Atmos. Chem. Phys. Discuss., 8, S2390–S2393, 2008
www.atmos-chem-phys-discuss.net/8/S2390/2008/

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Mode resolved density of atmospheric aerosol particles" *by* J. Kannosto et al.

Anonymous Referee #2

Received and published: 6 May 2008

General Comments

Kannosto et al. present the temporal evolution of the particle density of ultrafine boreal forest aerosol during a two-week period including particle formation events. They apply a previously developed density fitting method using simultaneous measurements of the aerodynamic and mobility diameter to determine the effective particle density in three different modes. The new aspect of this study is an evaluation of particle density changes during particle growth events. For example, the density changes of nucleation mode particles may be used to derive the corresponding densities of condensing vapors, thus contributing to a better understanding of secondary particle formation. After a general introduction about ultrafine aerosol particles, the authors describe and evaluate the density fitting method as well as the measurement site and instruments. Then,

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the results obtained from a two-week data set are presented before several interesting details of two individual days are highlighted. The manuscript should be edited for language and typographical errors before publication in ACP, and the authors should consider and address the following specific comments:

Specific Comments:

p. 7268, Fig. 1: What is the "guide for the eye" based on? The two lowest values by Ristimäki et al. (2002) seem too low, but all other open circle values are similarly close to the bulk value as the new values (black dots).

p. 7268: Could you add a little more information about the "detection limit" of the method? What kind of simulations is the detection limit based on? You state that "the density results of nucleation mode particles [...] can be accurate if circumstances are favourable". Could you provide a table with the minimum number concentrations required, and the minimum total current required in the ELPI measurement so that a 20% contribution of the nucleation mode yields reliable density values?

p. 7269, lines 14/15: What criteria are used to detect the two types of errors, i.e. what is defined as improbably high/low density values?

p. 7269, lines19/20: Is the addition of a 5% noise component a realistic representation of the measurement errors you expect from the ELPI instrument?

p. 7270, second section: Are the measurement ranges of the SMPS, DMPS and ELPI instruments given as diameters or radii? Can you state the lengths of the inlet lines? In lines 15 and 17, I suggest to use "about" instead of "ab.".

p. 7271, line 5: You state that you recorded a particle formation episode on May 8. This is surprising given the low total number concentration and the temporal evolution of the size distribution in Fig. 2.

p. 7272, lines 1/2: I cannot see that the modes are more clearly distinguishable on the aerodynamic axis in Fig. 3b.

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p. 7273, lines 2-4: With regard to the accumulation mode particles, was the absolute number concentration or the relative mode contribution too low for a successful density analysis?

p. 7273, Fig. 4: You state that the Aitken mode density values reached their maximum on May 14. Looking at Fig. 4, the values seem even higher on May 15 and 18. In addition, maybe you could add the time series of wind direction and relative humidity to Fig. 4.

p. 7273, lines 19-27: Maybe you could rephrase this section. For example, I don't understand the context of "During the night of 15 and 16 May, nucleation mode was present, but a clear increase in particle size was not detected".

p. 7273/7274, Fig. 5: You briefly refer to Fig. 5a on p. 7274. Could you add a few more words explaining Fig. 5? For example, explain the concentration spikes in the evening and night of May 4.

p. 7274, Table 1: Are the presented values in Table 1 daily arithmetic means, or median values, or maximum values? The potential temperature values are surprising. What is the difference between the column pairs labeled UV-A, UV-B and net radiation? Are you confident that the presented NO mixing ratios of 13 ppt and 0.4 ppt can be resolved with the NO measurement technique used?

p. 7274, Fig. 6: Could you explain why the error bars of the accumulation mode density values are much larger than the error bars of the Aitken mode in Fig. 6c?

p. 7274, line 21: "when the density levelled at 1.0 g/cm3": Could this leveling-off be due to the fact that the GMD reaches the size limit of the mode?

p. 7275, lines 3-9: Based on your results and previous studies, could you expand a little on potentially relevant condensing species? In the conclusions, you refer to studies where the density of condensing species ranges from 0.5 to 1.9 g/cm3. Your density values seem to indicate that condensing vapors with densities on the lower end

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of this range are dominant in Hyytiälä. What species could be most important?

p. 7275, line 15: Compare my comment about p. 7273, Fig. 4.

A few technical corrections:

p. 7264, line 12: "This allows us the follow" should read "This allows us to follow".

p. 7268, line15: "cut of curve" should read "cut-off"

p. 7272, line 9: The reference should read Saarikoski et al. (2005).

p. 7274, line 14: The particle formation event took place at noon: Write 12 pm, or better 12:00 noon to avoid confusion.

p. 7274, line 25: Remove "dashed" before "arrows".

p. 7274, line 29: "GMD" instead of "GSD"

p. 7275, line 1: "GMD" instead of "GSD"

p. 7287, Fig. 6: In the figure caption, remove "dashed" before "arrows".

Interactive comment on Atmos. Chem. Phys. Discuss., 8, 7263, 2008.