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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 #2

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Overview

Exchange of seawater across the Antarctic continental margins controls two processes that are of global interest: the southern branch of the global meridional overturning ocean circulation (MOC), and global sea-level rise through sub-glacial melting of ice shelves. This nicely written paper concisely presents the physical mechanisms that control exchange across the shelf break surrounding Antarctica. First, a brief overview is presented of physical oceanographic conditions that typify the Antarctic shelves. This overview includes brief assessments of the impact on dynamics of regional features such as weak vertical water column stratification, rugged bottom topography, and locally strong winds coupled with low air temperatures. Following this overview, dynamics for each of several mechanisms that control cross-shelf exchange are briefly

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described and literature references provided.

The process summaries are followed up by a detailed example derived from the results of a regional ocean circulation model of the Ross Sea, one of a small number of regions responsible for formation of Antarctic Bottom Water (ABW) and subsequent forcing of the MOC. Reasons for the choice of model and its resolution are presented, and basic parameterizations such as those used to compute bottom drag are given. Modeled temperature and salinity fields, supplemented by the evolving distributions of an artificial dye tracer, are shown to be consistent with conditions derived from a recently compiled regional oceanic climatology. The results confirm importance to cross-shelf exchange of weak vertical stratification, rugged bottom topography, and strong local and regional winds. These results also support the necessity for numerical models of this region to utilize grid sizes no great, and preferably less than, the local internal deformation radius.

Overall, this paper provides a well-written and complete introduction to, and summary of, those processes that dominate cross-shelf exchange around the Antarctic continental margins.

Technical points

Recent and ongoing work has focused on the impacts of locally strong tides and submesoscale bottom topographic features on exchange of water across the shelf break. The Ross and southwest Weddell seas, both primary sites for ABW formation, are impacted by strong tidal currents. These have been shown in the Ross Sea to significantly impact both cross-shelf exchange and diapycnal mixing. Similarly, submesoscale down-slope channels or corrugations can enhance down-slope transports of dense bottom waters. Marking the omission of these processes from this paper is not intended as a criticism. It serves, rather, as a reminder that sub-grid scale processes can in many cases be significant and that the community needs to continue to work toward workable methods for their inclusion in models.

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