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Interactive comment on "Arctic cloud annual cycle biases in climate models" *by* Patrick C. Taylor et al.

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Taylor et al investigate annual cycles of cloudiness in CMIP5 models and investigate biases among them using MERRA 2 and C3M data. I believe this is a relevant topic that, given its scientific implications, needs to be investigated. I find the analysis approach, i.e. doing investigations using stratifications by various relevant surface and atmospheric parameters, informative and useful.

I also had an opportunity to read the comments posted by the other reviewer and I must say that I broadly agree with the concerns that the reviewer raises and I do hope that the authors address them adequately.

In addition, I would like to underline few points here, where further clarifica-

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Discussion paper

tions/comments are needed before the manuscript is accepted for the final publication.

1) Let us remind ourselves that we are in the Arctic, the region that has been chronically problematic not only for models, but also for observations and reanalysis datasets. I can't help but wonder if the conclusions would change if the authors use ERA-Interim/ERA5/JMA etc instead of MERRA 2. Hinging their conclusions drawn from the stratification analysis (esp LTS, w) only on MERRA 2 is a bit risky.

2) The parameters like LWP and IWP have the largest uncertainties, no matter if you analyse reanalysis or observational data. How does this play a role? Also, can all models explicitly resolve cloud ice and cloud liquid water separately? Or does the partitioning depend on the temperature profile?

3) Over the Arctic Ocean, what kind of biases in the annual cycles of cloudiness models show if they are stratified according to sea-ice conditions, for example, permanently sea-ice covered regions versus completely ice-free regions?

4) The differences in the representation of dynamical meteorology among models are also importing while interpreting the results. For example, do models show similar heat and moisture transport into the Arctic, which has a strong influence on cloudiness?

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