

Referee #1

Dear referee,

Thanks for noticing the improvement of the paper, while keeping some discussion points active. We understand that these points weren't satisfactorily addressed and propose further changes.

*Original comment *45: The paper remains very unclear what "dynamic" means. The word is used 5 times in the paragraphs at the end of the Introduction, without any explanation. I provided a reference in my previous review ("for example Figure 8.30 of IPCC WG1 AR5 report and references therein") to what I thought "dynamic" means, but the authors did not adopt this, so I presume I am wrong. When reading the Glossary, I now maybe think that by "dynamic" they mean using a multi-pulse framework, but if this is so, why isn't this clearly stated? The new addition to the glossary "dynamic GWP and GTP are not included in this terminology" is an opaque statement. If this paper is intended to serve a pedagogical purpose to the LCA community, then they need to be much clearer.*

[Authors]: Belonging to the LCA community, cite and shortly explain the major contribution of Levasseur et al. (2010) about dynamic LCA appeared enough. Though we agree to integrate your suggestion by adding:

"Hence, dCCA is based on a multi-pulse and multi-GHGs framework, as well as on absolute and dynamic climate impact assessment methods."

Also, in the glossary, we propose to erase "dynamic GWP and GTP" and to add :

"Here, relative metrics are not included in this terminology. This paper addresses in particular two dynamic climate metrics: cumulative radiative forcing (ΔF) and global mean temperature change (ΔT)."

*Original comment *274: I originally pointed out "given that the time of peak warming varies little between gases, I can't see that AGTP_longterm serves a usefully different purpose to AGTP(500)". The authors' response (that it is me that is confused) completely baffles me. When it is introduced in the paper it is absolutely clear that it is in the single t=0 pulse context, but their response clearly refers to the multi-purpose framework, which is an irrelevance at this stage in the paper, and likely an irrelevance when it is applied (as no evidence to the contrary is presented). I maintain that AGTP_longterm and AGTP(500) will differ by such a small amount that introducing AGTP_longterm introduces unnecessary complexity without any greater utility. I also remain of the contention that AGTP_peak, if it has utility, could be adequately served by adopting a 10- or 15-year timescale, given the similarity of the AGTP_peak amongst gases.*

[Authors]: We originally wanted to have similarity in terms of recommendations between AGTP and ΔT and got a bit stuck with our idea. We do now clearly understand your point, agree with it and propose to replace AGTP_{long-term} by AGTP₅₀₀ in order to have a consistent reasoning at this stage of the paper, i.e. the single-pulse framework:

"In a single-pulse framework, AGTP₅₀₀ appears to be a representative mean value of this observed temperature change flattening on a long-term perspective."

$\Delta T_{\text{long-term}}$ is now described in the multi-pulse framework only, latter in part 4 *Results*:

"In a multi-pulse framework, peak temperature change of product systems might occur decades (see Fig.4), or even centuries after t_0 , which significantly shifts the time when temperature change becomes rather stable in a long-term perspective. Hence, instead of ΔT_{500} , we propose the metric $\Delta T_{\text{long-term}}$ being 500 years after ΔT_{peak} in order to stay representative of the long-term temperature change flattening."

As for peak warming, we stay with our nomenclature proposal and propose to add peak timing in the indicator as suggested by the other referee.

*Original comment *324: In the previous version I was concerned about the authors claim that IPCC's AR6 discussion on metrics lacks clarity, and that it was unnecessarily negative about IPCC's presentation of the metric formulation. My contention was (and remains) that it is "only" the two-term climate response that is relatively hidden in AR6. The authors now state that in Smith et al. (2021) the CH₄ and N₂O "indirect effects are not recalled". While technically true, Smith et al. (2021) is the Supplementary Material to Forster et al. (2021) and in Forster et al. (2021) the indirect formulations are very clearly stated in Section 7.6.1.3. This apparently general criticism of IPCC is completely inappropriate and must be corrected.*

[Authors]: The intention wasn't to criticize AR6 WG1 Chapter 7 as a whole. It was to notice that it requires a lot of energy and comprehension for a non-climate scientist to find all metrics equations, indirect effects particularities, parameter values and associated uncertainties. This observation actually motivated this paper.

Though, we do see now that it can be interpreted as a general criticism of IPCC and then propose to completely change the narrative.

"Supplementary Material of AR6 WG1 Chapter 7 has some limitations: [...]" is replaced by :

"Based on Forster et al., (2021) and Smith et al., (2021), this paper summarises main climate metric equations with no hidden parameter values: fast and slow response relaxation time values, as well as ECS value are explicitly given, as are their associated uncertainties; CH₄ and N₂O indirect effects are explicitly transcribed into metrics equations; CCf analytical solution is calculated and proposed in an open-access code page."

Referee #2

Dear referee,

By considering your comments, the paper gained indeed in clarity, consistency. Thank you again for that.

The association between the magnitude of ΔT_{peak} and its time occurrence is a discussion we also add. Your proposal to *“include a requirement (or at least a suggestion) that the ΔT_{peak} reports the time at which the peak warming occurs, relative to $t=0$ ”* is well-motivated. We do agree to support this by modifying the manuscript.

We propose to change Tables 2, 3 and S5 accordingly as well as to add in the main text:

“In this case [multi-pulse framework], peak timing is a required extra information. Hence, this metric that indicated both peak magnitude and timing occurrence appears even more pertinent.”

As for the relevant suggestion to better reflect product system mitigation objectives, it will be considered in coming research work that will apply the methodology described here to case studies.