EGU22-2561
https://doi.org/10.5194/egusphere-egu22-2561
EGU General Assembly 2022

Circulation and water masses on the Bellingshausen Sea continental shelf

Karen J. Heywood[1], Ria Oelerich[1], Peter Sheehan[1], Gillian Damerell[1], Andrew Thompson[2], Michael Schodlok[3], and Mar Flexas[2]
[1]Centre for Ocean and Atmospheric Sciences, School of Environmental Sciences, University of East Anglia, Norwich, UK (k.heywood@uea.ac.uk)
[2]Environmental Science and Engineering, California Institute of Technology, MC 131-24 Pasadena, CA 91125, USA
[3]Jet Propulsion Laboratory, MS 300-323 4800 Oak Grove Drive, Pasadena, CA 91109, USA

The circulation of the Bellingshausen Sea has not attracted as much attention as that of its neighbours, the Amundsen Sea and the West Antarctic Peninsula. Like them, it hosts a wide variety of vulnerable ice shelves, and exhibits inflows of warm deep water onto the continental shelf, and outflows of resulting ice shelf meltwater. Quantifying heat and freshwater transport, and understanding their temporal and spatial variability, is important for understanding the impact of a warming, melting Antarctica on ocean circulation.

First, we identify processes influencing interannual variability in warm deep water on the southern Bellingshausen Sea continental shelf using the GLORYS12V1 1/12° reanalysis from 1993 to 2018. EOFs of potential temperature below 300 m allow separation into warm and cold regimes. The Amundsen Sea Low is more intense and extends further to the east during warm regimes than during cold regimes. Increased Ekman transport results in a stronger frontal jet and Antarctic Coastal Current (AACC) in the cold regime. The warm and cold regimes are also linked to different temperature tendencies. In the warm regime, a wind-induced reduction of sea ice results in increased heat loss to the atmosphere, convection, and formation of cold dense water in winter associated with a cooling of the southern Bellingshausen Sea and a net northward heat transport. In contrast, conditions of the cold regime favour a gradual warming of the southern Bellingshausen, consistent with a net southward heat transport.

Second, we use high-resolution sections collected from two ocean gliders deployed in the Bellingshausen Sea between January and March 2020 to quantify the distribution of meltwater. We observe a cyclonic circulation in Belgica Trough, whose western limb transports a meltwater flux of 0.46 mSv northwards and whose eastern limb transports a newly-identified meltwater re-circulation (0.88 mSv) southwards. Peak meltwater concentration is located into two layers (~150 m and ~200 m) associated with different density surfaces (27.4 and 27.6 kg m^{-3}). The deeper layer is characterised by elevated turbidity. The shallower layer is less turbid, and is more prominent closer to the shelf break and in the eastern part of Belgica Trough. We hypothesise that these different meltwater layers emanate from different ice shelves that abut the Bellingshausen Sea.

To test the hypothesis of multiple source regions, we perform experiments using a regional set-up of MITgcm (approx. 3 km resolution), in which tracers released beneath ice shelves are used as a proxy for meltwater to diagnose transport pathways. Meltwater at the glider study site originates from ice shelves in the eastern Bellingshausen, particularly from George VI. Meltwater is primarily transported westward in the AACC; a small proportion detaches from the AACC via eddies and lateral mixing and, from the west, enters the cyclonic circulation within Belgica Trough, consistent with the glider-observed northward meltwater flow in the west and the southward re-circulation in the east. Very little meltwater from ice shelves immediately south of Belgica Trough enters this in-trough circulation.