Atmospheric Chemistry and Physics Discussions

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Comment on acp-2022-385

Anonymous Referee #1

Referee comment on "Impacts of an aerosol layer on a midlatitude continental system of cumulus clouds: how do these impacts depend on the vertical location of the aerosol layer?" by Seoung Soo Lee et al., Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2022-385-RC1, 2022

The paper describes the effects of the presence of aerosol layers above or below the cloud top/bottom by means of repeated simulations of a case study over the Korean peninsula. In addition, the study considers the effects of a different aerosol concentration in the layer, and separates the impacts of the radiative effects and the updrafts/downdrafts transport of the aerosols from the layer.

While the study points out relevant aspects in the interactions between clouds and aerosol layers, the manuscript is unfortunately hard to read and follow. The English in particular would need to be reviewed and the sentences restructured (I pointed out the most difficult to understand in the specific comments). Also, I found that some of the descriptive paragraphs on the different experiments were quite challenging to read. While the various simulations exercises are actually based on the simple concept of modifying one single feature at a time to see the effects, the description of the impacts are sometimes repetitive or diluted on a long dispersive text. I would suggest instead to shorten those sections and use, in all the various sections, the concise and straight-to-the-point style that the authors adopted on the paragraph between lines 435-452, which clearly emphasize the physical response of the added aerosol feature on the cloud system.

To conclude, I would suggest a major revision of the manuscript before having it accepted for publication on ACP.

General comments:

Page 4, lines 99-109: As many important concepts are introduced in this paragraph, it would be beneficial to add some references.

Page 5, lines 125-126: I would suggest to eliminate this sentence as the concept is repeated later on lines 130-132. The introduction mentions among the objectives the improved understanding effects of a cloud deck on a cloud deck but the paper then focuses only on aerosols layer.

Page 6: It is not clear the time resolution at which the simulation is run. Same for the time length. I would assume that it corresponds to the event length (10:00 to 18:00 LST) but that's not clearly stated in the manuscript.

Page 7, lines 183: The authors say that there is an observed aerosol system without showing it, It would be useful to have a reference or show the data indicating it.

Page 7, lines 188: what does the (20) stands for? Is it a repetition of the 20km resolution?

Page 7, lines 195: on April 15th 2015, from a radiosonde sounding collected close to the domain (how close? It would be better if you also pinpoint the radiosonde location on the map of figure 1)

Page 7, lines 198: What is an "open lateral boundary condition"?

Page 7, lines 200: Where is the AERONET site from which the data are used? Please indicate it also on the map of Figure 1.

Page 7, lines 206-216: The authors here refer a lot to the AERONET data (chemical composition, size distribution, aerosol concentration) but none is shown, it will be useful to have some of the data plotted.

Page 7, lines 220: What does justify the choice of 150 cm-3 as a concentration above the layer?

Pages 10 line 309: what does the (052022) mean?

Page 18 lines 530-537: It is not clear to me where the effect on CDNC is shown.

Specific comments:

Page 3, lines 63-64: For better readability purposes I suggest to rephrase the sentence as: “This is turn makes differences in cloud mass, which is larger when the layer is in the lower atmosphere and smaller when the layer is in the upper atmosphere”

Pages 3, lines 68-69: “Aerosol affects not only radiation but also aerosol activation” -> “Aerosol concentration affects…”

Page 3, lines 71,74: Similarly as above, I suggest to shorten it as: “As aerosol impacts on radiation team up with those on the droplet nucleation, the cloud mass get larger when the aerosol layer is in the low atmosphere rather than when the layer is in the upper atmosphere”

Page 9 line 254: “roles of cloud impacts on aerosols in aerosol-layer impacts on clouds are identified” this sentence is not clear!

Pages 10 line 288: I would remove the “As seen in” and start the sentence directly with “Figures 5b”..

Pages 10 line 297-300: This sentence is not clear

Pages 10 line 310: “In Figure 5” or “In the panels of Figure 5”

Pages 12 lines 343-345: Please rephrase, this sentence is hard to read.

Pages 12 line 357: I guess the authors are referring to the following hours, therefore I would rather say “the rest of the period”

Page 14 line 416: typo “conrol-1500 run”

Page 15 line 433: “The relatively short lifetime of the cloud system in the control run is shorter than..” -> “The lifetime of the cloud system in the control run is shorter than..”

Page 15 lines 446-448: I rather suggest “This means that with increasing concentrations of aerosols, the effects of radiative heating of aerosols in the low atmosphere enhances instability and cloud-liquid mass”

Page 16 lines 464-466: this sentence is a repetition of the lines 460-461.

Page 18 line 523: “surface-reading”? Reaching?

Page 20 lines 597-599: “this does not affect aerosol concentrations AND radiative heating of air..”

Figure 2, title: “Vericial” -> “Vertical”

Figure 3: I do not find this figure relevant, it can actually be removed also because the same information is also reported on Figure 7.

Figure 5 and 7: It would be better to have the whole 4 panels together in the same page