Variability of Weddell Sea Deep Waters with GLORYS12v1 Reanalysis

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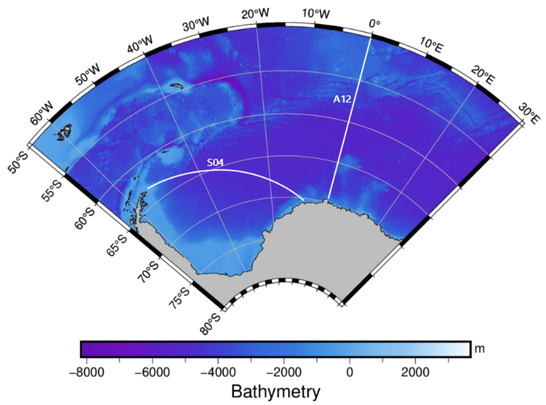
Introduction

The Weddell Sea s a key region for Antarctic Bottom Water (AABW) formation. Changes in AABW have profound implications for the stability of the Global Overturning Circulation (GOC). Therefore, understanding the variability of deep water mass varieties forming AABW is crucial for projecting changes in ocean circulation and assessing potential risks for the global climate. This study investigates the structure and variability of deep water masses in the Weddell Sea using the high-resolution results from the Global Ocean Physics Reanalysis 1/12° (GLORYS12V1) provided by the Copernicus Marine Environment Service (CMEMS).

Methodology



- Layer Definition (Kerr et al., 2018):
  - Optimum Multiparameter Analysis (OMP).
  - Neutral Density:

Warm Deep Water (WDW)	28.1 kg/m³ ≤ γn < 28.27 kg/m³
Weddell Sea Deep Water (WSDW)	28.27 kg/m³ ≤ γn < 28.40 kg/m³
Weddell Sea Bottom Water (WSBW)	γn ≥ 28.40 kg/m³

Results

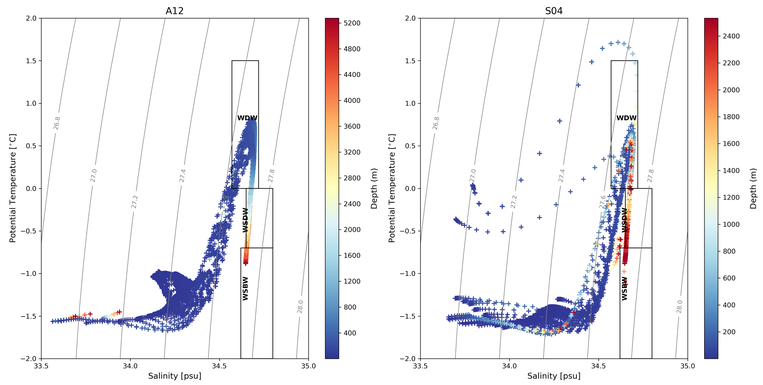


Fig 1: TS diagrams obtained from GRLORYS12v1 reanalysis (1993 to 2020) at the locations corresponding to WOCE A12 (left) and WOCE SR04 (right). The rectangles delimit the ranging values of potential temperature and salinity observed for the Weddell Sea Deep Waters.

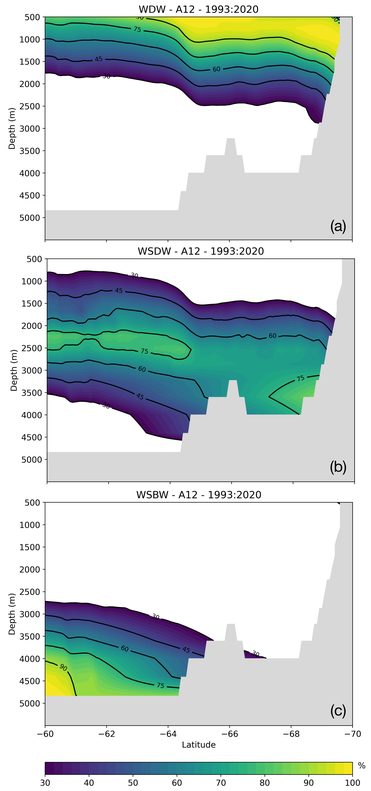


Fig 2: Averaged contribution (%) from 1993 to 2020 of (a) WDW, (b) WSDW and (c) WSBW obtained from the OMP analysis at the location corresponding to the WOCE A12.

