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Atmospheric Chemistry and Physics Discussions

Interactive comment on "The enhancement of droplet collision by electric charges and atmospheric electric fields" *by* Shian Guo and Huiwen Xue

Anonymous Referee #1

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Comments to the manuscript with ID "acp-2019-1140"

General comments: This manuscript investigated the effect of electric charges and atmospheric electric fields on the size distribution of cloud droplets numerically. The authors concluded that electric charges and fields enhance the collision efficiency of small droplets. My main concern of the manuscript is the novelty. As far as I understand, the manuscript does not specify clearly how different the study is from the one of Khain et al, 2004. The novelty should be stated clearly in the abstract and conclusion as well as in the introduction. Especially, the introduction needs to be improved substantially. This manuscript can be improved if the authors can summarize the open

questions in previous studies and address them in their study. By such a treatment, the authors can place their contribution in a more general context. Overall, this manuscript does not satisfy the novelty requirement of the ACP journal. Major revision is needed before it can be considered for publication.

Main comments, 1. The authors concluded that electric charges and fields enhance the collision efficiency of small droplets. Is this new in the cloud physics field? If so, how different this study is compared with the one of Khain et al, 2004? Which open question does this manuscript address? The third paragraph (starting from Line 35) of the introduction part summarized the work of Khain et al, 2004, but didn't bring up the open question in Khain et al, 2004. 2. The main conclusion of the manuscript is that electric charges and electric fields enhance the collision efficiency of small droplets pairs. The evolution of droplet size distribution with different initial radius is shown in Fig.7, 8, 10. To compare the evolution for different initial radii, I would suggest the authors to plot the size distributions in one plot at a single snapshot, i.e., plot r/r0 at x-axis and n(x,t=15 min) of different r0 at y-axis in one plot. This can help clearly demonstrate the conclusion. 3. The authors mentioned the Navier-Stokes (N-S) equation just above Eq.5. if you consider the backreaction from droplets to the flow, you can add the backreaction term to the NS equation. I don't see immediately why solving the N-S equation numerically with a low Reynolds number is difficult in this study. 4. How can I see from the terminal velocity curve in Fig.11 that the 5-um size droplet turns upwards?

Specific comments: I would suggest the authors improve the English writing of this manuscript carefully across the paper. One way to improve the readability is to read the manuscript more carefully before submit it. 1. Could it be an idea to use "droplet size distribution" instead of "droplet spectrum/spectra" so that readers from a different background (physics, astrophysics) can understand it? As you don't do any Fourier transform, right? What does the spectrum/spectra mean here? 2. L10: a pairà pairs 3. L12: the cloud à clouds. Please read through the paper and check if the same

revision is needed. 4. L22: in unit of um. 5. L30: “this method” is unclear. 6. L36: used Stokes flow to represent. 7. L43: SoàTherefore. 8. L56: meansà represents. 9. L69: you already defined “\epsilon” just below Eq.2. So, the first sentence is a repetition and is misleading. You may also consider merge the two paragraphs, where E and \epsilon are discussed. Also, could you provide the expression of \epsilon? 10. L73: usedàadopted 11. L85: What about “Momentum equation droplets”? Could you go through the paper and check “motion equation”? In physics, it is “the equation of motion”. 12. L88: the flow drag 13. L92: velocity vectorà velocity. You may remove “relative to the earth”. 14. L95: What does “The fluid property is treated as air” mean? 15. L100: I don’t understand this paragraph. Do you mean that there are no droplet-droplet interactions? In English, it is very are to put two nouns together in a sentence. You may read through the paper and try to rewrite those, which can help improve the readability of the manuscript. 16. L105: The nomenclature of the Reynolds number is unique here. It is “Re”. How do you define your Reynolds number here? I know in some atmospheric books, “N_Re” was invented. 17. L115: a function. 18. L131: a complex mathematical problem in physics 19. L146: the sign. 20. L147: it is obvious that. 21. L169: are not included. 22. L171: In thunderstorm conditions. 23. L173: approachesà is close to 24. L176: to the certain mass binsà to mass bins 25. L239: by a factor of about 26. L249: evolution of the droplet size distribution 27. L291: nearly notàhardly 28. L291: and differenceà and the one 29. L294: to the observation. Can you add the reference as well? 30. L326: Do you mean “the observed atmospheric conditions”? What does “real” mean here?

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