Geophysical Research Abstracts
Vol. 14, EGU2012-6269, 2012
EGU General Assembly 2012

Linear Interference in Extratropical Stratosphere-Troposphere Interactions

K. L. Smith (1) and P. J. Kushner (2)

(1) Lamont-Doherty Earth Observatory, Palisades, New York, United States (ksmith@ldeo.columbia.edu), (2) Department of Physics, University of Toronto, Toronto, Ontario, Canada

Vertical fluxes of wave activity from the troposphere to the stratosphere correlate strongly and negatively with the Northern Annular Mode (NAM) index in the stratosphere and subsequently in the troposphere. Recent studies have shown that stratospheric NAM variability is negatively correlated with the amplitude of the wave pattern coherent with the climatological stationary wave field, particularly its wave-1 component; when the climatological stationary wave field is amplified or attenuated, the stratospheric jet correspondingly weakens or strengthens. Here we quantify the importance of this linear interference effect by performing a decomposition of the upward wave activity flux into linear and nonlinear terms using reanalysis data. The interannual variability in upward wave activity flux in both the Northern and Southern Hemisphere extratropics is dominated by linear interference of quasi-stationary waves during the season of strongest stratosphere-troposphere coupling. Composite analysis of anomalous upward wave activity flux events reveals the significant role of linear interference, particularly for strong vortex events in the Northern Hemisphere, and shows that "linear" and "nonlinear" events are essentially independent. The persistence of the linear interference component of the vertical wave activity flux, corresponding to persistent phase or anti-phase locking between the wave-1 component of climatological stationary wave and the wave anomaly, may help improve wintertime extratropical predictability. It is also shown that linear interference is the dominant component to the upward wave activity flux anomalies preceding displacement stratospheric sudden warmings (SSWs) while split SSWs are preceded by nonlinear wave activity flux anomalies. Final warmings are shown to be predominantly linear, particularly in the Southern Hemisphere.