



EGUsphere, referee comment RC1
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Comment on egusphere-2022-802

Anonymous Referee #1

Referee comment on "Pathfinder v1.0.1: a Bayesian-inferred simple carbon–climate model to explore climate change scenarios" by Thomas Bossy et al., EGU sphere,
<https://doi.org/10.5194/egusphere-2022-802-RC1>, 2022

The manuscript introduces the climate-carbon cycle model Pathfinder v1.0, which is a reduced complexity models that mimics complex models. It outlines the model equations and the procedure of estimating the model parameters. It further gives a number of test simulations to evaluate the model. The model is certainly of value for the climate change community and this manuscript illustrates the skill of this model to some extend. However, it is difficult to follow much of what is presented and it would therefore require a major revision of the manuscript to be publishable. Detailed comments follow below.

major comments:

(*) Aim: What is the model aiming to simulate? It is not clear. It would help to spell this out clearly. The model equation have a lot of details, like sub-reservoirs or subpools, but it is unclear if it is the aim to simulate the values of these or are they just a means to simulate something else.

(*) Level of complexity: The level of complexity in many of the model equations seems overdone, considering the simplicity of the outcomes of this model. The authors need to better explain why they use highly complex models to achieve fairly simplistic outcomes. Is the level of complexity really needed?

For instance, the ocean carbon model has five subpools. It seems unlikely that this is needed. So why is this done?

Similarly for the land carbon model.

(*) Clarity: Much of the manuscript is really hard to follow. The authors assume a lot of detailed knowledge that only very few readers will have. The manuscript need to be understood to the largest part by a wider community, and I cant see how this manuscript does that. For instance, discussion of figs. 5, 6 and 8 points out details in the text, that I assume can be seen in one of the panels, but it is largely unclear which panel they are talking about, as the text does not refer to the figure nor does it use the same names or acronyms.

(*) Parameter fit: The authors use a "Bayesian" approach to fit uncertain model parameters. This approach is hard to follow. If all the parameters are optimised, does this imply some kind of cost function is minimised? If so by how much has the cost function been minimised? How is the success of the optimisation measured?

(*) Discussion of Figures: The figure are not properly or not at all (Fig.4?) discussed. The text discussion seem to discuss the figures in some cases, but it is unclear what figure or panel is discussed (e.g. Fig. 5,6 and 8).

other comments (in order as they appear in the text):

line 114 "... classic ...": Remove "classic".

line 116, five boxes: Why is this done? Why is this needed?

eq. [17]: What is C_p ?

eq. [18]: What is C ?

eq. [21]: Why is this not a function of C_o but C ?

 r_{npp} , eq. [24]: The equation is not easy to understand. It may help to put this into words a little bit. How does r_{npp} change if C or T goes up?

 r_{fire} eq. [28]: Why do wildfires (r_{fire}) depend on CO_2 and not just T ?

section 3.3 constraints: It is unclear how the constraints relates to the previous section

parameter fits. Does the constraints lead to changes in the parameters of the model? Are the same parameters changed again? It needs a bit more discussion.

section 4.1 Posterior distributions: This section is hard to follow. I failed to understand it, but it is central to the study. It seems the text is discussing the Figs. but it is unclear how. Example: "ECS (T2x) is the parameter with the strongest adjustment ..." Is this something the reader can see in a Figure? Which Figure? Why does the text refer to different names that have no match in the Figures?

Fig. 5 Distributions before and after the Bayesian calibration: It is unclear what the message of this analysis is. It seems there is not "truth" in this, so what is the reader suppose to see here? Is the before distribution assume to be the "truth"?

Fig. 8; temperature driven setup: this needs a bit more discussion. How is this simulation constructed? The upper panels are by construction a perfect fit? Where and how is T and the atmospheric CO2 evaluated? It seems it is not down here as T is prescribed.

model uncertainty ranges in Figs. 8 and 9: Where does the uncertainty ranges for the model come from?

Fig. 9: What are the columns 2 and 3 showing? Is this the integrated carbon uptake for land and ocean?

line 515 "The ocean carbon storage appears overestimated by 5% to 20% by Pathfinder across SSP scenarios": relative to what reference?

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