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Analysis of the vertically resolved ozone and temperature evolution in the lower and middle stratosphere

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The stratospheric ozone layer transforms energy-rich UV radiation into heat and has therefore a strong impact on the temperature in this region. Ozone has been investigated closely since the detection of ozone loss through anthropogenic ozone-depleting substances. Recently the decrease of total ozone has slowed down or even reversed due to emission restrictions by the Montreal Protocol and follow-up agreements. Although a range of global, vertically resolved ozone measurements exist, most of them were not intended for long-term use. In order to receive reliable trends from these data careful inter-calibration and drift corrections need to be applied.
We use ozone climatologies from the Solar Backscatter Ultraviolet (SBUV) instrument series, from the Global Ozone And Related trace gas Data records for the Stratosphere (GOZCARDS), and from four instruments presented in the HARMonized dataset of Ozone profiles (HARMOZ). For temperature we use a dataset provided by GPS radio occultation (RO). RO is a relatively new method with favorable properties like long-term stability, high vertical resolution, and no need for satellite inter-calibration. We use the recently reprocessed WEGC RO record, which includes measurements from the CHAMP, GRACE, and Formosat-3/COSMIC missions from 2001 to 2012. For comparison and for the analysis of longer time series of up to three decades we also look at radiosonde temperature data. Radiosondes also have high vertical resolution but sparse and irregular global coverage. Finally, we use re-analysis fields from the European Centre for Medium Range Weather Forecasts for both, ozone and temperature. We focus on the multi-dataset comparison of interannual variability and trends of ozone and temperature. The analysis is based on monthly zonal mean climatologies with a latitudinal resolution of 10 degrees. Interannual variability and trends are computed by applying a regression model to the de-seasonalized monthly climatologies, which includes ENSO, QBO, solar flux variations, and trend estimation. Our main goal is a detailed altitude-resolved analysis of temperature and ozone evolution, and close insight to ozone-temperature interrelations, throughout the lower and middle stratosphere.