Earth Syst. Sci. Data Discuss., referee comment RC1
https://doi.org/10.5194/essd-2020-280-RC1, 2021

Review of essd-2020-280

Anonymous Referee #1

Referee comment on "Catalog of NO_x emissions from point sources as derived from the divergence of the NO_2 flux for TROPOMI" by Steffen Beirle et al., Earth Syst. Sci. Data Discuss., https://doi.org/10.5194/essd-2020-280-RC1, 2021

This is a nice manuscript that describes an initial attempt to estimate NOx emissions from 100s of point sources around the globe using TROPOMI NO2. It is well-written and includes a lot the detailed information necessary for replication. Some minor comments are below. The three more major comments have an asterisk in front of them.

Page 3 Line 5. Please note here that section mask will be described in more detail in Section 3.3

Page 5 Line 26. Use a specific value, perhaps “less than 5 km” instead of “some km”

Figure 1a. Include a “+” at the end of the colorbar, as I am assuming there is a value somewhere >10x10^15

*Page 6 Line 1. It's still a bit unclear how the TROPOMI data is averaged and filtered. Are entire months excluded if there are only 4 valid overpasses instead of 5? Or is this just a selection criteria. Also are the emissions derived monthly (or some group of months together) and then averaged over the 24-month period? Or is the TROPOMI data averaged over all 24 months and then the emissions are computed? I'd imagine the former might be better for mid-latitudes since NOx lifetime varies quite a bit due to seasons.

Page 6 Line 10. Is it 6 months during each year (12 month period) or 6 months during the full 24 months?

Figure 2 caption. Prefer if "and" is replaced by "divided by". Presumably values shown here are a value averaged over all 24 months? Or only "valid months" shown? Also, would be good to state either in the figure caption or text accompanying the figure that polar regions have more interannual variability in the NOx lifetime at the TROPOMI overpass time. Lastly, while larger ratios likely exist over mountainous regions, I am not convinced that this particular image is showing that. Instead it seems like latitude is the primary driver of the variability. I suggest removal of the last sentence, and replacement with a comment such as "latitude (and associated confounders) is one of the primary drivers of the NOx/NO2 ratio".

Page 10 Line 5. Emphasize that latitude appears to be one of the largest controllers of NOx lifetime at the TROPOMI overpass time. Can you further comment on how this may bias your results for different areas? If I understand correctly, a region with a shorter NOx lifetime, might have a larger sink value, which is excluded by your method. So perhaps excluding the sink term may cause a larger bias in equatorial regions than mid-latitudes. Even if my understanding is incorrect please comment on how latitude affects NOx lifetime and any associated biases.

Page 10 Line 27. Would be good to give reader an estimate of the low bias, even if it is a range. Seems like bias can be anywhere from a factor or 1.2 to almost 2.5. Goldberg et al., 2019 discusses this a bit for U.S. power plants using the exponentially modified Gaussian fit (Beirle et al., 2011). Goldberg, D. L., Lu, Z., Streets, D. G., De Foy, B.,

Griffin, D., Mclinden, C. A., Lamsal, L. N., Krotkov, N. A. and Eskes, H.: Enhanced Capabilities of TROPOMI NO2 Estimating NOx from North American Cities and Power Plants, Environ. Sci. Technol., 53(21), doi:10.1021/acs.est.9b04488, 2019.

Page 11 Line 20. What is meant by the "Global maximum value"? Please clarify.

Figure 3 caption. Over what timescales are being shown here?

Page 17 Line 12. Any chance the csv file can be included as a supplement on the ESSD webpage or another publicly available webpage? Seems like you need an approved account to access the csv file, which might hinder some people from accessing it.

*Page 17 Line 15. Instead of or addition to every "100th", perhaps include the largest on each continent and their rank. Table 4 and Figure 5 have no values for US, Europe or Australia (and North America and South America only appear because they have a "100th"). As of right now, it's difficult to assess how well the method does in North America, South America, Europe, and Australia (these 4 continents likely represent a large segment of the journal readership).

Page 18 Line 5. Modify "large" to "high capacity"

Page 21 Line 21. Explicitly state that in your method, the reported emissions are a grouping of emissions from electricity generation and any related emissions from on-site activities such as heavy-duty diesel, etc. The latter may be small, but important to make this distinction.

*Page 21 Line 25. I understand that accurate quantification isn't necessarily the goal here, but it's still important to compare to reported NOx emission data. In the United States, at least, annual NOx emissions data from top power plants is very easy to acquire. To download annual data visit this website: https://ampd.epa.gov/ampd/ , scroll down to "Get Reports" on bottom right and click "Start", on next page click "Top Emitters", then choose Annual NOx emissions for 2018 (and 2019) by Facility for the top 50 emitters. Seems like European data is here: https://www.eea.europa.eu/data-and-maps/data/industrial-reporting-under-the-industrial-2 I recommend including a discussion in this section comparing your reported values to the values reported by the US and European agencies.

Page 24 Line 7. Would be good to cite Liu et al., 2020 here. Liu, F., Duncan, B. N., Krotkov, N. A., Lamsal, L. N., Beirle, S., Griffin, D., McLinden, C. A., Goldberg, D. L. and Lu, Z.: A methodology to constrain carbon dioxide emissions from coal-fired power plants using satellite observations of co-emitted nitrogen dioxide, Atmos. Chem. Phys., 20(1), 99–116, doi:10.5194/acp-20-99-2020, 2020.

Page 25 Line 7. Important to note in this section that there are plenty of point sources in North America and Europe, but many are generally too small to capture in your current method (i.e., blend in with background NO2 or other local sources).