

Earth Syst. Sci. Data Discuss., referee comment RC1
<https://doi.org/10.5194/essd-2022-74-RC1>, 2022
© Author(s) 2022. This work is distributed under
the Creative Commons Attribution 4.0 License.

Comment on **essd-2022-74**

Sergio Ibarra (Referee)

Referee comment on "Multispecies and high-spatiotemporal-resolution database of vehicular emissions in Brazil" by Leonardo Hoinaski et al., Earth Syst. Sci. Data Discuss., <https://doi.org/10.5194/essd-2022-74-RC1>, 2022

Hoinaski et al have developed a comprehensive database from annual vehicular emissions for Brazil with a spatial resolution of 0.05 degrees. This database covers 41 pollutants and Hoinaski et al provided the groups for the chemical mechanisms CB6. Hence, this manuscript presents an important effort to provide baseline environmental information for a big country such as Brazil. Furthermore, the data associated to this manuscript will serve as a tool to support the environmental planning. However, this manuscript present issues that need to be fixed before publications:

Major issues

- It is important to check the validity of comparison of the emissions with MERRA. The thing is that, yes, it is possible to compare emissions with concentrations but under specific conditions, for instance, when the boundary layer is low. In this way, the air pollutant concentrations should be representative of the emissions, as shown by Gallardo et al., 2012. As the database provided by Hoinaski et al present hourly factors, my recommendation is to compare under a similar set of conditions such as the ones presented by Gallardo et al. Author can find similar research on literature. Regarding the air pollutant concentrations, authors could use the CAMS global reanalysis (EAC4) Copernicus <https://www.ecmwf.int/en/forecasts/dataset/cams-global-reanalysis>.

Gallardo, L., Escribano, J., Dawidowski, L., Rojas, N., de Fátima Andrade, M. and Osses, M., 2012. Evaluation of vehicle emission inventories for carbon monoxide and nitrogen oxides for Bogotá, Buenos Aires, Santiago, and São Paulo. Atmospheric Environment, 47, pp.12-19.

- Lines 55-58: "Current inventories provide only annual emissions not reaching the spatial ... resolution... nor the concentration of chemical species..." According to these words, the authors are stating the one problem of the emissions inventories are not providing concentrations. This is conceptually wrong because emissions are mass and concentrations mass over volume. I think the author meant the inventories usually do not provide the required speciation, which would be an English problem, but need to check.
- Line 85: According to the CETESB (2019, the same reference used by author), RCHO is actually the sum of aldehydes and formaldehyde. Furthermore, CETESB also provides NMHC - ETOH emission factors. In addition, as the road transportation fuel consumed in Brazil has a vastly origin on bio-fuels, 27% of gasoline is ethanol and 7% of diesel is bio-diesel, this results in a unique chemical signature of the chemical composition of fuel, hence the emissions. Actually, there are literature mentioning the high number of carbonyls in the vehicular emissions (Nogueira et al., 2015). According to table SM7, the species C₂H₄O (ALD2), C₂H₆O (ETOH) and CH₂O (FORM PRIMARY) are present in the NMHC speciation. Then, in order to provide a correct speciation, the author must reply the following questions:

Which pollutant are they using to perform the speciation? NMHC or NMHC – ETOH?

Do the NMHC emission factors already consider RCHO?

If the authors are using NMHC, then it is supposed that ETOH and RCHO is already part of NMHC. However, this would result in a different chemical composition signature. Then, the recommendation would be preserving the proportions of ALD, FORM and ETOH and recalculate the speciation for the other compounds. I would say that this is more important for ETOH than RCHO. Can the author comment on that? Is this part of an ongoing work?

Nogueira, T., de Souza, K.F., Fornaro, A., de Fatima Andrade, M. and de Carvalho, L.R.F., 2015. On-road emissions of carbonyls from vehicles powered by biofuel blends in traffic tunnels in the Metropolitan Area of Sao Paulo, Brazil. *Atmospheric Environment*, 108, pp.88-97.

- Lines 102-104: While this method is conservative, the emissions need to be considered are currently expressed as points in space and not mass flux. Then, the current format is not appropriate for air quality models. In other words, the temporal mass must be divided by the area, for instance, the gases inputs to the WRF Chem model are expressed as $\mu\text{g}/\text{km}^2/\text{h}$. Then, the authors must recalculate the NetCDF output or add the proper flag indicating that the user must do divide by the area.

Minor Issues

There are many paragraphs consisting in less than two phrases. Each paragraph should have at least three parts, intro, body and conclusion. Please fix.

English needs to be revised

Line 83: "The software provides..." Improve English.

Line 84: Given that there are fuel consumption data by month available in Brazil, why the authors provide monthly emissions instead of calculating annual emissions with monthly profiles? Are you planning to improve this database?

Figure 2: Include the resolution in the figure, also, increase the size of the legend and fix itself.

Lines 120-121: can you a plot of the emission factors of RCHO and CO for heavy-duty and light-duty vehicles?

Figure 4: present the first three plots horizontally and below the expanded hourly temporal factors.

Lines 181-184; I think the author is being ambiguous. One thing is having the emission files according CB6 and another is that the files are according to these models. Each one of these models have emissions input files with different NetCDF characteristics. Then the authors must be more careful choosing the right words.

Figure 8: Make figure bigger, reduce space between Brazil for each comparison, use more pages if needed.

Figure 9: Correlation figures seems distorted. These figures could be a) EDGAR, b) BRAVES, c) bias with the same color legend. For instance, negative could be blue, positive red, centered at 0, with degradation.

Line 217. Why EDGAR is higher than BRAVES? On a recent paper (Nogueira et al., 2021) it was found that the CETESB emission factors need to be corrected to represent tunnel emission factors. The correction based on this publication is shown below. This correction is already available in the VEIN model (Ibarra-Espinosa et al., 2018).

CO, HC and NMHC:

Light duty vehicles: 2.62

Heavy duty vehicles: 4.78

NO_x

Light duty vehicles: 0.78

Heavy duty vehicles: 1.05

NO

Light duty vehicles: 0.54

Heavy duty vehicles: 1.05

Nogueira, T., Kamigauti, L.Y., Pereira, G.M., Gavidia-Calderon, M.E., Ibarra-Espinosa, S., Oliveira, G.L.D., Miranda, R.M.D., Vasconcellos, P.D.C., Freitas, E.D.D. and Andrade, M.D.F., 2021. Evolution of Vehicle Emission Factors in a Megacity Affected by Extensive Biofuel Use: Results of Tunnel Measurements in São Paulo, Brazil. *Environmental Science & Technology*, 55(10), pp.6677-6687.

Ibarra-Espinosa, S., Ynoue, R., O'Sullivan, S., Pebesma, E., Andrade, M.D.F. and Osses, M., 2018. VEIN v0. 2.2: An R package for bottom-up vehicular emissions inventories. *Geoscientific Model Development*, 11(6), pp.2209-2229.

Line 238: registered or circulating fleet?