

Interactive comment on “Prediction of source contributions to urban background PM10 concentrations in European cities: a case study for an episode in December 2016 – Part.1 The country contributions” by Matthieu Pommier et al.

Anonymous Referee #2

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This paper compares two source apportionment methods. The methods are not clearly explained. Some clarifications are needed and there are some methodological flaws. Also the English used in this paper needs to be revised.

Specific comments: 1. About the comparison between measured and modeled concentration. I understand that the author wants to compare the average concentration over an urban area. From model results it is easy to obtain this, averaging concentrations over some grid cells. Unfortunately you cannot obtain a comparable number from measurements. The stations are not equally distributed over the area of interest

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and the number of urban, rural and traffic stations might be different. Comparing an average of the stations with an average of the grid cells will introduce an additional uncertainty. Why not interpolate the model results at the station locations and compare with the measurements. A separate comparison for different station types should be made. I think the analysis for one cell, 9 cells and the GADM. I would restrict the analysis to stations inside the GADM.

2. The non-linearity discussed Line 374 and following The contributions of individual countries don't have to theoretically sum up to the contribution of all countries reduced together. Even for small reductions there is some non-linearity. But the non-linearity is small for small reductions. The difference between the sum of individual contributions and the joint contribution can be positive or negative. I would not speak about negative concentrations. You scale up to 100% but in fact you do a source apportionment of the top 15% of the PM10 column. That's perfect and useful for policy. Achieving small emission reductions is already hard enough.

3. Validation versus measurements The validation shows quite big differences between model and measurements. What is the impact of this error on the source apportionment? To which extent can it be trusted? In regard of this error, which differences between the two methodologies are significant? How certain is it that the biggest contribution is really the biggest?

4. Figure 6 Maybe it is more useful to present the analysis for some selected cities (and the others in Annex) than for all cities together. The behavior can be quite different across Europe. If non-linearity is small plots for one reduction percentage are sufficient. It is not clear to me which runs were done to obtain these plots. On line 358 is mentioned that emission per country were reduced with 15%. Are precursors reduced one by one or all together? How is the non-linearity calculated? Is it calculated as a share of the total concentration (Line 506). In my opinion it is more correct to use the concentration change as reference?

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5. Comparability of the two methodologies. For primary pollutants both source apportionment methodologies are comparable. Differences are due to differences in the models (transport, deposition,..). But for secondary PM the methods don't necessarily give the same result. E.g. an amount of NO_x emitted somewhere can result in a certain ammonium nitrate concentration in the receptor. If NO_x is emitted in excess (ammonia limited regime) an emission reduction will have little effect at the receptor point. On the other hand, in the NO_x limited regime the same NO_x reduction will have a big impact. The labeling method will give the same result in both cases while the 'perturbations' method will give different results. Hence, comparing contributions calculated by the two models is not very useful. The statement on line 513 is not complete: differences are not only due to differences in aerosol chemistry between the models.

6. Figure 8 How is the percentage of agreement defined? I think it's more useful to present this for individual cities.

Technical comments: Line 30: change '15% factor' > '15% emission reduction'. This 15% is not a factor. I think it's confusing. Change this in the whole paper. Line 30-33: revise grammar, sentence too long. We found that the combination of a 15% reduction and a larger domain help to reduce... Line 36: split sentence Line 68: crops yields > crop yields Line 71: states > better established/proposed a PM₁₀ limit value Line 77-79: very unclear contradictory sentence. If a pollutant has a short life time it's impact is close to the source and long-range transport doesn't matter much. Is PM₁₀ really so short lived compared to other pollutants (like NO₂). The concentration of PM₁₀ is rather uniform compared to the latter. Line 81: atmospheric processing? > formed by chemical reactions in the atmosphere. Line 85: traffic and transport, all traffic is transport Line 86: biomass burning refers to burning wood for heating. It is an anthropogenic source. You mean wild fires? Line 95: Revise grammar and content. With a country source calculation...???? Line 98: revise. Something like: The EMEP calculations use reductions of anthropogenic emissions... Line 115: Both models are part of... Line 122: Use a consistent terminology. You say 'SR system'

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and the next paragraph is called 'SA system'. A source receptor (SR) model is not a source apportionment (SA) system. Check this through the whole paper. Line 123 and 126: SR? I think it you mean source apportionment. Line 130: be consistent. SR product (should be source apportionment product)... real-time source allocation (= ? source apportionment) Line 132: for the 28 EU capitals, plus Bern, Oslo and R. Line 145: too long, split up Line 153: ...but the model has also been used... Line 161: sigma coordinates? There are... > grammatically incorrect sentence Line 212: word order! ...cover a slightly different domain... Line 119: ...by the IFS Line 236: 1 (grid) cell ... 9 (grid) cell... There is only one grid. Line 237: The latter... Line 238: ... living area... better 'urban area' or 'build up area' Line 244: BCs ? boundary conditions? Line 250: repetition Line 255: until fronts moved in Line 258: metrics Line 259: To properly estimate Line 267: N is the number of the reference dataset? The number of what? Hours? Days? Line 283: grid cell Line 285: city edge > city boundary Line 298: ...smoothed over a large domain... Do you mean smoothed over a grid cell? Mis-interpretation > underestimation. So, the correlation is similar for urban and rural stations but urban stations have a bigger bias. That's because peaks are smoothed out over the full cell. Line 303: By comparing only the 5... remove the comma Line 309: grammatically incorrect Line 312: ...than the ones from the EMEP model Line 315: globally > In general Line 318: ...at the urban... Line 332: negative correlation coefficients? Can you explain this better? Line 393: only ... as well as... confusing formulation Line 401: ...one source area. Line 445: Averaging out over more cells reduces non-linearity. I would not use the term 'negative concentrations' Line 454: confirms the global feature > shows the same trend (?) Line 475: reformulate Line 522: ...probably foresees an underestimation... unclear formulation.

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