Monthly scale variability in drivers of northern Australian rainfall

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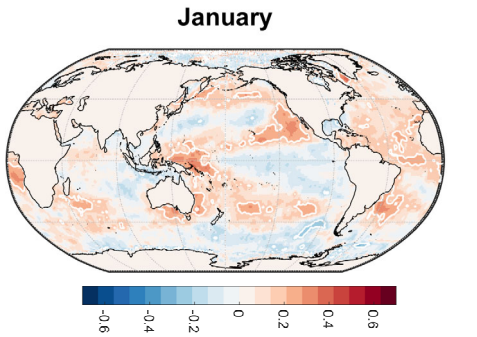
Northern Australian rainfall is highly variable from subseasonal to seasonal, interannual and interdecadal timescales. This research will identify the key drivers for variability of rainfall over northwest and northeast Australia throughout the wet season using step-wise linear regression.

Climate Drivers

- Large-scale climate drivers such as the Madden-Julian Oscillation, Indian Ocean Dipole, El Niño-Southern Oscillation (ENSO) and Interdecadal Pacific Oscillation contribute to this high variability.
- However, the influence of these climate drivers on northern Australian rainfall changes from austral spring through to autumn, which has implications for rainfall predictability over northern Australia.

January rainfall unforced by sea surface temperatures

- While the influence of local and remote sea surface temperatures (SSTs) on northern Australian rainfall peaks in November, this relationship decreases dramatically by January, after the onset of the Australian monsoon.
- The teleconnection with ENSO re-emerges in February, making ENSO a source of predictability from austral spring to the beginning of summer, and again for the later part of the monsoon season and beyond.



Regression coeffs (Northern rainfall, SST anomalies, 1920 - 2023)


Rainfall Northwest Australia


Rainfall Northeast Australia

	R^2			R^2		
Month	**SST only**	**SST, soil moisture & evaporation**	**Key predictors**	**SST only**	**SST, soil moisture & evaporation**	**Key predictors**
September	0.34	0.34	Timor Sea SSTs	0.23	0.32	CP Index, Oceanic evaporation; SSTs Arafura Seas and Gulf of Carpentaria
October	0.48	0.53	DMI, Niño 3.4 lag-1; Niño 3.4 lag-1, Soil moisture lag-1	0.27	0.27	Niño 3.4 lag-1; SSTs Arafura Seas and Gulf of Carpentaria
November	0.37	0.42	CP Index, Oceanic evaporation; Coral Sea	0.43	0.47	Coral Sea SSTs; CP Index, Oceanic evaporation
December	0.07	0.42	Oceanic evaporation	0.24	0.62	Oceanic evaporation; CP Index, Soil moisture lag-1
January	0.00	0.29	Oceanic evaporation; TPI	0.09	0.28	Oceanic evaporation, Ningaloo Niño Index
February	0.17	0.55	Oceanic evaporation; IOBW	0.10	0.28	Oceanic evaporation; IOBW
March	0.19	0.44	Oceanic evaporation; IOBW	0.14	0.44	Oceanic evaporation; TPI
April	0.04	0.20	Coral Sea SSTs, ET lag-1; Oceanic evaporation	0.16	0.16	Coral Sea SSTs; Arafura Seas and Gulf of Carpentaria

Table 1: Step-wise linear regression using observations and reanalysis data from 1940 to 2022 with northwestern (left columns) and northeastern (right columns) Australian rainfall as predictand.

Key research questions - current and future work

What are the mechanisms that lead to the break-down (January) and re-establishment (February) of the SST-influence on northern Australian rainfall? Which processes and feedbacks drive rainfall variability over northern Australia during each month, can they be quantified, and can these processes be captured in climate models?

- Work in progress -

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