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South Pacific hydroclimate response to multi-decadal modes of variability in the IGCM4 climate model

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The South Pacific Convergence Zone (SPCZ) dominates the climate dynamics of the tropical South Pacific, significantly influencing global climate dynamics. The magnitude, slope, and spatial extent of the SPCZ's precipitation pattern, are responsive to changes in both trade winds and the Southern Hemisphere subtropical jet. These changes are, in turn, driven by modes such as the MJO and ENSO. Whilst the drivers of SPCZ variability on subseasonal to interannual timescales are well-documented, understanding of its variability over multi-decadal to millennial timescales remains limited.

Quantitative reconstructions of South Pacific hydroclimate reveal rapid, and as yet unexplained, changes in the SPCZ over recent millennia that do not align with large-scale climate forcing. This study proposes that large-scale multi-decadal modes of variability may play a crucial role in driving SPCZ variability.

Using an Intermediate General Circulation Model (IGCM4), we investigate the SPCZ's response to sea surface temperature (SST) forcing corresponding to the Atlantic Multi-decadal Variability (AMV) and Interdecadal Pacific Oscillation (IPO). Applying monthly varying SST anomalies at a range of magnitudes and in different combinations, we assess the linearity of the SPCZ response to these multi-decadal modes. Additionally, we explore the pathways associated with each response by applying SST anomalies both globally and within the respective basin.

This research aims to enhance our understanding of the interaction between the SPCZ and multi-decadal modes of variability, providing insights into past changes in the proxy record and contributing to the development of future SPCZ projections.