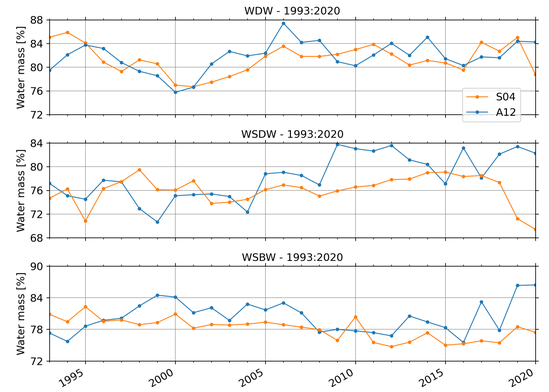


Fig 3: Time series of the annual average contribution (%) (contribution ≥ 60%) of WDW, WSDW and WSBW in the transects corresponding to WOCE SR04 and A12

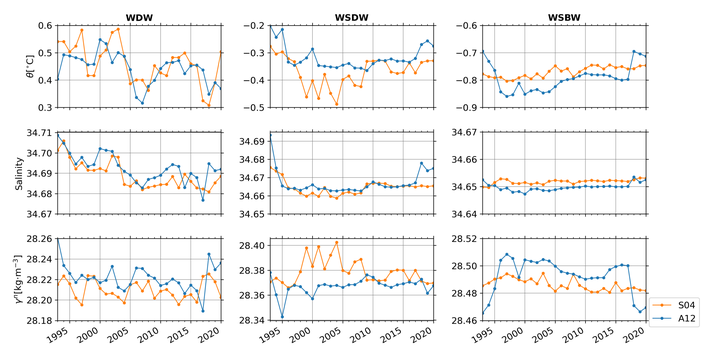


Fig 4: Time series (1993–2020) of the annual average potential temperature (°C; top), salinity (center), and neutral density bottom) in the core (contribution ≥ 80%) of WDW (1st column), WSDW (2nd column), and WSBW (3rd column).

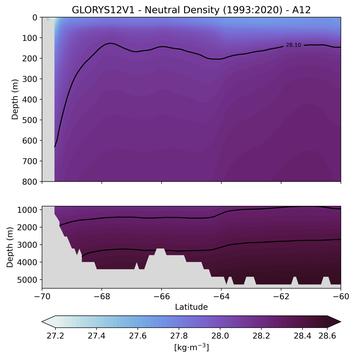


Fig 5: Cross-section of the averaged neutral density (1993-2020) in section A12. Contour lines delimit the Weddell Sea Deep waters layers.

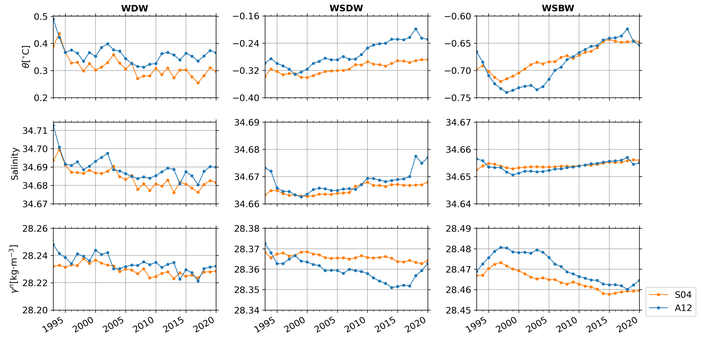


Fig 6: Time series (1993–2020) of the annual average potential temperature (°C; top), salinity (center), and neutral density bottom) in the layers based on the neutral density of WDW (1st column), WSDW (2nd column), and WSBW (3rd column).

Summary

- WDW:
  - Decadal variability associated with the potential temperature;
  - Colder and fresher ⟶ less dense
- WSDW
  - Increasing % of contribution in the 2000's;
  - Section SR04: 10% of decrease from 2018 to 2020.
- WSBW:
  - ↕ WSBW ⟶ ↕ WDW and WSDW
  - Section A12: period of recovery from 2017 to 2020;
  - Section SR04: continuous decreasing contribution.
- WSDW and WSBW: warming in the 2000's → less dense.

What's next?

- Investigate Weddell Gyre Circulation with GLORYS12v1;
- Investigate the influence of remotely formed AABW.

References

Kerr et al. (2018). Three decades of deep water mass investigation in the Weddell Sea (1984-2014): Temporal variability and changes. Deep-Sea Research Part II, 149, 70-83.

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