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Quantifying Antarctic deep waters in SODA reanalysis product

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ABSTRACT

The Antarctic intermediate and deep water masses present in the Atlantic sector of the Southern Ocean were quantified through the inverse method known as Optimum Multiparameter (OMP) analysis. The method was applied to the Simple Ocean Data Assimilation (SODA) product, which assimilates real observed ocean data into a hydrodynamic model. Results here show that the SODA dataset is able to capture reasonably well the intermediate and deep water mass (i.e. Warm Deep Water, Weddell Sea Deep Water, Weddell Sea Bottom Water, and Circumpolar Deep Water) regional distribution and contribution to the total mixture in the Weddell Sea and Weddell-Scotia Confluence. Those regions are, respectively, the main Antarctic Bottom Water source and export areas to the global ocean. We infer some aspects of the ocean circulation from the water mass distribution obtained. However, some efforts are still needed to better represent the deep salinity in these areas. The weak representation of this hydrographic parameter could be associated with the model's lack of important cryospheric processes directly involved with bottom water formation.

Key words: water masses, OMP analysis, Data Assimilation, Weddell Sea, Weddell-Scotia Confluence.

INTRODUCTION

Recent studies have drawn attention to the need for more realistic representation of both oceanic processes and their interactions with the cryosphere (Timmermann et al. 2002, Russell et al. 2006, Goes et al. 2008, Kerr et al. 2009a). These are important to identify and understand key questions related to ocean variability and climate changes. The numerical modeling significantly aids observational oceanography because of the lack of both temporal gaps and poorly uncovered regions normally present in observed hydrographic datasets. However, model results need to be extensively assessed and compared with observational data in order to assess their good representation of the oceanic processes and ocean characteristics. Moving towards this objective, several projects such as the Global Ocean Data Assimilation Experiment (GODAE), the Simple Ocean Data Assimilation (SODA), the National Centers for Environmental Prediction (NCEP) Global Ocean Data Assimilation System (GODAS) and others aim to assimilate observed data such as satellite measurements and hydrographic *in situ* data into geophysical numerical models. The objective of this procedure is to improve the numerical representation of the oceanographic parameters and processes in order to obtain a more realistic ocean.

Despite many efforts among all the world's oceans, the Southern Ocean is still not well rep-

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resented in some ocean and climate models due to the lack of measurements and/or poor parameterizations of important interactions of coupled ocean-atmosphere-cryosphere (e.g. ocean mixing, sea ice, ice shelves) processes (Russell et al. 2006, Kerr et al. 2009a, Renner et al. 2009). These coupled processes are responsible for the production of different water masses that spread throughout the global ocean at intermediate and deep levels. The deep ocean representation in many of these complex geophysical models is even not ideal, especially around the Antarctic continent. It is worth remembering that deep water mass formation is a process of significant importance. For example, deep and bottom water masses formed around the Antarctic shelf-slope margins are excellent indicators of changes in climate (e.g. Leffanue and Tomczak 2004).

Several regional dense bottom waters are formed around the Antarctic continental margins (Gordon 1974), particularly near the coastal areas of the Weddell and Ross Seas, and Adelie Coast (Jacobs et al. 1970, Gill 1973, Orsi et al. 1999, Bindoff et al. 2000). During their outflow from source areas, those water masses mix with the overlying intermediate and deep waters and become known as Antarctic Bottom Water (AABW). The Weddell Sea is a region that contributes more significantly than the rest of the Antarctic regional seas to AABW formation and export (Carmack 1977, Orsi et al. 1999). The AABW then spreads into the global ocean occupying the bottom layers near the floor of all oceanic basins. This water mass is part of the deep circulation cores of the meridional overturning cells (Gordon et al. 2001, Rahmstorf 2003). Any changes occurring during its formation can reflect into the global circulation via the overturning cell.

It is essential to identify how the reanalysis products are representing the AABW properties and dynamics in key source regions. The Antarctic deep ocean representation in reanalysis products is poorly known although changes in AABW production rates directly impact the global ocean conveyor belt. This study aims to characterize the deep waters in the Atlantic sector of the Southern Ocean (Weddell Sea and Weddell-Scotia Confluence region; Fig. 1) using the SODA reanalysis product and a water mass mixing inverse approach in order to investigate how well this product represents the real ocean in our study region. The regional oceanography of the study region and the details about the data and methodology used here are presented in the next sections of this paper.

WEDDELL SEA AND WEDDELL-SCOTIA CONFLUENCE HYDROGRAPHY

This study focuses in the Atlantic sector of the Southern Ocean, which includes the areas of the Weddell Sea and Weddell-Scotia Confluence. Four meridional sections were chosen to be analyzed at 0°, 20°, 30°, and 40°W starting from 55°S to 70°S at the Greenwich Meridian section and extending to ∼75°S in the other sections (Fig. 1). The meridional sections at 30°W and 40°W include the zone of the Weddell-Scotia Confluence north of 60°S. The Filchner-Ronne Ice Shelf region that closes the Weddell Sea to the south is not included in the sections. The sections were selected because they are expected to allow the detection and the tracking of the water masses distributed around the Weddell Gyre and their outflow into Weddell-Scotia Confluence region.

