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Interactive comment on "Source apportionment of highly time resolved trace elements during a firework episode from a rural freeway site in Switzerland" *by* Pragati Rai et al.

Anonymous Referee #2

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GENERAL COMMENTS

The manuscript describes a study to determine the sources impacting on PM10 in a traffic oriented site using a high resolution elemental dataset and processing data with the SoFi tool based on ME-2 receptor model algorithm. The manuscript is well organized, the language is clear and the English style is appropriate.

According to the authors, the SA study was conducted to characterize the source emissions at a traffic-influenced site. This is confusing because receptor models are normally carried out at the receptor site to characterize the source contributions rather than the source emissions. The authors claim the novelty of the work is due to the

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limited number of studies for trace element emission sources with high time resolution. However, as the same authors state, many studies were carried out using rotating drum and streakers that, despite being off-line, provide comparable information that can be processed in the same manner as this study.

SA of the entire PM based only on trace elements representing only a limited fraction of the PM mass (in this case 20%) is very uncertain because a considerable amount of information is missing about the main components of PM: elemental carbon, ions and the organic fraction. The risk is to overestimate the contribution of sources for which the elements are markers and neglect sources where elements are less relevant in particular the secondary organic fraction. In addition, the identification of factors into sources is hindered because the chemical profiles contain few diagnostic species or combination of species.

The authors claim MAAP and Q-ACSM were collected in parallel so it is not clear why they didn't use this information to obtain more robust SA results. The impression is that the authors are splitting the study in pieces to make more publications.

The study location is not well described. A map is needed to help the reader understanding the characteristics of the site.

The Conditional Bivariate Polar Function (CBPF) analysis is an important part of this work, there is a dedicated sub-chapter in the methodology section. However, there are no graphs about the results of this technique in the paper. The supplementary material is supposed to be used to provide information that supports the main findings of the work not to place essential results of the work.

The conclusion that the study result emphasizes the large influence of highway traffic on the composition of PM10 is trivial considering the study was conducted at a traffic site. In addition, this is not in line with the declared objective of characterizing the emissions.

In this manuscript there is a contrast between the highly sophisticated data treatment and the limited data input. The model allocates all the PM10 mass on the basis on the predictive capabilities of only 14 elements which do not provide enough information to properly identify all the factors and to allocate the PM10 mass to each of them reliably. This is due to lack of markers to allocate the carbonaceous fraction and part of the secondary inorganic (nitrate). As a consequence there are not well resolved factors (e.g. the two fireworks and the two dust factors and the road dust with the traffic related factor).

Source apportionment with receptor models is a routine technique and alone does not represent a scientific novelty. In addition, the application of these models with only trace elements does not fulfill the minimum requirements to obtain robust PM source apportionment because of the absence of important information to allocate the entire PM10 mass.

SPECIFIC COMMENTS

Page 1 line 29: the literature about the health impacts of PM need to be improved.

Page 3 line 6: the study by Park et al was carried out with XACT 620.

Page 6 line 2: is it reasonable to use 10% analytical uncertainty for all the species?

Page 7 line 18: how do you know salt is from sea and not road salt?

Page 7 line 25: the expression factor composition is not clear. Do you mean factor profile?

Page 9 line 14: the comparison between the on-line and off-line data is not clear. In the text are mentioned 28th and 30th July but the Mg/Na ratio is similar to marine aerosol also on 31st July.

Page 9 line 21 and foll.: There is not clear evidence to prove there are two different dust factors. The diurnal profiles are almost overlapping (Figure 3) and in the scatter

plot of fig S13 there is only one cloud of points. Also the CBPF plots in figure S8 show overlapping wind speed and directions. Soil dust should be farther from the origin than the more local road dust. Split of sources is a typical problem of using only elements in factor analysis source apportionment. In addition, how do you know that Ca rich is road dust and not other sources? Enriched Ca dust is common in construction works, for instance.

Page 9 line 25: only the Ca scaled residuals improve not those of Si.

Page 10 line 17 and foll.: The chemical composition of this factor indicates brake wear mixed to the re-suspended particles as Fe and Si are components of crustal material. Again there is an overlapping in the chemical composition with the so called road dust profile and these two profiles also have very similar diurnal profiles.

Page 10 line 29: the secondary sulfate does not provide any evidence to allocate the ammonium nitrate (another main secondary inorganic component of PM).

Page 11 line 8: The characterization of the industrial source is weak. There is no connection to any known industrial process. The fact that other studies in completely different areas found the same profile is not proving the industrial origin of this factor. On the contrary, it is unlikely that the same industrial process is present in many different sites.

Figure 4: Not clear what is the added value of this figure with respect to figure 1. Normalized concentration (should be explained in the caption). Why use different units than the other graphs. The the percentile box and whisker and the mean -+SD overlaps making the graph difficult to read. Choose one.

Figure S9: the connection between this data and the days with high "sea salt" is not clear in this figure. It should be better evidenced to allow the reader evaluating if there is a difference between the days with high sea salt and those without it.

TECHNICAL CORRECTIONS

Figure S6: not clear why the p25 is a single point while the p75 is a vertical line.

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