

Interactive comment on “Exchange across the shelf break at high southern latitudes” by J. M. Klinck and M. S. Dinniman

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We would like to thank the reviewer for helpful comments.

Specific Comments:

The steady transport in the bottom Ekman layer is to the right of the overlying flow in the Southern Hemisphere. Even though the mean flow in many areas is such that Ekman transport would be off the shelf, variability can lead to flow reversals which could have the opposite transport. This now raises the issue of sufficient time for the boundary layer transport to become established which leads us even further afield. It seems unlikely that the bottom frictional layer will be a major player in exchange across the shelf break. We have updated the text to emphasize that although this argument rules

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out Ekman flow in the bottom layer as an important forcing mechanism for CDW inflow when the mean slope flow is westward, it does not rule out CDW inflow in general when the slope flow is westward.

The magnitude of the shelf break exchange depends no doubt on the interplay between flow speed and bathymetric curvature. We have looked in detail at recent simulations on the west Antarctic Peninsula shelf to find a speed effect on the exchange in the vicinity of Marguerite Trough. Faster speed gives rise to more onshore flux due to a separation of the flow from the topography and a more direct "impact" of the flow against the side of a nearby bank. So this inertia-topographic mechanism is not robust, but depends on the careful alignment of quite a number of details.

Changes in the flow of the ACC along the South Shetland Islands (southern Drake Passage) are likely to have an interesting effect on the westward motion of water from the Weddell Sea. The effect of the eastward ACC in this area is to push Weddell Sea waters eastward (creating the Bransfield-Scotia Confluence). I would guess that there would need to be a significant reduction in flow speed along the shelf break, or a northward shift of the ACC, to allow the outflow near the surface to progress westward along the Peninsula shelf, but I am not aware of any analysis of this issue.

We agree that discussion of the effects of tides are lacking in the manuscript. In some areas, such at the western Ross Sea shelf break (as shown by the AnSlope observations), tides seem to play a role in regulating the export of dense water by moving the shelf break front. Tidal flow is also seen to play a role in basal melt of glaciers which influences the properties of water on the continental shelf. We have added comments to Section 2 (Overview of Antarctic Shelves) to mention these important effects of tides on these high latitude areas. It is beyond the scope of the current manuscript to delve too deeply into the effects of tides. This issue is clearly a topic for future research.

Technical Comments:

"exchange" in the title: We understand the point being raised. However, lacking any

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suitable replacement, we have kept the word in the title.

bumpy or irregular shelf break: We have rewritten this sentence to emphasize that we are referring to corrugations of the topography near the shelf break.

density units: CDW is defined by σ_o being the potential density in kg/m^3 (minus 1000) relative to the surface. We have modified the text to make this clear.

buoyancy forced: The dense water is created by buoyancy exchange with the atmosphere. We have changed this sentence to make that clearer.

flanks of depressions: Flow on the Antarctic continental shelves is typically along the flanks of the trough/bank bathymetry. We have changed the text to make that point clearer.

cross shelf exchange with more frequent eddies or different character? We are not sure where this comment fits in the manuscript. It is an interesting question of the relative importance of eddies and the character of the water at the shelf break. There are a number of subtle issues here which do not yield to simple theoretical analysis. We are not sure which of the two effect is more important. We have modified the text in Section 6.3 to mention this issue but we will not be able to provide any insight on its resolution.

Interactive comment on Ocean Sci. Discuss., 7, 143, 2010.

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