

Interactive comment on “Long term measurements of submicrometer urban aerosols: statistical analysis for correlations with meteorological conditions and trace gases” by B. Wehner and A. Wiedensohler

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First of all we thank the referee for his detailed comments and suggestions.

General comment: More detailed and quantitative information on the primary and secondary sources from the statistical analysis was expected by the referee. I personally think that there are many interesting results from the analysis shown here. But for conclusions concerning individual sources many more assumptions need to be done and one has to speculate a lot. One main advantage of investigations shown in this study is that they consist of mainly objective methods. That means all data were included into investigation, no special events were selected, such as nucleation events. Otherwise you have to invent some criteria to assort your data, and the investigation becomes

more and more subjective. The statistical investigation was intended to confirm some ideas from the mean values and find more relationships between the data being not visible in the data itself. Measurements in the urban area are influenced by many different factors and some correlations are not recognizable from the data itself. The detailed investigation of one or more special cases was not the subject of this work.

Detailed comments: Nucleation events and high surface area concentration are negative correlated, that result was found from the PCA. It was not recognizable from the data itself. To confirm this result by special cases, the data must be divided into different cases and that was not the idea of this study. You are right, the surface area is probably higher on weekdays than on weekends, but the concentration of accumulation mode particles as a main contributor to particle surface are mainly influenced by air mass origin. Here, continental air masses coming along with high pressure regions over eastern Europe were found to bring elevated concentrations above 100 nm and thus a higher particle surface concentration. That was one important result from the PCA because it was not recognizable without this investigation. The surface concentration is probably more influenced by the air mass than by day of the week.

Nucleation events were not recognized from the mean winter data. However, there are individual days showing the formation of new particles even in winter. But the mean do not show this, these very few events are superimposed by the dominating traffic influence. Thanks for your suggestion about the relative contribution of the different size classes, I included a table containing these numbers and the corresponding text at the end of the "Mean variation" section.

Concerning the new particle formation: As already explained in the general comment above, it was not the subject of this study to make case studies. It was intended to make an objective investigation of all data to find hidden relationships between the data. A detailed investigation of the nucleation event would go beyond the scope of this study. It may be a good suggestion for a further investigation of these data, but should not be included here. I do not know what the precursor gases are, it is most likely that

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the conversion from SO₂ to sulphuric acid is involved but there is no evidence for this assumption. But there was no clear correlation between nucleation particles and SO₂. Measurements of sulphuric acid are not available. If there is a correlation with certain wind directions, e.g. coming from city centre, this must be recognizable from PCA.

Comment to p.1705, line 24: the statement was removed because it is not significant. Adding error bars or confidence intervals would be interesting of course the clarity of the figures would be lost completely, thus I leave them out.

The PCA identifies relationships between the data and thus allows possibly to find the sources of aerosol particles. The proportion of explained variance gives the importance of this certain PC, i.e. how much it contributes to the urban particle concentration. The main result of PC1 was seen before, the combustion as one major source was confirmed by the PCA-result. But it was not recognizable from the data itself that accumulation mode particles are emitted from combustion sources too. A slight correlation between small particles and radiation for the winter months was found in PCA and was not recognizable before. The negative correlation between new particle formation and high surface concentration was not found before too. Additionally PCA shows the proportion of the individual sources and processes. Thus, combustion plays the most important role for summer and winter measurements. You are right, some of these results were qualitatively found before, but from the PCA one has an objective measure for the correlation. The high proportion of unexplained variance is not the result of missing a fundamental parameter because only the variables included contribute to the explained variance. Here, time series are used for the PCA resulting always in a high amount of noise, resulting in unexplained variance. Multivariate statistics, such as PCA, require normally distributed variables. I looked for the best scaling method for every variable and applied it to the data, as given in the table. Usage of the measured values for the statistics would provide too much weight for maximum or minimum values. Temperature and humidity are connected to global radiation and atmospheric pressure for several meteorological situation. Including temperature and humidity re-

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sults e.g. for the new particle formation events (PC2) in a positive correlation between temperature and global radiation and a negative correlation between global radiation and relative humidity with smaller factor values because they share now the influence of meteorology. And it gives no additional information. I changed the explanation about the persistence and hope it is clearer now. I rounded the time values as the results here, you are right, it makes no sense to give a value of 59 min here. An explanation of the meaning of these values was also added in the text. The trend in particle concentration was not really significant, I added this to the end of the ?Mean variation..? section. I de-trended all the data for statistics, I did not check if there was a significant trend or not.

The revised manuscript will be submitted soon.

Interactive comment on Atmos. Chem. Phys. Discuss., 2, 1699, 2002.

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