Ice-2-O: Interactions between ice shelves, sea ice and ocean

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The mass budgets of ice shelves, marine-terminating glaciers and the adjacent grounded ice sheets can change rapidly as the adjacent ocean state varies. The three water components – glacial ice, sea ice, and liquid ocean – interact in complex ways to affect not just the ice sheet mass balance, but also the production of dense water masses and the flux of sea ice northwards over the Southern Ocean. We use a model of the Ross Sea, including its ice shelf, to motivate a discussion of some climatically important interactions between these water components. We also consider the implications for mass loss mechanisms for large "cold water" ice shelves such as the Ross and Filchner-Ronne. We focus on the hypothesis that their future mass loss will be via frontal retreat caused by accelerated melting in, and associated calving of, the Ice Shelf Frontal Zone (ISFZ) rather than by thinning that is either concentrated near the grounding lines or broadly distributed under the ice shelf. The modeling points to the need to accurately represent the seasonality of sea ice production and advection when projecting ice sheet response to changing ocean state. Improved calving laws are also required to incorporate this potential mass loss process into projections of ice sheet mass change.