



Tropospheric planetary wave response to anomalies in the stratospheric circulation

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The NCEP-NCAR reanalysis is used to analyse the relationships between the state of the stratosphere and the tropospheric waves during the Northern Hemisphere (NH) winter. First, a cross-spectral analysis reveals that the strength of the polar vortex and the vertical component of the Eliassen-Palm flux (EPz) from both the troposphere and the stratosphere, are significantly related with each other and in lead-lag quadrature at periods longer than 50-60 days only. The spectral analysis also shows that these periods are also those for which the downward propagation of stratospheric anomalies occurs, confirming that the downward propagation in the stratosphere is caused by wave-mean flow interaction at these low frequencies only. More specifically, we found that a weak (strong) polar stratospheric vortex is preceded by positive (negative) EPz anomalies and followed by negative (positive) EPz anomalies at all altitudes from the troposphere to the stratosphere. We also found that at low frequencies, the EPz anomalies in the troposphere are significantly larger after stratospheric vortex anomalies than before. This marked difference in the troposphere is related to planetary waves with zonal wavenumbers 1-3, showing that there is a tropospheric planetary wave response to the earlier state of the stratosphere at low frequencies. Most of these results are recovered using a 20-years integration done with the stratospheric version of the LMDz GCM. This validates the stratospheric planetary scale dynamics in the NH extratropics of this model.