

## ***Interactive comment on “Modelling contrasting responses of wetland productivity to changes in water table depth” by R. F. Grant et al.***

**Anonymous Referee #2**

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Responses of wetland carbon cycling to environmental changes, particularly changes in water table depth, which are the key determinants to control the ecological and biogeochemical functions of wetlands, are highly non-linear and complex due to the dynamic interactions of several physical and biological processes. Several field experiments have found that wetland productivities have a significantly different response to changes in water table depth with respect to the position of water table at which the change occurred. Therefore, it is critical for an ecosystem model to capture this phenomenon in order to project well how the wetland carbon cycling would respond to the projected climate change. The authors presented the abilities of an ecosystem model *ecosys* to capture the contrasting responses of CO<sub>2</sub> fluxes at Lost Creek, WI, to changes in temperature and water table depth. This model was evaluated by comparing the modelled carbon fluxes with the EC measured C fluxes with a detailed  
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examination of diurnal and annual carbon fluxes with respect to changes in temperature and water table depth for two contrasting years (i.e. 2002 and 2006). The authors argue that the model's success is due to an explicit treatment of interactive processes among O<sub>2</sub> transfer, O<sub>2</sub> uptake, C oxidation, C fixation, N mineralization and N uptake by diverse microbial communities. Moreover, the model is examined for its sensitivities with respect to changes in external water table depth, which functions as a control to the internal water depth. The sensitivities assessment, by qualitatively showing the agreement of the modelling results to the field observation, further suggest the model, with the detailed treatment of oxygen diffusion and transfer in the oxic and anoxic zone, is able to simulate the complex responses of CO<sub>2</sub> exchanges to changes in temperature and WTD at diurnal, seasonal and annual time scales.

It is a well-written and well-organized paper.

I recommend that the paper be accepted with respect to the minor revisions.

As it is indicated in this paper, WTD is one of the key biophysical parameters to determine the biogeochemical processes in wetland ecosystems. Since *Ecosys* modelled the WTD based on the vertical and lateral flow, is it reasonable to compare the modelled WTD with the measured WTD to show the model's performance as well (in terms of a, b, R<sub>2</sub>, etc, same as the one done for C fluxes)?

P5580 Line 2-4: If all the processes are site-specific, what can we model them in a global scale or even a regional scale?

P5580 Line 14-17: It is confusing that greater WTD and shallow/deeper water tables were mentioned in the same sentence. What do you really mean for the greater WTD? Does it refer to shallow or deep WTD? Moreover, what do you mean diurnal CO<sub>2</sub> influxes and effluxes?

P5586 Line 12: Add in before the soil surface layer.

In Fig.1, what are the dz, dt and Lt?

In Table 1, RMSD was said to be RMSE? It is better to explicitly explain what are RMSE and RMSD here.

P5591 Line5-15: you have modelled hummock and hollow C fluxes separately with different configuration and parameterization. These modelled C fluxes represent the micro-scale C fluxes. However, how did you compare them to the EC measured C fluxes, representing the spatially-integrated landscape-scale C fluxes? Have you done any scaling-up for this comparison? Please check Wu et al. (2011) in Ecological Modelling, which addressed how to deal with the microtopography, for more details.

P5592 Line 13-14: Do you have any idea why this happened? Is it possible to associate with the issues on the modelled WTD?

P5592 Line 22-24: Do you mean influx refers to downward flux (i.e. C sink) and efflux refers to upward flux (i.e. C source)? If so, it is better to indicate them here to clarify.

P5592 Line 25: From Fig.3 a and d, I cannot see the weather for the two years are comparable. Can you justify this statement (i.e. comparable weather for year 2002 and 2006)?

Fig. 3,4,5 and 7: It is hard to see which one represents which one for Fig.3/4/5 b,c,e,f and Fig.7 b,c. Can you make some changes so that each presentation in these figures is more distinctive?

P5593 Line 9-11: Similar comment to the one for P5591 Line 5-15. Here hummock and hollow C fluxes were modelled with different configuration and parameterization separately. These modelled fluxes represent the micro-scale C fluxes. However, they were compared with the EC measured C fluxes, which represent spatially-integrated landscape-scale C fluxes, covering the footprints of the EC tower. So how can you make these two fluxes comparable, although they are at different spatial scales? Have you done any scaling-up work for this comparison? Please check Wu et al (2011) in Ecological Modelling that addressed how to deal with the microtopography for more

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details.

Table 2: How was NEP calculated? Can you indicate what refers to the negative DOC+DIC and NECB? How did you calculate the average from hummock and hollow fluxes? It is good to include the EC measured NEP in this table for clear comparison.

P5594 Line 26-28: Is it possible to justify this statement (i.e. driven more by variation in MAT than WTD) from model's sensitivity test or by regressing the annual GPP/NPP vs. MAT and WTD?

P5595 Line 5: Is it possible to justify this statement (i.e. driven more by variation in WTD than MAT) from model's sensitivity test or by regressing the annual Rh vs. MAT and WTD?

Fig 9 and 10: It is hard to see the distinction among these three categories. Can you change the graph scheme to make them more clearly to be distinguished?

P5597 Line 7: Add than after less and before those in NPP.

Table 3: In this table, it seems that all other variables, except water table, which was shown for hummock, were shown for average over hummock and hollow. To be consistent, why not also show the water table for average over hummock and hollow?

Section 4: Please double-check where the past tense should be properly used and where the present tense should be properly used in the Discussion section. For example, in section 4.1.1, it is difficult to follow when past tense was used for most cases.

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