

Geosci. Model Dev. Discuss., referee comment RC3  
<https://doi.org/10.5194/gmd-2021-384-RC3>, 2022  
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## **Comment on gmd-2021-384**

Anonymous Referee #3

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Referee comment on "Cyclone generation Algorithm including a THERmodynamic module for Integrated National damage Assessment (CATHERINA 1.0) compatible with Coupled Model Intercomparison Project (CMIP) climate data" by Théo Le Guenedal et al., Geosci. Model Dev. Discuss., <https://doi.org/10.5194/gmd-2021-384-RC3>, 2022

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### **General Comments**

This modeling system provides a much-needed bridge between global climate models and climate risk assessment. It represents an important contribution to what is an active area of research. What is presented is not a new model in itself, but rather a new combination of existing models, connecting across dynamical climate models, a statistical tropical cyclone track model, a bias correction procedure, exposure datasets, and damage functions. I congratulate the authors on producing this end-to-end modeling system that connects concepts across multiple disciplines. This is no easy task. The work is a substantial technical contribution and should be well received by the risk modeling community.

The work is well motivated with strong reference to most of the key prior studies. I also appreciate that the code and some data are publicly available and easily accessible. This supports reproducibility of the work. The methods are generally valid, though I do have requests to elaborate further on the data and methods (see specific comments below). The presentation quality is generally good although the manuscript would benefit from attention to grammar. I've called out a small number of errors at the end of this review, but there are many other spelling and grammatical errors that need attention.

The subject matter is appropriate for GMD and is worth being published after my comments below have been addressed.

## Specific Comments

My expertise is in climate and tropical cyclone modeling so my specific comes from that background.

- Line 17: I disagree that we are lacking tools to assess impacts of future TCs. See for example Geiger et al. (2021)

Geiger, T., Gütschow, J., Bresch, D.N., Emanuel, K. and Frieler, K., 2021. Double benefit of limiting global warming for tropical cyclone exposure. *Nature Climate Change*, 11(10), pp.861-866.

- Line 7 and Line 390: I disagree with the claim that the framework is 'a simple solution'. The framework requires expertise across multiple disciplines.
- Line 32-34: It seems odd to make this assertion in the introduction without any supporting evidence. I suggest reframing this statement as a hypothesis to be tested.
- This is perhaps my most important comment. I don't think the difference between your TC model and STORM is made clear enough. STORM appears to use the same SST-pressure drop relationship as you do, and STORM also uses MPI (calculated using the Bister and Emanuel formulation) to limit TC intensification. I don't understand what is new in your TC intensity formulation. Please clarify exactly what is new in the text. Is it the use of local MPI and SST along the synthetic tracks?
- On a related note, the paper highlights the importance of this new representation of the thermodynamic influence, and makes claims on lines 43-45 that it is better, but this has not been demonstrated. Is it possible (if not too onerous) to run projections with and without this new representation of thermodynamic influence to demonstrate its importance.
- It's not clear to me how you calculate local SST and MPI along the synthetic tracks. If I am correct, the synthetic track generation samples from the IBTrACS record. If so, how do you assign a calendar year to each synthetic track to extract SST and MPI (from

either ERA5 or CMIP)? If it's a random year then the environment might not necessarily be favorable for the synthetic TC (i.e., too cool SST or low MPI).

- ERA5 is still too coarse resolution to capture the most intense TCs. I suggest on Line 110 to change to 'better resolves than climate models'.
- Line 110-113: Your method to use data away from the storm center is fine but I don't think it's necessary. You are using monthly data that should smooth out the influence of TCs. This is just a comment – I'm not suggesting to make a change.
- Line 117: I note that ERA5 is now available back to 1950, but is considered preliminary.
- Line 122: Please be more descriptive of what you mean rather than the ambiguous term 'erratic'.
- I'm not sure what I learned from Fig. 3. I think this can be removed.
- Section 5: I think it would be useful to remind readers that you are keeping TC frequency and genesis distribution constant.
- Line 278-279: Please further explain why you wait 3 steps before applying the decay.

## Technical Corrections

- Fig 1: Correct 'Tranform' to 'Transform'
- I don't see a reference in the text to Figure 5.
- Figure 8: Please explain the distinction between the red shading vs. the red tracks.
- Line 81: Please correct 'AOCGM' to 'AOGCM' and expand the acronym.
- Line 273: Correct 'Algorithm 1' to 'Figure 1'.
- The reference to Figure 18 should be to Figure 17. If I am correct, then I'm also not seeing a reference in the text to Figure 18.