

*This manuscript performs an inversion using satellite data to estimate improvements to emission inventories of VOC's and NOx in East Asia. The research seems thorough, the results are interesting and the implications are relevant and important. I am happy to recommend publication subject to minor revisions.*

**Thanks for your review and recommending a minor revision.**

*Averaging Kernels are an important part of the work. They are mentioned in passing in the abstract, given a theoretical definition in the method section and then more discussion in the results. I would recommend adding a sentence in the abstract to help the non-specialist, and a more extensive explanation in the methods section to explain not just the mathematical definition but also the physical interpretation.*

**Thanks for your comment, we added:** *“Emission uncertainties are greatly narrowed (averaging kernels > 0.8, which is the mathematical presentation of the partition of information gained from the satellite observations with respect to the prior knowledge) over medium- to high-emitting areas such as cities and dense vegetation.”*

*In a similar vein, I felt that So and Se could be described in greater detail, especially giving more specific descriptions of the values used.*

**Thanks, we added the following details quantifying different components of the covariance matrix:**

*“We calculate the covariance matrix of observations using the column uncertainty variable provided in the satellite datasets and consider them as random errors associated with spectrum fitting. We consider 25% random errors for air mass factor calculations. Therefore, these values (as random errors) are significantly lowered down by oversampling the data over the course of two months. In addition to that, we consider a fixed error for all pixels due to variability that exists in the applied bias correction ( $3.61 \times 10^{15}$  molec.cm<sup>-2</sup> for NO<sub>2</sub> and  $4.62 \times 10^{15}$  molec.cm<sup>-2</sup> for HCHO). This error is based on the RMSE obtained from the mentioned studies used for removing biases. Despite the fact that we do not account for non-diagonal elements of the covariance matrices, the incremental updates of **G** adjusted by both NO<sub>2</sub> and HCHO observations should better translate the covariance matrices into the emission space.”*

*Line 258: “WRF-CMAQ largely underestimated (56%) tropospheric NO2 columns” – It would be interesting to also quote the bias in molec/cm2. CMAQ is too high in urban areas and too low in rural ones. Citing over/under predictions in molec/cm2 would give a useful perspective on some of these changes.*

**Thanks, we now added the molec/cm2 values too.**

*Minor language edits are needed throughout. For example, sometimes the text should say \*the\* US, \*the\* PRD. “representivity”, “intertwisted” need correcting.*

**Corrected.**