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Interactive comment on “Analysis of exceedances in the daily PM₁₀ mass concentration (50 µg m⁻³) at a roadside station in Leipzig, Germany” by C. Engler et al.

Anonymous Referee #3

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The paper provides an analysis of five years of PM₁₀ and PM_{2.5} measurements at three sites (roadside, suburban and rural) in the city and the surrounding area of Leipzig (Germany). The focus is on the investigation of the (meteorological) conditions leading to PM₁₀ concentrations exceeding the daily limit value. The authors use statistical methods and also cluster analysis of back trajectories for investigation of the transport of air masses.

General comment:

The manuscript certainly covers a topic that is relevant for ACP and the results are relevant for local authorities for better characterisation of situations with high PM₁₀

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concentrations, i.e. PM10 concentrations exceeding the daily limit value. On the other hand, the main result of the paper is something that is well known (highest air pollutant concentrations in winter during high pressure conditions, low temperature and low wind speed) and the authors do not present novel concepts, ideas or tools. The content of the manuscript is from a scientific standpoint therefore of limited interest. In addition, the manuscript is in my view too long and not always well structured. This makes the text sometimes difficult to read. I'm convinced that the main messages can be presented in a more condensed and concise way. My recommendation is that the paper can be published after major revisions as detailed below.

Special comments:

The description of the clustering analysis seems not sufficient: On page 15835 line 3, the authors state "In order to minimize subjectivity, a k-means cluster algorithm was applied in this study", and on page 15854 line 27 "it could be shown, the cluster analysis being an objective method". To me it is unclear on what basis the authors decided that clustering into 9 clusters is appropriate, the description on page 15839 (line 23 and following lines) and the first paragraph on page 15840 do not help very much. For example I do not understand the following two sentences "The deviation of the average PM10 concentrations (and the other aerosol and meteorological data) between the clusters was calculated for each test run and used for the choice of the weighing parameters. Selecting a small number of clusters will generate larger, more representative sub-sets of the data.". What does "more representative" mean, how was the clustering procedure exactly done? Please describe this more clearly. Otherwise it cannot be seen that the applied clustering is an objective method as stated. What is the effect of the choice of weights a_1 - a_4 on the results?

The manuscript is in some parts not carefully written, there are many typos and linguistic errors. An example is page 15849 lines 6, 9, 25 and 26. The text should be carefully revised accordingly.

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The methodical paragraph on the approach by Lenschow et al. (2001) should not appear in section 4.2.2, but in the statistical methods section 3.1. Are the given definitions for RT, UI and TI correct? If yes, then RT, UI and TI do not sum up to one. Please explain. Why not $UI = (PM_{10urban} - PM_{10rural}) / PM_{10roadside}$ and $TI = (PM_{10roadside} - PM_{10urban}) / PM_{10roadside}$? Then $RT + UI + TI = 1$ holds.

Section 4.2.2 appears lengthy, is hard to read and sometimes confusing. Many numbers are given and there are sentences that are hard to understand and irritating: Page 15843, lines 4-5: “Clearly higher concentrations were observed during exceedance days compared to non-exceedance days”. This is obvious for PM10 and also not surprising for PMcoarse. Page 15843, lines 7-9: “Even the standard deviations for PM10 . . . were above the average value over the entire measurement period”. Please rewrite or explain what this means. I would very much appreciate if the authors could carefully revise this section focusing on readability.

It is very hard to see any differences in the stacked bar charts (Fig. 6, 7, 9), as a consequence it is hard to follow the discussion. For a more clear illustration of the differences on exceedance days versus non-exceedance days, the authors might want to consider alternative representations. The concept of relative differences as used e.g. by Amato et al ACP 2011 could be a possibility.

The summary and conclusions section is mostly a repetition of the discussion section. Please avoid this, I suggest to drastically shorten this section to a short conclusions section.

Minor comments:

Abstract, line 17: What does “the latter factor was instrumental in generating ..” mean, please clarify. Abstract, line 24, there is a word missing: “Should be something like “. . . indicates that both contributions are equally . . .”.

Page 15833, line 7, abbreviations (TEOM, OPC) should be explained or avoided.

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Page 15835, line 1, typo "... with the analysis of the meteorological ...", also line 22 "previously" can be deleted.

Page 15836, lines 17-19. Please give the spatial distance between the suburban and the roadside site.

Page 15838: line 11. "The average chemical composition was calculated ...", should be something like analysed instead of "calculated".

Page 15838: line 13-14. Should be "It is used for testing whether two populations result from the same random distribution or not".

Page 15838: line 25. What does "custom-made k-means cluster algorithm" mean. Please provide the details of the software that has been used.

Page 15841, line 22. "with significant occurrence". What does significant mean here, how was significance determined?

Page 15842, line 22, "Figure 5 illustrates the seasonal differences in the occurrence of limit exceedances." Should be monthly instead of seasonal.

Page 15842, line 28-29, "Another reason is middle-range transport from eastern neighbouring countries playing an important role considering the PM10 mass concentrations in eastern Germany." It is unclear here how transport from eastern countries can be responsible for the seasonal dependence of exceedances. Do this transport events have clear seasonal dependence? Please provide more information here.

Page 15851, line 18. "alike a mixture of winter, spring and fall". What does this mean, please revise?

Page 15853, line 1-3. "Due to the very low winds ...". This seems not to be true. Figure 6 shows that PM_{coarse} is higher for exceedance days than for non-exceedance days. Or do you mean in relative terms – please correct or explain.

Legend of Table 2: I don't think that "significantly equal" exists. Should be changed,

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e.g to "not different".

Figure 4. Was regression line forced through zero? If yes, it should be mentioned.

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