Geoscientific Model Development Discussions

Geosci. Model Dev. Discuss., referee comment RC2
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Review Comment on gmd-2021-47

Anonymous Referee #2

Referee comment on "Development of a moving point source model for shipping emission dispersion modeling in EPISODE–CityChem v1.3" by Kang Pan et al., Geosci. Model Dev. Discuss., https://doi.org/10.5194/gmd-2021-47-RC2, 2021

The paper presents the development of a moving point source (MPS) model and compares it with two other common methods for evaluating the local dispersion of ship emissions, namely the line source model and the fixed point source model. The MPS was implemented as sub-grid module in the urban chemistry transport model EPISODE-CityChem to study the impact of ship emissions in numerical experiments with one and several ships, as well as in a real-world scenario in Singapore. The simulations are carefully done and the results properly discussed. MPS has a great potential when used together with AIS ship position data for real-time simulation of pollutant dispersion from ship emissions. The moving point source model is a valuable addition to the EPISODE model for assessing impacts of ship emissions on air concentrations and human health on local and city scale, allowing for more details on the spatial and temporal distribution. The comparison between MPS and the line source model reveals that differences between the two methods are more obvious for instantaneous concentrations than for longer averaging times (1 h), because the dispersion of single plumes released at different points along the same trajectory (line) becomes more homogeneous in space when longer time scales are considered. The real case did not reveal the clear benefits from using MPS, probably because the period of five hours was too short to cover different weather conditions, changes in the boundary layer structure or day/night variation. My suggestion is to include one more case that studies the role of different atmospheric stability conditions on the ship impact from the three emission models. Overall, I am in favor of publishing the paper after my specific comments below are sufficiently addressed.

Specific Comments:

1.) The abstract should better reflect the results from the study and give quantitative information about the evaluation of the performance of MPS. In particular, the larger discrepancies between the emission source models for instantaneous than for averaged concentrations should be stated more clearly.

2.) Is there any specific treatment when the plumes released from different virtual points during a simulation hour are crossing or overlapping each other? There should be some assumption about merging of the plume masses or other interaction between the individual plumes.

3.) Figure 4: what is causing the structures in the wind field?

4.) In general, there is too little information about the plume rise algorithm. How is plume rise handled in the LS model?

5.) What is assumed about the ship building height and width, since they can influence the plume rise?

6.) Real case study, section 3.3: a longer simulation period could reveal discrepancies between MPS and the LS model. The differences between the two models are very small and based on the real case it is currently not possible to conclude that MPS performs better. It is suggested to show the average 2-D fields for the observation period, to analyze where the largest discrepancy between the models occur and to look at a time series in the place of largest impact from ships. Differences in hourly average NO2 concentrations can be noticed, for example when looking at the 2-D plots in Fig. 15 at 180 min simulation time, over the eastern part of the city. It may be considered to show 2-D maps of concentration differences, to make such details clearer.

Technical Corrections

- 10 line 20: emission and concentration are confused here.
- 18 line 328: mention that locations of observation stations are shown in Fig. 6.
- 18 line 330: replace "may contributed from following aspects" by "may be attributed to the following aspects".
- 19 line 339: replace "very" by "vary".
- Figure 15: MPS and LS model 2-D plots ought to have the same color scale to allow for a quantitative comparison. This also concerns the other 2-D plots, like Fig. 13 and Fig. 14.