Atmos. Chem. Phys. Discuss.,
https://doi.org/10.5194/acp-2020-923-RC3, 2020

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Aerosol particle formation in the upper residual layer" *by* Janne Lampilahti et al.

Anonymous Referee #3

Received and published: 22 November 2020

This paper describes the influence of dynamics and especially the presence of freshly emitted particles in the residual layer on new particle events observed at the surface. As reported by referee 1, the manuscript is well written and straight forward. However and as reported by referee 1, many references are missed and the quality of the paper could be improved by adding more substance to it.

Major comments

- Roughly isokinetic sampling : Could you please be more precise. The inlet is either isokinetic with a control of the flow within the inlet or not isokinetic. It seems that you are controlling it with a valve and with a constant speed of the Cessna. Therefore most of the time the sampling should be isokinetic. However, roughly is too vague. What are the deviation from the isokinetic conditions ? This condition has a large impact on

Printer-friendly version

Discussion paper

the measurement quality and therefore on their validity. Please correct and add more information about that.

- Figure 3 analysis : “The layer had increased number concentrations of sub-20nm and sub-3nm particles.“ in comparison o what ? The descent profile ? I think you should clearly name the reference you are comparing these results to. Moreover, you should definitely show the profiles from the early morning flight on Figure 3. That would raise no doubts that the aerosol layer was not present before the sun rise and that could give the reader a clear reference. “at this point there were no signs of the particle layer” This is misleading. The layer didn’t disappear spread into lower layers, in this case the ML. Is there a threshold for the RL height ? I believe the highest is the better due to lower temperature and cleaner air. But is there any RL height range for those events ? Could you also add the ML height in this figure ?

- L 168-171 : The NPF starts at 12:36 but the vertical particle flux show minimum values at 10:30 et 13:00. If aerosols are coming from the residual layer (around 1700m), the process is not instantaneous right ? So the NPF should be related to the minimums of Vertical particle flux occurring at 10:30 and 11:30. Can you estimate the vertical speed of the aerosols ? Is the aerosol speed playing a role in the NPF occurrence ? I would think that yes due to the fact that slow motion aerosol would have grown to much larger sizes ? Could you run the analysis also for non event days ? Is there a vertical wind speed threshold that need to be exceeded ? Also for other NPF cases linked to RL NPF events, Can you tell us more about the vertical particle flux patterns observed before the occurrence of NPF ? Is it different for each case ?

- Figure 6 : I’m not sure what you plotted on this figure. The color code correspond to dN/dlogDp (cm-3). So is it a total concentration or is it from a specific bin ? It must be a specific bin and most probably within the fine diameter range due to the conclusions drowned. Could you please provide the percent of NPF event linked to aerosol formation in the upper layer ? Then you could used this result to justify the 75th percentile use.

Minor remarks

L52 : need to define ML

L147 : In the aircraft data : not well said

Figure 7 : Need to be more precise : - early morning of June 5th : 0 – 4h ? Is there a reason why you choose that time to determine the Residual layer ? could you provide some stat for each cases of the delay between the moment when the Inversion layer reach the Residual layer and the moment when the NPF occurs at the ground ? That could be great to have as well the RL height, and the estimated speed of the aerosol.

L220 : So you found 8 cases out of ? That would be nice to see a table showing the number of days of observations, the number of events at the ground, the number of event linked to roll vortices, the number of event linked to the RL, and the number of event that are not yet related to anything. And precise the type of events (classic banana or burst of particles at higher diameter than 3nm ? Again here you said these cases were not observed at the same time : Could you provide a table with their main characteristic : Start time, duration, GR, diameter at time start ?

L236 : please replace transported event by " transported event"

L237 : They occurred when the conditions inside the ML were less favourable for nucleation $\Rightarrow$ could you please explain what you have in mind ?

L 246- 252 : could you provide the number and the percentage ?

Reference that might be added to your manuscript : A lot of work have been done by the French group of the LaMP to study NPF events on the ground at an altitude site but also using aircraft measurements. You should cite some of them in your paper... Aircraft observations for links between altitude and NPF : Crumeyrolle et al 2010, Altitude site : Boulon, et al.: Investigation of nucleation events vertical extent: a long term study at two different altitude sites, Atmos. Chem. Phys., 11, 5625–5639, https://doi.org/10.5194/acp-11-5625-2011, 2011. C. Rose, et al. , Fre-

quent nucleation events at the high altitude station of Chacaltaya (5240 m a.s.l.), Bolivia,https://doi.org/10.1016/j.atmosenv.2014.11.015. H Venzac, et al - 2007 - Aerosol and ion number size distributions were measured at the top of the Puy de Dôme (1465 m above the sea level) for a three-month period. The goals were to investigate the vertical extent of nucleation in the atmosphere and the effect of clouds on nucleation. J. Boulon, et al. New particle formation and ultra- fine charged aerosol climatology at a high altitude site in the Alps (Jungfraujoch, 3580 m a.s.l., Switzer- land). Atmospheric Chemistry and Physics, European Geosciences Union, 2010, 10 (19), pp.9333-9349.

Also maybe look at that one : https://www.mdpi.com/2072-4292/12/4/648. It does also look at the impact of the dynamics on the nucleation events with a clear focus on the dynamics. You can actually see that the perturbation induced by flows at different altitude might also enhanced the possibility to observed NPF events. The turbulent fluxes occurring at each layer top is inducing favourable conditions to generate NPF events.

Interactive comment on Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2020-923, 2020.

Printer-friendly version

Discussion paper