Introduction

Bromine Monoxide (BrO) is an important trace gas in the stratosphere as it is involved in catalytic ozone destruction, both in high and mid-latitudes. BrO also seems to be the key species in the tropospheric boundary layer ozone depletion events observed in spring in the Arctic and Antarctic. More recently, indication was found for a substantial amount of BrO throughout the free troposphere, with important implications for atmospheric chemistry in this region. The number density maximum of stratospheric BrO is located close to the tropopause. Therefore, similar to the situation for ozone, any change in tropopause height will result in a change of stratospheric BrO column.

For the comparison of GOME and SLIMCAT BrO data, the SLIMCAT model was sampled at the time of GOME overpass (roughly 10:30 LT), and the vertical profile integrated. In the plots above, all data for 1997 is compared for three representative stratospheric columns at different latitudes. Unfortunately, as a result of an interference effect on the GOME diffuser plate, the GOME BrO columns are subject to an unknown offset in the slant columns. In this example, three different offsets have been assumed and are shown in the plots. As can be seen, GOME BrO always is higher than model BrO, and does show a different seasonality. From the selected offsets, 4E13 molec/cm² gives the most consistent picture at the equator, assuming that tropospheric BrO is present there. Therefore, this scenario is giving a lower limit of the atmospheric BrO column.

Discussion

When comparing GOME and SLIMCAT results, three main features can be seen:
- GOME measurements are consistently larger, in particular at high latitudes
- day to day variations are very similar, at least in fall, winter and spring (see figure on the right)
- GOME measurements see a clear seasonal variation while SLIMCAT predicts more or less constant values

As SLIMCAT has been successfully validated against ground-based and balloon measurements of BrO the reason for the differences has to be either a GOME problem or a substantial amount of BrO in the troposphere. Several problems could be present in the GOME data:
- a cross-section problem. However, this would only lead to a scaling of all values.
- an offset problem. However, as shown to the left, this can not explain the observations.
- an airmass factor problem. However, as shown to the right, the seasonality of the solar zenith angle (and therefore the airmass factor changes) does not coincide with the observed differences to the model.

Therefore, we conclude, that there must be a global BrO background with a maximum in spring at high latitudes but significant values throughout the atmosphere at all times.

Conclusions

A comparison of GOME total BrO columns with SLIMCAT stratospheric BrO columns shows, that:
- GOME measurements systematically are larger than SLIMCAT predictions
- the difference between measurements and model vary with latitude and season, having largest values in spring at high latitudes
- known problems in the GOME data analysis can not explain the observed differences
- from these observations, it is concluded, that
  - a global tropospheric background of BrO exists
  - it seems to be independent of the observed BL events at polar sunrise
  - correction of stratospheric variability is necessary for quantitative analysis of polar BL events from space

For a quantitative description of the tropospheric background BrO, more work is needed in the satellite data analysis, in particular with respect to the airmass factors.

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Selected References


see also: www.iup.physik.uni-bremen.de