

Interactive comment on “HIRM v1.0: A hybrid impulse response model for climate modeling and uncertainty analyses” by Kalyn Dorheim et al.

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The authors present a really interesting approach to simple climate modeling that I hadn't considered before. I think this is a smart idea. The authors have done a thorough job with their analysis. My only comments are related to phrasing and context of the results. I am recommending minor revisions.

Lines 12-14: This sentence caught my attention as needing more caveating. In linear time-invariant systems the impulse response fully characterizes system dynamics. In nonlinear systems it doesn't. So as written, this sentence is coming across as though your fundamental methodology is flawed (which I'm sure it's not – based on my reading of lines 51-52, you do understand the distinction). I do agree that your approach cap-

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tures some of the dynamics, perhaps even the most important parts of it, depending on what dynamics your model is designed to represent. Some rephrasing is needed.

Lines 32-34: That's one way to do it. There are others, for example: <https://agupubs.onlinelibrary.wiley.com/doi/abs/10.1029/2011GL048623>

Line 39: I'd be careful with the word "nonlinearities". You can have linear feedbacks that still result in interesting dynamical behavior. I agree that chemistry can result in substantial nonlinearities (I think Kate Marvel had a paper on this looking at single forcings), and some GHGs are known to have a nonlinear relationship between concentration and forcing, but talking about the entire suite of carbon cycle feedbacks as nonlinear is perhaps too much.

Lines 44-45: Again, they can be. They don't have to be.

Lines 68-72: Clever. And an excellent description of where the potential problems lie. And I appreciate the validation of your assumptions later.

Lines 89-90: This assumption is known to be incorrect (i.e., efficacy; Hansen et al., 2005). That's not a problem for your analysis, but you'll need a caveat on your interpretation of your results.

Lines 96-97: This strikes me as appropriate. It's always tricky to delineate temperature from response because they coevolve, but your choice here makes sense.

Line 110: How do you impose the RF pulse in the model? (Or if this is described later, say so.)

Section 2.3 is a bit odd. I expected to actually see the results of the validation here. Perhaps move these short descriptions to more relevant points of the manuscript?

Lines 132-133: I'm having trouble understanding this sentence.

Section 4.1: I'm having a bit of trouble understanding exactly what you did. If I understand it correctly, you (1) come up with ranges of uncertainties for each of those aerosol

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forcing terms, (2) sample those spaces to come up with 29,000 sets of parameters that you call uncertainty scalars, and (3) simulate those combinations in HIRM, throwing out results that don't match historical radiative forcing and temperature?

Line 214: Typo

Line 297: Typo in your acronym

Figure 2: Can you choose different colors? Orange and gray are difficult on the eyes.

Interactive comment on Geosci. Model Dev. Discuss., <https://doi.org/10.5194/gmd-2020-33>, 2020.

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