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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Direct determination of highly size-resolved turbulent particle fluxes withthe disjunct eddy covariance method and a 12 – stage electrical low pressureimpactor" *by* A. Schmidt and O. Klemm

Anonymous Referee #1

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The paper addresses an important issue of particle exchange between surface and the atmosphere. It also presents a new application of disjunct eddy covariance method for size resolved particle fluxes. The instrumentation presented seems reliable and is clearly described. The data presented shows the capability of the instrument for field measurements. The paper is well written and the subject is suitable for ACP. However, there are a few errors in the manuscript which should be straightened prior publishing in ACP.

MAJOR COMMENTS

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Interactive Discussion
Discussion Paper

In the Results and discussion part when comparing the EC and simulated DEC fluxes the authors seem to confuse the effects of analyzer response time, or sampling tome of the DE sampler, and sampling interval in the disjunct eddy sampling methods. This is obvious from the sentence "The deviations show a slight underestimation of the DEC fluxes probably due to the high frequent turbulence parts which can not be resolved using the applied measurement interval Δt" (Page 9010, lines 6-8). Also lines 8-9 on page 9009 are similarly misleading. The long interval between subsequent samples does not cause high frequency loss due to the aliasing of the frequencies higher than sampling frequency to the lower frequencies. On the other hand, the non-instantaneous response time, or the sampling time in the case of DES methods, causes higher frequencies to be lost from the fluxes. Thus in the case of the DEC system described in the paper the high frequency limit is defined by the sampling time of 0.4 s, not by sampling interval of 5 s. Thus the correct high frequency limit is 1.25 Hz.

The authors state on page 9012, lines 11-14, that the main diurnal cycle of the particle fluxes would be related to diurnal cycle of surface layer turbulence. Also, on page 9013, lines 4-5, they claim that the mean fluxes of smallest particle size classes are dependent on turbulent regime. However, comparing the particle fluxes on weekdays and to fluxes on Sundays (Figure 9a) one can clearly see that the driver of the diurnal cycle is not the diurnal cycle of turbulence, but that of emissions. This is also how it should be based on our theoretical knowledge on turbulent transport. Unless the turbulence is not for example stirring up material from surface, the flux should be independent on the strength of the turbulence, provided that turbulence exceeds some minimum value. This is the reason to filter the data using a suitable u* threshold value.

The authors do not provide any estimates of uncertainty for the flux values they present. The fluxes shown in Figure 4 d seem to be below detection limit of the system. The authors should clearly state if this is the case or not instead of a vague sentence "...the exchange of coarse particles appears to be more or less balanced within a diurnal cycle". There are also a few other parts in the paper, in which the uncertainty estimates

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would help interpretation of the data. The discussion on the Figure 9b, on page 9015 lines 7-9, should include estimation of the significance of these differences. Also the fluxes of the coarsest particles (Figures 9c) may not differ significantly from zero, which means that their fluxes are below detection limit of the system. Therefore the discussion on their differences between weekdays and Sundays (page 9015, lines 9-12 is not meaningful.

In the case that the flux values of the coarsest particles are not significantly different from zero, its value in the figure 10 shows not the significance of this size class to the total particle exchange, but instrumental background noise.

MINOR COMMENTS

Page 8999, lines 4-5: "Also the formation of clouds is driven by aerosols that function as condensation nuclei..." I would rather say that the driver for the formation of clouds is the flow dynamics of the atmosphere. This defines where the clouds form and where not. The aerosol particles of course are important in serving as CCN, but their scarcity rarely suppresses the clouds from forming when other conditions are met.

Page 8999, lines 26-28: "Considering... ...needed". This sentence seems somehow muddled.

Page 9000, line 3: "...EC method has to be replaced by other methods" The authors could mention some of these methods here. At least relaxed eddy accumulation has been applied to aerosol particle flux measurements (Gaman et al., 2004).

Page 9001, lines 14-17. "With respect... ...behind the measurement region of the 3D ultrasonic anemometer". Why was the inlet placed behind the anemometer? According to Kristenssen et al. (1997), the placement of inlet below the sonic anemometer causes a minimal loss of flux with no wind direction dependent lag time. How close was the inlet from the sonic, and was there any detectable lag-time due to this sensor displacement.

Page 9005, line 2: "...WPL-correction..." Is this correction needed? The inlet is likely to

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damp most of the temperature fluctuations before the air gets into the ELPI (see e.g. Rannik et al., 1997).

Page 9007, Equation (3): This equation is not immediately clear. Maybe a bit more explicit description could be included below it.

Page 9007, lines 13-15: "This was found by Bosveld and Beljaars (2001)". Similar results have also been obtained by Haugen (1974), Kaimal and Gaynor (1983), Lenschow et al. (1994), Rinne et al. (2000; 2008), and Hendriks et al. (2008), using simulations and field observations. The reference to Hendriks et al. is made again on page 9009, lines 10-12. Thus there seems to be some redundancy here.

Page 9010, lines 12-19: The Figure 4 should be referred already in this paragraph.

Page 9014, line 25: I would write "...biological net uptake of CO2 by the vegetation..."

Page 9015, line 2: "...small particles have no meaningful negative flux intervals..." Do the authors mean "small particles have no significant negative flux intervals..."

Page 9017, line 4: "The different size bins show different turbulent dynamics during daytime" I do not understand the meaning of this sentence.

Table 3: Uncertainties on the net fluxes would be useful. Also the formulation of the figures in the last column is confusing. I suspect the authors mean 10^{13} by the expression E+13. The formulation must be changed to a more conventional one.

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Interactive comment on Atmos. Chem. Phys. Discuss., 8, 8997, 2008.