MAX-DOAS measurements of bromine monoxide (BrO) during the Antarctic Polarstern cruise in 2006

Dr. F. Wittrock, University Bremen

Application Note

During each springtime, episodes of strongly increased bromine monoxide concentrations, so called Bromine explosions, are observed in the polar regions by satellite instruments like e.g. SCIAMACHY (see figure 1). The satellite data show, that wide areas can be affected by increased BrO values and that those events last typically for a few days. As BrO is a radical, it has an impact on the oxidation capacity of the atmosphere and its abundance in the polar troposphere is correlated with two further phenomena: The sudden depletion of ozone and of mercury in the polar springtime boundary layer.

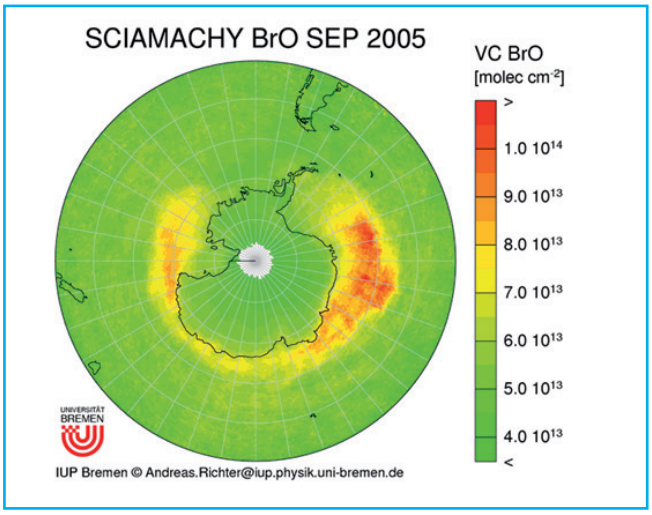

Figure 1: BrO columns as seen by the ENVISAT instrument SCIMACHY for measurements from September 2005. Elevated levels of BrO are mainly found close to the Antarctic coast lines above sea ice.

In order to investigate these important atmospheric events in more detail, scientists from several institutes perform measurements during the German research vessel *Polarstern* cruise ANTXXIII-7 which took place in the Antarctic spring from August 23 to October 27, 2006 in the Weddell sea.

Figure 2: German research vessel Polarstern in the Antarctic sea. The Bremen MAX-DOAS instrument is located in the container on top of the Peildeck.

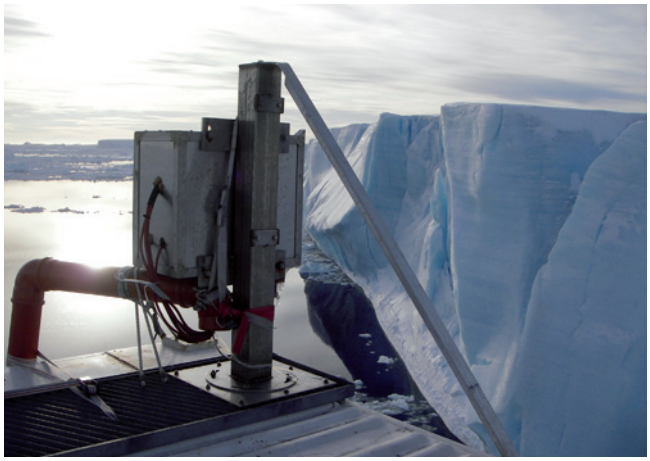

Figure 3: Telescope unit of the MAX-DOAS.

During this expedition, concerted measurements of BrO, ozone, mercury, surrounding conditions and ice properties were performed. In particular, BrO columns measured with a MAX-DOAS[1] instrument on the Polarstern (see figures 2 and 3) have been used to proof the reliability of BrO column values retrieved from measurements of the satellite instruments SCIAMACHY and OMI. On the other hand, the satellite data were used to search for a systematic pattern in the motion of the BrO plumes and for preferred regions for the initialization of the plumes. From this the conditions needed for the initialization of the release process of BrO are inferred.

1 MAX-DOAS: Multi Axis Differential Optical Absorption Spectroscopy instruments. These instruments are basically UV/visible spectrometers observing scattered light in different viewing directions towards the sky. The standard Bremen MAX-DOAS instrument consists of a grating spectrometer equipped with a cooled CCD detector and a separate telescope unit connected to the main instrument via a quartz fibre bundle. The spectrometer is temperature stabilized to avoid wavelength drifts. Although the CCD used is a 2-dimensional detector, it is operated in full vertical binning for optimal signal to noise. The quartz fibre bundle efficiently depolarizes the incoming light and also provides flexibility for instrument set-up. The telescope unit has two viewing ports, one to the zenith and one to the horizon.

MAX-DOAS measurements of bromine monoxide (BrO) during the Antarctic Polarstern cruise in 2006

Dr. F. Wittrock, University Bremen

Application Note

Figure 4: Helicopter transport of the mobile MAX-DOAS and other instruments towards a site on the sea ice.

Figure 5: Mobile MAX-DOAS on the Nansen sledge.

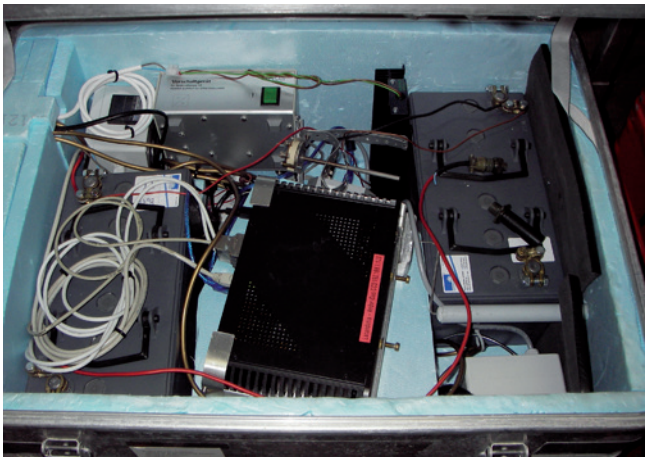

Figure 6: View into the spectrometer/detector unit of the mobile MAX-DOAS. The Shamrock 163i is located in an isolated box below the mini-pc. The whole instrument is powered by a standard car battery.

One of the main uncertainties in the BrO explosion is on which type of sea ice BrO release processes are most efficient. To further investigate this question a new mobile MAX-DOAS was constructed from scientists of the Institute of Environmental Physics at the University of Bremen (**www.doas-bremen.de**).

In order to reduce space and energy consumption of the instrument, a combination of a Shamrock SR-163i spectrograph and an iDus DV420A-BU CCD from Andor Technology detector was selected. With that it was possible to measure high quality BrO trace gas columns directly on the Antarctic ice sheet far remote from any external power supply for more than 24 hours (see figures 4, 5 and 6).

Contact:
Dr. Folkard Wittrock
Institute of Environmental Physics
University of Bremen
folkard@iup.physik.uni-bremen.de
www.doas-bremen.de

Henning Kirk
AWIPEV Base : French – German Arctic Research Base
at Ny-Ålesund / Spitsbergen
henning.kirk@awi-koldewey.no