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Effective forcing in CMIP5 assuming nonconstant feedback parameter and linear response

Hege-Beate Fredriksen
Department of Physics and Technology, UiT the Arctic University of Norway, Tromsø, Norway (hege-beate.fredriksen@uit.no)

We investigate a new algorithm for estimating time-evolving global forcing in climate models. The method is an extension of a previous method by Forster et al. (2013), but here we also allow for a globally nonlinear feedback. We assume the nonlinearity of this global feedback can be explained as a time-scale dependence, associated with linear temperature responses to the forcing on different time scales, as in Proistosescu and Huybers (2017). With this method we obtain stronger forcing estimates than previously believed for the representative concentration pathway experiments in CMIP5 models. The reason for the higher future forcing is that the global feedback has a higher magnitude at the smaller time scales than at the longer time scales – this is closely related to provided arguments for the equilibrium climate sensitivity showing changes with time.

We find also that the linear temperature response to our new forcing predicts the modelled response quite well, although the response is a little overestimated for some CMIP5 models. Finally, we discuss the assumptions made in our study, and consistency of our assumptions with other leading hypotheses for why the global feedback is nonlinear.

References:

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Proistosescu, C., and P. J. Huybers (2017), Slow climate mode reconciles historical and model-based estimates of climate sensitivity, Sci. Adv., 3, e1602, 821, doi:10.1126/sciadv.1602821