

## Breakdown of ENSO predictors in the 2000s: Changes in the thermocline variation and atmospheric intraseasonal forcing

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Variations in the warm water volume (WWV) of the equatorial Pacific and atmospheric forcing from intraseasonal variation (ISV) in the western equatorial Pacific are regarded as two good predictors of the subsequent El Nino/Southern Oscillation (ENSO), with a lead time of two to three seasons. Here we report that the robust predictability of these predictors for ENSO has changed in the 2000s.

During 1981-2000, the recharge (discharge) of the WWV and strong (weak) ISV forcing preceded El Nino (La Nina) by two to three seasons. However, in the 2000s, the interrelationship between the WWV/ISV and following ENSO became weak, especially for the El Nino/La Nina events after 2005. Notably, the discharged phases of WWV that led to subsequent La Nina events were less observed since 2001. These changes may be caused by frequent occurrences of the "warm-pool El Nino," which is characterized by SST anomalies centered in the central equatorial Pacific.

Keywords: El Nino/Southern Oscillation (ENSO), Equatorial Pacific, Equatorial Warm Water Volume, Atmospheric Intraseasonal Variation