The Cryosphere Discuss.,
https://doi.org/10.5194/tc-2018-239-AC2, 2019

The Cryosphere Discussions

Interactive comment on "A key factor initiating surface ablation of Arctic sea ice: Earlier and increasing liquid precipitation" *by* Tingfeng Dou et al.

Tingfeng Dou et al.

doutf@ucas.ac.cn

Received and published: 6 February 2019

We thank the reviewer for a helpful review. The reviewer's comments have guided further improvements in the logic and statement, making this work more rigorous. A detailed response follows below. Major CommentsïijŽ The authors use a model and time series observations from undeformed landfast first-year sea ice to investigate the impact of rain on snow events on sea ice ablation. The authors also use historical rainfall data from a coastal station adjacent to the sea ice cover and find that spring rainfall is occurring earlier, especially since the mid-1990s. The paper addresses a relevant and current topic, seasonal sea ice ablation as it pertains to increased or

earlier rainfall contributing to rapid snow ablation due to ripening and decreased albedo.

The authors do a commendable job of incorporating measurements and modelling to explain the impact of rain on snow metamorphism and ablation, as evidence by the agreement between simulations and observations. However as it is presented the results aren't particularly novel, and aside from the rainfall climatology for region of interest, the paper's conclusions about rain on snow are mainly a re-affirmation of the introductory statements (i.e. that these events should likely impact melt pond formation and sea ice ablation). As it is, the snow cover effects are addressed, but impacts on melt pond formation and sea ice ablation are not. Given the location of the study site, the authors should be able to incorporate data on melt pond and sea ice evolution (e.g. pond formation, sea ice thickness, timing of sea ice break-up, etc.) in order to provide valuable insights.

Response: This study focused on the effect of liquid precipitation on the early surface melt onset. The subsequent impacts on the melt pond, sea ice evolution will be studied in the next step. We have clarified this at the end of the article (P11, L440 in the revised MS).

Minor CommentsïijŽ The title of the paper is perhaps too broad given that the focus is on rain on snow events occurring on an undeformed landfast first year sea ice site.

Response: We estimated the distribution of liquid precipitation over sea ice during the early melt season using ERA-Interim reanalysis data (Fig. r1), and combined with our previous findings (Han et al., 2018), it can be seen that liquid precipitation occurs over a large area of the Arctic Ocean and is not limited to landfast first year sea ice. According to the conclusion of this paper, liquid precipitation plays a key role in promoting the surface ablation of sea ice, mainly by reducing albedo and releasing latent heat. That is, as long as there is snow on the sea ice surface in the early melt season, the influencing mechanism of liquid precipitation will work, no matter what kind of sea ice is involved. In view of this, we have retained the original title.

Reference: Han W, Xiao C D, Dou T F, et al. Arctic has been going through a transition from solid precipitation to liquid precipitation in spring (in Chinese). Chin. Sci. Bull., 2018, 63, doi: 10.1360/N972018-00088.

P2, L7: ": : : in recent decades." Done.

P3, L1: delete "over sea ice" Done.

P3, L9: Rather than headings for air termperature, wind etc. the appropriate variables should be described under the heading "Micrometeorological Observations". In this section describe air temperature and humidity together with the instrumentation since they were measured and logged together.

Response: Thank you for your comment, we classify observations of meteorological variables, such as air temperature and humidity into one category and use the title of "Micrometeorological Observations at MB Site". The description of snow depth observations is moved to "Radiation, Albedo, Surface Temperature and Snow Depth near MB Site". Details can be seen in "Data section" in the revised MS.

P3, L10: state the years of the study in the introductory sentence about the MB site.

Response: The study period has been included.

Section 2.2: Since the model is being presented in detail, include all of the appropriate units (only some are given).

Response: The units of all variables used in the model have been included. Please see details in the "Modelling of Snow Depth, Snow Density and SWE" in the section of "Methodology".

P5, L109: can be shortened to ": : : snow water equivalent in m, : : :" Done.

P5, L113: There is a change to present tense here; be consistent.

Response: The tense has been revised to be consistent with the previous section.

Please see details in P5, L235-249.

Please also note the supplement to this comment:
https://www.the-cryosphere-discuss.net/tc-2018-239/tc-2018-239-AC2-supplement.pdf

Interactive comment on The Cryosphere Discuss., https://doi.org/10.5194/tc-2018-239, 2018.

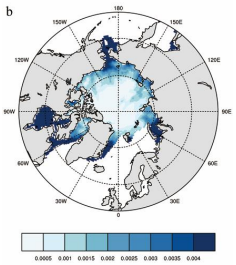

Fig. r1. The distribution of liquid precipitation (units: m) over Arctic sea ice on May during 1979-2015.

Fig. 1.