



Nonlinearity in the Northern Hemisphere atmospheric response to a linear ENSO forcing

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El Niño Southern Oscillation (ENSO) exerts a remote impact on the North Pacific and North American winter climate. Both observational and model studies have suggested nonlinearities in this teleconnection. However, it remains unclear if possible nonlinearities arise from the forcing strength or the forcing location in the tropical Pacific, or from factors external to the tropical Pacific. To separate these factors, a simplified physics atmospheric model is forced with seasonally varying sea surface temperature (SST) with linearly varying strength at a fixed location. Whereas for moderate events the North Pacific response is more linear, strong events exhibit significant nonlinearity both in terms of the strength and location of the impact. For instance, the North Pacific sea level pressure (SLP) anomalies shift eastward with increasing SST forcing in the tropics. The nonlinearity of the extratropical response can be traced back to the relationship between SST and tropical convection. In contrast, the relationship between the poleward divergent wind in the upper tropical troposphere and the North Pacific SLP response is found to be linear. Nonlinearity in the North Pacific response has important impacts on the teleconnection to the North Atlantic/European region across North America and through the stratosphere. In addition, nonlinearity in ENSO teleconnections may have important consequences for potential changes in the diversity of ENSO with climate change.