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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Production, growth and properties of ultrafine atmospheric aerosol particles in an urban environment" *by* I. Salma et al.

Anonymous Referee #2

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The paper by I. Salma et al. is analyzing a one year data set of aerosol particle size distributions acquired in an urban site of Budapest. A full year of data allows for a seasonal analysis, which is valuable information for data of this type. The authors provide a statistical analysis of median concentrations, over the size ranges 6-100 nm and 6-1000 nm, a statistical analysis of the occurrence of new particle formation (NPF) events, and compute the formation rate and growth rate of particles produced during these events.

The introduction is well written and well referenced. The first part of the paper dealing with average atmospheric concentrations is interesting. But then, it is frustrating that,

out of this one-year data set, only 4 contour plots are given as examples. The advantage of the yearly observation period is to have a statistically robust analysis of the size distribution daily variation and seasonal variation. I suggest that such an analysis is provided to the reader before the manuscript is considered for publication in ACP. My second concern is about the interpretations and conclusions, which are often speculative without ancillary data, and sometimes erroneous. At last, throughout the paper the authors report nucleation events, while the measurements start at 6 nm. Even though 6 nm is lower than 10 nm (found in most studies), the first particles detected are still too large to give information of the nucleation process, but rather give information on the new particle formation process (including nucleation and first steps of growth). I suggest a rewording from "nucleation" to "NPF".

Detailed comments:

Abstract: Line 17: I do not fully agree with the interpretation stating that "aged aerosol" is present under the conditions that favour nucleation and growth. Also, under the conditions that favour nucleation and growth, more condensable species might be present, that might grow pre-existing particles to larger sizes that usual.

Introduction: Page 13691, Line 25: as already mentioned, one can not study nucleation if the lower size cut of the instrument is too large. The authors explain very well later on (page 13693, last paragraph) that they can not derive J1.5, and that they have to calculate formation rate rather than nucleation rates. They should be consistent with this statement also for their observations of the events.

2. Experimental: 2.1. Measurements: page 13695, line 10: the prevailing wind direction might not be the same than the orientation of the natural topography by coincidence... 2.2. Data treatment: Page 13697, line 3:Were the distributions fitted by log-normal functions on a single size distribution basis (systematically), or on a monthly basis? Even if the reference for the Dofit algorithm is given, it would be usefull to have the size limits of the diameter ranges defined for the nucleation, Aitken and

accumulation modes, as this might artificially drive the resulting NMMDs of each class and be the reason why the NMMDs found in this study are lower than others found in the literature. For example, in some studies, a 26 nm mode would be classified as a nucleation mode rather than an Aitken mode.

3. Results 3.1. Average atmospheric concentrations page 13700; line 17: The authors state that most criteria air pollutants in Budapest do not show any seasonal tendency. Can they list which criteria air pollutants and give references? Line 25: the data set is subdivided into NPF event days, and non event days, but then the ratio which is studied is dealing with N6-100, which obviously includes the nucleation mode, the Aitken mode and even part of the accumulation mode (from the NMMD that the authors give for the accumulation mode). It might be more relevant to analyze the ratio of nucleation mode to the total concentration for these subclasses? Are 82+-5% significantly different from 78%+-6? If yes is this due to the nucleation mode? To another mode?

3.2. Mean size distributions Particle size distributions are log-fit but little use of these fits is made: time series of the NMMDs and modal concentrations would be helpful.

Page 13701, line 10: is the sentence dealing with the accumulation mode modal concentrations, GSD, or GSD? Line 18: I don't really understand the meaning of this sentence. N6-100 is precisely defined as the ultrafine particle number concentrations. Line 23: Which ratio?Aitken to accumulation mode modal concentrations?

Page 13702: The discussions wold be more percutant if the reader knew how representative the two 3D plots are of the general behaviour during new particle formation events. Line 5: as already mentioned, particles are not necessarily more aged during these events. Lines 9 to 11: This ratio should be compared to non event cases, in order to evaluate the increase of particle concentration solely due to new particle formation. Other wise this ratio could be due to other factors, such as traffic time evolution? Line 17: Can a nucleation mode be identified in the daily variation of aerosol size distributions averaged over the NPF events days? (this remark may belong to next

paragraph)

3.3. Time evolution of the size distributions page 13702, lines 25-27: I not not understand why the temperature of the exhaust gases should increase with time, and why this should decrease the number of exhaust particles. Are there any observations and references to support this?

Page 13703, line 9-10: The fact that new particles are not observed below 10 nm is not a proof that no nucleation occurred at all and that these particle are emitted primarily. Nucleation might have occurred at a larger distance from the sampling point, and then might have grown to 10 nm before they are being sampled. The example plot actually show a continuous growth, indicating that these particles have been produced not at the local scale (within the city perimeter) but at a larger scale. I would on the contrary exclude primary particles. This type of plot might indicate that nucleation occurs at the regional scale, but that it is inhibited at the city scale.

3.4. Nucleation event statistics Can you explain the contradiction between the statement made page 13704 line 21 (minimum of NPF frequency during summer), and the statement made 13705, line 7 (no clear seasonal variation except max april and september). Over the rest of the paragraph, the global causes for NPF frequencies to vary over the year are exposed in general, but there is no attempt to identify any in the frame of this study. Why should be addressed in a separated paper? 3.5. Formation and growth rates Page 13706, line 23: could the authors better explain why higher summer temperatures should imply higher growth rates in an urban environment? Page 13707, lines 6-13: I understand that the authors calculated the spatial extend of the NPF event by using the time over which the smallest particles detectable (here 6 nm) concentrations increase. If nucleation has occurred over 300 km, but only during 1 hour, then the authors would observe the 6 nm particles during one hour, and then a continuous growth of the nucleated particles over the time during which the air mass trajectory path is homogeneous. Hence, the events they observe happen on a larger scale than 33 km, and they are not representative of urban type nucleation

events (if the particles observed had been nucleated within the urban area

4. Conclusions Page 13708, line 1: How can this statement be done? The authors state page 13700 line 17 that N25-100 represent particles emitted directly, but then they do not study further their contribution to the total number concentration. Line 9: no data is presented to support this, no reference. The rest of the conclusion should be modified accordingly to the comments previously made on the rest of the paper.

Interactive comment on Atmos. Chem. Phys. Discuss., 10, 13689, 2010.