

Geosci. Model Dev. Discuss., referee comment RC2
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Comment on gmd-2020-430

Anonymous Referee #2

Referee comment on "Investigating the importance of sub-grid particle formation in point source plumes over eastern China using IAP-AACM v1.0 with a sub-grid parameterization" by Ying Wei et al., Geosci. Model Dev. Discuss., <https://doi.org/10.5194/gmd-2020-430-RC2>, 2021

This study examined the impacts of sub-grid particle formation (SGPF) in point source plumes on 20 aerosol particles over eastern China in IAP-AACM. By implementing a SGPF scheme into the model and optimizing the key parameter in the scheme, the authors found that the model performance in simulating aerosol components and new particle formation processes was improved, indicating that SGPF processes are important in chemical transport model. This study can contribute to the CTM community and the results are solid. It can be considered to be accepted after addressing my comments below.

There are two steps for improving the model in this study. First, coupling the P6 sub-grid parameterization scheme with the global nested aerosol model IAP-AACM. Second, modifying the key parameter of the scheme, effective OH concentration in the plume, to fit the local chemical background on the basis of extensive field observations in eastern China. Four simulations are performed including SG and F0 for 2014 and SG and noSG(fox 2.5?) for winter 2016. I don't get what questions were the authors trying to answer. Why did they design these two sets of simulations? Why don't they directly use SG and original model setup in all places, which should represent the improvement of the model.

Specific comments:

Lines 29, 31, 35: reduced and increased from xx to xx.

Line 32: Since here is the diurnal cycle, the overestimation is for a specific time or for the whole day.

Line 46: Suggest to include some recent studies (e.g., Yang et al., 2019, 2020)

Lines 80-83: Is 0-5% of SO₂ emitted as H₂SO₄? Is the 0-15% of H₂SO₄ from 0-5% of total SO₂ or the 0-15% of new partial from the total H₂SO₄?

Line 93: What does the "tens seconds of kilometers" mean?

Line 315: Suggest to add a table describing the detail of the simulation and what they are used for.

Line 341: Do you mean energy and industry sectors were emitted into the first "five and three" layers of the model, "respectively"?

Lines 343 and 345: Why the emissions in 2014 are from HTAP2 together with a scaling factor and the emissions in 2016 are directly from MEIC? MEIC also provides 2014 emissions.

Line 526: "Nodeling" to "Modeling"

Line 575: "nornalize" to "normalize"

Line 635: What does the "OD" represent?

References:

Yang, Y., S. J. Smith, H. Wang, C. M. Mills, and P. J. Rasch, Variability, timescales, and nonlinearity in climate responses to black carbon emissions, *Atmos. Chem. Phys.*, 19, 2405–2420, doi:10.5194/acp-19-2405-2019, 2019.

Yang, Y., Ren, L., Li, H., Wang, H., Wang, P., Chen, L., Yue, X., and Hong, L., Fast climate responses to aerosol emission reductions during the COVID-19 pandemic, *Geophys. Res. Lett.*, 47, e2020GL089788, doi:10.1029/2020GL089788, 2020.