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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Inter-community variability in total particle number concentrations in the eastern Los Angeles air basin" *by* N. Hudda et al.

Anonymous Referee #1

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♢ General comments

The manuscript discusses the spatial variability in particle number concentration (PNC) in the urban area of Los Angeles air basin (LAB). Contemporary measurements of PNC were taken at seven sites in LAB for about one year. The concepts of ultrafine particles in urban areas, both in terms of particle number and size distribution, compared to PM mass, and the difficulty to assess human exposure to their sharp number concentration spatial gradients, is well introduced, and clearly motivated the manuscript.

The work is original, but not completely new, and authors should probably give more credit to previous related works. One critical point is about the methodology used to

assess aerosol variability: If authors fully discussed particle number size distribution data instead of total PNC, they would probably get more robust conclusions.

Overall, it is a well-written manuscript addressing a relevant scientific topic within the scope of ACP, and substantial and interesting conclusions are reached. I believe the paper merits publication in ACP after considering the following specific comments, which should be addressed before publication.

♢ **Specific comments**

- Pag.13916, lines 20-21, and throughout the manuscript: I wonder whether the overall similarity in total PNC data in seven sites of LA basin can be an evidence for a well dispersed regional-scale aerosol. I would conversely say that aerosol populations - i.e. nucleation mode, Aitken mode, accumulation mode particles, etc., have to be analysed to get similar conclusions. I suggest to fully discuss particle number size distribution (PNSD) data, to make the conclusions on aerosol spatial variability more robust. (In this regard, PNSD measurements operated in parallel should be presented in a clearer way.) It is worth noting that when authors analyse aerosol particle spatial variability with the PNSD data (pag.13918, lines 10–25), overall CODs (Coefficients of Divergence) increase up to 0.67 and exhibite an inverse relationship with particle size. (Similar results were discussed by Costabile et al., Atmos. Chem. Phys., 9, 3163–3195, 2009.)

- Paragraph 3.2 and Figg. 2a, 3a, 4a: Interestingly, the plots of total particle number concentration (PNC) show a three-peak structure. Further insights to the interpretation given by the authors are likely to be provided by the analysis of the weekly PNC variability, e.g. week-end vs. week-day. More specifically, it would be interesting to add typical traffic flow profiles of the nearest freeways in order to compare trends and peaks. (E.g., this could help to understand the reason why, in Fig.2a, the hourly average PNC at the USC urban background site shows a morning peak from 5:00 to 10:00 a.m., whereas in July, the same morning peak

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starts at 4:00 a.m.) I believe that this could also aid in evaluating the contribution of traffic volume particle emissions to the third evening peak of PNC. This contribution can be as relevant as the contribution during the morning rush hours, the lower total PNC being due to a more intense vertical mixing after midday than during the early morning. (Similar results were discussed by Birmili et al., Atmos. Chem. Phys., 9, 2355-2374, 2009.)

- Paragraph 3.2: I suggest the authors to describe here more clearly the spatial representativeness of the selected sites with the aim to enhance text comprehension and readability. (This information should also be included in Table 1 by adding a column for site representativeness - e.g.: "USC = urban background" - and a column for the prevailing aerosol sources - e.g.: nearest freeway, regional transport, etc.) Besides, authors should explain why they decided to discuss three sites only - USC, UPL, and AGO. It is not clear if and why SMPS measurements were operated only at those three sites. (Perhaphs, those sites are the most representative ones in terms of urban background, downwind regional background, and remote regional background.) Finally, I suggest to name the sites according to their representativeness , e.g.: "the urban background site" instead of "USC". (The frequent referring to acronyms which are apparently unmeaningful- e.g. UPL, AGO, USC, makes it hard for the reader to follow through the text in some parts of the manuscript.)

