

## Comment on amt-2021-400

Anonymous Referee #2

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Referee comment on "A comparison of the impact of TROPOMI and OMI tropospheric NO<sub>2</sub> on global chemical data assimilation" by Takashi Sekiya et al., Atmos. Meas. Tech. Discuss., <https://doi.org/10.5194/amt-2021-400-RC2>, 2022

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The manuscript by Sekiya et al. compared the global chemical data assimilation results when using NO<sub>2</sub> retrievals from TROPOMI and OMI. The TROPOMI posterior NO<sub>2</sub> shows better agreement with NO<sub>2</sub> observations and smaller magnitude than the OMI one. The manuscript is generally well-written. The topic fit the scope of AMT. The result is important in interpreting existing NO<sub>x</sub> data assimilations. I suggest publication after addressing the following comments.

L7, if TROPOMI NO<sub>2</sub> is biased generally low, would the comparison with independent data improved for the wrong reason?

Figure 1. Please provide the resolution these data are gridded to in the figure description. How much do precision error and the number of observations in the super-observation grid each contribute to the smaller super-observation errors in TROPOMI data?

Line 221-222, it would be clearer to first explain what the range of chi-square is, and what do values larger and smaller than 1 generally mean.

Figure 2, I am a bit surprised that a large portion of the TROPOMI DA improvement is over the ocean, where there is no emissions. Please explain what possibly causes this.

L250-251, I am confused about the “regardless of the TROPOMI low bias” part. Is this only true because you calculate RMSE against the TROPOMI observations?

Figure 4, Please provide more information on what is being optimized in the DA. Are both NO<sub>2</sub> concentrations and emissions optimized at the same time? Are emissions all in the surface layer? If not, how are they distributed vertically, and how does DA adjust emissions differently at different layers?

L287, a similar comment as a previous one, if there are systematic low biases in TROPOMI data, why do its DA results have better agreement with independent data?

L330, could you also add a figure showing the changes in NO<sub>2</sub> concentrations from the two DA?

L339-351, based on the low biases in TROPOMI NO<sub>2</sub> retrievals and the comparisons here, what is the implication for existing DA and inversion results using this version of TROPOMI NO<sub>2</sub>?

L446-447, would you expect the low biases in TROPOMI NOx emissions reduce using this new product, and by how much?