

Response to referee #1:

Booge et al. presented a modeling study of bottom-up emission estimates for marine bromoform using a fully coupled ocean-atmosphere Norwegian Earth System Model, NorESM2. I think this is well done effort and it is very nice to see a comprehensive new bromoform emission estimate from a fully coupled ocean-atmosphere ESM. This study makes a great addition to the existing bromoform emission estimates, both bottom-up and top-down, and with further progress into the new era of a changing climate system. I support this paper to be accepted for publication in ESD, but I do have a few comments that should be addressed before the paper is published.

We thank reviewer #1 for the positive evaluation of our work and for providing valuable comments in order to improve the manuscript. We are addressing the comments in the following (highlighted in bold). The lines refer to the originally uploaded manuscript.

1. Page 7, L199-213. I think it would be more helpful to the readers if you can use a simple schematic diagram to illustrate these set of equations 16-18 that balance the oceanic, atmospheric concentrations, production, and flux. These terms are all inter-linked and the equations are practically identical, except the subscripts. The current way of trying to explain the relationships between these terms using just equations and text is not an optimal way, in my view.

We added a schematic diagram to the manuscript and moved Eqs (16-18) to the supplement. We now refer to this diagram when explaining the relationships between these terms in Section 2.5.

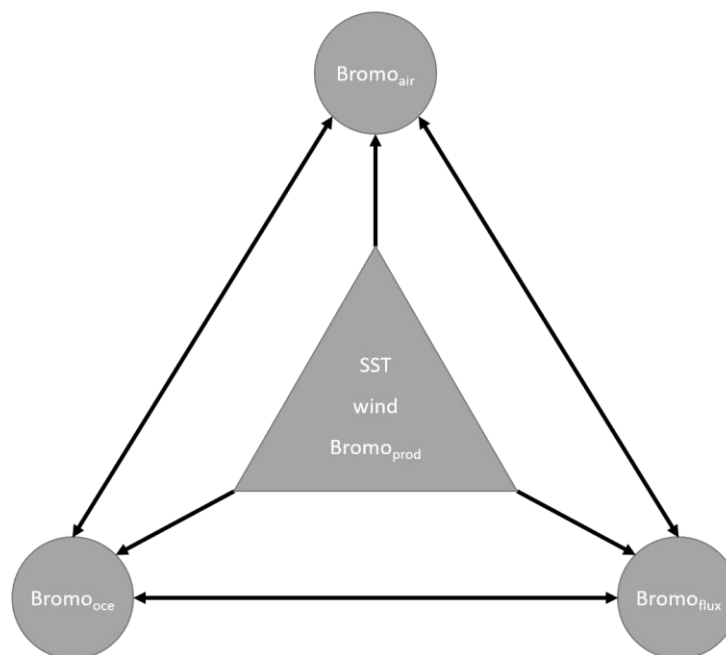


Figure 1: Schematic illustration of relationships between different parameters influencing each other. Generic parameters in triangle influence the derived parameters in circles. Each derived parameter in a circle is influenced by all other five parameters. Relationships are the basis for the multilinear regression analysis using Eqs. (16-18).

2. Section 3.2, L257-273. It is very distracting to read through all these mean, 25th, 75th percentiles, min and max. It also makes things harder when I want to compare the numerical values between observations and model output. I would suggest that you use 25th & 75th values as subscript & superscript for the mean values. If you really want to include the min and max, you can add them in the same way (sub & sup) with in parenthesis.

We like this idea. To further increase the comparability between different numerical values we deleted the mean value as well as the 25th and 75th percentiles and added min. and max. values as subscript and superscript to the median value, respectively.

3. Data availability and open data policy. I clicked on the link to <https://halocat.geomar.de>. It does not seem to me that these data are publicly available. The “click to join” link seemed to only let you submit an observation dataset, but nowhere on this page allows one to get access to data or even register to get an account to get access to data. This clearly does not meet open data policy that every journal is trying to abide by!

Thanks for pointing out this issue. As some of the datasets within HalOcAt are not directly published yet, we added further information on the website how to receive the data for now. We changed the sentence in the “data availability” Section to: “Observational data can be made accessible by contacting the principal investigator of HalOcAt through <https://halocat.geomar.de>”.

4. L515-518. I fully agree. It would be very interesting to see if you can use NorESM2 in a future climate and see how winds, SSTs, and the ocean-atmosphere balance change CHBr₃ emissions. I look forward to seeing future studies from the authors on this topic.

Thanks a lot for the comment. We absolutely agree and are working on future climate scenarios of bromoform emissions.

Minor comments:

1. Maybe it is more accurate to say annual mean fluxes, instead of emissions. When it is emission, it implies that it must be from ocean to atmosphere. Sinks is the corresponding term when flux values are negative, therefore from atmosphere to ocean.

The reviewer is correct, that it is more accurate to say annual mean fluxes, instead of emissions. We changed “emissions” to “fluxes” when describing average values or describing fluxes in general. When specifically talking about fluxes from the atmosphere to the ocean we use the expression “negative fluxes”. When talking about

fluxes from the ocean to the atmosphere we kept the expression “emissions”. These terms are now defined in Section 2.1.1 (l. 109).

2. Just say “winter”, instead of “winter seasons”. Short and adequate.

Done.

3. This is not a correct statement. The most important organic compound for atmospheric bromine is CH₃Br, not CHBr₃. But you can say it is “one of the most important ...”

Thanks for pointing this out. We changed the sentence to “Bromofrom (CHBr₃) from the ocean is one of the most important organic compounds for atmospheric bromine...”

4. L33-34, you already said tropics at the beginning, you don’t need to say “tropical” in the second half.

We deleted the word “tropical” to just state “deep convection”.

5. L101-104, you need to describe what each term is in Eqn (2). I couldn’t find descriptions of Si(OH)₄ and KSi(OH)_{4phy}.

Thanks for pointing out this missing information. We added the following description referring to Eq (2): “...where $K_{phy}^{Si(OH)_4}$ denotes the half-saturation constant for silicate (Si(OH)₄ uptake...”

6. I think you may be confused in terms of when to use “e.g.”. The Latin abbreviation for “for example” is e.g., which stands for “exempli gratia.”. For instance, L297-298 “Averaging data over time or space leads to lower values (e.g. gas emissions)” is not a correct way to use e.g. Gas emissions is not an example of lower values. L305, for example, (e.g. North and South Pacific) should be moved to after surface oceans

Besides, “e.g.” should always be italic and with a “,” after it. Make sure you look through all the e.g. in the text and fix when not appropriate.

Thanks for this comment. We went through the manuscript and deleted “e.g.,” where not appropriate. Whenever appropriate we added a “,” after “e.g.”. In L305, we moved “(e.g., North and South Pacific)” to after “surface oceans”. According to the Copernicus style, “e.g.” is not written in italic. Therefore, we kept it as is.

1. L324-327. Move North Atlantic, tropical West Pacific, and Southern Ocean to the end of the first sentence.

Done.

2. Change but also -> and

Done.

3. I think you can simply say “winter emissions” here, instead of “the emissions from the ocean to the atmosphere during winter seasons”. The current phrase is long and unnecessary. Emissions only occur from ocean to the atmosphere in this context.

We agree and changed it.