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Car MAX-DOAS measurements of the tropospheric Formaldehyde (HCHO) column around Bucharest (Romania) and in the Rhein-Main area (Germany)

Sebastian Donner, Reza Shaiganfar, Katharina Riffel, Steffen Dörner, Johannes Lampel, Julia Remmers, and Thomas Wagner

Max-Planck-Institut for Chemistry, Satellite Remote Sensing, Mainz, Germany (sebastian.donner@mpic.de)

The DOAS (differential optical absorption spectroscopy)-method analyses the absorptions of atmospheric trace gases in spectra of scattered sun light. It is an excellent way to determine the concentrations of different trace gases (e.g. NO_2, SO_2, HCHO...) simultaneously. MAX (Multi-AXis)-DOAS measurements observe scattered sun light under different elevation angles. From such measurements tropospheric vertical column densities (VCDs) or even vertical profiles of the measured trace gases and aerosols can be determined. We performed mobile MAX-DOAS measurements using two instruments on the roof of a car in summer 2015 in Romania during the AROMAT2 campaign and in the Winter/Spring 2016 in the Rhein-Main area (Germany). The latter is one of the densest populated areas in Germany. One instrument is a commercial Mini-MAX-DOAS instrument from the Hoffmann company, the other a self-built instrument using an AVANTES spectrometer with better optical characteristics. The instruments were looking in two different directions (one forward and one backward). Mobile MAX-DOAS measurements cover a quite large area in a short period of time. This enables to map existing gradients of concentrations of tropospheric trace gases, e.g. NO_2 and HCHO. The results of those measurements then can be used to validate satellite measurements or can be compared to model results. In this study we focus on formaldehyde (HCHO). In small amounts it is emitted directly by industries and other anthropogenic and biogenic activities. Large amounts are mostly secondary produced. As it is an intermediate product of basic oxidation cycles of other hydrocarbons its concentrations are determined by the abundances of other hydrocarbons. Therefore it can be used as an indicator for volatile organic compounds (VOCs). Furthermore HCHO plays an important role in photochemical smog chemistry and tropospheric O_3 chemistry.
In this work we present the measurement setup and preliminary HCHO results of the AROMAT2 campaign and first results of the measurements in the Rhein-Main area. We characterize the amounts, spatial gradients and identify potential emission sources of HCHO.