PalaeoWise- a palaeoclimate proxy model developed to stress-test water security planning.

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ABSTRACT

Accurate and robust water resource modeling is crucial for informed decision-making in water management, agriculture, energy production, and disaster preparedness. In the face of ongoing climate change and its anticipated impacts on hydroclimatic variables, the need for accurate modeling and forecasting of water resources has become increasingly pressing. One of the fundamental challenges in contemporary hydroclimate research is the scarcity of long-term observational data that adequately capture the full spectrum of climatic variability and extreme events.

Short time series, often spanning several decades at best, fail to capture the full spectrum of climate variability and extremes. Conventional water resource models relying on these data sources may be inadequate for making informed decisions in a future where climate patterns are expected to evolve rapidly. The inadequacy of short time series is further compounded by their susceptibility to data gaps and measurement inaccuracies. As a result, these models can underestimate the risks associated with prolonged droughts, increased precipitation variability, and other climate-related challenges.

To address these challenges, this paper introduces an innovative approach that leverages long time series of paleoclimate proxy data extracted from PalaeoWISE (Palaeoclimate Data for Water Industry and Security Planning) is a database of 396 unique climate proxy records which have been shown to relate to Australian hydroclimate (Croke *et al*. 2021). Correlation maps between these proxy data and catchment-averaged climate variables for 73 Queensland catchments show that many of these proxies have significant ($p < 0.05$) correlations with Queensland hydroclimate, offering an opportunity to extend our understanding of climate well beyond the observational record.

This is coupled with PalaeoWISE-R, a Bayesian model that uses a Markov Chain Monte Carlo approach to reconstruct hydroclimate variables from multiple proxies and estimates the uncertainty of each reconstruction at each year. Results presented show the impact of using the current 'static' or no climate variability data series and that palaeoclimate times series on predicted inflows into Wivenhoe Dam, a major water storage facility in one of the fastest growing regions in Australia. The approach holds potential for stress-testing water security scenarios under future climate change.

REFERENCES

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