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Asymmetric responses to ENSO in the tropical Indian and Atlantic Oceans

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Eastern-Pacific (EP) El Niño events since 1958 have mostly (75%) transitioned into La Niña events after their decay, whereas Central-Pacific (CP) El Niño events during the same period have most not transition into La Niña events (only 38% has the transitions). We explore the cause of this contrasting feature by comparing the transitional and non-transitional composites of the EP and CP El Niño. The different transitions between the two types of El Niño stem from the facts (1) that they invoke different surface wind anomaly patterns in the Pacific for their transitions and (2) that the corresponding transition wind pattern can be internally forced for the EP El Niño but not for the CP El Niño.

By comparing the transitional and non-transitional groups of El Niño, we find the reversal of western Pacific wind (WPw) from surface westerlies anomalies to easterlies since November is required for the EP El Niño to transition into La Niña, while the southward shift of central Pacific wind (CPw) since December is required for the CP El Niño to transition into La Niña. The former induces ocean waves propagating eastward to trigger the La Niña phase, whereas the latter intensifies local surface heat flux cooling to start the La Niña phase. The different transition wind patterns reflect the control of thermocline dynamics of the EP El Niño and the control of mixed-layer dynamics of the CP El Niño.

The WPw reversal is found to be caused by the intensification of western Pacific subtropical high or the warming of the Indian Ocean sea surface temperatures (SSTs), both of which can be induced by a developing EP El Niño. The WPw reversal required for the transition can often be produced by the EP El Niño itself. Therefore, the EP El Nino is more likely to transition into La Nina. The CPw shift required for the transition of CP El Niño is found to be mostly not related to the El Niño itself. Therefore, the CP El Niño is less likely to transition into La Niña.