Atmos. Chem. Phys. Discuss.,
doi:10.5194/acp-2015-1002-RC1, 2016

Atmospheric Chemistry and Physics Discussions

Interactive comment on "The effect of future ambient air pollution on human premature mortality to 2100 using output from the ACCMIP model ensemble" *by* Raquel A. Silva et al.

Anonymous Referee #3

Received and published: 3 March 2016

General comments: This study performs a global health impact assessment from ambient air pollution, using chemical transport or chemistry-climate models, for a set of RCP scenarios, for the years 2000, 2030, 2050 and 2100. Similar studies have been published before (properly acknowledged by the authors). The novelty of this study lies in the use of an ensemble of models, allowing for an evaluation of the contribution of model-calculated population exposure to pollution in the total uncertainty on the health impact. However a comparison of the outcome with previous studies, both for present day and future projections, is not obvious because of differences in methodology.

Specific comments: In the paper two ways are used to evaluate the impact of emission scenarios for the future on human health: 1) By using future demographics and

health statistics, and combining these with exposure to year 2000 pollutant levels and to pollutant levels corresponding to projected emissions for the specific year respectively and making the difference 2) by calculating the absolute number of mortalities for each considered year and making the difference with mortalities for 1850 ('mortality burden')

It took me a while to understand that reported 'avoided' and 'excess' mortalities refer to method 1). It should be better explained in the methodology section. Usually, avoided or excess mortalities for a given scenario are calculated versus a reference scenario for the same year (e.g. a stringent policy versus a business-as-usual as reference case). It's not clear here what the year 2000 pollution transposed to 2030 and 2050 actually represents as a reference. The avoided or excess mortalities can not be directly linked to specific policies (which pathway would have led to the year 2000 levels in 2030 - 2050 - 2100?). Wouldn't it make more sense to use e.g. RCP 8.5 as a reference, and evaluate the benefits of the 2.6 and 4.5 pathways? Using year 2000 pollution levels as a reference for future years also introduces an issue with exposure; concentration field spatial distribution is linked to population spatial patterns – in particular for PM. Does is make sense to overlay year 2000 pollution spatial patterns with year xxxx population spatial distribution?

Mortalities are estimated at 0.5x0.5 deg resolution: is this just a regridding of the native model resolution or was any downscaling done to better estimate the exposure in densely populated areas? Apparently the concentrations are just regridded; this can not be considered as a proper population-weighted exposure estimate at the coarse resolution of the models, as all population within a single grid will be exposed to the same level.

Regarding the use of Burnett's IER functions: specify whether age-specific functions have been used or all-ages. From what is written in the first par. of page 15, I understood that the Burnett functions have been applied without the counterfactual value? In fact it is not well explained how teh difference with 1850 was made: by first subtracting

1850 concentrations and then applying the exposure-response functions, or by applying exposure-response functions to both years and then subtracting mortalities. And how was it done for calculating the excess/avoided mortalities relative to year 2000?

The numbers in Table S3 do not seem to be consistent with year 2030 mortalities in Figure 4: In Table S3 only 2 models predict a global mean decrease in PM2.5 for RCP2.6 in 2030. In Figure 4 all models except 1 show a decrease in mortalities by 2030...Similar for the other RCPs; most flagrant for RCP8.5 where all PM2.5 appears to increase globally but only 1 model leads to an increase in mortality. How to explain this?

Table S4: should be mentioned as 'CHANGE' in mortalities between year 2000 pollution levels and respective scenario/year pollution levels. Also on Page 11, "Global 309 future premature mortality rises from 264,000 (-39,300 to 648,000) deaths in 2030 to 316,000 (-310 187,000 to 1.38 million) deaths in 2100" may cause confusion as these are again changes compared to 2000 pollution levels.

The fact that the range spans from negative to positive implies that the result is not significantly different from 0?

What has been the benefit of the multi-model analysis? And what can be learned from analyzing the RCP scenarios? Are the outcomes plausible in the light of the implicitly assumed rather stringent pollution controls?

The results section is dry and hard to digest with long lists of numbers of mortality changes per scenario, per region, with differences between models – all things that are much easier to read from the figures than in the text. For the reader it is hard to keep an overview and grasp the major message. Suggest to reduce and condense this section to most salient observations that are maybe not directly evident from the figures.

Discussion section: it looks like there is an increasing relative importance of O3 as health impact compared to PM for the future (what is the relative contribution of each

pollutant to total pollution mortality burden in each year, each scenario?) – this may be worth a few lines of discussion.

It is surprising that for the same emission scenarios, models have such different outcomes. Does the resolution play a role here? What could be done to improve the exposure estimate? Downscaling techniques? Use of regional models? Is it possible to evaluate the error made by using course resolution models?

It would be nice to see a graph summarizing other paper's results and this one (with error bars) for projected mortality burdens and to discuss what could be learned from this comparison.

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