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Onset of tropospheric circulation anomalies during Stratospheric Vortex Weakening events: the role of planetary-scale waves

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While mounting evidence links the deceleration of the stratospheric polar vortex during Stratospheric Vortex Weakening (SVW) events to the upward propagation of planetary scale Rossby waves from the troposphere to the stratosphere, the causes of the accompanying tropospheric circulation anomalies remain uncertain. To highlight the details of stratosphere troposphere dynamic coupling during the onset of SVW events, this study identifies SVW events using temporal vortex evolution and performs composite budget analyses of zonal wind tendency in the Transformed Eulerian Mean framework on daily time scales.

The time evolution of zonal wind anomalies shows a near-instantaneous vertical coupling in a time scale of a few days. No time-lagged downward coupling is observed during the onset of the SVW events although the resulting anomalies persist for up to a month after the onset. The synchronized zonal wind changes between the stratosphere and troposphere are caused by anomalous upward and poleward propagation of zonal wave-number-one and two waves, with tropospheric changes dominated by the latter. It is further found that while wave-number-one disturbances have no preferable geographical distributions during the onset of the SVW events, wave-number-two disturbances highly project onto the stationary waves in most cases. This results in a constructive interference that systematically modulates zonal-mean flow.