Atmospheric Chemistry and Physics
An Interactive Open Access Journal of the European Geosciences Union

Atmos. Chem. Phys., 7, 4375-4418, 2007
www.atmos-chem-phys.net/7/4375/2007/

Halogens and their role in polar boundary-layer ozone depletion

W. R. Simpson[1], R. von Glasow[2], K. Riedel[3], P. Anderson[4], P. Ariya[5], J. Bottenheim[6], J. Burrows[7], L. J. Carpenter[8], U. Frieß[9], M. E. Goodsite[10], D. Heard[11], M. Hutterli[4], H.-W. Jacobi[17], L. Kaleschke[12], B. Neff[13], J. Plane[11], U. Platt[9], A. Richter[7], H. Roscoe[4], R. Sander[14], P. Shepson[15], J. Sodeau[16], A. Steffen[6], T. Wagner[9,14], and E. Wolff[4]

[1]Geophysical Institute and Department of Chemistry, University of Alaska Fairbanks, Fairbanks, AK, 99775-6160, USA
[2]School of Environmental Sciences, University of East Anglia, Norwich, NR4 7TJ, UK
[3]National Institute of Water and Atmospheric Research, Private Bag 14–901, Wellington, New Zealand
[4]British Antarctic Survey, High Cross, Madingley Road, Cambridge CB3 0ET, UK
[5]McGill University, Canada
[6]Environment Canada, Toronto, Canada
[7]Institute of Environmental Physics, University of Bremen, Bremen, Germany
[8]Dept. of Chemistry, University of York , York YO10 5DD, UK
[9]Institute for Environmental Physics, University of Heidelberg, Germany
[10]University of Southern Denmark, Department of Chemistry and Physics, Campusvej 55 DK5230 Odense M, Denmark
[11]School of Chemistry, University of Leeds, Leeds, LS29JT, UK
[12]Center for Marine and Atmospheric Research , Institute of Oceanography, University of Hamburg, Bundesstrasse 53, 20146 Hamburg, Germany
[13]NOAA/Earth System Research Laboratory, Boulder CO, USA
[14]Air Chemistry Department, Max-Planck Institute of Chemistry, PO Box 3060, 55020 Mainz, Germany
[15]Purdue Climate Change Research Center, 503 Northwestern Ave. West Lafayette, IN 47907, USA
[16]Department of Chemistry, University College Cork, Ireland
[17]Alfred Wegner Institute (AWI) for Polar and Marine Research, Bremerhaven, Germany

Abstract. During springtime in the polar regions, unique photochemistry converts inert halide salt ions (e.g. Br^-) into reactive halogen species (e.g. Br atoms and BrO) that deplete ozone in the boundary layer to near zero levels. Since their discovery in the late 1980s, research on ozone depletion events (ODEs) has made great advances; however many key processes remain poorly understood. In this article we review the history, chemistry, dependence on environmental conditions, and impacts of ODEs. This research has shown the central role of bromine photochemistry, but how salts are transported from the ocean and are oxidized to become reactive halogen species in the air is still not fully understood. Halogens other than bromine (chlorine and iodine) are also activated through incompletely understood mechanisms that are probably coupled to bromine chemistry. The main consequence of halogen activation is chemical destruction of ozone, which removes the primary precursor of atmospheric oxidation, and generation of reactive halogen atoms/oxides that become the primary

oxidizing species. The different reactivity of halogens as compared to OH and ozone has broad impacts on atmospheric chemistry, including near complete removal and deposition of mercury, alteration of oxidation fates for organic gases, and export of bromine into the free troposphere. Recent changes in the climate of the Arctic and state of the Arctic sea ice cover are likely to have strong effects on halogen activation and ODEs; however, more research is needed to make meaningful predictions of these changes.

Final Revised Paper (PDF, 5811 KB) Supplement (2590 KB) Discussion Paper (ACPD)

Citation: Simpson, W. R., von Glasow, R., Riedel, K., Anderson, P., Ariya, P., Bottenheim, J., Burrows, J., Carpenter, L. J., Frieß, U., Goodsite, M. E., Heard, D., Hutterli, M., Jacobi, H.-W., Kaleschke, L., Neff, B., Plane, J., Platt, U., Richter, A., Roscoe, H., Sander, R., Shepson, P., Sodeau, J., Steffen, A., Wagner, T., and Wolff, E.: Halogens and their role in polar boundary-layer ozone depletion, Atmos. Chem. Phys., 7, 4375-4418, 2007. Bibtex EndNote Reference Manager