24 October 2022

Response to reviewer 2

Throughout this document, the two reviews are reproduced in black. Our responses are presented in blue and, where appropriate, quotations from the revised paper are included in indented *italic blue* text.

REVIEWER 02

Overall:
This paper described turbulent energy dissipation rate obtained by glider observations from two methods: one is estimated by estimating Batchelor wavenumber using fast-response thermistor and the other is from Thorpe-scale density overturn. The former is less than the latter one. The turbulent heat and salt fluxes are reported not to be influential, while the salt-finger double diffusive fluxes could be influential. These results are potentially worth to be published, but need to be further analyzed, because both the discussions why the difference between the two methods and for the salt-finger fluxes are not enough.

Specific points:

1. Methods of estimating the is not enough. Time response of the fast-response thermistor probe is not enough and needs to be corrected even for the glider observations. The underestimation from the spectrum fit could be caused by insufficient spectrum correction. Also the original method for estimating Batchelor wavenumber was proposed by Oakey (1982) and Ruddick et al. (2000) which should be cited.

We apologise for omitting information on the response time correction in our summary of the method of Scheifele et al. (2018). Once the temperature power spectrum, Λ_{32}, has been calculated from a 32-second segment, the transfer function of Sommer et al. (2013) is used to correct for the slow FP07 response time at high frequencies. This step is included in the Matlab toolbox provided by Ben Scheifele and Jeffrey Carpenter. We will add this step into our summary of the method.

> *"Values of Λ_{32} at high frequencies, where the thermal inertial of the fast thermistor is such that its temporal response is inadequate, are corrected using the transfer function of Sommer et al. (2013)."*

Furthermore, we will be happy to include the suggested references in our revised paper.

2. The regression coefficient between the Thorpe and Ozmidov -scales are also not decisive, and the Thorpe-scale method cannot estimate for depths without density inversions. The standard method for estimating is shear-probe measurements. Before comparing between the Batchelor and Thorpe methods, comparisons between shear and Batchelor and between shear and Thorpe methods should be discussed or appropriate previous studies should be cited.

While the regression coefficient between the Thorpe and Ozmidov scales (R_{OT}) is indeed not constant, the work of Ijichi and Hibya (2021) demonstrates that R_{OT} is not highly variable in the upper 1000 m of the water column. We feel that a full treatment of this matter is outside the scope of the present paper.

Futhermore, there was a fault with the shear probe and the data are unfortunately unusable. This will be mentioned in the revised paper:

"There was a fault with the shear probe on this deployment and the observations could not be used."

3. The estimation for the salt-finger double diffusive fluxes is relied on the parameterization for very simple situation. Discussion using the microstructure measurements should be done to evaluate the validity of the parameterization. The estimate of the density ratio is quite important for the parameterization. The procedure (bin length for gradient estimates) should be further described.

In response to comments by reviewer one, we have comprehensively revised this aspect of the methods. We will no longer divide the water column into gradient and mixed parts of the staircases, but simply implement Equations 10 and 11 over all areas of the water column that are susceptible to salt fingering – as identified using the Turner angle. Furthermore, our newly calculated double-diffusive fluxes (as parameterised in Equations 10 and 11) will be discussed in relation to our direct measurements of turbulent diffusivity from microstructure observations in the context of the density ratio.

4. Discussion is necessary on whether the estimated double diffusive mixing explains water property changes during the present 13 days observations.

We will include further discussion of the influence of double diffusive mixing on water property changes during the observational period.

Minor points:

- Figure 4: figure for log10($\varepsilon\mu$) versus log10() is desirable. From Fig.4c, the differences are both plus and minus.

A scatter plot of log10(ε_μ) versus log10(ε_T) will be included in the revised paper.

- 195th : Fig. 5a ï 5 ?

The incorrect reference to Figure 5a will be corrected.

- 208th : (<10^{-5}) ï (>$10^{-4.5}$) ?

- 217th : ï ?

We had neglected to include units after 10^{-1} on line 217: this will be corrected.