Ocean Sci. Discuss.,
https://doi.org/10.5194/os-2018-70-AC1, 2018

Ocean Science
Discussions

Interactive comment on "A three year time-series of volatile organic iodocarbons in Bedford Basin, Nova Scotia: a Northwestern Atlantic fjord" *by* Qiang Shi and Douglas Wallace

Qiang Shi and Douglas Wallace

qshi@dal.ca

Received and published: 28 September 2018

We thank the reviewer for his/her insights and very helpful comments for improving the manuscript. Please see our responses to specific comments below.

Important Point 1. Nevertheless of importance of concentration changes at 60m depth. It is difficult to follow the explanation described in the manuscript comparing with the Figure 4d (iodocarbon at 60m depth) and Figure 3 (salinity profile). It is necessary to add some detailed figures to explain timings of concentration changes of iodocarbon and water intrusions (based on analysis of salinity changes), etc.

Answer: We have added figure 9 (a, b and c) to clarify our discussion of the events at 60m, including intrusions, concentration increases, plateaus and "switches" (labelled 1 to 9). We also marked the 2017 mid-depth intrusion more clearly on Figure 2. We have completely rewritten this section (section 4.5) for clarity.

Important Point 2. Authors calculated the mass balance of CH3I in the top 10m of water column except for winter. However, mass balance must be calculated in the surface mixed layer defined by vertical variance of density. The thickness of the surface layer, in which water can contact with air, is crucial to estimate the balance between sea-to-air flux and net-production I the surface layer. The weekly observation of this study make it possible to set the thickness appropriately. I believe that it makes this paper more valuable.

Answer: We agree that the thickness of the layer is crucial for mass balance calculations. However, through most of the year, there is essentially little or no "mixed layer" as classically defined, as there was almost always salinity stratification between 1 and 5m. We therefore decided to perform the mass balance for the top 10m of the water column throughout the year. We did not show mass balance calculations of Pnet on Fig. 6 for the very limited periods of time when density (salinity) was constant from the surface to 10m and therefore mixing extended below 10 m.

3. Specific comments Abstract and discussion about "hypothesis that near-surface iodocarbon production is linked to reduction of iodate to iodide" I agree that dihalomethane production is supposed to associated with I2 (or HOI) production and subsequent reaction with organic matter. However, there is no evidence that I2 production is attribute to iodate reduction. Some previous studies supposed that I2 is produced as a results of iodide oxidation. Iodate reduction might occur in the surface seawater with depleting DIN. I can approve the hypothesis that near-surface iodocarbon production is linked to reduction of iodate to iodide at a discussion chapter, however, the hypothesis should not be described in the abstract.

Answer: We agree that we have no direct evidence about inorganic iodine cycling or speciation, and have therefore removed the hypothesis, that near-surface iodocarbon production is linked to reduction of iodate to iodide, from the abstract as suggested. We believe, however, that the timing of near-surface iodocarbon production with respect to nutrient drawdown and temperature increase can be usefully discussed in the context of experimental results in the literature (see also response to reviewer 2). Our discussion about iodine cycling in section 4.2 has been revised extensively, and we continue to mention the hypothesis in relation to results from experimental studies in section 4.3.1, and only briefly refer to it in the conclusions.

4. Abstract line 24: (2-3X) Does it mean "two to three times"? I am not sure that 2-3X is appropriate in scientific writing?

Answer: We changed 2-3X to a "factor of two" (P1L21).

5. Introduction line 6: "CH2ClI (hours) and CH2I2 (minutes)" is correct.

Answer: We corrected this (P2L22).

6. Page 7, line8: dissolved inorganic nitrogen (DIN), the definition of DIN (= NO3- + NO2- +NH4+) should be described at here, instead of page8 line 22.

Answer: We corrected the position of the definition of DIN. And moved it to line 6, page 8.

7. Page 8, line 6-12, etc. The authors explained degradation of organic matter using oxygen concentration. I think that AOU is better to explain the degradation of organic matter.

Answer: Yes, strictly speaking AOU is more accurate to quantify the degradation/ respiration of organic matter. But, here we feel that use of the trend/slope of oxygen concentration vs. time is sufficient and simpler to illustrate the degradation of organic matter over time. We preferred not to make this change for simplicity.

8. Page 9, line 22: "Missing from the bottom water time-series, were the ca. 1 month duration variation seen in summer time surface water", description is confused?

Answer: We added specific reference to the ca. 1 month duration peaks on line8 (page 9), and again used exactly the same wording later on in the same section, so that our discussion should now be clearer. In general we reduced our discussion of this "sub-seasonal periodicity" significantly, including no longer assigning it a separate section.

9. Page 16, line 16-18:" the correlation between [CH2ClI] and [CH2I2] in Bedford Basin (table 1) are consistent with this photochemical transformation" how is the correlation consistent with photochemical transformation? I think that the photochemical transformation of CH2I2 to CH2ClI should decrease the correlation under the low CH2I2 production rate, and photochemical transformation should increase the correlation under the high CH2I2 production rate, which is sufficiently exceeding photodegradation of CH2I2. Authors should explain about the link between photochemical transformation and correlation (CH2I2 vs CH2ClI).

Answer: We agree with the reviewer, that very efficient photochemical transformation of CH2I2 to CH2ClI should decrease the correlation between the two compounds, although we think that the photolysis rate may be more variable than the production rate. Where only a fraction of CH2I2 is converted to CH2ClI, we would expect a correlation. We have rewritten this section (4.2) to make this point, and note that there was no significant correlation at 1m depth, where the photolysis must be the most rapid (Page 16 and 17). We note here that Jones et al. (2010) used one-dimensional ocean mixed layer model to show that CH2ClI concentration can be almost uniform within the top 6 m, but that up to 100% of CH2I2 at 1 m depth can be photolyzed compared to at 6 m depth. In our study we also noted significant concentration differences of CH2I2 between 1 and 5 meter with the concentrations of CH2I2 at 5m being 20 times higher than at 1 m (in summer), likely due to photolysis. On the other hand, for CH2ClI, there were no significant differences between different depth (1, 5 and 10m). The strongest correlation between CH2ClI and CH2I2 occurred at 5 m depth, and this result is consistent with the photochemical transformation. We believe the discussion is now clearer on this point.

10. Section4.3.2 sub-seasonal periodicity", were there any periodicity within sub-seasonal scale during summer? If there is not a periodicity, it is not necessary.

Answer: We removed the separate section on sub-seasonal periodicity and now refer instead to "peaks of ca. 1 month duration." (P. 9 line 8).

11. Page 23-Page 24: I cannot follow the description of the manuscript comparing with figures. For example, the mid-depth intrusion of salty, offshore water (as denoted by the 31 salinity contour). I cannot read the intrusion timing comparing with temporal variation of CH3I. The authors should makes a major revision in page 23-24 adding some figures to support the explanation, as commented in "general comment"

Answer: we added a blue circle to figure 2b to highlight the mid-depth intrusion of saline water in 2017. We also added figure 9 to show changes at 60m in detail, with specific events denoted (1 through 9) and referred to in the text. We rewrote the entire discussion of the near-bottom variations for improved clarity.

Interactive comment on Ocean Sci. Discuss., https://doi.org/10.5194/os-2018-70, 2018.