

Interactive comment on “Flexible parameter-sparse global temperature time-profiles that stabilise at 1.5 °C and 2.0 °C” by Chris Huntingford et al.

Anonymous Referee #2

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General comments:

Huntingford and colleagues present a simple and transparent parametrization of temperature profiles that stabilize global mean temperature rise to a predefined level. They show how variations of two parameters can result in a wide variety of temperature profiles, with varying lengths of temperature overshoot. The authors suggest that these profiles can be used to better compare impact studies and that these profiles can be used to drive pattern scaling approaches. While I see no flaws in the mathematical description presented by the authors, there are several statements which have a weak factual basis, or for which evidence is missing. These statements require further analysis by the authors to show that their parametrization can capture temperature profiles

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in both a useful and appropriate way.

Specific comments:

- 1) The validation of the appropriateness of the parametrization of temperature profiles is insufficient for the area of applicability. The authors claim that their profiles “enable a common framework for discussion of warming profiles that stabilize to pre-defined temperature limits”, but provide no evidence other than being able to reasonably well fit to RCP2.6 simulations. To show its appropriateness as a common framework, the parametrizations should not only capture the response of multiple ESMs to one concentration profile, but also capture the multitude of concentration profiles available in the literature. The authors can deal with this by showing that their parametrization can be fitted to all temperature profiles of scenarios available in the IPCC scenario database (<https://tntcat.iiasa.ac.at/AR5DB/>), and the more recent SSP database (<https://tntcat.iiasa.ac.at/SspDb/>).
- 2) A smaller point is the dependence of the framework on stabilizing temperatures. For impact studies, it would also be interesting to be able to explore pathways which gradually decline temperatures.
- 3) P1L3: The Paris Agreement is committed to holding the rise in global average temperature increase to “well below” 2°C
- 4) P1L4-5: The “given emissions cuts to achieve the lower target may be especially difficult to achieve” argument is weak, and is not supported in the remainder of the manuscript. Depending on timing, similar emissions cuts are to be considered for 1.5°C and 2°C scenarios (but with a delay of 1 decade or so). In addition to the questions highlighted here, there is at least one more very important question, which is related to the reversibility of warming after an overshoot. I think this should also be mentioned.
- 5) P1L7: The basis for this “implication” is weak. Until now, models have been run in forward mode and have been able to provide lots of useful information for limiting

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warming to and impacts at specific temperature limits.

6) P1L14: Please specify that these are projections by different ESMs.

7) P2L3-4: It would be good to provide a reference for this claim.

8) P2L4-5: Not clear what the relevance is of this statement. The authors refer here to the purely academic case of constant concentrations. Such a case is arguably in practice even harder to achieve than eliminating emissions.

9) P2L9-10: Inverse modelling also cannot answer these questions, because there is no way to ensure that pathways are supported by technologies.

10) P2L14-15: Recent publications provide an overview of various methods of exploring differences between warming levels of 1.5 and 2°C (James et al, Wiley Interdisciplinary Reviews: Climate Change, 2017). It would be useful to situate the approach proposed here in the context of these various methods.

11) P6L15ff: This section is unclearly written. Please consider rewriting it providing a bit background to how the suggested activities could be implemented.

12) P2&6: More recent papers have shown limitations of pattern scaling (e.g. Tebaldi and Arblaster, Clim. Ch., 2016). It would be good to also discuss these more recently identified limitations in the context of the proposed approach.

Technical corrections:

1) P7L8-9: This sentences seems incomplete. More open to scrutiny and discussion compared to what?

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