

## ***Interactive comment on “Comparison of three aerosol representations of NHM-Chem (v1.0) for the simulations of air quality and climate-relevant variables” by Mizuo Kajino et al.***

### **Anonymous Referee #1**

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The paper by Kajino et al. 2020 primarily compares 3 existing aerosol representation schemes with varying complexity, namely a simple bulk, a 3- and a 5-category method within the newly developed chemical transport model (CTM) NHM-Chem. In a previous version of the paper, one of the key shortcomings was the missing link to the complete description of the model system, or the poor description within respectively. With the general model description paper now being published, the existing study gains in quality and also presents a relevant topic which itself fits to the scope of the journal. The language does not need significant review.

With the general functionality, the technical realizations and differences in aerosol rep-

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resentations being elaborately discussed, an overall synthesis is missing which provides clear statements of the potential of the three themes discussed. Beginning with the heading, it does not come out clearly what is meant by ‘air quality’ and ‘climate-relevant’ variables and how that difference is tackled within the study. That aspect should be highlighted better in the introduction and within the discussion/conclusion. The overall quality of the paper has pretty much increased compared to previous versions. The points however which still need further work will be pointed out in the following:

#### Abstract:

If online coupling is not done within that study, it should be removed from the abstract. That aspect however is important when discussing the shortcomings and the outlook.

Introduction Page 2, Line 21: unclear: decrease air concentration

2, 26-31: re-write avoiding repetitions ‘aerosols’

3, 17: are developed; the terms regional climate, air quality and operational forecasting should be explained more detailed, also highlighting how each single aspect has been addressed in the paper

3,20-25: unclear, whether the bulk and the 5-category schemes have been developed in the course of the study or have been existing before

#### NHM-Chem

4,11: better model configuration than schemes of the CTM

#### Aerosol representation

8,3: unclear: ‘fully solve for’

8,10: unclear whether data assimilation is done here. That aspect is important when discussing the model’s potential for operational forecast.

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Setup 11,15: How where the two datasets combined, please specify

#### Model performance

In the beginning of the chapter, it has to be clarified which different aspects are considered in terms of the relevant purposes operational forecast, air quality forecast and climate forecast. How are these aspects discussed in that paper? What are the differences between studied processes, variables or even model configuration? The R-Values for PM10 are particularly low. Please discuss that aspect in terms of model performance for operational forecast, also highlighting the differences to the performance for PM2.5. It is partly discussed in the text, but more clarity is needed.

Figure 3: white areas in left and middle panel (also in Figure 12)?

20,8: show simulated medians in Table 4

20,11: specify 'remote sites'?

20,12: What are the key problems in the underestimation of NO<sub>x</sub> here? Problems with the emission dataset or chemical origin? Please further discuss that aspect with regard for using that model system in 'operational mode'. What is the ratio between NO/NO<sub>2</sub> in total NO<sub>x</sub>?

24,20: discuss the large spread 20-100%

26,16: Why is that aspect particularly pronounced over sea areas? Figure 6: Why is 'Bulk' so much higher over the sea?

27,4: reason for patchiness?

#### Conclusion

As mentioned earlier, the conclusion is still missing a clear synthesis, which in places also results from missing details at various places in the manuscript. The authors are encouraged to address the following points:

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- P 41, Line 21: How was the operational forecast quality assessed? It is unclear if the term 'operational forecast' simply relates to the selected variables or also includes a change in the model setup (how is DA addressed?)
- P 41, Line 24: How exactly should the initial and boundary conditions be improved?
- P 41, Line 25: Referring to your model results: where are the biggest shortcomings?
- P42, Line 24: See point above. Summarize dominant reasons for discrepancies.
- P42, Line 31: what is meant by timely and properly reflected? What are the future plans? Despite the shortcomings; what are the key benefit of the current configuration presented in this paper? What should be the core areas of future development?

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Interactive comment on Geosci. Model Dev. Discuss., <https://doi.org/10.5194/gmd-2020-229>, 2020.

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