Dear Referee 2,

Thank you very much for the encouraging and insightful review. The following is our response to your comments.

Comment: This paper presents an interesting idea to derive a scaling law for global warming based on the physical fundamental physical properties of the climate system and the Buckingham-pi theorem for dimensional analysis. The scaling laws at two extreme conditions of positive or negative feedbacks dominating (complete similarity) are first derived, and then the case of incomplete similarity is discussed. I find this work novel and interesting, and a very good fit for an ESD Idea paper.

Answer: We appreciate your evaluation.

Comment: I have a number of questions and suggestions, mostly about the dimensional analysis part, which I hope the authors address.

- Line 57 and eq 3 (similarly, line 73 and eq 6): it is not clear to me how you can go from \phi(t/\tau_n, \lembda) to (t/\tau_n)^m in eq. (3). In Buckingham-Pi, the function \phi of some variables can be written as the product of each variable to an unknown power, but it is unclear to me why in eq. 3 there is no \lambda^q (q being another unknown power) in eq. 3 multiplied by the rest of the terms. This is my main comment/question about the method. Please clarify.

Answer: Your observation is correct. Indeed, λ^q may appear in equations (3) and (6). But since λ and λ^q are constants, λ^q has been absorbed by the experimental constant k.

Action: We will clarify this reasoning in the revised version of the paper.

Comment: - Line 46: the dimension of \epsilon. I guess it is correctly written as sec^{-\lambda-1), however, it does not appear clearly as far as I see. Please take a look and clarify if possible

Answer: The dimension of ε is [^{o}C sec^($-\lambda$-1)]. It looks like the pdf file of the preprint introduced some distortion in line 46 that may cause confusion.

Action: We will make sure that it is clear in the final version of the paper.

Comment: - Also you may want to clarify around line 50 that here there are 6 variables in (1), there are two fundamental dimensions (time and temperature), so Buckingham-pi states that there would be 4 dimensionless (pi) groups, as presented on lines 52-53.

Answer: Agreed

Action: This clarification will be included in the final version of the paper.

Comment: - line 22: the use of Buckingham-pi theorem in climate science has been rather limited, and the cited paper by Golitsyn is certainly a great example. You may want to also mention some of the recent papers using this approach to study the climate system, e .g.
+Chavas, D.R. and Emanuel, K., 2014. Equilibrium tropical cyclone size in an idealized state of axisymmetric radiative–convective equilibrium. JAS
+Yang, D. and Ingersoll, A.P., 2014. A theory of the MJO horizontal scale. GRL
+Nabizadeh, E., et al. 2019. Size of the atmospheric blocking events: Scaling law and response to climate change. GRL

Answer: Thank you for your suggestion. We agree that it will be helpful to our readers.

Action: Per editor's approval (number of references in ESD Ideas papers is limited to 12) we will be glad to include all your recommended references.

Minor comments:

- line 53: you may want to change this to ".... global temperature response T/(\epsilon t^{\lambda+1}) is a function of ....."
- I find the word "dimensionless" just sounding better than "adimensional" but it is up to you which one to use.
- line 99: m should be in the math mode
- line 16: is the word "similarity" in ".... in feedbacks similarity parameters ...." needed?

Action: All minor comments will be taken care of.

Mikhail Verbitsky and Michael E. Mann