General Comments

This paper presents useful data on GHG exchange for a relatively understudied temperate peatland system. The comparison of management regimes at the same site provides novelty, and potentially makes the paper of interest to policy/decision makers. With this in mind, I feel the authors should be careful not to overstate the generality of their findings. The last paragraph of the abstract concludes "Despite inter-annual variability, rewetting contributes considerably to mitigating GHG emission from formerly drained peatlands". On its own this study does not provide the evidence required for such a general conclusion. Generally the manuscript is well structured but the language lacks fluency in places and there are quite a few unnecessary words and minor errors. The methods are valid though some important details are missing from the methods section.

Specific comments

Introduction:

p6796 lines 3-9. Refer here to net ecosystem exchange, rather than total CO2 exchange of soils. The explanation of the drivers of GPP is unclear. I would say that plant abundance (i.e. the leaf area) is an equally, if not more important, driver of GPP than light use efficiency.

That is true, there are different biotic factors influencing the GPP (biomass, LAI). However, we used light efficiency because it has a high diel amplitude and can be measured easily. Plant abundance and biomass gain as well as other factors (biotic&abiotic) are incorporated indirectly because a model is built using the data of one measurement campaign and is only used for modeling GPP ca. 3-4 weeks until the next model takes over. Further, the parameters of two adjacent models are interpolated linearly between model data dates. While this assumes linear growth and change in environment–which may not be what is truly happening in nature–it is closely aligned to the seasonal development of many factors that drive GPP. This approach is quite often used in Germany but not so often elsewhere. The advantage is that we cover many factors indirectly. The disadvantage is that sometimes the models (especially in winter) do not tightly fit. We changed the text in order to prevent overstating the influence of photosynthetically active radiation on GPP. It reads now:

"The net ecosystem exchange (NEE) between soils and the atmosphere can be simplified into two contrary components: gross primary production (GPP) and soil respiration (R_{ECO}). One of the main driving forces of GPP is photosynthetically active radiation, which is apparent in the light use efficiency of the plants (Hall and Rao, 1999)."

p6796 line 14. Sentence beginning "Thus the rewetting. . ." is ambiguous. Is the production of CO2 and CH4 highest at -5cm, or just CH4?

This can be confusing, thanks for that comment. We meant the balance of both gases. Therefore we changed the text accordingly into:

"In contrast, methane emissions increase with rising water tables since CH_4 is mainly produced by methanogenic bacteria that require anaerobic conditions (Dalal and Allen, 2008). CH_4 production also depends on temperature (Bellisario et al., 1999, Blodau, 2002). Thus, it is essential to aim for an optimal balance between CO_2 and CH_4 production when rewetting deeply drained grassland sites; this balance seems to occur at groundwater levels around –5 cm."

Methods: p 6798 line 22. How many CO2 flux measurements were taken over the course of the day? What was the measurement interval?

The number of measurements per day was not constant throughout the measurement period because CO_2 exchange was always measured from before sunrise until late afternoon. Given an average duration of one chamber placement of 2–5min–including moving on to the next position and all other measurements– it is possible to conduct up to 114 measurements per day (cf. table 1 in the appendix). This number was well achieved during summer months when the days are longer but in winter substantially less measurements have been achieved per day at times. For constructing proper GPP models we used at least 10 flux data points per day. The measurement technique is described in detail in Drösler 2005.

P 6799 line 10. What was the headspace volume of the N2O/CH4 chambers?

We used the same chambers for CO_2 exchange as well for the CH_4/N_2O exchange measurements. Therefore the volume counts up to 78x78x50 cm or 304.2 l. We added that information to chapter 2.2. It reads now:

"A total of 29 measurement campaigns were conducted during these two years. Closed square chambers (0.78 m x 0.78 m x 0.5 m, 304.2 l) were used in through–flow (dynamic) mode."

P 6799 line 13. Is there potential for underestimation of CH4 and N2O fluxes due to water vapour dilution in the chamber headspace?

Of course this potential does exist, but we assume only a minor impact since

a) the implemented chambers have a relatively large volume of 304.2 l,

b) in comparison to that volume the relative concentrations of methane and nitrous oxide (parts per billion) are very low

c) water vapour can–according to gas physics– can only take up a maximum volume percentage of 4% in the headspace, which is very low. Levy et al. (2011, doi: 10.1111/j.1365-2389.2011.01403.x) who investigate error sources in chamber measurements, show that dilution in water vapour is a negligible source of error.

P 6800 line 1. Was a linear or non-linear model used to calculate head space gas concentration change over time (deltaC/deltaT)? On what basis?

We used a linear model based on Fick's 1st law assuming a diffusive flux and a steady state during the measuring time in the chamber headspace. Additionally we tried to keep the measuring time as short as possible (as mentioned above 2-5 minutes for CO_2, 60 minutes for CH_4/N_2O measurements). We never found a sign of saturation during our measurements. When saturation effects occur some others suggest the use of non-linear model (e.g. Kutzbach et al. 2007). However, in this case there can be no purely diffusive flux, because this assumes a steady, steep concentration gradient, which is disturbed when saturation occurs.

Results

P 6804 line 20. I disagree that fig4 shows high temporal variability in N2O flux for all sites. NO2 fluxes from the NW site are consistently close to zero.

We apologize. That's a typo, we meant variability between spots. We changed the text into: "N_2O fluxes (Fig. 4) show high variability between repetitions."

Discussion

P6810 line 26.Paragraph beginning "Furthermore, all three sites. . .." There is no description of a statistical test of significance in the methods or results. Suggest deleting.

