Hydrology and Earth System Sciences Discussions

Interactive Comment

Interactive comment on "Parameterization of the coupling CO_2 and H_2O gas exchange model at the leaf scale of *Populus euphratica* tree" *by* G. Zhu et al.

Anonymous Referee #1

Received and published: 22 December 2009

General comments

The manuscript by G. Zhu et al. parameterizes coupled Farquhar et al. type model for photosynthesis with Ball et al. type description of stomatal conductance for Populus euphratica tree using quite novel method in this aspect, genetic algorithm. This research represents important results about the gas exchange of a tree that has not been studied much in this respect. Also the use of genetic algorithm seems to be well applicable method to be used in this respect.

The English language of this manuscript is at times difficult to follow and contains

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errors. I recommend the text to be corrected by a native English speaker. Also some carelessness has occurred and several papers are missing from the reference list.

I recommend this paper to be published with major revisions. In addition to the comments below, I hope that the effect of relative humidity to the gas exchange would also be discussed and the relevance of this tree in ecosystem studies to be more highlighted.

Specific comments

Abstract: It would be clearer to have the definitions for Vcmax etc behind each symbol in parenthesis, instead of a list of the definitions in parenthesis.

Abstract: You could include the obtained parameter values of Vcmax and Jmax in the abstract, since they are highly interesting to the readers.

p. 6504, line 23: The Ball et al. model is empirical, like said on page 6518, but this sentence gives the impression that it is mechanistic. Please rephrase.

Maybe also the English name of P. euphratica could be mentioned somewhere.

p. 6506, line 29: I don't understand, what 'in suit' means in this sentence.. Should it be 'in situ'?

p. 6507, line 3: Does the word 'implementation' refer to the model implementation? Please specify.

p. 6507, line 20: Here Rd is defined as mitochondrial respiration. In abstract you mention Rd to be day respiration. Maybe you could define 'day respiration' here explicitly.

p. 6508, line 1: I consider Vcmax to represent Rubisco carboxylation, not 'activity' as mentioned here. Also photorespiration is Rubisco 'activity'.

p. 6508, line 2: You could also mention in parenthesis that the O2 concentration is considered to remain constant.

p. 6508, line 18: Maybe you could describe how you get value for alfa from quantum yield and leaf absorptance.

p. 6508. line 20: Where did you get the value for theta?

p. 6509: What are the references for these two different exponential temperature dependences? It should also be mentioned have they differ (..the other one is Arrhenius type and the other one has an optimum temperature..) and which response was used to each variable. From Table 1 I understand that only TPU uses eq. (7), but this should be clearly told and you could mention also that for Vcmax you tried both of them.

p. 6509, line 29: g_scmin should be g_swmin.

p. 6510, line 18-19: References to wrong equations. Should be to Eqs. 8 and 9.

p. 6511, line 5: Maybe you could mention when is the growing season.

p. 6513, line 2: Theta has been used earlier in eq. 4. You should use another symbol here.

p. 6513, line 4: You should define X already here, because it is used here, not after eq. 11 like it is done now.

p. 6513, eq. 11: What is 'w' in the equation?

p. 6515, line 5: Please provide units for g_swmin.

p. 6516, line 7: It seems to me that this would be wrong number mentioned here.

p. 6516, line 18: You state here, that the model overestimates transpiration. To me it seems that Fig. 6b has 3 points overestimated and 6 points underestimated.. In addition you state on line 21 that water loss was underestimated. There is some discrepancy in these statements.

p. 6516, line 24: Here it says that the model generally captures diurnal patterns of CO_2 and H_2O exchange resulting from variation in temperature and irradiation. I miss here

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some further evidence, even though the responses for temperature and irradiation have been shown in previous figures. Could you add environmental variables (irradiation, temperature and relative humidity) to Fig 6? I also wonder why you don't talk about the role of air humidity on the leaves. If the studied tree lives in arid areas and is resistant to drought, it would be good to bring also this aspect forward.

p. 6517, line 2: Was it referenced somewhere that GA method outperforms simultaneous estimates or how is this statement argued?

p. 6517, first paragraph: I find this paragraph difficult to follow. From line 6 I would understand that it's good to have wide bounds but next it is said that they results in biologically implausible results. Please clarify this text.

p. 6518, line 10: I found it difficult to follow how you found the minimum and maximum parameter limits for Vcmax and Jmax. Can you please be a little bit more specific when you deduce these values from the analysis above?

p. 6519, line 18: It is stated here that the photosynthesis is commonly Rubisco-limited. Could you provide some more justification for this argument? E.g., according to the model the photosynthesis is limited by Aj at all the light levels at 20 C (Fig 5d).

p. 6520, section 4.3: You discuss the value of m in detail but say nothing about the value obtained for g_swmin. The value you obtain for g_swmin from fit is negative and therefore I would consider it actually to be unrealistic. It's anyhow close to zero. You should mention its negative value in this section and discuss it.

Reference list: Sharkey et al. and Wullschleger are missing from the References. As well as Bernacchi et al. 2001, 2002 and 2003.

Figs 3, 5 and 7: Using both green and red in same plot makes the figures impossible to read for a color blind. I would change the colors by taking this point into consideration. In addition yellow line in Fig 3a is not very clear. Maybe that could be replaced by a darker color.

Technical comments

Title: Should 'coupling' be 'coupled'? Same to Fig 2.

References: There are several typos in the reference list.

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Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 6, 6503, 2009.