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Antarctic Bottom Water changes during the last fifty years

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Recent studies have reported significant regional climate changes around the Antarctic continent. The production and export of dense Antarctic Bottom Water (AABW) is an important factor to better understanding the Global Meridional Overturning Circulation and, consequently, their influence in the global climate patterns. As a result, changes in the physical properties of AABW in their formation areas can decrease it production rates and, as a long-term consequence, to affect the global ocean circulation. This work aims to investigate the hydrographic properties variability of coastal shelf and oceanic Southern Ocean dense water masses and, moreover, infer about the possible sea ice role in the variations patterns founded. The hydrographic dataset studied is composed by observed bottle, profiling floats and CTD data, spanning from 1958 to 2010. The sea ice concentration data time resolution is monthly, spanning from 1979 to 2007. Deep and bottom layers with neutral density higher than 28.26 kg m-3 were selected for analyses. Linear fitting of the annual oceanic series (bathymetry > 1300 m) for the Southern Ocean shows a statistically decrease in salinity (-0.0006 year -1) and density (-0.0005 kg m-3 year -1) for these water masses. The annual shelf waters time series reveals a warming trend (0.0093oC year -1), freshening (-0.002 year -1) and a reduction in water density (-0.004 kg m-3 year -1). A TS-time diagram based on decadal average of the shelf water hydrographic properties clearly shows these trends in salinity and density though the decades. The analysis of the different sectors of the Southern Ocean pointed out the decrease of salinity and density of the deep water masses in all of those sectors and an increase in temperature for the Weddell Sea sector. This warming trend (~ 0.013oC year -1) is similar to that found by Fahrbach et al. (2004) for the central Weddell Sea and can be related to the temperature increase of Warm Deep Water (WDW, Robertson et al., 2002), an important water mass source for AABW. Another possible cause for the warming is the SAM positive trend, which can intensify the intrusion of WDW into the shelf (Jacobs, 2006) and consequently warm the water masses. This intrusion could also cause the freshening trend by the ice shelf melting and a less production of sea ice, resulting in less dense bottom water in the region. The temporal series of the Ross Sea sector shows the freshening process (~ -0.001 year-1) documented by Jacobs & Giulivi (2010) for High Salinity Shelf Water (HSSW, - 0.003 year-1) and Modified Circumpolar Deep Water (MCDW, - 0.004 year-1). The freshening and as well a temperature decrease in the Ross Sea can be noticed in the spatial analysis, in which the properties trends were calculated for a 2-degree grid. In that analysis is also visible the cooling, freshening and density decrease trend for the bottom water of the Prydz Bay. This region is considered a bottom water formation area, and its annual temporal series confirms these decrease trends. Trough the spatial and temporal series analysis we shown that the decreasing in bottom water density is happening all over the Southern Ocean, caused mostly by the circumpolar freshening trend for shelf and oceanic dense water masses.