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Evaluation of cascading water formation and pathways from NEMO-shelf Arctic Ocean model.

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Cascading (or shelf convection) is a type of density-driven current in which dense water is formed over continental shelves due to cooling/freezing events and descends down the slope to a greater depth. In the Arctic Ocean cascading contributes to the transformation of warm and saline intermediate Atlantic Waters (AW), which underlies a fresh and cold layer, and the renewal of deep, salty and cold waters below AW (1000-4000m). These dense waters propagate as overflows from the Arctic to Atlantic Ocean, with open ocean deep convection contributing to the Meridional Overturning Circulation. Cascading is thought to be one of the major players in shelf-ocean interaction in the Arctic Ocean and to carbon export from continental shelves to the open ocean. However, as it is an episodic process, happening in wintertime, it is difficult to observe. To our knowledge, there are no observational based estimates of deep water mass formation fluxes at this time.
We use outputs from pan-Arctic NEMO-shelf model to examine the effects of cascading on water mass transformations on multi-decadal timescale (1980-2010). We identify key locations on the Arctic shelf where cascading is most probable; evaluate vertical and cross –shelf dense water fluxes and pathways; examine spatial and temporal variability and their relation with summer ice decline and atmospheric forcing (e.g. Arctic Ocean Oscillation).
The model has a moderate horizontal resolution corresponding to $\frac{1}{4}$o ORCA grid and high vertical resolution with terrain following s levels on the shelf, resolving the benthic layer, and z-partial steps in the deep ocean. The model explicitly resolves tides. The GLS vertical mixing scheme is used to reproduce the structure of benthic and ice-ocean boundary layers. We discuss further improvements of vertical coordinates, which will allow more accurate simulations of dense water boundary flows on the deep ocean.