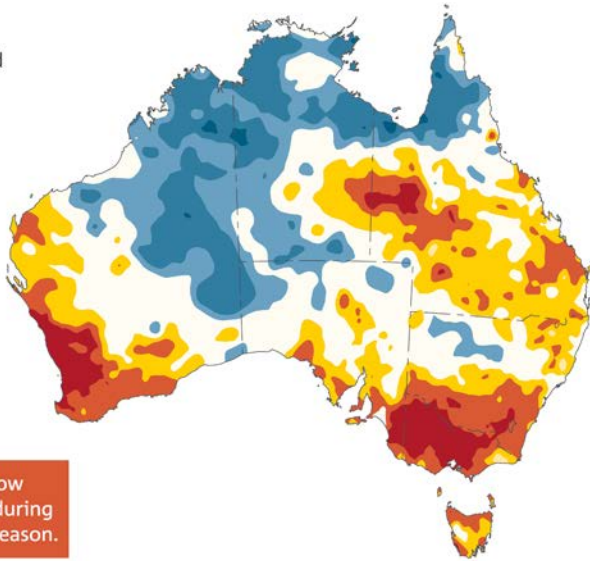
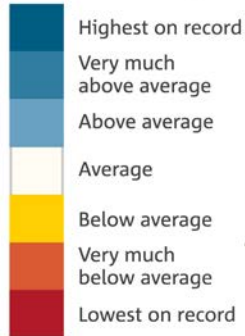


- Statistically significant relation to broad scale drivers
- Trade off between skill, temporal/spatial resolution of target



- Statistically significant relation to broad scale drivers
- Trade off between skill, temporal/spatial resolution of target

Rainfall decile ranges



Source: Bureau of Meteorology

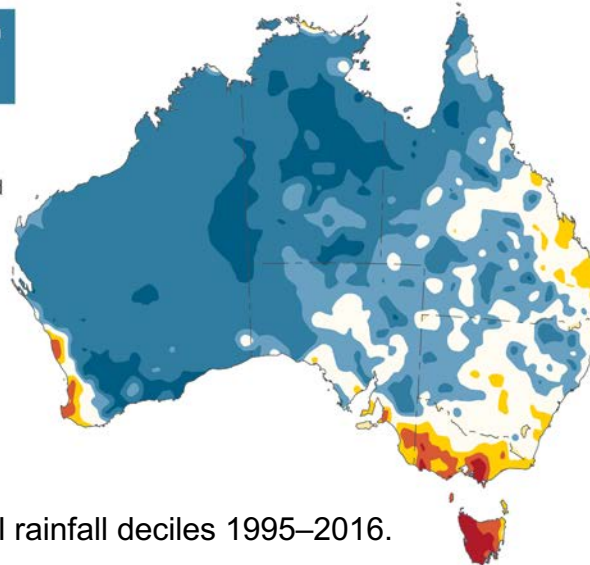
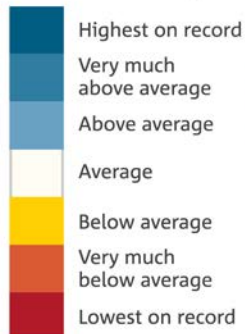
Rainfall has been very low over parts of Australia during the southern growing season.

April–October rainfall deciles 1996–2015

Compounding challenges:

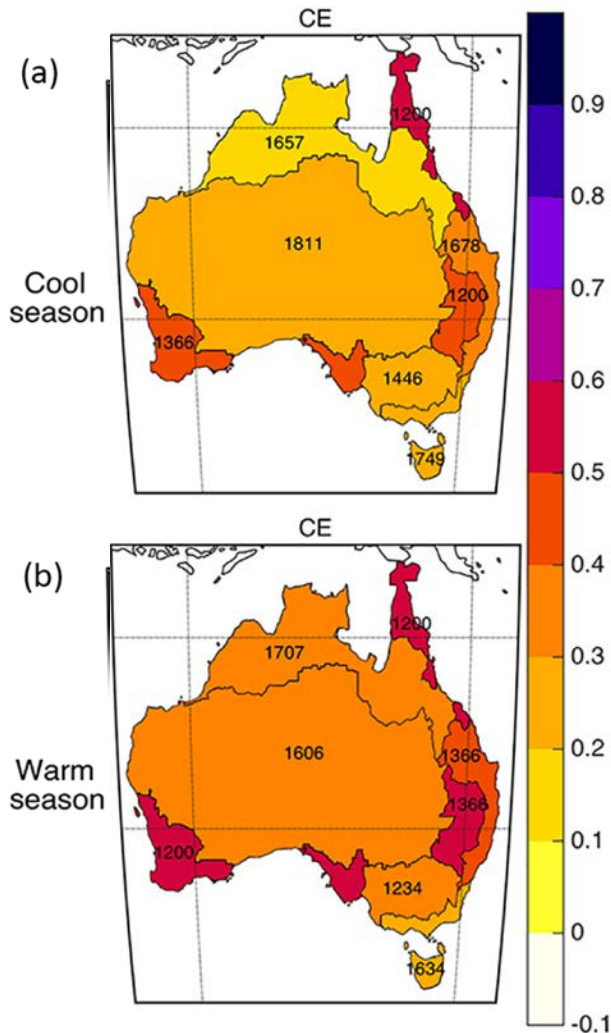
1. High variability and persistence
2. Changing rainfall patterns
3. Growing populations
4. Short observed records
5. High vulnerability to decadal-multidecadal “megadroughts”
6. Uncertainty from climate change

Rainfall decile ranges



Source: Bureau of Meteorology

October–April rainfall deciles 1995–2016.



