Interactive comment on "An improved parameterization of leaf area index (LAI) seasonality in the Canadian Land Surface Scheme (CLASS) and Canadian Terrestrial Ecosystem Model (CTEM) modelling framework" *by* Ali Asaadi et al.

Anonymous Referee #1

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Dear Authors,

These are my comments of the work entitled: An improved parameterization of leaf area index (LAI) seasonality in the Canadian Land Surface Scheme (CLASS) and Canadian Terrestrial Ecosystem Model (CTEM) modelling framework. Firstly, I want to thank the authors for the work done. I felt the manuscript quite interesting.

This paper describes the addition of the Non Structural Carbohidrates (NSC) module,

to the CLASS-CTEM model. NSC module allows to better represent Leaf Area seasonality, as well as to provide a mobile carbohydrate pool to the trees to increase its resilience to disturbances in absence of photosynthesis. It is tested in three Fluxnet sites, where GPP, LAI, and heat fluxes (Incident radiation, latent heat and sensible heat) model projections are contrasted against real data. In my opinion, this is an interesting, thoroughfull work, where the authors clearly demonstrate that the addition of the NSC module clearly improves model performance. My major concerns about the present paper are about its novelty. Currently most of process-based forest simulation models does include the NSC module (Fontes et al., 2010), in a similar way than the new module for the CLASS-CTEM model. So, in my opinion, your current manuscript doesn't clarify the novelty of your work. Furthermore, throughout your manuscript there is little reference to other models that include this key compartment, and I think it would be a nice element to include in the discussion, as there is plenty of other works in which the addition of NSC in a given model clearly improves its performance.

Specific considerations:

- I felt a little lacking how the Maintenance respiration was calculated in CLASS-CTEM. I've seen other reviewers asking for the same point, and I feel like an addition of the maintenance respiration formulae as well as the assumptions of the model about this process would improve significantly the paper. Besides, I have a couple of questions about maintenance respiration: it is dependent on temperature? It is assumed the same respiration rate for the structural and non-structural carbohydrates?

- It is a minor issue, but, in general, I think your explanations about Leaf Area (LA) importance upon photosynthesis. However, I think you are wrong when referring to them as LAI (for example, lines 1, 63). LAI doesn't perform photosynthesis, it is the Leaf Area, that does it. LAI is just an explanatory index about the surface of leaf area per unit of surface.

- In lines 175-177, you state that respiratory carbon loses are assumed to occur from

the non-structural part. Does it mean that structural carbon is not accounted in maintenance respiration? I guess you did not mean that, but as it is stated, it may lead to misinterpretations.

- In point 2.1.1 (Reallocation of non-structural carbon during leaf out period), you do state that "after reaching a threshold LAI, NPP is allocated to stem and roots in addition to leaves". I could not find in your work how these compartments are developed. Do your model follow any predefined rule (e.g. the Pipe model rule, Shinozaky, 1974)? Or they are equally allocated throughout the tree compartments according to a predefined rate?

- Line 372-373. I would remove the sentence "The figure legends, in addition to identifying the two mode versions and observations, also show the mean annual value of the quantity plotted", and I would include it in the figure footnote.

- Lines 419-420. Your sentence assumes an equilibrium between the atmospheric CO2 and the biosphere. Maybe is far beyond the discussion of your paper, but I think that this is not strictly true, as there has been previous works identifying the instability of the atmosphere-biosphere complex (e.g. Higgins et al., 2002). It is a minor change, but I would suggest to erase the "currently" in the sentence, thus indicating the responsive nature of biosphere to historical changes in atmospheric CO2.

- Line 451. Again, following which rule, besides the "after reaching a LAI threshold", are the carbohydrates allocated through the three compartments? A fixed rate? A mechanistic rule?

- Point 3.3. Here, you find that you do overestimate latent heat when modelling your three forests. Are there any research papers about evapotranspiration experiments in those forests? If they are, maybe you should transform latent heat into evapotranspiration values, so you can compare them to your data, and you might then have a better explanation about why does your model overestimates so high the evapotranspiration (Latent heat). In addition, how do this relate to your overestimation of Leaf Area? I

see a little discussion about it in lines 508-512, but I think you minimize the effect that you overestimate the LAI during the growing season by about 2 m2/m-2 in each plot, and this affect both the evapotranspiration at canopy level, but also to the evaporative energy available at ground level.

- Lines 519 to 523. Please, revise the Vmax concept: as states the original paper from Kattge et al, (2009), Vmax is the maximum carboxilation capacity, not the maximum photosynthetic rate. In addition: you are justifying a tautology: This is the parameter that we want to apply to Vmax, so we adjust all other model parameters to fit the results according to this Vmax value. In addition, you finish the sentence with "it is possible that the average Vmax value derived by Kattge et al. (2009) is not representative of [...]". I agree that mean Vmax value not representing correctly your forest performance is a possible explanation, but I would rather discuss that Vmax is not the only constrain to photosynthesis, as Jmax is also limiting assimilation rate.

- Figures 4-6. I would expand a little the footnote, to include the information that results are represented as averaged daily values. In addition, I would consider to change the Leaf Area Index inner pannel to represent the median values during the vegetative period rather than average values, as I think they would be more indicative of the similarities-differences between Fluxnet measurements and model outputs.