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Planetary wave propagation and circulation effects forced by zonally asymmetric ozone

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The stratospheric ozone of ECMWF Reanalysis (ERA40) shows a strong increase in wave one structure during the last decades, with amplitudes of about 10% of zonal mean ozone during the 1990ies. The decadal means of zonally asymmetric stratospheric ozone are derived from ERA40 and implemented in the GCM MAECHAM5 to investigate their effects during northern hemispheric winter on the circulation in the middle atmosphere down to the troposphere.

Based on different model simulations we found that the related radiation perturbations induce significant changes in temperature increasing with height (maximum zonal changes of 4 K in the lower stratosphere and 8 K in the lower mesosphere) mainly due to an increase in amplitude and a shift in phase of stratospheric wave one. Further analysis reveal that regions of strong vertically propagating planetary Rossby wave trains become much weaker over the Asian/North Pacific region and much stronger over the North America/North Atlantic region with the decadal change in zonally asymmetric ozone. These changes of the planetary wave propagation can be linked with anomalies of the Rossby breaking events, precipitation, humidity and stormtrack changes in the troposphere of midlatitudes which is discussed in the presentation.