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Modeling the Oceanic Exchanges Across the Main Arctic Gateways with Emphasis on Atlantic Water and Its Impact on Sea Ice and Climate

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Estimation of the oceanic budgets of total mass and property exchanges across the main Arctic gateways is challenging from both observational and modeling points of view. While data are insufficient to close such budgets, ocean models commonly struggle with representing transports through the narrow and shallow gates (i.e. Bering Strait and the Canadian Arctic Archipelago) as well as exchanges across Fram Strait or the Barents Sea. Uncertainties in observational constraints at those gates are part of the modeling problems. Yet, realistic model representation of oceanic fluxes, including those associated with Atlantic water, is critical to understanding, simulation and prediction of their impact on the sea ice cover and related feedbacks to the atmosphere and climate.

We analyze results from several multi-decadal simulations of the Regional Arctic System Model (RASM) focusing on oceanic fluxes across the Arctic gateways. RASM is a limited-area, process-resolving, coupled atmosphere - ice - ocean - land model that includes the ocean and sea ice models, which are regionally configured versions of those used in the Community Earth System Model (CESM): the Los Alamos Community Ice Model (CICE) and Parallel Ocean Program (POP). The Weather Research and Forecasting (WRF) is used for an atmospheric model, with land surface processes and hydrology represented by the Variable Infiltration Capacity (VIC) model. RASM's pan-Arctic domain covers the entire Northern Hemisphere marine cryosphere, terrestrial drainage and, major inflow/outflow channels to/from the Arctic Ocean, with large portions of the subpolar oceans to allow optimal simulation of the oceanic pathways into and from the central Arctic. The ocean model uses 45 vertical z-coordinate levels and 1/12º or 1/48º rotated sphere meshes with an equator extending across the North Pole, resulting in ∼9.3km or 2.4km resolution in the Arctic Ocean, and minimal area distortion near the boundaries.

The main objective of this research is to quantify the oceanic fluxes in and out from the central Arctic Ocean and to understand their sensitivity to model configurations and impacts on sea ice and climate.