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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Contribution of mixing in the ABL to new particle formation based on some observations" *by* J. Lauros et al.

Anonymous Referee #2

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Referee Report on the manuscript:

Contribution of mixing in the ABL to new particle formation based on some observations by J. Lauros, E.D. Nilsson, M. Dal Maso, and M. Kulmala

The authors present a combination of surface and atmospheric boundary layer measurements to assess the importance of individual variables for the formation of new particles. Their results support findings of previous studies concentrating on surface observations. The most relevant variables appear to be the condensational sink and time derivation of the potential temperature.

I suggest to publish the paper in ACP after addressing the issues given below.

General comments

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Discussion Paper

- The measurement period covers the months March to October. The time of sunrise varies significantly during this period of time. I wonder what the effect of different times of sunrise might be when comparing (t,z) pairs from different days. I expect the time of sunrise to have a significant impact on the temporal evolution of the boundary layer height. Please add a statement on this open issue.

- No sources are taken into account in your study. "event" days might be simply driven by high emissions of condensable organic compounds during these days. If so, this would reduce the impact of all other variables such as boundary layer dynamics on the occurrence of an event day. Would this alter your conclusions? If possible, please give an estimate of the effect of sources (p.7548, l.3-4) and the expected frequency of significant emissions. Why do you not consider a steady state between "source" (= emission rate of condensable vapors) and "sink" (= condensation rate of condensable vapor onto the surface of pre-existing aerosol particles) processes instead of the condensational sink only?

- Why do you use 30 minute averages? Why do you not utilize a higher temporal resolution given by your measurement intervals?

- I suggest to add a paragraph with discussion on the impact of sources and entrainment to section 4.1. Uncertainties introduced by the omission of these processes should be addressed with more detail and (if possible) should be more quantitative.

- Do you think your conclusions obtained from measurements at SMEAR II also apply to other measurement sites? Please add a comment on this.

Specific comments

- p.7538, l.17: Please give the name or type of the organic compound considered in your study.

- p.7540, l.22: Please give some more information on the mast such as measurement heights and instrumentation.

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- p.7541, l.7: You focused on the morning hours with an ABL in the range of 100-200 m (Fig.1b). The surface layer is about 10% of the height of the ABL (p.7540, l.23). How did you ensure that the mast measurements at 23.3 m used for the turbulent flux are always within the surface layer, in particular in the early morning (23.3 m might be above the surface layer)?

- p.7541, l.13: "was" —> "were"

- p.7541, l.15: Please give some basic information on the criteria to classify event and nonevent days, e.g. is there a minimum nucleation rate?

- p.7543, l.1: Please give some more details on the conversion of measured dry to wet particle size-distribution. Do you have information on the aerosol composition or do you make an additional assumption?

- p.7543, l.18: The equation for the particle number size-distribution does only include adiabatic expansion of the rising air parcel. Changes in relative humidity due to adiabatic temperature drop in the rising air parcel are not considered. In case of high relative humidity (>90%), the water uptake of an aerosol particle is usually highly nonlinear. This causes the size-distribution to be shifted towards larger particle diameters, i.e. N(log D_p) is altered. Please give a brief statement on why you can neglect the change in relative humidity.

- p.7546, l.3: "result" —> "results"

- p.7546, l.8: "implemented" —> "conducted"?

- p.7546, l.8: "observe" —> "assess"?

- p.7546, l.20-23: First, you state that the surface value of CS is not a good estimate of CS at elevated altitudes. But then you use a constant value for CS (Fig.5c). Why do you introduce this simplification? Please motivate why this simplification can be done in this case.

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- p.7549, l.2: Aerosol formation rate is usually specified as particles/cm3/s. What is meant by "...aerosol formation to about 1-2x10-3s-1."?

- p.7549, l.21-22: Could you give an estimate of the expected underestimation by e.g. assuming typical ABL heights?

- p.7550, l.23-24, "The variables ... were correlated (see Table 1) and this may have affected the results.": In which way did this affect the results? Please be more specific. Can you quantify this?

- p.7551, l.1: What is meant by "relatively large"? How does this compare to the size of your dataset?

- p.7551, l.14-15, "... mixing decreases ... RH as cleaner and drier air above the ABL is mixed to the boundary layer...": This does not comply with your assumption of constant specific humidity in the whole ABL which features an increase in relative humidity in an ascending air parcel once the parcel reaches the entrainment zone at the top of the ABL. Please expand your discussion on that issue.

- p.7551, l.27: "top of the atmosphere" —> "top of the boundary layer"?

- p.7557, Tab.1: The table is unclear to me. Which variable is correlated to what other variable? Please insert an additional row with the variable names to which the variables in the first column are correlated to. Additionally, it remains unclear to me which values correspond to the standard deviation (e.g. row 2 contains negative values only, but standard deviation is expected to be positive). What exactly is meant by the "standard deviation"? Please formulate more precisely.

- p.7557, Tab.2: Table 2 is also unclear to me. Which number in the table corresponds to which two variables that have been used in the logistic regression model? What numbers give the value for beta, what numbers for beta_0? I assume "beta_0 and beta" in the first row should read "beta"?! Please add a line to clearly show the variable pairs and clearly mark the numbers corresponding to beta and to beta_0.

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- p.7562, Fig.4b: Remove left parenthesis "(" and the end of the abscissa labeling.

- p.7563, Fig.5a: You show two dotted lines, which cannot be distinguished in the description of the figure caption. Please add e.g. the color of the lines to the description in the capation or use e.g. other symbols for the mean values of all days studied.

- p.7567, Fig.9: A "d" preceding "theta" (line 4) is missing.

Interactive comment on Atmos. Chem. Phys. Discuss., 7, 7535, 2007.