

Interactive comment on “Effects of ship emissions on air quality in the Baltic Sea region simulated with three different chemistry transport models” by Matthias Karl et al.

Anonymous Referee #1

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Dear Editor,

this is an interesting and useful paper comparing the performance of 3 CTMs for overall pollutant concentrations and also for shipping emissions. The first half of the MS deals with overall pollutant concentrations, and the second with ship-sourced emissions. Several major aspects need to be addressed, in my opinion, prior to publication: 1) the MS should be shortened, as some sections are repetitive and feel like a report; 2) I would suggest to change the Figures and add correlation plots to show more of the data used for model validation, which are now not evident in the MS; 3) model validation of the shipping contributions, was it carried out? it looks like no validation

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was performed, and this would need to be added, even if briefly; 4) if possible, add recommendations for users as to which model performs better under which scenarios.

Specific comments: - p1, l12-13: contradiction, is the performance of the models similar or does it differ for PM2.5 in summer?

- Introduction: can be shortened, specifically the paras dealing with CLs, literature review and SHEBA.

- p5, l23: are these total pollutant concentrations, or the ship-sourced fraction? This should be clarified throughout the text

- p6, l11-14: what about the non-linearity of O3? This approach (removing a source completely) has been seen to have higher uncertainty than if the source is only partially removed (e.g., decreasing its contribution by a given %), given that complete removal of the source doesn't take into account the non-linearity of certain species (e.g., O3). Please discuss how this may have affected the results.

- p8, l28: the use of monthly averaged gridded emissions is indeed a major difference between the models; wouldn't it have an impact also on the underestimation of titration, as described above for the spatial resolution (p4, l5-10)?

- The paper is very well referenced, in general.

- p11, l11: the model results were validated for total pollutant concentrations (e.g., against Airbase observation), and for ship-sourced pollutant concentrations (in this case, against what?)? Or only for total concentrations? Please clarify.

- p11, Fig S1: it is not practical for the reader to start the Results section with Figs which are in Supporting Info. Maybe the authors could add the 4 time series at the bottom of Fig 3, for example?

- p11, l27: stations were grouped as rural and urban background, why? It would be more useful to see the individual points, instead of the averages, to have additional

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detail.

- p13, l12: why were these 2 rural stations selected? Please clarify the criteria, here and for other pollutants.
- also in this section, instead of selecting 4 sites, what about plotting all of them in a correlation plot, for example the summer and winter mean per site? This would be helpful because with the current boxplot it is not so easy to see whether there is under or overestimation.
- subsections in section 3.1: their structure sounds a bit too much like a report, they are too similar (only changing the pollutant). Suggestion to redraft and shorten.
- section 3.1.3 (SO₂); what is the reason for the poorer performance of models for SO₂ at rural sites? There are larger differences between models, too. Please provide an explanation.
- p19, l4: recommendation to add a short concluding section on the comparison between models? This could include recommendations for users as to which model to select depending of the input data available or the purpose of the study.
- section 3.3: are the modelling contributions of shipping emissions validated in any way? A comparison with point locations could be carried out, based on literature review (even if the observational data correspond to different years, a qualitative comparison would still be necessary). Source apportionment studies should be used for this validation.
- p19, l12: would it be possible to provide an average for coastal areas? Or a range? This is usually where most population is exposed. This would be very useful for all the other pollutants as well.
- p21, l31: the ship-related EC concentrations are really low, were these data validated in any way? If not, please state clearly.

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- section 3.6: the deposition section doesn't seem to fit in this MS, could it be included in the Karl et al. companion paper, instead? Otherwise, suggestion to remove it.
- p23, l25: the uncertainties of the models or or atmospheric transport and transformation of pollutants were not addressed in the MS; please add this in the new section on recommendations and conclusions, or remove this phrase.

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