

Interactive comment on “Vertical structure and diurnal variability of ammonia exchange potential within an intensively managed grass canopy” by B. Herrmann et al.

Anonymous Referee #2

Received and published: 28 July 2008

General comments

This MS reports valuable field measurements of apoplastic NH_4^+ and H^+ concentrations in grassland and their variations over time, before cut, after cut and after fertilization. Such data are needed for a comparison to previous laboratory-based experiments, and for a future application in stomatal compensation point modeling of NH_3 exchange in atmospheric models. This justifies the publication of this MS, but there are inconsistencies in the reporting and the interpretation of the results. In particular, the vertical gradient of chi_s in a grassland canopy is highly temperature-dependent, which does not seem to have been accounted for properly in the MS. The relevance of

Full Screen / Esc

Printer-friendly Version

Interactive Discussion

Discussion Paper



these measurements to the modeling of NH₃ exchange with ecosystems using canopy compensation point models ought to be emphasized in the introduction and discussion.

Specific comments

Introduction, page 2899, 2nd paragraph: the direction of NH₃ exchange does not depend on the stomatal compensation point ONLY, there is the interaction with soil, leaf litter, non stomatal leaf surfaces, water films, etc.. Please alter 1st sentence accordingly.

Introduction, p 2900, top paragraph: the authors argue from the start that since diurnal variations in apoplast NH₄⁺ and H⁺ "seem to be small", changes in NH₃ emission "may be attributed to temperature effects". This is rather unfortunate wording, as one stated objective of the present MS is to characterize the diurnal variation in Chi_s or apoplastic NH₄⁺ in grassland. For the sake of logic, it might be advisable to write that in past studies in Barley (eg Husted et al 2000) and in Rye Grass (van Hove et al 2002), diurnal changes in emissions were interpreted to result from variations in temperature only, rather than diurnal changes in NH₄⁺, which were rather small. The authors must however justify why they seek to address the issue of diurnal NH₄⁺/H⁺ once more in the present study, ie why they assume that diurnal variations might be important here.

Methods, page 2903: Chi_s is calculated at canopy temperature, which was measured by an IR pyranometer from above the canopy. Does this means that any vertical gradient in temperature within the canopy was not taken into account? For a closed canopy like grassland before the cut, there can be several K difference between the bottom and top of the canopy, while the stomatal compensation point (as calculated from eq. 2) increases by approximately 10% for each additional K in the range 10-20C. This roughly means a doubling of Chi_s every 5K, which means that a comparison of chi_s between top and bottom of the canopy is meaningless unless the vertical variation in canopy temperature is known and accounted for. A comparison of NH₄⁺/H⁺ (gamma) values between canopy layers might therefore be preferable to poorly-defined chi_s

Full Screen / Esc

Printer-friendly Version

Interactive Discussion

Discussion Paper



(Fig.3).

Results: page 2904, line 10: "Yet the difference between the layers was not significant ($p > 0.05$)..". However, from Fig 2A it certainly does look as if the mean apoplast NH_4^+ concentration at 40-60 cm, around 0.09 mM is more than double the concentrations at 0-40 cm, is significantly higher, with no overlapping of the error bars / confidence intervals ? Please comment. (Remark that in the discussion, page 2906, lines 19-20, the authors write that "Apoplastic NH_4^+ and chi_s increased by a factor of 2 from the bottom to the top of the intact plant canopy", to go on to write that young leaves have a relatively high NH_3 emission potential. This inconsistency between results and discussion must be cleared up)

Same paragraph as above, p. 2904, line 16-18: " chi_s did not differ significantly between the different layers..". First, chi_s in the layer 40-60 cm pretty much does look significantly higher than below (no overlapping of confidence intervals). Second, was chi_s actually calculated using a within-canopy temperature profile, or with a common (mean) canopy T as measured by the pyranometer (see comment above)? It is likely that in daytime the temperature of the upper and middle layers would be higher than down below where solar radiation is attenuated. If the chi_s profile shown in fig.3 was indeed calculated using a mean canopy T, an actual temperature gradient would lead to even higher chi_s in the upper layer compared with the lower layers. If no within-canopy temperature T profile is available, it is probably preferable not to speculate on differences in chi_s between canopy layers.

page 2906, lines 1-3 : "...apoplastic NH_4^+ remained low on the following day probably because of the lower canopy temperature..". What would be the physiological mechanism involved? From a thermodynamic viewpoint, given a constant Γ , a reduction in temperature would tend to favour a shift of the $\text{NH}_3/\text{NH}_4^+$ partitioning toward the aqueous phase, and thus increase apoplast NH_4^+ . Please explain.

Discussion: the argument of young vs old leaves page 2906, lines 20-21, can be made

Full Screen / Esc

Printer-friendly Version

Interactive Discussion

Discussion Paper

on the basis of γ or NH_4^+/H^+ , rather than chi_s , given the uncertainty in the temperature profile.

page 2906, line 26: it is not clear to which flux measurements the authors are referring to in "The NH_3 measurements measured from the field after the cut..". No flux data are shown, and it is not obvious to the reader when NH_3 emissions were highest or lowest, or when deposition occurred.

Page 2908, line 14: the authors observe that there is a diurnal variation in apoplastic NH_4^+ , with highest values around midday and lowest values at night, but they do not offer any explanation or hypothesis as to why this is. Can they comment?

In the Abstract, line 6, instead of "leaf apoplastic NH_4^+ did not significantly differ..", it should be written that, in accordance with the above remarks, there was a significant vertical gradient in NH_4^+/H^+ (γ), but inferences regarding the vertical structure of chi_s are more difficult (temperature issue).

Technical corrections / typographical errors

page 2899, line 27: remove the comma between "yet" and "if"; line 28: "..of different ageS.."

page 2900, line 15-16: "..its diurnal variations by means of chi_s measurements."

page 2901, line 6: "It has been an intensively-managed grassland for 4 years..."

page 2906, line 27: "rise" rather than "raise"

page 2907, line 1: change "..on the ground could, however, not.." to "..on the ground, however, could not.."

page 2907, line 6: change "absorption from" to "re-capture by"

page 2908, line 1: insert a space " " in "increasedafter"

Interactive comment on Biogeosciences Discuss., 5, 2897, 2008.

[Full Screen / Esc](#)[Printer-friendly Version](#)[Interactive Discussion](#)[Discussion Paper](#)