Halocarbons in and above the tropical Atlantic

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Abstract

Short lived halogenated substances (halocarbons) occur naturally in the oceans. They contribute either direct or indirect to the overall halogen budget in the atmosphere, thus also taking part in ozone depletion in both the stratosphere and troposphere. Tropical convection leads to enhanced vertical transport of halocarbons in this area. Oceanic high productivity areas such as coasts and upwelling regions have been identified to be of high significance to the budget of brominated halocarbons. Bromoform ($CHBr_3$) and dibromomethane (CH_2Br_2) generally represent the largest fractions of naturally occuring very short-lived gases that contribute to the atmospheric bromine content.

Here, results of two cruises in the tropical Atlantic are presented. The first campaign from May and June 2010 investigated diurnal and regional variability of halogen emissions in the Mauretanian upwelling which is also exposed to strong coastal influences. The second cruise took place in June and July 2011 with the equatorial upwelling as the main research area.

DRIVE – Diurnal and Regional Variability of halogen Emissions

- The RV Poseidon started at the Tropical Eastern North Atlantic Time-Series Observatory (TENATSO) and followed a cruise track to the coast off Mauretania where coastal upwelling could be observed (figure 1).
- Parallel sampling of air and sea surface water on a nearly hourly basis at six 24-hour stations (indicated by red dots) in different distances to the coast gave the unique opportunity to investigate diurnal variations in concentrations and air-sea fluxes of halocarbons.

