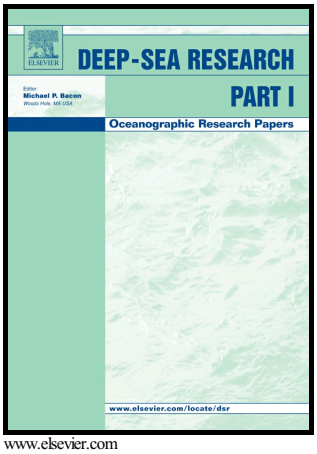

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Circulation and water mass transports on the East Antarctic shelf in the Mertz Glacier region

Antoine Martin[a,*], Marie-Noëlle Houssais[a], Hervé Le Goff[a], Claudie Marec[b], Denis Dausse[a]

[a] *Sorbonne Universités (UPMC, Univ Paris-06)-CNRS-IRD-MNHN, LOCEAN laboratory, 4 place Jussieu, F-75005 Paris, France*

[b] *Laboratoire d'Océanographie Physique et Spatiale, IFREMER- Centre de Brest, CS 10070, 29280 Plouzané, France*

Abstract

The East Antarctic shelf off Adélie-George V Land is known to be an important region for Dense Shelf Water (DSW) formation as a result of intense sea ice production in the Mertz Glacier Polynya during the winter season. It is also a region where the warm modified Circumpolar Deep Water (mCDW) penetrates onto the shelf during the summer. Using hydrographic observations from a summer survey in 2008 we implement a box inverse model to propose a comprehensive view of the steady state circulation on this shelf in summer. Additional information from mooring observations collected on the depression slope is used to provide context to the retrieved circulation scheme. Over the depression slope, the summer baroclinic structure of the currents is found to contrast with the almost barotropic structure in winter.

The summer circulation is strongly constrained by the DSW distribution and forms a clockwise circulation primarily transporting the fresh surface waters and the warm mCDW around the dome of DSW. Over the upper flank of the Mertz Bank, the inflow branch transports the mCDW towards the Mertz Glacier, while, over the lower part of the slope, the outflow branch returns to the sill a diluted mode of the same water mass. A total of 0.19 Sv of mCDW inflows at the sill and two-third reach the Mertz Glacier and recirculate in front of it, allowing the mCDW to penetrate into the deeper part of the depression. Possible scenarios of interaction between the mCDW and the DSW with the glacier are examined. It is shown that, despite the water mass pathways and transports suggest possible ice-ocean interaction, both lateral and basal melting were likely small in summer 2008. Finally, our results suggest that, in addition to bathymetric features, the distribution of the residual DSW which is left from the preceding winter sets up regional pressure gradients which provide a seasonal control on the shelf circulation. In particular, the spring collapse of the convective patch would contribute to setting up a deep pycnocline which strongly impacts the shelf circulation in the following summer, with possible feedback of the mCDW transports on the polynya activity and water mass formation.

Keywords: Antarctica, continental shelf, modified Circumpolar Deep Water, heat transport, freshwater transport, Adélie Georges V Land

1. Introduction

As a region of intense transformation of ocean water masses and strong interaction with the Antarctic ice sheet, the Antarctic shelf is recognized as a region of upmost importance for the ocean and Earth climate. Saline, dense shelf waters (DSW) formed in the coastal polynyas around the Antarctic continent (*Zwally et al.*, 1985; *Cavalieri and Martin*, 1985) are considered instrumental to the formation of the Antarctic Bottom Water (AABW), the densest water mass of the world ocean (*Jacobs et al.*, 1970; *Gordon*, 1971; *Gill*, 1973; *Orsi et al.*, 1999). As such, the AABW properties are largely controlled by the formation, transport and mixing processes occurring on the Antarctic shelf. Shelf ocean processes also play a crucial role in the evolution of the Antarctic ice sheet (*Jacobs et al.*, 1996; *Rignot*, 2002). Heat supplied by the shelf waters to the underside of the floating glaciers and ice shelves is thought to exert an important control on the current evolution of the mass balance of the ice sheet (*Pritchard et al.*,

*Corresponding author: antoine_martin@orange.fr