Introduction

The discovery of a rapid decline in springtime ozone concentrations over Antarctica and also the decreasing of ozone in the midlatitudes of about 0.5% per annum since 1979 has led to a number of studies about the mechanisms of this destruction. Several studies have shown that halogen radicals involved in catalytic cycles play an important role in the stratospheric ozone depletion. While the majority of inorganic chlorine in the stratosphere is tied up in the relatively long lived reservoirs HCl and ClONO₂, leaving at most a few percent of inorganic chlorine available in the reactive form as Cl₂ the destruction rates of HBr and BrONO₂, the main reservoirs of bromine oxide, are much faster. This makes BrO to the predominant inorganic bromine species in the stratosphere. Because of the partitioning bromine is much more efficient than chlorine on a per atom basis in destroying ozone. Observations and model calculations suggest that the catalytic cycles involving reactions of BrO with HO₂ and BrO with ClO represent important destruction mechanisms for lower stratospheric ozone.

In this poster a short overview about the first systematic ground-based measurements of BrO at low latitudes over a period of several years is presented. In particular the experimental arrangement of the ground based instrument in Nairobi and the analysis is described and some results with respect to BrO are shown.

Experimental Setup

Nairobi is one of the tropical stations of BREDOM (Bremen DOAS network of atmospheric Measurements) which is operated by the University of Bremen. The ground based DOAS (Differential Optical Absorption Spectroscopy) instrument is installed in the headquarter of the United Nations Environmental Programme (UNEP), at the outskirts of Nairobi. Its telescope (Figure 1) is mounted on the top roof stairs of a building with viewing direction of all axis measurements to the south, downtown Nairobi. The details and specifications of the instrument:

- The discovery of a rapid decline in springtime ozone concentrations over Antarctica and also the decreasing of ozone in the midlatitudes of about 0.5% per annum since 1979 has led to a number of studies about the mechanisms of this destruction. Several studies have shown that halogen radicals involved in catalytic cycles play an important role in the stratospheric ozone depletion. While the majority of inorganic chlorine in the stratosphere is tied up in the relatively long lived reservoirs HCl and ClONO₂, leaving at most a few percent of inorganic chlorine available in the reactive form as Cl₂ the destruction rates of HBr and BrONO₂, the main reservoirs of bromine oxide, are much faster. This makes BrO to the predominant inorganic bromine species in the stratosphere. Because of the partitioning bromine is much more efficient than chlorine on a per atom basis in destroying ozone. Observations and model calculations suggest that the catalytic cycles involving reactions of BrO with HO₂ and BrO with ClO represent important destruction mechanisms for lower stratospheric ozone.

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Data Analysis

Analysis method:
- to derive slant columns of trace gases the DOAS method is used
- to convert slant columns (SC) to vertical columns (VC) radiative transport model SCIATRAN calculation of air mass factors (AMF)
- full spherical, refraction and full multiple scattering included
- daily calibration measurements
- selected references

Selected References


Conclusions

First long-term measurements of BrO at the tropical site Nairobi are presented on the poster. As result of the small changes of NO during the year there is also no significant seasonal variation of the BrO DSCD's. The amount of BrO of about 1,5·10⁻³ molec/cm² is comparable to the observations that were made in high and mid-latitudes (e.g. Sinnhuber). A look on the slant columns of different lines of sight show that on most of the days an analysis of tropospheric BrO is very difficult (the normal situation in Nairobi). In contrast the slant columns of the 26th of December 2003 show that a tropospheric amount of BrO should be present and analyzable.

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Measurements

Figure 3: Observations of the daily morning and afternoon BrO Slant column values at 90° solar zenith angle as background.

Figure 4: NO₂ vertical columns above Nairobi observed at solar zenith angles (SZA) around 90°. Morning and afternoon values are given.

Figure 5: Slant columns of BrO for different lines of sight. For the 16th of February the values are very similar, the analysis of tropospheric BrO is very difficult (the normal situation in Nairobi).

Figure 1: Setup of the telescope.

Figure 2: Relevant cross sections in the BrO fitting window 344,7-359 nm.