

Disentangling ENSO and IOD Teleconnections

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Tropical modes of variability, such as the El Niño–Southern Oscillation (ENSO) and the Indian Ocean Dipole (IOD), play a central role in driving interannual climate variability in the tropics and exert widespread influence on extra-tropical climate conditions. However, commonly used indices of ENSO and IOD variability often exhibit substantial co-variability, making it difficult to quantify the independent contribution of each mode to the interannual climate variability. A common approach to address this issue involves statistically removing either ENSO or IOD variability from anomaly fields prior to calculating teleconnection patterns.

Here, we compare the results of this simple statistical approach with estimates of the ENSO and IOD independent contributions that are obtained by conducting a suite of coupled and uncoupled (atmospheric-only) modeling experiments, in which the sea surface temperature (SST) variability associated with either ENSO or IOD is suppressed. The partially coupled experiments include a fully dynamic ocean, but SSTs are restored to the model's monthly mean climatology within specified regions. We apply two different restoring masks: the first spans the eastern Pacific to suppress ENSO-related SST variability, and the second covers the Indian Ocean and western Pacific to suppress IOD-related SST variability.

Using the Australian climate as a case study, we show that precipitation patterns attributed to ENSO, when computed by statistically removing the IOD influence, significantly underestimate the true impact of ENSO on precipitation variability. Conversely, we find that IOD teleconnections estimated by regressing the Dipole Mode Index, DMI, onto June–October mean precipitation anomalies tend to overestimate the role of the IOD. Motivated by these findings, we propose a conceptual framework that offers a more effective approach for disentangling the independent contributions of ENSO and IOD to precipitation variability.