李崇瑋 NTUIO 2025/3/13

Title:
Wind Stress Forcing and Oceanic Dynamical Feedbacks in Regulating El Niño Duration

Abstract:
The El Niño-Southern Oscillation (ENSO) is the primary climate mode driving interannual variability in global climate. A deeper understanding of ENSO dynamics is essential for improving seasonal forecasting. While the duration of historical El Niño events ranges from single-year to multiyear, the mechanisms that differentiate their evolution remain unclear. This study investigates the coupled atmosphere-ocean processes that determine the duration of El Niño events. Our analysis shows that single-year El Niños exhibit earlier sea surface temperature (SST) and wind anomalies, which trigger more pronounced delayed negative feedbacks from oceanic waves, helping to terminate the event. In contrast, such feedbacks are absent in multiyear events. Additional model experiments reveal that the contributions of direct wind-driven and boundary-reflected oceanic waves to the decay rates are comparable. The results also indicate that the decay of El Niño is accelerated by coupled thermodynamic responses interacting with the western North Pacific monsoon. These findings provide new insights into the fundamental dynamics regulating El Niño duration and lay the foundation for improving ENSO prediction.

Related Publications:

Lee, C.-W., C.-H. Sui, and T. Izumo, 2025: Direct wind-driven and boundary-reflected oceanic waves for El Niño's evolution: single-year versus multiyear events. *Journal of Climate*, 38, 1205-1220.

Lee, C.-W., 2024: Mechanisms Causing El Niño'S Diverse Phase Transition. Ph.D. thesis, Dept. of Atmospheric Sciences, National Taiwan University, 130 pp. doi:10.6342/NTU202400026.

Lee, C.-W., C. Sui, and T. Li, 2023: Roles of Dynamic and Thermodynamic Processes in Regulating the Decay Paces of El Niño Events. *Journal of Climate*, 36, 6229–6246.

Lee, C. - W., Y. - H. Tseng, C. - H. Sui, F. Zheng, and E. - T. Wu, 2020: Characteristics of the prolonged El Niño events during 1960–2020. *Geophysical Research Letters*, 47, e2020GL088345.