

Response to the comments of Dr. Funfschilling.

Interactive comment on “The instability of diffusive convection and its implication for the thermohaline staircases in the deep Arctic Ocean”

by S.-Q. Zhou et al.

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The article on “The Instability of Diffusive Convection and Its Implication for the thermohaline Staircases in the Deep Arctic Ocean” is an interesting article that brings new idea to the field. So I think, it is worth to be published in Ocean Science Discussion if some minor corrections are done.

- Thanks for your recommendation and valuable comments. Below are our responses to the comments.

The article deals a lot with the bottom layer, but unfortunately we do not have a lot of information about it. It does not appear in Fig. 3, and it would be interesting to give the thermal and salinity gradient inside of it, even though these gradients seem pretty flat.

- Thanks for your suggestion. We re-plotted Fig 3, where the bottom layer can be well exhibited. Note that the data of MMP cannot reach the sea floor, here the data were measured by conductivity-temperature-depth (CTD) at Mooring A. As reported in Zhou and Lu (2013), both instruments provide the same the results.

In the definition of the salinity Rayleigh number, K_T the thermal diffusivity coefficient is used and not K_S , the salinity diffusivity coefficient. It would be interesting to know the reason of this choice.

- In the definition of the salinity Rayleigh number, either K_T or K_S can be found in the references. Most of them, *e.g.* Turner (1973), use K_T because the quantities related to salinity are always compared to those of heat. Then, K_T is used in the definition of the salinity Rayleigh number for the sake of convenience. But some also use K_S in the definition, *e.g.* Mamou et al. (2001), so that it is similar to the thermal Rayleigh number. Both definitions are related to each other by Lewis number, which is defined as K_T/K_S .

P1350 line 11, the PDFs of Ra_{TI} is given (as well as in P4). Is it a local measurement of Ta_{TI} ? How is Ra_{TI} measured? What is fluctuating with the time? The temperature difference? L the thickness of the layer? More information would be welcome.

- Ra_{TI} is the interface thermal Rayleigh number. These interfaces were obtained from the instantaneous temperature and salinity profiles, as shown in Fig. 3. The properties involved in its definition are temperature difference and thickness of the interface. Both are functions of time and their temporal fluctuations have been discussed in another paper (Zhou and Lu 2013). We will add this information in the present paper.

Author should be more explicit on the hypothesis done to obtain Equation 7 out of Eq. 5 and 6. More steps would help the reader in his understanding.

- We are sorry for the unclear description. Eq. 7 cannot be deduced from Eqs. 5 and 6. It is one of the results from Turner's (1968) theoretical work, where it was assumed that the mixing at the turbulent front occurs due to a Rayleigh-Taylor gravitational overturning. In the revised manuscript, Page 11, line 21 "When the instability of DC follows the above arguments based on Eqs.(5) and (6), this maximum thickness is deduced as" has been changed to "this maximum thickness was proposed to be the form of "

The English should be improved: P1351, line 7, I would see "it is reasonable to neglect it", rather than "it is reasonable to be negligible"

- It is corrected.

P1351, line 23, "is a small region close to the boundary" rather than "closing to"

- It is corrected.

P1351, line 26, "This temperature distribution is the result of convecting rolls"

- It is changed to "Such a temperature distribution is the result of convecting rolls."

P1352, line 1, "temperature gradient is the largest inside the interface"

- It is changed to "the temperature gradient is largest around the middle of the interface".

P1352, line 2, "it gets smaller and smaller as it approaches the edge of the interface"

- It is corrected.

P1352, line 20, "When the set of data is large enough to have good statistics", instead of "To the well statistical data"

- It is corrected.

P1353, line 10, "cannot explain well the dynamics: : :"

- It is corrected.

P1353, line 21, "In the laboratory experiments where a saltstratified : : :"

➤ It is corrected.

P1356, line 10, typing mistakes, there is 2 “of”

➤ One of them is deleted.