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Non-linearity in the extratropical teleconnection to ENSO and the QBO

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Modes of climate variability that remotely alter the northern hemisphere stratospheric polar vortex state are explored using the Hadley Centre Climate Model (HadGEM3). Experiments are performed that sample combinations of El Niño—Southern Oscillation (ENSO) and quasi-biennial oscillation (QBO) states. These modes were chosen as El Niño and QBO easterly phases are known to weaken the polar vortex.

The El Niño induced weakening of the polar vortex is found to be more pronounced during QBO easterly than QBO westerly. Likewise, the polar vortex weakening caused by QBO easterly is stronger during El Niño than during neutral ENSO conditions.

It is also found that El Niño induces a change to the QBO itself, namely an increase in the descent rate of the QBO, but this is not large enough to explain the nonlinear response of the polar vortex. Other possible mechanisms are investigated, such as whether the QBO and ENSO teleconnections to the polar vortex are sensitive to the prior state of the polar vortex. Impacts of this nonlinearity on the surface response are also explored.