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Interactive comment on “Organic sediment formed during inundation of a degraded fen grassland emits large fluxes of CH₄ and CO₂” by M. Hahn-Schöfl et al.

Anonymous Referee #2

Received and published: 20 February 2011

GENERAL COMMENTS:

I.) The manuscript of Hahn-Schöfl et al. presents very interesting research on anaerobic CO₂ and CH₄ production potentials in different organic soil materials sampled in a drained and recently re-wetted peatland. Samples were taken before and 2.5 years after flooding the site and were incubated. The presented data clearly show the importance of labile organic matter for the anaerobic CO₂ and CH₄ production potentials. Especially an organic sediment formed due to the dying-off of the grass vegetation after flooding exhibited extremely high gas production potentials and was thus probably the source of the extremely high CH₄ emissions observed in the years following re-wetting.

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The presented experiments provide new insights into the complex biogeochemical processes which happen in response to the drastic hydrological changes caused by the rewetting. A thorough understanding of these processes is very valuable for the planning of a successful restoration with the goal of reducing GHG emissions from degraded peatlands. The manuscript does fit well into the general scope of Biogeosciences.

II.) The manuscript is very clearly structured and easy to follow. It is mostly well written. However, I have quite some comments on orthography and style which I have listed under the technical comments below. The abstract is precise and informative. The introduction nicely introduces into the scientific topic and leads straightforward to the scientific goals of the study. I like the methods section very much as it provides very detailed information about the work that has been done. I recommend to revise the presentation of equation (1) which is used for the calculation of gas production fluxes (see specific comments). Also, a correct equation for the flux calculation by the flow-through chambers must be given. Furthermore, I find the differentiation of "peat profile incubation" and "top soil substrate incubation suboptimal and potentially confusing. In my view, we can consider all materials incubated in this study as soil substrates. Most of them are organic soil or peat materials. Maybe it would be better to differentiate between soil substrates before rewetting and after rewetting? I think that the main difference between the two experiments and incubation materials is not the difference between "peat" and "soil". Generally, the extensive results are well presented, and the figures and tables are clear and informative. The number of tables and figures are appropriate. The authors discuss their results in an interesting way and develop conclusions relevant for the community of peatland and wetland biogeochemistry.

III.) I recommend this interesting and relevant manuscript for publication after minor revisions.

SPECIFIC COMMENTS

Page 9275, lines 6-7: "...nearly zero": Please indicate for which region this is a valid

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statement. Globally? Europe? Germany?

Page 9275, lines 15-17: Please write these two sentences clearer. What do you mean with "...nutrients remain in the peat"? In which form? Which process leads to eutrophication?

Page 9276, lines 17-18: Where did the sand originate?

Page 9277, lines 11-12: Where were more intensive drainage activities in the 20th century additional to the drainage activities in the 18th century? I would expect that the land management in the 20th century had a much stronger impact on the peatland hydrology than the prior drainage activities.

Page 9277, line 20: "muck-soils". Is this term referring to the soil material or the soil type?

Page 9279, lines 13-15: How was this linearity checked? By which statistical measure? I doubt that a reasonable checking of linearity is possible with 3 data points. (The degrees of freedom of a linear regression would be 3-2= 1 !) Maybe it would be better to state that you just assumed linearity.

Page 9279, lines 16-17: Why did you omit the sampling point at 0.5 h for the regression?

Page 9279, lines 19-27: I urgently recommend to use consistent quantity equations which are independent of the units used. Equation (1) is actually a mixture of a quantity equation and a numerical-value equation.

The quantity equation would be:

$$FC\text{-CO}_2 = (M \times p \times V) / (R \times T \times A) \times \Delta_c / \Delta_t \times 1/C_t \times f$$

It is unusual to use rho as symbol for pressure which is normally symbolized by p. rho is normally used for density. You could also omit f in the equation and define M as the atomic mass of carbon.

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Page 9281, lines 14-16: Why did you choose for the “top soil substrate” incubation a different temperature than for the “peat profile” incubation? Can you preclude biases in the comparison due to the application of different incubation temperatures?

Page 9282, line 1: The calculation of the gas fluxes using a flow-through chamber must be different than for the closed-chamber approach! It is a quite different measurement principle, and the air flow velocity has to be taken into account.

