The Seasonal Cycle of Stationary Planetary Waves in the Southern Stratosphere: A Numerical Study

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Stationary planetary waves in the southern stratosphere display a characteristic seasonal cycle with two maxima in early and late winter and a relative minimum in midwinter. Previous research suggests that this behaviour is mainly determined by seasonally varying transmission properties of the atmosphere with respect to wave propagation. A related question is whether the index of refraction adequately diagnoses the seasonal cycle in wave propagation. In the present thesis these issues are investigated with the help of a hemispheric, linear, quasigeostrophic model, which prescribes the wave at the top of the troposphere and solves for the wave in the stratosphere.

The model reproduces well the observed overall amplitude and phase behaviour including the direction of wave activity propagation. It is internally consistent in that the upper stratospheric wave can be qualitatively diagnosed using the refractive index. Certain low altitude features of the refractive index turn out to be important. A sensitivity study reveals that mainly the variation in zonal winds and less the variation in forcing contributes to the seasonal cyle. Wave response and refractive index are quite sensitive to variations in the zonal wind field at low altitudes and to such variations that change the jet structure of the wind field.

However, despite its internal consistency, the model fails to simulate more detailed features of the observed wave. In particular it does not reproduce the observed midwinter minimum in the wave's seasonal cycle. It therefore remains unclear from this study to what degree the latter is determined by wave transmission properties alone.