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Interactive comment on “Emission factors of SO₂, NO_x and particles from ships in Neva Bay from ground-based and helicopter-borne measurements and AIS-based modeling” by J. Beecken et al.

Anonymous Referee #1

Received and published: 13 November 2014

General comments:

The paper presents an interesting and in many ways useful set of measurements of emission factors for SO₂ and NO_x as well as size distributions of emitted particles for ships in a SECA area (the Neva bay and the Gulf of Finland). This information allowed checking the performance of the STEAM model for ship emissions in this area. The fact that the authors make detailed information about all their measured emission factors available in a supplement is an example of openness that I think should be appreciated.

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The model appears to work well for international ship traffic for what concerns SO₂ and NO_x emissions but it strongly overestimates the SO₂ emissions from vessels used in domestic shipping. It is, of course, of interest to understand why several ships that technically could use fuels with 1% sulphur content are using fuels with a lower sulphur content. It is explained in the paper that “this reflects the restrictions of fuel used in inland waterway traffic”. Here a few lines about the rules concerning SO₂ emissions from ships sailing on inland waterways in Russia (if there are any) would be very helpful for understanding if the use of fuels with low sulphur content is related to legal restrictions or to other reasons. It is anyway an interesting observation that compliance with the limit for fuel sulphur content seem to be good.

The model simulations overestimate particle mass emissions by a factor 2-3 and this is attributed by the authors mainly to overestimation of the fuel sulphur content. However, I do not think that this explanation is sufficient: According to Figure 5, the passenger ships predominantly used fuels with a high sulphur content, i.e. close to what is assumed in the model; however the disagreement between model and measurement for what concerns the particle mass is typically about a factor of two (Fig. 10) also for these ships. More generally speaking, I find that the fact that for many ships information about fuel sulphur content as well as speed and the characteristics of the engine was available, should make it possible to evaluate how well the model works when all the requested model input information is available and reliable.

The study seems to be scientifically sound and I find that it can be published with only some minor revisions. I would like to ask the authors to consider the points mentioned above and those mentioned in the following.

Specific comments:

P. 25934, line 23, “...the measurements in 2011 were carried out at the transition period.”: Please mention the date when the 1% sulphur limit came into force in Russia.

P. 25934, line 27: Please state clearly if, to your knowledge, there have been other

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studies of ship emissions in the eastern Baltic.

P. 25935, line 24, “..but in most cases ships emit very little VOC...”: Please give reference.

P. 25936, line 15-16: Is it possible that the sampling frequency can be 10 Hz (i.e. 0.1 seconds for each sample) when the response time (t_{90}) is 0.5 seconds?

P. 25937, “2.2 Calculation of emission factors”: Although it is clear how the calculations were done, the description is formally incorrect and need to be changed. The authors want to explain, as far as I understand, that the concentration measurements are integrated over a certain time period, but in this case they should not use the summation symbol Σ which has a different meaning.

P. 25939, line 18, “...usually for several calibration steps 300 ppb for both gases”: The meaning of the sentence is not clear.

P. 25939, “2.3 Calibrations” and p. 25940 “2.4 Uncertainties”: Generally the uncertainties here are given as a percentage (e.g. on p. 2540, line 9.). However, I would presume that the relative uncertainties on the low concentrations (and consequently normally also on the low emission factors) generally are higher than the uncertainties on the high concentrations and thus on the high emission factors. I would suggest to the authors to address this issue, which is particularly relevant in relation to compliance monitoring in a SECA area, because reliable measurements also of relatively low SO₂ emission factors will be needed to check compliance with the limit of 0.1% maximum sulphur content in fuels, which will be in force from 2015.

P. 25944, “4 Results and discussion”: The study provides information about both fuel sulphur content and particle emission factors (number and estimated mass) for the same ships. It might be interesting to use this possibility to look at the dependence of particle emission factors on fuel sulphur content.

Technical corrections:

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P. 25933, line 8, “. . .with about 4% growth.”: . . .per year?

P. 25935, line 1: “i.e” should probably be “e.g.”.

P. 25935, line 15, “..for about 0.3 s.”: . . .each?

P. 25941, line 9: “Following” should probably be “according to”.

P. 25949, line 21, “. . .the model does not allow higher fuel sulfur content to be used. . .”: probably “higher” should have been “lower” here.

Interactive comment on Atmos. Chem. Phys. Discuss., 14, 25931, 2014.

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