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Geoscientific Model Development Discussions

Interactive comment on "Modelling of primary aerosols in the chemical transport model MOCAGE: development and evaluation of aerosol physical parameterizations" *by* B. Sič et al.

Anonymous Referee #2

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General comments

This paper describes the impact of updates to different aerosol parameterizations in the chemical transport model of Météo-France MOCAGE on primary aerosol simulations. This updates include changes to the aerosol parameterization concerning emissions (dust and sea salt), wet deposition (in-could and below-cloud scavenging, below-cloud scavenging due to snowfall) and sedimentation. The model simulations are evaluated using independent data from satellites (MODIS, SEVIRI), the ground (AERONET), and a model inter-comparison project (AeroCom) for aerosol optical depth (AOD). In order to isolate the effect of the updates of the individual schemes sensitivity simulations have been performed.

In general the paper is clearly structured and the work represents an interesting case study on the impact of different parameterizations of the given processes on aerosol simulation results in a global model. However the paper would benefit from some reorganization, elaboration and more explanations. Main points which should be taken into account in the paper:

The study should be better embedded in the current research on the impact of different parameterization schemes on model simulations by giving more references to relevant studies in the introduction.

Chapter 3 should be reorganized in order to clarify the differences between the current and the new parameterizations and to highlight the key aspects of the new schemes.

Please add a description on studies and projects the model is used for. Which model parameters are looked at and considered in these studies? This is important in view of the way the model is evaluated in this paper.

Why is only AOD used as a parameter to compare the model with measurements? AOD is a good parameter for a first analysis but for a more detailed evaluation of the model simulations it would be preferable if other parameters as for example the mass concentrations for BC and dust are also considered. It is very likely that in most of the studies other parameters than the AOD are analyzed. Please add a comparison with other measurement data or change the title of the paper to clarify that in present study only AOD is considered.

In order to get a clearer picture on the impact of the updates in SIM2 compared to SIM1 on the aerosol distribution plots showing the vertical and horizontal distribution of the mass concentration of the aerosol components should be included and discussed.

Please add a section describing the meteorological input field in more detailed including known biases and uncertainties. This is especially interesting as the parameterization depend on the meteorological fields and possible errors in the wind fields etc. are

used to explain differences in the model between different regions and discrepancies between model results and measurements.

One major explanation of discrepancies between model and simulations mentioned in the text is the fact that there are no secondary aerosols included but this is not looked at in more detail. There are more primary aerosols than considered in the model as the unspecified anthropogenic aerosols. Please comment on the possible impact of not taking these into account.

Please add a discussion on the impact of the new parameterization schemes on the physics and processes description. Why do the new schemes (e.g. for sea salt emission) show better results – what is the physical explanation?

Specific comments:

Abstract

- Please mention that this is a global CTM

- Please specify which primary aerosols are included in the model

- p. 2746, l. 10: add “the” in-cloud scavenging

1 Introduction

- Please mention that the simulations are on the global scale and for the year 2007

2 General description of the model

- Please add a short description on the studies/projects the model is used for.

- p. 2750, l.16: change “in” Meteo-France to “at”

3 Aerosol parameterization in the model

3.1. Sedimentation

- Please clarify the difference between the current and the updated calculation of the

sedimentation in the model

- p. 2753, l.4: The sentence structure is confusing, please rewrite the sentence.

3.2. Wet deposition

- This section is difficult to read, please reorder it. It would be helpful to have an introductory paragraph which describes the current version of the model and the updates. Please add the according chapter numbers where it is described in more detail. Please also explain a bit more why the new schemes are chosen.

- p. 2753, l.10: Please add a reference if available.

- p. 2753, l. 18-19: Does this mean that the rate of precipitation formation in (5) and (6) is calculated following Xu and Randall (1996)? Please clarify this in the text.

- p. 2754, l. 1-3: Why do you use the Brost et al. (1991) value if there are updated values?

- p. 2754, ll. 17-18: Why do you update the model with an older scheme (1986) than the one used before (1991)?

- p. 2755, ll.6-10: It would be helpful to get this information earlier in the text.

- p. 2755, ll. 15-16: What does “the considered time step” mean in this context?

3.2.3 Below-cloud scavenging due to snowfall

- p. 2758, l. 19: Please rewrite the sentence; it does not get clear whether there are wider sets of snowfall parameters needed or available.

3.3 Emissions

- Usually emission inventories for aerosols also include unspecified anthropogenic primary PM. Is this also included in the chosen database? If so why is it not used in the model?

3.3.1 Sea-salt source function

- p. 2761, l. 10: What is B?

- Which sea surface temperature data set is used?

3.3.2 Desert dust emission schemes

- Please describe in the beginning of the paragraph what the updates for the desert dust emission scheme are.

4 Observations

- p. 2763, l.23: “less than 5 observations” per what?

5 Experiment design

- p.2765, l. 7: Don’t understand this sentence, please clarify.

6 Results

- pp. 2765 + 2766, ll. 25-28 etc.: Is there a possible explanation for that feature?

- p. 2766, ll. 7-9: Where is this explained in the first paragraph? Please elaborate this a bit more.

- p. 2766, ll. 20-25: Please add the information that these numbers can be found in table 3.

- p. 2766, l. 26: To verify this it would be interesting to have more information on the quality of the input meteorological fields, especially on the wind fields as they are very important for dust and sea salt emissions. A short paragraph on this could be added to chapter 2.

- p.2767, l. 6: Please add the numbers for the correlation to the text.

- p. 2767, l. 26: Which date is it?

- p. 2768, l.14: But the sea salt lifetime in SIM2 is shorter compared to SIM1 and the burden is much higher than in AeroCom. How does this fit with the observation that the sea salt overestimation is reduced in SIM2 described on p. 2767?

- pp. 2768-2770: Nice and informative paragraph

7 Discussion

- p. 2771, ll. 4-5: sentence structure, please rewrite

- p. 2771, l. 17: sentence structure, please rewrite

- p. 2772, l. 3: “Longer mean atmospheric residence time” compare to what?

8 Summary and conclusion

- p. 2773, l.23: The dust size distribution is not shown in the results chapter – why not?

- P. 2773, l. 26: What is the physical reason for that?

Tables:

Table 2: This table is hard to read. Please consider reorganizing it, e.g. by scheme (in-cloud scavenging, below-cloud scavenging, sea-salt emission etc.) in the row and simulation names in the column.

Table 3: It would be interesting to also see the absolute number of MODIS and AERONET AOD at the individual station in the table.

Table 4: Is it averaged over the whole year and area? Why is OC not shown?

Figures:

Figure 2: What exactly is shown in this figure? Is it one dot for every grid cell?

Figure 3: It would be helpful to see the areas somewhere in a map. May be it is possible to mark them in figure 1.

Figure 5: Why is the figure for SIM2 shown first?

Interactive comment on Geosci. Model Dev. Discuss., 7, 2745, 2014.