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Studying the impact of changes in the Arctic outflow by using a coupled ice-ocean model

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The export of cold and fresh water from the Arctic Ocean into the North Atlantic Ocean happens mainly through the Fram Strait and the Canadian Arctic Archipelago (CAA). The magnitude of the Arctic outflow and its distribution between the Fram Strait and CAA has been suggested to change in the future. Such changes might affect the Arctic sea ice, and possibly alter the location and the intensity of dense water formation and, therefore, the Atlantic meridional overturning circulation (AMOC). One factor controlling the Arctic outflow is the wind forcing. Another factor is the Atlantic inflow to the Arctic, which also depends on the wind forcing and is linked to the intermediate circulation within the Arctic. There is also synergy between all the Arctic gateways. Here we explore the changes in CAA and Fram outflows accompanying the Arctic dipole mode as a plausible climatic state in future, and their corresponding impacts on the Arctic and Atlantic Oceans. For this purpose, a regional configuration of the coupled ice-ocean model, NEMO (Nucleus for European Modelling of the Ocean model) version 3.4 is used for a set of sensitivity experiments. For the surface boundary condition, composites of atmospheric variables associated with the two phases of Arctic dipole mode were calculated from the COREII data. To better understand what controls the distribution of Arctic outflow between the Fram Strait and CAA and to exclude their synergism, we launch similar experiments with a closed CAA. This will allow us to better understand the impacts caused by the modulation of the wind forcing versus changes in the gateway flows. Our results will also have implications for the paleo-studies of the Arctic.