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Geoscientific Model Development Discussions

Interactive comment on "pyPI (v1.3): Tropical Cyclone Potential Intensity Calculations in Python" *by* Daniel M. Gilford

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We thank the reviewer for their thoughtful comments and suggestions to improve this study, along with their positive recommendation of this work. We have sought to address the comments below, and hope the reviewer will find them to be an improvement on the previous iteration of this study, making the work more flexible and useful for the scientific community.

In particular, we have added a short appendix to note which functions are used and included in the pyPI repository, and relate them to the steps in the algorithm boxes. We have also added a short written section suggesting a few assumptions that one could modify to alter pyPI for their own tropical cyclone studies.

Major comments

1. We agree that a list of functions (and especially connecting them with the algorithm steps) would be a useful addition to the study for interested readers. We assume that the reviewer was referring to the steps in Algorithm 1 (in lieu of Table 1, which includes only the input/output variables).

In order to not detract from the flow of the main study itself—and to avoid moving the study towards a user's guide, as cautioned by the other referee—we have added this information in a short Appendix (B). We include the list of functions pyPI employs which are commonly used in meteorology: the empirical Clausius-Clapeyron equation (i.e. the Bolton eqn. for saturation vapor pressure), the latent heat of vaporization, vapor pressure and mixing ratio conversions, reversible entropy, and density temperature; we also include less common expressions which pyPI relies on or makes use of: CAPE, the minimum pressure estimate, the empirical LCL equation, PI efficiency, and the potential intensity decomposition.

2. We have sought to highlight the many assumptions in pyPI by (for the first time, in this study) fully documenting in section 3 the two algorithms which form the pyPI code base.

In response with the other reviewer, we considered the effects of several specific assumptions (both numerical and scientific). We discussed how changes in pLCL or CAPE could affect PI calculations, how the minimum pressure convergence threshold might affect the influence PI values, and the role of dissipative heating.

The adjustable parameters define the existing set of assumptions which can be quickly tested by users without any further code modifications. A (non-exhaustive) list of additional assumptions that would require code changes to address includes the definition of the outflow temperature, the LCL definition, inclusion of Ck/CD variability as a function of wind speed, and inclusion of a tropospheric stratification factor. Alternative characterizations of PI—such as the ocean coupled index (Lin et al. 2013) or "surface

PI" (Rousseau-Rizzi and Emanuel 2019)—could also be included in the repository as additional separate functions to improve pyPI's utility and flexibility.

We have added a short discussion in section 4 on these existing assumptions and opportunities for improvement, including the future inclusion of a tropospheric stratification factor (1-s(Gamma)) suggested by Kieu and Wang (2017). The section synthesizes what we see as the primary opportunities for growth in the pyPI.

There are certainly more assumptions which could be addressed than we mention here. For individual planned improvements in pyPI, we make use of the Projects tool in the Git repository to inform the community of our goals. We also strongly encourage users to bring them to our attention using the repository's "Issues" tool or by directly contacting the developer.

Minor comments

Eq. 14: Thank you for noting this typo. This should be R_d, and "Rd" has now been replaced in equation 14 with the appropriate "R_d" constant. Eq. 14 has also been updated for improved readability, in response to comments from the other reviewer.

References: Lin, I. I., Black, P., Price, J. F., Yang, C. Y., Chen, S. S., Lien, C. C., Harr, P., Chi, N. H., Wu, C. C., and D'Asaro, E. A. (2013), An ocean coupling potential intensity index for tropical cyclones, Geophys. Res. Lett., 40, 1878-1882, doi:10.1002/grl.50091.

Rousseau-Rizzi, R., & Emanuel, K. (2019). An Evaluation of Hurricane Superintensity in Axisymmetric Numerical Models, Journal of the Atmospheric Sciences, 76(6), 1697-1708.

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