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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Measurements in a highly polluted Asian mega city: observations of aerosol number size distribution, modal parameters and nucleation events" *by* P. Mönkkönen et al.

Anonymous Referee #1

Received and published: 4 November 2004

General comments:

This ms presents first aerosol number size distributions obtained in an urban area of New Delhi, India. The data show interesting phenomena and have consequences for the understanding of the regional air pollution situation. The data set is unique and the quality of data excellent, but the depth of scientific analysis is low and contains some errors.

One major lack of the paper is that only 4 days are shown in more detail. Presenting the whole period of 2 weeks would be better, but is also not representative. However,

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from the other paper (Mönkkönen et al., 2004a) I found that the measurement period covered more or less a whole year. Therefore, I suggest either including more data into analysis and do some statistic investigation with them or focusing on new particle formation events. Actually, the main outcome of the paper is the new particle formation, which is really impressing to me. Thus I would focus on that topic, maybe some more analysis could be done. Furthermore I miss any comments about long range transport from other polluted regions. I think its role is not negligible within these heavily polluted Asian countries and it should be investigated. Backtrajectories are a useful tool to investigate air mass history.

See also the detailed comments below.

Formal: Different time formats are used, that's really confusing: change to one format: e.g., 28 Oct. 2002 1:00.

Comments in detail:

Introduction:

The introduction is very general. There are lots of references concerning traffic emissions and biomass burning: I do not see their relevance for the present paper. Again, I suggest focusing on e.g. new particle formation, also within the introduction. Again, the pollution in New Delhi is probably not only produced within the city it might come also due to long range transport.

There is at least one study from another Mega city available and should be mentioned here: Dunn, M.J., J.-L. Jimenez, D. Baumgardner, T. Castro, P.H. McMurry, J.N. Smith, Measurements of Mexico City nanoparticle size distributions: Observations of new particle formation and growth, Geophys. Res. Lett., 31, doi:10.1029/2004GL019483, 2004.

P. 5409 L. 2: Balsano should probably be Baldasano

Methods:

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I would like to get more information about the site, e.g. height of surrounding buildings, is it a kind of street canyon, traffic density, traffic dominated site? Within the description of weather conditions during the experiment I really miss data about wind speed and direction. I think they are necessary to define a period as 'stable'. They could be also useful to explain changes in aerosol concentration during the day. For a complete description of meteorological situation the development of boundary layer height should be studied. Are there radiosoundings available? If not, trace gases or PM10 should be used to study this diurnal evolution. Later on trace gas measurements are presented, they should be introduced here, what is measured and where?

P. 5411 L. 17: Mäkelä et al. (2000): (probably) a is missing

Results:

Figure 2:
Why did the authors choose these 4 days? I would like to see some data from the rest of the experiment period or just to read if they are comparable or not. This figure contains much more information than given in the text. The new particle formation events are not mentioned at all. Later on trace gas measurements were used. Why not here? Time series of NO_x could help to distinguish between traffic and new particle formation. Furthermore, there are changes on the accumulation mode recognizable, the number concentration decreases prior to new particle formation. What are the reasons for this behavior? Wind data and mixing layer height would be helpful to explain this. A time series of calculated surface or volume concentration should be added too.

P. 5412 L. 19ff. Comparison of volume concentration would be interesting as well.

Figure 3:
Too many size distributions per figure, not all of them are necessary. Please remove one or two and/or change to color plots. Again, there could be more explanation given in the text. Why is the accumulation mode decreasing in the early morning (between 2 and 4 am)? Why not traffic in the evening? Do the authors have any information

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about traffic counts? Whats about cooking in the evening? The authors should use the trace gas measurements to explain the different size distributions. Is this evolution comparable with other days within the observed period?

Table 2/ Figure 4:
What day is presented here, again Oct.28? Please add the date to figure and table captions. Or is it an average over the campaign? Why do the authors use different averaging methods: geometric and arithmetic? The arithmetic values in table 2 for the nucleation mode look not reasonable to me. Too many of the GMDs are far below the measurement range of the DMPS and many σ are far below 1. The geometric values in Fig. 4 look completely different, are significantly higher than the values in the table. As far as I know the geometric average should be equal or smaller than the arithmetic one. Please check the data! In figure 4 σ has two times a value of 0 which is impossible! Different time formats are used in figure 4 and the corresponding text. Figure 4 should be explained in more detail, in particular with focus on new particle formation. The clear particle growth from figure 2 is hard to find in figure 4. Why do number concentrations decrease during morning hours? Another possible reason for increasing number concentrations and mean diameters could be the decreasing height of mixing layer. Then, emissions are trapped below the inversion layer and are accumulated there. Again, trace gases would be helpful to prove the speculations.

Figure 5:
Averages over Saturdays and Sundays during the campaign? How many days are included? What means 'slight differences', please give numbers. From the logarithmic plot they are hard to read. Without any explanations or conclusion I cannot see any reason to show this plot. I suggest leaving it out.

Figure 6 and 7:
These figures repeat two sections of figure 2. I would like too see some new information here, e.g. time series of the calculated parameters, such as CS, C. This section 3.3 should be extended to become the key section of the paper. More explanation

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about the calculated values should be given. With the time series the authors could define the key parameters triggering new particle formation. In the text is said that CS decreases before new particle formation start, this should be shown as a plot and the corresponding particle surface should be given.

P.5416 L.2ff Time series of trace gases should be presented here, they could allow to distinguish between emission and new particle formation.

Conclusion:

From such high quality data I expect more scientific outcome here. P.5416 L. 25 f: Ěvehicular emissions together with biomass burning has a significant contributionĚ This was not shown here, I did not see any hint which particles are produced by car traffic or biomass burning. It would need analysis of trace gases, traffic counts, and other nearby sources. Therefore, again, put the focus on new particle formation. Here, the major results (of section 3.3) should be pointed out more clearly! New particle formation happens, what are the key conditions triggering this process? It is said, but it should be emphasized! How is the condensational sink and corresponding surface area concentration compared to other urban sites? Does the new particle formation depend on air mass history? Whats about frequency of new particle formation during the year?

References:

Please check it carefully, several typing errors are already mentioned by reviewer 2. ACPD is usually a temporary reference, and if a manuscript has been there in 2002 it should have been published in ACP in between.

Interactive comment on Atmos. Chem. Phys. Discuss., 4, 5407, 2004.