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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Nucleation and growth of sub-3 nm particles in the polluted urban atmosphere of a megacity in China" *by* H. Yu et al.

Anonymous Referee #2

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This manuscripts analysis sub-3 nm particle formation in a polluted environment. The paper is definitely original and it appears scientifically sound. The text is well organized and relatively easy to read. While the paper is rather long, it contains plenty of material worth publishing and discussing. Therefore, I see no major need for shortening the text. I have a few, mostly minor, recommendations for revising the paper.

Scientific issues:

Section 1. The paper might benefit from adding a few fresh references on i) nucleation experiments that have aimed to get insight into atmospheric nucleation mechanism, and ii) modeling/field studies investigating the importance of atmospheric nucleation on CCN production.

Section 2.2. The authors define sub-3 nm particle formation events based on increases in particle number concentrations in this size range, and then divide these event into 4 classes (A1, A2, B1, B2). This is perfectly fine, as there no well-established terminology for such event when starting from sub-3 nm neutral particles. However, in order to avoid confusion among readers, it would be important to mention, or discuss shortly, the other nucleation event even classifications used commonly based on either DMPS/SMPS measurements, or ion measurement. Furthermore, I would encourage the authors to call their events as "sub-3nm particle events" throughout the manuscript, since the vast majority of literature reporting on "nucleation events" based their analysis on particles size distribution measurements not extending to below 3 nm.

Section 3.1. The authors mention one nocturnal sub-3 nm event in their observations. Such nocturnal events seem to be rather rare, but have reported in a few other investigations. The authors should mention that their finding is not unique, and also include a couple of references discussing earlier observations on this phenomenon.

Section 3.2, last full paragraph on page 18667: Please make clear for the reader that the organic vapor concentrations referred to in this context are not measured by any means, but estimated values based on theoretical understanding on sub-3 nm growth and therefore subject to uncertainties in i) the derived growth rate, ii) the theory by which the growth was related to the origanic vapor concentration, as well as iii) proxy-based sulphuric acid concentration which also contributes to this growth.

Section 4. I agree on the statement on calling for a robust proxy development for sulphuric acid in polluted enviroments. At the same time, however, the authors should bring up the need for developing means to estimate/measure ELVOC in such environments as well.

Technical issues:

I think that a 2-digit accuracy would be more appropriate for the reported quantities (J, GR, vapor concentration). 3 digits, and especially 4 digits, seem too accurate to me.

ACPD

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I am not sure if he authors use quite correctly the term "limiting factor" (section 3.1, lines 9-11 on page 18665) or “limiting” (section 3.4, lines 4-6 on page 18673). Any quantity may limit a process in two ways: it may be too small (in case it favors this process like radiation seem to favor nucleation) or it may be too large (in case it suppresses the process like condensation sink does for nucleation). Please check out this point in section 3.1. What it comes to section 3.4, the authors apparently mean that there was a lack of condensable organic vapors other than ELVOCs, and therefore particles >3 nm did not grow as effectively as in days when more such vapors were present. Please reword.

Page 18663, line 3: should be ". . .will also be shown in the next section."

Page 18664, line 21: should be ". . .will be discussed later. . ."

Page 18667, line 18: please define the table. Table 1?

Page 18668, line 14: should be "rapidly"

Page 18671, line 26: should be "summarizes"

Page 18672, line 27: ". . .than on Type B2 event days."

Interactive comment on Atmos. Chem. Phys. Discuss., 15, 18653, 2015.