That is true. However, we tested the significance of the linear regression in figure 5 which indeed was highly significant for all three sites. Yet, we discussed that issue again and found that it is way too speculative to reason an increase (GI and GE site) or decrease (NW site) out of only two years of measurement, though statistically there is one. Therefore we deleted that paragraph and changed figure 5 accordingly.

P6811 line 6 onwards. Regarding the NEE modeling exercise. Figure 6 shows very high R2 values, above 0.9 for all sites. As I understand it however, with fitted parameters for three sites and 29 time periods, there are approx. 348 fitted parameters for 840 data points. The "high accuracy" is therefore unsurprising - the model has also not been tested against any independent measurements. The first sentences of section 4.5 and Fig. 6 are a therefore a little misleading. My feeling is that as an empirical exercise to quantify differences in GHG flux between sites, the analysis is valid, but I would like to see some summary information on the degree of model fit for individual site/time points, and a figure or table showing how the fitted parameters (and model errors) vary through time.

You are right, this may not be clear to the reader. Now, we made an appendix and prepared three tables with model parameters, the standard errors of the models and the number of measurements used for modeling of all three sites throughout the measuring period. We point to the appendix in the text (at the end of chapter 2.5) at this position to allow the reader to delve deeper into the model description and statistics but–for the sake of conciseness–we did not include such a table in the main body of text.

P6812 lines 16-19. I agree with the Editor here, this sentence is overly speculative – it could be interpreted as a value judgement.

This may be true. We rewrote it and tried to avoid the value judgement. It reads now:

"The ultimate goal of restoration measures from the sight of nature protection should be to bring drained and exploited bog peatlands to near–natural conditions, since only under near–natural conditions will these areas be able to accumulate carbon at longer time scales like centuries. For shorter time scales like years to decades the rewetting and less intensive management of these areas can be a useful step enhancing their carbon balance."

Technical corrections

Define abbreviations in the first instance then use consistently.

We changed that throughout the text and made the explanation in the first instance.

Delete the use of "cf." from references to figures/literature unless needed to highlight a specific contrast or similarity.

We modified the usage of this abbreviation and removed it were it is not necessary.

p 6797 line 12. replace "were" with "are"

Thanks, we changed it accordingly.

p 6797 line 19. Provide full reference for "DWD 2010"

Thanks for the comment, we added the explanation for the abbreviation 'DWD', now it reads: DWD (German Weather Service), 2010). However, there is no full reference in the sense of a bibliographical reference. It is a data source.

p 6798 line 7. Keep units consistent with the following paragraph (g m-2 or kg ha-1)

Thanks, we changed it into g m^{-2}.

p 6803 line 3 sentence beginning "During the study period. . ." is too long.

That was indeed a long sentence, we edited this section and it reads now:

"During the study period, mean annual air temperatures were higher (10.2 C in 07/08 and 08/09, 10.8 °C in 2008) than the long-term average (8.5 °C) for all periods. The long-term average of precipitation is 926 mm. In comparison, precipitation was slightly lower in the first period (916 mm in 07/08), slightly higher in the second period (929 mm in 08/09), and even higher in 2008 (1024 mm). Thus, atmospheric conditions in both years deviated from the long–term (1961–1990) climatic averages (Fig. 2)."

P6803 line 20. replace "neutrally" with "neutral"

Changed accordingly.

P6803 line 21. Word missing in sentence beginning "In contrast. . ."

Thank you, we changed it into:

"In contrast, the NW site neither stored nor released CO_2 in the first year and accumulated CO_2–C in the second year with –8 ± 68 g m^{-2} and –127 ± 53 g m^{-2} (Fig. 3, Table 2)."

P6805 line 19. 441 ± 157g rather than 434 ± 157g is reported in results section.

Oops, we mixed the numbers of an earlier calculation. Has been corrected. The 434 ± 157g is the correct value.

P6806 line 3. Report statistical method and significance as p value in results section.

We added a sentence according to your comment to the results section (chapter 3.2), it reads now: "The GI site was the biggest source of CO_2–C in both years with 548 ± 169 g m–2 and 817 ± 140 g m^{-2}, respectively. However, when considering only NEE–without accounting for cutting and manuring–the years did not differ significantly (permutation test, significance of difference of means = 0.33)."

P6807 line 8. Replace "already huge" with "large".

Changed accordingly.

P6807 line 8. Reference to Fig 4 should be to fig. 3

Changed accordingly.

P6807 line 21. Delete "all in all" and replace "approve" with "support"

Changed accordingly.

P6810 line 6809. replace "is even" with "would be". Delete "even" from sentence

beginning "This would even. . ."

Changed accordingly.

P6810 line 23. Sentence beginning "after all, our study. . .". Delete "after all", "very", and "by others".

Changed accordingly.

P6811 line 4. Replace "bee" with "be"

Oops, that's an interesting typo. Changed accordingly.

Fig. 4. The dots symbolising manure applications look like data points, suggest changing to a different symbol.

We changed the symbols into triangles to differentiate them more clearly from the data points. Furthermore we changed the caption accordingly.

Fig.3. explain in legend that cumulative NEE is reset to zero at end of year (July)

Thank you, we changed the caption accordingly, it reads now:

"Fig. 3. Modelled CO_2 exchange during 2 years of measurement. R_{ECO} is below, GPP above zero at the left y–scale. The black line refers to cumulative NEE, which is displayed at the right y–scale. After one year (end of June 2008) it is reset to zero. White background represents the growing season, grey background non growing season. Note that for the GI site the measures (manuring, cutting) are displayed with respect to their absolute import/export value at the right y–scale."