- The early afternoon peak at the the USC urban background site has been apportioned to secondary particle formation. It is even more evident in the summer profiles of PNC at the USC site, but the corresponding PNC values in winter are as high as in summer, or even more. (PNC is up to 16000 cm^{-3} in January, and up to 13000 cm^{-3} in September.) A similar early afternoon peak is also evident in winter months at the other two sites, AGO and UPL. The findings give evidence for a significant contribution to PNC due to secondary photochemical formation in urban areas. This issue should probably be better discussed in the revised

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manuscript, including the related PNSD analysis.

- Pag. 13913, line 29: Fresh emissions are associated to the 14-25 nm size range. The 25-100 nm size range is contrarily associated with coagulation and/or growth of the pre-existing particles. However, where both these size ranges increase together - e.g., evenings in September at the UPL site, I think a soot-mode due to freshly emitted particles has also to be discussed.

- Pag 13914, lines 4-6: Authors conclude that "there could be significant distinction in the size distribution profiles observed at sites due to seasonal variation". I would suggest to provide more conclusions about the findings, including a categorization of results according to: site (spatial) representativeness, diurnal and seasonal profiles, and prevailing local emissions.

- Paragraph 3.2, figg.2, 3, 4: The modality of particle number size distribution is only qualitatively discussed, in terms of graphical visualization of the mode. As it is, the discussion can be strongly misleading since it depends on the y-axis scale of the graphs. (In this regard, it is not clear to me why the y-axes have a different - linear - scale for each plot.) I suggest to either mathematically quantify the modality or to provide a more detailed - and standardized- discussion. (I also suggest authors to re-plot the figg. 2b, 2c, 3b, 3c, 4b, 4c using a standard y-axis scale in order to enhance their inter-comparison.)

- Pag. 13912, lines 12-13: I suggest to use "not clearly evident" instead of "not significant". ("The seasonal variation of the diurnal patterns for particles $>$ 100 nm is not clearly evident".) I believe that in order to conclude that it is "not significant", one should provide a quantification of PNC variability instead of a graphical analysis only.

- Pag.13913, lines 19-28, and Figg.3b and 3c: I believe that the difference of PNSD observed in the early afternoon from 15:00 to 17:00 at the UPL site (downwind of

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LA) between September and December is interesting and probably lines 27-29 should discuss the point with more details.

- Pag.13915, lines 10-20: The transport of PM downwind of LA during afternoon and evening hours is a relevant topic. It is particularly interesting with respect to the transformation of the particle number size distribution (PNSD) from the particle and gas emission point to the downwind receptor sites. It would be interesting to include time/particle diameter/PNSD plots of some selected typical days, and discuss the findings.
- Pag.13920, line 19: I think that authors should also mention here that sub-30 nm particles can also be associated to previous new particle formation events.

♢ **Technical corrections**

- Pag.13910, line 9, Par.3.1: I suppose there has to be a mistake in figure numbering: "Fig.1a"? Equally, pag.13912, line 12: ("Fig.1a") and pag.13917, line 8 (Fig.5 and 6).
- Pag.13911, line 6: "error" instead of "erro"
- Pag.13913, line 23: delete "of"
- Pag.13915, line 27: delete "the"
- Fig.5a and 5b: I suggest to specify more clearly the meaning of "inland average", "overall" and "overall-USC", and equally the way data are represented in terms of COD
- Pag.13916, line 25: Which is "the following section" the authors refer to?

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- Pag.13917, line 1, and tab.1: Specify the distance of the USC site from the nearest freeway - 120 or 150 m?
- Figg. 5a and 5b: I suggest to use the same colours for the same sites in both figures, and possibly the same y-axis scale.
- Table 3: I believe there is some mistake in the temperature values at the AGO and DIA sites.
- Figg.2c, 3c, and 4c show PNSD during December 2009 for comparison with the total PNC during some selected months showed in fig.2a,3a, and 4a, respectively. Those figures (fig.2a,3a, and 4a), however, don't show any data for December. It would be nice to have the same periods in the figures to compare more easily the trends.
- Pag.13918, lines 1-9: The difference between inter-community variability (in the LAB), and intra-community variability (in LA) should be better explained.

Interactive comment on Atmos. Chem. Phys. Discuss., 10, 13901, 2010.