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Interactive comment on "BRICK v0.1, a simple, accessible, and transparent model framework for climate and regional sea-level projections" *by* Tony E. Wong et al.

Anonymous Referee #3

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Manuscript Number: GMD-2016-303 Title: BRICK v0.1, a simple, accessible, and transparent model framework for climate and regional sea-level projections

General comment

This manuscript outlines design choices for the simplified contribution-based sea level model BRICK, lists the underlying equations and shows some of its features. Further, it discusses a simple application deriving regional flood risk. I expected the manuscript to be a model description paper, (which is also the chosen GMD category), but it is not. The reader is directed to another manuscript (Bakker16b, https://arxiv.org/pdf/1609.07119.pdf), which is currently under review elsewhere. Figures on calibration of sea level components as well as global sea level projections

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Discussion paper

for the RCP scenarios, which I expected in this manuscript, are instead found in Bakker16b. It is therefore difficult for me to judge what is new and original in this paper (except for the applications) and would provide sufficiently substantial advance for publication in its current form. Both the manuscripts seem to point to the same source code and I think that attribution of the code needs to be clarified. Further, on p13,L9 the authors mention that the calibration has been modified. Therefore, the reader does not have means to build trust in the calibration even when reading the Bakker16b paper. As I guess there is no possibility to merge the two manuscript (which I would find ideal), I therefore find it necessary that the title and abstract are adjusted so that it becomes clear that this is an application paper of the model (with the extra of presenting the equations, which are missing in Bakker16b). Alternatively, to make this an original contribution as model description paper, it clearly has to be highlighted what is new and different in this paper as compared to Bakker16b. I would then like to see the figures for the calibration and projections of the sea level components repeated (I expect they are not completely the same). On a positive note, I highly appreciate the effort of the authors to be as transparent as possible, providing input data, calibration data and source code. I quickly managed to reproduce the core figures. I acknowledge the open-source approach, which is missing for still too many of the climate modeling papers published. See also the specific comments.

Specific comments

Though the authors refer to Bakker16b for details on calibration, p13,L9 mentions that the calibration has been modified. This is also evident from the posterior ranges in Tables A1-A5 as compared to Bakker16b Table S3. Therefore, even with Bakker16b at hand, it is not easily possible for the reader to assess the quality of the here presented numbers. This needs thorough further discussion, see general comment above.

You shortly discuss over-parametrization but I find your argumentation not yet convincing. In p16 L8: Wouldn't a lower BIC for the full BRICK model be a stronger indicator for the full model being superior? The higher BIC than BRICK-GMSL actually hints to over-

parametrization, right? Also, on p16L11 you discuss that missing annual variability is of little concern. Shouldn't your more complex full BRICK model with 39 parameters better capture the dynamics and thus also better capture the shorter timescales of variability than the 13 parameter BRICK-GMSL model? Please discuss this and include some hints on where "variability got lost" and on potential improvements.

You use the model for thermal expansion that uses global mean temperature as input (equ. 15) though the DOECLIM model explicitely provides ocean heat uptake, which could be used to calculated thermal expansion. Why did you not go the DOECLIM way? Can you compare the two approaches and discuss the difference?

Your model equations 3-7 cannot be easily related to equations 8-9, which are the relevant ones for model calibration and slr contribution from Greenland. They are not in Bakker16a. Your sentence on p9L20 "SIMPLE algrebra ..." is not enough to understand the simplification from equs 3-7 to 8-9. Please outline this derivation clearly. Equ 3-7 may be moved to an Appendix together with such outline as they are not fully necessary to understand your equ 8-9 model.

Land water storage changes through dams and groundwater pumping plays a role for past and future sea level rise, see the papers of Yoshihide Wada for example. Ignoring such influences your ensemble selection as you use past global mean sea level rise as a criterion. It will also add to future sea level rise and thus flood risk. If not included in the model this should at least be discussed appropriately. It would be good to shift in ensemble members if LWS is substracted from global mean sea level rise.

Similarly, not all sea level change can be attributed to climate change since the start of industrialization as the ocean, glaciers and ice sheets all have longer memory. If I see this correctly, you assume global mean temperature change being the sole driver, thus attributing all sea level change to temperature change since preindustrial. This has been a main critique to so-called semi-empirical models and you should comment on this here or, best, do some sensitivity tests.

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You do not mention how thermal expansion (or more generally: ocean dynamics) enters your regional sea level projections though it is an important contribution. I see in your code that you assume constant thermal expansion around the globe. This should a) be mentioned and b) be justified.

Equation 13, p30 is unclear to me. Sea level rise and Antarctic ice volume loss should be related by a constant factor. Instead, your right side of the equation is a sum. I think this is wrong. Please correct or explain.

One important last point: you provide the source code and the data as a zip file (though section 2.3 highlights the importance of version tracking.) Transparency and accessibility (as highlighted in sec 2.2 would profit if you'd follow your words: using one of the gitlab/github/bitbucket sites would make your code easier accessible and changes to it transparent. I think this is a precondition for publication of the manuscript if you want to keep section 2. Such repository should hold a README.md similar to your current readme, which names the additional R packages needed, i.e. Deoptim, ncdf4, gplots, fields. http://joss.theoj.org/about#reviewer_guidelines provides guidelines for such readme. A short and illustrative example with global sea level projections would be great. Why not creating a notebook for such? See https://github.com/tanyaschlusser/Jupyter-with-R/blob/master/example-Jupyter-R.ipynb as example. I guess such gitlab/github/bitbucket repository is on your plan after publication, as also indicated in Bakker16b.

