

## **Anonymous Referee #2**

Received and published: 5 August 2016

Metzger et al present an interesting study addressing process interactions and parameter sensitivity for model carbon dynamics in a natural peatland. This is a “heavy” topic and the authors did a good job. Their findings are important and meaningful for both model users and model developer, the latter of whom they overlooked. There are some aspects needs substantial revision.

a) There are too many small paragraphs with only one or two sentences. I would suggest the authors to combine them.

***OK, done in the revised version.***

b) The authors claimed “interactions between parameters” “limited transferability of parameter values between models and even between studies”. I am not quite understand the connections between the two topics. It could be great if the authors can elaborate more on this.

*If parameters interact, the value range resulting from a calibration depends on the values of other parameters. This demonstrate that parameters are not independent. Therefore, one cannot transfer the information obtained from a single parameter without also considering the value of the correlated parameters. The correlation obtained may be a phenomena that is related to a possible coexistence for this particular ecosystem, But it can also be because of the problem to constrain the model by not enough of data. Note that all parameters for the posterior distribution are uncertain and we do not expect to find a narrow range for single parameters since also the real world system is expected to have a range of parameters that represent the certain temporal and spatial variability of the system considered*  
***We reformulated this (in the first part of the discussion) to be more clear.***

c) The authors mentioned many times of “CO<sub>2</sub> model(s)”, which seems improper because the CoupModel is more like a C cycling model, rather than CO<sub>2</sub> model.

*We agree that the study is not with emphasize on CO<sub>2</sub> instead it will try to understand the full carbon turnover at the specific site. However, the use of NEE from flux measurements is of course the major response to all the ongoing processes and fluxes of the ecosystem.*  
***We changed the title to include heat and water fluxes.***

d) This work is not only meaningful for model users, but also for model developers. Nowadays, for example, many researchers develop and use models to predict impacts of climate change on carbon cycling or hydrology, and others. However, many of these models are not integrated or balanced enough representing all aspects (processes/modules). Such model predictions lack of credit for me. I could suggest the authors also discuss this aspect in the discussion section. Overall, I think the paper is publishable after major revision. Some specific comments are:

***With "modellers" we mean not only model users but also model developers. We included them more explicitly at several points in the revised manuscript.***

1) Line 9-10: From my understanding, most previous models focused only one or few modules because their model emphasized only on these module(s) and simplified (overlook) others. Interestingly, this could highlights the importance of the present study. The authors may want to elaborate this point more.

*Models are always a simplification, and even that we show the interactions between the different modules, we would not like to devalue simpler models - it always depends on how accurate the model prediction need to be.*

*We included the importance of considering the different processes together in the last sentence of the revised abstract.*

2) Line 13: Please specify the modules to make the reader to easy understand.

*OK, done in the revised version*

3) Line 20: This sentence is hard to understand. Please revise.

*OK, done in the revised version*

4) The introduction contains too many paragraphs and they are not very well logically connected. Please consider to reduce them into 4-5 paragraphs.

*We reordered the paragraphs in the introduction in a more logical order and combined them, including some reformulations.*

5) Line 28: I think these findings will be of critical importance for model development as well.

*We added the model development at several places in the manuscript.*

6) Line 1 in Page 9: What do you mean of “uniform random distribution”?

*The values are randomly taken, whereas all values in the range have the same probability of being used - this is added in the revised version*

7) Line 9 in page 9: Has this definition of sensitivity been used by others?

*There are several possibilities to quantify sensitivity. Most common are measures of the difference between prior and posterior parameter distribution. As we use a simple uniform distribution, it is not necessary to use sophisticated methods like Kolmogorov D statistic or stepwise regression analysis. The simplest way is to just compare the range of posterior and prior distribution. This has certainly be done in one or another way by other studies as well. In contrast to the R2 value between parameter values and performance, this accounts also for parameters that have an optimum range around in the centre of the prior distribution.*

8) Line 21 in page 9: Please explain clearer how the equifinalities was quantified.

*Reformulated to: "Equifinalities were quantified by the R2 value of a simple linear regression through the values of the interacting parameter pair in the accepted runs."*

Figures quality/resolution are low. It is hard to read these figures

*Higher resolution will be provided in revised version.*