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Interactive comment on "Tidally-induced lateral dispersion of the Storfjorden overflow plume" *by* F. Wobus et al.

Anonymous Referee #3

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This paper describes simulations of the overflow of dense water from Storfjorden which have been designed to examine the impact of tidal effects. The simulations, performed with and without tidal forcing, are idealized enough to isolate the tidal effects, yet realistic enough to be relevant to the real ocean. The numerical experiments are well-designed, the analysis is clear and focused, and the results are original. I therefore recommend publication, following some minor revision largely for clarification.

1. Comparison with the Antarctic scenario (Anslope).

Much of the discussion is devoted to examining the difference between the results seen here (where the inclusion of tides leads to less overflow water reaching the deep ocean) and the results seen in the Antarctic Ross Sea (Anslope) region (where the tides enhance the off-shelf transport). The authors suggest that this discrepancy is

caused by the presence of the headland topography in the Svalbad region, leading to tidally-generated lateral dispersion, whereas in the Antarctic, topographic variability on the shelf was less important. I wonder if this is really the main cause of the differences seen in these two cases? Firstly, in the Antarctic case, unlike the present case, without tides it is very difficult for dense water to move off the shelf (probably again because of the lack of topographic variation). Here, the Storfjordrenna provides a mechanism for steering some of the dense water off the shelf, even in the absence of tides. So the difference in the behavior without tides in the two regions will influence how tides impact the overflow. Secondly, while in both this study region and in the Antarctic, the tides lead to greater mixing, the impact of that mixing on the fate of the dense water will depend in part on the ambient stratification, and ambient currents. What is the density of overflow water after passing around the headland region of increased mixing, with and without tides, relative to the ambient water? (i.e. What would the section of figure 6 look like, if taken further around the peninsula?) Can the difference with the Antarctic also be understood in terms of the consequences of the tidal mixing for the density structure relative to the ambient stratification?

2. Equation 1 not clear

Make it clear that D is operating on tracer T, that T is any of heat, salt, passive tracer. Also, the div.p notation is confusing here, since p has not been defined. The sentence "The horizontal diffusion is represented by two factors" is not quite correct - the horizontal diffusion depends on those two factors, rather than is represented by them.

3. Section 2.4, Atmospheric and tidal forcing.

Can you clarify - does the atmospheric forcing correspond to the "normal year", or a particular time period?

4. Kappa_hor differences in figure 8.

Since the main differences in the plume behavior with and without tides are seen in the lighter, upper part of the plume, I suggest it would be more relevant to compare kappa_hor in that part of the plume, which may not coincide with the bottom layer. Or perhaps you might average kappa_hor over the whole plume thickness (as defined by the tracer), in addition to showing the bottom values.

5. Section 4.1 The "AnSlope" hypothesis.

Rather than referring to the "AnSlope" hypothesis, I would prefer to see this hypothesis spelled out in physical terms. Perhaps "tidal-augmentation of downslope dense water transport"?

6. Discussion in section 4.1, p707 in my copy

I found some of this discussion a bit confusing. Can you quantify how much shear-dispersion applies to your scenario (i.e. through the lateral spreading of the tracer)? The discussion of unresolved processes did not seem very relevant to me - in your simulations, it is the velocity gradients, rather than transient eddies or turbulence, which are generating the higher kappa_hor values.

7. Interaction with coastal current, last paragraph of section 4.1

In the absence of tides, isn't part of the reason for the dense plume not being mixed into the coastal current due to the difference in density? The plume dives under the current mostly because of its greater density, rather than because it is "narrower and thinner".

Interactive comment on Ocean Sci. Discuss., 10, 691, 2013.