Atmos. Chem. Phys. Discuss., 8, S7909–S7912, 2008
www.atmos-chem-phys-discuss.net/8/S7909/2008/

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Characterization of the size-segregated water-soluble inorganic ions at eight Canadian rural sites" *by* L. Zhang et al.

L. Zhang et al.

Received and published: 3 October 2008

We appreciate this reviewer’s very detailed comments, which have improved the revised paper. We have addressed all of the comments carefully and our answers to this reviewer’s general and specific comments are listed below. The paper has been revised by incorporating all three reviewers’ suggestions.

Answers to the general comments:

The data presented here can be of great use in many applications. A few examples of potential applications are briefly described below.

Within air-quality and climate models where size-resolved aerosols are a concern, the sectional or moment approach is commonly used to describe aerosol size distributions (e.g., Canadian AURAMS, US CMAQ). These models require size-distribution data as

Full Screen / Esc
Printer-friendly Version
Interactive Discussion
Discussion Paper

input. For the sectional approach, results shown in the original Figures 4 and 5 can be used directly; for the moment approach, a sum of two or three lognormal distributions is commonly used (e.g., Ackermann et al., 1998, A.E. 32, 2981-2999). Thus, in the present study fine and coarse particles are separately fitted into lognormal distributions for potential future applications. The two parameters describing the lognormal distribution, mass median diameter and the associated geometric standard deviation, were generated and presented in Table 5. Many air quality models consider particle species such as sulphate, nitrate, ammonium, black carbon, organic carbon, and soil dust. The data presented in this paper can not only be used as input for the model, but also be used to evaluate the model results.

The current monitoring networks in North America (Canadian CAPMoN and US CASNeT) only monitor bulk nitrate concentrations for estimating nitrogen deposition. It is known that the dry deposition velocities of coarse nitrates are around ~5 times higher than fine nitrates. The present study showed that coarse nitrates dominate their total mass in warm/hot seasons. Thus, treating all monitored nitrates as fine nitrates (as has been done in CASNeT) will underestimate nitrate dry deposition substantially (e.g., Zhang et al., 2005, A.E. 39, 7030-7043; Lee et al., 2008, A.E. 42, 2720-2732). With the data shown in this study, nitrate dry deposition fluxes (as well as for other ion species) can be improved substantially by using a size-resolved particle dry deposition model (e.g., Zhang et al., 2001, A.E. 35, 549-560).

The primary goal of the present study is to provide a comprehensive climatology of background aerosols (the eight ion species) so that the results can be used for the above-mentioned applications. What are needed to fulfill this goal are typical size distributions at different locations and during different seasons. Size distributions for a particular episodic air mass were not investigated, although the percentages of air masses from different trajectory clusters were investigated in this study to better understand the observed similarities and differences at different locations and/or during different seasons.

ACPD

8, S7909–S7912, 2008

Answers to the specific comments:

(1.) As mentioned above, the primary goal of the present study is to provide a comprehensive climatology of background aerosols. We agree that the short period of several weeks during each campaign might not represent the entire season, especially for the bulk concentration of each ion due to their strong dependence on air-mass origin. That is why we have based it on five years of data to generate the mean trajectory clusters (Figure 2) and the median and mean concentrations of all the ions associated with each cluster (Table 3). The discussion of the seasonal variations is mostly for the shape of the size distributions and the associated parameters (i.e., MMAD and GSD), which are mostly affected by thermodynamics (temperature differences) and sometimes, relative humidity. Considering that the average temperature and the average relative humidity do not change dramatically within the same season, data from the several week campaigns are thought, to a large extent, to be representative of the seasonal patterns.

There are many potential applications of the data provided in this study as mentioned above. A brief discussion has been added in Section 3 of the revised paper.

(2.) In the revised paper, this sentence was deleted and the next sentence was rewritten. The production mechanism of nitrate was briefly discussed at the beginning of Section 3.2 instead of in the Introduction section so that the discussion in Section 3 can be followed easily (see answer to comment 5 below). Thus, in the Introduction section, we only give a very brief discussion of nitrate fine/coarse fractions with the important references listed.

(3.) There was no coating for the filters. We would expect the large particles to be susceptible to particle bounce more than the small particles; this will potentially impact the size distribution and the total PM loadings; however, by comparing the MOUDI loadings with the loadings from other collection techniques (i.e., filter packs, denuder systems) we found a good agreement, which suggests that particle bounce does not play a significant role.

ACPD

8, S7909–S7912, 2008

(4.) A second extraction of the Teflon filters showed very low levels for the compounds of interest; that proves that the efficiency of the first extraction is close to 100%.

(5.) As the reviewer pointed out, only two or three sentences were presented at the beginning of each section. We realize that this information is well known and might be more suitable in the Introduction section instead of in the Results section. However, for an easy follow up of the discussions on individual ion species, we gave this brief introduction at the beginning of each subsection. Deleting these materials will save little space, but would make the discussion more difficult. However, we have shortened the results section by taking into account the next comment, and rewritten a few of the sections for more interesting results (Section 3.5, Section 3.6, and Section 3.7). Also see the answer to the next comment and the answer to reviewer #4 for further details.

(6.) Based on this reviewer’s comment, we have removed Figure 3 and modified the related discussions.

The seasonal contrasts between the two campaigns made at ALG cannot be explained based only on temperature differences and trajectory differences, as was done for other locations. Therefore a detailed investigation is needed. Section 3.6 (original Figure 6) is included for this purpose and we have explained this point at the beginning of Section 3.6 in the revised paper.

We revised Section 3.7 by considering comments from all three reviewers. The original Figures 7 and 8 have been replaced by one Figure (Figure 6 in the revised paper) showing size-dependent particle acidity (based on cation/anion ratio as a function of particle size). The discussions in Section 3.7 have been changed to focus on the size-dependence of particle acidity, instead of focusing only on sulphate-ammonium-nitrate association as in the original paper.

Interactive comment on Atmos. Chem. Phys. Discuss., 8, 13801, 2008.

ACPD

8, S7909–S7912, 2008

Interactive Comment