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A Mechanism from Pathway Perspective for the Generation of a Warm SST Anomaly in the Western Equatorial Pacific

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Processes leading to the onset and development of an El Niño event in the tropical Pacific remain elusive. Observed data and Ocean General Circulation Model (OGCM) simulations are used to reveal a well-defined pattern of sea surface temperature (SST) perturbations along the mean North Equatorial Countercurrent (NECC) pathways in association with the onset and evolution of some El Niño events. The OGCM-based sensitivity experiments are conducted to illustrate how a warm SST anomaly (SSTA) on the equator can result from a thermal forcing that is prescribed north of 10°N, similar to observed SST anomalies in December 1988. Within approximately one year, the imposed SST anomaly north of 10°N tends to be transported to the dateline region on the equator by the mean ocean circulation in the western Pacific (the low-latitude western boundary current (LLWBC) and the NECC). In due course, an upper-layer ocean warming is generated off the equator at 6-10°N and then on the equator, which acts to induce a westerly wind anomaly response; a simple statistical atmospheric wind stress model is then used to depict an expected westerly wind response. These resultant SST and surface wind perturbations can couple together over the western tropical Pacific, forming air-sea interactions and setting up a stage for El Niño onset. As such, this pathway mechanism can reasonably well explain the appearance of a warm SST anomaly on the equator in the dateline region and the corresponding development of westerly wind anomalies over the western Pacific in association with El Niño onset.