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Interactions between snow and melt ponds in sea ice models

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Snow cover on sea ice at the end of the winter persists into the early part of the sea ice melt season, and the spatial distribution of snow affects the surface topography, the distribution of initial melt pond formation and its subsequent evolution. After the initial formation of melt ponds, the low albedo of the ponds compared to snow or bare ice causes the ponds to preferentially absorb solar radiation and therefore further affects surface ice melt.

A physically based melt pond model was coupled to the thermodynamic-dynamic Louvain-la-Neuve Sea-Ice Model (LIM, version 3), which recently includes a representation of snow properties and processes. In the new snow scheme, snow is represented in multiple layers with varying thermo-physical properties, and simple parameterizations for blowing snow and fresh water refreezing into the snow were implemented. Several simulations were performed using the combined snow and melt pond configuration to study the impacts of the processes described above on the Arctic sea ice melt pond fractions. Preliminary results lead to two expected but uncorroborated model behaviors. In the simulations, blowing snow tends to decrease the average snow depth on sea ice due to losses into leads, thus allowing wider but shallower ponds on multiyear ice, while no significant effect is noticeable on first-year ice. Similarly, the refreezing of water in the snow curtails the amount of meltwater available to feed melt ponds on thick ice categories, where some snow may persist through the melt season, but has a limited or no impact on thin ice where snow melts away rapidly.