Earth Syst. Dynam. Discuss.,
doi:10.5194/esd-2016-55-AC2, 2017

Earth System Dynamics Discussions

Interactive comment on "Accounting for the climate-carbon feedback in emission metrics" *by* Thomas Gasser et al.

Thomas Gasser et al.

gasser@iiasa.ac.at

Received and published: 2 March 2017

Gasser et al. report on findings that the effect of including climate-carbon feedbacks for both the target species and CO2 produce GTP and GWP values that are much closer to their default values than was suggested in IPCC AR5 report. They also call for discussion in the community about the limits of the prevailing linear, impulse response function framework for describing complex feedbacks in the climate system.

I wanted to add some minor comments on the wording and equations:

Thank you for the comments.

Page 3 / L8: 'dynamic' – IRF describes a dynamic system, but not sure it is correct to

say that it is dynamic; i.e. the impulse response functions are invariant with regards to initial time

An IRF is the analytical solution of a set of ordinary differential equations with constant coefficients (i.e. linear). Therefore, it describes the exact same (physical) system as the differential equations do. If the system is deemed dynamic, we see no reason why the IRF should not be said to be dynamic as well.

Page 3: "the change in atmospheric concentration of the species (Qx)" - should be Qx(t) - Qx(0), or else equation on next line could simply be Qx(t) = ... Similar for the line about Tx

Note that the sentence can be read slightly differently: "the change in [atmospheric concentration of the species (Qx)]"; i.e. "Qx" is attached only to "atmospheric concentration of the species" and not to the whole beginning of the sentence.

Moreover, if we assume the sentence is read as the commenter suggests, the equation has to be written with Qx(0) on the right-hand side. But this is completely equivalent to the way we wrote it.

So we don't think any change to the sentence should be made, firstly for the sake of legibility.

Page 4/L7: should be approximate ($\approx$) symbol rather than definition ($\equiv$)

This has been changed to: $RF^x(t) = \varphi^x(Q^x(t) - Q^x(0))$

Page 4: 'mass' would be more clear than 'size' in describing the emissions

Though 'mass' would be physically correct, we prefer to use the more colloquial and yet widely used word 'size', as Joos et al. (2013) and IPCC did.

The word ‘normalized’ and ‘relative’ are used inconsistently (it is not always used to say that GWP is relative while AGWP is absolute and that both are normalized (to a 1 kg pulse) metrics). This is apparent on page 4 / L9-11, but also applies page 2 / L18 and elsewhere

Very true! We checked and corrected all occurrences.

There is also a subtle change in notation that is not mentioned that some of the equations on page 5 and 6 give terms that were previously explicit functions of time but are now shown with implicit dependence through the variables Tx, Qx, E0x, RFx and Θ

The change in notation is explicitly introduced with the following (existing) sentence: “To simplify the discussion and avoid quintuple integrals, we introduce the simplified notation $\star$ for the convolution: $a \star b \equiv \int_0^t a(t')b(t-t')dt'$, and note the commutative property of the convolution: $a \star b = b \star a$.”

The disappearance of the time variable comes with the new notation, and happens for the same reason: to keep the notation simple and legible.

Page 5 / L26: a(t) should be a(t’)

Yes. Corrected.

Page 6, L18: This seems to be the relation between pulse and continuous emission given in Aamaas et al. 2013, ESD 4: 145-170, but I could not follow the logic here. Also unclear that the ‘definition’ ($\equiv$) symbol is applicable

We have added a short sentence to make this part clearer: “[Note] that convoluting any function with the Heaviside function is equivalent to integrating it.”

Although, we have to say there is no ‘logic’ here apart from acknowledging that the

integral of a function f is – by definition – strictly equal to the convolution of f by the Heaviside function.

Page 9 / L19: the use of the word ‘extended’ causes a little confusion since the meaning is not described until L27-L29

Yes. We have moved that sentence to appendix B, where the details of the fit are given.

Constant intensity term (λ) “climate sensitivity”: overall there was not much discussion of this parameter, but believe should at least point out that it refers to an equilibrium climate sensitivity.

The parameter is defined in section 2.1. We have added the word “equilibrium” to the text to make it clearer.

Interactive comment on Earth Syst. Dynam. Discuss., doi:10.5194/esd-2016-55, 2016.