Page 9282, lines 12-14: Why the air had to be moved? Did the air in the tube installed at some soil depth not mix enough by diffusion within the whole tube volume without inserting water?

Page 9283, line 11: “substrate availability”: Maybe better “substrate decomposability” or “substrate degradability”? Availability is probably not only determined by C:N or C:P ratios but also by adsorption/desorption in soils, soil water dynamics and other soil processes.

Page 9290, lines 25-26: I would be good to write this somewhat more specific. Are you referring to the bulk of organic material of the peat? Or to a specific size/quality fraction?

TECHNICAL COMMENTS

Page 9274, lines 2-3: I suggest rephrasing: "...alter local emissions of greenhouses gases as CO₂ and CH₄."

Page 9274, line 16: I suggest inserting “the” before “2.5”.

Page 9274, line 22: “I suggest adding: “than for the new sediment layer” after “lower”. Remove comma before “and”. Insert “a” before “newly flooded”.

Page 9274, line 28: I suggest inserting “Significant” before “anaerobic”.

Page 9275, line 4: I suggest inserting “the” before “total”.

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Page 9275, line 6: “more efficient” ? Than what? Maybe better: “which has a higher global warming potential than CO₂”

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Page 9275, line 10: I suggest inserting “the” before “net”.

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Page 9275, line 25: I suggest “yr” instead of “y” as unit symbol.

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Page 9276, lines 19-20: Remove hyphen: “newly formed”.

Page 9277, line 5: I suggest rewording: “moderately continental temperate

Page 9277, line 11: I suggest “low-intensity agriculture”.

Page 9277, line 15: I suggest inserting “the” before “Zarnekow”.

Page 9277, line 25: Insert comma after “inundation”.

Page 9277, line 28: Reword: “...dying-off of plants.”

Page 9278, lines 11-12: I suggest removing the commas before “as well as” and after “chemistry”.

Page 9278, line 25: I suggest inserting the units to all quantities: “0.6. m x 0.4 m x 0.4 m” (following the recommendations of the International System of Units (SI)).

Page 9279, line 12: I suggest inserting “were” after “and”.

Page 9279, line 21: “headspace” instead of “head space”.

Page 9280, line 27: I would remove: “..., so as...”

Page 9281, line 5: This statement does not become clear enough: “assumed” or “applied”?

Page 9281, line 20: I suggest “measurements” (plural).

Page 9281, line 24: Change word order: “... does not fully compensate...”

Page 9282, lines 21-22: Insert comma before “and” and “was” after “chambers”.

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Page 9282, line 24: Insert comma after “analysis”.

Page 9282, lines 28-29: Please write more precisely: Which values were corrected for water content?

Page 9283, line 21: Insert “the” before “upper”.

Page 9283, lines 24-26: I suggest rewording: “The cumulative CO₂ fluxes over 363 days for the incubation of the material from the upper peat layer were... than for the incubation of the material from the middle peat layer and ... than for the incubation of the material from the lower peat layer.” Or something like that...

Page 9284, line 7: I suggest inserting “in the soil organic matter” after “initial C”.

Page 9287, line 15: Insert comma before “and”.

Page 9288, lines 3-5: I suggest rewording, the sentence now uses a rather casual style. The peat did not have “time to” do something.

Page 9288, line 9-10: Reword: “...study which reported rates of CO₂ and CH₄ production that were...”

Page 9288, line 10: I suggest removing the comma before “where”.

Page 9288, line 26: Insert comma before “and”.

Page 9289, line 3: I suggest removing the comma before “as”.

Page 9289, line 24: I suggest removing the commas around “therefore”.

Page 9291, line 1: I suggest rewording: “... and the decomposition of sedge residues...”

Page 9291, line 8: Insert hyphen: “dying-off”

Page 9291, line 19: I suggest “can be” instead of “are”.

Page 9291, line 18: I suggest inserting “high” after “extreme”.

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Page 9292, line 4: Insert comma before “and”

Page 9292, line 5: Remove hyphen: “newly formed”.

Page 9292, line 8: “substrates” instead of “substrate”.

Page 9292, line 9: “sediments” instead of “sediment”, “newly formed”

Interactive comment on Biogeosciences Discuss., 7, 9273, 2010.

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