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Interactive comment on "Impact of refreezing melt ponds on Arctic sea ice basal growth" *by* Daniela Flocco et al.

Anonymous Referee #1

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This study has two main findings. First, refreezing melt ponds can cause a 25 % reduction in basal ice growth. And second, this process is important and should be represented in large-scale climate models. Unfortunately, the robustness of both results remains unclear to me. Hence, I am unsure whether this paper can be published in The Cryosphere.

First, regarding the quantitative assessment of inhibited basal ice growth, the realism of the model remains unclear. A comparison with observational data sets would be very helpful in this respect. It also remains unclear whether the model setup is realistic with its mixture of ice thicknesses and melt-pond thicknesses. This makes it very hard to judge if the estimate of 228 km3 inhibited ice growth is realistic to within, say, +- 10 % or rather to within +- 80 %.

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Discussion paper

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Second, I doubt whether the process examined here truly is of relevance for climate models. I certainly appreciate that melt ponds are important in model simulations to better capture the evolution of albedo during summer. However, I doubt that an explicit modeling of the refreezing of melt ponds is of similar importance. Climate models usually transfer the surface-melt water underneath the sea ice, while in the present study it stays on top of the sea ice. Hence, for equal amounts of melt water and sea ice the two systems are energetically very similar at the onset of freezing. For similar incoming fluxes they then should overall remain energetically similar throughout the freezing period (unless outgoing fluxes differ substantially, which is unlikely). Hence, energy conservation requires that the amount of ice formed on top of sea ice in the melt-pond model should be very similar to the amount of ice formed underneath sea ice in standard climate models. This then immediately gives that the amount of inhibited basal growth should roughly be equal to the amount of melt-pond water at the onset of the freezing period. According to lines 254/255, this is also found here.

This to me suggests that neither the overall energy balance nor the overall salt flux is significantly affected by the process examined here. While I'd be very happy to be proven wrong, the present paper does not allow one to judge the robustness of this finding.

As I appreciate that the robustness of the results might be difficult to show, it might be worthwhile to consider a transfer of this manuscript to GMD with its stronger focus on the actual model development.

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