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# Why do oceanic nonlinearities play a weak role in Extreme El Niño events?

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Extreme El Niño events exhibit outsized impacts worldwide and considerably enhance the El Niño Southern Oscillation (ENSO) warm/cold phase asymmetries. While many mechanisms were proposed, no consensus has been reached and the relative role of atmospheric and oceanic processes remains to be illustrated. Here we quantitatively assess the contribution of oceanic nonlinearities through a state-of-the-art oceanic general circulation model, which realistically simulates extreme El Niño related characteristics and the oceanic nonlinear processes responsible for ENSO skewness. An effective way is developed to isolate sea surface temperature (SST) nonlinear response based on paired experiments forced with opposite wind stress anomalies. We demonstrate that the overall oceanic nonlinearities play a marginal role on extreme El Niño amplitude, which largely arises from the compensation between positive contributors from tropical instability waves (TIWs) and nonlinear dynamic heating (NDH) and negative contributors from subsurface processes and air-sea fluxes. The physical processes keep robust when using the other mixing scheme or mixed layer option for the heat budget. Our findings quantitively reveal the subtle contribution of oceanic nonlinearities, yielding strong evidence for the paramount role of atmospheric nonlinearities in shaping extreme El Niño events.