Atmos. Chem. Phys. Discuss., 10, C740–C743, 2010
www.atmos-chem-phys-discuss.net/10/C740/2010/

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Bromine measurements in ozone depleted air over the Arctic Ocean" *by* J. A. Neuman et al.

Anonymous Referee #1

Received and published: 21 March 2010

The number of in-situ measurements of reactive halogen species in the arctic atmosphere is still very limited. Despite the advanced knowledge on the chemistry associated with reactive halogens in the troposphere, the lack of ability to identify and measure many important species limits our understanding of the chemistry and its impact on local, regional and global scale. It remains limited due to the need of sensitive and specific techniques required to measure some key compounds. The importance of inorganic Br cycling is expected to vary in the future as a function of both increasing acidification of the atmosphere through anthropogenic emissions and climate changes. Complete characterization of individual halogen components in the air would provide information on the stage of the bromine chemistry and its source attribution. There is a critical need of development of highly sensitive and compound specific methods to detect trace concentrations of large spectra halogen compounds in the air. This study

makes a valuable contribution in that direction. The manuscript on "Bromine measurements in ozone depleted air over the Arctic Ocean by J. A. Neuman et al. submitted to the ASP Special Issue: POLARCAT (Polar Study using Aircraft, Remote Sensing, Surface Measurements and Models, of Climate, Chemistry, Aerosols, and Transport) presents very interesting results on temporal, vertical and spatial distributions of active bromine species across large area of the Arctic Ocean in April 2008. A common limitation of methods that require air to be introduced into the instrument through sample lines is that analytes are subject to losses and/or reaction on the lines. This disadvantage has been reversed by J. A. Neuman et al. and used to derive HOBr contribution into the active bromine. Authors conducted extensive laboratory studies and proposed an original method for evaluating HOBr abundance among the reactive inorganic halogen gases in air. Their findings bring potential in interpreting differences in previous observations and open opportunities for insights into the important role that bromine atoms and their precursors play in the chemistry of the marine boundary layer. Aircraft based in-situ measurements on halogen species abundance carry information on evolution of halogen chemistry, the effect of metrological parameters and surrounding environment. Of special interest would be to apply this method and confirm recently suggested suspended particulate matter as a source for bromine activation and recycling. (A. E. Jones, P. S. Anderson, M. Begoin, N. Brough, M. A. Hutterli, G. J. Marshall, A. Richter, H. K. Roscoe, and E. W. Wolff: BrO, blizzards, and drivers of polar tropospheric ozone depletion events Atmos. Chem. Phys., 9, 4639-4652, 2009; McElroy, C T, Bottenheim, J W, Banic, Narayan, J, Liu, P, Strapp, W, Haas, C, Stone, R S, Herber, A , Maturilli, M, Dethloff, K, Sokolov, V Y, Makshtas, A , Brauner, R: Observations of Boundary Layer air over Western Arctic Sea Ice During the April 2009 Polar-5 Airborne Campaign, AGU Fall meeting 2009 poster A31C-0105.) The major limiting factor to quantify reactive bromine components and make this new speciation instrument a powerful analytical tool is the method of instrument calibration. Authors communicate their method and results in well structured, logical and clear language supported by appropriate visual material.

Specific comments: Section 1. Line 41: Your statement for the number of ozone depletion episodes studies conducted mostly from coastal sites will be stronger if you expand the number of references.

Line 51: The number of the chemical model studies and satellite data could also be expanded.

Line 66: The depletion of Gaseous Elemental Mercury (GEM) in the polar atmosphere is thought to be caused by the oxidation of GEM by reactive halogens; namely Br atoms or BrO radicals (Ariya, P., Dastoor, A., Amyot, M., Schroeder, W., Barrie, L., Anlauf, K., Raofie, F., Ryzhkov, A., Davignon, D., Lalonde, J., and Steffen, A.: The Arctic: A sink for mercury, Tellus B, 56, 5, 397–403, 2004; Goodsite, M. E., Plane, J. M. C., and Skov, H.: A theoretical study of the oxidation of Hg-0 to HgBr2 in the troposphere, Environ. Sci. Technol., 38, 6, 1772–1776, 2004.; Skov, H., Christensen, J. H., Heidam, N. Z., Jensen, B., Wahlin, P.,and Geernaert, G.: Fate of elemental mercury in the Arctic during atmospheric depletion episodes and the load of atmospheric mercury to the Arctic, Environ. Sci. Technol., 38, 2373–2382, 2004.

Line 71: Experimental and modeling results supporting occurrence of halogen chemistry and ozone depletions not only over the Arctic ocean through the year: A. S. Mahajan, J. M. C. Plane, H. Oetjen, L. Mendes, R. W. Saunders, A. Saiz-Lopez, C. E. Jones, L. J. Carpenter, and G. B. McFiggans,: Measurement and modelling of reactive halogen species over the tropical Atlantic Ocean, Atmos. Chem. Phys. Discuss., 9, 24281–24316, 2009; M. Martin, D. Pohler, K. Seitz, R. Sinreich, and U. Platt: BrO measurements over the Eastern North-Atlantic, Atmos. Chem. Phys. Discuss., 9, 9291–9312, 2009; In the mid-latitude MBL, BrO has been shown to oxidize DMS up to an order of magnitude faster than OH (Saiz-Lopez, A., Plane, 5 J. M. C., and Shillito, J. A.: Bromine oxide in the mid-latitude marine boundary layer, Geophys. Res. Lett., 31, L03111, doi:10.1029/2003GL018956, 2004.

Section 2.3. Were similar sensitivity test conducted on DC-8 instrument and the other

WP-3D CIMS instrument? Results from both measurements are compared and it will be beneficial to provide such information. Section 2.4. Do you have any explanation on the origin of the large BrCl and Cl2 background variations?

Technical comments: Reference Kim et all line 152 appears under year 2007 while on reference list it is under 2004. Reference: Martinez at all. Line 391 appears under 2009 while on Reference lists it is 1999.

Interactive comment on Atmos. Chem. Phys. Discuss., 10, 3827, 2010.