

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

Anonymous Referee #3

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General comment: The manuscript reports trends for criteria air pollutants in three Swedish cities over the course of three decades. Reference relative risks on all-cause mortality are utilized in order to estimate changes in life expectancy. The intra-urban spatial variability is taken into account, in some cases, using dispersion modelling, for the determination of a population weighted exposure average. Although the paper doesn't introduce some methodological breakthrough, research results on the impacts that changing pollutant levels bear on life expectancy are not abundant in Europe. The manuscript would largely benefit from a more in-depth discussion on the factors that determine the observed trends, taking also into account regional inputs. Overall, atmospheric physical and chemical processes receive limited attention in the paper. The discussion and conclusions should focus more on policy implications for emission

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control and public health, as should be expected by a manuscript on pollution trends. A substantial revision along these lines is necessary, incorporating also the following specific comments and edits.

Specific comments: Page 2, lines 20-22: While the decline of NO_x emissions in the EU is larger as compared to PM, it is probably not as efficient as it has been initially projected (see the rates of attainment of national emission ceilings specified by the original NEC directive) and there is also a lot of between-country variation. Page 2, lines 23-30: The trend for O₃ levels with regard to the target value for the protection of human health, during the period 1990-2014 in the EU, has been rather a decreasing one. This has to be taken into account and make a distinction between mean ozone levels and higher percentiles more relevant for short-term exposure. The importance of the O₃ metric is already mentioned in line 28, but the authors should avoid indicating that O₃ levels are increasing all over the board in Europe. Page 3: lines 14-21: It would be better to provide the fractional changes of premature mortality instead of the net numbers, especially since the populations to which the studies refer can't be adequately described in an introductory section. Page 4, lines 20-30: Indicate if these stations are regulatory monitoring stations which provide measurements according to the reference methods. Page 4, line 21: Indicate the sampling height in Malmo. Page 6, line 9: The value selected for NO₂ differs from the one reported by Beelen et al. (2014) in the study which also provided the PM₁₀ RR used here. This should be discussed in section 4.4. Figures 3-4: There are some extremely low mean monthly values for PM₁₀ in Gothenburg and NO_x -NO₂ in Malmo. Provide an explanation, is it meteorology or else? Table 1: The Table repeats the information of Figures 2-4. It should be removed altogether. Section 4.1.: The section needs an overhaul. The discussion should be performed by pollutant at the first level and then city specific mentions should be made where important differences occur. More clarity is needed in the argumentation. The potential impact of regional emission reductions from non-transport sources should be incorporated in the discussion. Page 16, line 12: Correct the phrasing here. Also, it is not clear how the dieselization has led to the reduction of NO_x emissions. Krecl et al.

(2017) report that NO_x have remained constant during the process. Please elaborate. An indication of the change in the vehicle parc composition should be given in number. Page 16, lines 14-15: How does the location affect the trend? Indicating the distances from major roads could be informative, although the reported sampling heights are probably too large to represent direct road traffic emissions. Page 16, lines 20-23: Given the site types and the sampling heights, it is somewhat doubtful that the primary NO₂ variability could be captured. Page 17, line 21: The whole discussion regarding the increasing ozone trend is obviously founded on the assumption that photochemical processes for ozone production in Sweden should be of minor importance. Otherwise the reduction of precursor emissions would generally lead to the long-term reduction of ozone as well, as it has been observed in various studies. Please, better clarify the dominant mechanism explaining the O₃ presence in the urban setting. Page 17, lines 29-31: Given that PM₁₀ has been associated with vehicular emissions, shouldn't a similar to NO_x weekday-weekend pattern be observed? Justify this difference. Page 18, lines 7-10: The hypothesis for the whole period cannot be supported by just one year of data and moreover these regional background data should be better described. Also, it is not clear why there aren't long term regional background NO_x data available, when at Page 17, line 32 the availability of such data for NO₂ is stated. Page 20, line 24-34: The study which provided the RR for PM₁₀ includes similar results on mortality associations for PM_{coarse}. This could be discussed.

Technical corrections: Page 2, line 7: Check phrasing (“ending”). Page 2, line 11: Check phrasing, you could replace with “. . .of the apparent major health impact of exposure to air pollutants...”. Page 2, line 14: Delete “amount of”. Page 2, line 16: Equals sign not in subscript. Page 4, line 13: . . .represents the urban background. Page 4, line 13-18: Remove the coordinate information. Page 5, line 21: Delete “decreasing”. Page 6, line 22: Replace “increase” with “change” Page 7, lines 25-30: This information is already provided in the Figure caption. Remove accordingly from the text. Figure 5: Ensure that Malmo is spelled consistently throughout the manuscript. Page 14, lines 8-9: Check phrasing. It should be “If the change in O₃ was only associated with local

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NO titration. . .”. Page 16, line 10: Decrease and diminish, pick one. Page 19, line 14: Can be compared or can't compare? Please rephrase the sentence. Page 19, line 16: Delete “extra”. Page 20, line 12: “exposure occurs simultaneously”? What is meant here? Probably it refers to peak exposures. The same in section 4.5. Page 20, line 15: “Especially difficult is it. . .”. Correct wording. Page 20, line 23: “Observed materials”? Page 21, line 28: You mean the population distribution within the cities? Page 22, line 29: NO₂ is formed by the reaction of nitric oxide with O₃. Figure A1-A4: Correct decimal separators.

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