Additional revisions to the manuscript

Primary sulfate number emissions

During the review phase, we were informed that the model version used in this study (ECHAM5.5-HAM2.0) contains a small coding error in the conversion factor between SO_2 emissions and sulfate number. The emitted sulfate mass is correct, but the error changes the diameters of primary sulfate particles to be about 1.5 times larger than intended (which is the same as primary sulfate number emissions are lower than intended by a factor of 3.1). It should be noted, however, that the code version is internally consistent, i.e. the number and mass emissions are correct when this 1.5 times larger particle size is assumed.

Peters et al. (2013) calculated that changing the conversion factor to the originally intended value (i.e. increasing the number emissions and lowering the radii of emitted primary sulfate particles accordingly) changes the global mean Effective Radiative Forcing (ERF) due to aerosol emissions from shipping from -0.36 Wm^{-2} to -0.49 Wm^{-2}. This will not, however, affect the conclusions of our study since we do not directly compare the radiative effects and mortality with each other (i.e. calculate the number of deaths due to climate change that could be avoided with a certain amount of ERF) and all our simulations assumed the same size for primary sulfate emissions (and thus our simulation set is internally consistent).

We changed the description of our experiment design in the revised manuscript so that the correct radius of primary sulfate particles used in the simulations is given (44 nm instead of 30 nm). While this is larger than some recent measurements indicate (Petzold et al., 2008; Jonsson et al., 2011), it is still smaller than the primary sulfate size used in the standard ECHAM configuration (Stier et al., 2005; Zhang et al., 2012). See response to Referee 2 for more details about comparison to measurements.

Comparison to results by Peters et al. (2012)

On page 22001, lines 4-12 of the original manuscript we compared our results to experiment B of Peters et al. (2012). However, their experiment Bsc had SO2 emissions much closer to our ships-2010 simulation (12.95 Tg yr^{-1} and 12.5 Tg yr^{-1}, respectively). Therefore, we have changed that part of the text to:

"Peters et al. (2012) estimated a similar ERF of -0.36 Wm^{-2} for the total aerosol radiative effect with the same model, a similar treatment of shipping emissions, and similar amount of SO_2 emissions (12.95 Tg(SO2)yr^{-1} compared to 12.50 Tg(SO2)yr^{-1} in our simulation) as used in our study. There are two major differences between our study and the simulations by Peters et al. (2012). First, they used an empirical parameterization (Lin and Leaitch, 1997) for cloud droplet activation as opposed to the physically based parameterization (Abdul-Razzak and Ghan, 2000) in our study. Second, Peters et al. (2012) assumed that 4.5% of the sulfur mass emissions from shipping are emitted as primary SO_4 particles compared to 2.5% used in our ships-2010 simulation."

We chose to use the original study by Peters et al. (2012) as the reference instead the results from their corrigendum (Peters et al., 2013), because their original model version uses the same size for primary sulfate particles as our model version.

Technical corrections

We also corrected one inaccurate sentence in the manuscript by adding "almost everywhere in Europe" at the end of the sentence "In the simulation corresponding to future emission controls (ships-2020), the contribution of shipping emissions to PM2.5 was less than 0.1 ugm^{-3}."

On the behalf of the authors,
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