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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Influence of aerosols on the formation and development of radiation fog" *by* J. Rangognio et al.

Anonymous Referee #1

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In the manuscript radiation fog is studied using 1D model with two-moment liquid phase microphysics. Existing paramerizations are modified and used to describe fog droplet formation due to radiative cooling at the top of fog. Also the effect of aerosol size distribution and chemical composition on fog droplet number concentration was studied in detail. The subject of manuscript is interesting as radiation fogs are not too well known, but the actual scope of the manuscript is not so well defined. I have concerns about the methods used, and therefore I can not recommend publication of this paper without extensive and major revisions. If the authors are unable to convince reader about the modelling tools used, I would suggest changing the scope of the manuscript as there are some really nice elements related to measurement campaign, and that kind of data is valuable for the research community.

Main comments:

There is some text about the meso-NH model used, but how well does the model actually work in the case of 1-D simulations. Is it only subgrid scale turbulence moving air from level to another and advection is not included at all?

There is lot of discussion about the parameterization used to estimate cloud droplet number concentration. I do not see any reason why some equations are presented in the current manuscript (equations 4-7) from Abdul-Razzak et al. and others are not. At the end it is just stated that additional term is added to take into account radiative cooling without explaining what has been done, which actually should be the only thing needed to be presented in this section. As cooling due to the radiative heat loss is somehow different to cooling due to adiabatic expansion (the system parameterization is developed for) it is difficult to say if parameterization is usable at all with the current information.

Sensitivity of activation to aerosol properties is studied in detail. Things like this have been done many times with the parcel models. It should be well known how does the change in the aerosol mean size affect droplet concentration. Also, for example, the part dealing with surface tension is out of date as it has been shown that the partitioning of surfactant between aerosol surface and bulk need to be addressed to calculate actual effect of surfactant on cloud droplet formation. This part of manuscript should be clearly shortened just to state that increasing number of aerosol particles does not always mean increasing number of fog (or cloud) droplets. It's now stated based on parameterization that has probably not tested in such a conditions, and thus it needs to be discussed based on existing literature if it actually happens.

One of the largest shortcomings of the current manuscript is that in the most crucial things it does not cite available literature. For example papers like Bott (1991), and Bott and Carmichael (1993) are both cited once although in those articles the effect of aerosols on radiation fog is extensively studied. It needs to be shown what new

information does the new manuscript provide compared to those already published. Are the results in agreement and what are the differences in the methods used in the older studies compared to the new manuscript.

Specific comments:

You mainly use a term “cloud droplet” and less “fog droplet”. Should it be fog droplet in the case of fog.

Abstract: It is not allowed to use citations in the abstract. I would suggest that you mention already in the abstract that it is 1D version of Meso-NH model used in the study. Also what does 17000 particles per cc refer, what is the minimum size?

Page 17986, line 10-11: There is lot of “up to date” research on the surfactants which show that all conclusion from previous papers might not be valid for cloud droplets. See for example Priesle et al. (2008).

Page 17983: line 25: What you mean by “difference is usual in 1D simulation”?

Figure 9: It is stated that the formation phase is relatively well simulated. Is it just because log-scale is used in the vertical axis?

Page 17984, line 6-7: What do you mean by “It should be noted that the ascending velocity of the radiosonde (10m/s) which prevented an accurate estimation of the top of the fog layer.”?

Page 17984, line 24: If ARG parameterization does not take account kinetic limitations then maybe you should test Nenes and Seinfeld (2003) parameterization in case it produces better results compared to measurements.

Page 17985, line 6-8: I would say it is difficult (or impossible) to measure supersaturation in all clouds with the current instrumentation.

Page 17985, lines 13-15: Is it even possible that changes in the aerosol concentration could be a reason for variation in fog droplet number concentration based on your

analysis.

Page 17987, lines 14-15: “Maximum activation rate is located at the top of the fog...” What do you mean by rate (particles /(volume time))? Also is there droplet formation in some other part of fog than the top?

Page 17991, lines 21-23: How could chemical composition affect the time of fog formation if simulations were started after sunset?

Figures: Some figures could be made easier to read by using colors.

Proofreading needed. Examples of bad language: Page 17964, line 27: “the important of the interaction...” Page 17984: line 3-4: “leading to too cold a simulated fog layer.” Page 17988, line 19-20: “increasein”

References: Bergot et al 2008 was used as a reference several times. I do not know if it is reason for criticism, but the reference does not tell me too much as it is in French. As far as I see the most interesting part of this manuscript to scientific community is now the measurements done. Also the webpage referred is in French.

References:

Prisle, N., Raatikainen, T., Sorjamaa, R., Svenningsson, B., Laaksonen, A., and Bilde, M.: Surfactant partitioning in cloud droplet activation: a study of C8, C10, C12 and C14 normal fatty acid sodium salts, Tellus Series B-Chemical and Physical Meteorology 60B 416-431, 2008.

Nenes, A. and Seinfeld, J.H.: Parameterization of cloud droplet formation in global climate models J.Geoph.Res, 108 (D7), 4415, doi: 10.1029/2002JD002911, 2003

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