The influence of zonal ozone variations on the long-term variability of Rossby wave developments and large-scale circulation patterns

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The interannual and decadal variability of stratospheric zonal ozone variations is related to the temporal changes of large-scale structures in the atmospheric circulation, e.g. changes in polar vortex and ultralong wave 1 in stratospheric temperature. These large-scale structures are strongly influenced by tropospheric Rossby wave activity. On the other side, ozone is radiatively active and can contribute efficiently to large-scale circulation patterns via radiative forcing and subsequent changes in the temperature distribution. The aim of this study is to investigate the effect of the observed zonally varying ozone variations on Rossby wave developments and large-scale circulation patterns, based on ECMWF ReAnalysis data (ERA-40) and long-term sensitivity experiments with the GCM ECHAM5. The results show that the ozone perturbations can induce significant changes in stratospheric temperature and polar vortex structure, which impose changes in Rossby wave developments and large-scale circulation patterns via configuring the diffluent/confluent large-scale flow in the upper troposphere/lower stratosphere. The ozone-induced changes revealed by the climate model are discussed in relation to observed variability modes like NAO and to the observed long-term variability in Rossby wave breaking behaviour as derived from ERA-40.