The Weddell-Scotia Confluence is the zone separating the waters of the Weddell Sea from those of the Scotia Sea (Patterson and Sievers 1980). It extends from the northern end of the Antarctic Peninsula (AP) to 22°W (Orsi et al. 1993; Fig. 1). This zone is composed by water masses that circulate within the Antarctic Circumpolar Current (ACC) and arrive from the northern limb of the Weddell Gyre. The main contribution from the ACC in the Weddell-Scotia Confluence is the Circumpolar Deep Water (CDW). CDW is denser at the north of the Weddell-Scotia Confluence. Meridional density differences are associated with the warmest and coldest temperature maxima of CDW (Whitworth et al. 1998). For instance, over the

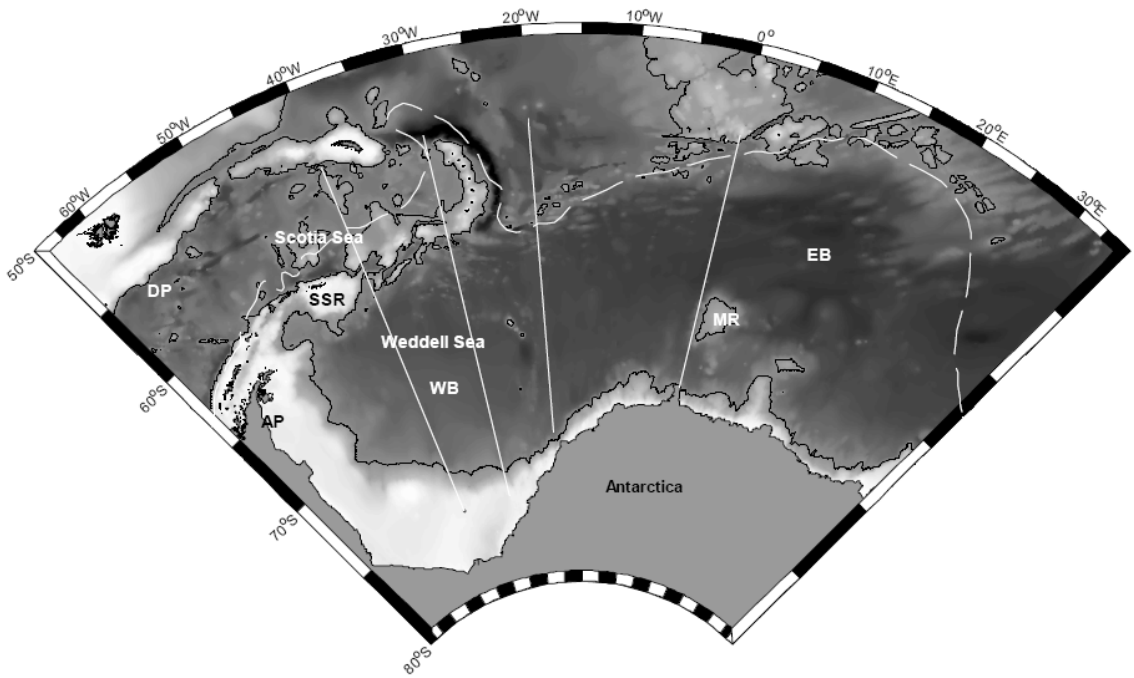

Fig. 1 – Study area in the Weddell Sea (WS) and Weddell-Scotia Confluence region. The thicker white lines show the repeat hydrographic sections selected to run OMP. The dashed white line shows de Southern Boundary of the ACC (as in Orsi et al. 1995). The black line shows the 3000m isobaths. Antarctic Peninsula (AP), Drake Passage (DP), Enderby Basin (EB), Maud Rise (MR), South Scotia Ridge (SSR), Weddell Basin (WB).

South Scotia Ridge (SSR; Fig. 1), the density range of denser CDW is occupied by the Warm Deep Water (WDW). This water mass is distinguishable in this area by its reduced potential temperature (0.2°C $< \theta <$ 0.6°C) and salinity (S $<$ 34.69) (Naveira Garabato et al. 2002). The Weddell Sea is an export region for both the WDW and the Weddell Sea Deep Water (WSDW). The last is the denser water mass found in Weddell-Scotia Confluence region (Naveira Garabato et al. 2002, Meredith et al. 2008).

Considering the Weddell Sea region, the following deep water masses can be identified in the observed potential temperature/salinity (θ/S) diagram obtained from the hydrographic stations available in the World Ocean Database 2005 (Boyer et al. 2006; Fig. 2). WDW (0° $< \theta <$ 1°C and 34.6 $<$ S $<$ 34.75) is found occupying the intermediate water layer between 200 m and 1000 m. This water mass is formed from the CDW that circulates within the ACC around the continent entering in Weddell Gyre near 20° − 30°E (Gouretsky and Danilov 1993). During CDW's trajectory towards the west, mixing with surface and shelf waters occurs. CDW advection into the Weddell Gyre results in a WDW relatively cooler and fresher than its source water (Gordon 1982).

