

Interactive comment on “symp1 (v. 0.3.2) and climt (v. 0.11.0) – Towards a flexible framework for building model hierarchies in Python” by Joy Merwin Monteiro et al.

Anonymous Referee #2

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General Comments:

A journal article needs to be published on `symp1` and `climt`, to document the usefulness and importance of the models. Even though `climt` is one of the earliest models of its type, the design decisions that have characterized the model have proven to be robust. `Symp1`, while newer, shows similar promise in terms of usefulness and design.

The flow of the current paper, however, I found difficult to follow. It seems to me that the paper is trying to do two things at once, and the ways these two theses are pursued leave the paper not as strong and focused as it could be. On the one hand, the paper seems to provide a summary documentation or manual of the models. On the other

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hand, the paper aims to provide an exploration of the implications of the structure and design of the models, as shown in the subtitle, "Towards a flexible framework for building model hierarchies in Python."

The difficulty I think is that these two purposes of the paper, as it is currently written, do not complement each other as well as they could. Put another way, the manual-like descriptions of the model can be more integrated into the exploration-of-implications aspect of the paper. That is, the descriptions of the model can better flow into the implications the authors are trying to bring out. Below are a few examples of this relative lack of connection:

- Section 4 provides a manual-like discussion of design decisions. This listing provides history and details the usefulness of Python as a language. But how does this connect to the thesis that the models provide a nice framework for traversing model hierarchies? I'm not saying that the features of Python listed do not contribute to such a traversal but rather that having described these desirable features, the paper appears to do little with describing how these features support their thesis. For instance, this could be done by providing some code snippets that illustrate how the broad ecosystem Python provides makes ML analysis of model results a piece-of-cake whether one is running a single column model or moist GCM and enables easy intercomparison between results at different levels of the hierarchy.
- Section 5 describes the abstractions `symp1` uses, but there does not appear to be much discussion of how these abstractions work to simplify traversing the model hierarchy, gain greater understanding of the model, or enable more or better science to be done. Section 5.5 provides a workflow and Figure 4 shows data flow, but it's not clear what the message is. Neither the body of the paper nor the caption tell us the message. Is the message that the data flow is easy to map unlike the traditional climate model spaghetti shown in the bottom of Figure

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1? That the sympl abstractions in Section 5 enable more science to be done by making it easier to set variables? Explicitly making the connection between the model description and the implications, plus providing an illustration, would be helpful.

- It's unclear to me what is the purpose of Section 6.2 on the climt model composition. Is it to say climt will have additional features? How is this connected to the thesis of the paper vis a vis traversing hierarchies? The section says automation will result and the sympl components are used in this task but there is no other description of what automation means in this case or how that fits into the workflow of understanding and using a model.
- On p. 15, line 1, the authors mention that the difference between a single column model and moist GCM is only 40 lines. Given how little extra code is required, why do the authors not show the difference (maybe as a side-by-side comparison) and walk the reader through the structure and differences? This would be a very effective way of making the point of how easy it is to traverse the modeling hierarchy.
- On p. 19, the authors describe the novelty of their approach and the ability of using the models for "fine-grained control." However, there are no examples of experiments illustrating such use of the model; for instance, as suggested earlier, a side-by-side comparison of the code used and model results from a single column and moist GCM, done with a single script. Put another way, examples of this sort and the analysis it supports, as opposed to only benchmarking, differentiate model documentation from an exploration of what a model can do.
- In Section 10, the authors describe how easy it is to create new models for exoplanet research. Here too, an example showing the ease of either transitioning from an Earth model to an exoplanet model, or creating an exoplanet model from scratch, would help make the point.

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Again, I want to emphasize that I think the message the authors have needs to be published, but I think the paper in the current form needs improvement. Perhaps the thesis the authors are advancing is obvious to users of sympl and climt, once a summary description of the model is given, but for the reader who lacks such experience, more explicit description of how the model's structure leads to the benefits claimed is needed for the paper to be as convincing as it can be.

Specific Comments:

- I was a little unclear on the purpose of Figure 1. What do the arrows mean? What's flowing between the boxes? Data? Control? As far as I can tell, neither the caption nor the text of the paper provides such a description.
- p. 12: More description could be made of how sympl and climt are related to each other. The only description I found was lines 2–5 on p. 12. I'd recommend putting a description like that earlier in the paper and providing a more detailed description of what that means later on.
- Another source the authors might want to consider referencing regarding software frameworks for modeling is Schmitz (2014)'s, even though that work focuses on hydrological models: <https://dspace.library.uu.nl/handle/1874/293818>. Regarding issues of component ordering and a framework to manage subroutine execution order (p. 4, lines 16–24), the authors might want to consider Lin (2009)'s work: <https://www.geosci-model-dev.net/2/1/2009/gmd-2-1-2009.html>.

Technical Corrections:

- p. 3, line 15: Should be "The processes that operate within each . . ."
- p. 13: I understood older versions of climt had Federations, but the text says they are to be created. Am I mistaken? I'm not saying the authors necessarily need to correct this, but it was something I noted.

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- p. 17: Are the Figure 7 results generated by the Figure 5 script? If not, can the authors describe where to find the script to generate those results?

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