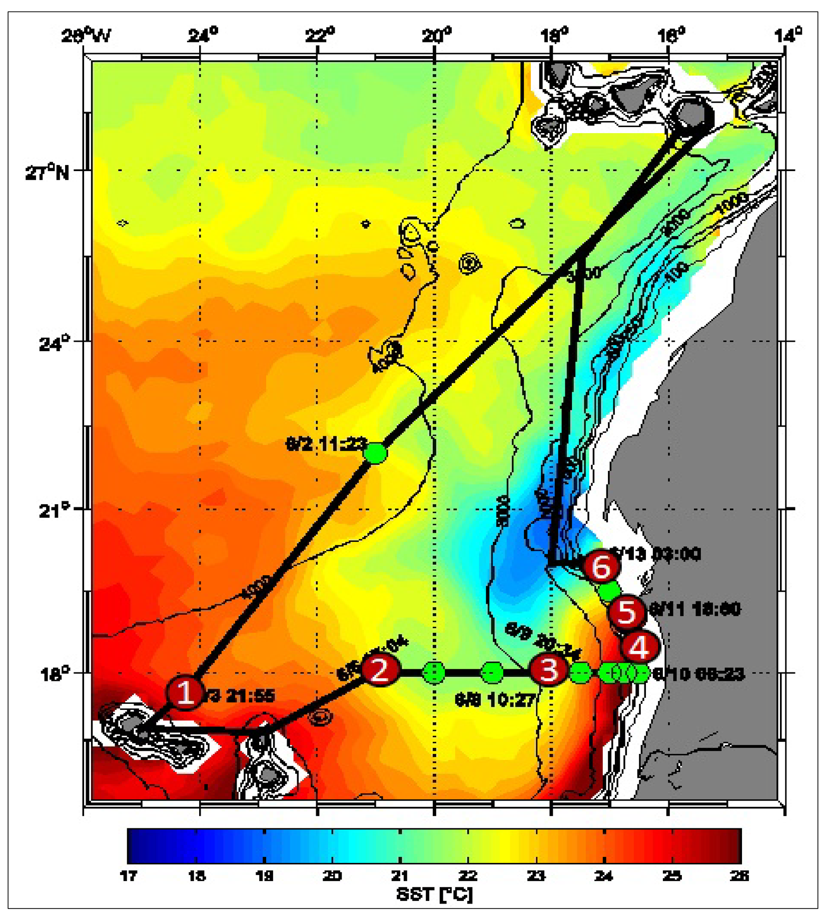

Figure 1: Cruise track and Sea Surface Temperatures during DRIVE, J. Schafstall

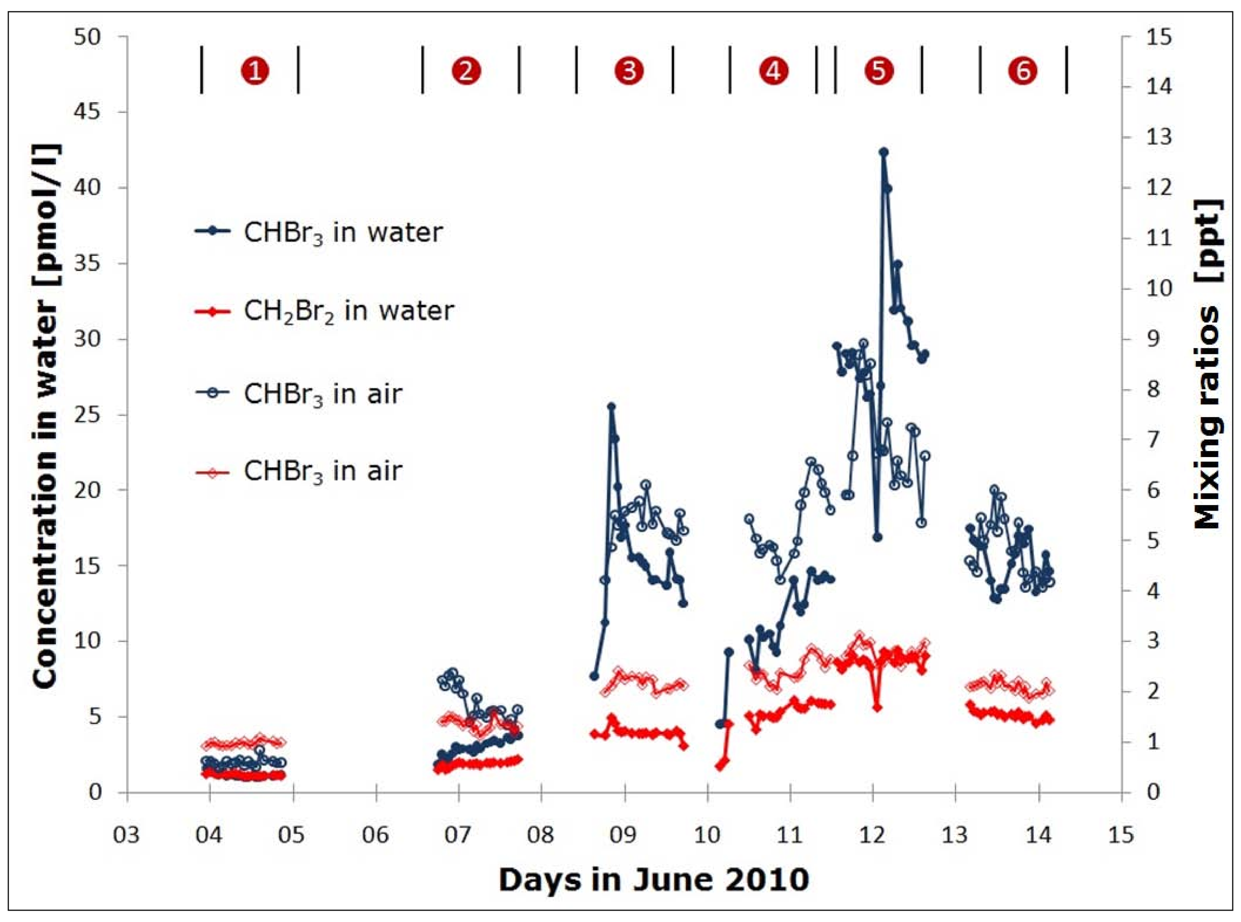

Figure 2: $CHBr_3$ and CH_2Br_2 concentrations in water and air during DRIVE

- Increasing regional gradient of $CHBr_3$ and CH_2Br_2 towards the coast with maxima and most diurnal variabilities at station 5 (figure 2)
- Station 5: closest to the coast, but not associated with the lowest temperatures (figure 1) that often indicate stronger upwelling with possibly higher primary production

Is the air-sea gas exchange the *only* source for halocarbons in the air in this region?

