

Review of: "The greenhouse gas balance of a drained fen peatland is mainly controlled by land-use rather than soil organic carbon content"

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MS No.: bg-2015-48

MS Type: Research Article

Reviewer, Lars Elsgaard

The present MS describes a one-year study of GHG emissions at a bog area with an active peat extraction site and three rewetted, vegetated sites. Very high methane emissions dominated the GHG balance at the vegetated sites. The study is interesting and deserves publication, but several issues need to be addressed. Overall conclusions need to be aligned with the limitations of the study. I have compiled a list of issues to be properly addressed and comments for inclusion in a major revision to improve and clarify the manuscript. The list below covers both scientific and technical issues. Page numbers and line numbers refer to the on-line discussion paper version

Title

The level of generalization indicated by verb in present tense is not justified; change to 'dominated'

Abstract

2810

4) 'thus potentially implies'

7) avoid the ambiguity on whether three different bogs were studied, change to, e.g., '...differently vegetated sites in a bog ecosystem 30 years...'

9-10) mention here what the measure of dispersion around the mean represents, i.e., what kind of uncertainty is included

11) 'CO₂, CH₄ and N₂O' rather than 'the three greenhouse gases'

13) '22-51' rather than '22 up to 51'

13-14) 'with highest rates found at'

17) 'assume' would be more appropriate term than 'conclude' as no direct evidence is presented for this statement

18) 'purple moor grass' rather than 'this grass species'

20) 'the mixed soil material' – this point should be phrased more explicitly; it can not be understood from the abstract what kind of mixed soil material the author refers to

22) the last statement should be modified to reflect the limitations of a one year one site study, e.g., 'is not inevitably limited to a short-term period.'

Introduction

2810

26) 'former peatland areas' rather than 'former extent peatlands'

2811

14) 'CO₂ equivalents (CO₂-eq)' rather than 'carbon dioxide equivalents'

27) 'Natural England (ed), 2010' is not a valid author declaration

2812

18-19) suggest to delete 'which established'

23-27) keep the past tense, i.e., 'acted as', 'were related', 'varied between'

25) 'three' rather than 'differing'

27) 'could' rather than 'is expected to'

27) 'recommendations' rather than 'implications'

26-27) qualify the stated hypothesis on N₂O; why were no significant fluxes expected?

Materials and methods

2813

8-9) although the annual mean precipitation and temperature of the study year corresponds to long-term averages, the conclusion on representative measurement conditions should be based on a more disintegrated comparison, e.g., on a monthly basis. In a previous report on methane emissions from a Northern German fen it was stated that "in Mecklenburg-Western Pomerania, the summer of 2011 was the wettest in the last 30 years. Total precipitation during July and August was 392 mm, which is three times the long-term mean. The exceptionally wet summer of 2011 gave us the opportunity to measure the effect on CH₄ effluxes of natural prolonged flooding with freshwater under high summer temperatures" (Huth et al., 2013/2014). I am not aware if the Hamburg areas had similar unusual climatic summer conditions as in the study area of Huth et al., (2013/2014), but these authors reported that up to 50% of the annual methane emissions were contributed by the August effluxes. As judged from Fig. 1 in the manuscript August 2011 indeed seem rather rain full also in the present study area.

2814

15) the use of frames with a high insertion depth of 50 cm could probably have an impact on the hydrological conditions in the plots (frames) thus resulting in reduced water movement in the plots as compared to the surrounding area. This could lead to higher methane emissions from the plots than from the study area. Was any measures taken (or information collected) to address this potential bias?

17) I agree with the intention, but maybe it is too firm to state that it was assured that the plots represented the whole site. Maybe rather state: '...with the intension of representing the whole site'.

2815

8) '(PAR transparency, approx. 50%)'

8-9) Always be specific, '...and a third measurement was done with two layers of gauze (PAR transparency approx. 30%)'

29) 'side' rather than 'site'

2816

2) state volume of samples (in addition to volume of the syringe)

7) I guess the keeping quality of the gas samples in the syringes was checked – please indicate so

9) '...being injected triply...' this wording is at least unfamiliar to me – consider to replace by '...being injected in triplicates...'

12) state volume (and brand/stopper type) of septum vial where 20 mL of sample was injected into. Was the vial prefilled with air containing N₂O (rather than filling with inert gas like He). Use of evacuated vials could have reduced the issue of sample dilution; this could be particularly appropriate since an enclosure time of 20 min is rather short for measurements of (low) N₂O fluxes.

