## *Anonymous Referee #1*

We thank this reviewer for helpful comments and suggestions. Below we provide a point-by-point response to this referee's comment. The page numbers refer to the original version published in ACPD.

### ***Comment***

There seem to be 3 more paper by the same author in discussion related to size distribution measurements, it just occurred to me that would there have been possibility to combine some of these manuscripts.

### ***Response***

All of these four publications used the dataset derived from the urban site PKU. However, the aspects dealt within these papers are totally different. Two of them are mainly focus on the nucleation mechanism of newly formed particles in polluted urban environment through model simulation and field data analysis. Another one tries to evaluate actions taken to improve the air quality during the 2008 Olympic Games. For this one, we are aiming to characterize the regional NPF events in the North China Plain and assess the contributions of NPF event to the aerosol direct and indirect effects.

### ***Comment***

Introduction is missing some long term size distribution measurement in China, at least: N. Kivekäs, J. Sun, M. Zhan, V.-M. Kerminen, A. Hyvärinen, M. Komppula, Y. Viisanen, N. Hong, Y. Zhang, M. Kulmala, X.-C. Zhang, Deli-Geer, and H. Lihavainen, Long term particle size distribution measurements at MountWaliguan, a high-altitude site in inland China, Atmos. Chem. Phys., 9, 5461-5474, 2009

### ***Response***

We have included this publication in the revised manuscript.

***Comment***

Page 20540, line 17-20; ...which can be explained by the favoring meteorological conditions such as: : :, how come these favor new particle formation, is this case in all around the world or are there studies one could refer for these sites. This section should be clearly open.

***Response***

Previous study (Wu et al., 2008) pointed out that the meteorological conditions in spring of Beijing could be characterized as the low temperature and humidity, which is favor the new particle formation event. Meanwhile, a higher frequency of strong wind from the northern China was observed in spring, leading to the higher nucleation mode particles (Shen et al., 2011;Wehner et al., 2008;Wu et al., 2008). Hence here we ascribed the higher particle formation rate to the favorable meteorological conditions. We have cited the related references in the revised manuscript.

***Comment***

Section 3.2; It would be nice to have more deeply analysis on what is causing the event to occur one place and not in the other.

***Response***

In this study, only five cases with NPF event at SDZ and non-event at PKU were observed. This might be caused by the concentration of pre-existing particles (CS). For these five cases, the mean value (8:00-11:00) was 0.025 $s^{-1}$ at SDZ, which was lower than that at PKU (0.047 $s^{-1}$). In addition, for several cases with the NPF event shown at PKU, we still observed the significant growth pattern at SDZ. However, the newly formed particles (down to 10 nm) were not observed. This might be influenced by the regional transportation. We have included these in the revised manuscript.

***Comment***

Influences to light scattering; how representative this is since coarse mode is missing in the analysis. Authors use density of 1.7 g/cmˆ-3, how did they come up with this

number? Which is dominating the light scattering, the effect of the growth of pre-exiting particles or the particles from new particle events that grow to optically active size?

***Response***

We appreciate the referee raise the coarse mode problem. This study mainly focus on the new particle formation and its influence. Hence we did not included APS data in the analysis. We have mentioned it in the revised manuscript.

"It should be stated here that the simulated particle light scattering coefficient might be underestimated due to that the coarse particles (> 1 μm) were not included in the calculations, which could contribute around 10% to the total scattering coefficient (Cheng et al., 2008)."

For the particle density, we have checked the particle density. Finally, we chose 1.6 $g/cm^3$, which was derived from a previous study in Beijing (Hu et al., 2012).

For the influence to the optical properties, we have calculated the particle light scattering distributions. The results showed that the particle scattering coefficients were mainly contributed by the accumulation mode particles. However, the distinct increasing of scattering coefficient due to the particle nucleation was also observed. We have stated these in the revised manuscript:

