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Localized subtropical forcing of tropical Pacific climate and decadal ENSO modulation

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The relative impact of the subtropical North and South Pacific Oceans on the tropical Pacific climate mean state and variability is estimated using an ocean-atmosphere-sea ice coupled general circulation model. Tailored experiments are performed in which the model is forced by idealized sea surface temperature anomalies (SSTA) in the subtropics of both hemispheres. The main results of this study suggest that subtropical South Pacific climate variations play a dominant role in tropical Pacific decadal variability and in the decadal modulation of El Niño-Southern Oscillation (ENSO).

In response to a 2°C warming in the subtropical South Pacific, the equatorial Pacific SST increases by about 0.6°C, being about 65% larger than the change in the North Pacific experiment. The subtropics affect equatorial SST mainly through the atmosphere-mixed layer interactions in the South Pacific experiments; the response is mostly accomplished within a decade. The oceanic tunnel dominates in the North Pacific experiments; the response takes at least 100 years to be accomplished. The statistics of ENSO exhibit significant changes in amplitude and frequency in response to a warming/cooling in the subtropical South Pacific: a 2°C warming (cooling) of subtropical South Pacific SST reduces (increases) the interannual standard deviation by about 30% (20%) and shortens (lengthens) the ENSO period. The simulated changes in the equatorial zonal SST gradient are the main contributor to the modulation of ENSO variability. The subtropical North Pacific thermal forcing did not change the statistical properties of ENSO as strongly.