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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Intra-community spatial variability of particulate matter size distributions in southern California/Los Angeles" *by* M. Krudysz et al.

M. Krudysz et al.

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Anonymous Referee 2 Received and published: 23 October 2008

Interactive comment on *Intra-community spatial variability of particulate matter size distributions in Southern California/Los Angeles* by Krudysz et al. This manuscript presents ambient aerosol size distribution measurements conducted over long time period in several sites in Los Angeles. The data is valuable and well presented. The manuscript contains new novel science. This a good manuscript and should be published in ACP after considering the issues discussed in the following.

The authors agree with the reviewer that the manuscript presents valuable and well

presented data that will contribute to the scientific body of work on the characteristics of particle number size distributions in urban areas and will add valuable information on the spatial variability of size-fractionated particle number concentrations. To our knowledge, this is the first study conducted using 3-4 co-located SMPS units. Results from this study provide important information on the relationship between particle size and spatial variability.

Major comment: The local meteorology is known to play a major role in shaping the spatial distribution of ultrafine particles in urban areas due to several near ground sources. The authors say that these are studied in more detail elsewhere. However, several of the phenomena studied here could have been better characterized if the local meteorology had been taken into consideration. (see e.g. my last detailed comment) I recommend that more discussion on these items are included into the manuscript.

The authors agree that local meteorology does play a major role in particle formation and the spatial distribution of ultrafine particles in urban areas. We would like to point out that differences in meteorological parameters at each site were discussed during inter-site comparisons. Due to the relatively small geographical area, most concurrently sampled sites exhibited very similar meteorology, and only sites such as LB1, SP1, and W1 (background sites), showed slightly different meteorological conditions due to their proximity to the ocean. A discussion on the effects of these meteorological conditions and impacts of other sources has been added to the text in Section 3.2.3.

Detailed comments Introduction, 1st paragraph: The study by Puustinen et al 2007 is an European study.

The sentence referencing spatial variability studies has been changed to *Studies in various locations throughout the world have shown substantial spatial variability in particle number concentrations.*

Introduction, 2nd paragraph: The authors discuss about processes that shift

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the mean diameter toward larger sizes. This should be explained more. I have difficulties to understand why e.g. the evaporation of volatile compounds or dilution with clean air lead to shift toward larger sizes.

The authors agree that not all of the atmospheric transformation processes discussed in the introduction shift the mean particle diameter to larger sizes. The text has been revised to clarify that these processes can change the shape of the particle number size distribution as particles travel from emission sources to the ambient environment. Text has been changed to *Ambient aerosols undergo atmospheric transformation after emission from a source due to processes such as condensation of low volatility products of photochemical reactions, evaporation of higher volatility particle8211;bound species, dilution with clean air, entrainment of polluted air, and coagulation, thereby modifying the shape of the particle number size distribution.*

Section 2.3., first paragraph: The authors state that the various instruments indicated the same size distribution within 10 %. How was this value calculated

As explained in section 2.3, the four SMPS units were tested side-by-side for intra-instrument variability. All four instruments were set to sample the same aerosol simultaneously for approximately 48 hours. As with the field measurements, the instruments were set to measure particles in the size range from 14 to 736 nm with a total scanning time of 5 minutes. One of the well-characterized SMPSs was used as a reference instrument to determine the channel-by-channel response of the other instruments. Based on this characterization, a size-specific correction factor for each SMPS was calculated. The size distribution data obtained after application of the correction factors were compared from the four instruments. Results indicated that the instruments did not differ from each other by more than 10 %. The correction factors obtained from the side-by-side comparisons were applied to the data collected in the field before data analysis.

The first paragraph in Section 2.3 was revised to include the above detailed description

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of the side-by-side comparisons.

Section 2.3, 2nd paragraph. The reason for 20 to 30 % lower concentration should be discussed. Some of the likely reasons should be indicated.

The SMPS system showed on average 20 to 30 % lower total particle number concentrations than the co-located CPC due to the differences in particle size cut-offs. Whereas the CPC measures number concentrations for particles ranging from 7 nm to more than 3 micro meters, the SMPS configuration used in this study counted particles in the size range from 14 to 736 nm. Therefore, the SMPS only measured a portion of the particle size range that the CPC detected. Also, the reason why some of the particles detected by the CPC were not accounted for by the SMPS may result from the wrong correction of the charging and size dependent detection efficiencies inside the Electrostatic Classifier by the AIM software.

Additional observations using an APS conducted simultaneously at many of the sampling sites indicate that very few particles larger than 700 nm are expected, therefore, it is likely that the real difference between the CPC and the SMPS total particle counts is in the 7 to 14 nm range.

These possible explanations were added to the text in Section 2.3

Section 2.3., 2nd paragraph: It remains somewhat unclear what concentration x if indicates. Is this CPC concentration for fixed size? Do explain also better, how the 10 % uncertainty is determined.

Concentration x if in the COD equation refers to the average hourly concentration of particles in a given size interval measured by the SMPS at site f. This was clarified in the text.

The statistical uncertainty, is related to the total count, N, through the equation:

uncertainty = $\sqrt{N/N}$

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where N is the particle count in a particle size channel

Because uncertainty in the particle count increases as the total number of particles counted in each particle size channel decreases, the statistical error can be reduced by increasing the number of particles detected. The last 19 size intervals (covering the range of 385-736 nm) were combined into 3 size bins (385-414 nm, 429-495 nm, 514-736 nm). The uncertainty for the new combined size bins was calculated from the above equation by including all particle counts within each new size bin.

Section 3.1., first paragraph: What does it mean that average temperatures and relative humidity were consistent

Certainly, the authors did not mean to imply that the temperatures and relative humidity were the same or similar across the entire sampling period. The word consistent was used to imply that meteorological conditions were not, on average, appreciably different between sites. This was explained more clearly by changing the text to *Meteorological data are shown in Tables 1 and 2. Average temperatures and relative humidity did not differ appreciably from site to site, although seasonal variation was observed.*

Section 3.2.3., 4th paragraph: In connection with LB5, the authors say that the local meteorology does not play major role. As the site is next to the freeway, I would expect the upwind vs. downwind situation being a major issue. Why it is not?

The authors do not mean to give the impression that meteorology is not important to the observations; temperature and relative humidity play a crucial role in particle growth. The discussion in section 3.2.3 focused on direct comparisons of particle number concentrations at two simultaneously monitored sampling sites, LB4 and LB5. As can be seen from Table 1, temperature, humidity, and wind direction were practically the same for both sites, therefore the discussion on the differences in particle number concentrations between the sites focused on the differences in sources and their strengths, not differences in meteorology. Because LB5 is located directly next to the freeway 710,

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the turbulent mixing of exhaust emissions from the nearby vehicles will have a large effect on the particle concentrations observed at that site. Effects of freeway emissions on sites located upwind, but in close proximity to a Los Angeles freeway have been observed previously (Zhu et.al. 2005). The text in section 3.2.3 has been changed to *Because LB5 is directly next to the freeway, it is constantly impacted by vehicular emissions and the turbulence induced by the freeway traffic has a large impact on the observed particle number concentrations. Changes in meteorological conditions will not affect particle number concentrations at LB5 to the same extend as LB4, which is not located directly next to a significant UFP emission source.*

References

Y. Zhu, W. C. Hinds, T. Kuhn, M. Krudysz, J. Froines. 8220;Penetration of freeway ultrafine particles into indoor environments.8221; Journal of Aerosol Science. 2004 Nov; 36(3): 303-322.

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