# Asymmetry and nonlinearity of the influence of ENSO on the northern winter stratosphere: Observations vs. simulations

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This study explores the nonlinearity and the asymmetry of ENSO’s influences on the northern winter stratosphere. It is revealed that the ‘moderate El Niño’ and the ‘strong La Niña’ are more efficient than the ‘strong El Niño’ and the ‘moderate La Niña’ respectively. The tropical rainfall anomalies induced by a moderate El Niño or a strong La Niña are centered over the central equatorial Pacific region near the dateline, while the convection responses to a strong El Niño or a moderate La Niña are centered farther eastward. Accordingly, the anomalous Pacific–North America wave train pattern is modulated by ENSO in a nonlinear and asymmetric way, which leads to the large nonlinear and asymmetric components of the vertical Eliassen-Palm (E–P) flux responses to ENSO in the extra-tropics. The nonlinearity and asymmetry of ENSO-stratosphere coupling are well confirmed by the long-term simulations from the CESM-WACCM. Sensitivity experiments with WACCM further reveal that the nonlinearity and asymmetry of the stratospheric responses to moderate ENSO are dominated by the inherent properties of the atmosphere. Whereas those of the stratospheric responses to strong ENSO are mainly resulted from the asymmetry of ENSO SST forcing between strong El Niño and La Niña. Furthermore, the and the “high-top” WACCM are adopted to investigate the asymmetry and the nonlinearity. It is revealed that the dominant role of the inherent properties of the atmosphere.

Keywords: Winter Stratosphere, ENSO's influences, Nonlinearity, Asymmetry

 