Ocean Science Discussions

Ocean Sci. Discuss., referee comment RC1
https://doi.org/10.5194/os-2021-4-RC1, 2021

Comment on os-2021-4

Anonymous Referee #1

Referee 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-RC1, 2021

This study uses ocean-sea-ice model simulations of idealized “water vintage” tracers to examine ocean ventilation, including how it varies inter annually. The approach used is novel and the manuscript contains many interesting results. Perhaps the most intriguing is that the variability in ventilation near the time of dye injection sets the long-term variability for the dye inventory, which has potentially important implications for understand heat and carbon uptake. The manuscript is written, results presented are new and important, and I think suitable for publication as it is. However I have a couple of suggestions that might improve the 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.

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.

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?

Minor Comments

Line 120 Question marks in Sv definition.

Line 350 "fficienciesnd"

References

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ventilation to changes in midlatitude westerly winds. J. Clim. 32:5345–5361