"In order to demonstrate the influence of the nucleation events, we also calculated the size segregated light scattering distributions at both sites (Figure 5c & 5d). In theory, the light scattering of a 100 nm particle at wavelength of 550 nm is about 2-order and 3-order of magnitude smaller than those for a particle with diameter of 200 nm and 400-500 nm, respectively. This means in general the light scattering is dominated by relatively large accumulation mode particles (> 100 nm), which was also the case at PKU and SDZ in the beginning of nucleation event (e.g., contribution to the light scattering by particles smaller than 100 nm was always smaller than 1%). Note that it is hard to rule out the contribution of decreasing boundary layer height in the late afternoon and evening, which also leads to the increase in particle mass concentration

and therefore light scattering. However, in Figure 5a & 6b, one could clearly see the continuous growth in particle diameters at both sites from nucleation mode (~ 10 nm) in the late morning (10:00, local time) through the Aitken and accumulation modes before the clearly dropping down of boundary layer height (e.g., 16:00, LT). Because of that, the scattering coefficient due to the particle nucleation and subsequent condensable growth kept increasing (Figs. 5c&5d). Although the contribution to total particle light scattering by ultrafine particles (Dp < 100 nm) is still negligible (< 1%) and for particles larger than 100 nm their condensational growth become very slow in terms of diameter changes (Cheng et al., 2012), these large number of grown particles might through the subsequent coagulation process to grow into larger size range (Seinfeld and Pandis, 2006), where they could contribute more efficiently to the particle light scattering as well as mass concentration. For example, at 16:00 LT, significantly increase in scattering size distribution within nearly the full size range from about 40-900 nm can be observed at both sites, especially at SDZ."

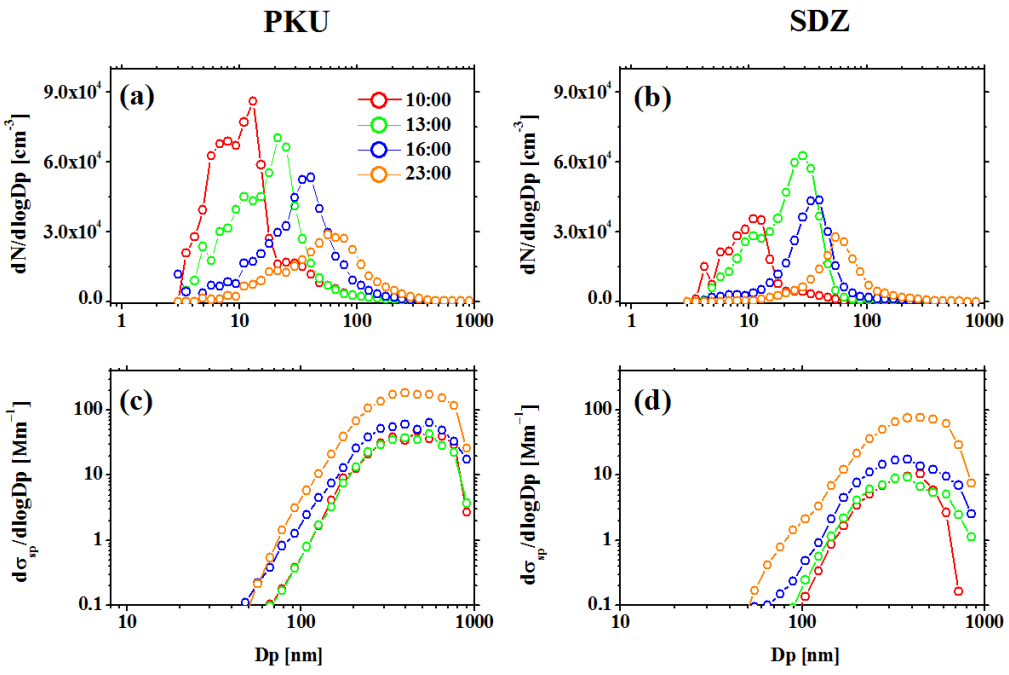


**Figure 5.** Evolutions of (**a&b**) the particle number size distributions measured by TDMPS and (**c&d**) the simulated particle light scattering size distributions at 550 nm from about 10:00 (local time) to midnight (23:00) on September 26, 2008. Left and right panels represent the PKU and SDZ sites, respectively.

## ***Comment***

The share of anthropogenic emissions to "potential" CCN, it is mentioned that this is more than 50 %. Is this based on difference on the results from two sites, how much the regional background site is influenced by short or long range anthropogenic emissions?

