

Interactive comment on “A statistical-parametric model of tropical cyclones for hazard assessment” by William C. Arthur

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Summary: This study describes a model of tropical cyclone (TC) wind speed distributions that is applicable to all global TC basins. The modular approach takes collections of TC track data as input and first generates synthetic tracks for a user-defined number of years. A spatial surface wind field is then constructed along all tracks using a combination of a parametric wind profile model of the winds above the boundary layer and a boundary layer model to bring the winds down to the surface. The final stage uses extreme value theory to fill out the tail of the wind speed distribution and characterize the rare, high-impact wind speeds. An example application and evaluation of the model over Australia shows that historical TC activity is, for the most part, statistically indistinguishable from simulated TC activity.

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I fully expect that this open source community model as presented here will have a large impact as a research tool for the broader research community and also as a risk assessment tool for the re/insurance industry and other risk managers. The paper is written with clear, logical flow and is well structured. The introduction is comprehensive in outlining the problem and motivating the work. The method is well explained, but there are a few details missing (as explained below). The subject matter is appropriate for NHESS and is well worth being published.

Specific Main Comments

- 1) Introduction: I understand that this model was motivated by TC risk over Australia. But this is a globally applicable model. I suggest broadening the introduction a little to also discuss global TC risk. Then focus down on Australia to motivate the case study demonstration of capability.
- 2) It's not clear to me the value of running the wind field model vs. simply running more synthetic years to build up enough tracks in each analysis grid cell. For example, what is the difference in the 500-year wind speed based on 100 tracks in each grid cell (no windfield module) and 100 wind field values in each grid cell (associated with tracks within and just outside each grid box)?
- 3) I think it's important to state more clearly the limitations of the approach in assessing TC risk. The track generator, for example, is not adding new information. It's my understanding that since it samples from the input track parameter distributions it cannot generate tracks far outside the input track distributions (unlike a free running dynamical model). Am I correct? This is important when it comes to interpreting the ARI uncertainty bounds. These uncertainty estimates are uncertainty in the model fit to the observations. These are not uncertainty bounds on the actual TC risk. The actual TC risk would need to account for uncertainty due to the short historical record. Perhaps one other limitation is that the TCRM as currently developed does not account for trends in TC frequency or TC intensity. It therefore assumes stationary statistics. It

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could certainly be modified in future releases to account for temporal effects.

4) Method: Please explain why the time rate-of-change of central pressure is used rather than the absolute value of central pressure?

5) Method: There are a number of regression equations (Equations 8, 9, 12) that appear to be tuned for Australia. Are users to rederive these regression equations for their domain of interest, or are they globally applicable?

6) Method: I don't understand the need for a decay rate model (Equation 10). Isn't the decay rate already included in the input best track (pmin) data?

7) Conclusion: I think it would be useful to mention the option to additionally use local wind multiplication factors to better account for local terrain effects.

Specific Minor Comments

1) I read that it takes a few minutes to run a single scenario. Can some detail be added on the computational cost of running 1000 years?

2) Introduction: I may have missed it, but I suggest including a statement that the model can also be used for single event scenario assessments?

3) Introduction or Conclusion: I suggest adding that the model can be run with any input track data, not just historical best track data. This broadens the applications of the model to be used in conjunction with, for example, TC track data from global climate models to study climate variability and change effects on wind exceedances.

4) Section 4.5: It is stated that there are differences in the inland decay rates between the East and West coasts. But then a single decay rate model is used. Please justify this decision.

5) Section 7.1: The somewhat poor performance of the model over Northwest Australia is explained by the lower genesis probabilities. How is it possible for the model to miss these local genesis patterns if it is sampling from the genesis probability surface?

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6) Conclusion: The introduction mentions the high cost of riverine and coastal surge flooding. Can a brief discussion be added on whether a TCRM-like approach could be used for TC rainfall and/or flooding?

7) Figure 5: Please add the units of the genesis probability.

8) Figure 13: What do the colors of the lines represent?

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