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Biogeosciences Discussions

Interactive comment on "Aerosol fluxes and particle growth above managed grassland" *by* E. Nemitz et al.

Anonymous Referee #3

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This is an innovative and useful paper and should be accepted for publication with revisions.

The authors present measurements of particle eddy fluxes which are then combined with measurements of aerosol size distributions and gas phase data for nitrogen species to estimate particle growth rates near the surface. The paper contains a good discussion of the controlling factors and presents conservation equation. The discussion of particle growth and formation in terms of a sort of a particle current; through the size distribution is interesting.

The appropriateness of the Damkohler ratio for evaluating the importance of chemistry to observed turbulent fluxes is considered and the paper highlights the sensitivity of

such an analysis to the choice of relevant turbulent time scale (p.363-4). This reviewer feels that the authors are probably correct in their conclusion (on lines 7-10, p. 360) that condensation particle growth across the 11 nm cut-off size of the CPC caused the emission (upward) fluxes after fertilization and endorses the authors recommendations in section 4.5 regarding flux measurements and local budgets of N.

More detailed comments (below) address some assumptions and approximations that may affect the magnitude of the calculated particle growth rates.

Aerosol fluxes were recorded at 10 Hz for an instrument (TSI CPC 3760) with about a 1 L/min flow rate. How are these fluxes affected by the slow response of the instrument relative to the sampling rate ? What portion of the flux could be lost in this situation for sampling at 2 m above the tall grass ? Were the instruments still 2 m above the vegetation after it was cut ? Does this change in displacement height and surface roughness change the fluxes and, if so, how will this affect the use of pre-cutting deposition velocities to represent surface removal during and after fertilization? The authors briefly address this on p.363, lines 18-21, but offer no bounds on its importance.

Each sampling period was relatively short to fully characterize aerosol deposition velocities (about: 8 days over long grass, 7 days over short grass after it was cut, 11 days for short grass after fertilized); does each period have the same wind speeds, stability, and relative humidity gradients ? If not how could these differences affect the calculated production rates by changing the actual deposition from that estimated from the long grass period ? (page 352, eq. 10).

p.350, line 26: Why can you assume stationarity and homogeneous conditions for simplifying the budget equation here ? The method is dependent on neglecting three terms in the RHS of eq(3) but there is no analysis presented that this is appropriate here. Were there no time changes /storage or advection ? On p.354 (lines 16-19) it is stated that there were certain observed changes in regional air masses or regional chemistry in some of the observations. What is the sensitivity of the calculated production rates

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to these assumptions for eq. 3 ?

p.351, line 6 Could not flux divergence also be related to the flow field besides just chemical production?

p.351, line 21 The particle growth rate is calculated from theory and an assumed value of the sticking coefficient (p.352, line 6) which itself has a large degree of variation. How do the results depend on the assumed value of alpha = 0.5 ?

p.352-353 Does this method assume that the particle growth rate is not a function of diameter ? If the surface area of advected aerosol varies with diameter over time will that affect your calculated growth rates ?

p.358, line 23-25 The paper states that the effect of non-zero water vapour fluxes can also cause artifacts but ought to be the similar before and after fertilization; but there is no support offered for this supposition. Were the soil moisture and ambient humidity profiles the same during both periods ? (the paper states that significant precipitation was reported only for June 6-7, just after fertilization). Were water vapor fluxes the same before and after fertilization ?

p.361, line 2, line 10/ Fig. 10 The concept of a maximum deposition velocity permitted by turbulence is mentioned and calculated without explanation or reference. Please define this term and show how it was calculated from these data.

Interactive comment on Biogeosciences Discuss., 6, 341, 2009.