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Biogeosciences Discussions

Interactive comment on "The annual ammonia budget of fertilised cut grassland – Part 1: Micrometeorological flux measurements and emissions after slurry application" *by* C. Spirig et al.

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Response to anonymous referee #1

We thank anonymous referee #1 for his/her constructive comments to our manuscript. We appreciated the detailed specific comments which helped us to eliminate some ambiguities of the discussion paper. Most of the comments were of technical character – we addressed them all with our revisions. For this public author response, we found it appropriate to focus on those comments where we wanted to reply in more detail.

Referee's comments to the abstract: l. 2. 'continuous' contrasts with 'semi-continuous' (l. 5) l. 6. measurements were carried out during 16 months which is not 1.5 years
Reply: The 'continuous' in l.2 describes a property of the instrument while the 'semi-continuous' in l.5 refers to the data coverage obtained in this work. We agree that this juxtaposition was unfortunate and therefore decided to remove the 'semi-continuous' in l.5, as the important information here is not whether the data coverage was continuous in the strictest sense but rather the fact that five complete growth-cut cycles were monitored. We also removed the "1.5 years" and gave the first and last month of measurements reported here instead. Together with the clear statement about the effective data coverage in section 3.1., the distinction between length of measurement period and operational performance is now clear.

Comment to l. 8./l.9: Unclear terms "background exchange" and "well established turbulence"
Reply: The distinction between background exchange and fertilizing events is explained in detail in the companion paper. Acknowledging that using the term 'background exchange' here is not self-explanatory, we replaced it, it now reads "Hence the flux measurements are considered sufficiently accurate for studying typical NH_3 exchange rates over growing vegetation". The expression "during conditions of well established turbulence" was replaced by "during unstable and near-neutral conditions". The corresponding text on the accuracy of the flux measurement system in the results section was also extended (see reply below).

Comment to l. 16-17. replace 'appear to be' by 'are'
Reply: We prefer the less definite statement, since we cannot conclude this with certainty from the observations presented here, but it is important to point out that there are plausible reasons for the low emissions observed.

Referee's comments to the MM section p. 9589, l. 3.: I doubt if the calculated gas-phase concentrations are correct. . ..
Reply: The given stripping flow rate on page 9588 l.22-23 was a rounded value,

since the important point in that context was the principal difference as compared to AMANDA. We replaced the rounded value of 0.1 ml/min with the exact 0.11 ml/min in the revised version. Doing the calculations with this value brings the concentrations to the numbers as given in the text.

Comment p. 9597: 22-24. I think this statement is incorrect. Though small, there is a systematic difference for which should be corrected. The AGM uses the difference between the two sampling blocks and these systematic differences could be important.
Reply: This statement was clarified. Neither does the slope significantly deviate from 1 nor is the intercept significantly different from zero. A correction is therefore not necessary.

Comments p. 9598: l. 7. what are 'background conditions'? l. 9. what is meant with well-established turbulence
Reply: The paragraph describing the precision of the flux measurement system was revised. The extensive presentation of the various error terms contributing to the overall uncertainty (including a revised Fig.6) underlines that no generic flux detection limit can be given. However, it is important for the results of the companion paper (focusing on ammonia exchange during periods not affected by fertilization events) to provide evidence that the precision is sufficient for detecting typical exchange rates during periods with ammonia concentrations close to background levels ($5\,\mu g\,m^{-3}$ or lower). The derivation of the given detection limit ($10\ ngm^{-2}s^{-1}$) has been clarified by explaining how the precision of the concentration measurements propagates into the flux uncertainty assuming typical strengths of turbulent mixing.

Comment to p. 9600, l. 19. How are the values for Γ slurry obtained from Table 1 and where are they shown in Fig 9? Explain.
Reply: The values were obtained by entering the pH and ammonium concentrations of slurry into equation 11. As suggested by referee#2, we also added information about the chosen acidity and Henry constants. The corresponding Γ values are shown in Fig. 9 at time t=0. For clarification, this information was added both to the text and to the

legend of Fig.9.

Comment to p. 9601, l. 5-10.: I wonder why this (validity check of the upper and lower limit nature of the two estimates) is done, as the method to correct Γ surface already seems to be the most realistic one.
Reply: We demonstrated that the initial data gaps caused a large uncertainty of the cumulative fluxes. It is therefore justified to give lower and upper limit estimates instead of a best guess to underline this limited accuracy. It is explained on p.9600 l.23f why the two presented variants represent lower and upper limit estimates. As suggested by referee#2 the revised version includes some quantitative information on the lower and upper limit estimate as compared to the "measured" cumulative losses for the two cases without saturation problem.

Interactive comment on Biogeosciences Discuss., 6, 9583, 2009.