The Weddell Sea deep water column structure is filled with WSDW (–0.7° $< \theta <$ 0°C and 34.62 $<$ S $<$ 34.68) and Weddell Sea Bottom Water (WSBW; $\theta <$ –0.7°C and 34.62 $<$ S $<$ 34.68). WSBW is produced by distinct water mass interactions at the southern and southwestern continental margins of the Weddell Sea (Carmack and Foster 1975, Foster and Carmack 1977). In the southwestern continental shelf-slope regions mixing occurs between High Salinity Shelf Water (HSSW; formed by brine rejection during sea ice production), WDW and Winter Water (a remnant of the surface mixed layer) to produce WSBW (Foster

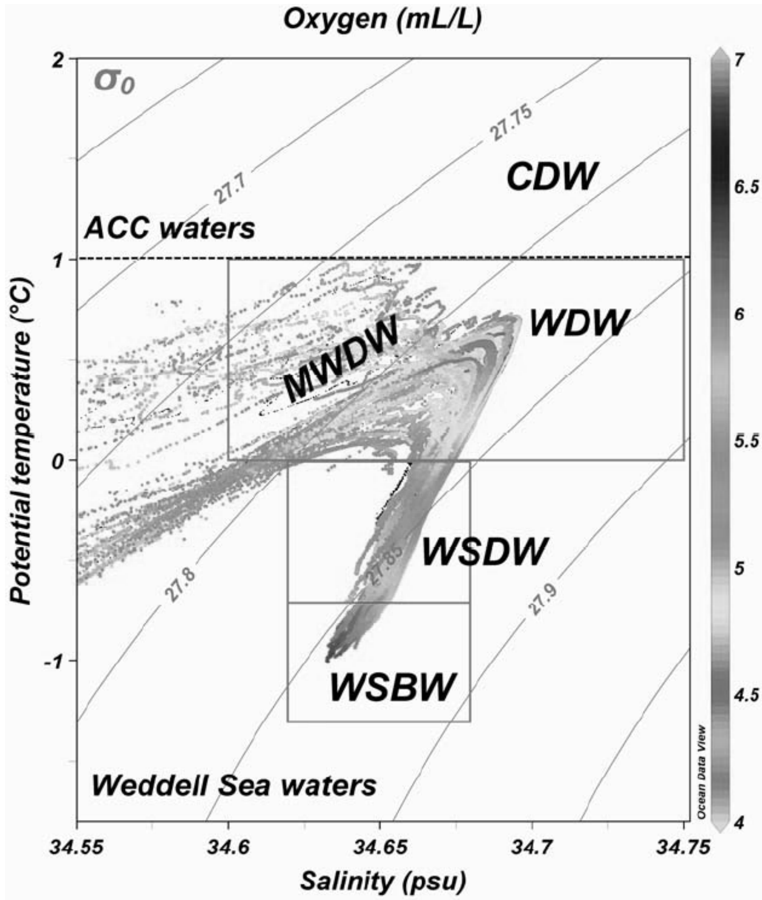

Fig. 2 – World Ocean Database 2005 potential temperature-salinity-dissolved oxygen diagram for Weddell Sea deep water masses below 200 m of depth. The straight lines show potential density (σ_θ) surfaces and the dashed line marks the limit between Weddell Sea and Antarctic Circumpolar Current (ACC) deep waters. Water mass limits (rectangles) of Weddell Sea and ACC regions are based on Robertson et al. (2002) property definitions.

and Carmack 1976). In the southern regions, mixing between Ice Shelf Water (ISW; a modified form of HSSW due to its interactions with ice shelves cavities) and WDW or modified-WDW (MWDW; a mixture between WDW and surface waters) occurs near the continental margins around the Filchner-Ronne Ice Shelves (Foldvik et al. 1985). Recently, Huhn et al. (2008) and Absy et al. (2008) reported evidence agreeing with previous studies that the western Weddell Sea is also a region of WSBW production, with a glacial water mass contribution supplied by shelf water interactions with the Larsen Ice Shelf located in the eastern Antarctic Peninsula.

WSDW and WSBW are distinguished by different source water types and age. The bottom is younger than the deep water. High dissolved oxygen concentrations reported for WSBW (Fig. 2) indicate that this water mass was recently present at the ocean-atmosphere interface. WSDW is a mixing product of WDW and/or MWDW with recent WSBW, thus acquiring physical characteristics that make it less dense than WSBW. The direct formation of WSDW is possible, but it depends on the source water masses properties that can produce a water mass that is not dense enough to reach the deep ocean floor (Orsi et al. 1993, Weppernig et al. 1996). As WSDW is less dense than WSBW, the direct outflow into the Weddell-Scotia Confluence region is facilitated through the deep passages of the South Scotia Ridge (Locarnini et al. 1993, Fahrbach et al. 1995, Orsi et al. 1999). On the other hand, as WSBW is denser than WSDW, it is confined in the Weddell Basin and recirculates along with the Weddell Gyre, leaving the region only if it mixes with WSDW above or at some particular deep trenches of the South Scotia Ridge (Fahrbach et al. 1995, Orsi et al. 1999).

