

Interactive comment on “Effect of reed canary grass cultivation on greenhouse gas emission from peat soil at controlled rewetting” by S. Karki et al.

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Received and published: 28 November 2014

Dear Reviewer,

We would like to thank reviewer for raising very interesting questions and providing us with useful comments to improve the quality of the paper. We have so far tried to address all the issues raised. The original comment is given first followed by our response.

1) In setting up the treatments, the authors compare reed canary grass to bare soil. Is this what would be happening in the field? Bare soil? Given the authors had to remove organic matter and grass from the cores they used that were bare, it seems bare soil

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is not likely to be what would be occurring in the field perhaps. Therefore, the authors need to justify why the compared to bare soil and perhaps include in the discussion a brief discussion about how these results might have varied if they had not compared to bare soil but instead to whatever native vegetation would have recruited naturally to a rewetted site.

We agree that for evaluation of GHG effects of rewetting under in situ conditions an appropriate reference would be a naturally vegetated (grass) soil. During the present experiment, however, comparison of RCG and bare soil mesocosms (rather than, e.g., grass vegetation) was done in order to tentatively isolate the contribution of RCG in the measured GHG fluxes. In doing this, the GHG emission from the bare soil mesocosm was subtracted from the emission from the vegetated mesocosms. Inclusion of grass-vegetated mesocosms would have been a third experimental treatment, which was not feasible in the present study. We intended to reflect our approach already in the title of the manuscript, but as both reviewers stresses this point; we obviously failed to justify it properly in the manuscript itself. We have now added such information in the discussion.

2) I think in the Introduction it would be worthwhile to mention that reed canary grass is an invasive species in some parts of the world (including the U.S.) and that it may not be prudent to use reed canary grass as a biofuel crop in places where there is concern about this invasive species spreading. Thus there are additional factors that must be taken into account besides the greenhouse gas balance before deciding to plant RCG and this should perhaps be discussed in the conclusion or discussion.

We have now mentioned in the introduction that reed canary grass is considered as an invasive species in some countries.

3) RVI is defined but not explained and this was not an acronym I was familiar with. Please explain this briefly when it is first introduced so the reader knows why it is a useful index.

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We have added following section in methodology part:

Biomass development was monitored through the non-destructive measurement of ratio vegetation index (RVI). RVI was determined for each mesocosm using a SpecroSense 2+ fitted with SKR1800 sensors (Skype Instruments, Powys, UK). The sensors measured the incident and reflected red light (R) at 656 nm and the incident and reflected infrared light (NIR) at 778 nm. RVI was then calculated as $(NIR_r/NIR_i)/(R_r/R_i)$ where the subscripts i and r denote the incident and reflected radiation. RVI has already been used as a useful predicting factor for modelling ER and CH₄ fluxes (Görres et al., 2014; Kandel et al., 2013a; Kandel et al., 2013b; Karki et al., 2014)

4) In the statistical method section, I think it would be useful to describe more fully what the CorAR1 structure versus compound symmetry represent since these were applied to the CH₄, N₂O or CO₂ fluxes.

Following lines were added in statistical section:

Dates were treated as repeated measurements by applying either compound symmetry structure (each dependent variable have constant covariance independent of time) or autocorrelation structure of order 1 (Errors at adjacent time points are correlated) (Maxwell and Delaney, 2004). Best model was selected by use of Akaike's Information Criterion (AIC). For CH₄ and N₂O, autocorrelation structure was selected while compound symmetry was selected for CO₂ fluxes.

5) I would really like to see a diagram/schematic showing GHG flux in and GHG fluxes out of each treatment and at each water level and then also the net balance (a la W. Schlesinger figures). This would visually help me understand the overall net fluxes and would support nicely the authors' premise that RCG can have overall the effect of making a rewetted peatland a sink for CO₂.

We are not familiar with mentioned W. Schlesinger figures. However, we have now added a graph with total GHG balance from each treatment of bare soil and RCG at

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different GWL in Figure 6d.

6) I would have liked a bit more discussion of the potential policy implications of this study. For example, the findings that increases in CH₄ emissions under RCG were offset by decreased N₂O emissions except when the water levels were at 0 would suggest that it is important if possible when reflooding peatlands to control the degree of wetting. Also, the peaks of N₂O emissions in the RCG treatments that occurred after fertilization suggest that it is critical to only fertilize when absolutely necessary and to keep that fertilization to a minimum. Perhaps some standards need to be set to ensure that fertilization application does not offset the potential benefits of replanting in rewetted peats.

This is indeed a very interesting comment by the reviewer. We agree with the reviewer that good fertilization management could decrease the total emission. We have now acknowledged that further studies are needed to assess the optimum amount and timing of fertilization required for optimum growth of RCG with acceptable N₂O emissions.

Technical Comments

1) Add lines in Table 1 to separate SO₄ from NH₄ from NO₃ more easily for the reader.

Done

2) Figure 7: Is this in comparison to the bare treatments? That would explain why there are negative bars for N₂O. But this needs to be clarified in the figure text.

The figure 7 represents the emission only from plants derived from the difference in emissions from RCG treatment and bare soil treatments. We have now made an effort to clarify the figure text.

3) I don't understand the sentence on page 13314 lines 13-14. "...as non-linear increase in gas concentration over time was often observed with non-steady state chambers for used gas measurement." What does "used gas measurement" mean?

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We have now changed the sentence as “as non-linear increase in GHG concentration over time was often observed during the non-steady state chambers measurements”

4) Page 13323, Line 1. "was" should be "WERE"

Done

5) Page 13324. Line 2. Remove "the" in "...which could suppress CH4 emissionS."

Done

6) Need to include the scientific name of Reed Canary Grass in the Introduction.

Done

Interactive comment on Biogeosciences Discuss., 11, 13309, 2014.

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