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Concurrent measurements of size-segregated particulate sulfate, nitrate and ammonium using quartz fiber filters, glass fiber filters and cellulose membranes

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1 Concurrent measurements of size-segregated particulate  
2 sulfate, nitrate and ammonium using quartz fiber filters,  
3 glass fiber filters and cellulose membranes

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12 **Abstract:**

13 Current science and policy requirements have focused attention on the need to  
14 expand and improve particulate matter (PM) sampling methods. To explore how  
15 sampling filter type affects artifacts in PM composition measurements, size-resolved  
16 particulate  $\text{SO}_4^{2-}$ ,  $\text{NO}_3^-$  and  $\text{NH}_4^+$  (SNA) were measured on quartz fiber filters (QFF),  
17 glass fiber filters (GFF) and cellulose membranes (CM) concurrently in an urban area  
18 of Beijing on both clean and hazy days. The results showed that SNA concentrations  
19 in most of the size fractions exhibited the following patterns on different filters:  
20  $\text{CM} > \text{QFF} > \text{GFF}$  for  $\text{NH}_4^+$ ;  $\text{GFF} > \text{QFF} > \text{CM}$  for  $\text{SO}_4^{2-}$ ; and  $\text{GFF} > \text{CM} > \text{QFF}$  for  $\text{NO}_3^-$ .  
21 The different patterns in coarse particles were mainly affected by filter acidity, and  
22 that in fine particles were mainly affected by hygroscopicity of the filters (especially  
23 in size fraction of 0.65-2.1  $\mu\text{m}$ ). Filter acidity and hygroscopicity also shifted the  
24 peaks of the annual mean size distributions of SNA on QFF from 0.43-0.65  $\mu\text{m}$  on  
25 clean days to 0.65-1.1  $\mu\text{m}$  on hazy days. However, this size shift was not as distinct  
26 for samples measured with CM and GFF. In addition, relative humidity (RH) and  
27 pollution levels are important factors that can enhance particulate size mode shifts of  
28 SNA on clean and hazy days. Consequently, the annual mean size distributions of  
29 SNA had maxima at 0.65-1.1  $\mu\text{m}$  for QFF samples and 0.43-0.65  $\mu\text{m}$  for GFF and CM  
30 samples. Compared with  $\text{NH}_4^+$  and  $\text{SO}_4^{2-}$ ,  $\text{NO}_3^-$  is more sensitive to RH and pollution  
31 levels, accordingly, the annual mean size distribution of  $\text{NO}_3^-$  exhibited peak at

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