

Interactive comment on “Recent changes in the global and regional carbon cycle: analysis of first-order diagnostics” by P. J. Rayner et. al.

Anonymous Referee #2

Received and published: 5 August 2014

The paper titled “Recent changes in the global and regional carbon cycle: analysis of first-order diagnostics” by Rayner et al. applies two simple first-order models based on the concentration of atmospheric CO₂ to investigate possible changes in the response of underlying CO₂ exchange (uptake). This paper shows that a reasonable fit can be achieved using these simple models at the global scale and that no significant deviation in the response of carbon uptake can be detected with the current atmospheric record. A regional analysis using inverse and terrestrial models highlights differing spatial patterns between the responses of the two flux estimates, while both types of models agree in the responses at the global scale. The study expands the use of simple first-order diagnostics to explore the response of the carbon cycle both regionally and seasonally and although these more detailed results are not necessarily robust, these analyses offer novel contributions that are both interesting and insightful. The

C4083

novel application of a pre-existing methodology offers a creative path forward in the investigation of the carbon cycle. I therefore recommend this article for publication after considering the following minor revisions.

General comments:

As this work relies on an analysis framework developed by Gloor et al. [2010], a clearer distinction in the abstract and introduction between the two studies would help highlight the novel contributions of the current study. Additionally, some discussion of how the Global responses results (Section 3) compare to the previous study may be useful, especially regarding the amplitude of the residuals with time. A figure showing these values may be useful.

Detailed Comments:

Abstract, lines 3-6, This text seems to be stating a conclusion already found by Gloor et al. [2010]. The authors should try to make the distinction more clear.

Page 9921, lines 27-28, “but for different purposes.” Clearly state different purposes.

Page 9926, line 9, How does that constant term manifest itself in the above equations?

Page 9926, line 22, How does this 0.95 Pg C yr⁻¹ value get used in the analysis? Is it added to R?

Page 9927, line 4, I understand why mathematically assuming independence of the annual uncertainties allows for a cleaner and computationally cheaper solution but would inflating this value make sense because this assumption is likely over optimistic, e.g. errors are likely correlated because accounting methods and hence errors from year to year are similar.

Page 9927, line 7-9, What does the increase in the amplitudes of the residuals imply? Could a plot be useful here?

Page 9934, line 5-8, It seems this method would also be useful in comparing “bottom-

C4084

up” and “top-down” methods to estimate CO₂ flux. While intercomparisons would also prove to be useful within modeling arenas, the difference in the regional responses between the inversions and terrestrial models shown here again highlight the contrast between methods to estimate carbon exchange.

Technical Comments:

Abstract, line 11, capitalize “t” in “Terrestrial”

Page 9922, line 5, insert “the” after “since the early 2000s,”

Page 9926, line 9, capitalize “t” in “This is. . .”

Interactive comment on Biogeosciences Discuss., 11, 9919, 2014.

C4085