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A model of the evolution of Arctic sea ice melt ponds and surface topography

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An accurate estimate of the fraction of the upper sea ice surface covered in melt ponds during the summer melt season is essential for a realistic estimate of the albedo for global climate models. I will present a sea ice model that simulates the two dimensional (areal) evolution of melt ponds on an Arctic sea ice surface. Water transport across and through the sea ice surface is described by the major hydraulic processes believed to be present. Thermodynamic processes are modelled using heat flux equations.

The model simulates a section of a sea ice floe where edge effects such as the presence of leads are neglected. The model consists of a grid of cells, each of which can be in one of four possible configurations: snow covered ice; bare ice; melt pond covered ice or open water. Eventually, a cluster of adjacent cells each containing melt water may be considered to have formed a melt pond.

Lateral and vertical melt water transport is described by Darcy's Law. Melting in each grid cell is simulated using a one-dimensional thermodynamic module for ice and snow melting (and freezing), with an additional parameterisation to describe the heat flux through melt ponds.

The model is initialised with ice topographies that represent either first-year or multi-year sea ice. The ice topographies are reconstructed from SHEBA ice thickness data using standard statistical methods; in this way characteristic examples of both first-year ice and multi-year ice can be constructed. The roughness of the ice surface was altered and studies were conducted to assess the sensitivity of the model to the initial data.