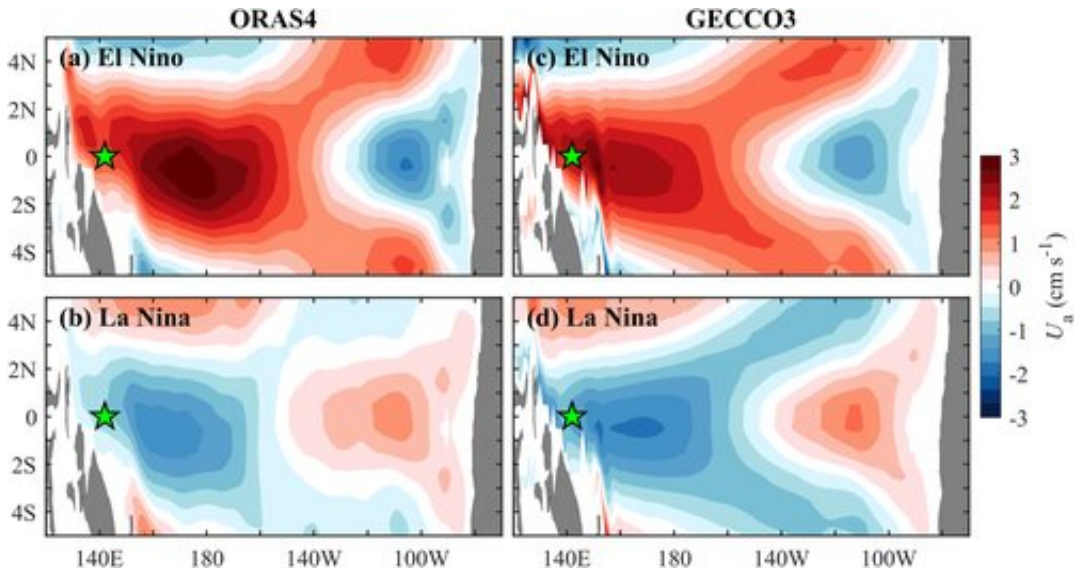
How Pacific decadal oscillation modulates the El Niño-related eastward transport anomaly

April 4 2022, by Li Yuan



Distributions of (left) ORAS4 and (right) GECCO3 composite zonal velocity anomaly (U_a) averaged over 400–1,000 m depths at a 10- to 12-month lag after the peak month of the (top) El Niño and (bottom) La Niña events. The green pentagram in each panel denotes the mooring site at 142°E/0°. Credit: *Geophysical Research Letters* (2022). DOI: 10.1029/2022GL098409

The equatorial intermediate currents (EICs) contribute to global circulation, climate variability, and distributions of heat, water mass, and biogeochemical quantities.

The EICs in the western Pacific show a significant interannual response to El Niño-Southern Oscillation (ENSO) at a 10- to 12-month lag, with an eastward transport anomaly *(Tr_a)* during the El Niño events.

A research team led by Prof. Wang Fan from the Institute of Oceanology of the Chinese Academy of Sciences (IOCAS) has documented the intraseasonal, seasonal, and interannual variability of the EICs in the western Pacific, and revealed that the El Niño-related eastward Tr_a can be modulated by the Pacific Decadal Oscillation (PDO).

The study was published in *Geophysical Research Letters* on March 22.

Based on the results from two long-record reanalysis products, the researchers ascertained that the PDO modulation effects were embodied in two aspects. The magnitude of the maximum eastward Tr_a during the warm PDO-El Niño was nearly twice as large as that during the cold PDO-El Niño, and the occurrence time of the largest eastward Tr_a for warm PDO-El Niño leaded that for cold PDO-El Niño by about two months.

The researchers further performed model experiments to explore the underlying mechanism. The above modulation was closely related to the wind forcing in the equatorial central Pacific. In the warm PDO phase, the enhanced and eastward-displaced anomalous westerly winds could induce the Kelvin waves with an intensified amplitude and eastward shift. These eastward propagating waves were reflected into Rossby waves at the Pacific eastern boundary. The westward and downward propagation of such Rossby waves induced the larger and earlier peaked eastward Tr_a.

"This study interconnects the PDO with the EICs, and expands the knowledge of intermediate current variability to an interdecadal

timescale. Such variability has potential consequences for long-term inter-basin exchanges of mass, heat, and biogeochemical properties," said Prof. Wang.

More information: Qiang Ma et al, Interdecadal Modulation of ENSO-Related Anomalous Equatorial Intermediate Currents in the Western Pacific by the PDO, *Geophysical Research Letters* (2022). DOI: 10.1029/2022GL098409

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