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Modeling Recent Changes in Sea Ice Volume: Effect of Oceanic Lateral Mixing Parameterizations

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As part of the Arctic Ocean Model Intercomparison Project (AOMIP), we have completed two 55-year, global, sea ice-ocean simulations, their only difference being treatment of lateral mixing of tracers in the ocean model. Produced on a 0.4 degree mesh, the simulations are considered eddy-admitting, but only one of them exhibits vigorous eddy activity at high latitudes. While the ocean simulations are similar at lower latitudes, their circulations differ markedly in the Arctic, leading to significant differences in ocean temperature, both near the surface and at depth. In spite of these differences, both runs perform well in comparison with submarine sonar measurements of ice draft and satellite estimates of ice thickness. Simulated Arctic ice volume decreases markedly over the past 2 decades, in good agreement with observations. By analyzing ice volume and ocean heat budgets for the Arctic, we find that ice export and changes in the thermodynamic regime both significantly affected the ice volume evolution. Reduced net thermodynamic ice growth was due to ice melting from the bottom of the pack, in turn associated with a warming ocean and increasing mixing in the Arctic Ocean.