

***Interactive comment on* “Evaluation of Simulated Cloud Water in Low Clouds over the Beaufort Sea in Arctic System Reanalysis using ARISE Airborne In Situ Observations” by J. Brant Dodson et al.**

Anonymous Referee #2

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This manuscript uses airborne in situ observations of low-cloud properties from the ARISE field campaign to evaluate the Arctic System Reanalysis (ASR) product based on thermodynamic regimes of air temperature, relative humidity and specific humidity. The authors find that the ASR product is generally too warm and dry compared to ARISE, which may contribute to biases in the cloud properties, but that the relationship between cloud properties and thermodynamic variables are more important for explaining the difference between the reanalysis data and ARISE. Finally, the authors also determine the impact of the limited sample size of their data on their results. They conclude that sampling noise may influence the comparison between ARISE and ASR and that future comparisons with limited in situ airborne data should not be restricted

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to the flight-track.

This is an invaluable study; the evaluation of ASR and the thermodynamic-cloud relationships are important for the improvement of models. The manuscript is well within the scope of ACP. I have some major and minor comments that I would suggest the authors consider:

My main concerns are 1) the interdependence of the thermodynamic variables with one another (they are not independent), 2) that assumption that these thermodynamic variables explain the bulk of the cloud properties and 3) uncertainties in the ARISE dataset that should be described in more detail. Regarding the second point, I am wondering whether cloud condensation nuclei (CCN) could explain some of the large differences in the vertical cloud profiles in ASR compared to ARISE. The authors mention the lack of ice in ASR and maybe the lack of importance of ice-nucleating particles, but there are also CCN. If CCN are important, then this may imply that local sources are important and that comparisons outside the flight track may not be fair comparisons.

Minor comments:

1) Figures 6 and 7: It would be more informative to make those datapoints show the frequency of occurrence of the datapoints using a colour as a third dimension. 2) Lines 320 to 323: should be one sentence. 3) In general, I think the writing can be clarified to state the key points more clearly. Many of the discussions can be distilled to simpler messages.

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