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Interactive comment on "Monitoring CO emissions of the metropolis Mexico City using TROPOMI CO observations" *by* Tobias Borsdorff et al.

Anonymous Referee #1

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Borsdorff et al. present an inversion approach to retrieve carbon monoxide (CO) emissions over ten urban districts of Central Mexico based on high-spatial resolution observations from the TROPOMI satellite and using WRF-Chem simulations. This work presents new insight into the needed high spatial distribution emissions using satellite observation and likely suitable for the journal. I do have some comments below that need to be addressed before publication.

Major Comments

One of the main concerns is regarding the CO background concentration and chemistry. Authors assume a time invariant CO background concentration, while I believe background processes in the region of interest and its surrounding are quite important. I highly suggest to describe in detail why a constant CO background CO has been used.

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[Discussion paper]

Please explain in detail how the background CO flowing into the domain produced by all non-metropolis Mexico City (10 districts) sources, including, non-metropolis Mexico City fires, is treated. Considering the relatively long lifetime of CO transport is extremely important.

Furthermore, biogenic non-methane VOCs emitted from vegetation might be important as a source for the chemical production of CO in the atmosphere. In the manuscript, I did not find information regarding these contribution, maybe it is too small for the metropolis?, what about the transport of the surroundings to the districts. It would be important to add a description on this.

Lastly, according to the authors the configuration of the model does not account for atmospheric chemistry, does that mean that Gas-phase Chemistry is not included?. Similarly, please include a description of why this configuration was chosen.

Specific Comments

Authors recognize the possible error sources, and if I understand correctly authors estimate uncertainties in the inversion, I highly suggest to include the uncertainties of emissions in the abstract.

P1, L2. It is mentioned that 551 overpasses are analyzed, please specify the exact time period. The season(s) might be relevant.

P1, L4. It is not clear to me if you use WRF coupled with Chemistry (WRF-Chem)?

P1, L8. Do you identify the sources missing in the INEM in Tula and Pachuca?

P1, 14. It is mentioned: "CDMX and ACDMX follow a clear weakly cycle with a minimum during the weekend" does this mean that the weekend effect is not found in the other regions?

Section2, TROPOMI CO data set:

In the current manuscript, I do not find a real value of including the FTIR observations,

however it might be good to include it in this section. I suggest to include comparisons between TROPOMI and FTIR for coincident dates, do they compare ok?

Section 3.1, The WRF model.

Important chemical parameterizations in the model are missing, e.g., what biogenic and biomass burning emissions are used?. What kind of boundary conditions?. Is the inflow of CO emitted by fires outside the region of interest included?. What time step is used?

P4, L17. Do you mean equation 1?

P5, L3-7. As in my major comment, it is a big assumption that " local enhancements of CO are due to emissions of the city districts of the same day" with a constant CO background?. It is well known that biomass/fire emissions can contribute significantly to the CO in the region. I wonder why an inflow of background CO is not taken into account, my understanding is that WRF-Chem can handle this.

In order to have a sense of the spatial distribution of CO, I highly suggest to include the urban districts in Fig. 3.

P8, L2-9. It is not clear how the background concentration was estimated.

P8, L9. It is mentioned that "the fire season many data cannot be considered", how many days (or percent) are excluded based on this?

Figure 4, It is hard to identify the districts on this figure, maybe you could include the contour/shapes of the districts.

Figure 5. I recommend to follow the names of the districts as in Figure 1. Especially for Ciudad de Mexico and CDMX.

Figure 5. Why does Tulancingo have a zero emission?

Figure 5. Is the number of collocations the same as the number of days?

Figure 7. What does negative CO emission mean?

Figure 7. It is hard to believe that emissions on Sat and Sunday are very similar, what time does it represent the emissions?

Figure 8. The weekly cycle of CO is considerably different than the weekly cycle of the emissions from Fig 7 (c), maybe I miss it but do you explain why?. Also, error bars from FTIR are extremely low, I do not think a standard deviation from the mean is the best way to characterize variability.

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