

## **Anonymous Referee #2**

This manuscript describes a one year mesocosm experiment with two types of vegetation communities sphagnum mosses and sphagnum + molinia grasses. CO<sub>2</sub> and CH<sub>4</sub> fluxes have been measured extensively over the one year period and this MS discusses the vegetation community caused differences in the annual GPP, ER and CH<sub>4</sub> fluxes. The topic is important but I have two main concern: 1) the authors don't report if the molinia impacts the sphagnum mosses in any way during the experiment. If the impact of molinia is simply additive it may not describe the "field impact" of dense vascular cover on sphagnum dominated ecosystem and its functions. 2) only 1/3 of the data used here is "new" and this is not clearly told.

### **Detailed comments:**

l23: to have pg1 l27: maybe C storage would be better term than C sink

- Yes, it have been modified

pg2 l1: this sentence doesn't read well. consider changing into something like: Accumulating Sphagnum litter forms a major component of peat (Turetsky, 2003) and creates acidic...

- It have been modified.

pg2 l9: reference needed for stimulation

- Indeed, we added the reference : Girkin et al., 2018

pg2l10,change order of sentences: the increase in greenhouse gas emissions,mainly carbon dioxide (CO<sub>2</sub>)and methane (CH<sub>4</sub>) could shift the peatland from a sink to a source of carbon

- Done

pg3 l1: how was Molinia removed? with roots and stems?

- The young Molinia was carefully removed with roots and stems (added in the text)

pg3 l3: how was the wtl controlled?

- Information have been added with : "with addition of peat water when necessary"

pg 3 l3: what was the density of the sphagnum mosses in the treatments?did molinia impact sphagnum in any way? Considering the impact on invasion, it is a very different situation if molinia is just added on top of the sphagnum or if the invading molinia affects the sphagnum by decreasing its cover. the studies you refer in introduction imply that vascular plants replace sphganum mosses: A dense vascular plant cover should make the moss layer less dense and therein impact its functions. I am not sure how your treatment is in line with this as I expect that the pure-sphagnum mesocosms have grown under molinia during previous growing seasons. or did you choose such plots that had very little molinia originally? I think this is a really major issue and you should properly explain how this operates in your experiment. so does the moss layer in the two treatments differ in any means?

- Information have been added : "All mesocosms were choose because they was entirely covers by *Sphagnum rubellum* and without *Molinia* stems. *Molinia caerulea* appeared in May and increased up to 60% of mesocosms on average until its senescence in November (Leroy et al., 2017) and did not affect *Sphagnum* cover (unpublished data)."

pg3, l10: are you using here the same data that has been published already by Leroy et al 2017, with only GPP added? This feels strange to me. only 1:3 of the data is new. At least you should be clearly stating this.

- The ER and CH<sub>4</sub> emissions data in Leroy et al 2017 are used to compare the temperature sensitivity between the plants communities. Here, we used in different purpose. It is to establish a C balance between the treatments and that why the GPP have been added. A sentence have been added to explant this.

pg3 l15: Did you measure PAR during your NEE measurements and did the irradiation stay stable during the measurement? using the PAR measured every 15 min might be fine during clear days, but often it varies quite a lot.

- The PAR was measured at the beginning and the end of each of the NEE measurement and remain stable during of the measurement.

pg3l20: Explain here that you are improving the data analysis from your previous paper so that you can evaluate the annual flux

- Done

2.3.2: Now this is very much unclear that you have actually not used the data collected as explained earlier to calibrate this model, but you use different data that is explained only later. I think you should move the GPP model calibration explanations here and explain the measurement methods much better

- Information have been added to clarify this point.

pg4 l9: did you measure PFD?

- The PAR was measured at the beginning and the end of each of the NEE measurement

pg4,l18: what is the measured T ?soil? air inside chamber? And how was it measured?

- T the air temperature measured with the weather station. The information have been added.

pg4 l21: maybe you should refer here to your previous paper?

- Done

pg4, l27: randomly selected pg5 l1: see previous comment on GPP model

- It have been modified

pg5l16: why did you decide to leave DOC out from this MS though you have measured it? 2.4: maybe open this a bit more. Effect of Molinia to what?

