Exploring special sea-level and circulation anomalies in the Philippine Sea during El Niño events

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The Philippine Sea (PS) is one of the regions with the strongest interannual variability in sea level and upper-layer circulation. During

the developing stage of El Niño events, the Philippine Sea shows sea level falling and cyclonic circulation anomaly. However, El Niño is complex, causing diverse Philippine Sea responses across individual events.

A research team led by Prof. Wang Fan from the Institute of Oceanology of the Chinese Academy of Sciences (IOCAS) has revealed the mechanism behind the special variations of sea level and circulation in the Philippine Sea during 2006 and 2009 El Niño events. The study was published in *Journal of Geophysical Research: Oceans* on June 3.

The researchers investigated the exceptional positive sea-level anomalies and anticyclonic circulation anomalies in the boreal spring and summer of 2006 and 2009 by synthesizing observational and reanalysis data sets. They also found exceptional changes in downstream regions, such as the southward shifted North Equatorial Current bifurcation, enhanced Mindanao Current intrusion into the Sulawesi Sea, and increased Indonesian throughflow transport in the Makassar Strait.

The persistent and strong equatorial easterly winds of the winter preceding 2006 and 2009 El Niño might be a major contributor to these changes. Sensitivity experiments from a simplified ocean model further suggested that the winds from February to March of the preceding year were most critical. Specifically, the negative wind stress curl in the western and central North Pacific played a dominant role, and the equatorial winds played a secondary role.

"The former La Niña builds up the background state of special sea-level anomalies, and a late-onset El Niño is favorable for the special variations of such special changes in the Philippine Sea," said Li Rui, first author of the study.

"Our findings help understand the sea level and circulation changes in

tropical western Pacific under El Niño-Southern Oscillation (ENSO) complexity, and will contribute to regional climate prediction and adaptation efforts," said Prof. Wang, corresponding author of the study.

More information: Rui Li et al, Special Sea-Level and Circulation Anomalies in the Philippine Sea During the 2006/2007 and 2009/2010 El Niño Events, *Journal of Geophysical Research: Oceans* (2023). DOI: 10.1029/2022JC019537

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