

## ***Interactive comment on “An integrated modeling study on the effects of mineral dust and sea salt particles on clouds and precipitation” by S. Solomos et al.***

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Response to Anonymous Referee #2

We would like to thank the reviewer for very thorough and thoughtful comments that have substantially improved the manuscript. Our responses to the issues raised are provided below.

General Comments: This paper uses a recently developed integral modelling system to assess the influence of aerosols on cloud formation and precipitation with idealized and realistic case studies. It addresses an interesting and highly relevant topic of atmo-  
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spheric science that fits well with the scope of ACP. The analysis is scientifically sound and the paper logically structured, but the presentation needs substantial revision. The language needs to be improved and the text and figures should be shortened. The Introduction needs clear objectives that are referred to in the conclusions. Other major and minor points of criticism are listed below.

[REPLY] We thank the reviewer for the useful comments. The manuscript has been extensively revised and reorganized to address these concerns. The figure quality has been improved and the objectives of the paper are now more clearly stated. More details on the changes are presented below.

Major Comments: 1. Length and scope: The paper is much too long. This is mainly due to the fact that a model description, and idealized and realistic case studies are squeezed into one article. In my eyes the former should be compressed as much as possible. Most new model features are taken from elsewhere and could simply be referenced here. You should not explain all possible options, but only the ones you use here. In a way, it would be better to publish the model development as a technical note separate from the science article. The actual results section also needs some shortening and streamlining.

[REPLY] This is the first paper using the ICLAMS model framework, so we feel that a thorough model description is necessary. We do understand the point raised, and have kept a brief model description summary in the text, and moved the details to appendices.

2. Structure: All the results are packed into one long section. In my opinion, one section about idealized and one section about realistic simulations would be better. You then need several clearly focussed subsections to these main sections. Give clearer motivations and introductions for each experiment and try to link the different parts better with each other.

[REPLY] Good point. The revised manuscript includes distinctive subsections for each

experiment and better description is provided.

3. Language: Particularly in Section 3.2 but also elsewhere, the language needs improvement. Examples of bad style are repetitions such as 2 times “aerosol-cloud-climate interactions” in L9 and 2 times “air quality and meteorology” in L12-13 in Abstract. Wordings such as “A description . . . is described” (end of section 1) sound bad. There are also grammatical errors such as subject-verb disagreements and wrong prepositions.

[REPLY] The manuscript has been thoroughly revised for language issues.

4. Usage of “air-quality”: I was somewhat surprised to see that the expressions “air quality” and “polluted” are used here as a synonym for “aerosol content and characteristics”. In my eyes the former has a lot to do with impacts on humans while the latter is more neutral and more appropriate here. For example, maritime air is rich in sea salt, but would be considered of high quality.

[REPLY] “Air-quality” is commonly used in air-pollution modeling as a term to describe the atmospheric loading of several pollutants that can be of anthropogenic or natural origin. We understand however the issues raised, and used the suggested terms wherever appropriate. We also agree with the reviewer that “polluted” may convey a negative meaning. In order to avoid this impression we used the terms “pristine” and “hazy” for low and high aerosol concentration, respectively.

5. Figures and tables: There are too many figures and tables. Go through all of them and check what is really needed and what could be combined or compressed. Captions are generally too short and do not contain all necessary information. Many numbers or labels are much too small. All panels should have labels a,b,c etc. for clear reference in the text. Omit unnecessary headings.

[REPLY] All figures have been revised following the comments from all reviewers. Figures 5, 10 and 17 have been removed while Figures 4 and 6 have been combined.

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Editorial Comments: 1. Punctuation: Lots of strange commas or missing commas throughout the text (e.g. L2). Does ACP use British or American enumerations? Check carefully throughout.

[REPLY] The paper has been revised for punctuation issues.

2. Tense: A lot of use of past tense. Present tense is often better, as it makes a paper livelier.

[REPLY] Good point. The paper has been revised according to the suggestions.

3. Abstract: You don't really do a single-cloud study, do you? Please separate clearly what comes out of the idealized and what from the realistic model study. Say more clearly what you are doing and what the main conclusions are. What is new, what has been known before?

[REPLY] The reviewer is correct. “Single cloud study” has been replaced by “idealized cloud environment” in the abstract.

4. Hyphenation: Decide whether you want to write “sea-salt” or “sea salt” and stick with it. Check for other examples.

[REPLY] “Sea salt” is used throughout the revised manuscript.

5. References: Chronological, then alphabetical order. If you use a,b etc., a should come first.

[REPLY] The reference list has been revised according to the suggestions.

6. Abbreviations: Define at first usage and then use throughout (e.g. IN).

[REPLY] Done.

7. Geographical terms: Be consistent. I would write northern (not Northern) Africa for example.

[REPLY] The revised manuscript has been thoroughly checked for consistency of geo-

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graphical terms.

8. Avoid first person, unless you would like to convey a personal opinion.

[REPLY] Done.

9. 23961, L7: Why old IPCC report?

[REPLY] We apologize for this oversight. We now reference IPCC, 2007.

10. 23962, L4-5: Parts before and after “and” say the same.

[REPLY] Thank you for pointing this out. Corrected.

11. 23965, L11: What is meant by the “the particle radius”here?

[REPLY] It is the radius of the particle in an environment of 80% relative humidity as described by Zhang et al., (2005). The corresponding reference has been added in the revised manuscript.

