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Circumpolar Deep Water transport and current structure at the Amundsen Sea shelf break

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The West Antarctic Ice Sheet has been losing mass at an increasing rate over the past decades. Ocean heat transport to the ice-ocean interface has been identified as an important contributor to this mass loss and the role it plays in ice sheet stability makes it crucial to understand its drivers in order to make accurate future projections of global sea level. While processes closer to the ice-ocean interface modulate this heat transport, its ultimate source is located in the deep basin off the continental shelf as a core of relatively warm, salty water underlying a colder, fresher shallow surface layer. To reach the marine terminating glaciers and the base of floating ice shelves, this warm, salty water mass must cross the bathymetric obstacle of the shelf break.

Glacial troughs that intersect the Amundsen shelf break and deepen southwards towards the ice shelf fronts have been shown to play an important role in transporting warm, salty Circumpolar Deep Water (CDW) towards the ice shelves. North of the shelf break, circulation in the Amundsen Sea occupies an intermediate regime between the eastward Antarctic Circumpolar Current that impinges on the shelf break in the Bellingshausen Sea and the westward southern limb of the Ross Gyre that follows the shelf break in the Ross Sea. Hydrographic and mooring observations and numerical model results at the mouth of the central shelf break trough leading to Pine Island and Thwaites Glaciers show a westward wind-driven shelf break current overlying an eastward undercurrent that turns onto the shelf in the trough. It is thought that the existence of the latter feature facilitates the on-shelf transport of CDW.

A less clearly defined shelf break depression further west acts as the main pathway for CDW to Dotson and eastern Getz Ice shelves. Model results indicate that a similar eastward undercurrent exists here driving the on-shelf transport of CDW. Two moorings on the upper slope east of the trough entrance show a persistent westward current in the CDW layer. We use hydrographic and ADCP sections to discuss the mechanisms that could be responsible for the formation of this feature and the implications for oceanic heat transport towards the western Amundsen ice shelves.