OPTIMUM MULTIPARAMETER ANALYSIS

The inverse method for water mass analysis called the Optimum Multiparameter analysis (OMP; Tomczak 1981, Tomczak and Large 1989) was applied in this study to investigate how well the SODA product represents the real Antarctic deep water masses. The OMP technique is used to determinate the relative contribution of each selected water type to a particular water sample by solving an over-determined system of linear equations for water mass mixing. The technique uses several conservative and semi-conservative parameters such as potential temperature, salinity, dissolved oxygen, nutrients, and others water mass tracers as fully described by Tomczak and Large (1989) and Karstensen and Tomczak (1998). Several studies have already applied this inverse modeling technique in different regions around the world to identify one or all of the following aspects: fractions of mixture, water mass variability and distribution, and numerical model performance (Karstensen and Tomczak 1997, 1998, Leffanue and Tomczak 2004, Kerr et al. 2009a, b). Here, the method was applied to fingerprint the distribution of the selected water masses in the deep water column simulated by the SODA reanalysis data. In addition, some aspects related to water mass pathways could be inferred through their distribution.

We follow Kerr et al. (2009a) to determine a water type index based on the idea of using the most pure water type adjusted for each specific dataset to represent the water masses. Briefly, if we aim to distinguish the water mass by its spatial distribution and relative contribution to the total mixture, a water type index is needed to represent the hydrographic characteristics of the chosen water mass. In this study we used the potential temperature (θ) and salinity (S) as the tracing parameters. This approach restricted to three the number of water masses considered in the analysis. Thus, we could not differentiate between waters from Weddell Sea and Weddell-Scotia Confluence. However, remembering that most of the sections analyzed here are located in the Weddell Sea as the source of the waters exported into the Weddell-Scotia Confluence, the following three water masses were analyzed here: (i) WDW, (ii) WSDW and, (iii) WSBW. Depth intervals for each water mass (Table I) to calculate the water type indices are defined based on current literature and Kerr (2006). After that, the θ and S mean values were estimated inside the Weddell Sea at each considered depth interval from the SODA data and used to represent the water type indices applied here (Table I).

As highlighted by Kerr et al. (2009b), resolving water masses within a small range of parameter values depends on correct weighting of the parameters (J. Karstensen personal communication). Thus, as our interest is only on deep water mass representation, we restricted the OMP analysis to the deep ocean below 500 m, which encloses the cores of the main deep waters in the study region and reduces the errors associated with mixture of surface waters. All hydrographical parameters are weighted in the system, which means that the parameters with higher weight (here potential temperature) are more influencing the determination of water type final contribution. Two physical restrictions are imposed: (i) the water type contribution cannot be negative and (ii) the mass conservation must be preserved, which means that the sum of all water types' contribution must account to 100% – in this case the maximum weight found between all parameters used is allocated as the mass conservation weight. Here, the parameter weights applied for each parameter to gauge the system were ob-

TABLE I
Water types and parameter weights used as OMP inputs.

Water Mass	Depth range (m)	θ(°C)	Salinity
Warm Deep Water (WDW)	500–1000	0.4	34.674
Weddell Sea Deep Water (WSDW)	1500–3500	–0.3	34.672
Weddell Sea Bottom Water (WSBW)	>4000	–0.9	34.661
	Parameter weight	2.7	0.1

tained through the variance of both the water types selected and the SODA data used to determine the water types (Table I; see for details Tomczak and Large 1989).

THE SODA DATASET

The SODA product provides an estimate of the evolving physical state of the ocean (Carton and Giese 2008). The dataset obtained from the SODA reanalysis represents a considerable improvement when compared with the existing hydrographic observations or even available numerical simulations in the analysis and diagnosis of ocean processes, in particular those related to water mass mixing and variability. The first version of the SODA reanalysis product (SODA version 1.2) was introduced by Carton et al. (2000a). The authors used the Geophysical Fluid Dynamics Laboratory (GFDL) Modular Ocean Model (MOM) v2.2 forced with observed surface winds from the Comprehensive Ocean-Atmosphere Data Set (COADS) and NCEP. The assimilation of the observed data comes from a variety of historical datasets (see Carton et al. 2000a, b). Following those studies, a methodology for bias correction was introduced by Chepurin et al. (2004). This older version of SODA had some disadvantages like poor spatial resolution both on horizontal ($0.5° \times 2.5°$ latitude/longitude resolution in the tropics) and vertical (20 levels only). This could result in some bias of the SODA data with respect to the reanalysis data.

The SODA product used here combines the Parallel Ocean Program (POP) model (Smith et al. 1992) with method of sequential estimation for data assimilation (Carton et al. 2000a, Carton and Giese 2008). The model has a vertical resolution of 40 levels and a horizontal resolution of $0.25° \times 0.4°$ latitude/longitude. SODA version 1.4.2 spans from 1958 to 2001. It is forced by European Center for Medium-Range Weather Forecasts (ECMWF) atmospheric reanalysis (ERA-40) wind stresses and assimilates all available data from hydrographic stations, expandable bathythermographs (XBTs) and floats. Freshwater fluxes are determined from precipitation data of the Global Precipitation Climatology Project (available since 1979) and evaporation is calculated from bulk formulae. The surface heat flux is also calculated using bulk formulae. This study used the climatology average of SODA version 1.4.2 (hereafter referred to as SODA). A complete overview of the SODA reanalysis methodology is detailed by Carton and Giese (2008).

