This manuscript performed NOx 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 NOx 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 NOx?

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.