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Adélie Depression seasonal circulation and dense shelf water export

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We present the hydrographic results of the Australian 2007/08 expedition to the East Antarctica Mertz polynya region and describe the circulation over the shelf and dense water outflow across the Adélie Sill. The Austral summertime survey shows low oxygen, warm and relatively fresh modified Circumpolar Deep Water (MCDW) intruding southward across the shelf at the eastern edge of the Adélie Sill below the summer mixed layer. This MCDW intrusion extends southward along the eastern edge of the Adélie Depression and over the shelf, almost to the edge of the Mertz Glacier Tongue, deepening and becoming cooler and more saline as it does so. This overlies dense shelf water (SW) which fills the depression and is exported off-shelf through the western edge of the Adélie Sill, as well as Ice Shelf Water (ISW) which is largely found on the eastern slopes of the depression, below the maximum depth of the sill. We describe the summer circulation of these water masses using ship CTD and ADCP data.

An array of temperature-salinity sensors, as well as two ADCPs, were also deployed across the Adélie Sill between December 2007 and January 2009 to observe dense water outflow events from the depression and estimate Antarctic Bottom Water (AABW) formation rates. These show a clear seasonal density cycle with potential densities peaking at over 27.95 kgm^{-3} in mid October, and dropping to below 27.8 kgm^{-3} at the end of March. The intrusion of warm and relatively fresh MCDW above 420 m is evident between late December to May across the entire sill, but is strongest in the east. For the first time we observe significant seasonal circulation variability at the sill, where there is eastward (northward) transport between March and October in the west (east) and northward (confused) transport between October and April in the west (east). This variability differs from previous assumptions of a steady off-shelf current and has a significant impact on dense water export estimates. We examine the depression seasonal circulation variability and the water mass transformation driving this using a high resolution ice shelf model, and compare and contrast the observational exchange of MCDW and shelf water across the sill with that of the model.