Atmos. Chem. Phys. Discuss.,
https://doi.org/10.5194/acp-2018-1107-AC1, 2019

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Impact of a nitrogen emission control area (NECA) on the future air quality and nitrogen deposition to seawater in the Baltic Sea region" *by* Matthias Karl et al.

Matthias Karl et al.

matthias.karl@hzg.de

Received and published: 11 January 2019

We are very grateful to Prof Nicolas Moussiopoulos for his kind review of the manuscript. Below his remark on the suitability of regional scale simulations for health impact assessment is addressed.

1. The manuscript is very well written and the results obtained convincingly presented. The authors apply a state-of-the-art methodology and use simulation models that are suitable for their study. The assumptions made are realistic and the input data appropriate. The illustrations included in the paper reflect successfully the key findings of the analysis, and the conclusions are plausible.

Reply: We thank the Reviewer for their assessment of the scope and methodology of the manuscript.

2. As the only aspect worth commenting, the authors selected to work with an innermost grid of 4x4 km^2. This resolution may be acceptable for regional scale simulations, yet it is clearly insufficient for predicting air quality in coastal urban areas, especially if such estimates are subsequently used to assess their impact to human health. Although it is understandable why the authors did not decide to increase the resolution to, say, 1 km, they should discuss the inevitable uncertainty associated with their intention to describe the air pollution situation in Baltic Sea harbours extending over hardly more than the assumed minimum cell surface area (16 km^2).

Reply: The presented study makes no claims about predicting air quality and human health impacts within coastal urban areas. However, results from our study can be used for the regional scale assessment of health impacts due to shipping emissions and the relative change of these impacts in the future (2040) when the NECA is introduced in 2021, given that regulations are implemented as outlined in the future ship emission scenarios. Brandt et al. (2013b) used an integrated model system, Economic Valuation of Air pollution (EVA) that integrates a regional scale atmospheric chemistry transport model, to examine the relative health-related external costs in Denmark from international ship traffic in the Baltic Sea and the North Sea. The finest horizontal resolution applied in that study was 16.67 km covering the North Sea region and parts of the Baltic Sea region (Brandt et al., 2013a). Compared to Brandt et al. (2013b) the present study allows for a better resolution of the coastal areas and the ship traffic. Ideally, a resolution of 1 km should be used for resolving the urban increment (Schaap et al., 2015) in the coastal areas. However, operating CMAQ at a grid resolution of 1 km is not feasible for the extent of the Baltic Sea region because of the data demands and the enormous increase of computational time. We refer to manuscripts in preparation for the Special Issue "Shipping and the Environment - From Regional

to Global Perspectives" that deal with the impact of shipping on the urban air quality in harbour cities of the Baltic Sea. The model output from the regional scale simulations with CMAQ is used as boundary conditions for the urban domains to simulate the present-day air quality in the harbour cities Rostock, Gdansk and Riga (Ramacher et al., 2019b) and the air quality in Gothenburg in 2040 (Ramacher et al., 2019a).

The following has been added in the Conclusions (page 29, Line 21) with respect to the limitations for use of the regional scale model data for health impact assessments in urban areas:

"Use of the presented model data for health impact assessment in the densely populated coastal areas of the Baltic Sea region is connected to uncertainties arising from limitations of the chosen grid resolution. Despite the fine spatial resolution of the innermost model grid, the concentration gradients between urban areas and their surroundings (urban increment) and within harbour cities are not adequately resolved by the simulations due to the large spatial and temporal variability of emissions in urban areas. Ideally, a grid length of 1 km should be chosen to resolve the urban increments (Schaap et al., 2015) in the coastal areas. However, a finer resolution brings along the need for more accurate emission data in the urban areas, which is challenging because the compilation of urban emission inventories requires specific information for each emitting sector (Guevara et al, 2016)."

References:

Brandt, J., Silver, J. D., Christensen, J. H., Andersen, M. S., Bønløkke, J. H., Sigsgaard, T., Geels, C., Gross, A., Hansen, A. B., Hansen, K. M., Hedegaard, G. B., Kaas, E., and Frohn, L. M.: Contribution from the ten major emission sectors in Europe and Denmark to the health-cost externalities of air pollution using the EVA model system – an integrated modelling approach, Atmos. Chem. Phys., 13, 7725–7746, doi:10.5194/acp-13-7725-2013, 2013a.

Brandt, J., Silver, J. D., Christensen, J. H., Andersen, M. S., Bønløkke, J. H., Sigsgaard,

T., Geels, C., Gross, A., Hansen, A. B., Hansen, K. M., Hedegaard, G. B., Kaas, E., and Frohn, J. M.: Assessment of past, present and future health-cost externalities of air pollution in Europe and the contribution from international ship traffic using the EVA model system, Atmos. Chem. Phys., 13, 7747–7764, doi:10.5194/acp-13-7747-2013, 2013b.

Guevara, M., Lopez-Aparicio, S., Cuvelier, C., Tarrason, L., Clappier, A., and Thunis, P.: A benchmarking tool to screen and compare bottom 25 up and top-down atmospheric emission inventories, Air Qual. Atmos. Health, 10, 627–642, https://doi.org/10.1007/s11869-016-0456-6, 2016.

Ramacher, M. O. P., Tang, L., Moldanová, J., Matthias, V., Karl, M., and Johansson, L.: The impact of ship emissions on air quality and human health in the Gothenburg area - Part II: Scenarios for 2040, Atmos. Chem. Phys., manuscript in prep., 2019a.

Ramacher, M. O. P., Karl, M., Bieser, J., Jalkanen, J.-P., and Johansson, L.: A generic approach to evaluate urban population exposure to NO_2 emissions from local shipping in three Baltic Sea harbour cities, Atmos. Chem. Phys., manuscript in prep., 2019b.

Schaap, M., Cuvelier, C., Hendriks, C., Bessagnet, B., Baldasano, J. M., Colette, A., Thunis, P., Karam, D., Fagerli, H., Graff, A., Kranenburg, R., Nyíri, A., Pay, M. T., Rouïl, L., Schulz, M., Simpson, D., Stern, R., Terrenoire, E., and Wind, P.: Performance of European chemistry transport models as function of horizontal resolution, Atmos. Environ., 112, 90–105, http://dx.doi.org/10.1016/j.atmosenv.2015.04.003, 2015.

Interactive comment on Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2018-1107, 2018.