The ocean is generally a net source for both compounds with a maximum flux of ***6800 pmol/(m²*h)*** for $CHBr_3$ at station 5 (figure 3)

➡ This flux is ***not*** sufficient to explain the observed rapid elevations in atmospheric mixing ratios

- To achieve an increase of 2 ppt in 1 h, a flux of ***200,000 pmol/(m²*h)*** would be needed

➡ There must be an ***additional source*** for halocarbons in the air in this region.

Where could the possible source be?

- Northern source region indicated by air mass back trajectories → ***Banc d'Arguin?*** (figure 4)
- Rich in seagrasses which have been identified as halocarbon source

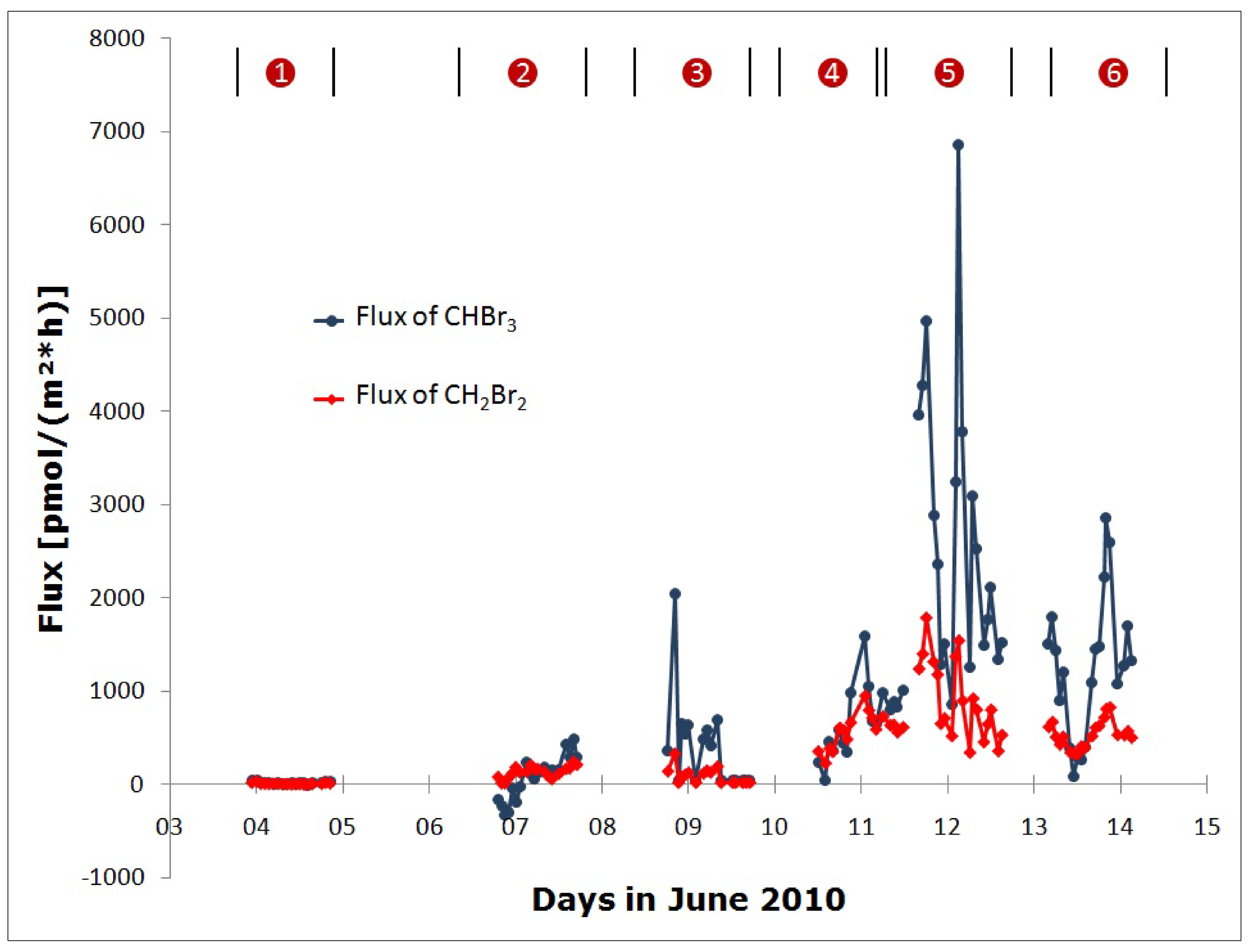

Figure 3: Air-sea fluxes of $CHBr_3$ and CH_2Br_2 during DRIVE

Figure 4: Location of Banc d'Arguin in relation to station 5

MSM18/3 – Halocarbon concentrations in the equatorial upwelling

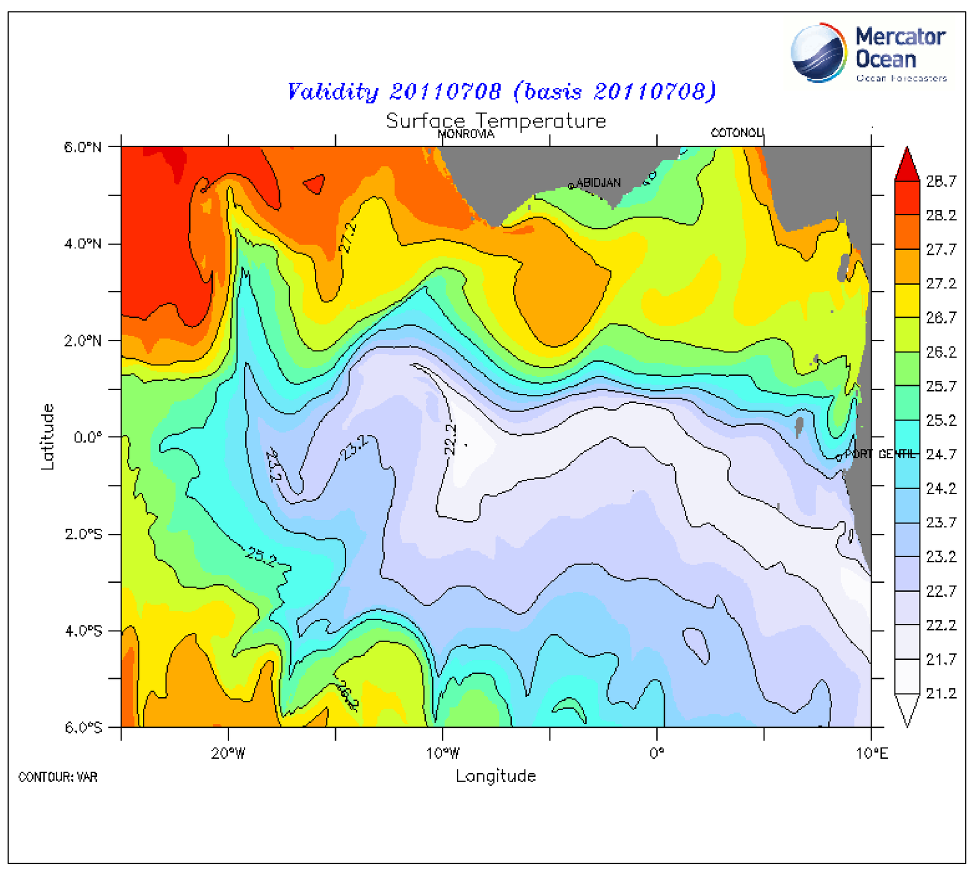

Figure 5: Projection of SSTs for July 8th 2011 for the equatorial Atlantic (provided by Mercator)

