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Indo-Pacific basin interactions and their impacts on Austral-Asian hydroclimate over the last millennium

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Rainfall associated with the Austral-Asian monsoons affect the livelihoods of over half of the world's population, yet the impacts of anthropogenic forcings on regional hydroclimate trends in the coming decades remains uncertain. Observation-based studies have found that monsoonal rainfall over Austral-Asia is influenced on interannual-decadal timescales by tropical sea surface temperature (SST) patterns in the adjacent Indian and Pacific Oceans. In recent years, interactions between the tropical Indian and Pacific Ocean (tropical basin interactions) have been recognized as important in understanding Austral-Asian hydroclimate variability. However, instrumental observations are too short to clarify the relationships between Austral-Asia rainfall and Indo-Pacific basin interactions on longer (multidecadal-centennial) timescales.

Here we utilize last millennium climate model simulations, Indo-Pacific SST and hydroclimate multi-proxy (e.g., stalagmites, corals, marine and lacustrine sediments) archives and various climate field reconstruction methods (e.g., composite plus scale, offline data-assimilation) to investigate low-frequency tropical basin interactions over the last millennium. Specifically, we assess whether the zonal SST gradients in the Indian and Pacific Oceans, which reflect basin-wide Walker Circulation strength, are coupled on multidecadal-centennial timescales. Preliminary analysis suggests intervals of decoupling between the two basins which coincided with simultaneous changes in the strength of the Australian and Asian monsoons. These findings provide dynamical insights into interpreting hemispherically in-phase hydroclimate records as well as long-term context for climate-risk management over Austral-Asia.