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Ocean Science
Discussions

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

Anonymous Referee #1

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General Comments This manuscript presents an updated overview of the processes most likely to account for the observed onshore contribution of volume, heat and salt across the Antarctic shelf break. It provides a succinct introduction of the peculiarities of the Antarctic shelf and local processes, followed with original discussions on specific mechanisms for cross-slope transport. In particular it demonstrates that along-slope current instabilities and their interaction with irregular underlying topography constitute the most effective forcing for the observed oceanic inflow across the Antarctic slope. A revealing, and likely controversial, conclusion is that key processes in other marginal areas, like the wind driven upwelled inflows and those within the frictional bottom Ekman layer, play relatively minor roles in the Antarctic upslope transport.

The relevance of how Circumpolar Deep Water (CDW) is recycled within the Antarctic

shelf is definitively global and climate related. Localized water mass transformations exert important influences to the regional productivity, freshwater budgets, sea level, and variability in the strength of the meridional overturning circulation. Thus improved understanding of how the parent oceanic waters cross the shelf break is fundamental, and that is the core subject addressed in this paper.

Specific Comments Basically the authors argue that only where there is eastward flow over the upper continental slope can the frictional bottom layer drive waters toward the shelf. This argument might rule out the observed funneling of CDW inflows at specific locations where the slope flow is westward, but it also seems to explain the broader proclivity of most of the Antarctic margins to extrude cold slope waters to the deep ocean.

The discussion of inertial driven inflow of CDW notes the likelihood of threshold speeds for currents found near the shelf break. Since CDW doesn't seem to flood all of the offshore protrusions or bends in the shelf break, there might also be a threshold curvature at play. Also the two-step process might not be strong enough to elevate the CDW pass the shelf break where it is found intersecting the mid slope.

Section 3.3 mostly relates to changes in isopycnal tilt due to increase in thermal wind.

It seems to me that a small northward shift of the poleward boundary of the ACC at Drake Passage would lift the bounding isopycnal of shoaling Pacific CDW, but it might also allow for more westward flow of Scotia slope waters available to mix with before crossing the shelf break.

It is curious to note that the effects of tidal circulation and the suspect enhanced vertical mixing at some locations near the shelf break are not included explicitly in the discussions.

Technical Corrections Exchange in the title might be misleading, as the paper does not dwell on the balancing offshore transport across the shelf break.

page 150, line 20) Bumpy or irregular shelf break, if referred to protrusions?

page 152, line 6) density or potential density relative to sea surface? Units are missing.

page 154, line 11) Atmospherically or buoyancy forced?

page 154, line 11) Are these “locations” specifically the eastern and western f;anls of shelf depressions?

Page 162, line 17) Would cross-slope exchange increase in response to more frequent eddies appearing near the shelf break, or would waters with different characteristics would be exchanged at a similar net rate?

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