

Intercomparison of MAX-DOAS NO₂ retrieval algorithms

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Ground-based Multi-Axis Differential Optical Absorption Spectroscopy (MAX-DOAS) measurements are a powerful method for monitoring of atmospheric composition in an automated way. The number of instruments and sites operated has been rapidly increasing over the last years. However, integrating the measurements from all these instruments into a consistent data set necessitates careful homogenization of measurements and data retrieval procedures.

For this reason, several MAX-DOAS intercomparison campaigns have been carried out in the last years. Mostly, slant columns measured by different instruments and retrieved by different software were intercompared, i.e. observed differences were potentially caused by both, the instrument and/or the retrieval.

In contrast, the approach presented here is a pure intercomparison of MAX-DOAS retrievals. In total, 16 international groups and institutes working in the field of MAX-DOAS participated. The work was performed as part of the EU-funded QA4ECV project.

The intercomparison exercise is based on data recorded by the IUP-Bremen MAX-DOAS instrument during the MAD-CAT campaign (Multi-Axis DOAS comparison campaign for Aerosols and Trace gases), which was carried out at the Max-Planck-Institute of Chemistry in Mainz, Germany, in summer 2013. Each group participating in the exercise presented here performed MAX-DOAS fits using their own retrieval software but common input (IUP-Bremen spectra, same cross-sections, and same fit settings).

The resulting slant columns show in general an excellent agreement (correlation coefficient > 99.9%). Surprisingly, the correlation is substantially smaller when using sequential Fraunhofer reference spectra instead of a noon reference indicating that groups calculate the sequential reference differently. Further differences were found to arise from treatment of the slit function and subsequent convolution of cross-sections as well as from wavelength calibration.

The results indicate overall a high maturity and comparability of the retrieval algorithms but also point at areas where further homogenization or at least better documentation of retrieval procedures would be beneficial.