

Interactive comment on “The Multi-Assumption Architecture and Testbed (MAAT v1.0): Code for ensembles with dynamic model structure including a unified model of leaf-scale C3 photosynthesis” by Anthony P. Walker et al.

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The paper describes a new modeling framework developed under R that can be used to estimate the epistemic uncertainty in any system model. This new tool was tested on a leaf-scale photosynthesis model whose internal processes and state variables can be simulated following several approaches or equations. Such tool would be definitely useful for the modeling community irrespective of their system of interest (global vegetation, hydrological cycles, forests etc.); however the present manuscript has some minor issues, and should be clarified in some aspects:

C1

First, there is a problem with the structure of the paper. (1) Relatively to the description of MAAT, the photosynthesis model is highly detailed. This is unbalanced, especially when looking at the abstract where only 3 sentences are devoted to the photosynthesis model. (2) The section P2-L31 to P3-L12 looks like M&M. At least I would not include it in the Introduction. (3) I would move the section 2.4 (HPC) at the end of the section 2.1. During my first reading of P6, I was wondering why the classical ‘apply’ functions were used (L16), while functions from the parallel R package were not... This information should be better located here. (4) I’m wondering if the section 4.3 could be better placed at the end of the section 4: the Brent solver can be used for any other equations/models that have to be solved, not only to calculate C_c .

Second, the photosynthesis model simulates many different processes. For some of them, only one function (~equation) can be used (e.g., C_c ; eq. 13c), while for others, there are many possibilities (e.g., photorespiratory compensation point; g_s ; etc.). It would be great for the reader to include an additional table, which summarizes the processes for which many functions can be used (e.g., processes as rows; equation number as columns); it would also highlight the high number of combinations generated by the factorial simulation design.

Finally, I’m quite frustrated to not see any sensitivity statistics in the section 5 and in the discussion. It may be intended for another paper, but the reader of the present paper can feel disappointed to not see any result (e.g., what is the uncertainty in A due to the selection of the stomatal model? see Figure 5).

Other comments:

It may worth mentioning in the title and/or in the abstract that this modeling framework was developed under R

P2-L3: “unforeseen pattern”. Do you mean emerging pattern sensus Levin (1992; Ecology)?

C2

P2-L24: “ensemble of possibilities” rather than “ensemble of opportunity”?

P2-L24: add MIP after inter-comparison projects

P2-L25: “models in the ensemble are not independent of another. Correct, here I would give as example the genealogy of global climate models developed by Masson & Knutti 2011 *Geo. Res. Lett.*”

P4-L7: As method to estimate model sensitivity to variable process representation, I would mention the classical variance partitioning approaches (~uncertainty decomposition; e.g., Nishina et al. 2015 *Earth Syst. Dynam.*; or better Dietze 2017 *Ecol. Appl.*)

P6-L1 to L4: It is not very clear what you mean by ‘run’, ‘run function’, ‘run script’, ‘runtime’; e.g., what is the difference between a script and a ‘run script’? Because of that, I misunderstood what you meant by “can configure the ensemble of all possible combinations of these choices during run time” (P2-L34), and “allowing variable assignment during runtime” (P1-L9; P7-L1). I initially thought that you could change functions to simulate a given process within a run of your photosynthesis model (e.g., for simulating gs: Ball et al. 1987 function at time step 1, Leuning (1990) function at time step 2, Medlyn function at time step 3, Leuning at time step 4 etc.), which would have been strange, and not adequate to calculate sensitivity indices. Rather, your script generates a complete factorial combination of options, and then run the photosynthesis model for each combination of parameters/variables/functions (P9). I would remove these ‘during runtime’ statements. I would also use the term ‘run’ only when you do (run) a simulation of your photosynthesis model (which could be an hydrological model, a DGVM, etc.).

P6-L27 to L29: there is a contradiction in your definition of ‘secondary state variables’. On one side, you write that they ‘can be thought as dynamic parameters’ (L17), but on the other side, they ‘are fixed parameters’ (L29). Please clarify.

P6-L30: I don’t really understand the sentence. . . could you rephrase?

C3

Figure 2: “Panel a) represents the first two steps”. Not really, the step 3 ‘run ensemble’ is also represented. Also, I’m wondering if the color information of the arrows (call, write, read) is really needed: this is a technical aspect, which makes the figure more difficult to understand.

P9-L22: remove ‘ensembles’

P23-L12 to L13: any word missing here?

P24-L19 to L21: not clear, please explicitly mention that optimums are reached at process-specific thresholds after which rates decrease.

P25-L17: add “after an optimal value” after “with higher temperatures”

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C4