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Ocean Science
Discussions

Interactive comment on "Diapycnal mixing across the photic zone of the NE-Atlantic" *by* Hans van Haren et al.

Anonymous Referee #2

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The manuscript titled "Diapycnal mixing across the photic zone of the NE-Atlantic" by Haren et al. quantified the upper ocean nutrient flux using a custom modified CTD and nutrient measurements at discrete depths from a latitudinal transect along 17±5°W between 30 and 62°N in summer. The authors observed no increase in vertical mixing or diapycnal nutrient flux from south to north, where the temperature increased. Further, they opined that nutrient supply by diapycnal flux to the euphotic zone might not be affected by the physical process of global warming. It is a well-written manuscript and presents an interesting take on the ocean biophysical coupling in the global warming scenario. However, I feel that the authors jumped into a conclusion without providing enough evidence to support their say. Hence I recommend major revision.

Major Comments

L63-96 The introduction needs a more general introduction to the oceanography of the region. Especially knowledge of bathymetry, background internal wave field, eddy kinetic energy, and wind conditions during summer.

L123 In the Thorpe length calculation section, please mention the lowering speed of the CTD. A slow lowering can resolve overturns efficiently. In the mixed layer, the Thorpe method will consider it as a large overturn.

How you will justify the validity of diffusivity within the mixed layer, where N^2 is weak. A brief discussion on lowering speed of CTD and justification for the diffusivity within the mixed layer will give clarity to the reader.

L256-258 Substantiate the surface cooling and internal wave breaking using data.

L264-265 I could not understand this sentence.

L284-286 The nutrient flux depends on the eddy diffusivity and the nutrient concentration gradient, which changes dramatically with depth. The nutrient fluxes thus may vary with two-or-three orders difference. In the manuscript, nutrient flux is calculated using a low-resolution profile of nutrients. Does this discrete measurement introduce bias to the flux calculation?

What is the typical depth of the euphotic zone in the study region?

L318-320 General understanding is that the Thorpe length method overestimates the diffusivity (Mater and Venayagamoorthy 2015; Alberto Scotti 2015).

L328-329 Here you can add a detailed discussion on how internal waves can be a feedback mechanism to counteract the suppression of mixing by increased stratification.

L344-364 Authors need to provide data evidence to prove that Internal wave energy/eddy kinetic energy is more in Northern stations, and thus, the relatively increased stratification (compared to south) could not suppress the diapycnal flux of nutrients to the euphotic zone from deeper depths.

This will give the readers a better understanding of the lack of correspondence between temperature /stratification and diapycnal flux with latitude.

One could employ the GM spectrum calculated using gridded Historical data sets (ARGO) to give an idea on the background Internal wave energy. However, I won't insist on doing this analysis.

A discussion on the meteorological conditions during the observation period is also warranted. What if the southern stations were characterized with anomalously calm weather that mixing was inactive and became comparable to the northern stations.

References

Scotti, A. (2015). Biases in Thorpe-scale estimates of turbulence dissipation. Part II: energetics arguments and turbulence simulations. Journal of Physical Oceanography, 45(10), 2522-2543.

Mater, B. D., Venayagamoorthy, S. K., St. Laurent, L., & Moum, J. N. (2015). Biases in Thorpe-scale estimates of turbulence dissipation. Part I: Assessments from large-scale overturns in oceanographic data. Journal of Physical Oceanography, 45(10), 2497-2521.

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