ANTARCTIC DEEP WATER MASSES REPRESENTATION

The OMP results obtained with SODA data show a good agreement between the water mass spatial distribution and the water mass neutral density surfaces (γ^n; Jackett and McDougall 1997). Following Orsi et al. (1999) and in agreement with Franco et al. (2007) and Meredith et al. (2008) that have studied, respectively, the northwestern Weddell Sea and the Weddell-Scotia Confluence area, the separation between WDW and WSDW occurs at $\gamma^n = 28.26$ kg.m^{-3}, while the isopycnal of 28.40 kg.m^{-3} separates WSDW and WSBW. Franco et al. (2007) used $\gamma^n = 28.10$ kg.m^{-3} to characterize the WDW layer and considered a $\gamma^n = 28$ kg.m^{-3} as the interface between Antarctic Surface Water and WDW. Thus, considering the above γ^n surfaces, the water mass core contribution (i.e. total water type's contribution varying between 70% and 100%) obtained

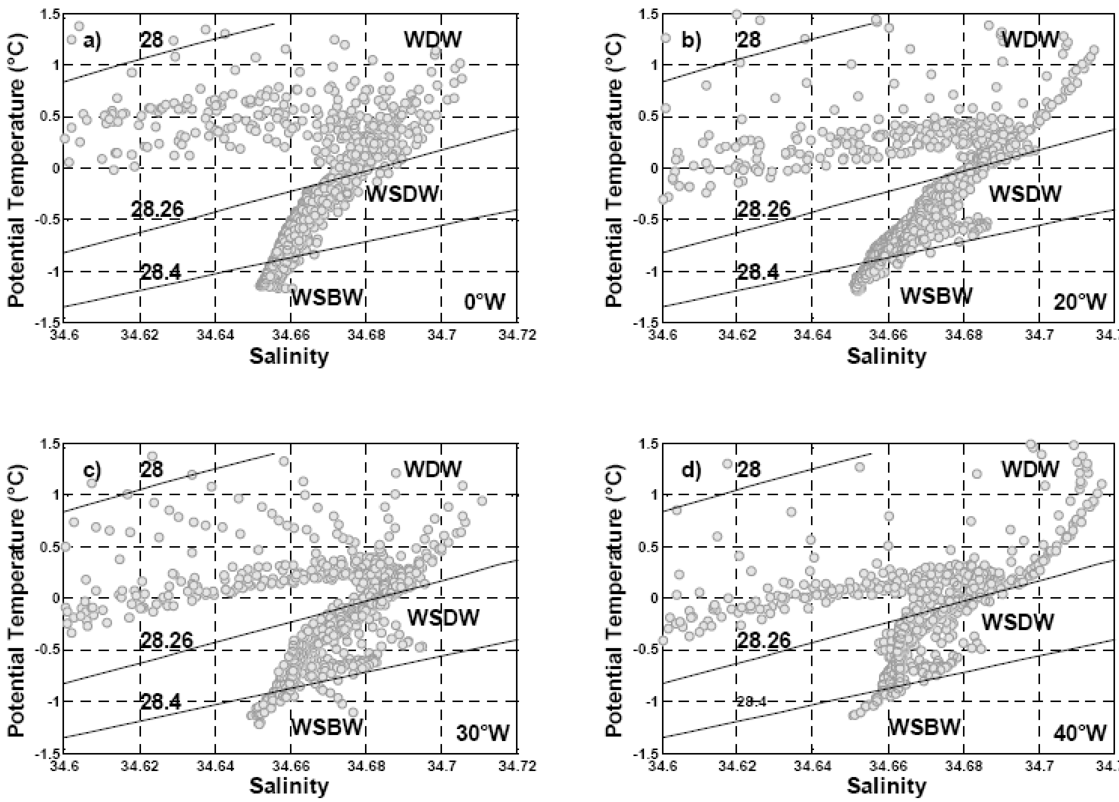

Fig. 3 – SODA potential temperature-salinity diagram for the meridional transects analyzed as indicated at the bottom of each box. Neutral density values of 28, 28.26, and 28.4 kg.m^{-3} were selected as AASW/WDW, WDW/WSDW and WSDW/WSBW interfaces, following Franco et al. (2007).

for all water masses is presented in the expected γ^n layers, which validates the OMP spatial distribution and expected core contribution for the water masses. Although the deep water masses that occur in the Weddell-Scotia Confluence region have differences in the thermohaline properties when compared with the water masses of the Weddell-Enderby Basins, the OMP application used here allowed a reasonable representation of the deep waters structure in this area. The distinction of all deep water masses represented by SODA was possible because all sections analyzed are representing well the deep water column structure. This allowed the prompt differentiation between the intermediate, deep and bottom layers (Fig. 3).

