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Assessing the need for a O4 scaling factor for MAX-DOAS measurements during the MAD-CAT campaign in Mainz Germany, Summer 2013

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MAX-DOAS measurements of the atmospheric absorption of the oxygen dimer O4 are often used to derive information about the tropospheric aerosol distribution. For that purpose measured absorptions are compared to results of a forward model based on radiative transfer simulations and assumptions about the atmospheric state. Many studies demonstrated good agreement of the derived aerosol results with independent observations. Nevertheless, in some studies also systematic differences between the measurements and the forward model were found. E.g. measured O4 absorptions on clear days were found to be even larger than the forward model results for an assumed aerosol-free atmosphere. These discrepancies motivated the use of a scaling factor for the retrieved O4 absorptions. Reported values of this scaling factor range from about 0.7 to 0.9. On the other hand, several studies found excellent agreement between measurements and forward model without the need of a scaling factor. So far, there is no convincing explanation for these conflicting findings.
In this study we compare measurements and forward model results for two clear days during the MAD-CAT (Multi Axis DOAS - Comparison campaign of Aerosols and Trace gases) campaign in Mainz, Germany in Summer 2013. On these days the aerosol extinction profiles were well constraint by measurements of a ceilometer and a sun photometer. For almost all of these measurements (made in 4 azimuth directions) we find a systematic underestimation of the measured O4 absorptions by the forward model indicating the need for a scaling factor of about 0.65 to 0.9. We investigate several potential reasons for the observed discrepancy including the influence of the profiles of temperature, pressure and aerosol extinction as well as the aerosol optical properties.