14) as comment to line 9

16) suggest to delete 'mistakes and'

22) Introduce abbreviation at first mention: 'Gross primary production (GPP)...'

2817

2) '...the last 10 of' rather than '...the last 10 s of'

9) 'Standard deviation (SD)...'

10) state explicitly which measure of dispersion is used here (for 0.06 ppm)

26) 'Net ecosystem exchange (NEE), Reco and GPP were...' (as the two latter terms have already been introduced)

2818

1) 'All individual plots ($N = 16$) were...'

4-5) only very sporadic measurements were done to document night-time fluxes; these measurements can hardly be inferred to attest the general validity of modelling based on day-time fluxes. I suggest to remove the sentence here and, in the discussion, state that a premise of the current work was that modelling was based on day-time fluxes and that this at least was not compromised by the one-occasion night-time measurements.

7) 'Elsgaard et al. (2012)'

11) 'appropriately'

10-11) what were the criteria for evaluating if Model 1 could explain the data appropriately? And how well could Model 2 explain the data if Model 1 failed?

23) were methane and nitrous oxide also measured during 10 am – 14 pm and could temperatures here be considered to represent daily means?

24) '...interpolation; this also applied to annual N_2O ...' rather than '...as well as the annual N_2O '

26) use only GHG; already defined

22-24) Specify how data for Jan-Apr 2011 were included in annual budgets when no CH_4 and N_2O flux measurements were done?

2819

5-6) meaning unclear; rewrite sentence

A number of statistical tests were done and referred to in the results and discussion (ANOVA, Kruskal-Wallis one way ANOVA). These tests, and fulfillment of assumptions for their proper use, should be presented in the Materials and methods section, e.g., under a section '2.7 Statistical analyses'.

Results

2819

13) 'On the contrary...'

19) spell out genus names at first mention

2820

1-3) use Reco, GPP and NEE without introducing them again

5-8) here and throughout in the results and discussion; be careful to use the appropriate tense (here the past tense) to describe the observations that are made for the specific study (and thus are not of general validity). Thus change verbs in line 5-8 as 'displayed', 'has', 'was', 'began'; and in line 10 – 'predominated', 'was'

16) here and throughout; always explicitly state the measure of dispersion and the associated N (or do it once for all subsequent mentions)

17-18) delete decimals

19) your conclusion must be that NEE did not differ between the sites if you use the significance level of $p = 0.05$ (define this in the statistics section suggested to Materials and methods). If you use $p = 0.1$, you can claim that they are different. Here and elsewhere; if H_0 of no difference is rejected, a post-hoc test should be made to qualify which treatments are then different. Indeed including the industrial site in the ANOVA tests creates a high likelihood of rejecting H_0 as this site is fundamentally different to the restored sites. It will be much more interesting to know the significance of differences between the restored sites.

22) data on CH_4 emissions should absolutely be presented in detail. These data are of vital importance for the whole paper, so to have them as 'data not shown' is inappropriate. Indeed the spatial and temporal dynamics of the observed high methane fluxes should be shown and highlighted for better interpretation of the importance of the study. A figure should be included.

23) give a third decimal different from zero in the p value

2821

1) here and elsewhere; be careful not to entirely repeat entries from tables

4) what is meant by 'Significant emission' ? are statistical tests included for rates?

11-12) '... for a better visualization...': delete this and rest of sentence; delete Fig. 6

12-25) here again you tend to use present tense which translate into too much generalization of your observations; use verbs in past tense. Specifically line 12, 'were'; line 13, 14, 17 'was'; line 14, 'was';

12-13) 'GHG'

14) 'proportion'

15-16) rephrase to read more fluently

20) 'GHG emissions' rather than 'ones'

Discussion

2822

4) 'dominated'

7-8) in addition to water table the plant composition could reflect differences in nutrient status. Indeed the differences in water table shown in Fig. 1 are quite modest for the restored sites.

8-9) you mention interaction between dry surface and vegetation (purple moor grass) as reasons for high CH₄ emissions; dry surface in itself would facilitate methane oxidation, so the argument on interaction may be confusing. Consider to use 'relationship' rather than 'interaction'

10) 'resulted'

11) specify what you mean by 'Here, ...'? is it the purple moor site or the other two vegetated sites? The highest CH₄ emission was from purple moor grass; the highest (annual) GPP was from Sphagnum, so the sentence is confusing .

