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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Simultaneous measurements of new particle formation in 1-second time resolution at a street site and a rooftop site" *by* Yujiao Zhu et al.

Anonymous Referee #1

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This manuscript investigates new particle formation (NPF) observed simultaneously at two sites in a polluted urban environment. The analysis is based high-time resolution measurements, which increases the originality of the results. The background for this study (section 1) as well as the used methods (section 2) are very well written. Contrary to this, there are serious problems in how many of the results, have been interpreted. As a result, a large part of section 3 needs substantial revisions, and most of the sections 3.4-3.6 need to be entirely re-written. My detailed comments in this regard are given below.

Major comments:

The authors provide two very general statements based on their results: 1) reduced

NPF at street site compared to rooftop during spring, and 2) enhanced NPF at street site compared with rooftop in winter. These finding are supported by only 1-2 cases (days) of observations, which is way too little to make this kind of a general conclusion.

The used proxy for gaseous sulfuric acid (SA) concentration has two problems: 1) it has been developed and evaluated for moderately-polluted sites only, so its applicability in highly-polluted sites like this one may be questionable, 2) SO2 is measured at rooftop site only, so it is unclear how well this represents SO2 in the street site. Also, the ratio in the SO2 concentration between the street site and rooftop is likely to be different between spring and winter, and there is no means to estimate this difference. As a result, the authors need to be very careful when making any interpretations that rely on estimated SA concentrations.

Class II NPF events have very low particle growth rates above 10 nm. All theoretical arguments indicate that >10 nm particles grow faster than smaller particles, and practically all observations on size-resolved particle growth rates support this view. This lead to a serious question: what is the origin of these particles? More specifically, if there are little condensable vapours to growth >10 nm, there should be even less vapors to grow smaller particles. One possible explanation for this is that particle of Class II originate from very local NPF, in which high local vapor concentrations initial nucleation and make the formed particles to grow very rapidly to a few nm, even to 10-20 nm. This rapid growth is then stopped due to atmospheric dilution of emitted vapors. This kind of process has been reported to occur in some coastal areas (Mace Head), in car exhaust to ambient air, and also close to other localised combustion sources. If Case II event are caused by very localized sources, it is questionable to compare NPF between the street site and rooftop in such cases.

The authors use condensation sink (CS) in interpreting their results. This problematic. The particles are formed below 2 nm size (J<2), but the authors calculate the formation rate of 8 nm particles (J8). The value of J8 depends on 3 quantities. J<2, CS and the growth rate of particles below 8 nm. Since neither J<2 nor the sub-8 nm growth rate

are known, it is impossible to infer how CS might affect J8 in the observed cases.

The authors assumed that only biogenic organics could influence NPF and subsequent growth. Why? There certainly large anthropogenic emissions of organic vapours in this kind of environment, and the oxidation of such vapors is very likely to produce low-volatile compounds that could affect nanoparticle formation and growth.

Considering the points highlighted above, many of the interpretations made in sections 3.4-3.6 are not justified. The most problematic of these is section 3.6 which is highly speculative.

Minor comments

I would recommend using terms other than short-term and long-term NPF events. In atmospheric time series, long-term usually means something that last for years or at least for months.

line 208: should be written: . . .only lasted for few minutes

lines 254 and 270: did't detail is a strange expression. Please modify

line 320: what is meant by ..reaction should proceed to solid state

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