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Interactive comment on "Reduced complexity model intercomparison project phase 1: Protocol, results and initial observations" *by* Zebedee R. J. Nicholls et al.

Anonymous Referee #1

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Dear authors, I appreciate your paper that incorporates and compares a wide variety of different RCMs with different qualities. I would like to contribute to the progress of your RCM inter-comparison project and provide a review on the manuscript submitted to Geoscientific Model Development.

As far as comments on the content are concerned, the question arises how do different RCMs introduce nonlinearities of the temperature response. Your paper is about quantifying the temperature response and does not discuss different concepts that provide conceptual understanding. However, the (equilibrium) temperature response does not always scale linearly with CO2 forcing, and explaining the reader why we have nonlin-

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earities of the temperature response (e.g. explicit feedback temperature dependence, among others) might be helpful for the reader to understand different or common model behavior. Another aspect that is important for an unexperienced reader and related to the former comment is why are different RCMs fitted to different numbers of CMIP models. For instance, some models are likely to runaway in the case of high forcing input, and this runaway can be attributed to different model parameters. Further, I can hardly imagine that a parameter which represents feedback temperature dependence is well constrained by the observational record. I wonder how strong model parameters vary between fits to the reference period/observations and abrupt CO2 experiments. Adding brief, explicit paragraphs would be helpful. This also holds true for the discussion on probabilistic projections. You mention very important aspects but how do the different models actually compare?

I've a specific comment on the understanding of time-and state-dependent feedback (lines 417-427). It is said that models with time or state-dependent feedback avoid the problem that linear models predict an equally large amplitude to negative radiative forcing as positive radiative forcing. This holds true for state-dependent feedback or the combination of time- and state-dependent feedback but the temperature response of purely time-dependent feedback scales linearly with forcing. As a short technical note, please revise your plotting routines in the supplementary material.

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