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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Technical Note: Anthropogenic and natural offline emissions and the online EMissions and dry DEPosition submodel EMDEP of the Modular Earth Submodel system (MESSy)" *by* L. N. Ganzeveld et al.

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Dear reviewer,

Thank you for the feedback on our manuscript submitted as a technical note to ACPD in 2006. Based on your and the other reviewers comment's as well as discussions with the co-authors and editor, we have changed the set-up of the manuscript such that it is now resubmitted to ACP as a regular manuscript instead of a technical note. This, and having repeated some of the model simulations, also explains the rather long time period in between the publication in ACPD and the resubmission of this revised version of the paper.

We would like to respond to the major and minor comments:

“My first major comment is that I fail to see how this technical note will be of interest to the larger scientific community. This seems to me merely a model description disguised as a technical note and no one but the people involved in the use and development of MESSy will find useful information in this note. In my early evaluation of this note, I had asked for not publishing it and I still think this should be the case, unless the authors are able to explain better the significance of this publication."

In our view technical notes contribute to a better documentation of components and tools (models or measurement techniques) that form the basis of scientific analysis, and thus contribute to the requirement that it should be possible to repeat and check scientific investigations. Possibly, the fact that our manuscript consisted not only of a description of some of the specific features of the representation of emission and deposition in ECHAM5/MESSy1, but was complemented with a discussion on the sensitivity of deposition fluxes to the emissions heights, might have created a misunderstanding how to appreciate this paper.

Based on the raised critisism, also by the other reviewer, the manuscript has been strongly revised; some more technical issues of the gaseous and aerosol dry deposition, described in section 3.2 have been removed and scientific arguments have been extended. A more detailed analysis of the sensitivity of the simulated atmospheric chemistry, more particularly the boundary layer concentrations, associated with changes in the assumptions on emission heights has been included. This is also expressed by the new title: *Sensitivity of atmospheric chemistry and surface deposition to emissions in the ECHAM5/MESSy1 model.* Various statements have been introduced to stress that this analysis indicates specifically how simulations of boundary layer concentrations and surface deposition are affected by rather arbitrarely made assumptions on the effective emission heights in ECHAM5/MESSy1 and most comparable atmospheric chemistry models. According to our knowledge such sensitivity test

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have not yet been presented so explicitly, except for a study by Freitas et al. (2006) using a cloud and biomass burning plume resolving model. In our work we show the consequences of assumptions on emission height, not only of biomass burning but also other emission processes. As such the paper demonstrates that the representation of the emissions, especially the spatial and temporal resolution, in models such as ECHAM5/MESSy needs a high priority for further model improvement, which makes this paper also of relevance to larger scientific community.

"To achieve that goal, a significant amount of analysis of the significance of interactive vs non-interactive emissions would help. The authors document that they are different, but we don't know if this matters."

Concerning the interactive emissions, we have limited the analysis of the sensitivity of the horizontal resolution to the sensitivity of emissions, indicating especially for the reactive VOC's relevant differences which are, however, much smaller compared to the uncertainty in the global emission budgets (Alex Guenther has indicated that according to him this is $\sim$100%). We refrained from showing the differences in atmospheric chemistry and surface deposition associated with the different online calculated emission fluxes also since this the different resolutions of the climate model result in a different simulations of climate and the major drivers of the interactive emission calculations.

1) what is the difference between this publication and the list of publications mentioned in lines 48-52?

The main differences between the Ganzeveld et al. (2002b) publication and this manuscript are described in the first part of Section 3, indicating modifications of the original emission representation in ECHAM4, e.g., the inclusion of animal manure induced NO emissions and the representation of biomass with a maximum Leaf Area Index of 7 for tropical forests. The differences between this manuscript and Kerkweg et al. (2006a, b) was also confusing to the other reviewer. We have modified the text such

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it should make the similarities and differences more clear. ONLEM and DRYDEP are presented in technical notes describing two other MESSy modules being used in for example the extensive model evaluation by Jöckel et al. (2006) for the calculation of a selection of online emissions and dry deposition, respectively. In fact these submodels are mostly recoded versions of the subroutines of the original work included in EMDEP, which have been developed during the difficult development stage of MESSy to provide benchmark versions of user-friendly and efficient calculations of online emissions and dry deposition. The concept of the calculations is the same. EMDEP is continuously further developed, with modifications also being implemented in ONLEM and DRYDEP. Soon, a version of EMDEP will be made available for the coupled calculations of emissions, dry deposition and canopy interactions.

“2) why would the ship emissions be emitted above 145m?"

Ship emissions are not emitted above 145m, they are redistributed over the two lower levels of the model where the two heights resemble the heights provided by the EMEP model.

For those categories not mentioned in the EMEP model, we assumed that the effective emission height is either 45 or 140m except for ship emissions which we distributed equally over those two emission heights.

These heights relate to the vertical layers of the default setup of ECHAM5/MESSy such that 50% of the ship emissions are in the surface layer of $\sim$ 65m whereas the remaining 50% is emitted in the layer of $\sim$140m depth (reference height $\sim$ 130m).

“3) it seems to me that the inrcease in sea-salt emissions (line 311-315) should be related to larger values of surface (or 10m) winds, which should be more the case in the high-resolution case than the coarser resolution."

You are right with the statement that it is expected that the higher resolution would result in simulated larger extremes in the 10m wind speed and consequently, with the non-

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linear response of the emissions in a substantial increase. However, despite this we simulate apparently a larger emission flux compared to the higher resolution simulation by Stier et al. which has been nudged towards the ECMWF analyzed meteorology and which apparently does not only results in simulated lower wind speeds over the oceans but also over land (see discussion about mineral dust emissions).

4) in the discussion at lines 337-340, what is the 10m-wind bias of the model vs observations?

A direct comparison of simulated and observed 10m wind speeds has not been conducted for the present work. In previous analyses of different sea salt emission parameterization in our group it has been concluded that the model nudging leads to reduced wind speeds, generally lower than in the ERA40 reanalysis data, whereas the free running model seems to generate wind speeds closer to the ERA40 reanalyses.

Interactive comment on Atmos. Chem. Phys. Discuss., 6, 5457, 2006.