

Temporal variation of stratospheric BrO from 1997 to 2018 observed by ground-based zenith sky DOAS and estimation of stratospheric Bry budget

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Stratospheric bromine compounds are much less abundant than chlorine compounds but their ozone depletion efficiency is roughly 45 times larger than that of chlorine. Among inorganic bromine species, BrO is the most abundant species (around 60 – 70 %), and it can be measured only by UV/Vis remote sensing instruments. Very recent research reported that ozone depleting substances have been strongly reduced, which indicates an ozone recovery. However, the evolution of the BrO concentration in the stratosphere is still worth to be investigated due to the lack of knowledge of the bromine releasing mechanisms and chemical recycling processes.

This study shows the temporal variation of stratospheric BrO from 1997 to 2018 and also estimates the total stratospheric bromine budget above Kiruna, Sweden by using ground-based zenith sky DOAS measurements. Kiruna (67°N, 22° E) is located north of the polar circle and is thus well suited for the investigation of polar stratospheric ozone chemistry.

The stratospheric bromine budget is hard to determine because of the large uncertainties of the contribution from brominated very short lived species (VSLSSs). From this study, the total stratospheric inorganic bromine budget (Bry) was derived from the retrieved BrO to about 21 pptv. Considering the mean age of air, 5.7 years, it seems that the stratospheric BrO load has increased until 2001, and after it has slightly declined. Such a tendency is consistent with the decrease of its tropospheric precursor gases. From the comparison of the derived total stratospheric inorganic bromine load, the expected contribution of VSLSSs to the total stratospheric inorganic bromine is estimated to around 5 - 6 pptv.