Reconstructions of Australian regional rainfall, based primarily on remote palaeoclimate proxies and their association with climate drivers

Clim. Past, 13, 1751–1770, 2017
<https://doi.org/10.5194/cp-13-1751-2017>
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Climate of the Past
 Open Access
 EGU

Multi-century cool- and warm-season rainfall reconstructions for Australia's major climatic regions

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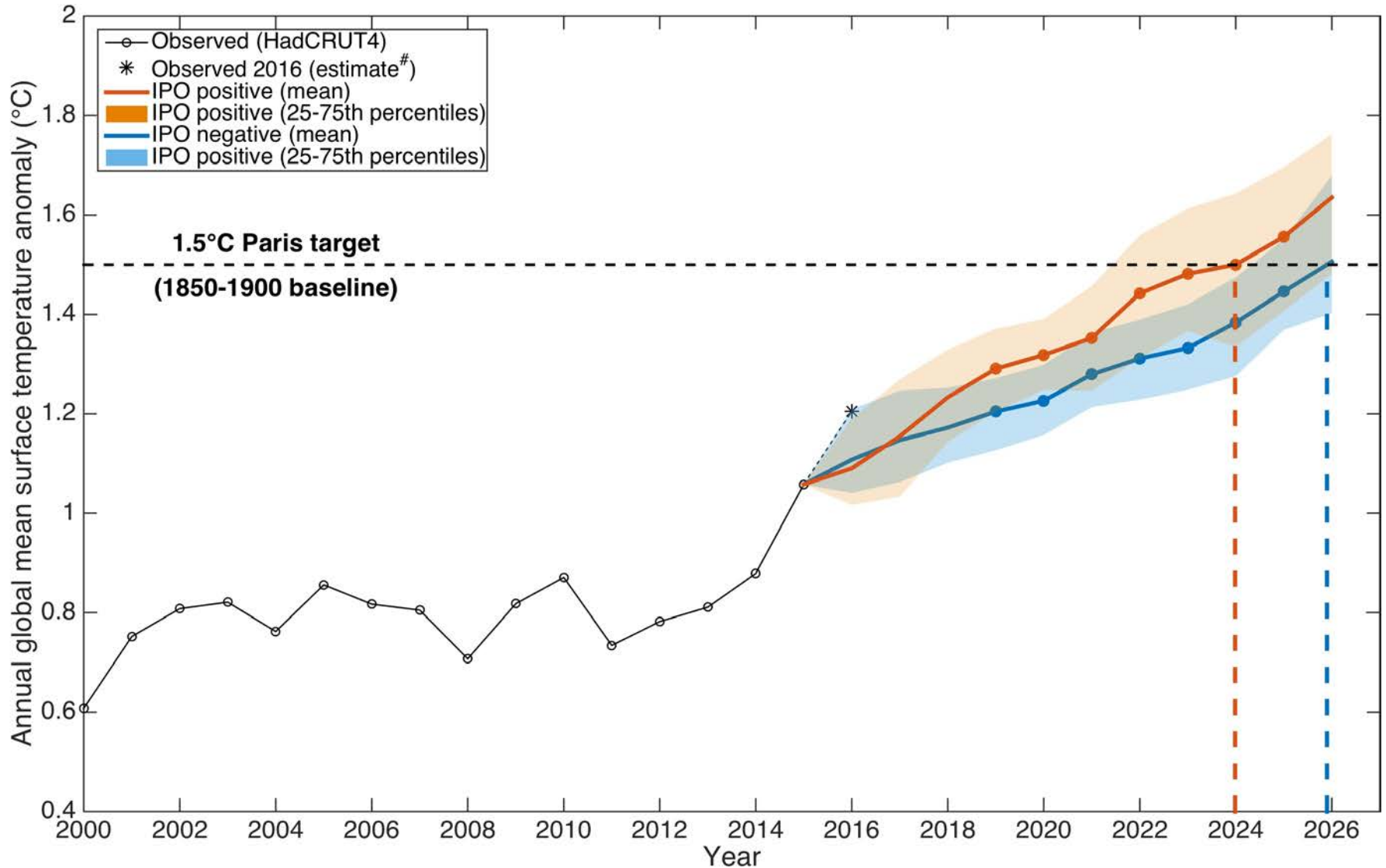
Correspondence to: Mandy Freund (mfrend@student.unimelb.edu.au)

