Geoscientific Model Development Discussions

Geosci. Model Dev. Discuss., referee comment RC1
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Comment on gmd-2021-135

Anonymous Referee #1

Referee comment on "The Comprehensive Automobile Research System (CARS) – a Python-based automobile emissions inventory model" by Bok H. Baek et al., Geosci. Model Dev. Discuss., https://doi.org/10.5194/gmd-2021-135-RC1, 2021

This manuscript describes the CARSv1 system, a python-based automobile emissions inventory model that allows estimating high-resolution emissions from road transport activities. The strength of CARS is in its ability and flexibility to generate emission results in multiple formats and for multiple purposes, ranging from policymaking to air quality modelling. Moreover, the system makes use of very detailed and local input datasets, which allows computing emissions with a high level of representativeness. Emissions computed by CARS for South Korea are presented and compared against a local emission inventory to illustrate its capabilities and to show the high sensitivity of the results to the vehicle operating speed. The paper is very well written and structured, and its quality is excellent, which makes it a very good contribution to GMD. I therefore recommend to accept this manuscript for publication once the following minor comments have been addressed.

- CARS estimates hot exhaust, cold start, and evaporative emissions from road transport. However, PM emissions from non-exhaust processes (i.e., tyre, road and brake wear, resuspension) are not included in the calculation process. Several studies have highlighted that non-exhaust PM emissions can dominate total traffic PM10 emissions (e.g., Denier van der Gon et al., 2013; Amato et al., 2014). Are the authors planning to include these emission processes in the CARS system as part of future developments? If so, it may be good to mention it in the conclusions section (or at least mention the current limitation of the system regarding the estimation of PM emissions).

Hugo A.C. Denier van der Gon, Miriam E. Gerlofs-Nijland, Robert Gehrig, Mats Gustafsson, Nicole Janssen, Roy M. Harrison, Jan Hulskotte, Christer Johansson, Magdalena Jozwicka, Menno Keuken, Klaas Krijgsheld, Leonidas Ntziachristos, Michael Riediker & Flemming R. Cassee (2013) The Policy Relevance of Wear Emissions from Road Transport, Now and in the Future—An International Workshop Report and Consensus Statement, Journal of the Air & Waste Management Association, 63:2, 136-149, DOI: 10.1080/10962247.2012.741055

Fulvio Amato, Flemming R. Cassee, Hugo A.C. Denier van der Gon, Robert Gehrig, Mats Gustafsson, Wolfgang Hafner, Roy M. Harrison, Magdalena Jozwicka, Frank J. Kelly, Teresa Moreno, Andre S.H. Prevot, Martijn Schaap, Jordi Sunyer, Xavier Querol, Urban air quality: The challenge of traffic non-exhaust emissions, Journal of Hazardous Materials, 275, 31-36, https://doi.org/10.1016/j.jhazmat.2014.04.053, 2014.

- The CARS system considers the influence of temperature on different emission processes (e.g., cold-start, NOx diesel hot exhaust). How is the information of temperature provided to the CARS system by the user? Can the user provide gridded information? Or only a single set of temperature values for the whole domain of study? Please specify in the text.
- The CARS system is capable of computing CTM-ready emission inputs. Could you provide a list of the CTMs that are currently compatible with the CARS output files (e.g., CMAQ, WRF-CHEM,…)? (for each CTM, emission input files need to be provided in a specific format, e.g., attributes and name of the variables of the NetCDF file, spatial projection, units)
- While Figure 1 of the manuscript gives a clear overview of the CARS methodology and workflow, I think it would be good to also include a summary table with a list of the names of the input files that are needed to run the system, classified by category (i.e., activity data, emission factors, …).
- I recommend to update the reference Rey DR (2018) to Rodriguez-Rey et al. (2021):

Rodriguez-Rey, D., Guevara, M., Linares, MP., Casanovas, J., Salmerón, J., Soret, A., Jorba, O., Tena, C., Pérez García-Pando, C.: A coupled macroscopic traffic and pollutant emission modelling system for Barcelona, Transportation Research Part D, 92, https://doi.org/10.1016/j.trd.2021.102725, 2021.