

## ***Interactive comment on “Saharan dust event impacts on cloud formation and radiation over Western Europe” by M. Bangert et al.***

**Anonymous Referee #1**

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The paper investigates the impact of mineral dust particles on clouds, radiation and atmospheric state during a Saharan dust event over Europe in May 2008, addressing relevant scientific questions, which are within the scope of ACP. The impact of dust on clouds is still poorly understood and the paper represents a step forward in the field. It uses sophisticated parameterizations for aerosol activation and ice nucleation and two-moment cloud microphysics, dust-radiation interaction, the effects of soluble coatings on dust, and the inclusion of other aerosol species. The scientific methods and assumptions are valid and clearly outlined and the results shown are overall sufficient to support the main conclusions of the paper. The main conclusions are the rather low impact of dust on warm clouds with a slight increase in the case of coated dust, a rather large impact on ice clouds between the freezing level and the level of homogeneous freezing (which somehow is in agreement with the lidar statistics of Seifert

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et al. (2010)), and the combined effects of the interaction of dust with clouds and the direct effects (including semi-direct feedbacks) improving the weather forecast skill for 2m temperature in the region of study.

General comments

While the emphasis of the paper is on the impact of dust on liquid and ice clouds, the interaction of radiation is also included. I believe that an additional simulation including only dust-radiation interactions compared to the simulations already included in the paper would be helpful for the community to further understand the local semi-direct effect feedback of dust on clouds. The simulation presented in the paper including dust-radiation interaction also includes the impact on clouds and only at the end of the manuscript it is described in terms of total perturbation to the incoming fluxes and 2m temperatures. Besides the direct effect, dust absorption changes the thermal structure of the atmosphere, its dynamics and cloud properties. The authors may consider including a brief analysis of the separate effects of radiation on clouds.

Minor issues:

- Page 31939, lines 17 to 28: Please include as well other more seminal references on the transport of dust towards Europe and the Mediterranean. Also the order of the references should be chronological. With respect the improvement of weather forecasts, in the text extend its application to dust affected areas (not only where there are sporadic events). For example in North Africa, although the background levels may be well represented by climatologies, there are strong dust storms affecting the radiation balance which are significantly underestimated by climatologies.
- Page 31941, line 17: IN instead of ice nuclei
- Page 31947, line 14: introduce a comma in “. . .COSMO-ART, the measured. . .”
- Page 31948, Radiation: Given the uncertainties in the optical properties of dust, please include a brief summary about the ones used here.

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- Page 31951 line 28: "a coarse comparison (to verify) if the..."
- Page 31952, line 17: "...the dust particle(s)...", line 27: "...is favorable (for) heterogeneous..."

Tables:

Table 2 caption should define if, ic, jf... (which is included in table 1 caption)...

Figures:

- All the figure captions lack of details about the subfigures. Please explicitly list and give more details about all the subfigures.
- Figures 5, 11 and 12 cannot be clearly seen in my printed copy

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Interactive comment on Atmos. Chem. Phys. Discuss., 11, 31937, 2011.

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