

Response to reviewers

We thank Carine van der Boog and one anonymous reviewer for their very helpful recommended improvements to this manuscript. We will incorporate all the reviewers recommendations in our revised manuscript.

Response to comments

The main point raised by both reviewers is our use of suboptimal salinity data for the classification of thermohaline staircases. In the revised version of the manuscript, we will better explain how our algorithm uses salinity and temperature profiles by adding additional sentences in Section 2.2 . As Reviewer 2 noted, our classifier uses temperature profiles to identify potential thermohaline staircases. Temperature and salinity profiles are used to distinguish between thermohaline staircases and other structures such as thermal intrusions. As part of the revision, we will include in Section 2.2 a quantitative analysis on the effect of using both temperature and salinity profiles for the initial step of identifying thermohaline staircases, as performed by Carine van der Boog et al. (2021), vs using only temperature profiles for this step.

Following Reviewer 1's detailed comments, we will make the following changes:

- More accurate consideration of the contribution of thermohaline staircases to the meridional overturning circulation, referencing recent literature (see later list of papers to include)
- More careful use of terms steps, interfaces, layers and staircases throughout the paper
- Remove duplicate discussion of Turner Angle, as this is adequately described by the density ratio
- Explanation of terms such as maximum mixed layer height and step height ratio
- More explanation of glider specific terminology such as glider slope, as well as a more thorough description of the glider microstructure system and differences between ascending and descending profiles
- Describe the binning methodology in more detail, particularly the result when a given bin contains only two samples.
- Expand discussion of the identification of steps in the salt-finger and diffusive-convective regime
- Discuss use of temperature and salinity directly vs their use as density components for staircase classification
- Discussion of previous work with ice tethered profilers in the Arctic, and how gliders could complement these observations.
- A clearer explanation of the selection and use of critical parameters for the detection of thermohaline staircases, including tables, and how these affect our results.

- Clearly stating which observations and conclusions are based on Mediterranean and Atlantic data.
- More quantitative comparison between the classifications produced by our algorithm and VDB operating on the same profiles.
- Checking the order of figures

The reviewers brought several recent papers to our attention that we had not discussed in the original submission. We will include discussion of the following papers in our revised manuscript:

van der Boog et al. 2021 Double-diffusive mixing makes a small contribution to the global ocean circulation <https://doi.org/10.1038/s43247-021-00113-x>

Shibley et al. 2017 Spatial variability of the Arctic Ocean's double-diffusive staircase <https://doi.org/10.1002/2016JC012419>

Durante et al., 2021 Mixing in the Tyrrhenian Interior Due to Thermohaline Staircases <https://doi.org/10.3389/fmars.2021.672437>

Ferron et al. 2021 Contribution of Thermohaline Staircases to Deep Water Mass Modifications in the Western Mediterranean Sea From Microstructure Observations <https://doi.org/10.3389/fmars.2021.664509>

Meccia et al. 2016 Decadal variability of the Turner Angle in the Mediterranean Sea and its implications for double diffusion <https://doi.org/10.1016/j.dsr.2016.04.001>

Community review

This manuscript has not received any community reviews from non-nominated reviewers. However, Frederic Merceur of IFREMER contacted us via email to request a more complete acknowledgment of Argo data used in this study. We have added his suggested citation to the acknowledgements section of the revised manuscript.