

***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.

**Anonymous Referee #1**

Received and published: 30 November 2009

General comments:

This paper and the accompanying paper by Flechard et al. (2009) present the results from a long-term measurement campaign of ammonia fluxes over fertilised grassland. Although many papers have been published lately on this topic (GRAMINAE Integrated Experiment in Braunschweig), the high data coverage and the new measurement device are interestingly enough to be published in this journal. The paper is generally well-structured and clearly written. Most of the figures are clear as well. However, I have some questions, comments and suggestions.

Specific comments:

p. 9584:

- I. 2. 'continuous' contrasts with 'semi-continuous' (I. 5)
  - I. 6. measurements were carried out during 16 months which is not 1.5 years
  - I. 6. reconsider the use of 'growth-cut' cycles instead of 'growth' cycles
  - I. 8. what is meant by 'well established turbulence'? Neutral or unstable conditions? Explain.
  - I. 9. insert 'was' after 'limit'
  - I. 9. suggestion: replace ',' by a '.' and start a new sentence with 'Hence, the flux measurements are considered sufficiently accurate'
  - I. 9. what is meant by 'background exchange'?
  - I. 11. suggestion: insert a '.' after interpolations and start a new sentence with 'Especially, the initial emissions during broadspreading of liquid manure in some parts of the experiment were difficult to capture.'
  - I. 15. what are these typical values for broadspreading of liquid manure? Insert 'e.g.' after 'values'.
  - I. 16-17. replace 'appear to be' by 'are'
  - I. 17. remove 'here'
- p. 9585:
- I. 1. insert 'should' after 'levels'
  - I. 1. move 'further' after 'reduced'
  - I. 3. replace 'thresholds' by 'critical levels'

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p. 9586:

l. 9. see comments on p. 9584 l. 2 and l. 6

l. 17. change 'It is therefore' in 'Therefore, it is'

l. 17. 'also' → what else?

l. 19. what is meant with 'background exchange'? Not influenced by local sources? Explain.

l. 20. 'some of its principal premises are violated' → such as?

p. 9587:

l. 3. see comment on p. 9584 l. 2

l. 18. what is meant with 'normally'

l. 22. add 'amounting to about 150 kg N ha<sup>-1</sup> yr<sup>-1</sup>' after 'fertiliser'

p. 9589:

l. 3. I doubt if the calculated gas-phase concentrations are correct. Maybe, I make a mistake in the calculations below. Please comment.

50 ug NH<sub>4</sub><sup>+</sup> l<sup>-1</sup> (in solution) = 50/18 umol NH<sub>4</sub><sup>+</sup> l<sup>-1</sup> (in solution)

1 liter solution ~ 10000 liter air ~ 10 m<sup>3</sup> air (p. 9588 l. 22-23)

50/18 umol NH<sub>4</sub><sup>+</sup> l<sup>-1</sup> = 50/18/10 umol NH<sub>4</sub><sup>+</sup> m<sup>-3</sup> (in air)

1 umol NH<sub>4</sub><sup>+</sup> = 1 umol NH<sub>3</sub>

50/18/10 umol NH<sub>4</sub><sup>+</sup> m<sup>-3</sup> (in air) = 50/18/10 umol NH<sub>3</sub> m<sup>-3</sup> (in air)

1 umol NH<sub>3</sub> = 17 ug NH<sub>3</sub>

50/18/10 umol NH<sub>3</sub> m<sup>-3</sup> (in air) = 50/18/10\*17 ug NH<sub>3</sub> m<sup>-3</sup> (in air)

50/18/10\*17 ug NH3 m-3 (in air) = 4.7 ug NH3 m-3

p. 9590:

I. 3. change 'i-' in '1)' and 'ii-' in '2)'

p. 9591:

I. 1. What to do in transition periods?

I. 1-5. A1\_5 seems to have a period of about 15 minutes. Can you explain this?

I. 16. remove 'rather'

I. 17. change 'Erismann' in 'Erisman'

p. 9593:

I. 1. change '1-' in '1)' etcetera

p. 9594:

I. 16. why 'even'? That is what we would expect.

I. 16. suggestion: replace 'beyond, and thus. ....' by 'beyond. This results in a potentially severe flux divergence within the measurement footprint'.

p. 9597:

I. 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.

p. 9598:

I. 7. what are 'background conditions'? (see also p. 9584 I. 9)

I. 9. what is meant with well-established turbulence? (see also comment on p. 9584 I. 8)

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p. 9599:

l. 12-16. add different assumptions for MBM to legend and use thicker lines in figure.

p. 9600:

l. 19. How are the values for  $\Gamma$ slurry obtained from Table 1 and where are they shown in Fig 9? Explain.

p. 9601:

l. 5-10. I wonder why this is done, as the method to correct  $\Gamma$ surface already seems to be the most realistic one.

l. 26. 'November' should be 'October'

l. 28. see previous comment

p. 9602:

l. 9. change 'Kruit' in 'Wichink Kruit'

p. 9604:

l. 20. rewrite 'favours losses'

p. 9605:

l. 25. remove 'AiRRmonia-based'

p. 9609:

l. 22. 'Kruit, R. J. W.' should be 'Wichink Kruit, R.J.'

p. 9614 (Table 1):

change '0.99' in '1.0' in the 'DM content' column to be consistent. Tair in Celsius? Give all dimensions. So, also pH is dimensionless

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p. 9619 (Fig 4): In my printer-friendly version of the manuscript the daily means are not clearly visible. Consider to use filled symbols for the daily means. The caption of the figure mentions a 'top frame' and a 'bottom frame'. However, the figures are displayed next to each other in my printer-friendly version. It would also be interesting to see the distribution (a histogram) of the plotted data on the x-axis and the y-axis.

p. 9620 (Fig 5): The units on the x-axis and the y-axis need extra spaces.

p. 9623 (Fig 8): Add extra legend entry for the modified MBM with a higher background concentration.

p. 9624 (Fig 9): Be consistent with other figures and use 13.7.06, 27.9.06, 30.10.06, etc. instead of July, September, October, etc. in the titles for the individual plots in this figure. Show  $\Gamma$ slurry in the figure.

p. 9625 (Fig 10): See previous comment.

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

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