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# How unusual was Australia's 2017-2019 Tinderbox Drought?

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Australia's Murray-Darling Basin experienced three consecutive years of meteorological drought across 2017–2019, collectively named the 'Tinderbox Drought'. Rainfall deficits during the three-year drought were focussed in the Australian cool season (April to September), and deficits in both the cool season and the annual total were unprecedented in the instrumental record. However, at ~120 years long, Australian rainfall records are not long enough to have captured the full possible range of variability, particularly for multi-year extreme events. That is, observations are an incomplete sampling of the full possible range of rainfall variability. Climate model simulations may provide longer timeseries, however climate models have known biases in Australian rainfall (Grose et al. 2020). Therefore, to determine if the Tinderbox Drought was outside the expected range of internal variability, we constructed Linear Inverse Models (LIMs) that simulate internal variability in Australian rainfall and associated global sea surface temperature (SST) anomalies. We used the LIMs to produce 10000-year-long rainfall records that emulate the stationary statistics of observed Australian rainfall, hence reflecting more of the full possible range of variability.

Overall, we find that rainfall deficits were most severe 1) in the northern Murray-Darling Basin; and 2) during the final year of the drought (2019). Global SST anomalies during the drought mostly did not resemble the pattern that is most reliably associated with low rainfall over the Murray-Darling Basin (warm anomalies in the central tropical Pacific and the western Indian Ocean). In fact, global SST anomalies observed during the Tinderbox Drought are not reliably associated with negative rainfall anomalies across the Murray-Darling Basin—this is particularly the case for the first two years of the drought. In terms of single-year rainfall anomalies, the only aspect of the Tinderbox Drought that was beyond the expected natural range was annual-total rainfall over the northern Murray-Darling Basin during 2019. However, when considered in terms of basin-wide rainfall over the full three years, negative anomalies during the Tinderbox Drought were beyond the expected natural range in terms of both cool season and annual rainfall. This suggests an anthropogenic contribution to the severity of the drought. Additionally, we find that Linear Inverse Models are a valuable tool for estimating whether or not an observed extreme rainfall event falls within the expected natural range.

**References**

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