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Integrated equivalent latitude as a proxy for dynamical changes in ozone column

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It is well known that short-term variability in ozone column at a given location is almost solely caused by dynamical changes connected to tropospheric pressure systems. Long-term trends and interannual variability of ozone are also influenced by these dynamical changes. We address two questions here, which are still under discussion: What is the impact of these dynamical changes on the observed long-term trend of ozone, and what is the quantitative contribution of the physical processes standing behind the dynamical variability to the trends and short-term variability? These processes are identified as horizontal isentropic transport and the vertical displacement of isentropes. We use a multiple regression model to analyze the variability of the total ozone column. The model includes a newly introduced explanatory variable based on the equivalent latitude profile at a given location. After transforming the equivalent latitude profile into an ozone profile with the help of an ozone climatology, we integrate the ozone profile by using the pressures at the isentropic levels, thus incorporating the effect of compression and expansion. Ozone column data is taken from 8 high quality stations of the European Dobson spectrometer network.

Results show that short-term variability in ozone column is dominated by pressure changes that cause a compression or expansion of the total column, but not by horizontal transport. About 30%-50% of the long-term trend in total ozone in Europe can be explained by long-term pressure changes, while long-term changes in transport are negligible.