

Reply on RC1

Alice Marzocchi et al.

Author comment on "Surface atmospheric forcing as the driver of long-term pathways and timescales of ocean ventilation" by Alice Marzocchi et al., Ocean Sci. Discuss.,
<https://doi.org/10.5194/os-2021-4-AC1>, 2021

We thank the reviewer for the very positive comments and for the helpful suggestions, which we will address in our revised manuscript.

Major Comments

1) I have a couple of concerns regarding the "ventilation depth" metric. First I am not sure "ventilation depth" is the best terminology as it gives the impression that this related to a measure of how deep the ventilation is occurring in the water column. At least as I was reading the text that is what I was tempted to think and I had to remind myself it was not a physical depth.

- This is a good point. We will clarify in the text that this is not a physical depth and we propose to rename this metric "ventilation thickness".

Second, and partly related, I am not sure it is best to start with this metric. I think it would be better to start with metrics / plots like figure 9. These plots give a much better impression of how the tracer had infiltrated the ocean interior / where the tracer is. These could then be related to the tracer volume per area metric, which could then used as the summary metric.

- We will re-order some of the existing figures and introduce earlier in the manuscript metrics and plots that show the distribution of the tracer more explicitly.

2) Most of the focus is on NH but there have been well documented changes in SH winds (eg SAM trends). I think it would be good include some discussion on whether there is any signal of these trends in your ventilation tracers.

Related to this, several recent papers (Jones et al. 2016, 2019, Waugh et al. 2019) indicate that the rate that young waters is transported into the southern permanent pycnocline depends not only on the rate at which they are subducted but also on the speed at which the gyres circulate. Is this inconsistent with your result that the ventilation near the time of dye injection sets the long-term variability for the dye inventory?

- The focus on the NH is due to the known strong link between surface atmospheric forcing and deep-water formation in the subpolar North Atlantic and the availability of observations that can be compared more directly to our results. Such as those

pinpointing years of particularly strong convection in the Labrador and Irminger Seas. But we certainly agree with the reviewer that additional discussion about SH processes, and in particular trends in SAMW, would be beneficial – we are indeed working towards a separate study addressing changes in these regions. Nevertheless, in our revised manuscript we will include further discussion of results for the SH and comparisons with the available literature, such as the studies mentioned by the reviewer.

Minor Comments

Line 120 Question marks in Sv definition.

Line 350 "fficienciesnd"

- Thank you. We have corrected these.