

Spectroscopic Studies of Atmospheric Trace Gases

This project has been a cooperation between the 'Institute of Environmental Physics at the University of Heidelberg' (<http://www.iup.uni-heidelberg.de/>) and the 'National Institute for Atmosphere and Water' (<http://www.niwascience.co.nz>) (NIWA) at Lauder, New Zealand.

The aim of the project was the study of trace gas distributions in the atmosphere by Differential Optical Absorption Spectroscopy (DOAS). With this well known technique different trace gases (e.g. ozone, BrO, NO₂, IO, OClO) can be detected in measured uv-visible scattered sun light spectra by means of their individual absorption structures.

A spectrograph detector unit has therefore been installed at the New Zealand Antarctic Station "Scott Base" in 2002 and is run by NIWA, with the logistic support of 'Antarctica New Zealand' (<http://www.antarcticanz.govt.nz>).



Fig.1 The adjustable mirror system at the Arrival Heights observatory close to Scott Base.

The instrument works with an adjustable mirror system (Fig.1) that sequentially scans different viewing directions between zenith and horizon, because measurements close to the horizon are more sensitive for trace gases near the ground, whereas zenith measurements are mostly dominated by stratospheric absorbers. Thus information on the vertical distribution of trace gases can be gained.

The analysis and interpretation of these measurements have been the central focus of the project.

Fig. 2 shows an example of a bromine oxide (BrO) analysis. On October 15 a so called 'bromine explosion' event (i.e. sudden rise in the level of reactive Br) can be seen. These episodic events occur in the Arctic and Antarctic springtime, when heterogeneous processes on sea ice lead to an autocatalytic release of reactive bromine from sea-salt. The bromine is then photolysed, yielding free bromine atoms which react with ozone to form BrO. These events can lead to substantial or even complete boundary layer ozone depletion. The processes involved in these events are not entirely understood yet, e.g. what happens to the BrO after the ozone depletion, which made the BrO measurement of special interest.

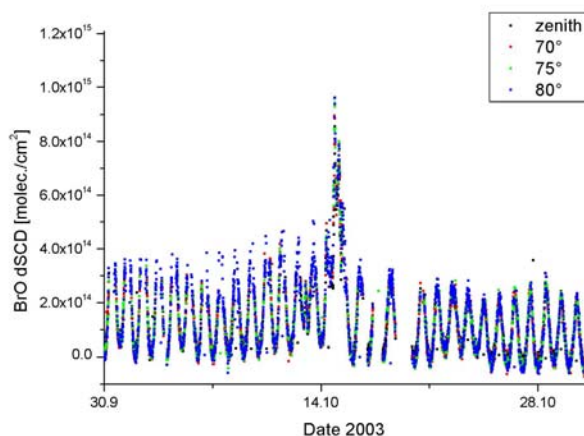


Fig.2 BrO results

For further quantification of the measurements, a radiative transfer model is needed, to simulate the different light paths that contribute to a measured spectrum. During the project both sides successfully developed and improved their radiative transfer models, which has lead to a still ongoing cooperation.

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