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Stratosphere-troposphere coupling: The role of linear interference in troposphere-stratosphere interactions

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Vertical fluxes of Rossby wave activity from the troposphere to the stratosphere correlate strongly and negatively with the Northern Annular Mode 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 that corresponds to the climatological stationary wave field, particularly its wave-1 and wave-2 components; 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 flux in both reanalysis and general circulation model (GCM) data. The interannual variability in upward wave activity flux in the Northern Hemisphere is dominated by linear interference of quasi-stationary waves from fall to spring. In summer, the variance of the flux associated with the wave anomalies themselves becomes relatively greater and much of this variance is associated with high-frequency eddies. The negative covariance between interference and anomaly components of the upward wave activity flux suggests a lead-lag relationship between the two. This is explored using composite analysis of anomalous upward wave activity flux events. Finally, using model data from low-top and high-top GCMs, the importance of a well-resolved stratosphere is addressed within context of the characteristics of linear interference.