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Atmospheric, oceanic, and sea-ice variability along Nares Strait: a numerical model study

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Nares Strait, between Greenland and Ellesmere Island, is one of the main pathways connecting the Arctic Ocean to the North Atlantic. The multi-year sea ice that is transported through the strait plays an important role in the mass balance of Arctic sea-ice as well as influencing the climate of the North Atlantic region. This transport is modulated by the formation of ice arches that form at the southern and northern of the strait. The arches also play an important role in the maintenance of the North Water Polynya (NOW) that forms at the southern end of the strait. The NOW is one of the largest and most productive of Arctic polynyas. Given its significance, we use an eddy-permitting regional configuration of the Nucleus for European Modelling of the Ocean (NEMO) to explore sea-ice variability along Nares Strait, from 2002 to 2019. The model is coupled with the Louvain-la-Neuve (LIM2) sea ice thermodynamic and dynamic numerical model and is forced by the Canadian Meteorological Centre's Global Deterministic Prediction System Reforecasts.

We use the model to explore the variability in ocean and sea ice characteristics along Nares Strait. The positive and negative degree days, measures of ice decay and growth, along the strait are consistent with the warming that the region is experiencing. Sea-ice production/decay did not show any significant change other than an enhanced decay during the summers of 2017-2019. Sea-ice thickness on the other hand has decreased significantly since 2007. This decrease has been more pronounced along the northern (north of Kane Basin) portion of the strait. What is more, ocean model data indicates that since 2007 the northern Nares Strait upper 100m layer has become fresher, indicating an increase in the freshwater export out of the Arctic Ocean and through the strait. The southern portion of the strait, on the other hand, has become warmer and saltier, which would be consistent with an influx of Irminger Water as proposed by previous modelling results. These changes could impact the formation and stability of the ice arch and hence the cessation of ice transport down Nares Strait as well as contributing to changes in the characteristics of the NOW.