- The DOC is not discussed in this MS because we measured its concentration but not its export (due the experiment setup). In this way, the discussion about the difference of DOC would have been close to our previous article.

pg6 l4: why does PAR differ between the treatments? did you have a sensor in each mesocosm and at which height? from methods I understood that you have a weather station measuring par, temp, wt variables, but these results make it look like they have been measured from each mesocosm

- The environmental parameters reported in the Table I are those measured during the 15 min of CO<sub>2</sub> measurements and measured for each mesocosm.

pg6 l2: why are ghg fluxes mentioned here? replace more important with "higher"

- It have been replaced

pg7 l2: you already showed this with your previous paper

- Indeed, the ER and the CH<sub>4</sub> emissions was showed in the previous paper. However, here we added the GPP and NEE and mostly want to showed these results without need for lecturer to go to our previous paper.

pg7 l3: delete table 1

- Done

pg7 l4: the fig 1b gives impression that sphagnum has not yet stabilized to conditions without molinia during the first summer, while during the start of next summer GPP is clearly higher. maybe the cover and density of sphagnum has increased as they have grown for a year without any shading molinia? Similarly, the difference in the rate of ER is much more pronounced during the second year, implying that molinia roots in pure-sphagnum plots have decomposed.

- Indeed, there are an increase of fluxes the second year. However, this effect was noticed in both vegetation treatments (not only in pure-sphagnum plots). It can be related to a growth of Sphagnum mosses but also to different environmental conditions during the measurements.

pg7 l13: increased (not decreased)

- It decreased from -4.6 to -7.4  $\mu\text{mol m}^{-2} \text{s}^{-1}$ .

Figure 4 b) Do you think it reasonable to present daily GWP? how did you even obtain the values as in methods you say you calculated them based on annual, not daily flux estimates?

- The Fig. 4b was removed. It was not referred in the text

pg11 l1: GGCB

- Modified

pg11 l1: is it possible that there remained some root of clipped molinia in sphagnum columns that were decaying during the first half of the year?

- When the mesocosms was collected, they only contains only Sphagnum. However, they was also all surrounding by Molinia caerulea, so it is possible that some roots was decaying in plots.

pg11 l8-10: maybe you want to give some reason, with references why molinia increased GPP. more photosynthesizing plant material, potentially higher photosynthetic capacity? Molinia did not decrease sphagnum cover compared to pure sphagnum (true or not?).

- Yes, indeed. This points have developed in the discussion part.

pg11 l14: lower GPP or actually lower photosynthetic capacity and lower leaf area?

- We regrouped both photosynthetic capacity and lower leaf area into the term of GPP because there are lower leaf area of shrubs compared to *Molinia caerulea*. However, the comparison of their photosynthetic activity have not been performed.

pg11 l22: *Molinia* is not a sedge

- Right, it have been modified

pg11: 4.2. I am not convinced how interesting is the discussion about the parameter sensitivities, especially for empirical parameters that do not have a clear ecologically meaning full explanation (such as  $P_{max}$  or half saturation constant), My advice is to shorten this section and leave only meaningful explanations

- With the comment below, this sections was modified

pg11 l28: how did you validate this?

- With the supplementary material Fig. S1a.

Pg11l30: through out the MS you use terms irradiation ,PPFD and PAR, please choose one of these and use only it

pg12 l2-3: delete "as CO2 emissions", it is bit confusing there

- Done

pg12 l4-5: this is one example of unvague text that I would delete: Parameter d connected to the WTL had an opposite sign in the two vegetation covers. This difference was difficult to interpret as the large variation of parameter e shifted the relationship between parameter 5 d and the WTL.

- This part have been removed

pg12l9-10: rephrase: Vascular plants as *Molinia caerulea*, can influence the methane production through the introduction of root exudates into the deep peat layer by increasing substrate availability.

- Done

Also, add a reference for this pg12 l13-14: based on the above explanations I don't quite buy this. why would it switch to hydrogenotrophic as acetates are provided for acetoclastics? pg12

- The sentences was modified as follows : Whilst roots exudates are source of acetate and thus suggested to favor acetoclastic methanogenesis (Saarnio et al., 2004), the roots exudates also stimulate the decomposition of recalcitrant organic matter favoring hydrogenotrophic methanogenesis (Hornibrook et al., 1997), and maybe more than acetates promoting acetoclastic methanogenesis.

l20-21: you could add the references also to here

- Done

pg 12 l26-27: but you do have last year's roots there?

- At the beginning all mesocosm was only pure-sphagnum plot. During the collection, only few roots was apparent, especially in comparison to the the end of the experiemnt

where, Molinia+Sphagnum mesocosm contains high roots biomass ( at visual scale, not measurement was performed)

pg13 l31-pg14 l4: I don't think you need to repeat this information here but maybe you can give some implications that your study likely has.

- This paragraphs was here to sum up the informations discussed previously but some ipmications have been added