

Reply to comments by anonymous referee 2

We thank anonymous referee 2 for his helpful comments. Please find our responses to his comments below. The reviewers' comments are copied into the document for ease of reading and appear in blue. Our responses are given in black.

General comments: A well-written ms. addressing technical aspects of metrics for comparison of climate impacts of emissions of different greenhouse gases. No new ground is broken but a systematic comparison is made of previously published metrics. The results are potentially useful by showing that for policy making it is enough to consider the two clearly distinct metrics: GWP and GTP.

Specific details

Introduction: it would have been interesting to add a comment on why previous authors have felt the need to introduce other metrics, in addition to GWP and GTP. In particular, why did the IPCC 2009 report write that researchers should "develop new refined metrics"? What weaknesses of the "traditional" metrics were identified?

Agreed that is an interesting point, but this question is perhaps better to address directly to the IPCC authors rather than to us. The general reason behind the discussion about new metrics stems from; as we are sure the reviewer is aware of, the critique that has been directed towards GWP, and the search for alternative metrics. It is in this light one should see the IPCC request.

p 114, l 21: "comparing emissions of different .."

Agreed ,will change.

p 116, l 9-10: Unclear

This sentence has now been removed from the text since it did not add anything to the analysis.

p 118: many assumptions are used in the formulation of the model, but in the sensitivity analysis only vertical heat diffusivity and climate sensitivity are investigated. How do you know that other parameters are less critical?

We also test different greenhouse gases (i.e., test the role the life time of the greenhouse gas play) as well as the time horizon. It is found that the choice of time horizon is the most important one.

In addition, the temperature response to forcing perturbations is primarily dependent on the climate sensitivity and the ocean heat uptake. In the UDEBM the ocean heat uptake on a decade to century time scale is primarily controlled by the diffusivity.

We could also have tested temperature feedbacks on the carbon cycle, but this is beyond the scope of this paper which primarily seeks to address the fundamental differences and similarities between IGTP and GWP. But more work may of course be done on this.

[p 119, l 2: Are there other such cases when the forcing is homogeneous?](#)

We have now rewritten this slightly. CO₂ is homogeneously distributed around the globe, but the forcing differ somewhat across latitudes. Other gases which are homogeneously distributed have climate efficacies close to one. Differences occur primarily for forcers which are (geographically speaking) very heterogeneous, aerosols, ozone and contrails. We have now made this clearer.

[p 119, l 10: When using subjective words like "close" or "slightly higher" one must have some standard in mind. What is it?](#)

We agree that subjective terms should be avoided, but we also believe that it is clear from the table, the figure and the text just below that the difference is less than 10%.

[p 121, eq. 4: Define lambda](#)

Thanks! Lambda is the climate sensitivity parameter. This is now defined in the paper

[p 122, l 12: What is the difference between "perturbation life time" and "adjustment time" used on p. 118?](#)

There is no difference in meaning between "perturbation life time" and "adjustment time", hence just different words for the same thing.

[p 124, l 14-24: These are important conclusions that should also appear in some form in the abstract.](#)

We will add the following lines to the abstract: "We conclude that while it matters little for abatement policy whether IGTP, SGTP or GWP is used when making trade-offs, it is more important to decide whether society should use a metric based on time integrated effects such as GWP, a "snapshot metric" as GTP, or metrics where both economics and physical considerations are taken into account. Of equal importance is the question of how to choose the time horizon, regardless of the chosen metric. For these questions, value judgments are needed."

[p 126, l 11: The cycles themselves need not be linear.](#)

Agree, changed to "...when radiative forcing and adjustment time for each additional unit greenhouse gas are constant and linearity holds for the temperature response to radiative forcing changes"

[p 126, l 20: Background conc. of what?](#)

Agree that this needs to be clarified. This will be written as "If the background concentration of CO₂ and gas X is changing SGTP and IGTP will only be approximately equal"

[Tables C1-C3: How do the numbers change for sensitivities below 2, e.g. 1.5?](#)

For lower climate sensitivities, the climate system become less inert, and the IGTP values become closer to the corresponding GWP value.