Moving towards the Weddell-Enderby Basins (latitudes higher than 60°S), high WDW contributions varying between 70-100% was found until approximately 1000 m (Fig. 4). This is consistent with the fact that the core of WDW $\theta_{\max}$ and $S_{\max}$ is found around 500 m and 800 m, respectively (Orsi et al. 1993, Muench and Gordon 1995, Meredith et al. 2008). Contribution of WDW is present until 2000 m. However, below the 1500 m depth, only 30-50% contributed owing to the mixing with upper WSDW (Fig. 4). As discussed before, in the Weddell-Scotia Confluence region a mixture of WDW and CDW occurs at intermediate levels. Thus, the WDW water type index has marked the mixture of WDW/CDW (hereafter referred to as CDW only) in the area due to its closer hydrographic properties. Hence, CDW is observed at deeper levels (until 3000 m) with contributions varying between 70-100% (Fig. 4). This is expected, as CDW is the main water mass within the ACC system occurring down to deeper levels. At the 40°W

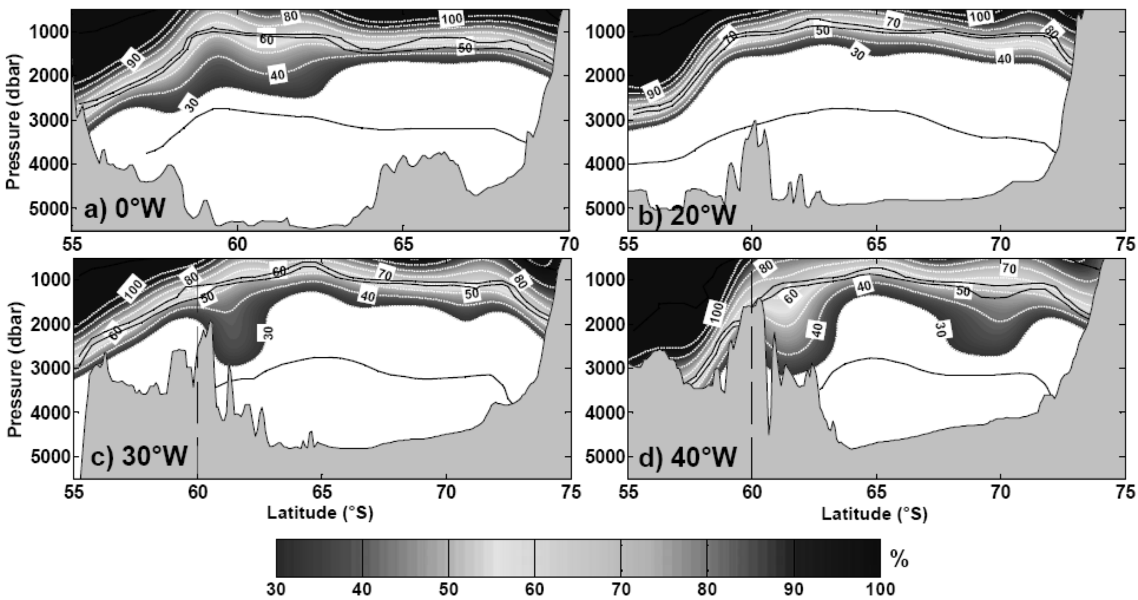

Fig. 4 – Warm Deep Water (WDW) contributions (%) at each meridional section analyzed as indicated by the annotations. Contour intervals are of 10% from 30% to 100%. The black lines indicate the neutral density (γ^n) isopycnals of 28.10, 28.26, 28.27, and 28.4 kg.m^{-3} for 0°, 20°W, 30°W, and 40°W, respectively. The dashed line shows the limit between the Scotia and Weddell Seas at 30°W and 40°W.

section, where the Southern Boundary of the ACC (or the poleward edge of the less dense fraction of CDW, as defined by Orsi et al. 1995) is displaced to the south (Fig. 1), the presence of CDW is observed to be more intense (with contribution between 90-100%) near the limit between the Weddell Sea and Scotia Sea waters (Fig. 4). The southward displacement of the Southern Boundary of the ACC is also observed at 20°W. The above results allow us to infer few aspects of the ocean circulation in the region. We analyzed the water mass distribution and percentage of contribution to the total mixture to find that: (a) WDW is noted to circulate at intermediate levels inside the Weddell-Enderby Basins (latitudes below 60°S); (b) CDW (here marked with a WDW index) is observed at deeper levels in the Weddell-Scotia Confluence region (latitudes between 55°S and 60°S) (Fig. 4).

Now is necessary to remember that the water type concept is an artificial construction of a water mass quantitative analysis and it does not occupy any volume in space (Tomczak 1999). Mathematically, the water masses are represented by the relationship between their hydrographic characteristics and their respective standard deviations, which reflects both the environmental variability and the precision of the instruments used in the data collection (Tomczak 1999; Poole and Tomczak 1999). Thus, some water masses with parameter indices close to each other can mark different water mass present in the area analyzed to respect the restriction of mass conservation in the mixing equations (Tomczak and Large 1989). This is the case of CDW being detected in our data by WDW water type outside the Weddell Sea.

Considering the deep layer, WSDW is present in the Weddell Sea with contribution higher than 50% between 1500-3500 m (Fig. 5). The WSDW water type index used here has probably been able only to mark the upper WSDW (less dense). As the lower WSDW has hydrographic properties similar to WSBW, the denser WSDW has probably contributed to the WSBW results. However, the WSDW clear identification in the water column

