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The effects of sub-ice-shelf melting on dense shelf water formation and export in idealized simulations of Antarctic margins

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Dense shelf water (DSW) is formed in coastal polynyas around Antarctica as a result of intense cooling and brine rejection. A fraction of this water reaches ice shelves cavities and is modified due to interactions with sub-ice-shelf melt water. This modified water mass contributes to the formation of Antarctic Bottom Water, and consequently, influences the large-scale ocean circulation. Here, we investigate the role of sub-ice-shelf melting in the formation and export of DSW using idealized simulations with an isopycnal ocean model (MOM6) coupled with a sea ice model (SIS2) and a thermodynamic active ice shelf. A set of experiments is conducted with variable horizontal grid resolutions (0.5, 1.0 and 2.0 km), ice shelf geometries and atmospheric forcing. In all simulations DSW is spontaneously formed in coastal polynyas due to the combined effect of the imposed atmospheric forcing and the ocean state. Our results show that sub-ice-shelf melting can significantly change the rate of dense shelf water outflows, highlighting the importance of this process to correctly represent bottom water formation.