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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Spatiotemporal variability of NO_2 and $PM_{2.5}$ over Eastern China: observational and model analyses with a novel statistical method" *by* Mengyao Liu et al.

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The most substantial issue is the choice to exclude SOA from the GEOS-Chem model simulations. This is a huge caveat that strongly impacts the interpretation of any of the GEOS-Chem results and conclusions. The authors correctly point out that more than 20% of the PM2.5 in Eastern China could be from SOA. The reason given for not including SOA is that the mechanism underestimates aerosol formation, but then the main conclusion about GEOS-Chem is that it severely under predicts PM2.5 in Eastern China anyway, so this is circular reasoning. Even a simple SOA scheme would be better than nothing. I recommend that the authors add some discussion about

how the lack of SOA may impact their evaluation of GEOS-Chem, beyond just the bias in the seasonal mean. How does the lack of SOA impact the day-to-day and diurnal model observation comparison? Since it is stated that CMAQ includes SOA, perhaps you can draw conclusions about the impact of SOA from CMAQ. (By the way, it is stated in the manuscript that GEOS-Chem "does not include" SOA, but the more accurate statement would be something like "these simulations of GEOS-Chem do not include SOA", since the capability is there in the model in general.) This simulation of GEOS-Chem underestimates PM2.5 by about 35% (Table 3), much larger than can be explained by the missing SOA (up to 21%). Thus we suggested in the original manuscript that other factors may also play some roles.

We have also revised the text to indicate that this simulation of GEOS-Chem does not include SOA. As added in the end of revised Sect. 4.3: "We further use CMAQ simulations to investigate whether the inclusion of SOA affects our analysis of the spatiotemporal patterns of PM2.5. Supplementary Fig. S1 compares the time series of CMAQ-simulated PM2.5 with versus without including SOA. Although SOA contributes about 8-9 μg/mˆ3 of PM2.5 averaged over the days, inclusion of SOA does not affect the temporal variability. The EOF-EEMD results in Supplementary Fig. S2 further confirm that the spatiotemporal scales are very consistent whether or not SOA is included."

Minor comments:

Line 33-34. Mention what time averaging frame these biases refer to (I assume Fall-Winter seasonal average)

Changed.

Line 39 and several other places in the manuscript: change "anthropogenic dusts" to "anthropogenic dust". Also there was a mention of "sea salts" which should be changed to "sea salt". These are typically already plural without the added "s".

Changed.

Line 50. "Downwind" is probably more appropriate than "downstream" since we're talking about air pollution here.

Changed.

Line 81. PM2.5 is called "the dominant pollutant". In terms of what? Emissions, mass, human health burden? Specify and cite.

Changed and relevant citations added.

Line 86. Reference Wu et al. is written in all capital letters. Same in the reference list. Please fix.

Changed.

Line 93. I don't know what the "M" in "MEEMD" is. Thus far, I think you've only defined the acronym "EEMD"

Changed.

Line 277. "while noise" should be "white noise"

Changed.

Section 3.1 and Figure 5. There is a units issue here. The text says microgram per cubic meter, but Figure 6 is labeled as microgram per cubic centimeter. Surely that must be an error. Please check all units.

The units labeled on Figure 6 were wrong, and we have corrected them.

Section 3.2. Why are only RH, wind, and temperature chosen for meteorological parameters? Was this the only data available. Justify the choice.

We chose these meteorological parameters based on previous studies (line 65-67). Three-hourly data for surface pressure, temperature, RH and wind speed are available from the meteorological stations. We do not use surface pressure additionally, because it is highly correlated to air temperature and relative humidity on the day-to-day scale.

Line 545: "...both models simulate the observed EOF1 and EOF2 patterns fairly well". This is vague. "Fairly well" is a value judgement; please quantify.

Changed.

Figure 9 and throughout: Label your plot axes.

We have added units in the caption.

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