

Review of EGUsphere-2024-3436

Effect of double diffusion processes in the deep ocean on the distribution and dynamics of particulate and dissolved matter: a case study in Tyrrhenian Sea
by Durrieu de Madron et al.

Overview

The manuscript by Durrieu de Madron et al. presents CTD, ADCP and optical profile data along a section crossing the Tyrrhenian Sea and investigates salt finger staircase effects on particulate and dissolved matter distribution.

I believe that the measurements would be interesting to the community. The analysis and results are generally well presented and the figures are clear. However, in some instances, the conclusions are fairly speculative, there are inconsistencies or redundancies, clarifications are lacking or phrasing is deficient. Therefore, I recommend a detailed revision based on the comments below.

1 General comments

- a) I would suggest replacing 'salty' with 'saline' throughout
- b) Replace 'shipborne' and 'ship-borne' with 'shipboard' throughout
- c) Revise tenses for consistency; e.g., 'The first ADCP was' (line 180) [...] 'The second ADCP is' (line 182)
- d) Add longitude as an upper x-axis on depth-distance section plots, for better reference to the map.
- e) You could support the claims of staircase persistence with low measured microstructure derived dissipation rates and diapycnal diffusivity in Ferron et al. 2017
<https://doi.org/10.1002/2017GL074169>

2 Specific comments

Line 15: Replace 'will be' with 'is' to have a consistent tense

Line 45: ocean, temperature

Line 48: are on the order

Line 57: Replace 'Such thermohaline diffusive convection' with 'This' - diffusive convection refers to the double diffusive process opposite to salt finger formation.

Line 63: Perhaps add some references to support these numbers

Line 80: during their

Line 102: (Falco

Line 104: references

Line 108: cuts across

Line 119: water column with and without staircases, respectively, between

Line 122: , with depth in color.

Line 125: Shipboard

Line 129: with a shipboard rosette

Line 131: Profiler UVP

Line 133: 2 cm vertically

Line 134: °C and 4×10^{-5} ? S/m, and

Line 135: °C and 3×10^{-4} ? S/m, respectively.

Line 138:] and resolution

Line 147: Define the quantities in the parenthesis. Maybe provide some details on the validation, e.g., how many samples over how many profiles.

Line 155: clarify what ' $\#l^{-1}$ ' means

Line 159: and $-\alpha$ denotes ?

Line 163: represent up to

Line 176: scans

Line 186: 2 km given mean ship speed of ...

Line 187: various quality criteria (references?)

Line 187: Bathymetry (Etopo 1 resolution?) was incorporated in the processing to account for

Line 191: S-ADCP not defined (line 180?)

Line 199: downward looking

Line 203: which is a

Line 207: What are w and g , how are all these parameters estimated? Perhaps give a bit more detail if you are going to include the equation.

Line 211: (I assume) CTD (singular)

Line 225 and 226: -4 in exponents

Line 261: Give source, date (or is it an average over the whole period?) and spatial resolution for mean absolute dynamic topography

Line 263: Clarify how this is both SADCP and LADCP?

Line 269: Delete 'In terms of vertical current velocities'

Line 326: What are the horizontal gray lines?

Line 338: Delete 'the double diffusion phenomenon by'

Line 339: Delete 'The analysis of the'

Line 340: Delete 'and position'

Lines 362-363: delete

Line 366: Replace 'strongest processes' with something more specific like 'thickest salt-finger-induced thermohaline staircase structures'

Line 371: Replace 'particulate' with 'particular'

Line 378: Replace 'more diffuse' with something like 'less evident'

Line 379: Replace 'diffuse convection' with 'diffusive convection'

Line 382: internal gravity waves

Lines 383-385: 'Our observations show that the presence of significant staircase structures down to 2000 m can also be influenced by mixing induced by cyclonic eddies present in the basin.' Please rephrase. This is not true as written since you did not measure or estimate mixing, it is just speculative based on the existence of steps / eddies.

Line 386: What is the evidence for 'the intensity and variability of the currents in the transition zone'?

Line 390: Unclear what is meant by 'the lower part of the salt finger region'

Line 391: Unclear what is meant by 'the central Tyrrhenian thermohaline steps observed in the heart of the basin interior' and how this relates to the PERLE observations.

Lines 417-432: Fig. 5 does not show a particle size spectrum, what is the evidence for these claims? Replace 'spectrum' with something like 'vertical distribution'.

Line 427: 92.6 μm ?

Line 428: similar particle distribution with depth below the ...

Line 442: m^2

Line 447: The current vertical velocity estimates on the order of mm/s [this is probably below what can be resolved]

Line 448: homogenize their abundance with depth

Line 484: delete 'Based on this study'

Line 487: define all the variables in the equation

Lines 478-501 and Fig. 13: Clarify that these are exclusively double diffusive fluxes, and they assume very small turbulence intensity (i.e., small turbulent diapycnal diffusivity).

Line 493-494: Not clear what is meant by 'It is conceivable that the release of additional nutrients at the upper interfaces increases the local vertical gradient, thereby enhancing diffusive fluxes.'

Line 497: each density vertical gradient

Line 500: Replace 'making it possible to' with 'and used to'

Line 501: add something like: 'Double diffusive nitrate fluxes across each interface are annotated in blue'

Line 504: examines the effect of observed weakly

Line 505: delete 'phenomena'

Line 520: resolved down to

Lines 522-523: i.e. are homogeneous at depths corresponding to thermohaline staircases.

Line 524: caused by salt finger staircases

Lines 532-533: matter, contributing to upward diapycnal diffusive fluxes of oxygen and nitrate.