

Characteristics of Oceanic Response to ENSO Estimated from Simulations with the NCEP Climate Forecast System

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ABSTRACT

The ocean temperature response to El Niño–Southern Oscillation (ENSO) is examined based on 31-yr (1981–2011) simulations with the National Centers for Environmental Prediction (NCEP) Climate Forecast System (CFS) coupled model. The model sea surface temperature (SST) in the tropical Pacific is relaxed to observations to ensure realistic ENSO variability in the simulations.

In the tropical Pacific, the subsurface temperature response to the ENSO SST is closely related to the variability of thermocline. The early temperature response is stronger and deeper in the tropical Indian Ocean than in the tropical Atlantic. The analysis at three selected locations (Fig. 1) reveals that the peak response of the subsurface temperature to ENSO lags the Niño-3.4 SST by 4, 7, and 7 months, respectively, in the tropical Indian Ocean, subtropical Atlantic, and North Pacific, where SSTs are known to be strongly influenced by ENSO. The ENSO-forced temperature anomalies tend to penetrate to deeper ocean with time in the North Pacific and subtropical Atlantic, but not in the tropical Indian Ocean where peak anomalies are found at month 4 over all depths above the 300 m depth. The longer (shorter) response timescale in the North Pacific and subtropical Atlantic (tropical Indian Ocean) is closely related to more (less) persistent local surface wind stress anomaly forced by ENSO. The results presented in this study may help understand the attributions for SST anomalies and oceanic variability in different ocean basins and their link to the ENSO variability.

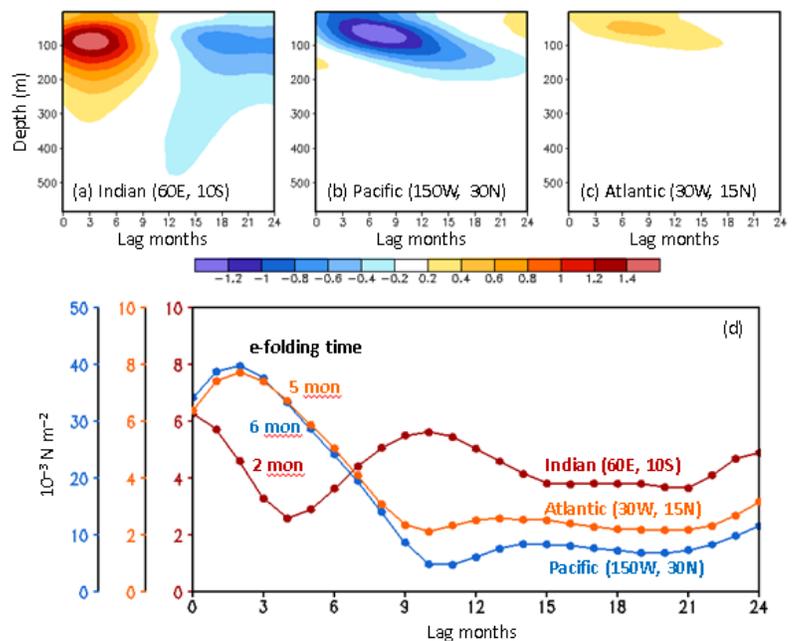


Fig. 1 Ocean temperature anomalies at (a) tropical Indian Ocean (60°E, 10°S), (b) North Pacific (150°W, 30°N), and (c) subtropical Atlantic (30°W, 15°N) and (d) corresponding amplitude of surface wind stress anomalies at 60°E, 10°S (red), 150°W, 30°N (blue), and 30°W, 15°N (orange) obtained based on lagged linear regressions against the Niño-3.4 index for individual CFS simulations and then averaged over the nine members. The anomalies correspond to a two-standard-deviation Niño-3.4 SST anomaly (1.8°C) and lag the Niño-3.4 SST anomaly from 0 month to 24 months.

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