EGUsphere, referee comment RC2
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Comment on egusphere-2022-802

Ian Enting (Referee)

Referee comment on "Pathfinder v1.0.1: a Bayesian-inferred simple carbon–climate model to explore climate change scenarios" by Thomas Bossy et al., EGUsphere, https://doi.org/10.5194/egusphere-2022-802-RC2, 2022

Referee comment on Bossy et al by Ian Enting

1. GENERAL COMMENT

The editors have advised me that this paper has been submitted to GMD as a 'model description' paper.
Accordingly, I have assessed it against the GMD criteria for such papers, (in about/manuscript_types.html on the GMD website)

In the primary text, I find the introduction is short of detail on the context and that the detail
about accessing the model is insufficient.

The specifications note that the text should describe the software and hardware requirements for running
the model. This is missing.

The specifications say that a publication should consist of text, code and user manual.

The authors acknowledge the incomplete nature of the current state of their site, describing it as "messy".
I have downloaded and expanded the zip file and extracted files manual.pdf and manual.md. As a user manual, I find it
inadequate because it is only a brief download instruction, a list of model variables an

a list of equations that presumably repeat those in the text and essentially nothing about how to use it.
The latter two sections are faulty (unreadable) as described below.

If the authors want people to try the model, they need to do better.

My recommendation is that the authors withdraw the paper and resubmit when the online information
is better organised. Releasing the model at this stage is doing a disservice to the modelling community
and the authors themselves.

1.1 SPECIFIC QUESTIONS TO BE ADDRESSED

1. Does paper address questions within GMD scope? YES.
2. Does paper present novel tools etc? NEW BUT NOT NOVEL
3. Does paper represent an advance. YES (by using Python, multiple forcing modes).
4. Are methods and assumptions clear and correct?? NEEDS MORE DETAIL IN PLACES (cf other referee)
5. Do results support conclusions? YES
6 Is description enough to allow independent implementation? YES FOR MODEL, QUESTIONABLE FOR CALIBRATION
7. Do authors credit previous work? IMPROVEMENT NEEDED
8. Does title reflect contents? YES
9. Is abstract sufficient ? YES
10. Is presentation well structured and clear? MOSTLY
11. Is language fluent and precise? YES
12 .Is maths etc OK? YES
13. Should any parts be reduced? NO
14. Are number of references sufficient? NEEDS IMPROVEMENT. SEE Q7.
15. Is amount and quality of supplementary material adequate? NO.

2. SPECIFIC COMMENTS

2.1 Without doing a line-by-line check, it seems to me that the description is sufficient to enable
someone else to implement equivalent code to integrate the model equations.
The ability to run with multiple choices of two input series is more problematic
(without actually writing 6 separate versions (sharing some code) using the principles described by Wigley 1991).
There does not seem to be enough information to independently implement the model calibrations. (This is not necessarily a GMD requirement).

2.2 The manuals and online information.
(This is based on the contents of the zip file from the zemodo repository).
The manual consists of 3 sections :
* Run a simulation
* Notation
* Equations
2.2a. Manual.pdf
Many aspects are not being displayed, even in the list of variables. My guess is that the pdf has been created
in a form that makes use of external fonts on the author's system, rather than importing the
requisite font descriptions (maybe for math fonts) into the pdf file. The whole of the equation section
fails to display.
2.2b. Manual. md. This is the other way round. The equation section displays as math characters, presumably reproducing what is in the text.
However the Notation section is just an unformatted, unspaced string of ascii characters with occasional
math symbols, presumably those missing from column 1 in the equation section in manual.pdf.

2.3 The online files. (From the .zip)

As noted, the "manual" does not describe what is needed to run the model, in particular what input files
are involved? For example what is the role of the .nc (netcdf?) files and the .xlsx files.
How do these relate to the RCMIP standards noted by Nicholls 2020, 2021?

Similarly, the comments at the beginning of each python file give no information about what the file is for
and even if is is the main file or a module called by one or more main files.

2.4 Role of model.
The authors state that they have identified the need for a new model, citing Nicholls 2020.
This is not obvious from that paper. More detail should be given, being more specific about the
niche that the model is intended to fill and the relation between this paper and earlier work such as
Meinshausen 2009.

2.5 Mixed layer pools.

The other referee raised the issue of the meaning and number of the mixed layer pools. This
structure has no physical meaning and simply represents a mathematical transformation to go from the impulse response function of Joos 1996 to a set of differential equations. This is presumably a well-known transformation, although I first became aware of it through
Wigley 1991. The number of pools derives from the number of exponentials in the impulse response function. An approach (derived from electrical engineering) for deriving lower order
approximations is given in my recent paper Enting 2022.

The structure has the 5 pools operating in parallel. Writing the equations in matrix vector form
as dx/dt = A x + b.f, where f is the input, it should be possible to take linear combinations (applied to both rows and columns of A) such that only one element of b is zero,
and maybe even end up with A in the tridiagonal form representing pools in series.

2.6 Calibration
At one point is is noted that the philosophy that priors are defined by the more complex earth system models,
with posterior values determined by applying observations as constraints. If this is true throughout,
it should be stated in both the abstract and the introduction. Of course, this sort of Bayesian
calibration is vulnerable to the likelihood that such priors will be drawing on some of the same information as the constraint data.

An extra sentence on the PyMC3 operation would be helpful.

2.7 Input time series.
It is unclear what happens to the two input time series (which would seem to be needed at all times) as
as the calibration adjusts the 6 parameters that characterise these series.

3 TECHNICAL CORRECTIONS

Line 296. Cross reference not working.

Line 440. to be -> from being

Line 549 stricken -> struck

Caption for table A1 notes an indicator of prognostic variables. This does not seem to be used.

I have not made any attempt to check against the guideline that papers should use either US or UK English, but not mix them.

4. REFERENCES

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VOLUME = {13},
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Ian Enting 29 September 2022.