

Interactive comment on “The importance of micrometeorological variations for photosynthesis and transpiration in a boreal coniferous forest” by G. Schurgers et al.

Anonymous Referee #2

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General comments

In this paper, the authors assessed the importance of accounting for the respective vertical distribution of light, CO₂ concentration, humidity and temperature when modelling the canopy-atmosphere exchange of carbon and water vapor. To this end, they combine a radiative transfer model, a leaf-level photosynthesis-stomatal conductance model, and in situ measurement from a boreal coniferous forest in Sweden. They found that their simulation of GPP and transpiration could be significantly improved when explicitly considering vertical profiles of the aforementioned quantities, most notably light (PAR), rather than using canopy-integrated values.

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The problematic addressed by this study are relevant, and the results will help future advances in land surface modelling. Most of the paper is well-written, the analysis is sound, and I find this work suitable for publication in Biogeosciences. Nonetheless, some clarifications and an effort of rewriting are necessary to make this contribution more reader-friendly.

Specific comments

p. 12446/15-16: The fact that part of the analysis is conducted on 5-day periods is only mentioned later in the results section (from p.12453/15). It would be good to adapt the text in order not to confuse the reader.

p. 12448/6: "Instead" is here confusing, since you do use the 2004-2010 data to derive your 'updated' $f_{dif} - f_{trans}$ relationship.

p. 12449/12: Could you provide the equation used to get J ?

p. 12449/16-18: The sentence is difficult to understand at once, consider rephrasing it (e.g., replacing "here" by "in Eq. (3)", etc.). In addition, "all respirations" or "all respiration components" would be more correct.

section 2.2.2: How is the transpiration flux modelled ?

p. 12454/7-8: Any thoughts on why ?

p. 12454/16-20: Is there a corresponding figure ?

pp. 12454/21-28 - 12455/18: From the time series (Fig. 5d), no large differences between the different cases are visible. The relative deviation plotted in Fig. 5e and

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5f is indeed much clearer, but their references come too late in the text. In addition, please consider dividing the long sentence p. 12455 1-6 into shorter sentences.

p. 12455/16-20: This statement/summary is somewhat too blunt, as its demonstration only comes later in the same section...

p. 12457/2: "optimal" is a rather subjective term here, all the more that the LUE distribution results in this case from a modelling inconsistency.

p. 12457/12: "linear" might be more descriptive than "even".

p. 12457/14-18: Why don't you use the same criterion of clear/cloudy days as in Fig. 7 ?

p. 12458/3: Aboveground autotrophic respiration also occurs at night.

p. 12458/18-19: I would rephrase this part of the sentence to make it clearer, e.g. : [...] *photosynthesis largely takes place at the top of canopy, where the relative deviation of CO₂ concentration from the above-canopy value is small (Fig. 9c and e) [...]*".

p. 12458/25-28: I do not understand this sentence. If stomata are closed in the model as described in (3), how can the transpiration be overestimated ?

section 3.5: It would be good to better define the different variability metrics used here (and maybe the sample size), e.g. by completing the end of section 2.3.

Section 4: The authors should consider rewriting the discussion section. Indeed, at present it mostly appears to be a summary of the results sections (especially the first paragraph) to which are added results from the literature without clearly making the link with the discussion of the present results. The first paragraph should go to the

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conclusions, while reorganizing the later paragraphs would make much clearer the authors' reflexion with respect to the current scientific state of the art, and potentially increase the impact of this study.

p. 12465/3: This is a rather strong assumption, so that it would be good to have some justification and/or associated references.

Technical corrections

In general #1: When referring to biogeochemical or biogeophysical fluxes and their magnitudes, it would be better to use "photosynthesis/assimilation/transpiration" along with "flux" or "rate", respectively. Not only it would be more accurate, but it also avoids confusions like those of using "assimilation" alone in a model-data comparison study where it bears several potential meanings.

In general #2: On many occasions, past and present tenses are used jointly, breaking the sequence of tenses. It would be good to revise it carefully.

p. 12449/10: Drivers might be better than "driving forces".

p. 12452/8: "artificially" goes before "remove".

p. 12453/1-2: "considerably" goes before "overestimates".

p. 12457/25: "smaller", maybe, instead of "less".

p. 12458/13: "percents".

p. 12458/18: "largely takes place at the top of the canopy".

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p. 12459/12-15: "variable" might more accurate than "condition". Also, "this" is rather vague. Consider for example merging the two sentences.

p. 12459/21-26: "to play a role/roles" is repeated in three of these four sentences.

p. 12460/1: "the latter" might be better than "those".

Figure 5: Fig. 5d does not correspond to the caption (no observed values).

Figure 9: The letters (a), (b), etc. are missing from the figure. Please also consider increasing the font size.

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