Effects of changes in the open ocean on the melting underneath the Ross Ice Shelf in a model of the Ross Sea

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In an oceanic numerical circulation model that includes basal melting of a floating ice shelf above the water, the characteristics of the water in the open ocean adjacent to the ice shelf cavity can be critical to the calculation of the basal melting. Therefore, changes in model forcing and bathymetry to just the open ocean portion should still affect the melting underneath the ice shelf.

Satellite imagery shows that there was substantial variability in the sea ice extent in the Ross Sea during 2001-2003. Much of this variability is thought to be due to several large icebergs that moved through the area during that period. In this study, a high resolution (5 km) model of the Ross Sea (including the cavity beneath the Ross Ice Shelf (RIS)) was developed to study the effects of these changes in sea ice on circulation and water mass distributions. It would be difficult to simulate the highly variable sea ice from 2001-2003 with a dynamic sea ice model since much of the variability was due to the floating icebergs. Here, sea ice concentration is specified from satellite observations. To examine the effects of changes in sea ice, simulations were performed using either climatological ice concentrations or the observed ice for that period. The changing sea ice affected not only the open ocean, but the water underneath the RIS. For example, from September 2002 to September 2003, the model average basal melt over the entire RIS was reduced from an average of 14.8 cm/yr to 13.0 cm/yr primarily because the Ross Sea Polynya opened up late that summer (possibly due to the presence of iceberg C-19) and there was less warm surface water adjacent to the RIS available to be advected underneath the shelf. The effects on the basal melting of recent changes in the winds used to force the model and the bathymetry in the open ocean part of the model will also be discussed.