Atmos. Chem. Phys. Discuss., 3, S1490–S1494, 2003
www.atmos-chem-phys.org/acpd/3/S1490/

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Fine and ultrafine particles in the Zürich (Switzerland) area measured with a mobile laboratory. An assessment of the seasonal and regional variation throughout a year" *by* N. Bukowiecki et al.

N. Bukowiecki et al.

Received and published: 10 September 2003

First of all, we would like to thank the two referees for their valuable comments on our ACPD manuscript. We believe that their comments have helped substantially to improve the quality of the revised manuscript. Since the two referees have addressed similar issues, we will answer all comments cumulatively, covering every question/remark that the referees have raised.

1. Length of the statistical analysis

We agree that the ANOVA section (Section 3, first paragraphs) may be too long in the ACPD manuscript. As suggested by both referees, we dropped the three figures show-

ing ANOVA quality assurance plots. Additionally, we decided to drop Table 4, listing the detailed ANOVA output parameters. Instead, we now present the whole section in a more illustrative and intuitive way, without changing the statements of the section. To do so, we start the section with a new box plot (Fig. 3 in the revised manuscript), showing the spatially and seasonally resolved variation of the considered parameters. From this box plot, the major findings can already be seen. The ANOVA tests then additionally serve as a statistical backup for the statements, including probabilities for significance etc. Overall, the section has become shorter, with a stronger focus on the actual results and less on the statistical procedure.

Regarding the PCA section (Section 4), we think that there is not much leeway for shortening the section, because most of the final results base on this analysis and therefore deserve to be sufficiently explained. The general question whether most of these finding can be obtained in a simpler way, i.e. without PCA, is of course a basic question which we discuss further below in this comment, in a separate paragraph.

2. Comparison of mobile and stationary measurements (Section 3, last paragraphs)

Unfortunately, we only had limited data available for comparison of our mobile measurements with stationary measurements performed by the Zürich City Authorities. Their measuring stations do not measure any particle number concentrations, since this is not required by current Swiss environmental law. Therefore, the only aerosol parameters that could be compared for this study were PM10, PM2.5. Since both referees brought up remarks to this issue regarding clarity and statement quality, we have decided to rephrase this section and to present the comparisons in a new way. Figure 5 in the revised manuscript now depicts bar graphs of the mobile and stationary measurements, resolved by season. Additionally, we applied F-test statistics for a more thorough discussion of the comparison.

Finally, we agree with the referees that this entire comparison does not fully support the conclusions in the ACPD manuscript, stating in a rather general way that "mobile

ACPD

3, S1490–S1494, 2003

measurements are suitable for long-term pollutant assessments to obtain good information on spatial variability and reasonable information on seasonal variability". We have rephrased this passage (last paragraph in Section 6) in the revised manuscript to more carefully describe the actual seasonal representation of our mobile measurements.

3. Primary vs. secondary ultrafine particles

Both referees seemed to be confused about the terms "primary ultrafines" and "secondary ultrafines". This terminology has been introduced in the last years in several studies, taking into account the entirely different nature of these ambient ultrafine particles (origin, occurrence, composition etc.), although nucleation is involved in the formation of both types. This terminological separation into a primary and secondary subcategory is strictly limited to ultrafine particles. In the revised manuscript, additional phrases were added to make it better understandable to the reader (Section 1).

4. Local background concentrations

We realize that the issue of what we actually measure while driving on the road is not straightforward (mix of different plumes, dispersion, ageing etc.). We have discussed our approach to measure local, i.e. road-near, background concentration (no peaks from single vehicles) in our earlier publication (Bukowiecki et al., 2002b) in detail. Since a repetition of that discussion in this paper would result in a significantly longer manuscript, we have decided to only add a few explanatory remarks to the revised manuscript (Section 2.3).

5. Technical comments

Evidence of secondary ultrafine particles: One of the referees stated that the weak evidence for secondary ultrafines during YOGAM was phrased in a too strong way in the conclusions. We agree and have rephrased the respective passage (Section 6).

Absolute number concentrations: We included supplementary information on our indi-

ACPD

3, S1490–S1494, 2003

cated number concentrations (lower size cut etc.) where necessary (Table 2, Abstract).

Figure size: All figures have been checked for readability in the revised manuscript.

Grey literature: Unfortunately, the information given in the Capaldo and Pandis (2001) reference has not been directly published elsewhere by the authors. However, we consider this report to be important to be included in our paper. The citation information should be sufficient to directly contact the authors, to get a copy of the report.

Broken axes in Figures 13 and 14 (15 and 16 in the ACPD manuscript): We have spent quite some time to figure out the ideal way to present this graph. Removing the break results in a axis width of over seven (y axis) and four (x-axis) orders of magnitudes. The features discussed in the text are then no longer seen in a satisfactory way. The Şgraph in the graphŤ serves to show the link between the OPC and SMPS distributions, which we consider as important. We therefore decided to stick to the version with the broken axes.

6. General remarks about multivariate exploratory data analysis

Both referees addressed the general question whether most of the findings of this study can be obtained in a simpler way, i.e. without PCA or ANOVA, based on initial qualitative plots. In fact, exploratory data analysis leads in many cases to results that seem to be obvious in advance. However, it can (although it not necessarily has to) be dangerous to solely rely on these initial interpretations, even if the final ANOVA results in our case supported them. Using monovariate data analysis, one can never be entirely sure whether some underlying connections between parameters are missed or not. In our opinion, this is in fact where the power of multivariate statistics comes into play. Besides finding new eventual correlations, they serve as an alternative and entirely statistical way to check whether the intuitive initial interpretations are confirmed. In this way, the final results become statistically more secure and give less room for speculations. Finally, we would like to point out that in our case the PCA results actually served as input for the final analysis of the data set (defining pollution categories, temperature

ACPD

3, S1490–S1494, 2003

resolved size distributions etc.). Thus, the PCA was not only a confirmatory tool, but also a major exploratory tool.

Interactive comment on Atmos. Chem. Phys. Discuss., 3, 2739, 2003.