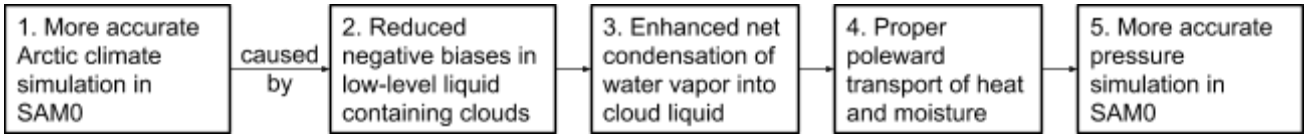
This manuscript demonstrates the better simulated Arctic clouds and climate in SAM0 than in CAM5 and attributes this improvement to the enhanced poleward transport of heat and moisture. The overall flow is clear and the writing is easy to follow, despite some redundancy and lack of topic sentences. My main concerns are about the logical chain, summarized as follows:



From statement 1 to 3, the arguments are strong. However, from 3 to 5, the evidence is mostly circumstantial. Without corroborating these causal links by more analysis and/or experiments, conclusions of this manuscript could not hold. Please see my detailed comments and suggestions below.

Major issues:

1. For the link between statement 3 and 4, the authors cite Park et al. (2014): "the horizontal and vertical transports of heat and moisture are the important factors inducing the net condensation of water vapor into cloud liquid (NCD) both in SAM0 and CAM5". Are these factors also important in the Arctic regions? How dominant are these factors? Are there any other important factors? Could other modifications in SAM0 contribute to the enhancement of NCD? For example, in-cloud turbulence and precipitation from super-cooled liquid clouds.

   The following analysis of concurrence and correlations between advection and clouds are not definite evidence either. As a model study (instead of observational data analysis), more concrete evidence is expected for this imperative link. How about adding a budget analysis like the one for statement 2 and 3 or experiments turning on/off certain model processes?

2. The authors speculate that horizontal advection rather than vertical transport is responsible for the enhancement of NCD due to the identical surface boundaries. Could the authors provide some discussion instead of speculation on the role of vertical transport? Is it possible that the modification of SAM0 on the convection scheme alters the vertical

structure of the atmosphere, which could also contribute to the NCD enhancement?

3. Evaluated against ERA-Interim, SAM0 exhibits smaller biases than CAM5 in annual-mean geopotential heights simulations. However, this does not guarantee a more accurate simulation of heat and moisture advection. For example, SAM0 overestimates geopotential height at 850 hPa in tropical Pacific and underestimates in sub-Arctic Pacific, leading to larger heat transport into the Arctic. The moisture transport is also affected by the location of pathways. Could the authors evaluate the heat and moisture advection directly against observations?
   More importantly, this is the only way to validate the claim of "**proper** heat and moisture transport is the key process in simulating Arctic climate". Otherwise, the evidence could only support a claim of "enhanced heat and moisture transport improve Arctic climate simulations" because the larger advection could be an overcompensation in order to increase liquid clouds.

4. Page 1 Line 23-26, "proper simulation of poleward heat and moisture transport is one key factor for simulating Arctic clouds" could not be wrong. However, drawing this conclusion from an uncertainty level of "association" hurts rather than lends credibility, especially in a model study. Would the authors provide more evidence to substantiate this claim? Or this manuscript could focus on the improvement of SAM0 and thoroughly evaluate all the causes.

Minor issues:

5. Page 1 Line 9: "with a large inter-model spread" → "causing a large inter-model spread"

6. In the abstract, there needs to be a transition (e.g., your specific question) from the first and second sentences (the big-picture question) to the third (your approaches). Otherwise, readers might wonder how a comparison between two models could possibly address such a complex issue.

7. Page 1 Line 17-18, "~~it was found that~~"

8. Page 1 Line 18-19, “reducing the Arctic clouds biases in CAM5” → “reducing the **negative** Arctic clouds biases in CAM5”

9. Page 1 Line 19, “budget analysis” is not a common term to me. I suggest removing it from the abstract or at least point it out in Paragraph 2 Page 5 before starting this analysis.

10. Page 1 Line 20, in the rest of this manuscript, “clouds” are used instead of “stratus”. Please keep it consistent.

11. Page 2 Line 30-35, it’s better to show how the manuscript is organized here rather than presenting results without any analysis.

12. Page 2 Line 34, the phrase “It is/was/will be shown/found” does not convey any messages. It’s safe to remove them in most cases to make the writing more concise.

13. Page 4 Figure 1, could the authors add error bars to this figure? e.g., a standard deviation of inter-annual variability.

14. Page 6 Figure 3, have the authors looked at the seasonal breakdown? In winter, could larger moisture transport lead to more NCD to cloud ice?

15. Page 8 Figure 4, what is the percentage of these differences relative to the absolute values of CAM5. If it’s too messy to plot on the figure, a description in the text would be fine too.

16. Page 8 Line 12, “~~this result in~~” since you’ve already used “Because”.

17. Page 9 Figure 5 a and b, the correlation seems to weaken in the recent years. Any reasons?

18. Page 9 Line 2, “~~sequentially~~”

19. Page 9 Line 15-16, “All models simulate consistent poleward moisture transport”. “Consistent” is not clear. Consistent how? Suggestions: “All models simulate consistently positive poleward moisture transport” or simply “All models simulate positive poleward moisture transport”

20. Page 10 Figure 6c, I am confused about the unit: 10^3 K kg m^{-1} s^{-1}. Could it be 10^3 K m^{-1} s^{-1}?

21. Page 14 Line 15, "~~seems to~~"

22. Most of the paragraphs lack a topic sentence to guide readers. For example, the topic sentence for the first paragraph in Section 3 could be "SAM0 reduces the negative biases of CAM5 in liquid cloud simulations".