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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Modeling of Saharan dust outbreaks over the Mediterranean by RegCM3: case studies" *by* M. Santese et al.

Anonymous Referee #2

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The paper under review presents a model study of Saharan dust outbreaks over the Mediterranean. The authors use the regional model RegCM3 coupled with an aerosol module that treats mineral dust, black carbon, organic carbon and sulfate. For two case studies they present results on the direct radiative forcing of mineral dust and on the radiative feedback.

The topic of the paper fits into the scope of ACP. My main point of critique is that the presentation of the simulation results is rather limited to "listing values" that are obtained in the three simulations. The interpretation is lacking. This leaves me unclear as to what the main point of the paper is. I will substantiate this concern in my evaluation

below. Before this paper can be published, I recommend that the comments below should be addressed.

Major comments:

1. Model description: It does not look like that there has been any significant model development, since the authors refer extensively to previous publications. While this is fine for the most part, I would like to know more about the assumptions made regarding the treatment of dust. For example the authors state in the introduction that "sign and magnitude of the direct dust radiative forcing are controlled by the dust optical properties, which depend on the dust size distribution and refractive index. The latter in turn depends on the mineral composition and particle mixing state".

This leads to my questions: What are the assumptions made regarding optical properties? And what is the sensitivity of the results regarding the optical properties? Since the results show that SW and LW radiative forcing partially compensate each other, one important question that a model like this could investigate is: How robust are the findings on overall radiative forcing when the optical properties are varied within the range of their uncertainties? The size distributions should be looked at since this may help to explain the underestimation of dust load after transport. If the particles sizes are simulated too large, the removal due to gravitational settling might be overestimated.

2. Regional climate model versus global model: It would be useful to highlight which processes can be represented more accurately with RegCM3 compared to a global model. The authors mention on page 19408 that aerosol effects vary within few tens of kilometers and conclude that high resolution regional climate models are necessary to resolve this. While I agree with this statement in general, I am wondering if the 50 km resolution is actually high enough to do so. Also please add information on the model time step.

3. Section 3.3: The comparison of lidar measurements and model calculation shows that the model underpredicts the extinction coefficient in Lecce. The authors attribute

this to “weak long range transport”. What does this exactly mean? Are the wind fields wrong? However, on page 19394 the authors conclude that the wind patterns are captured well. Are the emissions too low? Are there biases in the prediction of the size distribution? The paper would be greatly improved if this discussion were deepened. Given that the underprediction occurs in the lowest 3 km it looks more like this is due to the missing anthropogenic aerosol contribution.

4. Page 19402, line 7: Which aerosol optical and microphysical properties are meant here?

5. Case study for 17 and 24 July: The results for 17 and 24 July look qualitatively quite similar, what is the point in showing both of these? If nothing new is added, one of the cases should be omitted, which would reduce the number of figures.

6. Section 5, Discussion on aerosol radiative feedbacks, page 19403, line 14: What is meant by “internal model variability”? Throughout this paragraph there it is mentioned that the results are dependent on “simulation assumptions”. What does this mean?

Figures 13 and 14 show that simulations REF and Exp1 are slightly different. Supposedly simulation REF is closer to reality as it includes radiative feedback. Does this improve the quality of the simulation?

7. Simulation Exp2: With this simulation the impact of radiative forcing of mineral dust alone should be isolated. The authors conclude that mineral dust has a significant role. However this conclusion is not surprising as they state earlier that anthropogenic aerosol contribution might be underestimated. Please comment on this.

Minor comments: 1. page 19399, line 9: Notation “–(10-5) W/m2”. Looks confusing to me. I suggest replacing it with “-10 to -5 W/m2”.

2. The multi-panel figures are very small and too low resolution. They need to be improved to make them publication quality.

Interactive comment on Atmos. Chem. Phys. Discuss., 9, 19387, 2009.