

Interactive comment on “Climate and atmospheric drivers of historical terrestrial carbon uptake in the province of British Columbia, Canada” by Y. Peng et al.

Anonymous Referee #1

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Peng et al. estimate the terrestrial carbon uptake in response to climate change and atmospheric CO₂ concentrations using a process-based ecosystem model (CTEM). Analysis is provided as regional-scale modeling study for the British Columbia Province, Canada. The paper is generally well written and easy to follow. An adequate review of literature is provided. Results are presented clearly and put in adequate context. Results are compared/validated to observation-, model- and measurement-derived data. Limitations of the simulation results are discussed.

I would recommend the paper for publication after the authors address some changes that must be made regarding the presentation of the results and their structure within the text. Though the study in a regional context adds scientific knowledge, the presen-

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tation of results and conclusions in a broader context would be appreciated.

Scientific comments:

1. Novelty of research is based on the application of a process-based modeling framework that explicitly accounts for effects of climate change and atmospheric CO₂ for entire BC province and the study being the first regional assessment for BC province. Please highlight why BC province in particular is important (example for mid-/high-latitude forests, available data sets?).

2. Modification of PFT set (p13612, l20-24): The modification of the standard PFT set with introducing a second needle leaf evergreen PFT is well explained and justified. This is stated in section 2.3 and in detail explained in the appendix and also in the appendix results for one and two representations of this PFT are compared. As it is presented and according to introduction section this does not seem not to be the main objective of the paper, the topic should be limited to these sections. p13630, Tab.2: I would suggest excluding the results for the analysis with one NE-PFT from this table. Give your results instead for all three simulations (CO₂, CLIM, CO₂+CLIM) as this is the objective of your paper. Include the comparison of simulation results for CO₂+CLIM to references (for different time periods) in this table, see other comment. p13612, l20-24: Remove these lines as this is already stated at the end of the appendix. Start line 24 with e.g. "Although by the introduction of a second needle leaved evergreen PFT, the agreement between simulated and observation-based estimates for LAI and GPP was significantly enhanced, limitations still remain." p13613, l9: delete: "... from the simulation with two NE PFTs" p13614, l8-11: to appendix

3. Structure in section 3: The headings are misleading. There are also other comparisons to observation-based estimates in section 3 that are not included in section 3.1. For comparison with observations in section 3.1 results of historical simulations are used, which are (according to the heading) only explained in section 3.2. Your order is more related to considered variables (LAI, GPP, C pools in 3.1 vs. C fluxes in 3.2), so

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say so.

4. Time periods in section 3.2: The simulated carbon sink is given at p13616/l4 with 40 TgCyr⁻¹ for 1901-2009. At p13614/l24 sink is given for averaging period 1900-2010 with 41 TgCyr⁻¹. Sinks given for the 3 simulations individually (p13615, l23) are calculated as averages of 1990-2005 (45.1 TgCyr⁻¹). Cumulative sinks are presented for 1860-2000 (p13615, l15). Forest-only fluxes are given over 1990-2010 (p13616, l6). Fire trends for 1901-2009 (p13616, l3). See also further paragraphs in section 3.2. The selection of one consistent period to calculate averages and sums for the long-term (e.g., entire simulation, last century) and one short-term period (e.g., last decade) would in my opinion help the reader when comparing results/contributions of individual fluxes and to grasp essential statements. I cannot see a necessity to jump between different periods, unless values for comparison are only available for a certain time frame. One suggested practical solution for this would be first to present fluxes/pools for the reference period(s) and then compare their values for specific other time periods to literature values. In addition I would suggest adding the information of individual comparisons to table 2 (with time periods used in each comparison).

5. The discussion section is based on a validation of one specific simulation output (stemwood growth) to ground-based measurements. The applied ground data base is valuable and so is the comparison. Though this is a comparison, same as simulation results in section 3 were compared to observation- and model-derived estimates. To my opinion data and methods description of it should be included in section 2, and the comparison itself should be an own section within the result section. If you have results and discussion sections separately, please split your text accordingly.

6. Summary and conclusions section is largely a summary. Formulate your main conclusions clearly based on the findings of the research. It would be appreciated to give conclusions of this regional-scale study in a broader context. p13620, l11-16 and p13621, l1-3 should be moved to discussion section.

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Minor comments:

- p13604, l2 + p13606, l5: simulation time from 1900 on: define analysis time frame and be consistent throughout the paper. Your transient historical simulations starts in 1860/61.
- p13604, l7: “compared to pre-industrial conditions” in this sentence not necessary as an annual flux is given. It should be moved after “About three-quarters of the simulated sink enhancement . . .”
- p13604, l8 and p13621, l11: “when multiplied with the . . . km² area of the province” delete, not necessary in an abstract/conclusions. P13608, l9: living vegetation . . .
- p13609, l13: Please specify what is meant by missing data.
- p13610, l6: about 40 x 40 km.
- p13610, l9: check sentence structure.
- p13610, l22: Mekis and Vincent (2011) not included in references.
- p13610, l23: “. . . large positive trends in precipitations. . .”. Provide estimate or average so that it can compared to the 4.4% increase shown by CRUNCEP.
- p13611, l5: Is year 1860 part of spin-up/pre-industrial simulation or part of transient historical simulation? p13611/l5 vs. p13615/l15, also elsewhere. Please clarify.
- p13612, l11: “. . .obtained by applying the modified PFT set”.
- p13613, l5+l6: unit is m²m⁻², same at p13622, l26+l28.
- p13613, l8: living (. . .) and dead (. . .) carbon pools. Same at p13616, l21.
- p13614, l17: “net sink of carbon since about 1940”: according to Fig. 5a the change from source to sink seems to be shortly after 1930?
- p13614, l25 and p13615, l25: In both cases carbon sinks averaged over a multiple-

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years time frame (Cm-2yr-1) are translated to cumulative sinks (TgC/yr) over the area of BC province. In first case real province area (944 ... km²) is used while in second case area covered by model grid is used (1005 ... km²). Use same reference for both calculations. Also abstract and p13621, l11.

- p13615, l8-13: This is no result but discussion. Move it there.
- p13617, l6: Why only 1958-1998 and not the entire period covered by the data? 1959-1998 at p13617, l21, p13618, l6 and elsewhere.
- p13616, l13-23: In the end of section 3.2 the average annual sink enhancement due to climate change and CO₂ is discussed. This topic was already raised earlier in this section (p13614, l26f). Move this paragraph to the appropriate position.
- 13620, l5: Insert comma after Canada.
- p13623: “better agreement” instead of “better comparison”?
- p13624, l28: line break after Wageningen.
- p13630, Table 2: Insert footnote to Stinson references that states alternative averaging time for these carbon pool sizes.
- p13630, Table 2: British Columbia consequently abbreviated in entire text, though not here (+ p13612, l25).
- p13633, add “averaged over 1998-2005” after “. . . Beer et al. (2010)”.
- p13634, Fig. 4: Is there a reason for the longer averaging period (1990-2005) selected for this figure? On page 13613/l10, the spatial distribution of vegetation biomass of Fig. 4 is compared to LAI in Fig. 3 though averaging time frames differ from 5 years (Fig. 3) to 15 years (Fig. 4). Averaging time frame for Tab. 2 values is 1998-2005, as is for GPP in Tab.3. Why not show Fig. 4 also for averaging periods 1998-2005 (or 2000-2005) to keep averaging times more consistent?

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-p13636, Fig. 6: check unit.

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