

Anonymous Referee #1

We thank the referee for his(er) insightful and very helpful comments, which contributed to improve the manuscript. Please see the revised draft with the changes marked in bold blue and in underline red for all grammar and spelling fix.

The answers to his(er) questions and comments are below:

RC: Referee's Comment

AR: Author's response

AC: Author's changes in manuscript

1. RC:

In term of technical for this manuscript:

strength point: use the secondary information of 258 roads in the calculation

AR: We thank the reviewer for this appreciation.

2. RC:

weak point:

- Methodology used in the calculation equal to Tier 1 (just roughly estimation, don't consider on the factors that related to the emission (as engine type, etc.).

AR: We thank the reviewer for this perspective. However, we are not aware of similar studies on cities in a tropical forested region like Amazonas rain forest. Furthermore, most of regions of Brazil does not have emission-specific inventories and specific informations related to the emission (e.g. traffic volume, age and fuel type of vehicle, engine type,

etc.) at local or municipal details. But, any additional literature that the reviewer is aware of would be very useful to this work.

3. RC:

- Result not represent for the whole area (as mentioned in the manuscript, traffic volume is only from major road), it will be better if it has some explanation that mention the coverage of the major road → it can used to calculate the uncertainty (from the completeness of information) of this result.

AR: Great observation. We thank the reviewer for this perspective and your comments. In order to address this point, the following paragraph was included in the manuscript (line 171).

"... we obtained data by manually counting vehicles along the 258 main traffic routes from Manaus, representing 85% of the roads likely to have high emission contribution, over two time ..."

4. RC:

- In the methodology mentioned only the traffic volume during the peak time, meaning that the result from this study represents only emission during the peak time, isn't it? No detail (unit) of traffic volume even in the figure 2. and no detail in the methodology that mentioned about the traffic volume during off-peak period.

AR: We thank the reviewer for this perspective and comments. In general, for vehicle emission studies and modeling, the peak hours are of higher importance than off-peak periods. Unfortunately, in most Brazilian cities the traffic volume is observed only during peak hours. Additionally, in the Manaus urban area, the traffic volume doesn't show strong variations in during day-time. Recently Ibarra-Espinosa et al. (2018) showed that in some days of the week the profile traffic volume at Metropolitan Area of São Paulo (MASP) doesn't show strong variations as a typical function double Gaussian distribution. Even with the present

limitations, we believe that this work is important for the tropical area context that still suffers serious limitations in the spatial and temporal representativeness of the urban emissions.

AC: *The figure 2 legend was rewritten and improved:*

Figure 2. The top panel shows the mean spatial distribution of traffic density (vehicles/hr) along Manaus urban area main roads for each vehicle category, respectively: light vehicles (a); bus (b); trucks (c); motorcycles (d). The bottom panel shows the boxplot for each vehicle category. Upper and lower whiskers represent 1.5 interquartile ranges for the period, from the 25th and 75th percentiles; outliers are represented by dots. The crosses represent sample median value and the black square is the average value.

AC: *Thus, in order to address all point, the following paragraph was written (insert in line 174):*

"... In most Brazilian cities, the traffic volume is monitored only during the peak hours, furthermore in Manaus urban area the traffic volume doesn't show strong variations during the day-time. Thus, the off-peak periods is not considered in this study."

5. RC:

- the figure 3 and 4 and the name under figures might be wrong. The result from figure 3 and 4 are mismatched with the traffic volume that presented in figure 2. Please check the result and the name it might be mismatched.)

AR: *We thank the reviewer for this comments. However, we did not find the errors the reviewer referred . Any way for clarification the legends were rewritten.*

AC:

Figure 3. Grid-based vehicle emission inventory of CO at Manaus urban area for each vehicle category in kg h^{-1} , respectively: light vehicles (a); motorcycles (b); bus (c); trucks (d).

Figure 4. Grid-based vehicle emission inventory of NO_x at Manaus urban area for each vehicle category in kg h⁻¹ , respectively: light vehicles (a); motorcycles (b); bus (c); trucks (d).

AR: *We analyzed the results shown in figure 3 and 4 and don't observe an incompatibility with the figure 2. For example, in figure 2 (top panel, figure 2a - light vehicles) the maximum values are found in the south urban region (lines in red). In this region, the segment of road present means of 4 km. The maximum values represent the mean traffic density of 4553 vehicles per hour. Using the equation for finding the emitted mass of a pollutant (Eq. 1 shown in the manuscript), here we adopted carbon monoxide to exemplify, and an emission factor for light vehicles of 1.2 g/km (found in Table 1) we find values compatible with those shown in figure 3 (~ 21 kg/h of emitted mass of carbon monoxide).*

References

Ibarra-Espinosa, S., Ynoue, R., O'Sullivan, S., Pebesma, E., Andrade, M. D. F., and Osses, M.: VEIN v0.2.2: an R package for bottom-up vehicular emissions inventories, *Geosci. Model Dev.*, 11, 2209-2229, <https://doi.org/10.5194/gmd-11-2209-2018>, 2018.