

Interactive comment on “Role of ammonia in European air quality with changing land and ship emissions between 1990 and 2030” by Sebnem Aksoyoglu et al.

Anonymous Referee #1

Received and published: 25 September 2020

Dear Editor,

this MS presents a modelling study dealing with the role of ammonia on air quality in Europe, with a focus on shipping as a key emission sector. The text is straightforward and well-written, and of interest to the scientific community. I have only minor issues which should be clarified prior to publication:

- line 51: what is the reason behind the increase in ammonia emissions since 2014?
- line 67: what is the status of this implementation? Have these new sulfur emission regulations been effectively implemented (as they were supposed to start in 2020)?

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- line 77: same as above, what is the status of this statement? "According to the European Environment Agency, emissions of nitrogen oxides from international maritime transport in European waters are projected to increase and could be equal to land-based sources by 2020 (EEA, 2013)." The reference dates back to 2013, do the authors have data on the current emissions? How accurate was EEA's projection from 2013?

- line 120: the scenarios "current legislation (CLE)" refer to the regulations included the lower sulfur limits from 2020 (see comment to line 67)? Or prior to 2020? Please clarify.

- line 135, please review sentence (2 verbs): "The model results for 1990, 2000 and 2010 were compared with the measurements available at the EDT project database based on EMEP datasets and model performance for SO₂, NO₂, PM₁₀, PM_{2.5} and hourly O₃ was discussed in detail in Jiang et al. (2020)."

- line 140: measuring ammonia is rather complex, therefore the quality of the observations should also be discussed (even if briefly). Please add some information on the measurement method and comparability between (the few) ammonia datasets available.

- line 156: "and/or deposition is underestimated by the model for which the resolution might also be critical factor". Is the model resolution not the same for all regions? If it is, then it could not explain the differences between central Europe and Iberian Peninsula and in Scandinavia (Fig. 1). Can the authors provide an explanation about why deposition might be more underestimated in central Europe than in the Iberian Peninsula and in Scandinavia? This seems a more likely cause for the model's overestimation around these high emission areas.

- line 171: "Among the SIA components, the best agreement between model and measurements is for sulfate". Can the authors quantify the relative difference (in %) between modelled and measured concentrations, for sulfate and nitrate respectively? It

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would be useful for the reader to have this information as well as the absolute difference (in microg/m³ shown in the Figure). Also for ammonia, in the previous paragraphs.

- lines 180-185: similarly to above, what is the reason for the increases in ammonia emissions? Is it increases in key sources (agriculture)? Or to a mix of emissions and atmospheric processes?

- line 197: "On the other hand, since simulations for 2030 were performed using the meteorological parameters of 2010, one should keep in mind that potentially higher temperatures in the future might increase the evaporation of ammonium nitrate to form its gaseous components NH₃ and HNO₃". This is a key point which could be highlighted in the abstract.

- line 217: as above, please clarify what is meant by "current legislation" (before or after 2020): "Results of future scenario simulations suggest that sulfate concentrations will continue to decrease in central Europe as well as along shipping routes until 2030 assuming a current legislation (CLE) scenario (Fig. 3d, right panel)"

- section 3.4: only as a suggestion, it might have been interesting to add an additional scenario including the implementation of a SECA in the Mediterranean (Rouïl, L., Ratsivalaka, C., André, J.-M., Allemand, N., 2019. ECAMED: a Technical Feasibility Study for the Implementation of an Emission Control Area (ECA) in the Mediterranean Sea. IMO report MEPC 74/INF.5.). An analysis of the potential impacts/benefits of this potential SECA in the framework of the authors' study could be very useful.

- Table 1: please define the acronyms (CLE, MTFR) in the table header.

Interactive comment on Atmos. Chem. Phys. Discuss., <https://doi.org/10.5194/acp-2020-872>, 2020.