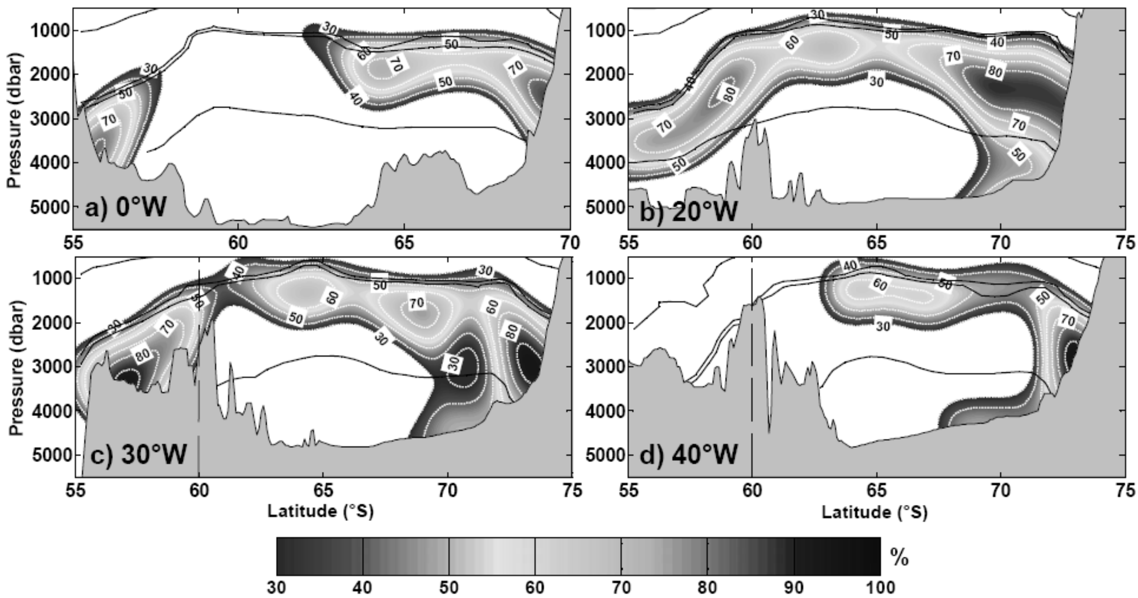

Fig. 5 – Same as Figure 4, but for Weddell Sea Deep Water (WSDW).

becomes difficult because it occurs over a wide depth range (around 3000 m) and has a relatively large temperature range (Kerr et al. 2009a), which may indicate that more than one water type should be used to mark this water mass in the whole water column (OMP2 2005).

Our results make possible to observe the exit of the upper WSDW into the Weddell-Scotia Confluence (section 30°W) and in surrounding areas. High WSDW contribution (>70%) is observed between 55°S and 60°S, flowing above the South Scotia Ridge and sinking in the water column at 20°W and 30°W until it finds and occupies its density level in the water column (Fig. 5). No WSDW outflow is noted at 40°W. At 0° in the Greenwich Meridian, the WSDW found at deeper levels is probably the dense form that does not escape from the Weddell Sea and is actually recirculating within the Weddell Gyre. This region is recognized as an area where permanent circulation patterns divide the Weddell Gyre in a double-cell structure below 1000 m (Beckmann et al. 1999). This implies that the Greenwich Meridian surroundings are more dynamically active around this depth (Kerr 2006). WSDW is an essential contribution to AABW, which will then spread to fill the abyssal layers of much of the global ocean.

The densest water mass found in our region is WSBW. As expected, it is confined inside the Weddell-Enderby Basins by the peculiar topography of the South Scotia Ridge. This water mass presents high contributions (>70%) below 3000 m (Fig. 6) at all meridional sections. However, contributions higher than 90% are only found below 3500-4000 m, which mark the expected WSBW layer (as marked by γ^n surfaces; Fig. 6) closer to the seabed. At 20°W the bathymetry allows the direct northward outflow of WSBW. However, as discussed above, the WSBW contributions lower than 70% are probably linked to a distinct and denser component of WSDW.

SUMMARY AND CONCLUSIONS

This study applied the OMP water masses analysis to the SODA product version 1.4.2 to verify how well the deep ocean around Antarctica is represented. The deep water mass structure and contribution to the total mixture in two regions of the Southern Ocean (the Weddell Sea and the Wed-

