

Interactive comment on “The impacts of uncertainties in emissions on aerosol data assimilation and short-term PM_{2.5} predictions in CMAQ v5.2.1 over East Asia” by Sojin Lee et al.

Anonymous Referee #1

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This manuscript described a method using two different emission inventories to estimate background error covariance (BEC) for 3D-Var chemical data assimilation, and performed the corresponding sensitivity studies compared with the traditional NMC-method generated BEC. One key issue is whether the better result achieved with the new method came from its better science or simply the larger BEC shown in Figure 5. If the difference between these two emission inventories was not so big, since they were just estimated emissions, could the new BEC still outperform the control run?

Here are the specified comments.

Line 63-75. You may need to re-write some contents. The NMC method used the later-

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initialized field to reflect the more reliable prediction, or nearer the observation. Based on that difference, the model error was estimated. It is true that the NMC method may not be suitable for chemical DA, since the AQ model sometimes is more sensitive to emissions instead of the initial conditions, not because “emissions are not a state variable propagated in time” (line 67). In your later discussion (2.1 Model Configuration), there was nothing representing the observation for BEC estimation. How could you estimate the model error just based on difference between the two emission inventories?

In the main description (line 105-130) about the new BEC construction, it stated where these two emission inventories came from, but did not mentioned the uncertainty in the emissions, which was more important. In fact, once the emission uncertainty is known, one may get the BEC from perturbing a single emission inventory instead of two.

Section 2.3. This section only mentioned how to filter out bad observation, and did not tell how to estimate observation error used in the DA. Figure 5, Besides the profiles of BEC standard deviation, it is better to have a regional map showing its horizontal distributions. Figures 6-9. These comparisons have issues. It should be avoided comparing DA results to the same observations used in DA. Otherwise, the higher BEC, the better results. All the comparisons should be made after certain hours of the forward simulation to make sure that the DA will not degrade the prediction or cause side effects, e.g. RMSE would not increase.

The Figure 10 and all the statistics should follow the same comparison rule mentioned above.

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