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Geoscientific Model Development Discussions

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.

Philippe Thunis

philippe.thunis@ec.europa.eu

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In this publication, the Authors compare two different source apportionment approaches (referred as "scenario" and "labeling") and conclude that they reach a satisfactory agreement (68% for PM10, 50% for SIA) between the two methods for a few-days episode analyzed in more than 30 cities. This claim of a satisfactory agreement is based on numbers that represent average results across cities and forecast days. While this average agreement/non-agreement probably represents a necessary first step, it is not sufficient in my view. Given the capacity of air quality models to de-

liver highly resolved data in terms of space and time, a user will mostly be interested in the results for a specific city and specific day. When looking at results detailed in terms of city and forecast day (Figure 9 and box-plots 8 and 10), the agreement is quite low for some cities/days. Moreover, a low agreement between the two methods for some cities/days is not surprising. Indeed, conceptual differences do exist between the scenario and tagging/labeling approaches that have been shown to generate important differences in terms of results for non-linear compounds (see for example Burr and Zang 2011, Grewe et al. 2010, Thunis et al. 2019). This point was also made by Kranenburg et al. (2013) themselves. In their work, Clappier et al. (2017) and Grewe et al. (2010) explained conceptually why these two approaches do not lead to comparable results for non-linear compounds and concluded that these two methods should serve different purposes. Given the above points, I find the Author's conclusions surprising and also misleading in terms of their implications on air quality management practices as they suggest that both methods are equally suited for calculating source contributions (see e.g. lines 113-114) when this is known not to be the case.

A few other points are raised below.

- As shown by Clappier et al. (2017) or Kranenburg et al. (2013), the results of the scenario and labeling techniques would lead to identical results for the linear fraction of PM (primary), if obtained with the same underlying air quality model. The level of agreement obtained for primary compounds like EC therefore provides quantitative information on the difference caused by the underlying model (LOTOS vs. EMEP). On the other hand the difference in agreement between primary and secondary (NO3, SO4 or NH4 Figures 8 and 10) is a direct consequence of the apportionment of the secondary fraction which conceptually differs in the two methods. The lower agreement for SIA than for primary is not only due to differences between EMEP and LOTOS as suggested at lines 477-478, but also, according to me, because of the conceptual differences between the labeling and scenario approaches.

- The impact of the reduction percentage used in the scenarios is shown as an average over cities and forecast days (Figure 6). It is unclear how the average indicator has been obtained (have negative and positive differences been summed-up in absolute term?) but even if in absolute terms, the average process does not show the real level of non-linearity obtained for specific cities and days. Thunis et al. (2016) have shown, based on LOTOS_EUROS simulations, that non-linearities could reach more that 5 to 10% on daily values and that the "interaction non-linearity (ignored in the current work) was the dominating factor (up to 20% in some cities). The level of non-linearity obtained here (around 1%) is very low and therefore surprising. It would interesting to see detailed values of this non-linear indicator for each city/day.

- When noting that the results of scenario and labeling differed for non-linear species, Kranenburg et al. (2013) compared a 5% scenario reduction with a simulation where only 5% of the emissions where labeled. Could the Authors explain why they did not label only 15% of the emissions in this comparison?

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