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Interactive comment on "Technical note: On comparing greenhouse gas emission metrics" *by* Ian Enting and Nathan Clisby

Ian Enting and Nathan Clisby

ian.g.enting@gmail.com

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Author comment: Proposed additional section - Practicalities for implementation

The aim of our analysis has been to provide a better understanding GWP vs GWP* and similar metrics. Any comprehensive analysis of what might be politically feasible needs to be done by others with greater expertise in such areas.

However, there are various aspects of our analysis that bear on the practical applicability and political acceptability of various metrics and the trade-offs that need to be balanced in political choices.

Past studies suggest that an equivalence metric should capture the context of emissions at the time. The analysis by Enting (2018) (see equation 12 above) notes that

GWP_H is close to FEI equivalence for a growth in emissions with an e-folding time of H. Thus a 100-year GWP was a plausible approximation at the time that it was introduced. For very large H, the GWP of short-lived gases goes to zero as $1/H$ suggesting that a derivative of growth rates should define the metric for such long timescales. In contrast, for short-term trading and target setting, a metric that captures the short term context is desirable in order to avoid distortions that would hinder political acceptability.

An important goal of defining emissions equivalence is to allow for emissions of different greenhouse gases to be substituted for each other, so that a given target expressed in terms of radiative forcing (or equivalently in terms of CO_2 concentration equivalence) target can be achieved for the least economic cost. If, as is the case for GWP100, the metric over-estimates the extent to which CO_2-equivalent emission reductions contribute to radiative forcing, then methane reductions based on such equivalence will fall short of the CO_2 concentration-equivalent target. Conversely, for short timescales where GWP100 under-estimates to forcing reduction of CO_2-equivalent methane reductions, short-term targets based on such equivalence will over-estimate the extent of requisite methane emission reductions as in the example given by Wigley (1998).

In considering how our analysis feeds into such considerations, we note:

- the metric should capture both the long-term context needed for stabilisation and the more immediate context in which both trading and international agreements are conducted;
- if the metric for emissions equivalence is too complex, as it is for FEI, then it may be difficult or impossible for an effective trading scheme to be implemented;
- the metric needs to be 'backward looking' and avoid giving present credit or debit on the basis of promises of future;
- however the backwards view should not extend too far as the relevant actors can change over time, even in the cases of nations or even multi-national groups,

such as the EU which has in the past set collective targets;

- metrics defined in terms of derivatives need to be supplemented with a specification of how this is determined in practice e.g. as difference by Cain et al. or the transformation from equation (19) in terms of rates of change of sources to equation (20) in terms of actual sources for the Reduced Model metric.

Finally, we note that our analysis is illustrative, using specific numbers primarily from the 5th IPCC assessment. The forthcoming 6th IPCC assessment may well make minor changes to specific numbers, effective lifetime and CO_2 response as well as such things as the inclusion of feedbacks, forcing efficacies and indirect effects (Myrhe et al, 2013. IPCC AR5 WG1 Ch 8).

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