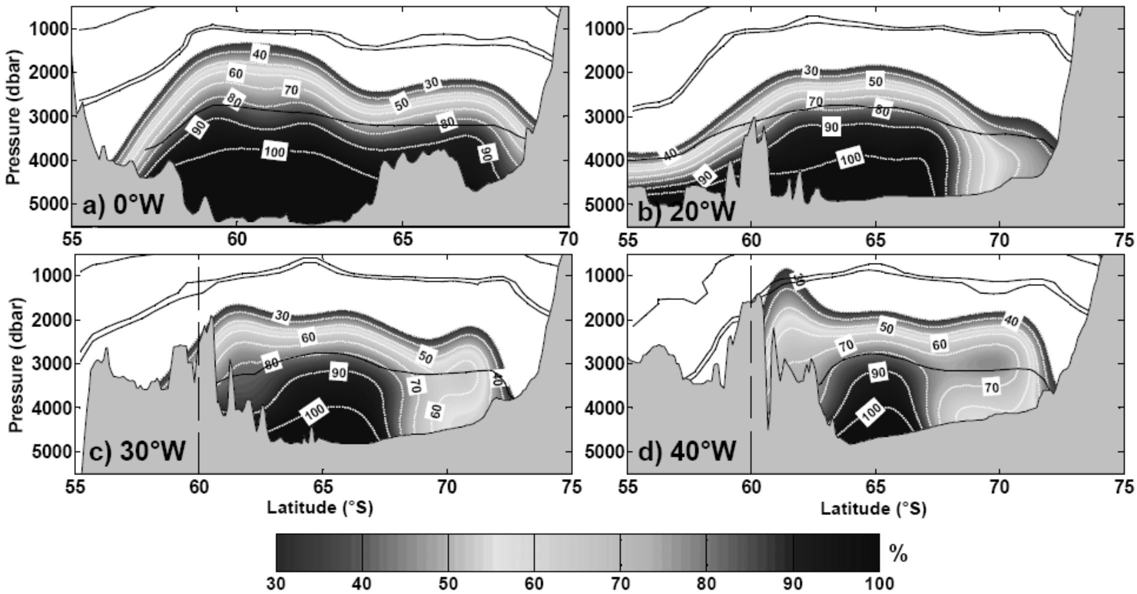

Fig. 6 – Same as Figure 4, but for Weddell Sea Bottom Water (WSBW).

dell-Scotia Confluence) was investigated using this technique. The deep water mass structure estimated from the SODA data is well represented in both regions when compared with the current literature. WDW was found occupying the intermediate layer of the Weddell Sea in depths down to 1000-1500 m. Additionally, it was possible to distinguish the CDW and also its mixing with WDW at the Weddell-Scotia Confluence region using a WDW water type index. Results show a significant presence of WDW/CDW mixture reaching depths deeper than 1500 m. WSDW was found at deep levels between 1500-3500 m. An outflow of its upper form from the Weddell Sea is well noted at sections 20°W and 30°W. The WSBW was found above the seabed with contributions higher than 90% below 4000 m depths constrained within the Weddell Gyre.

In addition, a mention is needed to highlight the recent observational efforts conducted in the Weddell Sea to increase the knowledge of this remote area and to decrease the regions scarcely sampled. Agreeing with previous work (e.g. Orsi et al. 1993, Gordon et al. 2001), Huhn et al. (2008) and Absy et al. (2008) provided more detailed information about the regional differences of the water mass physical properties within the Weddell Sea water column structure. Those and other new datasets will probably contribute in a near future to a better representation of the real oceans through reanalysis products.

In spite of the good results obtained with the SODA assimilation product in representing the deep ocean around Antarctica, more effort is needed to address the deep and bottom salinity representation. This was also highlighted by the Climate Variability and Predictability (CLIVAR) Salinity Working Group (2007). Furthermore, as reported by Dee et al. (2005), all data assimilation systems are affected by systematic errors associated with: (i) problems with the input data, (ii) approximations relative to the *in situ* observations, (iii) limitations of the assimilating models and, (iv) the assimilation methodology. As a limitation of this work, the water mass distribution presented here could be affected by one or more errors pointed out by Dee et al. (2005). The results obtained here were also somewhat dependent on our choices of water masses, water types and weights of the seawater properties used in the analysis. Despite the uncertainties and limitations of the assimilation process and methodology used, this type of study is definitively valid and necessary because it provides useful information both for modelers and observational scientists. In addition, we encourage analyses expanding to other reanalysis datasets. Thus, performing a comparative study will be updating the scientific community about the performance of the reanalysis product in both Southern Ocean and deep water column structure. Hence, the efforts could detect where the assimilation processes is probably failing to represent important oceanic areas with climate impact.

Finally, this work contributes with the efforts of the Brazilian High Latitudes Group (GOAL) through the International Polar Year (IPY) project entitled: Southern Ocean Studies for Understanding Global-Climate Issues (SOS-CLIMATE) – towards a better understanding of the Southern Ocean processes and climate linkages. SOS-CLIMATE project has projected the Brazilian Antarctic activities into an international scenario through collaboration with several IPY cluster projects, which strengthened the actions of the Brazilian Antarctic Program (PROANTAR) during the legacy of the IPY.

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RESUMO

As massas de água intermediárias e profundas presentes no setor Atlântico do Oceano Austral (Antártica) foram quantificadas utilizando-se o método conhecido como Análise Otimizada de Parâmetros Múltiplos (OMP). O método foi aplicado nos registros obtidos com a assimilação de dados reais observados nos oceanos em um modelo hidrodinâmico denominado *Simple Ocean Data Assimilation* (SODA). Os resultados mostram que os processos de assimilação do banco de dados SODA estão desempenhando um bom papel na representação regional da distribuição e contribuição para a mistura total das seguintes massas de água, presentes no mar de Weddell e na Confluência Weddell-Scotia: Água Cálida Profunda, Água Profunda do Mar de Weddell, Água de Fundo do Mar de Weddell e Água Circumpolar Profunda. Estas regiões são, respectivamente, as principais áreas de formação e exportação da Água Antártica de Fundo para os oceanos globais. Através da distribuição destas massas de água pode-se inferir alguns aspectos da circulação oceânica na região. Entretanto, esforços ainda são necessários para uma melhor representação da salinidade das águas de fundo na região. A fraca representação deste parâmetro pode estar associada à ausência de consideração de importantes processos relacionados à criosfera e diretamente envolvidos na formação das águas de fundo.

Palavras-chave: massa de água, Análise Otimizada com Parâmetros Múltiplos (OMP), assimilação de dados, Mar de Weddell, Confluência Weddel Scotia.

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