

Interactive comment on “Carbon monoxide air-pollution on sub-city scales and along arterial roads detected by the Tropospheric Monitoring Instrument” by Tobias Borsdorff et al.

Anonymous Referee #3

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The authors have used TROPOMI CO column data over Iran and Armenia to estimate CO emissions from Tehran, Yerevan, Urmia, and Tabriz between 1 November – 20 December 2017. As a result of its high accuracy and observational coverage, TROPOMI is able to capture the influence of urban emissions at unprecedented temporal and spatial resolution. Using WRF simulations, the authors found that the EDGAR v4.2 inventory significantly underestimates CO emissions from Yerevan, Urmia, Tabriz, and Tehran. Furthermore, they found that the TROPOMI data suggested transportation emissions in the vicinity of Yerevan that are absent in the EDGAR v4.2 inventory. The manuscript nicely shows the potential of the TROPOMI data for improving our knowledge of urban scale CO emissions. I agree with the authors that the data will challenge

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our current modeling approaches at high spatiotemporal resolution. I therefore recommend the manuscript for publication in ACP after the authors have addressed my comments below.

General Comments

1) It would be useful to see what the background CO fields look like across the region. How much do they contribute to the total columns shown in Figure 3, for example? How much does the background contribute to the variability in the model simulations of the observations on 27 November, 12 December, and 17 December? Knowing how the background is changing on these days will help interpret the variations in the estimated emissions (shown in Table 2) on these days for Yerevan, Urmia, and Tabriz.

2) The analysis produced negative emissions of -4.17 kg/s, with an uncertainty of 2.31 kg/s, for Tabriz on December 17th. How do the emissions go from 2.64 kg/s on Dec 12 to -4.17 kg/s on Dec 17th? I realize that the authors stated, concerning future work, that “follow-up studies must show if this variability can be attributed to a variation of the emission sources or to biases of the inversion approach used,” but how does one explain this sink of CO on Dec 17th in the context of urban sources of CO? It would be helpful to learn more about the fitting process for the emissions. Also, could discrepancies in accounting for the background contribute to this negative estimate for the emissions?

3) How is the sensitivity that is shown in Figures 4 and 5 calculated? Also, how does the sensitivity for Yerevan, Urmia, and Tabriz vary between Nov 27th, Dec 12th, and Dec 17th?

4) Is the sensitivity to emissions from Urmia and Tabriz as localized as that for Tehran? I ask because Table 2 shows that including the road emissions produces large changes in the emissions for Urmia and Tabriz, even though these two cities are to the south of the region of the road emissions (as shown in Figure 2). If the fitting sensitivity for these cities is also localized, why are the emissions changing so much when the road

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emissions are included?

Technical Comments

- 1) Page 1, lines 7-8: Since the WRF simulation is not being used to evaluate the TROPOMI data, I would suggest changing the order of this sentence to: "The WRF simulation agree well with TROPOMI CO, with a mean difference of 5.7%."
- 2) Page 1, lines 15-16: Please change "since 13 October 2017" to "on 13 October 2017."
- 3) Page 1, line 23: Please change "at the Northern Hemisphere" to "in the Northern Hemisphere."
- 4) Page 2, line 10: Please define TCCON and NDACC.
- 5) Page 2, line 11: Can you please state what are the precision and accuracy requirements? It would help the reader with interpreting the results of the analysis.
- 6) Page 3, line 5: What do you mean by "good sensitivity"? Can you give a quantitative measure of what you mean by this?
- 7) Page 5, line 4: See Main Comment 3 above. How is the sensitivity calculated?
- 8) Page 5, lines 21-22: It is not easy to tell where Urmia and Tabriz are located. It would be good to label the locations of Yerevan, Urmia, and Tabriz on this map. Similarly, it would be good to have these labels on Figure 7.
- 9) Page 6, line 3: Can you please give a quantitative estimate for the improvement in the agreement?
- 10) Figure 3: It is difficult to see the details in this figure. Can you please enlarge the figure?
- 11) Figure 7: Please add the date of the observations to the figure caption.

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