

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 #1

Received and published: 18 July 2014

This manuscript presents an interesting study into decadal trends in the strength of carbon cycle feedbacks, extending the approach applied in previous publications by a decomposition of global tendencies into regional and seasonal components. The methodology and its application to inversions and ecosystem models is interesting as it allows a different way of looking at existing simulations. As pointed out for the global analysis, for which longer data records are available, shorter-term results may not point at robust tendencies. The question remains if this lesson of caution doesn't also apply to the inverse model and vegetation model results, which are evaluated over shorter periods. Whether or not robust, the ideas presented in this work are definitely worth publishing. Below are a list of corrections and suggestions that will hopefully facilitate the reading, and a few scientific issues that require some further attention.

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GENERAL COMMENTS

Although the focus of the paper is on trends in the carbon cycle response to its forcing, the mean sensitivities that are derived deserve some attention also. The absence of a weakening in the oceanic response is quite significant in light of a few others studies, as is discussed. However, the mean values that are derived for the sensitivity of the ocean seem rather small, which calls for an explanation also. At least an effort should have been made to compare the numbers with Gloor et al, 2010.

SPECIFIC COMMENTS

Abstract, line 11: 'also' suggests a similarity with the previously sentence, which is not the case.

Footnote 1: But if policy decisions change the long-term mean flux (due to some new infrastructure becoming functional) then the corresponding source may be constant, rather than constantly growing. This is different for a policy decision that causes the infrastructure to evolve in time. In that case the flux may integrate a single political decision, but otherwise not.

Eq.7: If 'M' and 'q' both represent burdens of carbon or CO₂ in the atmosphere, then why not use the same parameter? They are not defined exactly the same, but this seems to make the equation unnecessarily complicated.

Page 9926, line 8: $J=q$ i.o. $1/q$

Page 9926: Please mention briefly what dM/dt is based on.

Page 9927: How realistic is it to assume independence of annual estimates of F_{anthro} ? The 1% seems quite optimistic. I wonder if it is supported by the size of the fit residuals.

Page 9927, line 5-10: Are these results shown somewhere?

Page 9927: 'The large uncertainty in beta' i.o. 'The large beta value'

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Page 9927: 'the mean residual of the fit' i.o. 'the residuals of the fit'

Page 9928, line 2: What is the meaning of 'disjoint' in this context? That the corresponding processes are independent? This doesn't necessarily hold for a seasonal decomposition.

Page 9928, line 1-10: It is not directly clear which regression problem you solve in this case (in terms of J and y). I suppose you start now from equation 6 where $y = F_{\text{ocean}}$ for solving beta-ocean, and $y = F_{\text{land}}$ for solving beta-land?

Page 9928: How do you get 6 periods of 11 years for the period 1960 to 2010?

Page 9929, line 5–10: Why is this best compared without the fossil component? Any difference between the GCP and CCAM fossil fuel prior would be mapped to the non-fossil component. The main requirement is that the model reproduces the observed trend in CO₂, right?

Page 9930, line 13: 'aliased into the calculated beta' io 'aliased into errors in calculated beta'

Page 9932, line 25: What is the reason for using a different region definition for the inversion and the biosphere model?

Page 9932, line 25 ...: Earlier it was mentioned that LUC drives beta in the tropics. Then to properly interpret the results of LPJ it is necessary to know if its LUC in recent years resembles that of GCP.

Page 9933, line 14: Since part of the paper deals with CCAM it would be better to specify 'model' here as an ecosystem model.

TECHNICAL CORRECTIONS

Abstract, line 11: 'Terrestrial models' i.o. 'terrestrial models'

Page 9926, line 'This' io 'this'

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