



Analysis of the Non-Linearity of El Niño Southern Oscillation Teleconnections

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The El Niño Southern Oscillation (ENSO) has significant variations and non-linearities in its pattern and strength. ENSO events are shifted along the equator, with some located in the central Pacific (CP) and others in the east Pacific (EP). To study how these variations are reflected in global ENSO teleconnections we analyze observations and idealized atmospheric general circulation model (AGCM) simulations.

Clear non-linearities exist in observed teleconnections of sea level pressure (SLP) and precipitation. However, it is difficult to distinguish if these are caused by the different signs, strengths or spatial patterns of events (strong El Niño events mostly being EP events and strong La Niña events mostly being CP events) or by combinations of these. Therefore, sensitivity experiments are performed with an AGCM forced with idealized EP and CP ENSO sea surface temperature (SST) patterns with varying signs and strengths. It can be shown that in general the response is stronger for warm events than for cold events and the teleconnections shift following the SST anomaly patterns. EP events show stronger non-linearities than CP events. The non-linear responses to ENSO events can be explained as a combination of non-linear responses to a linear ENSO (fixed pattern but varying signs and strengths) and a linear response to a non-linear ENSO (varying patterns). Any observed event is a combination of these aspects. While in most tropical regions these add up leading to stronger non-linear responses than expected from the single components, in some regions they cancel each other resulting in little overall non-linearity. This leads to strong regional differences in ENSO teleconnections.