

Atmos. Chem. Phys. Discuss., referee comment RC2  
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## Comment on acp-2020-1301

Anonymous Referee #1

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Referee comment on "Impact of aerosol–radiation interaction on new particle formation"  
by Gang Zhao et al., Atmos. Chem. Phys. Discuss.,  
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New particle formation contributes to more than half of CCN and thereby is important for climate. This work conducts the vertical measurements of particle number size distribution based on a moving cabin of 350 m tower. This kind of experiment is interesting and can improve the understanding of the vertical distributions of new particle formation (NPF) in urban environment. However, I believe that the evidences on the occurrence of nucleation at 240 m or upper boundary layer in this manuscript is not enough. A major revision is needed before considering publication in ACP.

Comments:

Line 44-50: It is not suitable to put equations of sulfuric acid proxy and CS and the explanation of these two equations in the Introduction. I suggest moving those to Section 2.

Line 79-89: The time resolutions of instruments need to be presented. How do they compare with the lifting speed of the cabin?

Line 119-121: I suggest the author gives the description of the changes of TUV model in SI.

Line 144-145: What are the differences in PNSD when cabin moving upward and downward? Because the time is close when cabin moving upward and downward, I would suppose the PNSDs are similar. If so, I suggest the author merges the upward and downward PNSD. If not, please explain the reasons.

Section 3.2: In this section, the authors discussed the stronger nucleation in the upper boundary layer. However, some more evidences are needed for this conclusion.

- The maximum altitude of this vertical measurement is 240 m. The boundary layer height is around 1500 m in winter. Therefore, I don't think this measurement can represent the situations of upper boundary layer even in winter. I suggest the author uses 'above the urban canopy' instead of the 'upper boundary layer'.
- I suggest the author give the legend of each profile in Fig.3.
- Are there any ground-based measurements on this day? From the ground-based measurements, is it a new particle formation event day?
- The ratio of nucleation mode particles number concentrations to Aitken mode particles number concentrations increased at 16:15. Does the author mean the nucleation occur at late afternoon? Most of NPF events start at noontime when the solar radiation is strong. Although the ratio increased at 16:15, the PNSD shown in Fig. 2 is not a typical PNSD of nucleation.
- Although the wind speed is low during the measurement, the wind direction changed at around 16:00. Is it possible that the change of the air masses caused the observed phenomenon? Are there intensive local anthropogenic emissions to the southwest of measurement site?

Line219-220: The author needs to give some evidences or cite some references here. SO<sub>2</sub> can be from the power plant and the NO<sub>x</sub> is most from the vehicle emissions. They may have different vertical distributions.

Figure 4: The concentration of NO<sub>x</sub> can be more than 200 ppbv. Is it a heavy pollution day?

Line 243-248: The vertical measurement in this study is from ground level to 240 m. However, in this section the author takes lots of words on the differences between the situations of ground level and the top of boundary layer. From Fig. 5, the [OH] didn't increase that much at 240 m compared to ground level.

Line 247-254: I don't think a schematic graph is needed here. Moreover, the schematic graph is not well presenting the author's view. The loop showing in Fig. 6 is a positive feedback loop, but I think it is not the case in this study.

Section 3.4: In this section, the author discussed the vertical profiles of photolysis rates for 4 types of aerosol profiles. But most of discussions are about the comparisons between the top of boundary layer and ground, which is not related to the measurement of this study. The author also needs to consider the vertical distribution of SO<sub>2</sub>, CS, VOCs when discussing the reasons of the NPF occurring at high altitude.