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Geoscientific Model Development Discussions

Interactive comment on "NHM-Chem, the Japan MeteorologicalAgency's regional meteorology – chemistry model (v1.0): model description and aerosol representations" *by* Mizuo Kajino et al.

Anonymous Referee #2

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The paper by Kajino et al. 2018 introduces a new regional chemical transport model NHM-Chem based on the mesoscale non-hydrostatic meteorological model NHM of the Japan Meteorological Agency. It primarily compares 3 existing aerosol representation schemes with varying complexity, namely a simple bulk, a 3- and a 5-category method. As such, the paper fits to the scope of this journal, but however, significant details are missing in order to get a complete picture about the model system as indicated in the title.

In my point of view, the paper has to include the most important features of this new system, core developments, model setup (domain etc.), important schemes and improve-

ments compared to other existing (coupled meteorology-chemistry) models such as WRF-Chem, WRF-CMAQ, EMAC, COSMO-ART. Presented aerosol schemes should be set in context to other existing schemes such as GMXe (Pringle at al. 2010) and the author should further include a statement what makes their most sophisticated aerosol scheme unique compared to others found in literature. The title in a way is misleading, as it assumes a detailed description of the model also including model evaluation. The latter is not represented in the current version of the GMDD paper.

The authors already made an attempt to provide these information in a similar paper in another journal, which however is not published yet. In my point of view a better way would have been the publication of follow-on papers in the same journal (compare: MESSy, COSMO/MESSy in Jöckel 2004, Kerkweg 2012 and follow on papers). As already mentioned by other reviews, the author should definitely check for text duplication between both manuscripts and provide a suggestion how to tackle this issue.

For these reasons, I unfortunately can not recommend the paper for publication in GMDD in its current form but am willing to consider to review a revised version. To support this statement I have added further comments below:

Introduction

There is a focus on aerosols only. Please highlight other chemical compounds and reactions used in this study (e.g. ozone). As mentioned above, it would be interesting to learn more about the intention of developing this new model, meaning how it sets apart from other existing systems and what does it have in common. Which processes should be improved and which areas of research benefit from this model. These aspects are mentioned briefly (P2, Line 31-32), but however need more clarification. In order to get a feeling of the model performance (P3, Line 8), comparing the model results to observations is a crucial part.

Model description

This section (particularly 2.1) is too short and needs more details on most important schemes, model setup, configuration, domain (Figure needed) and also details on technical realization of the coupling between meteorological and chemical model. As parts of the above mentioned aspects are mentioned later in Chapter 2.4, Chapter 2 needs to be re-structured.

Some minor points:

P3,L14: specify term 'acusa' and provide literature

P3,L15: simpler than what?

P4, L4: identical vertical resolution just for your selected model configuration?

P5, L9: You mention two options to calculate the efficiencies. Which option did you chose and why?

P6,L9: short definition of internal and external mixing should be provided before.

P6,L11: Are dust plumes a regular feature of that region, how are they linked to meteorological conditions and where are they originated from. Please summarize the findings of Zhang and Iwasaka 2004 in this context.

P6,L31: Is any data-assimilation used in your study?

P7,L11: Numbers have to be provided in respective table.

P8,L26: The actual model domain is hard to figure out from Figure 2-10. How many domains where used? Nesting? How was the coupling achieved?

P9,L13: Please indicate the grid resolution of the anthropogenic emission.

P9,L19: Please provide more detail on the calculation of the biogenic flux.

P10, L20ff: Where are the values originated from?

Model performance

P11,L24: In my opinion the term operational forecast is misleading (see also at other locations in the manuscript) as the study rather discusses a 1-year hindcast simulation for 2006 than an operational forecast. Further it is not entirely clear how the scope of Chapter 3.1 and 3.2 differ. They could potentially be combined.

General: How does Ozone link to dust and PM2.5 concentration. Please discuss why O3 differs for different aerosol representations. What are the respective pathways and reactions?

P12,L1: due to the small figure size, the prevailing wind patterns are hard to capture

P12,L3: please specify, provide more details on the 'source region'. Why is concentration highest in spring?

P12,L16: clarify the term 'operational forecast issue'

P13,L2: Can you provide proof for the overestimation of NO3-?

P13,L9: How do you explain the large range of 20-100% here?

P13,L11: More information of the discrepancy between simulated and observed PM2.5 needed.

P13,L13: provide R-values

P13,L19f: the term 'air quality issue' is too general

P13,L21: How do you explain the large range of 20-100% here?

Chapter 3.2

Understanding of the differences in simulated PM2.5 needs for a more quantitative analysis as the reader does not have a clear picture if the presented values are realistic compared to observations.

The link to air quality does not come out clearly in this chapter or is too general. In my opinion discussing AQ related questions, needs for inclusion of other pollutants as well

such as the CO- and NO-family, Ozone and PM10.

Chapter 3.3, Chapter 3.4

For both chapters, the term ‘climate relevant indices’ is not very clear. Maybe it is better just to keep with 3.3 Aerosol optical depth and 3.4. Aerosol-cloud interactions.

P14,L27: Specify why the bulk method is not suitable for climate modeling. The term ‘climate modeling’ however is misleading here as it is not subject to this study. Please clarify this sentence.

P14,L30: explain the large range 20-100%

P14,L31: are you referring to the boundaries of the domain here?

L15,L27: General assumption, or do you refer to any meteorological models in particular here?

P16,L1-3: The conclusion of your findings are not clearly presented here.

Conclusion

The development and description of NHM-Chem is not sufficiently presented in this paper or not the main aspect as the study mainly focuses on the comparison of existing aerosol schemes. Further it should be indicated why the aerosol representation is a unique feature of NHM-Chem. In general, the analysis and the results are not detailed enough to show the models capability to serve operational forecast and air quality needs and observations are missing in order to substantiate your conclusion. Overall the paper lacks of a general conclusion, a discussion of the applicability of the results and the model’s capabilities or recommendation for future modeling efforts in this field.

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