

Interactive comment on “The impact of ship emissions on air quality and human health in the Gothenburg area – Part I: 2012 emissions” by Lin Tang et al.

Anonymous Referee #2

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This study combined regional and city-scale chemical transport models to investigate the effect of ship emissions on air quality and health in the port city of Gothenburg in 2012. The results of this study are interesting, however, there are a number of flaws preventing the acceptance of the manuscript at the current form. A substantial revision is needed to demonstrate the novelty of the study before it fits the quality of the journal.

Major comments: 1. About the model set-up I feel some information about the advection and diffusion needs to be described, so that people can understand how the air pollutants transport horizontally and vertically over the Eulerian grid. What is the model top pressure? How many layers are there in the TAPM? The authors mentioned that

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only simple formation of secondary inorganic and organic aerosol exist in TAMP. How does that affect the simulation of PM_{2.5} and PM₁₀? Any underestimation? I would imagine the ability of TAMP in reproducing particulate matters may not be as well as CMAQ. Please refer to my second concern, in which I strongly suggest a comparison be made between CMAQ and TAPM.

2. Model evaluation Figure 4. only shows the wind rose plots, and it is hard to tell whether the meteorological conditions perform well by the model. The authors mentioned that temperature, relative humidity, total solar radiation, wind speed, wind direction and precipitation shows high correlation and low bias. How low is the bias? Is it within certain criteria, i.e., temperature bias within half to one degree Celsius? The same applies to the evaluation of air quality variables. I feel it is very hard to read Fig. 5. The authors mainly show the annual mean comparison. How about daily scale? Any statistical metrics such as mean bias, mean normalized bias, etc. were calculated?

I think it is useful to construct either a time series comparison or scatter plot to give readers an overall impression how the model performs in terms of the daily scale, or even hourly scale, if possible.

How about the performance of the 4km * 4km CMAQ results? I believe it is interesting to do a comparison between the CMAQ results and the urban-scale model results, of course, together with the observations. Based upon this comparison, people can easily judge the usefulness of the ultra-fine scale city-level model. Currently, the city-scale model has a higher spatial resolution of 250-m, however, if the model performs worse than CMAQ, what is the major purpose of the ultra-fine resolution? The same applies to the meteorology. I don't feel the science was advanced by simply focusing on the city-scale model without detailed clarification of the advances of the model.

The authors evaluated the species of PM₁₀, O₃ and NO₂, however, the health impact assessment is based on PM_{2.5}, O₃ and NO₂. Why not evaluating PM_{2.5} directly? Line 493 mentioned that “In the chemistry mode of TAPM, simplified chemical reac-

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tions for the secondary PM are included and the secondary particulate matter consists of organic carbon, reactive nitrogen and sulfate.” I am also worried about the performance of PM_{2.5} in the TAPM since only simple secondary inorganic and organic aerosol scheme was applied. How about the aerosol modes? Is the model using bulk mode aerosol or sectional bin model in TAPM?

3. Fig.9 the effect of local emission on ozone The summer mean impact implies the NO titration effect. How about daily scale? The summer mean ozone is indeed quite low. Is there any day with slightly higher concentration, which may reveal different role of local shipping? It is not very persuasive by only using seasonal mean.

4. the section of 3.2 Impact of ship emissions on local air quality Most of this section simply describes the figure by using domain average, which does not make too much sense and not too much useful. Some comparisons might be made with either other sources or other studies to reveal the advancement of this study. For instance, what do the contributions from the local and regional shipping emission tell us? Is it useful in future strategies in the control policy? Only simple descriptions greatly discount the value of the study.

Minor comments: 1. Line 48 Our study show “show” changed to “shows” 2. Line 49: emphasising changed to emphasizing 3. Line 157: exposureresponse Please add a space between exposure and response 4. Line 233: In this study, the meteorological component of TAPM was driven by the recently published ECMWF ERA5 synoptic Since the COSMO-CLM model has higher meteorological model and TAPM was driven by CMAQ 4km * 4km, why not using COSMO-CLM drives TAPM?

5. Line 235: five nested domains What are the five domains? It is better to show a figure of the five nested domains. The authors also need to clarify the spatial resolutions of the five domains. Fig. 3b: the domain should be inferred in Fig. 3a, so the readers can tell where the domain of the finer resolution is.

6. Line 307: “NOX” should be replaced by “NO_x”. 7. Line 512: “μg m-3” should be

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replaced by “μg m⁻³”, and the same applies to Line 523 and 549. 8. Line 488: “A3 in Appendix”, but the Appendix only have S3, not A3. The same issue applies to “Fig. A4 in the Appendix” on line 503 and 511. 9. Fig 8, the x-axis label needs to be changed. For instance, either all using the mid-day of the month, i.e., 15/01, or something else to make it easy to follow. 10. Figure captions can be more succinct. A lot of repetitive words.

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