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Results from a high resolution model of melt ponds

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During winter the ocean surface in polar regions freezes over to form sea ice. Sea ice floats on the ocean and has a matrix structure caused by the rejection of salts during freezing. In the summer the upper layers of sea ice and snow melts producing meltwater that accumulates in Arctic melt ponds on the surface of sea ice.

A melt-pond–sea ice model is introduced to describe the evolution of melt ponds on Arctic sea ice. This model used realistic ice and snow topographies, meltwater transport rates calculated from hydraulic gradients and ice permeability, and a detailed one-dimensional, thermodynamic-radiative balance. The model was used to simulate the evolution of the melt-pond–sea ice system for typical first-year and multi-year sea ice floes.

Here we present simulations in which we investigate the sensitivity of pond fraction, pond depth and ice ablation to changes in ice topography, snow topography and vertical ice permeabilty. The impact on pond coverage, and total ablation, of changes in topography, ice and snow thickness area not always obvious. Snow was generally found to have an important impact mainly at the start of the melt season, whereas initial ice topography strongly controlled pond size and pond fraction throughout the melt season. A reduction in ice permeability allowed surface flooding of relatively flat, first-year ice but had little impact on the pond coverage of rougher, multi-year ice.