Review on "Examination of Aerosol Indirect Effects during Cirrus Cloud Evolution" by Maciel et al.

Aerosol effects on clouds constitute of one of the largest uncertainties in climate change projection. Particularly, aerosol effects on cirrus clouds are rarely studies but can be potentially important. This study investigates the aerosol indirect effects on cirrus clouds by analyzing in situ aircraft observations of cloud microphysical properties and aerosol number concentrations from NSF and NASA campaigns. The uniqueness of this study is that the analysis separates out five evolution phase of cirrus clouds so that the aerosol indirect effects can be more robustly examined. The observational data analysis is also used to compare with and evaluate the CAM6 model simulations of these field campaigns. Overall, the analysis is solid and the results are convincing. The manuscript is well written. I recommend the publication of this manuscript in ACP after my comments are addressed.

My major comment is that an important objective of this study is to evaluate the model simulations with observation data and some outstanding biases of the model simulations are thus identified. Therefore, it would be helpful to add some descriptions of the CAM6 model parameterizations of cloud microphysics and aerosols. I have also some minor comments as outlined below.

1. Abstract. L19-21. "*Observations show stronger aerosol indirect effects (i.e., positive correlations between IWC, Ni and Na) in the Southern Hemisphere (SH) compared with the Northern Hemisphere (NH*),.." It is somehow count-intuitive because there are not as many INPs (e.g., dust) in SH as in NH. The authors are suggested to add some more elucidations for this statement.
2. L50. "*the number of ice crystals that are nucleated is affected by both strong diffusion and turbulence*." The number of ice crystals that are nucleated is affected by cooling rate (or updrafts). Can the authors clarify what "diffusion" means here?
3. L132. What do you mean "center point phase identifications"?
4. L136. When you use NCAR CAM6 to conduct simulations it would be needed to add some descriptions of CAM6 parameterizations of cloud microphysics and aerosols.
5. L136. Here you mention the NSF campaigns. Why do not you conduct the similar simulations for the NASA campaigns?
6. L152. How do you calculate Na100 and Na500 from modeled aerosol modes?
7. L164. How do you calculate the ICRs and ISSRs spatial scales?
8. L171. What is the implication of this result? "*a cloud segment has the highest probability to be in the early growth phase (i.e., phase 3) for almost all the campaigns (except MACPEX)*."
9. L189. Shall "0.35" be "0.2"?
10. L266-270. "*This feature indicates that as Na500 exceeds a threshold, the available INPs in the air parcel may have been depleted, and therefore no new ice nucleation can be initiated with additional larger aerosols that are not INPs*." Here, the explanation is vague and not very convincing. there is no data beyond logNa500> 1.3. Na500 cannot be depleted at those high concentrations (>10 cm^{-3}). What are the additional larger aerosols that are not INPs?

11. L326. "…*that increasing aerosol concentrations in the SH may be more effective in increasing ice nucleation compared with the NH*." This statement is interesting but may need more elucidation.
12. L331-332. Here the authors talk about the model bias related to cirrus microphysical properties. However, there is also large bias in aerosols (Na100 and Na500). Add model-observation comparisons of aerosols.
13. L342. Shall "40 seconds" be "1 second"?
14. L348. "Both the lower σ_w values and lower ice supersaturation frequencies can contribute to the lower IWC in the model". How about modeled Ni?
15. L378. Here the authors talk about the model sub-grid scale supersaturation and w and their impact on IWC. Why is the modeled Ni relatively better simulated than IWC?