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The role of the Antarctic region in the oceanic deep circulation

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The starting point of the deep ocean circulation is downwelling of dense water from the sea surface to the deep ocean. This process, called deep water formation, takes place mainly at several locations of high latitudes in the present state of the climate. In the Antarctic region notably dense waters are found on the continental shelf of the Weddell Sea, the Ross Sea, and East Antarctica. The principal factor of this dense water formation is brine rejection associated with active sea ice production at coastal polynyas, which is heavily affected by coastal geometry of Antarctica, grounded icebergs on the continental shelf, and coastal winds. Dense water formation is also strongly affected by the interaction of seawater and ice shelves, whose base exhibits a temperature significantly lower than the freezing point at the sea surface. These dense waters formed on the Antarctic continental shelf eventually reach the ocean floor and drives a significant part of the oceanic global deep circulation. On its way through the continental slope, the dense waters are affected by various small scale processes, which control the property of deep water and the amount of deep circulation. It is one of the most important points in the investigation of the deep ocean circulation to reveal the role of such physical processes. Observation is very difficult and limited in the Antarctic region, but recent efforts of linking existing observational data and numerical modeling are providing a lot of new insights.

Keywords: deep ocean circulation, deep water formation, sea ice, Antarctica