

Interactive comment on “Role of cabbeling in water densification in the Greenland Basin” by Y. Kasajima and T. Johannessen

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We are very grateful to the reviewers and the editor for the constructive and helpful comments. Both reviewers pointed out that the section 4 was unclear and needed to be revised. We acknowledge that the lack of coherence between subsections and the missing statements/explanation cause confusions, and the concluding remark (section 5) should be deepened in connection with the title. Reflecting on the comments, we have revised the section 4 and 5.

Response to the comments on section 4.1 (Detailed comments 3. from Referee #1 and specific comment 2. from Referee #2)

In the paragraph 2 and 3, we tried to argue the relative contribution of the buoyancy frequency, the lateral temperature gradient and the cabbeling parameter to the velocity,

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though it was not straightforward for the last two parameters. We admit that Fig.8 and the statement about the cabbeling parameter were not appropriate for the argument, and we removed the figure and the speculative statement about the cabbeling parameter. In stead, we put more focus on the description of the background condition (beta and alpha) in connection with the temperature gradient and provided a new figure. The potential of the high beta region is referred in the discussion.

Response to the comments on section 4.2 (Detailed comments 4., 5., 6., 7., 8, 9. from Referee #1 and specific comments, 3., 4., 5. 6. from Referee #2)

We acknowledge that the lack of the explanation how the volume flux was determined in the eq. (5), the statement about the size of the fronts and the mixture between the water mass formation rate and the volume transport caused a big confusion. In the revised version, we defined the volume flux (in eq.(5)). The vertical expansion shown in Table 3 in the previous version would indicate the volume of the front though it was not really correct, and the size of the fronts was listed in the revised version. The sources waters can be seen in Fig.11, therefore we omitted them from the table. The purpose of the estimation of the water mass modification rate is to examine the mixed water production, especially in the lowest layer. The water mass modification rate was used to estimate the volume transport, and 123 m³/day at SB (for example) indicates the transport of the water due to cabbeling.

Response to the other comments from Referee #1

Detailed comments

1. Correction of Figure 2. The arrow was put in the right position, (~12 oE).
2. The statement about the presence of sea ice in the third paragraph in section 4.1 was deleted since it is not relevant to the current study area as you pointed out (the vertical area of the neutral surface range $\gamma_{27.50} - \gamma_{28.07}$ is equivalent to approximately 50 m (in the western part) - 1500 m). The black markers indicate

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only the locations of the active cabbeling spots, and the purpose of this is to show the locations of the active cabbeling spots relative to the stratification.

10. and 11. We re-written the section and removed the statements about the areal variation of the fronts since it does not play any role in the net density gain. In the revised version, the areal size of the fronts is listed in Table 3.

Editorial comments

The relevant corrections in the revised version were applied.

Table 4 The usage of in situ density in Fig.14 (in the revised version) and potential density in Table 4 was confusing. The density gain listed in the revised version Table 4 was calculated from in situ density difference and averaged over at the fronts. The potential density of the lowest layer is shown in the revised version.

Response to the other comments from Referee #2

Specific comments

1. The same CTD dataset which was used to calculate the velocity was applied for the equation of the effective diffusivity.

6. The fact that the sum of the volume transport through the layers does not become zero (or close to zero) is special at SB. We argued in the section 5 that the mixed water overflow takes place at SB.

Technical comments

The manuscripts were re-written and only the relevant corrections were applied.

Interactive comment on Ocean Sci. Discuss., 5, 507, 2008.

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