12. 23968, L23: Is vapor a hydrometeor?

[REPLY] No. Vapor is not a hydrometeor and this sentence has been rephrased in the revised manuscript.

13. 23969, L21: Schulz (also 23977,L10)

[REPLY] Corrected.

14. 23970, L 10: What is “winter weather type”?

[REPLY] We agree with this comment. This sentence has been rephrased to “winter convective clouds”.

15. 23970, L11: 3x wind in one line.

[REPLY] Done.

16. 23971, L 19: “clouds suppress precipitation” sounds odd.

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[REPLY] This sentence has been rephrased.

17. 23971, L24: Do you mean hazy here? I am confused.

[REPLY] No, we mean “pristine”. This sentence has been rephrased for clarity.

18. 23974, L2-7: A lot of bad terminology here. What is a “cold cyclone”? What do you mean by “second air mass”? Is that the warm sector of the cyclone? When you talk about air masses interacting, do you mean frontal uplift? Say exactly where the convection is triggered. When you say northeasterly, do you mean northwestward? “Hail dispersed”... sounds odd.

[REPLY] This section has been rephrased for clarity in the revised manuscript. Also the area where convection occurred is now indicated in Figure 6b.

19. 23974, L17ff: Rather technical and should be integrated into section 2.

[REPLY] We believe that the description of model configuration is more appropriate here since it is used for this specific case study.

20. 23975, L3: I see more than 2 main dust sources.

[REPLY] Indeed. This sentence has been rephrased in the revised version of the manuscript.

21. 23975, L6: How do you vary chemical properties from source to source?

[REPLY] The present version of the model does not include the capability to differentiate dust composition based on origin. This was a general statement and has been removed from the revised version of the manuscript to avoid confusion.

22. 23976, L2: What do you mean with “average location”here?

[REPLY] “Average location” here is the mean geographic location during each sampling period. For each aircraft sampling period the starting geographic location (start\_lat, start\_lon) and the final geographic location (end\_lat, end\_lon) were available. The

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mean location was calculated as This sentence has been rephrased in the revised manuscript.

23. 23976, L8: Omit “qualitatively and”.

[REPLY] Done.

24. 23976, L14: Why is shear important here?

[REPLY] Wind shear is important because it produces turbulence and it helps the vertical transport of salt particles.

25. 23978, L2-3: Process rather than procedure? The increase in THETA $\epsilon$  is not very clear.

[REPLY] Corrected: “Process” instead of “procedure”. Also the wind contours have been removed from Figure 15c (now Figure 12c) and the increase in  $\theta_e$  is more clear.

26. 23979, L10 and elsewhere: I don't think it is appropriate to give bias improvements in %.

[REPLY] Done.

27. 23979, L11: Air mass type is not only about aerosol, it also includes temperature, moisture and stability.

[REPLY] “Air mass type” has been replaced by “aerosol concentrations” in the revised version of the manuscript.

28. 23979, L14-15: Sentence should be dropped.

[REPLY] This sentence cannot be removed because it describes significant findings. We have rephrased it however for clarity.

29. 23979, L18 and elsewhere: I would say it is all the same case, but a different sensitivity experiment.

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[REPLY] The various sensitivity experiments that are presented in this section are named as Cases1-9 just to distinguish between them.

30. 23980, L1-11: Too general. Try to write a very focused and concise conclusion section. This is what most people read.

[REPLY] The conclusion section has been shortened and revised in the new version of the manuscript.

31. 23980, L17: “clouds suspended precipitation” sounds odd.

[REPLY] This sentence has been rephrased in the revised version.

32. 23982, L10: I don't recall this number from reading the paper. Don't introduce new results here. Summarize and discuss.

[REPLY] The reviewer is correct. These numbers were in an older version that was shortened and they were removed. Now they have been added in section 3.2.4 of the revised manuscript.

33. 23981, L22: basis?

[REPLY] Yes. Corrected.

34. 23982: Bias is standard and does not need to be explained. Omit Appendix.

[REPLY] We believe that it is better to keep it in the Appendix for clarity and completeness.

35. The reference list seems a little too extended for my taste. Can you concentrate more on key publications?

[REPLY] We are aware of the long reference list, but it is in our opinion necessary for this manuscript.

36. Table 1: Basic equations in plural. DA: Do you mean analysis data?

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[REPLY] Yes. It is now corrected.

37. Table 2: not really needed.

[REPLY] Indeed. It has been removed.

38. Table 4: Strange use of word “air mass”.

[REPLY] “Air mass type” has been replaced by “aerosol scenario” in the revised manuscript to avoid confusion.

39. Combine Figs. 4 and 6.

[REPLY] Done.

40. Green lines in Fig. 8 are almost impossible to see. Quantify near-surface. Don't repeat date in caption, but reword (other occurrences).

[REPLY] Done.

41. Fig. 9: Does flux need time in the unit? Strange color scale. Omit the many ticks around the frame (also Fig. 13).

[REPLY] Flux is measured in  $\mu\text{g m}^{-2}$  per model timestep. The figure has been redrawn.

42. Fig. 10: Why different views in a and b? Do you really need Fig. 10? Fig. 11 says practically the same thing.

[REPLY] Figure 10 has been removed.

43. Fig. 15: Caption should say that this is EXP2.

[REPLY] Done.

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Interactive comment on Atmos. Chem. Phys. Discuss., 10, 23959, 2010.