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Atmospheric Chemistry and Physics Discussions

Interactive comment on "The roles of sulfuric acid in new particle formation and growth in the mega-city of Beijing" *by* D. L. Yue et al.

Anonymous Referee #2

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Comments on the paper "The roles of sulfuric acid in new particle formation and growth in the mega-city of Beijing" by D. L. Yue, M. Hu, R. Y. Zhang, Z. B. Wang, J. Zheng, Z. J. Wu, A. Wiedensohler, L. Y. He, X. F. Huang, and T. Zhu.

First I apologize for my late response due to heavy work load. I have read the paper thoroughly and I give my comments below. During the review process I have not checked the references i.e. checked that all papers referred by the authors are mentioned in the reference list. Nor have I checked that the referenced papers actually say what the authors claim they say. The formulas are not checked in detail.

General:

In this paper the authors study New Particle Formation events (NPF) in Beijing during

the CAREBeijing-2008 campaign in summer 2008. In all 12 NPF events are studied, and particle formation rate and particle growth are investigated. Both observations and modeling are used to analyze particle formation and growth. The role of sulphuric acid is discussed.

This is a well written paper that deserves publication. It is interesting and reveals new aspects of particle formation and growth in the Beijing area. However I have some comments listed below that I think need to be addressed before publication.

Major comments:

1) A key question here is what kind of processes controls the NPF events. Is it sulphur (sulphuric acid), organic compounds or other processes not discussed here? In fig 2a FR is proportional to H2SO4. This indicates that sulphuric acid is the "trigger" for this process. Fig. 1 shows the concentration of H2SO4 and small particles, both show a maximum around 11a.m. And observations show that concentrations of sulphuric acid are higher during NPF events than during days of non-NPF. All of this supports the idea that sulphuric acid controls NPF. However, in fig. 4b, right panel ("sulphur-poor") there are very low concentrations of smaller particles. Most abundant particle size is around 10-20 nm (at noon). This "absence" of smaller particles should be investigated further. See also comment 5) below.

2) The CAREBeijing campaign took place from 12. July to 25. Septembre 2008. Beijing hosted the Summer Olympics from 8. to 24. August this year. To improve air quality in Beijing many restrictions were imposed on industry and on traffic in Beijing and surrounding areas. This implies that the chemical composition of the air in Beijing was different just before and during the Olympics, compared to "normal" conditions. 4 out the 12 NPF events occurred during the Olympics (Fig. 1). This means that 1/3 of the events occurred during these 16 days which covers 16/76 ($\sim$1/5) of the campaign period. This may indicate that the "cleaner" air played a role. This is not mentioned and should be discussed by the authors.

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3) The observations were sampled at Peking University, in the N-W part of Beijing. The paper states that “The NPF events usually occur in conjunction with high wind speed from the north, low relatively humidity (below 45%), and intense solar radiation” (section 3, p. 2718). During episodes with wind from the North I would expect a considerable amount of mineral dust. However mineral dust particles are usually large particles ($\sim\mu$m). Was there any mineral dust present during the NPF events? And if so, how may this mineral dust influence the results and findings in this paper?

4) 7 out of 12 events are characterized as “sulphur-rich” and 5 as “sulphur-poor”. In the sulphur-rich events there was 30% higher concentration of sulphate than organic compounds whereas for the sulphur-poor there was 20% lower concentration of sulphate compared to organic compounds. During NPF events the concentration of sulphuric acid was relatively high (5$\times$10ˆ6 cm-3) compared to non-NPF days (typical concentration 2$\times$10ˆ6 cm-3). In figure 3b it seems that there is hardly any difference in sulphuric acid concentration for sulphur-rich and sulphur-poor events. Hence sulphur concentration is almost identical, whereas the sulphur/organic ratio varies, due to changes in organic compounds. To me it would perhaps be more appropriate to call it “organic-poor” rather than “sulphur-rich” and vice versa. Is there any information available about the concentration and composition of organic compounds? The authors should discuss this.

5) From figures 1 and 4 it seems that high concentrations of the very small particles occur early during the day ($\sim$10a.m. for 12. August in fig. 1 and 8.a.m for 31. August in fig 4). The two lowest panels in fig. 4 show sulphuric acid and organic compounds for events, but only for 2 p.m. to 6.p.m. It would be interesting to see sulphuric acid and organic compounds early in the morning, i.e. when the concentrations of smaller particles are at a maximum, and NPF events start. This would tell us whether organic compounds play a role in the very start of NPF events.

Minor comments:

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1) Fig. 4: The scales for e and f as well as g and h are different. The left panels go up to 3, whereas the right ones go up to 6. This may be a bit confusing since the colours are the same.

2) In formula (1) FR (formation rate) = dN/dt (change in concentration of N) + Fcoag + Fgrowth. Here Fcoag and Fgrowth represent a loss. It would appear more clearly that these are loss terms if there were "minus" rather than "plus". As the formula (2) is written now, Ki (Brownian coagulation coefficient) must be negative since Fcoag is negative, and Ni is definitely positive. However, if “minus” is used to show a loss, Ki must be positive.

Interactive comment on Atmos. Chem. Phys. Discuss., 10, 2711, 2010.