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Sea ice-ocean modelling of the Antarctic shelf seas

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The Antarctic continental shelf seas feature a bimodal distribution of water-mass temperature, with the Amundsen and Bellingshausen seas flooded by Circumpolar Deep Water that is several degrees Celsius warmer than the cold shelf waters prevalent in the Weddell and Ross seas. This bimodal distribution could be caused by differences in atmospheric forcing, ocean dynamics, ocean and ice feedbacks, or some combination of these factors.

An idealised sea ice-mixed layer model has been developed to investigate the physical processes controlling this situation. Under regional atmospheric forcings and parameter choices the simulations demonstrate the Weddell Sea destratifying completely and forming cold shelf waters, while the Amundsen Sea mixed layer remains shallower, allowing a layer of deep warm water to persist. Applying the Weddell atmospheric forcings to the Amundsen Sea model destratifies the whole water column, and applying the Amundsen forcing to the Weddell setup produces shallow mixed layers. The simple model cannot rule out a governing role of ocean dynamics, but the results suggest that the difference in surface forcings alone is sufficient to account for the bimodal distribution in Antarctic continental shelf-sea temperature.

We have also coupled this simple mixed layer model component to CICE, to extend our study region to the entire Southern Ocean and to more accurately represent the buoyancy fluxes to the ocean. Results from this model are forthcoming.