Reply to the reviewer's comments: TransEBM v 1.0: Description, tuning and validation of a transient model of the Earth's energy balance in two dimensions (gmd-2020-237)

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Summary of changes

We thank the anonymous reviewer for taking the time to assess our manuscript and for providing many valuable and in-depth comments. In response to the suggestions by the reviewer, we plan to

- improve the readability and flow of the text in sections 2.2 and 2.3 and
- improve the presentation of figures and tables, in particular with respect to color choice, as well as table layout and descriptions.

A detailed response to the helpful remarks of the reviewer is given below.

1 Detailed response

(Original report cited in italics)

1.1 Minor comments, general

I find the flow of the text disrupted in Sect. 2.2, due to the many small tables and long table captions. I ask the authors to make the row/column structure consistent for every parameter and shorten the captions if possible. I suggest rewriting paragraph 2-4 of Sect. 2.3, preferably placing the details related to software, computer type, compilers and processor in the same paragraph.

We appreciate this valuable comment and agree that the tables as they are hinder readability. We will make the table structure consistent and try to shorten the descriptions as much as possible. We will also rewrite Sect. 2.3 to reflect the referee's comment and improve the flow of the text.

1.2 Minor comments, specific

L. 10, 210,364: when referring to the climatological period, I would prefer to write the complete year 1989 (1960-1989, instead of 1960-89). You switch between both writings throughout the text.

We thank the referee for spotting this, we will write the years out in full consistently upon revision.

L. 18: "...fill gaps left by proxy and observational records," -¿ isn't a proxy record also an observational record? Consider reformulation.

Indeed, this is misleading, we will change the phrasing.

L. 233: "... were only discarded if they produced a change in GMT by several degrees". Please specify to greater detail the cut-off. "Several degrees" is not informative enough.

We agree with the referee that this is too vague and will improve it.

L. 127: "...timescales of order 10ˆ2 years and higher", consider replacing "higher" with "longer".

We will implement this replacement.

L. 251-252: "TransEBM agrees well with the reanalysis. In particular, it is able to simulate the dip in temperatures around the equator as well as the temperatures in the polar regions."
This appears to be contradicting the sentence on Discussion lines 371-372, or you need to elaborate:
"In the latitudinal temperature distribution, the dip in temperatures near the equator related to the Intertropical Convergence Zone (ITCZ) is not reproduced."

We thank the referee for noticing these inconsistent statements. We will adjust the writing in both cases to refer to the specific simulations: in the first case, the statement refers to the tuning period, for which a better match at low latitudes around the ITCZ was achieved in comparison to the parameterization by Zhuang et al. (2017). The part in the discussion was meant to describe simulations outside the tuning period. In these, the agreement in equatorial regions decreases as shown for example in the simulation of the past millennium. We will improve the statements accordingly.

L.269-285: consider specifying that the validation in this subsection relies of the implemented restarting extension.

We will improve the phrasing of the subsection to make this clearer.

L. 286-306: Similarly, this validation is associated with the extension to transient forcings and transient simulations. Consider highlighting these features.

Many thanks to the referee for this excellent suggestion, we will incorporate it in the text.

L. 288: "...follows Neukom et al. 2019, as does CO 2 ." Not clear what you mean by "follows", please reformulate.

We will improve the wording.

1.3 Comments on figures, including color choices

The following comments on color choices and contrasts for the figures are given because printed colors appear slightly different than they do on the screen. A high-quality printer was used for printing this manuscript, so the following comments should be generally applicable.
Page 5, Figure 2: the black font on blue background color is difficult to read in printout.

Indeed, we did not test the colors in a printout and are grateful the referee made us aware of this shortcoming of our color palettes. We will adjust and test them during the revision of our manuscript for all figures, in particular those suggested by the referee below.

You use italic fonts for CO 2 for the first time in the caption. Italics are also used later in the main text, but inconsistently. Normal fonts are used e.g. in the abstract. I prefer normal fonts for CO_2, please check throughout the text and make the use consistent.

Again, we thank the referee for spotting this inconsistency. We will eliminate it in the revision process.

Page 12-13, Figures 6-7: the individual colors used to distinguish "changed" and "unchanged" features are too similar for the printout.
Page 14, Figure 8: Yellow-ish colors are difficult to discern for the printout.
Page 20, Figure 13: Please add legends to this figure as well.

We will move the labels into a dedicated legend.

Page 21, Figure 14: colors of PAGES2k and CESM time series are too similar to discern for the printout.
Page 29, Figure C1: both panels labeled as (b). Numbers superposed on the maps are difficult to discern for printout.

We thank the referee for discovering the error in the panel labels, we will correct it. Similarly, we will improve the coloring of the superimposed text.

1.4 Comments on tables

Consider shortening captions for tables 1-4 in sect. 2.2.

We agree with the referee that the tables disrupt the readability of the section and will try to shorten them accordingly.

Page 19, table 9: consider specifying the context of the zero-sea level of Grant et al. (2012).

We will specify the zero-sea level of the reference.

1.5 Suggested addition and references

Introduction pages 2-3, lines 58-73:
Studies show that EBMs are able to simulate hysteresis and tipping points, but CMIP5 GCMs cannot simulate such strong transitions, exemplified for the Arctic sea ice and the Atlantic meridional overturning circulation (Wagner & Eisenman (2015), Bathinay et al. (2016)). It could be relevant to highlight this capacity of the EBMs compared with more complex models.

We agree that this is a quality of EBMs that it is worthwhile to mention and thank the referee for pointing us to the references. We will adjust the paragraph using the suggestion.

1.6 Comments related to the GitHub code repository

Include readme file in repository:
The code is well-documented in the GMDD manuscript and in the GitHub repository. Please ensure that the manuscript and associated documentation can be easily traced from the repository. A readme file visible on the front page of the repository is recommended, referring to the Zhuang et al. (2017) and Ziegler & Rehfeld manuscripts. The readme file could for instance also list the necessary software needed to run the code and repeat the statement of the software license which is included in the manuscript.

We agree that the repository should include a readme (listing references, license information, and necessary software) and will update the repository to that effect.

Suggestion of test code visible on the front page of the repository:
The authors describe the default configuration file on manuscript lines 325-329. This information together with other defaults could be summarized and highlighted in a separate "Test run" file of the repository, instructing the user to an example testable code to help validate their installation.

Another excellent suggestion that we will gratefully implement.

References

Zhuang, K., North, G. R., and Stevens, M. J.: A NetCDF version of the two-dimensional energy balance model based on the full multigrid algorithm, SoftwareX, 6, 198–202, https://doi.org/10.1016/j.softx.2017.07.003, URL http://dx.doi.org/10.1016/j.softx.2017.07.003, 2017.