

Interactive comment on “Analysis and quantification of the diversities of aerosol life cycles within AeroCom” by C. Textor et al.

Anonymous Referee #3

Received and published: 24 October 2005

Review of paper acpd-2005-0179: Analysis and quantification of the diversities of aerosol life cycles within AeroCom Author(s): C. Textor, M. Schulz, S. Guibert, S. Kinne, and AeroCom modellers

The manuscript describes the differences (or diversities) between 16 global scale aerosol models assessed within the AeroCom intercomparison exercise. The main focus of this AeroCom paper (more manuscripts to come) is to describe the differences in aerosol burden and distribution due to differences in the various model components, including meteorological parameters provided by the off- and online driver models and aerosol processes including emissions, dry and wet deposition, sedimentation and transport. The paper addresses as such an important topic that gives an

Full Screen / Esc

Print Version

Interactive Discussion

Discussion Paper

insight in how much credibility we can give to some of the most important applications of such models, calculation of the aerosol radiative forcing (not addressed in this paper). It clearly indicates that there is still a long way to go with respect to global aerosol models but at least the comparison indicates about priorities of future research on large-scale aerosol modelling not only with respect to the aerosol processes but also concerning the meteorological parameters such as precipitation and boundary layer turbulent transport.

The paper is well structured including many tables and figures but which are required to describe the main features of all the models and the analysis.

I have mostly suggestions for textual modifications:

Pp 8333, line 19: The burdens of dry masses decreases from largest to smallest: ...

Rewrite: The burdens of dry masses in decreasing order are:...

Pp 8334, line1: Here the term diversities is already being used where it is defined later in the text, or least explained why they use diversity rather than uncertainty. Could you not use in the beginning simply “differences” and define already in the introduction what you mean with/the motivation to use diversities?

Line 8/9: similar for a given species: what is meant with that?

Line 16: “acid rain and toxic chemicals”; Change to “acid rain and contamination with toxic chemicals such as.. ”, could you give an example of which toxics you refer to?

Pp 8335, line 1-3: The sentence is quite vague, embarks? multi-angle strategy? Suggest to change it to “AeroCom aims at evaluating the performance of global aerosol models by intercomparisons and by comparison with observations”

Line 8: it would be better to already indicate about what kind of diagnostics are involved here.

Line 11: The statement about “constraining” raises a lot of questions. How are the

models constrained with observation data? From what I inferred from the model descriptions are the models mostly run as they are, without forcing them, except maybe of the meteorology in the nudged model simulations. But are there also constraints imposed on the aerosol processes? If so, then this should be described.

Line 27-28: the sentence should be reformulated: It is not clear what is meant with “on all processes except for one, which is under investigation”

Pp 8338, line 13: “to investigate the global models” I guess you should chance that to “to investigate the host models”. Instead of using host models, an alternative could be “driver models”

Line 21: Not all the readers might be familiar with the term nudging and consequently this should be explained in a little more detail and/or including a reference that describes the technique.

Page 8340, line 5: turbulent dry deposition. Throughout the document you use this term but within the different contexts it gets confusing. Why don't you simply write it down as “wet and dry deposition and sedimentation”. I assume that you used the term turbulent dry deposition since in the model the split is made between sedimentation and the dry deposition due to turbulent transport, Brownian diffusion and impaction where in the real world measuring a dry deposition flux would include all four terms (and re-suspension/re-bouncing). If this is indeed the motivation to use this definition you could include a statement: “Note that hereafter dry deposition refers to surface removal due to turbulent transport, Brownian diffusion and impaction excluding the contribution by sedimentation which is generally considered separately in the model analysis”

Pp 8342, line12: See previous comment: Could you move this statement forward?

