**Atmospheric
Chemistry
and Physics
Discussions**

Interactive comment on "Assessing the mineral dust indirect effects and radiation impacts on a simulated idealized nocturnal squall line" *by* R. B. Seigel et al.

Anonymous Referee #1

Received and published: 11 January 2013

The paper investigates in a comparative way the individual and synergistic impacts of mineral dust and the cloud radiation feedback for the case of an idealized nocturnal squall line. For this a sophisticated model framework is used with a high spatial resolution (in comparison to other available three dimensional studies dealing with dust) and a factor separation analysis is applied to separate the impact of dust, the impact of the cloud-radiation feedback, and non-linear feedbacks caused by the combination of both. The results are well structured and are sufficient to support the conclusions.

The impact of mineral dust on cloud microphysics and the non-linear feedbacks introduced in cloud development are still poorly understood and the paper, using simula-

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Interactive Discussion

Discussion Paper

tions with high spatial resolutions and factor separation analysis, is a good contribution to improve our understanding in that field. I find the paper suitable for publications in Atmospheric Chemistry and Physics after the following comments and corrections have been taken into account:

- I think the title can be confusing. It can be read in a way that suggests that the direct impact of dust on radiation is studied in the paper (which is - so far - not the case). Maybe 'cloud-radiation feedbacks' or something else is more specific than 'radiation impacts'.

- If technically possible, I highly recommend to include the direct impact of dust on long-wave radiation in the analysis. The dust particles may have a strong impact on radiation in this case. The discussion of synergistic effects of dust and radiation therefore needs the direct contribution of the dust. I know that the focus of the paper is on the microphysical impact of dust particles, but accounting for the impact of dust on radiation and using factor separation to analyze the synergistic effects would be a great step forward in understanding reality. I think the paper would benefit a lot.

- To put the results in context, more details about the realization of the dust-cloud interaction are needed. Especially because the cited paper including all the details (Saleeby and van den Heever, 2012) is not published yet and therefore not accessible.

  – Please provide details about the representation of the dust size distribution (log-normal distribution? Parameters used?) and the dust properties (For example, what is the hygroscopicity of the dust? How is the activation of the dust treated in the model).

  – Is there only homogeneous freezing in simulation dOFFrOFF and dOFFrON? If no, what assumptions are made? Which parameterizations are

used?

– Since the parameterization of DeMott et al. 2010 only accounts for temperature, is there a specific supersaturation threshold w.r.t ice applied for het. nucleation?

– A table giving an overview about the parameters used in the cloud microphysics would be nice (e.g. for the gamma functions used, . . .).

– How is the parameterization of the cloud optical properties realized in the model? Do the optical properties depend on droplet and crystals size?

– You mentioned that emission by saltation etc is included in the model. Is the emission of dust treated or is the dust concentration only prescribed by the initial conditions? If emission is treated, what are the assumptions (emission everywhere, soil properties, etc.)

• I recommend not to use the term 'aerosol indirect effect' in the context of this paper. In the paper only the impact on cloud microphysical properties is discussed, not the impact on the radiation budget or consequences for the climate. Using 'aerosol cloud interactions' (ACI) is maybe an alternative to AIE.

• Please introduce variables (italic, lowercase letters) instead of lengthy abbreviations like TMIX, CL2RT, ... The results section is very uncomfortable to read because of the many uppercase abbreviations. Only the different factors should be in uppercase.

Minor comments:

29610 l. 29 In order to improve ...

29612 l. 27 Saleeby et al., 2012 not in References

29613 l. 3 two-stream radiation; l. 5 NACL is not used in this study please mention this somewhere; l. 15-17 more details needed about hygroscopicity, feedback with supersaturation,...

29614 l. 11 ... mineral dust and to the radiation feedback; l. 13 ... vertical grid spacing from ...;

29615 l. 1 Aerosol data measured near...; l. 5 The DeMott paper discusses measurements from CRYSTAL FACE in 2002. I do not see how this confirms that the data used here is a 'good' sampling of the SAL;

29617 l. 23 no " "

29619 l. 19 something is wrong with this sentence. ...as for precipitation... (?!)

29625 l. 16 is the "cloud-to-rain process" in this case autoconversion or accretion or both?

29627 l. 4-6 I don't understand this sentence. We are talking about water vapor diffusion here, and not the condensation of e.g. sulfuric acid vapor or something which is related to aerosol nucleation (... nucleate a dry aerosol...).

29629 18-... Since the overall impact of SYNERGY is small, I think its impact is overemphasized in the summary (roughly one third of the whole summary).

Table 1 'Dust acting as CCN and IN' maybe more specific than 'being microphysically active'

Table 2 What is meant by "Part of the predicted field ..."?

Figure 3 Please enlarge the label of the maximum surface wind reference vector.

re 4 and 5 Units are missing at the colorbar. Please switch the plot axis to be consistent in Fig 4 and Fig 5.

Interactive comment on Atmos. Chem. Phys. Discuss., 12, 29607, 2012.

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