## ***Response***

Yes, this value is obtained based on the results from two sites. We have rewritten the basic assumption. In addition, we can't quantify the influence of short or long range anthropogenic emissions. We have pointed this in the revised version:

"It also should be clarified that we might produce several potential misunderstanding on estimating the contributions of NPF to CCN number concentration. The CCN in the ambient atmosphere could be formed in the following three ways: 1) primary particles able to act as CCN directly; 2) CCN resulting from NPF and subsequent growth; 3) primary particles that cannot originally act as CCN but become CCN after aging (growth and addition of hygroscopic material). However, it is extremely difficult to distinguish the contributions of diverse sources to the CCN enhancements, particularly which we assumed that all due to NPF, in fact, might also be contributed by the primary emission or the following aging process, especially at the polluted urban environment with the intensive primary emissions by anthropogenic activity. Nevertheless, these effects could be neglected at a regional background site such as SDZ. Hence, in this section, we only pay attention to the regional NPF events observed concurrently at both sites (total 34 events in Class I type). The potential contributions of regional NPF event to production of CCN are firstly calculated for the regional and urban sites, and the gap is roughly estimated as mainly contributed by the anthropogenic emissions at polluted urban environment. In addition, the regional transportation between these two sites was not evaluated in quantity in this study, which might also cause uncertainties. "

## ***Comment***

Were there any supporting measurements at the sites, like SO2, that could have been used in the analysis?

## ***Response***

We do not have the supporting measurements both at two sites. The datasets come from two different Affiliations.

## ***Reference***


Cheng, Y. F., Wiedensohler, A., Eichler, H., Su, H., Gnauk, T., Brüggemann, E., Herrmann, H., Heintzenberg, J., Slanina, J., Tuch, T., Hu, M., and Zhang, Y. H.: Aerosol optical properties and related chemical apportionment at Xinken in Pearl River Delta of China, Atmos. Environ., 42, 6351-6372, http://dx.doi.org/10.1016/j.atmosenv.2008.02.034, 2008.

Cheng, Y. F., Su, H., Rose, D., Gunthe, S. S., Berghof, M., Wehner, B., Achtert, P., Nowak, A., Takegawa, N., Kondo, Y., Shiraiwa, M., Gong, Y. G., Shao, M., Hu, M., Zhu, T., Zhang, Y. H., Carmichael, G. R., Wiedensohler, A., Andreae, M. O., and Pöschl, U.: Size-resolved measurement of the mixing state of soot in the megacity Beijing, China: diurnal cycle, aging and parameterization, Atmos Chem Phys, 12, 4477-4491, 10.5194/acp-12-4477-2012, 2012.

Hu, M., Peng, J., Sun, K., Yue, D., Guo, S., Wiedensohler, A., and Wu, Z.: Estimation of Size-Resolved Ambient Particle Density Based on the Measurement of Aerosol Number, Mass, and Chemical Size Distributions in the Winter in Beijing, Environ Sci Technol, 46, 9941-9947, 10.1021/es204073t, 2012.

Seinfeld, J. H., and Pandis, S. N.: Atmospheric Chemistry and Physics. From Air Pollution to Climate Change, Wiley, New York, 2006.

Shen, X. J., Sun, J. Y., Zhang, Y. M., Wehner, B., Nowak, A., Tuch, T., Zhang, X. C., Wang, T. T., Zhou, H. G., Zhang, X. L., Dong, F., Birmili, W., and Wiedensohler, A.: First long-term study of particle number size distributions and new particle formation events of regional aerosol in the North China Plain, Atmos Chem Phys, 11, 1565-1580, 10.5194/acp-11-1565-2011, 2011.

Wehner, B., Birmili, W., Ditas, F., Wu, Z., Hu, M., Liu, X., Mao, J., Sugimoto, N., and Wiedensohler, A.: Relationships between submicrometer particulate air pollution and air mass history in Beijing, China, 2004–2006, Atmos Chem Phys, 8, 6155-6168, 10.5194/acp-8-6155-2008, 2008.

Wu, Z. J., Hu, M., Lin, P., Liu, S., Wehner, B., and Wiedensohler, A.: Particle number size distribution in the urban atmosphere of Beijing, China, Atmos. Environ., 42, 7967-7980, DOI 10.1016/j.atmosenv.2008.06.022, 2008.