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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Regional scale effects of the aerosol cloud interaction simulated with an online coupled comprehensive chemistry model" *by* M. Bangert et al.

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We thank the reviewer for his valuable comments.

»»While in my opinion, this is a paper publishable with just minor modifications, I believe it would be worth investing some more effort at one point to make it even more interesting: If the authors put a little additional work into their study of the effect of orography, they could propose a parameterisation for this effect directly applicable to large-scale models. Specifically, I suggest to compute the terrain-slope index TS not for 2x2 (thus, 28x28 km2), but for 10x10 (i.e., 140x140 km2) to obtain a scale relevant for current global climate models. Further, I suggest to compute at a coarser grid, aver-

aged over 10x10 grid-points of COSMO-ART, the terms contributing to the cloud-scale updraft given in Eq. 4, that is, w at the coarse grid, the TKE and radiation contributions at the coarse grid, and the contribution by subgrid orography, for which a formulation in terms of the TS index might be found.««

We agree with the referee that it is worth putting more effort in a parameterization of the orografic effect on aerosol activation for the use in climate models. But this is a major effort, because it should be investigated for more cases and longer periods to get stressable numbers. Therefore we want to postpone it to a follow up paper. Nevertheless we included a first pragmatic parameterization of the mean vertical velocity as a function of TS, which is based on the presented simulation data of this study and which can be applied in climate models directly, following the approach which was already described in the text.

Specific comments:

»»p2 l15: CCN should be spelled out where appearing first««

We added the full spelling.

»»p3 l14: the main limitation is from the fine grid meshes««

We improved this sentence.

»»p6 l11: It would be worth mentioning here that no dust is considered (or is it?). Some words on the representation of in-cloud chemistry are needed as well. One could mention here that the emission inventories are detailed later««

We extended the model description section. In this study in-cloud chemistry is neglected, but will be included in COSMO-ART for future studies.

»»p9 l7: ratio (without "n")««

We changed it.

»»p9 l25: It would be useful to explain how the ice crystal number concentration is obtained. Is this a diagnostic quantity related to ice mass mixing ratio?««

We extended the section describing the ice phase processes.

»»p11 l23: "The simulation period is 16-20 August 2005." (without "the")««

We changed it.

»»p12 l9: please explain briefly why it is switched off««

We wanted to focus on the interaction of aerosol with cloud microphysics only. Introducing the direct interaction with the aerosol will introduce possibly feedback mechanisms that make it more difficult to understand the mechanisms we are looking for. But nevertheless the combination of both is very interesting and will be part of a future study.

»»p14 l13: I assume this vertical velocity is the one computed using Eq. 4. Please specify here.««

For this evaluation the grid-scale vertical velocity is used, because we wanted to rely the analysis on directly simulated and resolved quantities.

»»p18 l11: The authors seem to have another simulation available for this period, which is the one without aerosol-cloud interactions from Vogel et al. (2009) - as they say p11 l24. It would be worth briefly describing whether another slight perturbation to the model (as done by Vogel et al., 2009) also introduces a shift in precipitation patterns of similar amplitude. Or, alternatively, one could perform a simulation with slightly perturbed initial or boundary conditions to assess the influence of slightly perturbed weather on precipitation. The intention would be to get an impression of the significance of the aerosol-cloud interactions for this precipitation perturbation.««

The results of Vogel et al. (2009) show a shift of similar amplitude in the precipitation patterns for the simulation of the whole 5 day period (26.-30 Aug.2005, Fig. 1). Perturbations of a regional model always will produce these shifts in the precipitation

pattern after some days of simulation, especially in the case of locally isolated clouds (e.g. convective clouds). This makes it hard to isolate and quantify processes that have a direct physical impact on the precipitation formation, just by looking on precipitation distributions. For Precipitation events with a homogenous spatial precipitation distribution for a larger area this plays a minor role. We were aware of this problem. To minimize the impact of this model sensitivity we've chosen on the one hand a rather short simulation period of only 2 days for the investigation of the precipitation impacts and on the other hand we isolated the physical impact of the aerosol by investigating the distribution and the averages of the precipitation susceptibility.

»»Caption Fig. 5: It would be good to specify whether this is w as inferred from Eq. 4.««

The "w" is the grid scale vertical velocity. See reply on comment for p 14 l13.

»»Fig. 11: The authors might choose a joint histogram rather than points to illustrate where most of the points are located.««

We changed the distribution of points to a joint histogram to highlight were most data points are located.

Interactive comment on Atmos. Chem. Phys. Discuss., 11, 1, 2011.

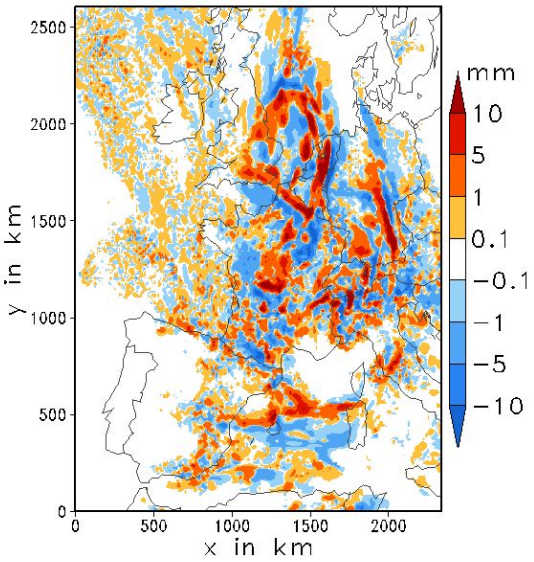

Fig. 1. Difference in accumulated precipitation after 5 days (26.-30 Aug.2005), initiated by the direct radiation effect of the aerosol (simulation data from Vogel et al. 2009)