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Fragmentation and melting of the seasonal sea ice cover

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Recent years have seen a rapid reduction in the summer Arctic sea ice extent. This loss is coupled with an increase in the proportion of the Arctic described as having a seasonal ice cover i.e. sea ice is present for some but not all the year. This also means that the marginal ice zone, here defined as regions of the Arctic with between 15 and 80 % sea ice cover, will increase in extent during the summer melting season.

Currently in climate models it is assumed that ice floes are uniform in size. This is inadequate for the representation of the marginal ice zone in such models. Floe size impacts lateral melt rate, floe rheology and atmosphere-ice-ocean momentum exchange. Furthermore, to assess the impact of processes which impact floe size such as wave-ice interactions, models must accommodate a variable floe size.

This study examines key features and processes which dominate the evolution of the marginal ice zone within the CICE sea ice model coupled to a prognostic ocean mixed layer model. This includes lateral melting, wave induced break up of floes, and feedbacks of these processes with the mixed ocean layer. The sensitivity of the model to the form of the floe size distribution will also be considered, to identify whether such a distribution can be imposed on the model or requires a less constrained approach.

These results are then used to quantify the proximate mechanisms of seasonal sea ice reduction in the sea ice—ocean mixed layer model. The impacts of introducing these processes to the model will be discussed and the preliminary results of sensitivity and feedback studies will also be presented. Observations will be used to identify whether these processes adequately represent the sea ice retreat or whether further mechanisms need to be identified and considered.