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Oceans outside the tropical Pacific influence ENSO when ENSO predictability is poor

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Various studies demonstrate that the El Niño Southern Oscillation is influenced by each of the Atlantic Ocean, Indian Ocean, extra-tropical Pacific Ocean and Southern Ocean. However, there is no cohesive picture of the relative importance of different ocean basins. Furthermore, even when considering only one basin, there is disagreement over the strength of it's influence on ENSO. Differences between previous studies likely arise from differences in their design. Untangling interbasin influences is non-trivial, due to the need to distinguish between correlation and causation. Investigating these interbasin interactions is additionally complicated by model bias, and computational expense limiting the breadth of model studies.

We investigate the interbasin influences on ENSO from a new angle. We use analogue forecasting instead of initialised ensemble forecasting: we select analogues similar to some target state from a long model run (e.g. pre-industrial control or single model initial-condition large ensemble), rather than initialising from that target state. The analogue forecasts, made by following the selected analogues through time in the model run, have been previously evaluated to show similar skill to an initialised forecast. These forecasts are much faster than traditional initialised forecasts, allowing us to explore multiple models, lead times and initialisation months. We explore whether these analogue forecasts are improved by considering information from regions outside the tropical Pacific, and then infer how these regions contribute to ENSO evolution.

When ENSO forecasts are skilful, before the Spring Predictability Barrier, outside influences have little impact on ENSO forecast skill. When ENSO forecasts cross the Spring Predictability Barrier and are poor, then considering information from outside the Tropical Pacific Ocean improves forecasts. We conclude that when ENSO is in a growth phase it dominates the climate system, but in a decay phase ENSO is influenced by regions outside the tropical Pacific. This behaviour is consistent across at least two global coupled climate models, despite large variability in the way these models represent ENSO's seasonal evolution. We intend to expand this investigation to more models, and to compare the impacts of verifying forecasts against observational or model data.