

Interactive comment on “Strong atmospheric new particle formation in winter, urban Shanghai, China” by S. Xiao et al.

Anonymous Referee #1

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This paper reports on field measurements of new particle formation in the urban atmosphere of Shanghai. The concentrations of clusters and nanoparticles along with concentrations of potential nucleation precursors obtained during the field campaign are used to derive the nucleation and growth rates. Conclusions are made regarding the different factors that govern the nucleation and growth mechanisms. This study provides substantial data that will help to understand mechanistic details and identify the sources of secondary aerosols in China, where aerosol pollution is severe but its causes are not understood. A major deficiency of this paper is that presented data do not always substantiate the conclusions and interpretations; also, some crucial statistical information is missing. These deficiencies need to be addressed before the manuscript can be considered for publication.

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Major points:

As presented, the paper lacks clear focus. It will be beneficial to list scientific questions that were to be addressed by the field campaign.

Based on the slope (L359-367), authors conclude that the nucleation of new particles can be explained by the activation theory. However, no standard deviation of the slope is given anywhere in the article. In fact, Figure 4 shows very poor correlation between the nucleation rate and sulfuric acid concentration, so the reported value of 0.64 could be significantly higher or lower. This needs to be addressed. Similarly, the standard deviation must be provided for the slope obtained from Figure 5 for ammonia.

What is the uncertainty in the calculation of proxy sulfuric acid concentration? Is day-time average sulfuric acid proxy a good metric for producing Figure 4? Maybe better use the peak concentration?

Figure 8 shows no clear correlation between GR and PM_{2.5}. What are the corresponding correlation coefficient and standard deviation for the slopes? Would aerosol surface provide a better correlation? If not, in my opinion, this fragment and Figure 8 should be removed.

The abstract gives an excessively detailed description of some of the obtained results, e.g., growth rates binned for many size ranges are given with standard deviations. On the other hand, no standard deviation is provided for the power exponent of the sulfuric acid, although the latter is used to make an important conclusion regarding the nucleation mechanism.

I suggest adding a scatter plot showing the concentration of 1.34-10 nm nanoparticles as a function of the aerosol surface area obtained from SMPS measurements (L4339-452). The scatter plot may show a better dependence. Also, the surface area may be a better parameter than PM_{2.5}.

Minor comments and corrections:

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L68: add comma after 'air pollution' L93,99: replace 'have been' with 'are' L119: A flow rate of 153 CFM corresponds to more than 4 m³/min. This does not appear to be a 'low-volume blower' L127: replace 'silica' with 'silicon' L136: replace 'grow' with 'grows' L170: 'aerosol cutter' is not a good term L176: must be 'Data Processing' L182: perhaps a better term can be used instead of 'growth losses'. Unlike coagulation, growth does not reduce the particle number concentration. L229: rho_d is not defined. Also, is it not necessary to account for the uptake of water by sulfuric acid, e.g., by assuming that sulfuric acid is instantaneously equilibrated with gas-phase water? L238-242: 'In this study...event' – this sentence is very heavy. Consider rewriting. L273-276: Elaborate explicitly on why similar size distributions 'suggest' that photochemical products contribute to the formation of smallest particles. It is not clear as written. Section 3.2 and Table 1: It would be beneficial to add and discuss the data obtained in other sulfur-rich locations, e.g., Atlanta L331-336: This sentence is very heavy. Consider adding a small table and revising the sentence. L336: Replace 'size-depend' with 'size-dependent' L336: Elaborate explicitly why size-dependent growth owes to nano-Kohler activation. What about size-dependence of the accommodation coefficient of sulfuric acid on clusters/nanoparticles? Isn't it supposed to decrease for with decreasing size? L344: 'was intense' – consider rewording L346: replace 'will grow' with 'would grow' L360,362: replace 'have been' with 'were' L362: replace 'the data points on both figures are' with 'the number of data points on both figures is' L363-364: why proxy for ammonia? Was it not measured directly? L391: elaborate explicitly on the 'co-occurring sulfuric acid concentration'

Interactive comment on Atmos. Chem. Phys. Discuss., 14, 26655, 2014.

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