Revision 1:

Recommendation: Accept with minor revisions.

Comments to Author(s):

Manuscript Number: egusphere-2023-2986
Manuscript Title: Microphysical processes involving the vapour phase dominate in simulated low-level Arctic clouds
Authors: Theresa Kiszler et al.

Overview and general recommendation:

The authors have made significant improvements to this manuscript. I find that nearly all my concerns have been addressed. My remaining comments are listed below. Beyond the minor corrections, my comments are largely concerned with how the authors discuss the imbalance between evaporation and deposition when the WBF process is active. Specifically, evaporation exceeds deposition, indicating a cloud state that is constantly losing water. The other reviewer raised a very similar point in their comment on the study's choice of location and the authors have partly addressed this in their response. However, I think that the results regarding the WBF process will be of greater value when discussed in the context of: a) the evaporation-deposition imbalance indicating a strong cloud water sink that may exceed the WBF mass rate itself, b) how the choice of location likely causes this behavior and the relevance of these results to Arctic regions characterized by high sea ice cover (as opposed to Svalbard).

Comments are formatted as:
Line number in trackchanges document: "*Text"*
Specific Comment

182-183: "Further…"
I think that a slightly longer explanation is needed here for readers to understand this. Additionally see later comments regarding the WBF values and why they sometimes exceed the deposition and evaporation values.

184-202: Whole paragraph.
The authors have done a great job introducing this important point early on. Given that the results presented here may depend strongly on location, I think it would be useful for the authors to discuss how location may affect their results in the discussion. Specifically: Is the result that the WBF process is deposition-limited specific to this case over land? Given that many studies of low-level Arctic mixed-phase clouds is often focused on their ability to persist over long time periods, is this case where at least 33% of the clouds are evaporating representative (line 234)? And if the evaporation exceeds deposition when the WBF process is active are these cases more representative of the WBF process sustaining clouds or cloud evaporation/glaciation? *I think that this kind of discussion will help readers understand how this study fits into the broader literature around Arctic mixed-phase clouds.*

249: "demonstrates visualizes"

Wording error here.

256-257: “This shows…WBF process.”
Can you comment on the evaporation rate increasing more than the deposition rate (and that generally the evaporation rate exceeds the deposition rate)? Similar to a previous comment, the WBF process shifting liquid to ice is mostly discussed here but the high evaporation rate indicating instability seems quite important as well.

273-276: “We hypothesize…set in.”
Interesting! So there may be an indirect effect of riming/rain freezing/secondary ice processes that enhances the WBF effect at relatively high temperatures?

296: Figure 4
If the WBF process is taken as the minimum of deposition and evaporation, how can it exceed either of them in this figure and else? I may be misunderstanding so an explanation to the readers could be helpful here.

351: “This we only found partially.”
Check wording here.

427: “simultaneaously”
Correct to “Simultaneously”.

425-428: “When combining…tendency.”
I struggled with understanding the authors’ meaning here and recommend revising these sentences.

429-431: “Additionally,…liquid mass.”
What caused the 10x increase in evaporation? I don’t think that I agree that it is the occurrence of the WBF process because the increase in deposition is much less, right? Doesn’t this indicate that the WBF process is already strongly limited by the deposition rate? Would decreasing the deposition rate as the authors recommend just lead to the cloud evaporating instead of transitioning to ice? I understand that there is additional complexity here (the air may saturate earlier), but in general if evaporation increases more than deposition when both are active I would expect that enhanced evaporation to dominate the cloud changes.

464-465: “Specifically…formation phase.”
See previous comments. The importance of the study’s location and regime of cloud decay is closely connected to the imbalance between evaporation and deposition seen in the process rates and WBF process analysis. I think that linking these concepts together is a critical aspect of this paper and should be included in the discussion.