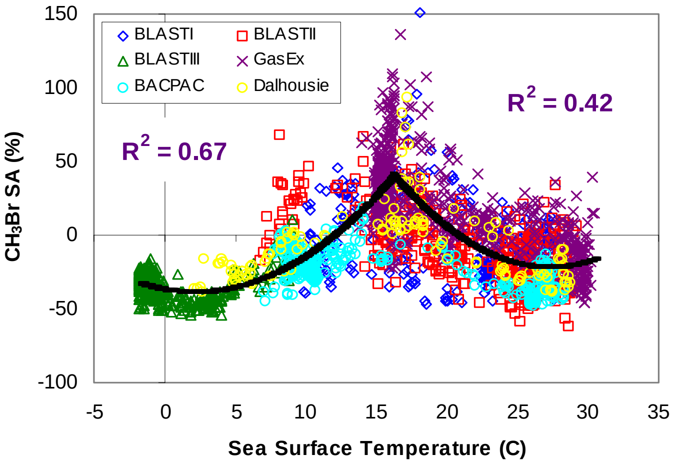
Identification of Seasonality in Oceanic Methyl Bromide Saturations

D. B. King[1,2], J. H. Butler[1], S. A. Yvon-Lewis[3], S. A. Montzka[1], and J.W. Elkins[1]

[1]NOAA Climate Monitoring and Diagnostics Laboratory, 325 Broadway, Boulder, CO 80305;
303-497-7015, Fax:303-497-6290, E-mail: dking@cmdl.noaa.gov
[2]Cooperative Institute for Research in Environmental Sciences, Univ. of Colorado, Boulder 80309
[3]NOAA Atlantic Oceanographic and Meteorological Laboratory, Miami, FL 33149

Atmospheric halocarbons are significant contributors to stratospheric ozone depletion and radiative heating of the atmosphere. Although the budgets of those species that are solely anthropogenic are reasonably well understood, the calculated budgets of many naturally produced halocarbons are not in balance. The oceanic contribution to these budgets can be complex, is often large, and currently is not well understood. Future changes in global climate likely will alter the concentrations of natural halocarbons in the air and seawater, and, consequently, their air-sea fluxes. Field measurements identify gross sensitivities that modelers can then use to assess the potential effects of such changes in global climate. CMDL has measured the seawater saturations of about 20 halocarbons during 5 separate research cruises dating back to 1994. These field missions have encompassed a number of oceanic regions over different seasons. The results provide clues as to the overall behavior of these gases in the surface ocean and lower atmosphere.

In 1998 and 1999 the HATS group participated in two research cruises: Gas Ex 98 in the North Atlantic Ocean and northeastern Pacific Ocean during spring/summer and RB-99-06 in the North Pacific during fall. The results from these cruises, in conjunction with previous data, have greatly improved the understanding of the oceanic methyl bromide cycle (King et al., *J. Geophys. Res.*, 105, 19,763-19,769 [2000]). There appears to be a temperature dependence of the methyl bromide oceanic saturation, with variations in sea surface temperatures accounting for 40-70% of the variability in the saturation (figure). This relationship, along with climatological and satellite-derived sea surface temperatures, can be used to predict air-sea fluxes of methyl bromide globally. However, this extrapolation predicts supersaturations in temperate waters that are not supported by observations. Observed methyl bromide supersaturations in temperate waters of the North Atlantic support the existence of an open ocean seasonal cycle, and the use of two relationships (spring/summer and fall/winter) more accurately reproduces the measurements. A functional relationship between sea surface temperature and saturation enables a reasonable prediction of methyl bromide air-sea fluxes for a climate change scenario.



Measured CH_3Br saturation anomalies from five CMDL and two Dalhousie University research cruises are plotted as a function of sea surface temperature. Quadratic equations are used to fit the data above and below 16°C.