

Interactive comment on “Halocarbon emissions and sources in the equatorial Atlantic Cold Tongue” by H. Hepach et al.

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Anonymous Referee #1

General comments: This manuscript presents the results of halocarbon measurement during a cruise campaign during the equatorial Atlantic Cold Tongue season. The importance of biological production in the surface water was confirmed and the production in the surface mixed layer was also suggested. In this study, the diapycnal fluxes and sea-air-exchange fluxes were investigated for the four halocarbons. Generally, the results and discussion are based on a well organized field campaign with quite high quality data and the manuscript is thoroughly prepared. I would like to recommend it to be published in Biogeosciences.

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We thank anonymous referee #1 for the helpful input and suggestions. We refer to the specific comments in the following sections. Changes in the manuscript according to Anonymous Referee #1 are highlighted in red, while changes according to Anonymous Referee #2 are marked blue. Additional changes will be flagged in green.

Specific comments: C5021 1. Page 5571, L14-26: In this part, the authors showed the correlations between halocarbons and other environmental/meteorological parameters and to give their suggestions. However, I found some of the correlations are too weak to support their points e.g. the correlation coefficient between CH₂I₂ and global radiation was only -0.25 and it seemed not solid enough.

We agree that the stated correlations are rather weak due to the interaction of sink and production processes. The anticorrelation of CH₂I₂ with global radiation for example is weakened by its daylight production, which leads to a less significant correlation as could be expected considering its very short lifetime (see section 5.3.3). However, as these weak correlations are significant, we think that it is worth mentioning these influence factors. We reworded several sentences and clarified in the corresponding sections that drawing conclusions from these correlations are subject to great uncertainty. We added some phrases in the discussion sections 5.1.1 and 5.1.2 to tone our statements based on the weaker correlations down. For example: Section 5.1.1: “Although the correlation analysis of halocarbons with phytoplankton groups cannot directly resolve production and loss processes by algal activity, it is still an indicator for possible involvement of these species in halocarbon production.”

Section 5.1.2: “The very low sea surface concentrations of CH₂I₂ with lowest concentrations during the day can be explained by its fast photolysis (few minutes lifetime in surface sea water) (Jones and Carpenter, 2005; Martino et al., 2005).”

2. Page 5576, L2-7: I do not understand why the strong negative correlations of Prochlorococcus HL with CHBr₃ and CH₂Br₂ pointed to the association with warmer oligotrophic water.

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We wanted to state that it's more the other way round: the association of Prochlorococcus with warm water leads to the strong non-causal negative correlation, since bromocarbons are associated with cold water. The occurrence of Prochlorococcus in warm water can be observed via the correlation with SST ($r_s = 0.44$, Table 2). This is not surprising since Prochlorococcus is one of the most abundant phytoplankton groups in the tropical and subtropical ocean, and occurs in warmer water that is less rich in nutrients (Johnson et al., 2006). On the other hand, bromocarbons correlated negatively with SST, showing that these compounds were rather connected with cold water and species within the cold water. Prochlorococcus were also most abundant north of the equator (see positive and significant correlation with latitude of $r_s = 0.49$) where waters were warmer than in the southern transects of the cruise. We modified this section in 5.1.1 as follows:

"These significant negative correlations can be explained by the large abundance of Prochlorococcus in warm water, while bromocarbons on the other hand are more correlated with the cooler water of the EUC, which is richer in nutrient and chrysophytes, haptophytes and dinoflagellates."

3. In the section 5.2, the distribution of halocarbon in the water column was not always similar in the different locations. e.g. highest CH₂I₂ concentrations were measured in the sea water layer of 0-30 m in CTD stations #4 and #6. As suggested by the authors, it could be affected not only by the production but also but the sink process. I am curious on how important the photolysis may be, especially for the shorter-lived CH₂I₂. The different local time for collection may lead to the different temperature, radiation etc., which seems not mentioned in the manuscript. More CH₂I₂ during night time should be expected.

We agree with the reviewer that the distribution of halocarbons within the water column may strongly depend on the time of day. Photolysis is potentially the most important sink for CH₂I₂ in the surface ocean, while the time scales for the other three mentioned compounds are much longer. For the calculations of photolytical destruction in section

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5.3, the diel cycle of radiation was of course considered. We plotted the global radiation in Fig. 2c) as indicator for the time of day at which CTD stations were performed (see also numbering of the CTD in the figure). While CTD station 4 was carried out during noon, station 6 was indeed executed during night time. We checked the local time for all of the other stations as well, and found no relationship between time of the day and the location of the maximum in the CTD profiles, neither for bromocarbons nor for iodocarbons. The regional variations in production seem to be much larger than the diel variability. We added a sentence covering this aspect, since we consider this interesting information. We added to the end of section 5.2.:

"Surprisingly, the time of day, influencing sink and production processes, seemed to play a minor role for the shape of the profiles for all four compounds (see the location of the CTD stations in Fig. 2)."

References: Johnson, Z. I., Zinser, E. R., Coe, A., McNulty, N. P., Woodward, E. M. S., and Chisholm, S. W.: Niche partitioning among prochlorococcus ecotypes along ocean-scale environmental gradients, *Science*, 311, 1737-1740, 10.1126/science.1118052, 2006.

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