

Atmos. Chem. Phys. Discuss., referee comment RC2
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Comment on acp-2020-1243

Anonymous Referee #1

Referee comment on "Vehicle-induced turbulence and atmospheric pollution" by Paul A. Makar et al., Atmos. Chem. Phys. Discuss., <https://doi.org/10.5194/acp-2020-1243-RC2>, 2021

This study develops/proposes a parameterization for an additional source of atmospheric dispersion due to moving vehicles on roads (vehicle-induced turbulence, VIT) for use in 3-D chemical transport models. The topic is relevant as mobile sources are often dominant contributors to air pollution in many urban areas while grid scales typically employed by 3-D CTMs are not sufficiently fine to adequately represent those roadway sources. The manuscript is well organized, and the methodology and study outcomes are effectively presented.

What's missing in the current manuscript is a proper evaluation of the proposed VIT scheme. The authors evaluated performance of a 3-D CTM with and without the VIT scheme against observations and showed that the model performance was generally better with the VIT scheme. As the authors also noted, however, model performance of a 3-D CTM is affected by a number of factors, and good model performance doesn't necessarily mean that the model is right for the right reasons. For example, improved model performance could be resulted from model biases due to over-estimated vehicle emissions being reduced by increased mixing by the VIT scheme. While the 3-D CTM simulations serve well as a sensitivity analysis (it's clearly shown that the proposed VIT scheme implemented in a 3-D CTM has significant impacts on the model results), a better evaluation of the VIT scheme may be to directly compare the scheme in a simplified version of the CTM (e.g., with a single horizontal grid cell with multiple vertical layers) with a finer-resolution LES or CFD model, using a small test case with a more controlled setup (e.g., a hypothetical roadway with a predefined vehicle configuration). At least, more discussion on this should be added.

Minor technical issues are listed below.

Line 64: "a vehicle11" ?

Line 282: "added via the "F" terms in (6)" -> "added via the "F" terms in (8)"

Line 302: "All six panels also show a trend of $\partial K/\partial z$ becoming more negative" - revise this sentence; many of the panels actually show positive $\partial K/\partial z$.

Line 358: "with different values for the input coefficients of thermal turbulent transfer coefficient (K)" -> "with different values for the input coefficients of thermal turbulent transfer coefficient (K) and for the lower boundary conditions (E)"

Line 479: "metrics used to here (see Methods)" -> "metrics used here"

Line 497: "Figure 7(a,b)" -> "Figure 7(a,c)"; "Figure 7(c)" -> "Figure 7(e)"

Line 587: "S11" -> "S10"

Line 830: Figure 1 caption says "the length scale of turbulence immediately behind the leading vehicle, a large transport truck is only 3m, while the length scale immediately behind the trailing vehicle in the ensemble (an identical transport truck) is 12.73m", but Table 1 shows that the mixing length for an isolated lead diesel cargo truck is 5.13m and that for the 2nd diesel cargo truck in an ensemble is 14.64m. Explain the discrepancies.

Line 836: In Figure 2 caption, "at low (a,c) and high (c,d) resolution" -> "at low (b,d) and high (a,c) resolution"

Line 845: Figure 4(b) caption says "equation (8)", but the legend says "eqn (6)".