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Impact of melt ponds on Arctic sea ice in the HadGEM3 global coupled climate model

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Stand-alone sea ice simulations with a physical based melt pond model reveal a strong correlation between the simulated spring pond fraction and the observed as well as simulated September sea ice extent for the period 1979 to 2014. This is explained by a positive feedback mechanism: more ponds reduce the albedo; a lower albedo causes more melting; more melting increases pond fraction. This feedback process is a potential reason for the acceleration of Arctic sea ice decrease in the last decade and the failure of many climate models (without an implicit pond model) to simulate the observed decrease.

We implemented the Los Alamos sea ice model CICE 5 including our physical based melt pond model into the latest version of the Hadley Centre coupled climate model, HadGEM3. The model surface shortwave radiation scheme has been adjusted to account for pond fraction and depth. A 30-year simulation with constant present-day atmospheric C02 has been undertaken. The sensitivity of the simulated sea ice area and volume to parameters pertinent to the melt pond parameterization will be discussed and compared to those in uncoupled (forced) simulations. The analysis focuses on the impact of melt ponds on the summer melt, and asks if the strong correlation between spring pond fraction and September sea ice extent found in stand-alone simulations, can be confirmed in the coupled climate simulation.