

## ***Interactive comment on “Atmospheric new particle formation in China” by Biwu Chu et al.***

### **Anonymous Referee #1**

Received and published: 25 September 2018

This manuscript summarizes the atmospheric new particle formation (NPF) studies in China currently available in the literature, which represents a major effort in advancing our understanding on NPF in China. A number of NPF parameters, including frequency, formation rate, and growth rate, have been compared across the country. In addition, NPF under a heavily polluted atmosphere is discussed. From this perspective, this manuscript should be published in Atmos. Chem. Phys. On the other hand, this reviewer believes that the authors should be more critical and try to rationalize NPF features in China according to the latest research findings. Below are the detailed comments.

1. The authors provide an excellent summarization of NPF papers in the literature, but it is not a critical review. The senior authors are the leading figures in current NPF research, and I believe, they are perfectly aware of the drawbacks of some of the research that have been conducted, as they have acknowledged in the manuscript. For

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example, NPF measurements with a 10 nm detection limit may overestimate the NPF frequency, because the growth of the automobile emission of sub-10 nm particles may look like a NPF event. I fully understand that it is premature to judge an ambient observation, but there are potentially two strategies for this issue. The authors can only include journal publications that are mostly related to the topic, but looks to me that this is not what the authors want to do according to the current format of the manuscript. On the other hand, the authors can at least state the latest findings/conclusions, caution the readers, and ask the readers to be selective and look into the references. Also, my impression after reading the current manuscript is that there are many, many possibilities in the observed events. Can the authors help to rule out some, which is the value of a critical review?

2. Key publications are missing. Included are, but not limited to, measurements of amines by Lin WANG's group at Fudan University, the ammonia network by Yuesi Wang's group at Institute of Atmospheric Physics, and HOMs' role in NPF by Aijun Ding's group at Nanjing University.

3. Figure 2 could be misleading. Some of the formation rates are the daily averages whereas some are maximum values during a day.

4. (Figure 3), there are so many data points are color-coded with gray, which, as stated by the authors, come without a size information. I would rather remove these gray points because they make the figure pretty busy and no clue. Well, the figure is still quite obscure even without the gray data points. On the other hand, what does "GR size" really stand for? The upper size, the lower size, or something else?

5. (Figure 4), GR could vary by a factor of 10 for different particle size ranges. I suspect that the current GR for the data points in Figure 4 are in fact values in a wide range of particle sizes. This would not make sense if one plots in this way.

Minor comments, 6. (Page 1, Line 9), is the goal of "exploring the nucleation and particle growth mechanisms" achieved? 7. (Page 1, Line 11), revise "cannot not be

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fully explain” 8. (Page 1, Line 17), rephrase the sentence 9. (Page 1, Line 20), in terms of number concentrations 10. (Page 1, Line 24), rephrase “gaseous vapors nucleation” 11. (Page 1, Line 29), HOMs instead of HOM 12. (Page 2, Line 25), revise “recentZu years” 13. (Page 2, Line 28), rephrase “which was later than that observed for SO<sub>2</sub>” 14. (Page 3, Line 12), revise “including in” 15. (Page 3, Line 17), The authors stated here that they summarized NPF studies in polluted regions in China. In fact, many included studies are from clean atmospheres, even compared to European countries 16. (Page 3, Line 26), provide evidence that Xi’an and Urumqi are more polluted. Is this only from one study or always true? In fact, a yearly average might be more convincing. 17. (Page 3, Line 29-), provide the detailed locations of the sites mentioned, since readers may not be familiar with these Chinese supersites. Also the same for Table 2. 18. (Session 3.1), In addition to the many factors that have been discussed in the manuscript, emission is a major player in determining the NPF frequency, which is not quite emphasized in the current manuscript. 19. (Session 3.2), discuss Kerminen-Kulmala equation under the umbrella of Kulmala et al. Faraday Discussions 2018. Deriving J<sub>1</sub> from particle formation rate at a larger size may not be feasible. 20. (Page 8, Line 19), rephrase “in the NPF Chinese megacities” 21. (Page 9, Line 15-19), rephrase the sentence 22. (Page 9, Line 32), Tao et al. (2016) looked at really large particles, the composition of which may not be directly related to NPF 23. (Figure 2), assign the references to each of the bars, either in the figure or a number in the figure and details in the figure caption

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Interactive comment on Atmos. Chem. Phys. Discuss., <https://doi.org/10.5194/acp-2018-612>, 2018.

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