

Interactive comment on “Global carbon budget 2014” by C. Le Quéré et al.

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We thank all reviewers for their insightful comments, which have helped clarify the manuscript. Our detailed response is provided below (in blue). We hope we have clarified all the issues raised.

The main modifications to the manuscript made in response to the comments received were:

1. The Section 2.7.2 on ‘Anthropogenic carbon fluxes in the land and ocean continuum’ has been clarified and focused on the anthropogenic perturbation, and Equations have been added.
2. We have included Table S1 as an appendix and it will now appear as part of the manuscript to preserve it.

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3. Figure 8 has been corrected to include both land and ocean fluxes and the corresponding text in Section 3.1.3 has been expanded to include a more detailed interpretation of the figure.

Referee - Le Quéré et al. deliver another update for the global carbon budget. Since the main text of the manuscript changes little from previous years and has been reviewed multiple times, the manuscript is already in good shape.

Le Quéré et al - Thank you.

Referee - As a first time reviewer of this living data set, however, I am able to find few things that improve this manuscript.

I am unable to document small suggested changes in the manuscript so I am attaching a scanned version of the annotated pages of the manuscript. Hopefully, my hand writing is clear enough.

My major comments are ...

1. As a reader, I was confused when I read the part describing the river flow of DIC/DOC from land into the ocean. This is a natural flux, of course. And, the manuscript is about the change in carbon budget quantities. We already know that the perturbations to the quantities of the global carbon budget are riding on top of already big natural fluxes. In this context, and in absence of any equations containing the riverine flux of DIC/DIC, I wasn't able to follow the text properly. I suggest some additional equations in the manuscript to clarify the text around riverine flux of DOC/DIC.

Le Quéré et al - Two equations have been added and the text has been simplified, as follows: "More importantly the residual land sink calculated in a budget which accounts for the LOAC (SLAND+LOAC = 3.25 ± 0.9 GtC yr⁻¹) is larger than the residual land sink (SLAND) value of 2.9 ± 0.85 GtC yr⁻¹ (2004-2013) calculated according to Eq. 8. This is because this flux is partially offset by the net source of CO₂ to the atmosphere of 0.35 ± 0.3 GtC yr⁻¹ from rivers, estuaries and coastal seas (ELOAC):

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$$\text{SLAND} = \text{EFF} + \text{ELUC} - (\text{GATM} + \text{SOCEAN}) + \text{ELOAC} \quad (9)$$

In addition, because a fraction of anthropogenic CO₂ taken up by land ecosystems is exported to the LOAC (FLH), the annual terrestrial ecosystems carbon storage change comprising the land vegetation, litter and soil (ΔCTE , 1.35 GtC yr⁻¹) is notably smaller than what would be calculated in a traditional budget that ignores the LOAC. In this case, the carbon storage change for the period 2004-2013 (Table 8) is estimated as 2 Gt C yr⁻¹ from the difference between SLAND (2.9 Gt C yr⁻¹) and ELUC (0.9 Gt C yr⁻¹). With the LOAC included, we now have:

$$\Delta\text{CTE} = \text{SLAND} - \text{ELUC} - \text{FLH} \quad (10)$$

A significant fraction of the anthropogenic carbon displaced from land ecosystems to LOAC is stored in freshwater and coastal sediments (ΔCLOAC), and to a lesser extent, in the open ocean (FHO) while the rest is re-emitted to the atmosphere by freshwaters (ELOAC). The annual ocean carbon storage change with LOAC included (ΔCOCEAN) is therefore equal to: $\Delta\text{COCEAN} = \text{SOCEAN} + \text{FHO}$.”

The rest of Section 2.7.2 has also been simplified to focus on the anthropogenic perturbation.

Referee - Please see the attached annotated pages of the manuscript.

2. There are many places in the manuscript where units can help. Please see the attached annotated pages of the manuscript.

Le Quéré et al - All comments incorporated throughout the manuscript, thank you.

Exceptions:

- a) BP is no longer British Petroleum it is now branded as simply ‘BP’
- b) IFF is defined earlier in the text
- c) Territorial and consumption emissions are defined earlier in the text

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d) Equation (1) is valid also in other time scales than annual time scales so we have specified earlier in the paragraph that we report annual budget, but left out the specific suggestion of the reviewer related to the annual resolution of equation (1)

Referee -

3. At a number of places in the manuscript correlation between quantities is mentioned. However, it isn't clear that the correlation is for annual or decadal values or over what time period. Please see the attached annotated pages of the manuscript.

Le Quéré et al - We have clarified throughout the manuscript where it may not have been clear to a reader whether the correlations were annual or decadal values, thank you.

Interactive comment on Earth Syst. Sci. Data Discuss., 7, 521, 2014.

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