Review comments of “Exploring aerosol-cloud interactions in liquid-phase clouds over eastern China and its adjacent ocean using the WRF-Chem-SBM Model” by Zhao et al., 2023

General comments

The authors simulate the liquid-phase clouds in eastern China over land and ocean and explore the different aerosol-cloud processes including aerosol activation, precipitation and entrainment-evaporation in eastern China (EC) and eastern China ocean (ECO). Their simulations use the technical as detailed as possible and evaluation is very valuable. The analysis of aerosol-cloud interactions provides many new insights in this specific region, such as which mechanisms dominant in which region. Overall, I recommend publish it after address some specific comments below. Given that the comments below are mainly at the aspect of presenting and discussion, I guess the reviewer can address them in 2-3 weeks. So I recommend minor revision.

Specific comments

1. The simulation uses SBM, 4d data assimilation and WRF Chem. All those techniques are the current “most” detailed representation of aerosol-cloud interactions. So I believe readers may be curious about the computational cost of this kind of simulations. I think it valuable to describe the computational cost in the method section for other people to decide on their model configurations.
2. “supersaturation pathway”, this terminology is mentioned without a clear definition. Based on the content, I guess the “multiple supersaturation pathway” means the multiple contributing factors to supersaturation, or multiple aerosol-cloud processes that impacts supersaturation, is that right? I suggest a clear definition of it. If this terminology was used in previous literature, I recommend citing the papers. For me, “pathway” is usually used to describe the spatial trajectories.
3. Abstract: surface longwave radiative forcing cooling is mentioned. Also, the cloud top radiative cooling is also mentioned in the results section. Please specify which cooling you refer to in the item 3 for EC and item 2 for ECO.
4. Line 174-175: add “respectively” at the end of the sentence
5. Line 185-186: How did you match that? Please clarify it.
6. Figure 2: 4d data assimilation has large effects on temperature and humidity. Are those the two major variables assimilated? Does the assimilation take care of wind also?
7. Figure 4: I don’t mind the figure goes in the current form, but add a legend showing the red, blue and black lines would be better.
8. Line 248: “low over land and high over ocean” is only evident for CER, but not Nd. Modify the sentence please.

9. Line 258-259: Aerosol and clouds are still not good. Probably it is better to go through those differences and provide a possible explanation for the differences. I know simulating aerosol and clouds are hard (I believe “everybody” knows that), but it is not good to explain Figure 5 in this way, given the fact that model underestimate CTH, overestimate CTP, overestimate CER over ocean, overestimate Nd over land...
10. Line 263 “produced by anthropogenic emission”. To reach this explanation, a plots showing the chemical composition may help. Although Figure 7 can be used to infer this, but a pie diagram is better and clearer.
11. Line 265-266: “ECO aerosols are mainly transported from EC”. I can not reach this from Figure 7. Please clarify.
12. Line 315: Two methods are mentioned here. So which way did you use for Figure 9 and 10, and why?
13. Line 325: Do you mean Figure 9a and 9e?
14. Figure 9: The subplots are not the same in size, which looks odd. Also, the order is odd too. Add the four figures in the third row to the end of the first and second row for EC and ECO, respectively. I recommend using log for the x-axis for N_aero and Nc.
15. The authors use the differences between Nd and N_aero in Figure 9, and the ratio of Nd to N_aero in Figure 10. Why did you use different metrics? What would the figure be like if you use another metric?
16. Figure 10: use log for x-axis
17. Figure 10 caption use “water vapor variation”, but y-axis use “water vapor changes”. Please use consistent word.
18. Line 382: did you use the exact 0? Or a very small threshold values?
19. Line 383-384: this phenomenon is not specific to precipitating clouds. The non-precipitating clouds also has similar trends.
20. Line 384: influence -> net influence
21. The major problem with figure 11 and related text: data after a large Nd may have very small sample size. So I don’t think it is valid to derive any conclusion using that portion of plots, say when Nd>16000 cm-3 for EC and >12000 cm-3 for ECO.