Atmospheric Chemistry and Physics Discussions

Atmos. Chem. Phys. Discuss., author comment AC1
https://doi.org/10.5194/acp-2021-533-AC1, 2021

Reply on RC1

Linhui Jiang et al.

Author comment on "Hyperfine-resolution mapping of on-road vehicle emissions with comprehensive traffic monitoring and an intelligent transportation system" by Linhui Jiang et al., Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2021-533-AC1, 2021

The manuscript by Jiang et al. establishes an urban on-road vehicle-specific emission inventory, which makes an important technological breakthrough and is central to urban ozone and particular matter pollution control. In particular, this study proposes a hyperfine resolution bottom-up model framework built upon a series of valuable ITS facilities and algorithms, like radar velocimeters, surveillance cameras, and the image recognition algorithm. To my knowledge, this is the first time for investigating urban on-road emissions with a resolution up to several meters. The authors much have gone a long way towards such findings. Consequently, an unprecedented emission map is obtained in this study. Therein, widespread and persistent emission hotspots emerged. They are of significantly sharp small-scale variability, up to 8 ~ 15 times within individual hotspots, attributable to distinct traffic fluxes, road conditions, and vehicle categories. Overall, this work is novel, important, and well-written. I recommend its acceptance for publication after minor revisions.

Response: We truly appreciate the interest and support of the reviewer. We are also grateful for all the constructive comments and suggestions. We have adopted all the suggestions in our revised manuscript.

The followings are our point-to-point responses to the reviewers' comments.

General comments:

Line 394. The authors conclude with several final important implications of this work. For the public, as pointed by the authors, "the hyperfine-resolution emission inventory can alter personal behaviour, much as real-time traffic navigation data now inform individual driving patterns.". However, policymakers still question how this hyperfine resolution emission inventory would help improve air quality and address exposure misclassification. Hence, the discussions would be more insightful if the authors could make this clearer. I believe the chemical transport model (CTM) might be a key link.

Response: We thank the reviewer for raising this important issue. We have supplemented associated discussions to clarify this issue.

Added/rewritten part in Conclusions: By pinpointing localized emission hotspots, these data may provide new opportunities for policymakers. Specifically, our results can replace the coarse-grid (> 1 × 1 ~ 25 × 25 km^2) emission inventory (Janssens-Maenhout et al., 2015; Li et al., 2017; Zhang et al., 2013) as the input for the CTM. Comparably, the meteorological input should also be hyperfine sufficiently, which thus needs to account for large eddy simulations (e.g., WRF-LES). In so doing, dispersion models (e.g., AERMOD) (Yang et al., 2019), instead of full CTMs (Mehmood et al., 2020; Wong et al., 2012; Yu et al., 2013), are sufficient to resolve street-level gradients of air pollution concentrations. Through combination with CTM outputs and near-road air quality measurements (Apte et al., 2017; Grange et al., 2017; Jiang et al., 2018; Yang et al., 2018), the hyperfine-resolution scanning of responses of air quality to emissions becomes possible. This would help understand highly nonlinear air pollution mechanisms, such as the O_3-VOCs-NO_x relationships (Li et al., 2019), and thus optimize mitigation policies. Besides, the resulting hyperfine-resolution maps of air pollutant concentrations can help address exposure misclassifications and even directly alter personal behaviours, such as real-time traffic navigation data can now inform individual driving patterns. In addition, these hyperfine-resolution emissions and air quality maps might result in broader societal consequences, including urban land-use decisions, ecological planning, and political economy.

Specific comments:

Line 113: What is the exact period of the "rush hours"? As appearing for the first time, it has to be specified.

Response: We thank the reviewer for the suggestion. We have supplemented the exact period of the "rush hours"?

Added/rewritten part in Comprehensive traffic monitoring network: Since 2016, routine measures to ease traffic congestions, such as license restrictions during the morning and evening rush hours (from 7:00 to 9:00 and from 16:30 to 18:30, Local Time) on weekdays (i.e., from Monday to Friday), were implemented over the Xiaoshan District.

Line 171: Does "during the morning and evening rush hours" mean the same as "during the morning and afternoon rush hours" (Line 113)? If so, please unify the definitions.

Response: We thank the reviewer for the suggestion. We have unified the definitions.

Line 159: Please give brief definitions for the "light-duty vehicles (LDVs), middle-duty vehicles (MDVs), heavy-duty vehicles (HDVs), light-duty trucks (LDTs), middle-duty trucks (MDTs), and heavy-duty trucks (HDTs)?"

Response: We thank the reviewer for the suggestion. We have supplemented the definitions. This classification follows the national standard. The LDVs were all designated as vehicles in a length of ≤6 m and ridership of ≤9. The MDVs and HDVs were of the same length but with different ridership of 10 ~ 19 and >20, respectively. More definitions of the trucks could be found in the national standard profile.

Added/rewritten part in Hyperfine-resolution bottom-up model framework: Herein, six vehicle categories were detected and defined, including light-duty vehicles (LDVs), middle-duty vehicles (MDVs), heavy-duty vehicles (HDVs), light-duty trucks (LDTs), middle-duty trucks (MDTs), and heavy-duty trucks (HDTs). This classification follows the national standard (GA802-2008). The LDVs were all designated as vehicles in a length of ≤6 m and ridership of ≤9. The MDVs and HDVs were of the same length but with different ridership of 10 ~ 19 and >20, respectively. More definitions of the trucks could be found in the national standard profile (GA802-2008).

Line 222: The "overall" should be deleted.

Response: We thank the reviewer for the suggestion. We have deleted the word.

Figure 8: This picture lacks the description of the abscissa. Is that the number of weekdays?

Response: We thank the reviewer for the suggestion. We have supplemented the abscissa. We have also revised the figure caption to make it clearer.