Received: 28 February 2017 – Discussion started: 10 March 2017

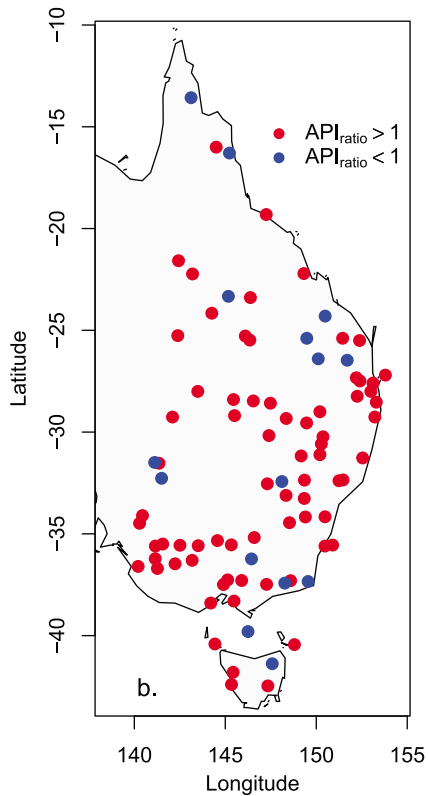
Revised: 17 October 2017 – Accepted: 17 October 2017 – Published: 30 November 2017



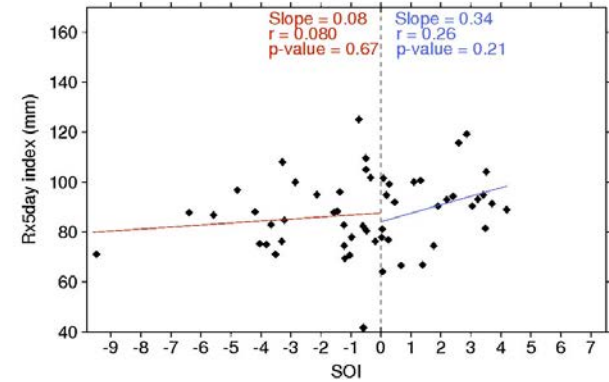
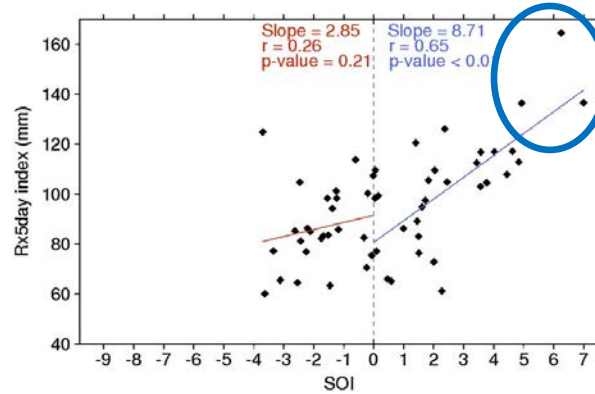
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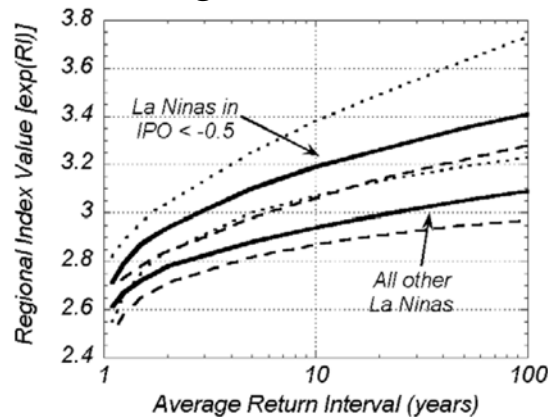
Pui et al (2011)
Antecedent wetness



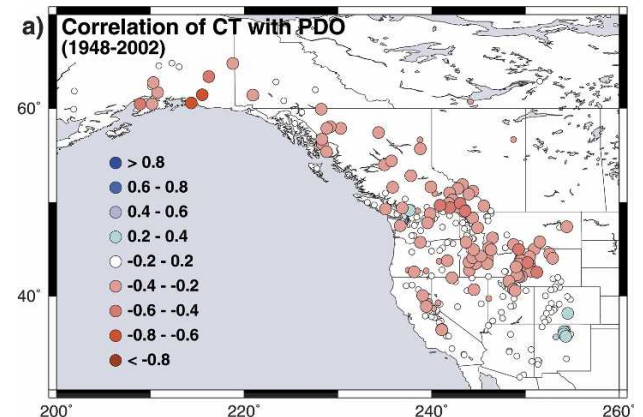
King et al (2013) Extreme rainfall in Eastern Australia
IPO negative IPO positive



Kiem et al (2003)
NSW regional flood index



Stewart et al (2005)
Streamflow timing



Future connections:

- What would you like us to look at?
- What are you most concerned about?
- Come and talk to me if you want data, plots, papers
- Lots of research momentum, several proposals under assessment, *fingers crossed!*
- Email me, say hi on twitter, check out our articles on *The Conversation*



Thanks!

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