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Impact of the Indian and the North Pacific Ocean on ENSO Variability in a Hybrid Coupled Model

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Abstract

This study examines the impacts of the Indian Ocean and the North Pacific Ocean on El Nino and the Southern Oscillation (ENSO) variability through a series of numerical experiments with a hybrid coupled model. In the control run, an atmospheric general circulation model (AGCM) is coupled to the Zebiak-Cane simple ocean model in the tropical Pacific. Outside the tropical Pacific climotological sea surface temperatures are prescribed in the control simulation. In the first (second) experiment, a slab thermodynamic mixed layer model is coupled to the AGCM in the Indian (North Pacific) Ocean. The inclusion of the Indian Ocean has little impact on the ENSO amplitude, however, the Indian Ocean modifies the ENSO frequency via interactions with the Indian monsoon. The power spectrum of the Indian monsoon rainfall has significant biennial time scale around 20~30 months in the first experiment, which may enhance the biennial time scale of ENSO variability through a shift of the horizontal structure of zonal wind stress variability in the central equatorial Pacific. On the other hand, the North Pacific Ocean (i.e., the second experiment) differently plays a role to modify the ENSO statistics in terms of amplitude and frequency compared to the Indian Ocean. By comparing directly the two idealized experiments we discussed how differently the North Pacific Ocean acts to the ENSO variability.