Earth Syst. Dynam. Discuss.,
https://doi.org/10.5194/esd-2018-6-RC1, 2018

Earth System Dynamics
Discussions

Interactive comment on "A quantitative approach to evaluating the GWP timescale through implicit discount rates" *by* Marcus C. Sarofim and Michael R. Giordano

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Received and published: 2 March 2018

This paper usefully links the well-used GWP metric with more economic comparisons of the ratios of damages. It is suitable for publication and I only have minor comments.

The relationship to the Paris goals are only briefly alluded to. I suggest including a longer discussion of the differences between: a temperature limit, a long-term temperature goal, and least economic cost. Presumably neither a temperature limit nor a long-term temperature goal are optimal economically using the damage function here? Is this a problem with the Paris agreement? The choice of metric depends entirely on the choice of target, and the authors here are implicitly assuming that least eco-

nomic damage is the most important target. The authors dismiss short-term GTPs as implying unrealistic discount rates, which of course they do for an economic damage target. However, if the Paris agreement is taken to imply that temperatures should not be allowed to exceed 2 degrees, then a GTP with a time horizon ending at the time of peak warming (20-30 years) is an entirely appropriate metric. Similarly, if the Paris agreement is taken to mean a long-term goal to stabilise at 2 degrees then GWP* is the appropriate metric.

The overall formula for the damage function needs to be shown as a function of temperature, discount rate, GDP etc.

Page 1, line 26: Maybe a different word other than "endpoint" could be used so as to avoid confusion with the later discussion of integrated and endpoint metrics.

Page 2, first paragraph: The main difference between GTP and GWP is the difference between endpoint and integrated metrics. This should be brought out more in this paragraph. The iGTP could be mentioned as it is more similar to GWP than GTP.

Page 2, second paragraph: Boucher ESD 2012 should also be discussed for economically-based equivalences.

Page 4, line 1. These GDP pathways should be shown (maybe in the supplement).

Page 4, line 6. It is not obvious why 1951-80 should be chosen as a baseline. A problem with damage functions that are non-linear functions of temperature is that a point needs to be chosen when temperatures were optimal.

Figure 1: I was surprised by the shape of 1 (c). Why does the damage from CH4 keep increasing? Is the damage an integral quantity, or is this increase purely due to an exponential increase in GDP? In 1(d) the damage decreases. Is this because the discount rate is larger than the GDP growth? With the GDP growth of 2.06% would a discount rate of less than 2% give an increasing damage for a gas like CO2 with a non-decaying component?

Page 6, line 13: I don't think "exponential function of temperature" is the right term for temperature raised to a power.

Table 2: The ranges (either 25%-75% or 10%-90%) need to be shown as well as the central value. These are quite large for the timescales and may well include 1.0 for many of the damage ratios.

Page 6, line 25: GWP100 seems to agree very well with the 3% discount rate within the uncertainty rather than overvaluing or undervaluing.

Page 6, line 25-29: I didn't understand this sentence. Are you saying that the uncertainty in GWP100 is such that it covers agreement with the 3% discount? If so, that seems to contradict the previous sentence which suggested a under/overvaluing.

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