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Biogeosciences Discussions

Interactive comment on "Ammonia emissions from cattle urine and dung excreted on pasture" *by* J. Laubach et al.

J. Laubach et al.

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Reply to Anonymous Referee #2

General comments

This is a very thorough, detailed examination of the amounts and mechanisms of NH3 volatilisation from urine and dung excreted by cattle and I believe it makes a worthwhile contribution to our understanding of the volatilisation process. The analysis of the resistance of the dung crust to NH3 exchange is a very useful contribution of the paper, particularly for the treatment of dung pats as porous media. This provides a good basis for modelling NH3 loss from grazed areas. I recommend acceptance by Biogeosciences after consideration of aspects that I mention below.

Reply: We are delighted by these positive comments. On the subject of dung crust resistance, we would like to make an unprompted addition to the manuscript and give credit to Olesen and Sommer (1993) who determined the crust resistance on pig slurry as 119 s/m, a value fully compatible with the dung crust resistance obtained by us (to be inserted on p.13305, L.9).

Reference: Olesen, J. E. and Sommer, S. G.: Modelling effects of wind speed and surface cover on ammonia volatilization from stored pig slurry, Atmospheric Environment, 27A, 2567-2574, 1993.

I have to say that I found the MS hard reading, rather long for its message and in some aspects rather reliant on supposition. Examples might be the comparison with the work of Bussink in Section 4.1, Ammonia loss fractions, and the discussion of the secondary maximum in NH3 loss several days after the cattle were removed from the test area, Section 4.2, Contributions of urine and dung to ammonia volatilisation. I would encourage the authors to consider these aspects if they are revising the MS, but I concede that my perceptions of it may be my own problem, rather than the authors'.

Reply: We believe Bussink deserves credit for his work, and our discussion aims to inform the reader of similarities and differences in his experiments and ours. In response to a query of Reviewer 1 we will provide a revised version of this passage, where the effects of different animal presence time, and consequently different excreta density, on the NH3 emissions are discussed. - In Section 4.2, we agree that the separation into urine and dung contributions is somewhat "reliant on supposition". We have tried to formulate extremely carefully how and why we make our inferences, and to provide justification from different kinds of observations by other workers, which we cite. The responses of both reviewers indicate to us that they have understood our intentions, and so we would like to leave this section as it stands. - We believe the overall length of the manuscript is appropriate. In A4 print version, the text of the Methods section is about 5 pages, Results 3 pages, and Discussion and Conclusions 6 pages long. The Methods section is packed full with relevant details, so its length reflects the complexity

of the experiment and the number of factors to be observed or considered. The Results section reports the relevant quantitative results, without distractions. The Discussion section provides literature context as well as process understanding and includes the description of the proposed dung crust resistance model, which has been well-received by both reviewers. We are happy to consider any specific suggestions for minor cuts but do not see scope for major reduction without losing substance.

Minor comments

2.1 Site and schedule. The experimental area was mown to 5 cm, but what about the surrounds where the dung pats were located and the wind speeds measured? The wind speed close to the ground would have been important in determining volatilisation rates.

Reply: The same issue was raised by Reviewer 1, so our response is the same: The grass had been mown to 5 cm in the fenced circle and in a similar-sized area surrounding the wind profile mast, which included the locations of the experimental dung pats and urine patches. The canopy height "seen" by the wind profile was thus similar to that "seen" by the NH3 sampler profile. We agree [with Reviewer 1] that a roughness length of 2 cm appears implausible for 5 cm canopy height. The main explanation for this is that the terrain was not perfectly flat. There were undulations at the decimetre scale, and these contributed to increased roughness. Additional minor contributions may have come from the taller grass outside the mown areas, and from the presence of the cattle. We are convinced that the roughness length, derived from the wind profile, is a correct representation of the flow parameters at the site.

2.5 Ammonia collection, etc. I think "passive samplers" is a more appropriate description than "Leuning samplers".

Reply: What would the word "passive" refer to: merely the absence of a pump? The Leuning design differs from other "passive sampler" designs in its ability to rotate into the prevailing wind within a very short adjustment time. We would prefer to use the

specific label rather than the general one.

3.2 Estimation of nitrogen deposited, etc. , p.13297, line 13. Suggest "animal" for "cattle"

Reply: We agree.

3.3 Ammonia emissions, p.13298, line 4. Night-time variations in NH3 emission rates can result from the onset of dew and low winds as well as the "diurnal temperature cycle"

Reply: We agree that dew can affect the emission rates, but the second night of the experiment was the only one after which a small amount of dew was observed in the morning. Since night-time collection periods comprised the whole night, we would not have resolved dew-induced variations anyway. The sentence beginning in Line 4 (and the preceding one) refers to the large differences between day and night, which are primarily controlled by temperature, so the text is correct as it stands.

3.5 Moisture and mineral N of dung samples, p.13299, line 19. Suggest "were" for "was"

Reply: This comment prompted us to check usage of the words "content" and "contents" throughout the manuscript and interchange them where appropriate. In this instance, it should correctly be: "The NHx-N content of the dung interior was. . ."

Interactive comment on Biogeosciences Discuss., 9, 13287, 2012.