Pp 8347, line 8: “SO₂ stems from emission datasets”; weird sentence. Rephrase to something like “The SO₂ emissions are prescribed based on anthropogenic emission inventories (e.g., EDGAR, referĚ) whereas DMS emissions are calculated online from

[Full Screen / Esc](#)[Print Version](#)[Interactive Discussion](#)[Discussion Paper](#)

global oceanic DMS concentrations fields and sea-air transfer coefficients as a function of windspeed”

Pp 8348, equation 4 and some other equations; the fonts are not consistent (normal versus italics)

Pp 8350, line 1, see previous comment; wet and dry deposition and sedimentation

Pp 8355, line 8; (table 8), remove parenthesis

Line 17-18: This sentence is not clear to me: It is meant to express that you would expect a different order in species with respect to the relative contribution by convective rain due to for example their solubilities. So what you mean with a consistent sequence?

Pp 8356, line 4; In the next Section, we examine...

Pp 8358, line 1: “we do not explore in this paper” Will there then be another paper on this, one that is already in preparation?

Line 27-30: “This can be due to concerns about the particle size data in AeroCom..” How does the concern explain the lack of correlation between dry deposition coefficients and the mass fractions? Coming back to one of the previous points: What do you with particle size data? Are these some of the data used to constrain the models?

Pp 8362, line 11-12: The statement about dry deposition being underestimated above suggests that dry deposition also occurs higher up in the PBL, which is not the case. Dry deposition is the removal at the earth surface where models to describe this process also include the turbulent transport from the reference height in the surface layer (~ 10% of PBL depth) to the surface where the removal occurs. I guess you want to express that there is a possible overestimation of surface removal (dry deposition) and an underestimation of the downward turbulent transport in the PBL to compensate for the efficient surface removal. In the previous sentence you express somehow that this problem is related to the representation of turbulent transport in the models, which

Full Screen / Esc

Print Version

Interactive Discussion

Discussion Paper

is correct with the models failing to reproduce observed turbulence features. But so, dry deposition is more than turbulent transport. The dry deposition of accumulation mode particles is controlled by the Brownian diffusion, being the limiting parameter. It is also interesting to think about having a problem in the opposite direction, associated with the operator splitting problem. There could be potential too fast upward transport of the emitted species if you include for example the emission flux as the lower boundary condition in your vertical flux calculations explaining the possible underestimation of surface layer concentrations. Anyhow, an important issue is addressed here about the role of surface exchanges in controlling surface layer concentrations which are used for the model evaluation. This stresses the importance of further tackling this problem in follow-up studies where a main limitation is imposed by the lack of direct aerosol flux observations. This is something that could be stressed in the conclusions/recommendations for further research.

Pp 8368, line 14: Rephrase to; “Surface and boundary layer turbulence and surface cover properties largely control aerosol dry deposition”

Pp 8369, line 1: If you talk about residence times should it not be longest and shortest instead of greatest/least

Pp 8370, line 5-7: “disagreement on the particle sizes, and possibly also to the application of operator splitting technique...” Coming back to the previous comment; has it been discussed in the AeroCom community how to address this problem? It would be an option to include here a suggestion how to proceed to tackle this problem, e.g., using a selection of the models that give very contrasting results in terms of the vertical dispersion in case studies changing the sequence of the calculation of surface exchanges, vertical mixing, wet deposition, etc. but also comparing simulated boundary layer aerosol profiles with field observations (when available).

Pp 8372, line 3: remove the statement “(and this is not trivial)”

Line 10-15; Closing statement suggestion: “Several processes and parameters, which

[Full Screen / Esc](#)[Print Version](#)[Interactive Discussion](#)[Discussion Paper](#)

are particularly relevant for aerosol radiative forcing calculations, with high diversities are:

- Masses..
- ..dispersal

Consequently the improved representation of these processes and parameters in large-scale aerosol models deserves a high priority to reduce the uncertainty of the..

Interactive comment on Atmos. Chem. Phys. Discuss., 5, 8331, 2005.

Full Screen / Esc

Print Version

Interactive Discussion

Discussion Paper