Atmos. Chem. Phys. Discuss., 8, S6651–S6654, 2008
www.atmos-chem-phys-discuss.net/8/S6651/2008/

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Relationships between submicrometer particulate air pollution and air mass history in Beijing, China, 2004–2006" *by* B. Wehner et al.

B. Wehner et al.

Received and published: 3 September 2008

D. Covert (Referee), Referee's comments are displayed in italic letters

The authors present a wealth of aerosol physics data from a geographical location and anthropogenic source area, Beijing and northwestern China that is of importance regionally and globally and that historically has not had such an intense measurement series as this. The submicrometric aerosol measurements were coordinated with meteorological measurements at the surface and aloft and with air mass trajectory analysis. Two previous papers have presented results and analysis of subsets of this data in a more focused context. This manuscript presents a general summary of the entire data set in the context of diurnal and source region averages and their relationships to

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local meteorological parameters and trajectories. The data set is extensive and could support further analyses and discussions.

Coagulation is referred to frequently as the process that explains the shift in size distribution modes to larger sizes under higher ?pollution? levels. Of course there are other processes, condensation and aqueous phase gas-to-particulate mass conversion that should be mentioned and dismissed or discussed as appropriate.

Right, especially condensation and other gas-to-particle conversion plays a significant role and should be mentioned in the text. The manuscript was modified in the discussion of both: air mass origin and cluster analysis.

Figure 2 is not particularly informative. It demonstrates the progression of positive and negative correlation with size increment. This information could be expressed in a few sentences of text along with regression statistics.

I agree, in the beginning I thought it might be informative but maybe a few words can give the same information as the whole figure. Figure 2 was removed from the manuscript and the information is given in the text now.

Page 1335 Line 25 "The mean evolution of the total number and volume concentration is shown in Fig. 13. ..." I disagree with this analysis. First what is shown in figure 13 is the 24 hour, diurnally averaged time series. To say that this is represents aerosol number or volume evolution requires that it be, strictly speaking, a Lagrangian time series or at least a single, relatively homogeneous air mass. I propose that the midday increase in [N] for trajectory clusters 1 and 2 and to a lesser extent clusters 3 and 4 are due to mixing of two or more air masses, the residual night-time surface based air mass, a residual boundary layer and a free tropospheric air mass that are mixed by instability developing during the late morning and early afternoon. Figure 14 and discussion associated with it support this on average. Otherwise you have to propose a sink or removal mechanism for the particulate volume in that time period.

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This is correct, the description of the figure is not as exact as it could be. I think most variations in the diurnal cycle are caused by the mean boundary layer development: here, mixing processes may play the dominant role. If the mixing causes cleaning of the air as it happen for cluster 1 and 2, it might be followed by new particle formation.

It seems like the trajectory analysis by cluster is more useful and well defined that the analysis by sector. What additional information or insight does the sector analysis provide?

The manuscript reflects also the development of the whole analysis. However, we think that is worth to publish both. Maybe the arguments are not clear and strong enough in the present version, thus it was modified in the new manuscript. The point is that the sector analysis is the more obvious way which would be chosen by many scientists as a first try. And it shows that reasonable results are obtained, thus we can conclude the particle characteristics depend on the direction of backtrajectory. But it was a relatively subjective method, means we expected already a certain result before doing this analysis. Application of the second method is relatively objective, thus the method looks for similarities excluding any expectations of the user. From this we found that only the direction but also the length of the trajectory affects the particle characteristics. Thus, we try to demonstrate that such an objective method should be applied to get an unexpected result, which might be more obvious than the expected one, as in our case. The following paragraph was added to conclusions:

"Comparing the two methods can be concluded that the differences found by cluster analysis being the more objective methods are more significant than those by the simple air mass direction classification. Thus for such studies as many characteristics as possible should be included into analysis, not only the direction of backtrajectories. Overall results of both methods are in good agreement but this study should also illustrate potential differences obtained by the different methods. One major finding from the cluster analysis is that the pollution level in the Beijing region depends not only on the direction of arriving air mass but also on its transportation speed. This result could

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not be obtained from the first method alone."

Interactive comment on Atmos. Chem. Phys. Discuss., 8, 11321, 2008.

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