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Atmospheric Chemistry and Physics Discussions

Interactive comment on "The impact of shipping emissions on air pollution in the Greater North Sea region – Part 2: Scenarios for 2030" *by* V. Matthias et al.

V. Matthias et al.

volker.matthias@hzg.de

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Response to the comments of Reviewer 1

General comment

R: The paper is well written with a clear focus and relevance for the field of air quality and emission policy. The methods are straightforward and sound. The choice to look at relative changes in con-

centrations is appropriate, but at some locations the concentrations are very low, so I wonder whether the relative changes are meaningful there (e.g. impact of shipping on nitrate concentration in north eastern and south western part of North Sea, on ozone concentrations in English channel). A word on absolute concentrations would be helpful there.

A: We agree that at some locations, absolute concentration differences are very low and relative changes are not meaningful. Therefore, cutoff values were chosen below which the relative differences are not shown and the areas in the plots remain white. We added information about the cutoff value in the relevant figure captions. We don't show plots with the absolute differences for all substances because this would add too many plots to the paper that is already quite long. Absolute values are given for selected regions in Figs 6, 9, 12, A6, A7, A8.

R: Although I understand the choice of the authors to keep the anthropogenic emissions constant I would welcome an indication of the relative contribution to concentrations of shipping for 2030 in the discussion. In particular for ozone this would be relevant, as the chemical regime may change.

A: If European policies on the reduction of NO_x emission will be

successful, we can expect lower NO_x emissions from land based sources in 2030 compared to today. This would mean that the relative contribution from shipping to NO_2 levels and to nitrate aerosol concentrations would be higher than shown here.
For ozone in summer, lower NO_x emissions from land would mean that even the area of the English Channel, which is currently VOC limited, could turn into a NO_x limited region. Additional NO_x emissions from ships would then enhance ozone where it is now reduced. This would be the case in the English Channel in the No ECA and the ECA SCR 21 scenarios. We discussed this already briefly in the text at the end of the conclusions. We now added a small paragraph to this.

Detailed comment

R: P 11330 l 4-6: Grammatical construction of sentence is incorrect, which makes it difficult to read, please rephrase

A: Has been rephrased.

R: P 1135: Mention that the impact of shipping is determined by comparing a simulation including both shipping and other anthropogenic emissions to a simulation excluding the shipping emissions. Would you need to be concerned about nonlinearities by

completely shutting down shipping emissions instead of looking at the impact of 10% reduction?

A: We added a paragraph on the method in the beginning of section 4.2. We tested possible nonlinearities in other applications by shutting down emissions from one sector by different percentages and found that the effects were very small. Nevertheless, nonlinearities might occur, because the entire chemical system is nonlinear. However, it is doubtful that the impact of shipping can better be quantified by upscaling the effects of a 10% emission change by a factor of 10.

R: Please describe what the white patches in the figures 2, 3, 5 and 7 mean, also how I should interpret the red patches close to Denmark and North of Ireland (Figs 2,3)

A: In the white areas in Figs 2 and 3 shipping emissions were too low (or even 0, e.g. over land) to calculate sensible quotients for the scenario maps. Red patches north of Ireland and close to the German coast are a result of low emissions in the reference case, too. We now also turned these regions into white areas, where no values are given. In Figs 5 and 7 white regions also denote areas with too low values to show sensible concentration ratios. We now give the limit values in the Figure caption.

R: P 1136 l 23: I would rather say 50 %, since it is nearly 100 % over large areas.

A: Has been changed, although large parts of those regions have low absolute concentrations.

Technical issues

R: Fig 6: name of scenarios not consistent with main text. Why 2a instead of 2? Better to refer to ECA specification.

A: Has been changed.

R: Fig 10: it would be helpful if SO_2 and SO_4 would be indicated next to the respective figure instead of only in the caption

A: Has been changed.

Interactive comment on Atmos. Chem. Phys. Discuss., 15, 11325, 2015.