

RECONSTRUCTING PRE-20TH CENTURY TEMPERATURE, RAINFALL AND MSLP FOR SOUTHEASTERN AUSTRALIA USING PALAEO, DOCUMENTARY AND EARLY WEATHER STATION DATA

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OVERVIEW

No country in the developed world is more vulnerable to the effects of climate change than Australia. We are the driest inhabited continent with the most variable rainfall on Earth. Over 60% of the country is classified as arid or semi-arid; that is, most of the country is naturally characterised by low, erratic rainfall.

South-eastern Australia – which supports around 58% of our population – receives an average of just 500 mm of rain per year while its evaporation rate is more than three times that (1620mm/year). Evaporation due to high temperatures accounts for the very large losses of our nation's water resources.

Climate models are now consistently predicting that the densely populated south-eastern Australia will become warmer and drier under climate change, with less frequent and more intense rainfall. Consequently, increasing temperatures due to global warming leaves Australia's most densely populated region extremely vulnerable to dwindling water supplies and the marginalisation of agricultural land. Policy-relevant research into south-eastern Australia's pre-20th century climate variability is now an urgent national priority.

In Australia, high quality climate observations only extend back to the late 19th century at best and therefore only provide us with a brief snapshot of our climate, its mean state and its short-term variability.

Palaeo records like tree rings, coral, ice cores, speleothems (cave) and boreholes are used to estimate climate variability and trends before the instrumental record, providing us with an opportunity to test and improving our understanding of the nature of Australian climate variability. They provide the length of records necessary for testing climate models that instrumental records are simply too short to provide. By analysing palaeodata we can improve our description of our natural range of climate variability that will help interpret how recent climate trends may influence future resource management (especially water).

While the suite of global, hemispheric and continent-wide reconstructions that have emerged during the last decade now form an important basis for the Intergovernmental Panel on Climate Change's (IPCC's) future scenario estimates, they still suffer from inadequate estimates of the range of Southern Hemisphere variability.

The overall aim of this project is to fill a critical gap in Australian climate science by assembling a range of pre-20th century data to develop annual climate reconstructions (temperature, rainfall, MSLP) for south-eastern Australia for the past 200–500 years. The data sources can be broadly classified as follows:

- **Palaeoclimate records** e.g. tree-ring, coral, borehole, ice-core, speleothem (cave) records
- **Documentary accounts** e.g. early European settler accounts, government correspondence
- **Early weather station data** e.g. weather diaries, station observations and ship logbooks

Specifically, this project will target a recognised management need for extended estimates of regional-scale climate variables other than temperature to reduce uncertainties about climate change and its potential impacts in Australia. It aims to complement work being done by the South-eastern Australian Climate Initiative (SEACI) program (current climate, future climate and seasonal forecasting) by providing estimates of pre-20th century climate variability. Importantly, this project will also contribute regional data to the international Atmospheric Circulation Reconstructions over the Earth (ACRE) 'data rescue' program (www.met-acre.org).

Developing annual reconstructions of pre-20th climate variability using palaeo, documentary and early weather station data will be the first study of its kind in Australia. It will bring together a team of Australia's leading climate scientists, water managers and historians with the common goal of reconstructing south-eastern Australia's climate history. Given the large number of very extreme climate events south-eastern Australia has been experiencing, this research will provide a timely context for understanding recently observed changes and an opportunity to constrain future climate change projections using broader estimates of natural climate variability.

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