

Submitted to EGU sphere

Title: Measurement report: Observational Analysis of Mode-Dependent fog DSD Evolution.....

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Decision: Major improvements are needed, if not corrected properly, suggest its rejection.

#### General summary

This work uses FM100 measurements over 27 fog events and I suggest its DSD to be represented by 2-3 peak-modal distributions. Then, provide summary of mean values of MP parameters. They represent DSD in segments and apply Gamma-DSD to show how good fits. Results are also used for evaluating optical thickness and SSA. Then, conclude that these MP parameterizations based on GDSD can improve NWP models.

Overall, its goal is acceptable scientifically. But having only DSD from FM100 measurements and do various gamma DSD fits do not qualify this paper's publishing. We all know that DSD may not follow up a single mode GDSD, and we use double or even triple mode GSDS based on segmenting the measurements. The work should do beyond the GDSD fits and I summarized below:

1. Paper is mainly focusing on mostly Chinese studies (see discussion section, and others). Intro is better but also limited in scientific content. Earlier work were not mentioned properly.
2. Method; provides equations but analysis is not clear to me. For example, macro and micro processes are mentioned; where are the macro processes/conditions? You have 27 events? It means what? No synoptic conditions are summarized. High pressure? Low pressure? Even no temperature range/RH?
3. Where are the temperature, RH and wind measurements? What caused DSD having 3-modes? Why?
4. Where is the Vis from PWD? You have FM100, I am sure you have PWD Vis data too?
5. Fig. 1 summarized the results; when I see this figure, I thought this paper should be rejected. Reason is that single mode is very different than others but other are almost same values with very small differences.
6. Fig. 1 and analysis; what are the time averages used? 1 sec? 1 min, 10 mins, 60 mins and why? I don't see this. Your results are time dependent/averages. All results should be reevaluated.

7. Where are the time series of Nd, LWC, and MVD for at least 2 events?
8. How come LWC becomes close to  $1 \text{ g m}^{-3}$ ? For some cases?
9. Nd is more than  $200 \text{ cm}^{-3}$  and goes up to  $600 \text{ cm}^{-3}$ ; where is PWD Vis comparison?
10. At least show a couple pics from camera for dense fog events?/satellite images please, 3.9 micron channels.
11. Ln27; fog definition is wrong, see Gultepe et al 2016 Gultepe et al Atmos Res; AMS Bull on ice fog. Fog can be liquid or ice ...
12. Large scale processes ; see Gultepe et al 2021 BLM
13. Ln43,44,45 ; 3, 3.5 and 4.5 micron numbers mean nothing because they are in the range of measurement uncertainty at about 1-2 micron.
14. First bin is removed (ref: Gultepe and Isaac QJRM 200?)
15. Ln 49; how do you know because of collision processes? Where is the wind measurements in this paper?
16. Ln63; decreases I guess.
17. Ln59; T and RH, wind measurements still have very large uncertainty in predictions; who said they are correct?
18. Ln66-67; not bulk also with bin MP.
19. Ln73; what kind of fog; radiation? Advection? Marine etc.
20. Ln83; should be 1-50 micron; not 0-50 micron.
21. Method section is not clear to me, providing eqs are not enough. How did you make averages? Where is the Vis etc.
22. Table 1; show a figure with 1 sec spectra of the dsd.....
23. Ln123; why Nd is more than bimodal case? Explain it
24. 25; figure 2; make a square box for DSD same length in x and y.
25. Until fig 2; no averages mentioned; why those averages are taking?
26. Fig 3a Nf spectra, pdf are almost same; is it contradict to other events/cases etc. what is averaging time?
27. Fig06; represents what? Using obs or theoretical data?
28. Eq. 11; not z but dz
29. Fig. 7; you have many points with  $\text{LWC} > 0.5 \text{ g m}^{-3}$ ? In polluted environment you should have that high. Why is that?
30. LN315-318; see rev paper on Fog Pure and Appl Geop 2007 Gultepe et al.
31. Ln342; I don't think Nf increases with broadening, should decrease. This contradicts everything I know for DSD. You need wind measurements.....

Overall; needs a major work, intention is good but analysis and representation are very poor. This work needs additional observations/knowledge to improve the paper. I suggest major corrections and improve t4ext flow.