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Surface and tropospheric influences of atmospheric circulation changes caused by stratospheric zonally asymmetric ozone

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Over the last years various studies showed that zonally asymmetric ozone changes in the stratosphere induced changes in the general atmospheric circulation. They found an unexpected strong influence in the upper stratosphere as well as in the lower mesosphere. Due to strong coupling processes of planetary waves we expect also a strong impact on the troposphere and surface. In order to understand and to study these pathways of ozone action on the circulation via the inducing differential radiative forcing in more details two sensitivity runs with the GCM ECHAM5 have been performed and diagnosed. We run the model over 40 years from 1960 to 1999 with a zonal symmetric ozone field and with a seasonal mean zonal ozone anomaly by using sea surface temperatures as known from the AMIP project. Both runs were diagnosed with different methods in order to examine the influence of zonally asymmetric ozone on troposphere and surface. Main findings in the stratosphere are changes in the vortex displacement and an increase in the number of sudden stratospheric warming events. These are related to a downward influence on the tropospheric circulation due to a change of the variability of the upper tropospheric large scale structure (AO or NAM) in winter. Further we examined the ozone influence on Rossby wave breaking events in the upper troposphere and found a broader region of poleward breaking events over the North Atlantic/ European region in winter under the action of zonally asymmetric ozone. The pathway of downward coupling will be shown with the focus on the North-Atlantic European region including changes of precipitation and surface winds.