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The impact of under-ice melt ponds on Arctic sea ice volume

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A one-dimensional, thermodynamic model of Arctic sea ice [Flocco et al, 2015] has been adapted to study the evolution of under-ice melt ponds, pools of fresh water that are found below the Arctic sea ice, and false bottoms, sheets of ice that form at the boundary between the under-ice melt pond and the oceanic mixed layer. Over time, either the under-ice melt pond freezes or the false bottom is completely ablated. We have been investigating the impact that these features have on the growth or ablation of sea ice during the time that they are present.

The sensitivity of our model to a range of parameters has been tested, revealing some interesting effects of the thermodynamic processes taking place during the life-cycle of these phenomena. For example, the under-ice melt pond and its associated false bottom can insulate the sea ice layer from ocean, increasing the thickness of sea ice present at the end of the time frame considered.

A comparison of the results of the model of under-ice melt pond evolution with that of sea ice with a bare base has been used to estimate the impact of under-ice melt ponds on sea ice volume towards the end of the melt season. We find that the under-ice melt ponds could have a significant impact on the mass balance of the sea ice, suggesting that it could be desirable to include a parameterisation of the effects of under-ice melt pond in the sea ice components of climate models.