Atmospheric Chemistry and Physics Discussions

Interactive
Comment

Interactive comment on "Tropospheric aerosol size distributions simulated by three online global aerosol models using the M7 microphysics module" *by* K. Zhang et al.

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Reply to referee 1

We thank the reviewer for his/her constructive comments. Below is a list of our response for each specific point.

P5804 L2: modal approach of what? The word aerosol microphysical model should be part of that sentence. L5: The reason for this study is to identify the influence of the host model on the aerosol simulation. Rewrite the second sentence.

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In response to these two points, the first paragraph of the abstract has been modified:

"Tropospheric aerosol size distributions are simulated by three online global models which employ exactly the same aerosol microphysics module, but differ in many aspects such as model meteorology, natural aerosol emission, sulfur chemistry, and deposition processes. The main purpose of this study is to identify the influence of these differences on the aerosol simulation."

P5807 L5: Give references for the different methods.

References have been added.

P5806. I don't understand the meaning of the sentence in line 1-5.

These lines have been re-phrased as follows:

"Theoretically, one should carry out sensitivity experiments by changing one parameter of a single contributor at a time. For example, in the work of Liu (2007) a bulk aerosol model was used to analyze differences in aerosol mass distribution and anthropogenic aerosol direct forcing caused solely by changes in meteorological fields. In terms of aerosol physics and chemistry, however, given the vastly different schemes and configurations employed in existing models, we will have to perform a prohibitively large number of simulations in order to cover all possible combinations. Sensitivity experiments thus need to be carried out in a more efficient way."

P5811 L 4: Is there a reference available for the inclusion of nucleation schemes into the M7 model respectively ECHAM or CAM.

Vignati et al. (2004) pointed out that the Vehkamaki (2002) scheme is valid in broader ranges of temperatures and humidity, thus this scheme is used when the M7 module is implemented in HAM and LIAM. There is no published results comparing the behavior

of this scheme in ECHAM or GAMIL/CAM against the Kulmala et al. (1998) parameterization. Kazil et al. (2010, ACPD) recently introduced a new nucleation scheme in ECHAM5-HAM.

P5819 l8: What do you mean by "other conditions"?

What we have in mind as "other conditions" is stated later in the section, on page 5820, lines 8-12: "Possibilities include the parameterization schemes and coefficients of the chemical reactions, the related meteorological conditions (such as cloud liquid content and cloud cover), and the sequence of calculating the various processes (including the gas/aqueous phase reactions and deposition processes) within the sulfur chemistry scheme."

We've realized that mentioning "other conditions" on page 5819 without giving details does not make much sense. Thus in the revised manuscript only the two immediate reasons are mentioned. Item (3) is removed.

P5825 l10: It is not clear why the influence of aging on the size distribution can't be investigated. That should be straight forward.

What we have in mind as the most thorough way to identify the reasons why the three models produces different insoluble number concentrations is to compare the following aspects for each insoluble mode:

(1) emission; (2) deposition (dry and wet); (3) intramodal coagulation which converts two insoluble particles into one particle of the same mode (Aitken mode only); (4) conversion of insoluble particle to soluble due to condensation of H_2SO_4; (5) conversion of insoluble particle to soluble due to coagulation with soluble particle.

Among these items, (1) is readily available in our data; (2) can be easily obtained by summing up the corresponding deposition rates; But the aerosol number sinks due to (3) - (5) are not yet available as output of the M7 module, and the computation is not

trivial. This is why we stated in the manuscript "Such diagnostics are not yet available in the three models used in this study, thus a quantitative comparison of the impact of aging on the size distribution is not yet possible". Our original statement was unclear and we have removed it.

Why not combine Fig. 1 and 6? Or at least present them next to each other.

In the manuscript we arrange the figures in the same sequence as they are discussed in the text. Fig. 6 is not discussed until the last part of Section 4, before which several figures showing sensitivity experiments closely related to Fig. 1 are presented. We think this arrangement gives better consistency between the text and the figures.

Fig 8: The campaign and region name could be mentioned in the map for easier orientation later.

Modification has been done as suggested.

P5843 table 1: Model resolution should all be given in degrees.

For ECHAM5 and CAM3, model resolution is now given both in degrees and in spectral truncation.

P5845 table 3: nucleation etc typo

The words "nucleation", "condensation", and "coagulation" overlap because of the relatively narrow layout of the discussion paper. The problem will not appear in the finial version for ACP.

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