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Biogeosciences Discussions

Interactive comment on "Ammonia fluxes in relation to cutting and fertilization of an intensively managed grassland derived from an inter-comparison of gradient measurements" *by* C. Milford et al.

Anonymous Referee #2

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General comment

The paper is a well written and a straight forward description of an inter comparison of measurement of atmospheric ammonia concentrations and fluxes over grassland. The measurements are part of an experiment dealing with improvement of quantification and parameterisation of ammonia exchange over grassland. The measurements are done prior to and after cutting of grassland and after fertilizing the grassland. Ammonia concentrations and fluxes are measured by four independent systems. The results show periods of good agreement as well as significant differences between the

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systems, demonstrating the difficulties measuring ammonia concentrations and fluxes. The paper produces an estimate of the ammonia flux through out the period of investigation with a high coverage in time for that particular experiment. The reasons for deviations in concentrations and fluxes are briefly discuss, though a more throughout analysis would make the paper even more interesting in a general perspective. Further, comparison to other experiments as well as use for modelling work will require an analysis of data related to the influence of meteorological conditions and this would therefore be of great interest.

Specific comments

Corrections on advection etc.

It is hard to see through the correction for instationarity and homogeneity of the atmosphere. There is a correction for storage and local advection, though for the chemical reactions it is ignored. It is mentioned in section 3.6 that the storage and advection correction in general are low. The corrections are also presented as a % of the flux in figure 7. Even though the corrections are presented in figure 7, it makes the results rather difficult to see through. It would be of more general interest to see data, not corrected for storage, advection, gap filling, presented for the whole period (including the "bad" days) in order for the reader to understand, what all the corrections does to the data. Then, with all the calculations, the final "best estimate" could be presented.

I haven't read the references Loubet et al. (2008) and Hensen et al. (2008) on the local advection, though I found some information in Sutton et al. (2008b). Here the advection correction is described as a model calculation and with an estimated emission from the nearby sources. I don't know the model, though it sounds rather hard to calculate the dispersion, not knowing the actual emissions with a time resolution comparable to the average time of the fluxes and with a precision that can correct vertical ammonia gradients 600 m down wind (site 1)? And since the gradients are corrected (section 3.3), why aren't the concentration measurements in figure 1? The corrections during

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stable conditions at night time are even more complicated, since dispersion during these conditions is very difficult to calculate. It should be mentioned, whether the four systems are corrected individually and what consequence it has on the agreement or disagreement of concentrations and fluxes.

Considering the uncertainties in the advection calculations, are these corrections relevant considering the uncertainties in the aerodynamic gradient method and the measurements of ammonia concentrations?

It is mentioned that measurements at site 1 and 2 are used for advection considerations. Is this reasonable when the concentrations measurements sometimes deviate significant between the measuring systems?

Could there be an inhomogeneity in the emission from the field (up wind emissions suppressing the down wind emission area), leading to "true" differences between site 1 and 2?

I assume, that all these corrections are made to correct for the lack of constant flux layer. Why is the flux then calculated to the reference height z0?

Average time for fluxes

What are the considerations choosing an average time for the fluxes to 15 minutes and is that period sufficient long time during stable and unstable conditions?

Measuring systems

Only the deviations on concentration differences are given in Table 3. To my knowledge the calibration curve of the AMANDA isn't linear. Does this influence the deviations on gradients/differences?

What does a non-linear calibration curve have of consequences measuring "out of the calibration range" (p. 4718 line 27)?

What does the QC concentrations correspond to in atmospheric concentrations?

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Why aren't the absolute concentration determinations of the QCs in table 3 given since atmospheric concentration measurements are compared?

It is written, that the AMANDA measures 150 s in each of the three heights, having a full profile in 450 s (p. 4707 line 6-7). How is "carry over" in tubes/detector handled when shifting heights/sample? Is "carry over" - if any - equal at the whole concentration range?

Concentrations and fluxes

Some of the deviation in the fluxes is caused by deviations in concentration determinations by the four systems. Could X*/X (ratio of concentration scaling parameter and concentration) be compared in order to reveal, how much influence the deviations in concentration explain of the flux differences?

Regressions

Making regressions, the data need to follow a normal distribution and if not, one should transform them. It is mentioned that the data are log normal distributed (p. 4715 line 7) and therefore, they should be transformed.

It is a choice to compare FAL-D, CEH to FAL-CH (figure 3), though FAL-CH do also have a measure error. Therefore, a total least square (orthogonal regression) would be more correct in this analysis between systems. Choosing FAl-CH as the reference, the period before cutting is left out. This should be stressed out. Why isn't FRI compared to FAL-CH?

Meteorology

More information on meteorological conditions (a figure with i.e. temperature, wind speed/friction velocity, wind direction, precipitation) would be welcomed and more analysis of the concentrations and fluxes in relation to meteorological conditions would be very interesting, giving the data and paper a more general aspect, both with respect to other experiments and the parameterization of model calculations.

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More explanation

p. 4720 line 10-12 is written: "Substantial emission also occurred at night immediately after fertilizer application (5-6 June), demonstrating the importance of surface emission from the soil and litter surface". Could this be elaborated more? As I understood, the cut grass was removed before the field was fertilized?? Why would the soil emission increase after fertilization?

Comparison between measuring systems

As written in the paper, more attention should have been given to analytical differences of the detectors of the measuring systems as well as a parallel exposure of all systems, revealing problems with inlets conditions etc.

Technical corrections

Abstract line 17: ...analyzers were variable...

Abstract and conclusion: it should be stressed out, that the differences in % are defined as the relative standard errors.

Text of figure 6 and 7: NH4NO3 instead of NH4+NO3-

Interactive comment on Biogeosciences Discuss., 5, 4699, 2008.