Minor comments:

Section 2: Framework design As said before, I highly appreciate your efforts to be open source and transparent, but I think this section can be shortened considerably here as it does not contribute to the understanding of the model. You could address the points mentioned in a more direct way as outlined in the last paragraph of the specific comments.

There is a zoo of reference periods, including 1850-1870, 1850-1970, 1961-1990,

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1986-2005 and 1960. I wonder if this could be reduced for clarity.

Timeseries figures: Think about your color scheme: pink and violet may not be the best combination.

Citations: The introduction includes a lot of references to co-authors. It is therewith a bit difficult to assess the paper's position within the field. Could you be broader?

Introduction: If you expand this to be a model description paper, I would like to see a recap of the state of the art of sea level projections. What about the past, what data is available, what can large climate models do . . . ?

p1: L18: useful for uncertainty quantificiation: repeats the "pivotal role in the quantification . . . of uncertainties. . ." of L16. Rephrase or delete this sentence L23: "aims to help mitigate": maybe two verbs would be enough. L23: "these issues": I can guess what you mean, but it is not clear. Be more precise.

p2: L9: "allotment" is this "allocation"? L32: "there is a wide range ...": I would move such outlook to the end of the paper.

p3: L10: "They simulate climate ...": they simulate global mean temperature change would be more appropriate at this level of complexity I think. L15: "drive high-risk events" suggests some physical driver. this is not true I think. rather "represent" or similar L17: "its flexibility": not clear -> "the flexibility of ..."

p4: L3: "to simulate climate change", as before: you rather try to model the response of global mean temperature to perturbations in the radiative forcing. "simulating climate change" is bigger than this. L4 rather "simulated temperature and sea level rise"

p.5: L9: " through a clear outlet for coupling to socioeconomic models": I think you talk about a stable and well documented API (application programming interface).

p7: L26: "below" can go I think L27-29: "Initial conditions . . . earliest year of the simulation" These two sentences do not make sense to me. Why do you start at "certain

years" and why would you integrate backwards? If this is not the standard forward in time modeling, you should explain this in more detail.

p8: L14: Why do you not calibrate the uncertain glacier equilibrium temperature -0.15°C?

p9 L20: "SIMPLE (algebra) simplifies . . ." not clear. please rephrase and expand.

p8-p9, equations 3-7 How do these equations relate to the model you use? The relation is also not evident from Bakker16a. See specific comment above.

p10: L10: Why include the time rate of sea level change? L27: 14 parameters: I think over-parametrization should be discussed also here.

p11 L3: "Each mass ..." This is about fingerprints and valid for all contributions. I would suggest to mere it into the more general section 3.3. L13: "is the main equation ..."

p12 L18: You assume the fingerprints to be constants, they would not be so in reality. As you explain later, this assumption is ok here.

p13 L9: There seems to be a modification to the approach of Bakker16b, it is however unclear how this changes your results. See general comment.

p14 "Exchanging BRICKs and full sea-level rise module intercomparison" This heading is rather confusing to me. In the first part you talk about plugging in a global sea level model. In the second part you discuss several goodness-of-fit measures. You can be more precise in the heading. And have a subheading for the goodness of fit paragraph.

p15 L5: "this specific emulator ..." refer to Rahmstorf once again here, otherwise unclear.

p16 L8: "These mixed results ...": I think this sentence has no strong basis. You should explain better why you think your model is not overparametrized if you get "mixed results." Wouldn't a lower BIC for the full BRICK model be a stronger indicator for the full model being superior? The higher BIC actually hints towards overparametrization,

right? See also specific comments.

L11: Paragraph about variability "... missing annual variability is of little concern." You are running over this, but you should not. Your 39 parameter model captures much less short term variability than the GMSL model. You add complexity just to note that you can resolve less the dynamics of SLR? You should find a good reasoning here to justify this.

p19, paragraph 4.4.3: You should name somewhere Fig. 5 as I think that is what you are talking about here.

Fig. 2: I think you here name "BRICK-R07" what you normally call "BRICK-GMSL".

Source Code Comment:

Just to let you know how a person new to the code may address this: I had a look into the code and found the READMEs and comments within the code files, great! I did not get the model running straight away, but almost. Here is my way: First, look into ./README: Ok, I need to compile fortran files. This was easy after reading fortran/README and deleting the *so and obj/* files. I think it is better to not deliver them with the code, as they are platform dependent (at least). As I did not want to do the full calibration, I wanted to test the projections. I searched for projections and you write in ./README to have a look into /calibration/README_projections, which I did. However, the script described therein, run_BRICK.R, is not given in the repository, so I could not run the projections. I went back to the ./README, followed the text and read further about./calibration/processingPipeline_BRICKexperiments.R, which I got running after an install.packages("ncdf4"). I adjusted the plotdir, needed to install.packages('fields') and install.packages('gplots') and could then source("analysis_and_plots_BRICKexperiments.R"). Nice!

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