Atmos. Chem. Phys. Discuss.,
https://doi.org/10.5194/acp-2018-7-AC1, 2018

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Trends in air pollutants and health impacts in three Swedish cities over the past three decades" *by* Henrik Olstrup et al.

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Received and published: 11 April 2018

Comments from Reviewer 2 and answers from the authors

First of all, we want to thank the reviewer for valuable comments regarding the manuscript. Below follow the comments and our answers. The changes have been implemented in the manuscript.

This is a paper on the changing air pollutant levels over time and its health impacts. It is an important paper for countries yet having to work on reducing air pollutants to be able to see some quantified effects. However, some improvements and clarifications needs to be made.

My main comment is that the paper is very long and results and methods could benefit

from being presented in a more concise manner. The same for the discussion parts which also could be richer in references and less on speculation on own results. Below is some additional comments:

Reply: We have shortened the discussion and added relevant references to make the discussion less speculative.

Abbreviations should be spelled out first time used:

Reply: The abbreviations PM2.5, PM10 and NOx have been changed so that they are defined the first time they are used.

However, tests have shown that the calculations in life expectancy give very similar results regardless of the year (1997–2015) in which the population structure and mortality statistics are based on. Reference is needed for this statement:

Reply: This statement is based on our own calculations of change in life expectancy by using the population structure and mortality statistics from different years. The calculated change in life expectancy differs by only a few days depending upon which year the population structure and the mortality statistics are based on. We have clarified that in the manuscript.

We have applied relative risks obtained from previous epidemiological studies, where the relationships between mortality and exposure to NOx, NO2, O3, and PM10 have been analyzed. A discussion of choosing this over HRAPIE could be extended.

Reply: We have extended this discussion in section 4.4. In HRAPIE, the RR associated with long-term exposure to NO2 is based on Hoek et al. (2013). In the Discussion Section 4.4, there is an explanation that we have chosen Faustini et al. (2014) instead of Hoek et al. (2013) since Faustini et al. (2014) also calculated this RR based on European studies only, which are more relevant for the Swedish conditions. For O3, our choice of the RR of 1.01 (95 % CI 1.005–1.02) per 10 μg m-3 increase in Turner et al. (2016) is very close to the RR of 1.014 (95 % CI 1.005–1.024) in Jerrett et al.

(2009), which is presented in HRAPIE. The study of Turner et al. (2016) has been implemented in a later period of time in comparison with Jerrett et al. (2009). This slightly later period of time is more in line with the period 1990–2015, which our trend analyzes are based on, making the RR in Turner et al. (2016) more relevant for our study. For PM10 and NOx, the HRAPIE report does not provide any RR for all-cause mortality associated with long-term exposure to these pollutants.

We have done this for NOx in Stockholm and Gothenburg, and for O3 and PM10 in Stockholm. Why not for Malmö and why not for all places and not all places?

Reply: We have added a sentence in the section "Method 2.5", stating that the lack of data is the reason for why this cannot be performed for all pollutants in all cities.

Spatially resolved O3 concentrations in Stockholm are calculated from a combination of measurements and dispersion modelling of NOx concentrations. This could be a problem since you use same input data.

Reply: This should not be a problem; the modelling of NOx has been validated with good results (Johansson et al., 2017; Molnar et al., 2015).

Have the 03 model been validated by spatially distributed measurements?

Reply: The ozone modelling has been validated based on measurements of ozone at four different sites in the Greater Stockholm area. These measurements cover the period 2003 to 2015, but with different amount of data for the different sites. R2 of model predictions versus measured monthly mean values for the 4 sites varied between 0.71 and 0.89, and the overall R2 (all data) was 0.77. We intend to send this for publication as soon as possible.

Some models have been validated with measurement data but to my knowledge not so much on data from earlier period. Please state year.

Reply: The model validations are based on several years, and not a specific year.

It is quite unclear when measurements or modeling has been applied, please clarify.

Reply: To keep it short, we refer to Johansson et al., 2017 (and references therein) for Stockholm, and for Gothenburg, we refer to Molnár et al., 2015.

Please move some results and tables to supplemental material.

Reply: We have moved Table 1 to Appendix A. Figure 6–8, where the trends are divided into weekdays and weekends, could possibly also be moved to the Appendix, but since they provide important info regarding the extent to which the emissions are local, we have chosen to have these figures in the result section.

The changes in life expectancy are calculated with 10 the mean values and the 95 % confidence intervals of the relative risks, while for the trends and the population-weighted exposure concentrations, only the median and the mean values, respectively, have been used, but without considering their confidence intervals. This belongs to methods:

Reply: We have added these sentences to the first paragraph of "Methods". For the sake of clarity, these sentences are repeated in the result section, where the change in life expectancy is described.

Additionally, the particulate filters used for diesel vehicles will also give rise to an increased NO2/NOx ratio, since some of these filters work by oxidizing NO to NO2 (Grice et al., 2009; Wild et al., 2017). The O3 levels in Stockholm (Fig. 2 and 6) exhibit increasing trends during the period. More stringent emission standards with reduced emissions of NO mean that less O3 is consumed, due to a reduction of the NO titration, and thereby arises an 25 increasing trend. PM10 exhibits decreasing trends in Stockholm. Unclear if these two sentences match.

Reply: We are not completely sure if we understand this comment correctly, but we have changed this text.

O3 is also affected by the weather that year and this should be mentioned.

Reply: Our trends are all based on measurements, and the relation between urban-background concentrations and population-weighted concentrations are taken from several years. The fluctuations between years driven by weather are not important for the long-term trend.

References

Faustini, A., Rapp, R., and Forastiere, F.: Nitrogen dioxide and mortality: review and meta-analysis of long-term studies, Eur. Respir. J., 44, 744-753. doi: 10.1183/09031936.00114713, 2014

Hoek, G., Krishnan, R. M., Beelen, R., Peters, A., Ostro, B., Brunekreef, B., and Kaufman, J. D.: Long-term air pollution exposure and cardio- respiratory mortality: a review, Environ. Health, 12, 43, doi: 10.1186/1476-069X-12-43, 2013

Jerrett, M., Burnett, R.T., Pope, C.A. 3rd, Ito, K., Thurston, G., Krewski, D., Shi, Y., Calle, E., and Thun, M.: Long-term ozone exposure and mortality, N. Engl. J. Med., 12, 1085-95, doi: 10.1056/NEJMoa0803894, 2009

Johansson, C., Löverheim, B., Schantz, P., Wahlgren, L., Almström, P., Markstedt, A., Strömgren, M., Forsberg, B., and Nilsson Sommar, J.: Impacts on air pollution and health by changing commuting from car to bicycle, Sci. Total. Environ., 584-585, 55-63, doi: 10.1016/j.scitotenv.2017.01.145, 2017

Molnar, P., Stockfelt, L., Barregard, L., and Sallsten, G.: Residential NOx exposure in a 35-year cohort study. Changes of exposure, and comparison with back extrapolation for historical exposure assessment, Atmos. Environ., 115, 62-69, doi: 10.1016/j.atmosenv.2015.05.055, 2015

Turner, M. C, Jerrett, M., Pope, C. A. 3rd, Krewski, D., Gapstur, S. M., Diver, W. R., Beckerman, B. S., Marshall, J. D., Su J., Crouse, D. L., and Burnett, R. T.: Long-Term Ozone Exposure and Mortality in a Large Prospective Study, Am. J. Respir. Crit. Care. Med., 193, 1134-1142, doi: 10.1164/rccm.201508-1633OC, 2016

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