

Interactive comment on “Dynamics of global atmospheric CO₂ concentration from 1850 to 2010: a linear approximation” by W. Wang and R. Nemani

Anonymous Referee #2

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Main points:

The manuscript reports on the results of the development and application of a simple linear box model of the global carbon cycle. The simplicity of this model prevents the results from being publishable as a research paper, as the approach falls behind similar and more advanced studies that have been published decades ago.

It is true that a linear system of pools and fluxes will always respond to an exponentially increasing external forcing by a constant ratio of its pool sizes after some exponentially decaying transitional period. However, this is true for any such system with any number of pools. The model used here is just the simplest such system. It is by no means necessary that conclusions reached with this particular realisation of a linear carbon cycle will stand up to further inquiry.

Apart from that, predictions with simple linear representations of ocean carbon uptake tend to deviate from observations as already noted by Joos et al. (1996), who suggested an alternative representation. This issue is further discussed by Gloor et al. (2010), cited in the present manuscript. That paper in fact contains an almost exhaustive treatment of the subject that goes far beyond that contained in the present manuscript, and to which the present manuscript adds nothing. A recent discussion of the response of linear systems to exponential and non-exponential forcing from the viewpoint of carbon cycle research can be found in Raupach (2013), a reference that is thoroughly missing here.

Presentation is often somewhat inaccurate and the discussion of e.g. the airborne fraction is superficial.

Specific comments:

p13959, l7-11: It is trivial that the airborne fraction is influenced by changes in emissions, this follows from its definition.

p13959, l12: It is not true that Gloor et al. (2010) focussed on the constancy of the airborne fraction.

p13960, l7: There is quite some literature about changes in atmospheric CO₂ both during the last 1000 years, and since the beginning of the Holocene, so the statement is not strictly true, even though it may be a suitable approximation.

Technical comments: p13958 l 26 -> has not been reached

Overall assessment:

With some substantial improvement of the presentation quality and of the discussions, the manuscript might become suitable for an introductory textbook, but it is not suitable for publication as a research article, including publication in Biogeosciences.

References:

Joos, F., M. Bruno, R. Fink, U. Siegenthaler, and T. F. Stocker (1996), An efficient and accurate representation of complex oceanic and biospheric models of anthropogenic carbon uptake, *Tellus*, 48B, 397-417.

Raupach, M. R. (2013), The exponential eigenmodes of the carbon-climate system, and their implications for ratios of responses to forcings, *Earth Syst. Dynam.*, 4, 31-49.

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