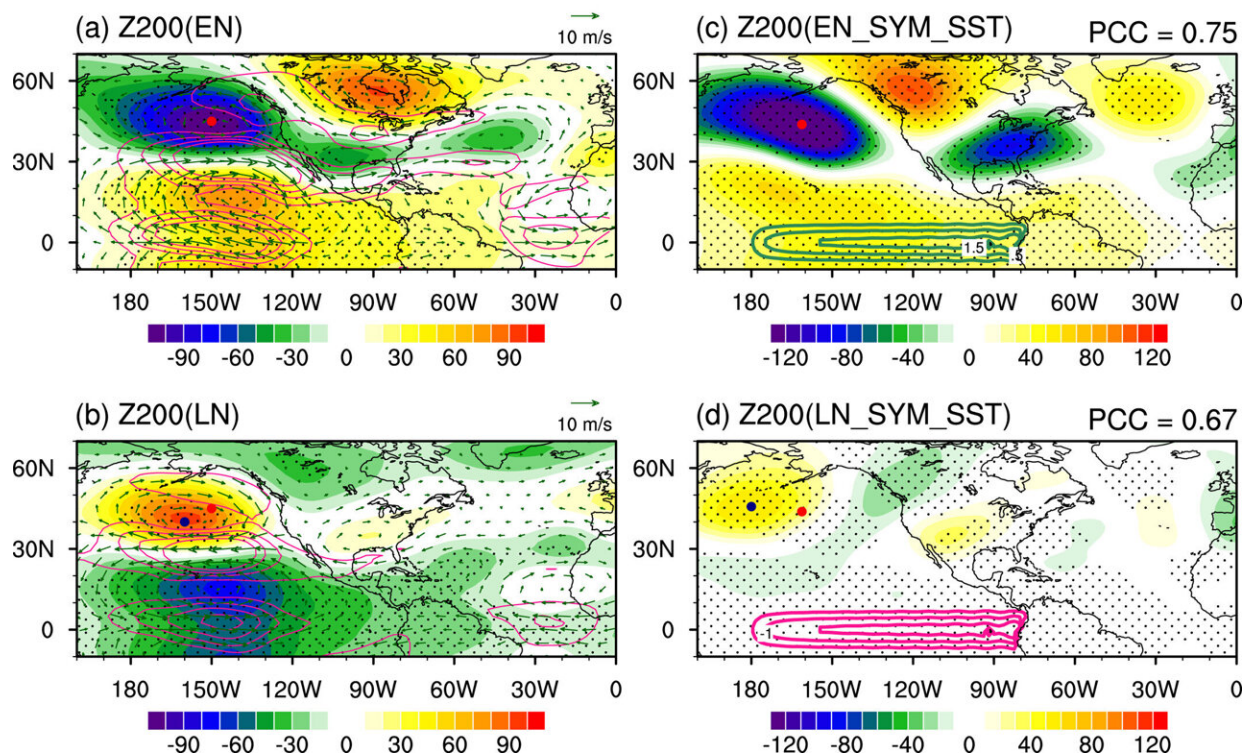


Unlocking the complexity of ENSO teleconnections through nonlinear energy insights

September 15 2023, by Li Yuan



DJF composite 200-hPa geopotential height (shading; m), winds (vectors; 10 m/s), and eddy kinetic energy (EKE; contour lines with interval of 10 m²/s²) anomalies during (a) El Niño (EN) and (b) La Niña (LN) in NCEP2. The red and blue circles represent the central position of the anomalous geopotential height in North Pacific during EN and LN, respectively. Strong El Niño/Southern Oscillation (ENSO) events with Niño3.4 index greater (less) than 1 (−1) °C are selected in this study, as the atmospheric response to strong ENSO events is more pronounced than weak ENSO events. DJF anomalous 200-hPa geopotential

height (shading; m) and SST (contour lines; K) during (c) EN and (d) LN in SYM_SST experiments. PCC denote pattern correlation coefficient of the model responses with the corresponding observed composites. Zonal mean anomalies have been to focus on the Pacific-North American teleconnection pattern. Credit: *Geophysical Research Letters* (2023). DOI: 10.1029/2023GL105277

A new study by researchers from the Institute of Atmospheric Physics of the Chinese Academy of Sciences challenges traditional climate research frameworks. It demonstrates the pivotal role of nonlinear energy processes in shaping the zonal asymmetry observed in El Niño-Southern Oscillation (ENSO)-induced Pacific-North American (PNA) wave trains.

The study was published in [*Geophysical Research Letters*](#).

The researchers found that nonlinear energy processes played a crucial role in shaping the zonal asymmetry observed in ENSO-induced Pacific-North American wave patterns, which challenges traditional linear frameworks.

The researchers found that ENSO triggered a complex interplay of zonally symmetric and asymmetric responses within the atmosphere, ultimately affecting the positioning of Pacific-North American teleconnections. The nonlinear energy advection processes drive contrasting energy advection modes during El Niño and La Niña events, leading to variations in the zonal position of the Pacific-North American pattern.

The team's findings have been successfully reproduced and confirmed in model experiments of varying complexity, verifying the significance of nonlinear energy processes in shaping ENSO-induced teleconnections.

This study sheds new light on intricate mechanisms in ENSO-induced teleconnections, and emphasizes the need to consider nonlinear energy processes in climate research.

More information: Ya Wang et al, The Role of Nonlinear Energy Advection in Forming Asymmetric Structure of ENSO Teleconnections Over the North Pacific and North America, *Geophysical Research Letters* (2023). [DOI: 10.1029/2023GL105277](https://doi.org/10.1029/2023GL105277)

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