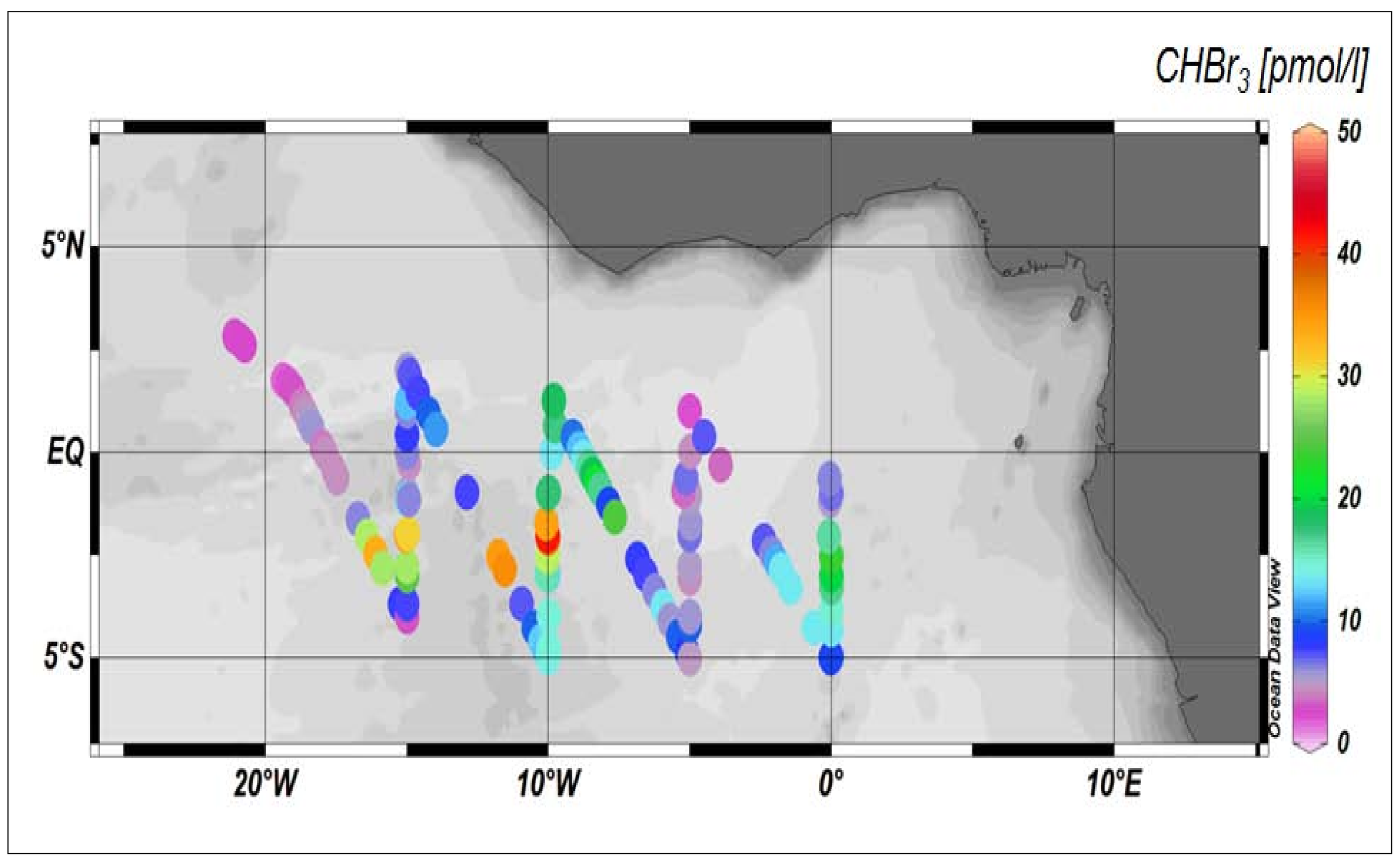

Figure 6: Preliminary data of $CHBr_3$ concentrations in sea water during MSM18/3

- The RV Maria S. Merian followed a cruise track from Cape Verde to the equator
- Rather low temperatures were observed around the equator (figure 5), possibily associated to oceanic upwelling
- Sea water concentrations of $CHBr_3$ of up to 41 pmol/l could be observed (figure 6), but, in agreement to DRIVE, these do not necessarily coincide with the lowest temperatures.

➡ Flux calculations and comparisons to biological parameters will help further identify halocarbon sources there.

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