Geophysical Research Abstracts
Vol. 13, EGU2011-13022-1, 2011
EGU General Assembly 2011

Exploring high resolution measurements of ozone depletion chemistry in coastal Antarctica through use of a 1D marine boundary layer chemistry model (MISTRA)

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Tropospheric Ozone Depletion Events (ODEs) have been known to occur in polar regions for over 20 years. During such events, ozone concentrations can fall from background amounts to below instrumental detection limits within a few minutes and remain suppressed for on the order of hours to days. The chemical destruction of ozone is driven by halogens (especially bromine radicals) that have a source associated with the sea ice zone. Although our knowledge of ODEs has increased greatly since their discovery, some of the key processes involved are not yet fully understood.

In 2007, year round measurements were made at the British Antarctic Survey station Halley, in coastal Antarctica, using a Chemical Ionisation Mass Spectrometer (CIMS). During specific periods in the spring the CIMS was configured to measure concentrations of BrO, Br_2 and BrCl. In addition, concurrent measurements of surface ozone and local meteorology were made. Due to the rapid photolysis of Br_2 and BrCl their daytime concentrations should be nil, however we see a clear signal for both species during the day. A recent paper by Neuman et al. (2010) has highlighted that there is a conversion of HOBr to Br_2 on the CIMS Teflon inlet when using this technique.

We present here an analysis of these datasets and a model study looking at halogen release, from a source region identified using HYSPLIT air parcel back trajectories. A 1D Marine Boundary Layer (MBL) chemistry model (MISTRA; von Glasow et al, 2002) has been modified to be representative of Antarctic conditions by implementing; measurements from Halley station which include aerosol size distribution and composition (Rankin and Wolff, 2003), local meteorology (Anderson et al., 2008), and chemistry in the model. MISTRA was then used in box-model mode in an attempt to reproduce these CIMS halogen measurements. We explore the possibilities of halogen release which varies with Solar Zenith Angle (SZA) and has no contribution from HOBr, and constant halogen release (here in the form of Br_2 only) from a source region which includes HOBr conversion to Br_2 and BrCl.

Although results from both studies show some agreement with the daytime concentrations of Br_2 and BrCl as measured by the CIMS in spring at Halley, the recent study by Neuman et al. (2010) would suggest that HOBr conversion should be included to correctly reproduce the CIMS daytime measurements.