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Topic: Ocean-ice-atmosphere interactions

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ABSTRACT Subject :

Effects of Projected Changes in Wind caused by Amundsen Sea Low on the High Salinity Shelf Water in the Ross Sea

Abstract 14/02/2023 13:25:07

The Amundsen Sea Low (ASL) is a low-pressure system that dominates the West Antarctic climate variation, and its future changes and impacts on the ocean are of great concern. In this study, we used the CMIP6 multi-model ensemble to project the future changes of the ASL and obtained the future changes of winds associated with the ASL over the Ross Sea and the Amundsen Sea on decadal time scales. Using a high-resolution sea ice-ocean-ice shelf model covering the Ross Sea and the Amundsen Sea, we examined the influence of projected changes in wind on the formation of High Salinity Shelf Water (HSSW) formation, which is the precursor of Antarctic Bottom Water. By forcing the model with changes in wind over different key regions, this study quantifies the respective impacts of different wind-driven oceanic processes on the formation of HSSW. Results from wind sensitivity experiments show that projected deepening of the ASL will lead to increased wind speed in the Ross Sea by 2.5% in 2050 and 7% in 2100, which will drive an increase in sea ice production by 2.3% and 7.5% over the Ross Sea continental shelf and increase in HSSW formation in the Ross Sea by 0.2% and 5.6% in 2050 and 2100 respectively. In the western Amundsen Sea, the future southward shift of the ASL center leads to enhancement in westerly winds, which reduces the amount of meltwater entering the Ross Sea from the Amundsen Sea ice shelves by about 8.7% and 20.19%, resulting in an increase in the volume of HSSW in the Ross Sea by 1.17% and 3.10% in 2050 and 2100, respectively. In the eastern Amundsen Sea, the future southward shift of the ASL will strengthen westerly wind at the shelf break dramatically and enhance the intrusion of CDW by affecting the strength of the undercurrent near the slope, resulting in an increase of 0.2–0.7 m yr-1 in the basal melting rate of the Amundsen Sea ice shelves. Meanwhile, the enhanced westerly wind also increases the offshore Ekman transport of glacial meltwater, which finally results in decrease in glacial meltwater transport from the Amundsen Sea into the Ross Sea and increase in the HSSW formation in the Ross Sea.