

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

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This technical note provides an interesting theoretical analysis of CO₂ forcing equivalence. Even though the note is designed to be mainly technical it poses many issues that require more discussion here.

The analysis provides a nice comparison of different metrics using a Laplace framework. It seems that the forcing equivalent CO₂ emissions can be expressed as a Reduced Model in equation (20). It should be explained if this is a simpler methodology than inverting the CO₂ response function as in Wigley 1998.

It is not clear from this paper how this could be applied in any policy context. Typically emission metrics are presented and used as a single number (or two numbers, short

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and long, in Levasseur et al. papers). The authors should explain in what context a continuous function $\Delta_S \text{CO}_2(t)$ could be useful as a metric.

It appears (like Cain et al. 2019) that the metric depends on the past emission history. This means that the larger the past emissions the lower the metric. This could be controversial politically and at least some short discussion is warranted on how/why past behaviour influences the future, and what the implications might be for policy.

Given the similarities of equations 15 and 20, it would be useful to compare them more fully. Do the two terms on the left hand side of equation 20 correspond to the two terms on the right hand side of equation 15? Can the 4 and 3.75 coefficients in equation 15 be related to the b coefficient in equation 20?

The conclusions would be better as flowing text, rather than the series of bullet-like points.

Line 16: I'm not sure "so-called" is a necessary qualifier for greenhouse gases.

Line 21: a_x needs to be defined.

Sections 3.2 and 3.3 need to refer to figure 1 and it needs to be clearer which lines in the figure are being referred to in these sections.

Section 3.4: The key parameter here is "b" so there needs to be more explanation of what this might relate to physically. The text explains a derivation for a 1%/yr growth rate. Would b be completely different for a different emission profile (e.g. figure 2)?

Line 129: This sentence about frequency aliasing is too cryptic as written here. This either needs to be expanded or removed.

Line 136: Why does the behaviour at shorter timescales become important when used for emission trading?

Figures 2 and 3: Since these need to be viewed together I suggest combining into two panels (a) and (b) of figure 2.

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Line 164: Some explanation is needed why “least cost” overshoots the radiative forcing target for GWP100.

ACPD

Conclusions: I found this bullet style very difficult to read or to pull out the key points. I suggest rewriting completely and focussing on the key points as to what has been concluded, and what should a reader take away.

Line 174: It might be better to write as “faster growth rate”, since “shorter timescales” might be confused with GWP20 etc., and line 177. Also I’m not sure this is very policy-relevant as no plausible future emission scenario has exponentially growing methane emissions.

177: I think “shorter timescales” here means something different to line 174. It is not obvious why the ratio of airborne fractions is a good representation of long-term behaviour, but not for emissions trading.

Supplementary material The text and code need to be separated here. It was very difficult to follow the text when it was so broken up by code.

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