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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Observations of Particles at their Formation Sizes in Beijing, China" *by* Rohan Jayaratne et al.

Anonymous Referee #1

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This paper contributes to the understanding of some of the factors that control new particle formation (NPF) events in more-polluted regions of the atmosphere. The paper is well written and falls within the scope of the journal. I find the comparisons between NPF and non-NPF days to be of particular interest, along with the detailed measurements of NPF events in the ~2-10 nm range by the NAIS, a range not well-captured by studies that rely on SMPS-type particle number concentration measurements alone. I recommend this paper to be published in ACP with minor revisions, as discussed below.

General comments:

Page 4, lines 81-83: This statement is confusing. Did the PNC exceed 105 cm-3 on all 45 days or just for the 25 days that NPF was observed? Please clarify.

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Page 8, calculation of the diffusion coefficient: It would be good to include a brief discussion of the assumption that the main condensing vapor is sulfuric acid. Particle composition measurements were not a part of this work, but the authors do cite Yue et al. (2010) as showing that some NPF events in Beijing had sulfuric acid accounting for much less than half of the total growth rate, with organics accounting for ∼55% of the growth. In the kinetic regime, the RMS speed of a molecule depends on 1/sqrt(MW), where MW = molecular weight = 98 g/mol for sulfuric acid = ∼200 g/mol for organics. This would mean that organics would be about ∼30% slower, and condensation in the kinetic regime is proportional to RMS speed. The continuum regime is trickier as it depends on the diffusion coefficient instead of RMS speed, but if we simplify to assume everything is in the kinetic regime, then the CS would scale as sqrt(MW of sulfuric acid) / sqrt (MW of orgs) ∼ sqrt(98) / sqrt(200). There are of course limited calculations and measurements of the diffusion coefficients of organic molecules as a function of temperature; however the authors could briefly comment on some of the literature values compared to their assumed value of D using sulfuric acid.

Page 9, condensation sink (CS) calculations: Why did the authors (1) choose to use 303 K in their diffusion coefficient (D) calculation (line 204) and (2) only use the SMPS PNC for the CS (line 203)? In regards to (1): temperature data wasn't reported in this paper but was taken as part of the meteorological data. The historical data reports Beijing's average temperature in January as being around ∼270 K. This difference in temperature doesn't lead to a particularly large change in D but certainly is worth addressing. In regards to (2): I would like to know why the authors chose to neglect the PNC data obtained from the NAIS for <14 nm size bins. A few calculations with "toy" size distributions show that, depending on the number concentration at these <14 nm bins, the CS can be non-trivially changed with the inclusion of these smaller bins. If the size distributions during NPF events in this paper such that the CS hardly changes with the inclusion of the smaller size bins, this should be stated. Page 13, lines 294-296: It is also worth mentioning that the pre-existing particles coming into the region from the winds from the south are also increasing the condensation sink, further reducing the

likelihood of NPF.

Figures/Tables:

Each figure (excepting Fig 4) could benefit from being more professionally presented. I'm not sure what programming language was used to create these figures but if it is e.g. python, using savefig('name.png',dpi=300) and savefig('name.pdf') would create much nicer looking figures. The text is somewhat blurry and could benefit from being saved at a higher dpi (for png) or as a pdf without the grey backgrounds.

Figures 2 and 7: The colorbars need labels of units. The numbers on the colorbars are quite blurry and need to be sharpened.

Technical comments:

Abstract, lines 29-31: The sentence would read better is if said 'Estimated characteristics...are very different than to when the measurements. . ..

Page 3, line 57: environments (needs an 's')

Page 11, line 247: no comma after 'that'.

Page 16, line 385: This sentence might read better if it said '...in the smallest particle size bin 2-3 nm for the times at which the rate of increase. . .'

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