

Interactive comment on “Air Quality and Climate Change, Topic 3 of the Model Inter-Comparison Study for Asia Phase III (MICS-Asia III), Part II: aerosol radiative effects and aerosol feedbacks” by Meng Gao et al.

Anonymous Referee #2

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General comments

The paper is the second part of two papers discussing the results of the MICS-Asia III model inter-comparison exercise with special focus on the performance of online coupled air quality models in simulating high aerosol pollution in the North China Plain region during wintertime haze events. While the focus of first part is on the description of the design of the modelling exercise and the overall model performance, this paper focuses on the role of aerosol radiative forcing and aerosol meteorology interactions for six different models. By means of case studies with one of the models, the authors

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investigate the sensitivity of aerosol radiative forcing to different aerosol descriptions. The current paper includes some interesting results and is generally worth to be published. However, some aspects need to be discussed in more detail and the presentation quality must be improved for major parts of the paper. Therefore, I recommend to publish the paper after major revisions.

Specific comments

Although the paper is the second of two associated papers, it is necessary to add a section that gives a brief overview of the experimental design and model setup as well as the applied models. Furthermore, the name of the models should be connected to the abbreviations M1, M2, ... This information is given in Part 1, so this is obviously not a secret. It could be looked up there, but including this information also in this paper (e.g. in Table 1) would enhance the paper's readability considerably. Please add also some information about the length of the simulated episode and the simulation setup. Was the entire episode covered by one single simulation or was the episode simulated as a sequence of shorter time slices? The way how the simulation is performed can affect the development of semi-direct effects to a certain amount.

Why is model M3 not included?

According to part 1 (Gao et al., 1918a) the simulation with WRF-CMAQ (M7) was performed with aerosol–radiation interactions turned off. If this is also the case here, this should be mentioned and eventual implications on the results should be discussed.

Line 78-80: Since e.g. Grell et al., 2011 (doi:10.5194/acp-11-5289-2011) and Yang et al. 2012 (https://doi.org/10.5194/acp-12-3045-2012) describe the development and implementation of aerosol-meteorology interactions into WRF-Chem, these papers should also be mentioned here and not only application papers. This holds of course also for the other models.

Lines 122-123: Please give a reference here.

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Lines 125-126: Please try to explain this behavior.

Lines 133-134: What is 'other model treatments'?

Line 156-159 and caption of Fig. 3: The name of the model would be more helpful here.

Line 181: Why are the results for M6 so different?

Lines 228-242: These results should be discussed in relation to the results by Curci et al., 2015 (<http://dx.doi.org/10.1016/j.atmosenv.2014.09.009>) and similar studies.

Lines 253-254: Model names in addition to M5 and M5 would be helpful. Does M1 (which is also WRF-Chem) definitely not include any soil dust? It is possible to use MADE-Sorgam in combination with a dust option. Please clarify this in the paper.

Lines 285 (Language quality): 'Previous paper': Which previous paper?

Line 291: What is the reason for this?

Line 299: Which studies?

Caption of Fig. 2: Which month?

Caption of Table 1 and 2: To which area do the results given in the tables refer to?

The language quality must be improved by consulting a native speaker or a language editing service.

Minor points

Line 101, 175, 188: Start a new paragraph here (and everywhere else, where you start to discuss a new topic).

Lines 104-105, 122, 133 (could be resulted), 216-220, 291, 303-304 and many other lines: Odd language

Line 122: 'an external assumption': About what?

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Line 122: Why 'also'? Which other models use also the assumption of external mixing?

Line 169: A word seems to be missing here.

Line 225: A reference should be given here.

Line 282: A reference should be given here.

References in Figure captions: 2018a or 2018b? Better mention the models instead of the institutions (eventually not necessary for all figures)

Line 450: Use either complete list of authors (Forkel, R., Balzarini, A., Baró, R., Bianconi, R., Curci, G., Jiménez-Guerrero, P., Hirtl, M., Honzak, L., Lorenz, C., Im, U., Pérez, J. L., **Pirovano, G., José, R. S., Tuccella, P., Werhahn, J., and Zabkar, R.**: Analysis of the WRF-Chem contributions to AQMEII phase2 with respect to aerosol radiative feedbacks on meteorology and pollutant distributions, *Atmos. Environ.*, 115, 630–645, 2015.) or 'et al' after the third author.

Interactive comment on *Atmos. Chem. Phys. Discuss.*, <https://doi.org/10.5194/acp-2019-719>, 2019.

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