Effects of ENSO on Southern Hemisphere Jet Structures

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Centers of deep tropical convection can affect high Southern Hemisphere latitudes by mass outflow surges in the upper troposphere / lower stratosphere (UTLS) and radiation of planetary wave trains through the connecting westerly waveguide. Depending on the season and on the phase of the El Nino Southern Oscillation (ENSO), these wave trains will alter high latitude patterns of temperature, geopotential height, wind, and the distribution of column ozone. We employ global observations and simulations with the University of Wisconsin Nonhydrostatic Modeling System (UWNMS) to investigate the hypothesis that ENSO and seasonal changes in the location of convective centers and changes in the UTLS wind structure modulate the propagation of planetary wave trains, thereby influencing the distribution of circulation anomalies from the surface of Antarctica into the polar stratosphere.

Column ozone anomalies correlate highly with barotropic temperature anomalies in the UTLS, and may be linked to distinctive patterns of Antarctic surface temperature and wind anomalies for El Nino versus La Nina. During the SH winter to spring transition a westward shift in convection during La Nina of 30-50° corresponds to a 30-50° westward shift of planetary wave patterns from the tropics to Antarctica and of the zonal asymmetry in column ozone. In SH winter and spring during La Nina, a region of significant poleward planetary wave activity flux in the UTLS occurs near (amplified) Indonesian convection, while during El Nino the poleward flux is weaker and more diffuse across the Pacific. A primary result is that La Nina favors a barotropic low pressure anomaly over the Ross Sea, a colder East Antarctica, stronger westerlies in Drake Passage, greater downward penetration of the polar night jet (PNJ), and a more displaced but stronger polar vortex, hence stronger planetary wave one. The influence of ENSO on the structure of the subtropical jet, subpolar jet, and its vertical coherence with the polar night jet is highlighted. "Split Jet" and "Spiral Jet" structures are intimately related to the downward extension of the polar night jet in preferred longitude bands, according to season and phase of ENSO.

Key words: ENSO, Antarctica, wave activity flux, jet structures, teleconnections