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The role of tides on the carbonate chemistry of a coastal polynya in the south-eastern Weddell Sea

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Tides have a large impact on coastal polynyas around Antarctica. We investigate the effect of semi-diurnal tidal cycles on the seawater carbonate chemistry in a coastal polynya hugging the Ekström Ice Shelf in the south-eastern Weddell Sea. This region experiences some of the strongest tides in the Southern Ocean. We assess the implications for the contribution of coastal polynyas to the carbon dioxide (CO_2) air-sea flux of the Weddell Sea.

Two site visits, in January 2015 and January 2019, are intercompared in terms of the dissolved inorganic carbon (DIC) concentration, total alkalinity, pH, and CO_2 partial pressure (pCO_2). The tides induce large variability in the carbonate chemistry of the coastal polynya in the austral summer: DIC concentrations vary between 2174 and 2223 umol kg^{-1}.

The tidal fluctuation in the DIC concentration can swing the polynya from a sink to a source of atmospheric CO_2 on a semi-diurnal timescale. We attribute these changes to the mixing of different water masses. The amount of variability induced by tides depends on – and is associated with – large scale oceanographic and biogeochemical processes that affect the characteristics and presence of the water masses being mixed, such as the rate of sea ice melt.

Sampling strategies in Antarctic coastal polynyas should always take tidal influences into account. This would help to reduce biases in our understanding of how coastal polynyas contribute to the CO_2 uptake by the Southern Ocean.