**School and Workshop on Polar Climates: Theoretical, Observational and Modelling Advances**

**Title opt1:** Does dense shelf water formation in ocean models depend on the vertical resolution at the ocean surface?

**Title opt2:** Ocean surface vertical resolution constrains the Dense Shelf Water formation in the Antarctic Shelf

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The formation of deep and bottom waters in polar regions is responsible for atmospheric carbon and heat uptake and is one of the main processes that ventilate the deep oceans. Nevertheless, ocean models often fail to represent the formation of the two main dense waters that fill the deep and abyssal oceans, the Antarctic Bottom Waters and North Atlantic Deep Waters (NADW). To properly form these waters, the ocean model surface has to be sensitive enough to buoyancy fluxes to generate deep convection. Thicker ocean cells require stronger buoyancy loss to increase their density than thinner ones, due to their higher volume and capacity to hold heat and salt. Therefore, the thickness of surface ocean cells could affect how efficient the ocean model is in forming dense waters. In this study, we tested to what extent the thickness of ocean top cells alters the production of NADW and Dense Shelf Waters (DSW), a precursor of Antarctic Bottom Waters along the Antarctic Shelf. Several sensitivity studies were run with the ACCESS-OM2 and the MOM6 Pan-Antarctic ocean-sea ice models, with varying top cell thicknesses. We find that thickening top ocean cell decreases the rate of DSW production along the Antarctic shelf in both ACCESS-OM2 and MOM6, with a 60% decrease when cells go from 1m to 5m thick. Ocean only, single column experiments show that this decrease is caused by a more buoyant surface in simulations with thicker surface cells. In contrast, the production of the densest NADW waters in the Labrador Sea increases as the top ocean cell thickens. The reason for the contradicting response between the DSW and NADW is yet not clear. However convection in the Labrador Sea is driven by heat fluxes instead of salt-driven convection on the Antarctic Margins. Therefore, differences in the top cell sensitivity to heat and salt fluxes could explain the opposite NADW and DSW responses.





