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TITLE: Variations in Tropical Sea Surface Temperature and Surface Wind Fields Associated with the Southern Oscillation/El Niño

AUTHOR: ['Eugene M. Rasmusson', 'Thomas H. Carpenter']

ABSTRACT:

Surface marine observations, satellite data, and station observations of surface pressure and precipitation are used to describe the evolution of sea surface temperature (SST) anomalies, surface wind fields, and precipitation anomaly patterns during major warm episodes in the eastern and central tropical Pacific. The sequence of events is described in terms of composite SST and wind fields (30°N?30°S) for six warm episodes since 1949, and time series and cross-spectral analyses of mean monthly data along six shipping lanes which cross the equator between the South American coast and 170°W. During the months preceding a warm episode, the equatorial easterlies are stronger than normal west of the dateline. This and other coherent and strongly developed anomaly patterns over the western equatorial Pacific and South Pacific are associated with a South Pacific Convergence Zone (SPCZ) located southwest of its normal position. During October-November prior to El Niño, the equatorial easterly anomalies in the western Pacific are replaced by westerly anomalies. This change coincides with the appearance of positive SST anomalies in the vicinity of the equator near the dateline. East of the dateline (140?170°W), the wind anomalies along the equator follow a different pattern, with the diminution of the easterlies lagging rather than leading the development of positive SST anomalies near the Ecuador-Peru coast. Further south, SST's increase and the easterlies show a general decrease over most of the latitude band 10?30°S prior to the coastal warming. Composites and cross-spectral analysis clearly show a westward migration of the eastern equatorial Pacific SST anomaly pattern from the South American coast into the central equatorial Pacific. Maximum SST anomalies typically occur around April-June along the South American coast, and near the end of the year around 170°W. This westward spread of positive SST anomalies coincides with the intensification of westerly wind anomalies along the equator and the development of anomalous northerly flow across the mean position of the Intertropical Convergence Zone (ITCZ). The southward shift of this convergence belt is accompanied by a northeastward shift of the SPCZ, resulting in a matter wedge-shaped dry zone and enhanced precipitation in the eastern and central tropical Pacific. The surface wind anomaly field in the central equatorial Pacific is most strongly developed during August-December following the maximum SST anomalies along the Ecuador-Peru coast. During the northern winter following El Niño, the positive SST anomalies, as well as the low-level convergence and positive precipitation anomalies, are concentrated in the central equatorial Pacific. A simple calculation based on the surface divergence composite indicates that at this time enhanced large-scale vapor flux convergence in this area is comparable in magnitude to the enhanced precipitation. The western end of a precipitation anomaly seesaw also appears in the data. Below normal precipitation is observed over Indonesia during the year of El Niño. Negative precipitation anomalies in the subtropics are associated with enhanced divergence and a weakened east Asian northeast winter monsoon in the Northern Hemisphere, and a weakened summer convergence zone east of Australia in the Southern Hemisphere.

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