Boreal planetary wave transport of zonally asymmetric ozone during the polar healing phase

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Ozone, a major ingredient of the stratosphere, gains its importance due to the absorption of ultra-violet radiation. During the late 1970s a strong decrease was observed. Due to the successful introduction of the Montreal Protocol concentrations of ozone depleting substances are significantly reduced. The complex interaction of chemistry and transport of minor constituents in its action is not fully understood including the global warming effects. It is expected that ozone recovers in this century. The recovery process of polar ozone includes multiple stages: a reduced decline of ozone, a leveling off of the ozone, and a significant increase – the healing. Previous studies show that during the decline stage (till the 90s) in mid-winter the zonal asymmetric total column ozone is mainly determined by the horizontal and vertical advection of the ultra-long waves. In extension to previous investigations the relationship is reinvestigated for three 15-year time intervals: 1979-1993, 1991-2004, and 2002-2016 for January for the Northern Hemisphere, roughly corresponding to the three stages. The analysis period encompass the period from 1979 to 2016 using the reanalysis data of the ECMWF, ERA-Interim. In general, the trend of the geopotential at the upper troposphere and lower stratosphere mainly determines the trend of the zonally asymmetric total column ozone in January during the first two stages of the ozone recovery. However, this relationship is disturbed during the healing stage. During the third stage the correlation weakens between the trend of the geopotential and trend of the zonally asymmetric total column ozone and other processes should be included. A detailed analysis investigates the relationship and add other processes like climatological ozone wave transport in order to examine if the climatological ozone wave transport changes under zonal mean ozone changes.

Key words: planetary waves, zonal asymmetric ozone, ozone transport, transport equation