Geophysical Research Abstracts
Vol. 19, EGU2017-10645-1, 2017
EGU General Assembly 2017

Spatial and Temporal Variation of the Vertical Column Density of the Oxygen Dimer O_4 on a Global Scale

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Measurements of the oxygen dimer O_4 are often used in remote sensing applications to infer information on the atmospheric light path distribution. While such information is interesting in itself, it can also be used to retrieve properties of clouds and aerosols. The concentration of O_4 is usually expressed as the square of the oxygen concentration, which can be derived from atmospheric temperature and pressure profiles. Accordingly, the atmospheric O_4 concentration and the so called O_4 vertical column density (VCD, the vertically integrated O_4 concentration), change with variations of atmospheric temperature and pressure. Variations of the O_4 VCD at a given location can be up to 20 % and thus have to be considered in the analysis and interpretation of O_4 observations. Another important aspect is the temperature dependency of the O_4 cross section, which can lead to systematic errors of about 10 % for a temperature mismatch of 30 K. This temperature dependency can be accounted for by using an empirically determined temperature dependent scaling factor to correct the atmospheric O_4 VCD. This leads to a temperature independent O_4 VCD(T_{const}), which can be then used for the interpretation of O_4 results obtained using a cross section of the same temperature. In this study we use global meteorological data sets of temperature, pressure and humidity from ECMWF to calculate the corresponding O_4 VCD. We also apply our empirical correction for the temperature dependence of the O_4 cross-section to convert the O_4 VCDs into a temperature independent O_4 VCD(298 K). Our results indicate that due to variations of temperature and pressure, the local O_4 VCD(298 K) can vary by up to 30 % while variations on a global scale are expected to be larger. In addition to the integrated VCD, we use the meteorological data set to quantify variations in the vertical profile of O_4.