Analysis and interpretation of DOAS measurements of H_2O at UNEP/Nairobi

Water vapour is the most important and arguably the most variable greenhouse gas in the atmosphere. It is linked to global warming by various feedback processes including convection, cloud formation, radiative forcing and impact on rain and thereby changes in the biosphere. Precipitable water is also one of the key quantities in weather forecast models, and precise prediction of the atmospheric water vapour column is needed for reliable forecasts. Water vapour drives the hydrological cycle, transports latent heat and also is involved in atmospheric chemistry e.g. in OH production.

Tropospheric water vapour is routinely measured by radio sondes and also from space using microwave measurements e.g. by SSMI. However, microwave instruments do not provide data over land. This gap can be filled by UV/visible spectrometers such as GOME and SCIAMACHY which can determine water vapour columns over land, albeit at poorer spatial and temporal resolution. These data have already been compared to model results, and good overall agreement was found but also a number of differences. Ground-based MAX-DOAS (Multi Axis Differential Optical Absorption Spectrometer) measurements can be used to derive water vapour columns and coarse vertical profiles, and such measurements could be used to validate both satellite measurements and models. A MAX-DOAS instrument was installed at the UNEP in Nairobi by the University of Bremen in July 2002, and has been operational since that time. The wavelength region of the instrument was extended in January 2004, facilitating water vapour retrieval at a tropical location.

As a semester project, a student could perform an analysis of H_2O columns and vertical profiles retrieved from measurements of the DOAS instrument operated at UNEP/Nairobi by the University of Bremen. Some optimisation of the H_2O retrieval would be needed as well as sensitivity studies to assess the impact of line saturation on the results. The water vapour data obtained could be compared with satellite measurements from GOME and SCIAMACHY, radiosonde profiles and ECMWF model results.

The main steps in the project would be

- reading and learning on measurement techniques used for in-situ, optical ground-based, and space-borne measurements of water vapour
- reading on the role of water vapour in atmospheric chemistry, meteorology, and climate
- sensitivity studies on the impact of line saturation on H_2O measurements in different absorption bands available in the measurements
- retrieval of tropospheric H_2O columns and vertical profiles from the MAX-DOAS measurements using software and data provided by the University of Bremen
- collection of data from satellite instruments (GOME, SCIAMACHY), radio sondes, and ECMWF model runs for the location and time considered
- comparison of the different data sets and analysis of systematic differences
- preparation of a summary report on the analysis and the results

The Institute of Environmental Physics at the University of Bremen will support this project by provision of spectra and preliminary H_2O columns measured by the MAX-DOAS instrument in Nairobi as well as by GOME and SCIAMACHY and by provision of useful links to information and data sources (e.g. ECMWF). It can also provide limited support for questions related to data handling, analysis, and interpretation.