

Earth Syst. Dynam. Discuss., referee comment RC1
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Comment on esd-2021-78

Anonymous Referee #1

Referee comment on "Earth System Sensitivity: a Feedback perspective" by Peter O. Passenier, Earth Syst. Dynam. Discuss., <https://doi.org/10.5194/esd-2021-78-RC1>, 2021

In the paper *Earth System Sensitivity: a Feedback perspective*, Peter O. Passenier discusses emergent constraints for equilibrium climate sensitivity (ECS) and argues that slow feedbacks (e.g. permafrost and icesheet dynamics) are not properly accounted for in previous work. The paper is short - which is nice in many respects, but I also have a concern whether it adds new information. Science papers need to explain the current state of science on the chosen topic to demonstrate that they are up to date (scholar.google search with "'emergent constraints" AND ECS' gave 239 hits, many of which were published since 2018 - most of the cited literature herein are older than those). This manuscript doesn't do that. It may nevertheless, present some new ideas and insight, but I'm not able to say if it is or isn't. Analogies from the world of electronics, however, are interesting and probably quite novel within climate research.

Another question is whether some of the derivations and mathematics presented in the Methods section could be left in an appendix.

It is possible that slow feedbacks also affect the fast ones and that the dynamics and thermodynamics involve nonlinear interactions so that the total feedback no longer is the sum of individual feedbacks. Hence, the paper assumes that the effect from various processes are additive, which I don't think has been convincingly demonstrated. The paper does, however, discuss combined earth-system feedbacks in the context of earth system sensitivity. I think that this part needs to be explained more carefully.

I find it a bit hard to see the 'red thread' in this paper, which presents a selection of 'facts' without sufficient context or explanation for why. It would be easier to follow the train of thoughts with a clearly stated hypothesis and explicit definitions. Explain why the mathematical derivations and why presenting e.g. Fig 1. It doesn't suffice doing so only in the introduction.

In conclusion, the paper presents some interesting ideas, but I find it difficult to follow and think it needs to account for more of the recent progress concerning emergent constraints. Also, a more careful guidance through the ideas and concepts will make the paper easier to follow. It is always a bit more difficult to follow interdisciplinary work because some aspects often are a bit unfamiliar. Here, the paper relied on ideas from electronics in addition to maths.

Minor; 'IPPC' should be 'IPCC'.