12) 'GPP'

22) '...30 years, in contrast to what was hypothesized.'

23) '...and, considering the uncertainty related to spatial variability, was close to a...'

26) delete 'respectively'

2823

2) 'were' rather than 'are'

3) but still some GPP is indicated on Fig. 4 for the industrial extraction site?

4) '...is within the range of 11 reported...'

8) stay in the unites of t CO₂ ha⁻¹ yr⁻¹

15) 98% rather than 99% is mentioned on p 2821 line 14

21) only use 'respectively' when two series of elements are reported (so delete here)

21) should it rather be '22' than '21'?

22) do you consider that your data demonstrates large fluctuation in water level? I don't think Fig. 1 substantiates this. Rather it seems that at least in the study year the site is often inundated. Probably the inundation should be used in your argumentation

2824

12-13) I think the data on relation between coverage of aerenchymatous plants and annual CH₄ emissions are only indicative; so arguments and conclusions based on this should be made with caution. Here, I would suggest to replace the statement with a sentence like: 'Thus it was shown that in some plots high CH₄ emissions coincided with a high coverage of aerenchymatous plants species.'

19) 'conditions'

27) 'filled' rather than 'fulfilled'

2825

Conclusion

13-15) this conclusion should be based on a post-hoc test to conclude where among the vegetated sites you actually have significant differences. For example, a tentative test of methane emission rates (based on Fig. 5) indicate that no significant differences exists between the three vegetated sites.

16) maybe give more weight to inundations than to fluctuations

16) the argument on aerenchymatous plants is rather weak; the C substrate arguments seem more important

18) 'soil-to-atmosphere'

22) 'was' instead of 'is'

22 '...to a short-term period at our study sites, as described for other sites in the literature.'

2826

References; the number of references (67) is quite extensive and may be reduced depending on journal policies. Two cited references are missing from the reference list; Jaiswal et al. (2000) and Parish et al. (2008). Italics for species names should be included consistently. A number of, e.g., German reports are included; if possible permanent web-addresses for such literature should be included.

2827

11-13) should be cited as a PhD thesis

2830

3-4) ClimateXChange 13 pp. This is a single contribution , do not use 'in: ', but rather provide web-address

2833 ff.

Table 1;

'...and two temperature-driven...'

'...where $t = \text{air}_{\text{or}} \text{soil temperature}$; a and b are fitting parameters.'

Table 2;

'...Londo (1976) at the three...'

Indicate the meaning of the sign '-'; not present

Table 3;

'Mean annual CH₄ and N₂O fluxes ± SD (N = 4) at the four different bog sites.'

I find it odd to give annual rates in units of s⁻¹; consider to recalculate to units of yr⁻¹

Table 4;

Footnote: '*Three replicates'

Figure 1;

Symbols are difficult to distinguish; maybe colored lines would be an option

'Mean daily water table and daily precipitation sum at the four bog sites over the measurement period...'

Figure 3;

Instead of designation (a), (b) and (c), consider to use designation (upper row), (middle row) and (lower row). And delete A, B and C from left column panels (or at least be consistent in use of upper and lower-case letters). Consider to put year id on lower x-axis.

Fig. 4;

'... four replicates (plots) at each site...'

Fig. 5;

To some extent this figure could be misleading. Thus looking within sites there is no consistent pattern in emissions as function of coverage (of aerenchymatous species) and the suggested relationship is driven apparently just by one plot showing the combination of high coverage and high emissions. And why would an exponential relationship be invoked from these data? I suggest to delete this figure. If it is kept, then at least be more careful in interpretations related to the role of shunt species as this is not explicitly assessed in the study. And also if kept omit exponential regression line and provide full x-axis title.

Fig. 6;

Delete; this figure is redundant to Table 4 (as already acknowledged by the author)

Literature cited in the review

V. Huth, A. Günther, G. Jurasinski and S. Glatzel (2013/2014). The effect of an exceptionally wet summer on methane effluxes from a 15-year re-wetted fen in north-east Germany. *Mires and Peat*, Volume 13 (2013/14), Article 02, 1–7. <http://www.mires-and-peat.net/>, ISSN 1819-754X