Geophysical Research Abstracts,
Vol. 11, EGU2009-6071, 2009
EGU General Assembly 2009

Shelf-basin transport of freshwater into the Labrador Sea

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Freshwater exiting the Arctic Ocean through the Canadian Arctic Archipelago (CAA) has been shown to affect meridional overturning circulation and thereby the global climate system. However, due to constraints of spatial resolution in most global ocean models the CAA is often represented as a single wide channel or it is completely closed, thereby distorting or completely preventing the flow of low salinity water to the Labrador Sea. Furthermore, coarse resolution prevents direct simulation of eddy activity which may transport this fresh water to areas of open ocean convection and thereby affect deep water formation.

To address some of such issues we use a high-resolution, ice-ocean model of the pan-Arctic region (with a realistic representation of the CAA) and forced with realistic atmospheric data. We analyze the modeled hydrography and dynamics of the Labrador Sea in an effort to understand the interactions of eddies with fresh water outflow and their effect on convection. Due to the decreasing Rossby radius of deformation at increasingly higher latitudes, our model at 1/12-degree (or about 9 km) horizontal resolution is not considered fully eddy resolving over the entire region. However, even with such a limitation the processes associated with eddies can be investigated at least qualitatively. In an earlier study of the Gulf of Alaska, the model showed skill in simulating eddies and their effects on shelf-basin exchange of mass and properties. Specifically, it showed how the modeled eddies transported fresh water off of the continental shelf and into the deep basin in accordance with observations. Additionally, this model previously showed some skill in the Labrador Sea, where the modeled eddy kinetic energy compared well to observations.

This study seeks to determine if modeled eddies contribute to the transport of low salinity CAA outflow off of the continental shelf and into the Labrador Sea. We examine if the model can resolve locations of active convection and deep water formation, and if those are influenced by or interact with the modeled eddies. In particular, we analyze model output for potential evidence of eddy transport of fresh water to convective regions. Finally, modeled results are compared to available observations in the Labrador Sea.