

Atmos. Chem. Phys. Discuss., referee comment RC1
<https://doi.org/10.5194/acp-2022-435-RC1>, 2022
© Author(s) 2022. This work is distributed under
the Creative Commons Attribution 4.0 License.

Comment on acp-2022-435

Anonymous Referee #1

Referee comment on "Inferring and evaluating satellite-based constraints on NO_x emissions estimates in air quality simulations" by James D. East et al., Atmos. Chem. Phys. Discuss., <https://doi.org/10.5194/acp-2022-435-RC1>, 2022

This manuscript performed NO_x emission inversions using finite difference mass balance and OMI and TROPOMI data. The authors found systematic low biases in the estimates from TROPOMI due to the biases in the retrievals. They also found improvement in the posterior simulation of ozone with measurements. The topic fits the readership of ACP. However, several clarifications and more detailed discussions are needed, see details below.

Specific Comments

Abstract, please include what is the period and spatial scale for this work.

L15-16, Please explain how 3D-Var plays a role in the inversion.

L73-74, it is not clear to me how this work is different from previous assimilations in addressing near-surface NO₂ just based on this statement. Please elaborate more.

L197, "assimilating" causes some confusion here. A more proper word here might be "performing an inversion"?

L224, please clarify whether you are using the total NO₂ column to adjust lightning NO_x or only NO₂ observation in the upper atmosphere. It makes more sense to me if it is the latter.

L255, again, I think most previous emission inversions did the same. It is not clear to me how the method used in this work differs from previous work.

Figure 6, for the emission adjustments, could you discuss a bit more on how you determine whether it is due to emissions or chemistry in the model? Over those regions that have different seasonal adjustments in emissions, would that be due to different beta under different chemistry regimes? Otherwise, would the activity or emission factor of anthropogenic emissions have seasonal variations that are not well-captured?

Figure 7, are the differences in emission adjustments proportional to the differences in the NO₂ column from OMI and TROPOMI?

L475, did you see better agreement in upper tropospheric NO₂ between the simulation

and observations after adjusting lightning NO_x?

Section 4, I presume the motivation to use this FDMB is to reduce computational cost. Please discuss how the computational cost of this work is compared to other methods.