The effects of atmospheric uncertainties on two melt pond schemes in global climate models

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In order to predict future changes in the polar regions, the ice-albedo feedback must be adequately represented in the climate models. The albedo in the Louvain-la-Neuve Sea Ice Model is calculated as the weighted sum of the bare ice, snow covered, and open ocean surfaces. The albedos of the ice and snow are functions of their thicknesses and of the surface temperature. During the melt season in the Arctic, melt water collects in the depressions of the ice field. The albedo of the ponds is lower because of the melt water, absorbing more solar radiation. For this reason, melt ponds are hot-spots for the ice-albedo feedback. However, melt ponds are generally poorly accounted for in climate models, by tuning the albedo to include a constant bare puddled ice offset.

There is two main approaches to represent the melt ponds in Global Climate Models. The first approach is empiric and relies on observations to determine the available water capacity of the ponds from the sea ice state. Then, a fraction of the surface melt water accumulates is the ponds. The second makes use of the Ice Thickness Distribution to infer the surface topography of the sea ice and distribute the melt water among the ice categories.

Although the role of melt ponds has been extensively studied, less is known on the response of the ponds to atmospheric uncertainties. Insights can be gained from using different reanalyses of the atmospheric surface state to force the ocean and ice components. Because of a lack of observations in remote areas, reanalyses still suffer from biases notably in the polar regions. The choice of a reanalysis has a strong influence on the representation of the sea ice state of the Antarctic. We expect similar deviations in the Northern Hemisphere. To evaluate the effect of the melt pond schemes on the sea ice when subject to uncertainties in the atmospheric state, we have run the empiric and topographic schemes forced with JRA-55, DFS 5.2, and NCEP/NCAR atmospheric reanalyses. From the simulations, We expect to see the degree of difference between the pond schemes and the influence of the forcing onto their climatic response. We will be able to assess the importance of the melt ponds for the climate and check the consistency of the parameterizations. This will allow us to formulate a recommendation on the use of melt ponds in climate models.

Poster preference