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Geoscientific Model Development Discussions

Interactive comment on "Ensemble Forecasts of Air Quality in Eastern China – Part 1. Model Description and Implementation of the MarcoPolo-Panda Prediction System" *by* Guy P. Brasseur et al.

Guy P. Brasseur et al.

guy.brasseur@mpimet.mpg.de

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We would like to thank reviewer 2 for the detailed reading of our paper and the suggested changes. Reviewer 2 also detected an error in the paper, which we were able to correct (see below).

Line 115: Change "include assimilated data" to "assimilate data". Response: Done

Line 145: I guess you mean to say "Numerical weather forecasting at seasonal scales. . ." here. Response: Our point concerns numerical weather forecast in general and not

only on seasonal scales.

Line 152: In addition to meteorological forecasts, I think it would be useful to drive a single model with an ensemble of emission scenarios and chemistry. Response: We added the words "emission scenarios and chemistry" as suggested by the reviewer.

Line 158, 161 and 162: I suggest naming all the processes instead of leaving the reader with the curiosity of what ". . .." mean here. Response: we removed the signs "..." and used "e.g." instead.

Lines 177-190: I suggest defining all the acronyms (e.g., WRF-Che, WRF-CMAQ, SILAM etc.) upon their first use here. Response: We spelled out all the acronyms except in the case of Chimere, which is the name of the model but is not an acronym.

Line 207: Change "aata" to "data". Response: Done.

Line 214: Suggesting adding NOx to ozone-CO-NMVOC. Response: Done.

Line 237: Could you please provide a brief summary (2-3 lines) of the overall performance of IFS over March-May 2017? Response: It is impossible to provide such an evaluation in a few lines. We prefer to refer the reader to the reports that are available from ECMWF.

Section 2.2: Please provide information about at what resolution CHIMERE forecasts were produced. Response: Done. It is 0.25 degrees.

Line 275: Change to Fast et al., 2006. Line 319: Spell out STEAM. Response: Done.

Line 433: Could you say more about how anthropogenic emissions are adjusted every week? Do you employ a machine-learning approach? Response: The emissions for several species such as SO2, CO, PM2.5, PM10, etc. are adjusted by applying a factor that accounts for error in the predicted concentration the week before. See more details below. The text has been slightly adjusted. No machine-learning.

Line 440: I guess you mean "ideal" profiles and not "idea". Response: Corrected.

Line 453: All these papers focus on the U.S. It is okay to cite these papers but it would C2 GMDD be useful to add few references for applications of CMAQ over China. Response: We added two references and some text.

Section 5.1: Can you say something about the role of representativeness errors in model-observation discrepancies? Will the model performance change if you isolate the comparison only to rural sites? Response: This is discussed in Paper 2 by Petersen et al. (submitted to GMD). A sentence mentioning the representativeness error and referring to Paper 2 has been added in the introduction of the paper.

Line 754: Is better performance of IFS related to assimilation? Response: yes. Text added.

Lines 735-758 are the same as 760-784. Please remove the duplication. Thanks for noting this. Duplicated text is removed.

Lines 811- 812: It is well known that models have difficulties in reproducing nighttime concentrations of air pollutants including ozone. How does the model perform for daytime ozone? Section 5.2 provides some information about the daytime performance in three metro areas but it will be good to examine and discuss spatial patterns of daytime ozone in particular. Response: This is discussed in detail in Paper Part 2 by Petersen et al. (Section 5.5).

Line 906: Change RSME to RMSE. Response: Done.

Figs. 8 and 9: I am somewhat puzzled by the PM2.5 panels in Figs 8 and 9. For Beijing, ensemble median (Fig. 8) is lower than the observations for March 5-10 while all models show higher PM2.5 values than the observations in Fig. 9. I also suggest using the same color for observations throughout. Fig. 8 shows observations in black and Fig. 9 shows in red. Adding legends to Fig. 8 will also be useful. I was also expecting the spread will be higher in Fig. 8 because IFS has such large value of PM2.5. Similarly, all the models are lower than observations for ozone (Fig. 9) but

the median of the models in Fig. 8 is higher than the observed ozone. Please check the plots carefully and revise the discussion. Line 935: Do you want to say that WRF-Chem-MPI meteorological simulations are driven by IFS? Response: here the model has detected an error in the paper (thank you!). In fact, in all figures including Figure 8, the calculated median values are in black and the observations are in red (and not the opposite). When this correction is made, there is no inconsistencies anymore between Figures 8 and 9. The text and the captions have been changed to correct this mistake.

Line 958: Even the WRF-Chem-SPS does not agree with other models for odd-oxygen. Response: We have added that the WRF-Chem-SMS model does not agree with other models for odd-oxygen.

Note regarding the adjustment of the emissions by the Nanjing air quality model.

It should be noted that the anthropogenic emissions in mainland China are not fixed in this system, but are automatically adjusted every week according to the system performances in the past week. Briefly, there are 334 prefectural-level divisions in mainland China, and in each prefectural-level division, the mean relative deviations of SO2 (ΔSO2), NO2 (ΔNO2), CO (ΔCO), PM10 (Δpm10) and PM2.5(Δpm2.5) between the predicted and observed concentrations for the past week are calculated every Sunday. In each division, the spatial distributions of each pollutant emission are assumed to be right, but the emission levels have deviations. A series of scaling factors are given to adjust the emissions of SO2 (ðİŻŇSO2), NOx (ðİŻŇNOx), CO (ðİŻŇCO), PM2.5 (ðİŻŇpm2.5), and PM10 (ðİŻŇpm10), respectively, namely, the emission after adjustment is equal to the original emission multiply the scaling factor. Meanwhile, We also assume that the relationships between the concentrations and the emissions are linear, and the bias of NO2 in each division is all caused by local NOx emission, while the ones of SO2, CO, PM2.5 and PM10 are 60% contributed by local emission errors, and the rests are transported from the other divisions. So, for NOx, ðİŻŇNOx = ðİŻŇNOx, old *1/(1+ΔNO2); for SO2 and CO, ðİŻŇ = ðİŻŇold *(0.4+0.6/(1+Δ)); for PM2.5, we assume that 50% of PM2.5 is from the primary PM2.5 emissions, therefore, ðİŻŇPM2.5 = ðİŻŇPM2.5, old *(0.7+0.3/(1+△PM2.5)); for PM10, the PM10 emission in the inventory only includes coarse particle, therefore, the predicted and observed coarse particle concentration (i.e., PM10 minus PM2.5) are used during the calculation of △pm10, thus, ðİŻŇPM10 = ðİŻŇPM10, old *(0.4+0.6/(1+△PM10)). The ðİŻŇold represents the scaling factor of last week. It is noted that the emission of NH3 is not adjusted and each VOC species has the same scaling factor, and is equal to the one of NOx.

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