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Processes controlling surface, bottom and lateral melt of Arctic sea ice in a state of the art sea ice model

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We present a modelling study of processes controlling the summer melt and disintegration of the Arctic sea ice cover. The CPOM sea ice model is a branch of the Los Alamos community code CICE, version 5.0, that includes recently developed new physics of halodynamics, melt ponds, anisotropic rheology, and the impact of sea ice topography on air-ice and ice-ocean flux exchange coefficients (momentum, sensible heat, latent heat). The CPOM model is modified to include a prognostic mixed layer and a three equation boundary condition for the salt and heat flux at the ice-ocean interface.

The study focuses on the relative roles of lateral melt, basal melt and surface melt. Lateral melt is calculated based on a parameterized variable average floe perimeter and is modified to account for an observed power law floe size distribution. Basal melt is sensitive to the seasonal cycle of temperature, salinity and depth of the prognostic mixed layer as well as to the boundary condition at the ice-ocean interface. Surface melt utilises a model of melt ponds on sea ice and is also affected by halodynamics in the ice interior. This study assesses the seasonal and inter-annual model response of the Arctic sea ice cover to prescribed atmospheric and oceanic forcing in a stand-alone setting. Because it quantifies the relative importance of several new physical mechanisms in driving the summer melt of the sea ice this work can serve as a guide for future research priorities.