

Interactive comment on “Medusa-Aqua system: simultaneous measurement and evaluation of novel potential halogenated transient tracers HCFCs, HFCs and PFCs in the ocean” by Pingyang Li and Toste Tanhua

Anonymous Referee #1

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This manuscript examines the usefulness of a suite of halogenated compounds as ocean transient tracers to better constrain ocean ventilation. I think this is an important topic, and can see many potential benefits of having measurements of the suite of tracer with different atmospheric histories. However, I think the manuscript needs some revisions before it is suitable for publication.

MAJOR COMMENTS

1. I think the overall conclusions of the study need to be more clearly presented. I

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like Table 5, and accompanying discussion in Section 6, as a summary of the analysis/paper, but the Introduction, and Conclusions are less clear. I think some one just reading these (as a lot of people will do before reading the whole paper) will come away a bit confused. I don't have any specific suggestions, but I think some rewriting is required so it is clearer which tracers are definitely not suitable, and which are (and may be a third category of tracers where not sure and more measurements / tests needed).

As part of this I think you need to clarify what is meant (or remove usage) in the highlights by “most possible” and “most potential” tracers. I think I understand what is meant but only after reading the paper in detail.

2. As written the manuscript seems to suggest that a conserved tracer is only useful as a transient tracer if it is linearly increasing, and can then be used to estimate the mean age. However, a tracer with nonlinear history can still be used as a transient tracer, and be used to help constrain the TTD (especially if multiple tracers are available). For example, a linear and quadratically increase can be used in combination to estimate both the mean and the width. Also, the fact that the atmospheric concentration of the tracers is essentially zero at differing times in the past (e.g. HFC-125 in late 1990s, HCFC-142b in late 1980s, and HCFC-22 in late 1960s) might be very useful for containing aspects of the TTD, even if can't estimate the mean age from each tracer. The authors make a few references to determining more complex TTDs as in Stoven and Tanhua, but even if you still assume IG TTD multiple tracers could be used to estimate both parameters of the IG.

It might be asking too much for a detailed multi-tracer analysis in this paper, but even if this is the case I think the possibility a multi-tracer analysis that does not aim solely at estimating the mean age needs to be discussed. I would encourage the authors to think if there are more appropriate approaches than just estimate the mean age assuming $D/G=1$, and whether this may change conclusions on whether a tracer is useful.

3. The description of how the mean age is estimated from each tracer needs to be

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clearer. I don't find the description on top of page 7 and figs 4 and 5 very helpful, and if I wasn't already familiar with the approach would be confused.

Related to this the text "mean age of HCFC-141b" (and other such usage throughout the manuscript) needs to be replaced with "mean age estimated from HCFC=141b". This may seem like petty semantics, but it is important to be clear that you are trying to estimate the same mean age from different tracers and not a tracer dependent quantity (as written it implies the latter). I think a paragraph where you clearly describe how you estimate the mean age from measurements of a given tracer, and then define your terminology, will help.

Actually, what are the take home points from figures 4 and 5? I understand what is shown but I don't know what I am meant to take home from them (and if purpose is to describe the calculation of the mean age, I don't think it works). Note, I find figures like fig 5 nice to look at but difficult to interpret / read off values.

4. The shorter atmospheric history is given as a possible cause of the young estimates of mean age from HCFC-142b, HFC-134a, and HFC-25 (pg 13, line 21), but what does this not cause a similar bias for HCFC-141b? Can the differences in mean age estimates be linked to the location of points on figure 12? I think fig 12 and 13 need to be linked together better than they currently are.

Would it help to include curves for different Delta/Gamma on figure 12 (thick curve is Delta=0, and could add curves for a couple of values D/G)? This might show whether data consistent with different values of D/G.

MINOR COMMENTS:

Pg 6, line 5: This description of fig 3 needs to be earlier, when fig 3 is first mentioned. Also, I think what is meant by relative tracer concentration should be in the caption.

Pg 6, line 23: The sentence "... the calculated age is mean age considered both advection ... " does not make sense.

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Pg 12, lines 27-34 are repetitive.

Pg 13, line 15. Remove "1" from "1IG".

Pg 15, line 1: "one star as no as some higher ..." does not make sense.

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