Biogeosciences Discuss., 10, C8971–C8973, 2014
www.biogeosciences-discuss.net/10/C8971/2014/

Biogeosciences
Discussions
Open Access

Interactive comment on "The declining uptake rate of atmospheric CO_2 by land and ocean sinks" *by* M. R. Raupach et al.

Anonymous Referee #2

Received and published: 25 February 2014

Review of "The declining uptake rate of atmospheric CO2 by land and ocean sinks", by Raupach et al.

Changes to natural sink strength is an on-going concern for climate modelling, especially the ability of the land and ocean to sequester emitted CO2 reduces. Hence the topic is of general importance.

Below are a few points the authors may wish to consider in the revised manuscript:

(a) The airborne fraction concept has served us well, and provides an instantaneous assessment of how much of a tonne of CO2 remains in the atmosphere. So whilst understanding the reasons given for the alternative approach, I maintain AF remains an important policy tool too. Something to this effect should be said in the paper.

(b) What is clever about the k_s concept is that it instead provides an instantaneous timescale of temporal distance back to pre-industrial conditions. So if for instance k_s=0.02 yrˆ-1, then if no further changes occurred to it, this suggests the planet is order 50 years away from returning to pre-industrial state should emissions stop.

(c) However, to verify this, maybe the authors could consider k_s and its changes in the event of near-sudden termination of emissions. I would like to see an additional set of runs with their simple model to see how k_s changes with zero emissions. This would inform the "overshoot" debate, and point (b) above. I suspect in fact k_s will change quite a bit in a zero-emissions situation?

(d) Possibly something for discussion, but k_s could be defined as (future) distance from contemporary climate state too. Or if the two-degrees threshold is demonstrated to really be a limit society would not want to extend beyond, distance from (associated CO2 concentration), if that warming limit is exceeded.

(e) There is a technical problem I struggled with. Possibly I'm mis-reading something? So line 5 p18410 points out that AF has been nearly invariant for the last 50 years. The paper then explains this as a consequence of roughly exponential emissions increase, and linear response of sinks (so sentence start line 20, p18410 "It has long been known.....".) i.e. the "LinExp" case, as the authors describe it. However line 13, p18412 says "Sixth, under the LinExp idealisation,,,,, k_s is constant in time". Surely this is in contradiction with the title? In other words, for "LinExp", which is near to reality, then the title says k_s decreases?

(f) In discussion of Figure 3, and volcanoes, then this is an example where I think the AF is a good metric. Because volcanoes are rare, and their effects are only felt for short periods (i.e. a couple of years), then instantaneous impact on emissions during that period make sense. But is a volcanic dependence on k_s sensible when, by definition, it is associated with long timescales that themselves are a Century-timescale consequence of perturbation of the planet away from pre-industrial times. If there was suddenly a rapid sequence of multiple volcanoes then the perturbed k_s number would then be useful. Or, if the authors dare mention it, a way of characterising geo-engineering through options such as deliberate aerosol increases.

(g) Around line 5 of page 18415, I feel this is unnecessarily critical of C4MIP. Toy models such as SCCM can always be made to fit historical records, globally, because they are parameter-sparse. But they have very little predictive capability. However full GCMs do retain the possibility to have good predictive strength as quantities such as the carbon cycle are most likely to show large differential changes according to geographical region.

(h) One speculative thought - as k_s is in a sense a single metric of carbon-cycle distance from a particular state - here, pre-industrial - then could it somehow be related to accumulative emissions, which is also a (independent of emission-pathway) concept that gets mentioned a bit these days.

(i) Some of the diagram label fonts are rather small (e.g. Figure 4).

Interactive comment on Biogeosciences Discuss., 10, 18407, 2013.