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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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Please see the attached PDF file.

Please also note the supplement to this comment:
http://www.ocean-sci-discuss.net/10/C726/2013/osd-10-C726-2013-supplement.pdf

Interactive comment on Ocean Sci. Discuss., 10, 1343, 2013.

Response to the comments of Dr. Brown.

Dear Dr. Brown,

Thanks for your efforts in reviewing our manuscript. We appreciate your strong recommendation for publication. Below are our responses to your comments.

We agree with you that there is no much difference to use Ra_{Π} or $Ra_{\Gamma\Delta}$ to represent the thermal Rayleigh number of boundary layer at the current accuracy level as shown in Figure 5. There is only a factor of 2 between them. In most of the previous studies (e.g. Padman & Dillon (1989)), the interface has been directly treated as the boundary layer. Our concern is mainly based on the theoretical reasons. As shown in Figure 1 of the manuscript, there are convective rolls in each mixed layer. From the classical fluid mechanism, it is known that the boundary layer has its own characters. It is relatively hard to imagine the convective rolls in the neighboring mixed layers could share the same boundary layer. In fact, we do find that the horizontal velocity is zero at around mid-point of interface in the laboratory experiment. Similar observation can be found in numerical simulation (Carpenter et al. 2012). This may mean that the diffusive convection staircases look like the stacks of many single layer convecting layers in some sense. That is why we treat a half interface as the boundary layer thickness of one convecting layer, so does the corresponding Rayleigh number.

Padman, L. & Dillon, T. M. (1989): Thermal microstructure and internal waves in the Canada Basin diffusive staircase. Deep-Sea Res. 36, 531–542.
J. R. Carpenter, T. Sommer and A. Wüest (2012). Simulations of a double diffusive interface in the diffusive convection regime. Journal of Fluid Mechanics, 711, pp 411436 doi:10.1017/jfm.2012.399

Best regards,

The Authors

Fig. 1.