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Moving to a Seasonally Ice Covered Arctic.

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The area of seasonal sea ice that forms each year is increasing. This study investigates how this will affect the brine that subsequently enters the ocean and how it contributes to the formation of the halocline or is transported from the Arctic Shelf Seas to the deep Arctic Ocean.
Two idealised experiments were carried out using ocean/sea ice models NEMO-SHELF/LIM2 on a 3km resolution domain of a section of the Arctic continental shelf and slope, where dense water cascades have been observed. The model used hybrid vertical coordinates that are able to resolve dense flows down the continental slope, temperature and salinity from climatology for initial conditions and liquid boundary conditions. The model was forced with surface fluxes according to the CORE formulation using the DFS4 database. When ice forms and brine is rejected, a passive tracer, with concentration proportional to the brine was introduced in the surface layer. This brine tracer allows us to track the penetration of newly formed waters and their pathways. The heavy, salty and cold water mixes with adjacent waters and penetrates to different layers, depending on the density of the newly formed water masses.
Each model idealised run was initialised with an ice cover to approximate summer ice conditions in: (a) the early 1980's when the region was nearly 100% ice covered and (b) the late 2000's when the region was ice free. All the other forcing fields were identical between runs. The experiments initialised with no summer ice cover formed more ice over the freezing season and 40% more entered the model ocean. The concentration of brine tracer was 6-fold higher to a depth of 840m. The locations where brine can cascade off the continental shelf correspond well to the locations, where cascades have been observed. A 40% increased salt flux from increased seasonal sea ice leads to more brine reaching the sea bed in these model simulations. More brine is also transported down the continental slope and into the deep ocean, with brine concentrations up to a depth of 840m. In addition to transporting salt, the dense cascades of brine will export carbon, nutrients and dissolved gases to the deep Arctic Ocean.