



## Diurnal variations of BrONO<sub>2</sub> observed by MIPAS-B and estimation of lower stratospheric Br<sub>y</sub>

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Chlorine and bromine species play a dominant role in ongoing stratospheric ozone depletion. The relative abundances of the two major inorganic bromine (Br<sub>y</sub>) species in the lower stratosphere (BrO and BrONO<sub>2</sub>) are mainly controlled by photochemical processes.

The first stratospheric measurements of the diurnal variation of BrONO<sub>2</sub> around sunrise and sunset are reported. Arctic flights of the balloon-borne Michelson Interferometer for Passive Atmospheric Sounding (MIPAS-B) were carried out from Kiruna (68°N, Sweden) inside the stratospheric polar vortices in January 2010 and March 2011 where diurnal variations of BrONO<sub>2</sub> around sunrise have been observed. High nighttime BrONO<sub>2</sub> volume mixing ratios of up to 21 parts per trillion by volume (pptv) were detected in the late winter 2011 in the absence of polar stratospheric clouds (PSCs). In contrast, the amount of measured BrONO<sub>2</sub> was significantly lower in January 2010 due to low available NO<sub>2</sub> amounts (for the build-up of BrONO<sub>2</sub>), the heterogeneous destruction of BrONO<sub>2</sub> on PSC particles, and the gas-phase interaction of BrO (the source to form BrONO<sub>2</sub>) with ClO. A further balloon flight took place at mid-latitudes from Timmins (49°N, Canada) in September 2014. Mean BrONO<sub>2</sub> mixing ratios of 22 pptv were observed after sunset in the altitude region between 21 and 29 km.

Measurements are compared to a multi-year simulation performed with the Chemistry Climate Model EMAC (ECHAM5/MESSy Atmospheric Chemistry). Using the nighttime simulated ratio between BrONO<sub>2</sub> and Br<sub>y</sub>, the amount of Br<sub>y</sub> observed by MIPAS-B was estimated to about 21-25 pptv in the lower stratosphere.