

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. 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 - Overall excellent compilation and very well presented. One of the best constructed and most useful excel spreadsheets I have encountered.

Le Quéré et al - Thank you.

Referee - A few comments, mostly with respect to text, below, but with one substantial question about data in Figure 8.

Referee - Page 525 Line 23 - I wonder if this sentence should more properly read ‘We compare mean land and ocean fluxes and their variability to estimates...?’

Le Quéré et al - Changed as suggested.

Referee - Page 526 Line 9 - changes in carbon intensity of the <global> economy or changes in carbon intensity of <national> economies?

Le Quéré et al - Changed as suggested (<global> economy was the intended meaning).

Referee - Page 528 The paragraph starting line 5 finishing line 19 gives qualitative and quantitative justification for why Eq 1 does not account for lateral fluxes (estuarine etc.) but omits a similar quantitative assessment of not including the oxidative processes (e.g. CH₄ to CO₂). Similarly small? Mention the omission begs an explanation? Explanation given later, section 2.7.1, shows only minor impact. Mention that here?

Le Quéré et al - A quantitative assessment of the oxidative processes has been added, as follows: “CO emissions are currently implicit in EFF while anthropogenic CH₄ emissions are not and thus their inclusion would result in a small increase in EFF.” We also reversed the order of the last two sentences of this paragraph to clarify the text.

Referee - Line 26 - Global Carbon Project ... who has, who have? which has?

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Le Quéré et al - Changed (which has).

Referee - Page 529 Line 3 - ... et al., 2014). Where the carbon budget year... comma rather than full stop? Rather... et al., 2014), where the carbon budget year refers to budget calculations based on emissions data recorded through the end of the prior year (e.g. the 2013 budget covered emission data through 2012 and this 2014 update covers emissions through 2013).

Le Quéré et al - Comma inserted instead of full stop as suggested.

Referee - We read this more explicitly later, at the middle of page 7, but the explanation also seems useful here following the dated list of prior budgets.

Le Quéré et al - No change. Our intension was indeed to make this very clear here even though it is repeated later on in the manuscript.

Referee - Line 7 - again this question of the global economy or of national economies?

Le Quéré et al - Changed as suggested (<global> economy was the intended meaning).

Referee - Page 530 Line 3 - we already defined IPCC and AR5 on page 529 in lines 15 and 16?

Le Quéré et al - Changed as suggested.

Referee - Line 11, 12 - applaud this!

Le Quéré et al - Thank you!

Referee - Page 535 Line 25 - Should the parenthetical phrase read (2013 in this budget)??

Le Quéré et al - It should read 2012, we have moved to using three years of BP data in this budget. The UN update of fossil fuel emissions was delayed this year and so it was necessary to use three years of BP data to bridge the resulting gap.

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Referee - Page 555 Line 10, 11 - An informed reader will know the assimilation tools 4D Var and Ensemble Kalman Filtering but should we define these terms for all readers? Sufficient to point to the references, referring back to 3 citations at the start of this paragraph?

Le Quéré et al - We removed the parenthesis '(4d-VAR, EnKF)'. The following sentence makes it clear that the details of each method are presented in the references at the start of the paragraph.

Referee - Line 18 - to set these. What? The total EFF terms?

Le Quéré et al - Text clarified as follows: "They do not estimate EFF separately but assess EFF using similar data sources as described in Sections 2.1.1 and 2.2.2."

Referee - Line 25 – perhaps: In this first application of inverse models to the carbon budget we focus...

Le Quéré et al - Changed as suggested (but with 'methods' rather than 'models', consistently with the rest of the text).

Referee - Page 556 Line 1 - singular/plural, land fluxes correlate or land flux correlates?

Le Quéré et al - Changed as suggested (land flux correlates).

Referee - Page 560 Line 14, 15 - ... diffusion in ocean models, though as data-products also support.... Rather, ... diffusion in ocean models, although as the data products also support a lower mean CO2 sink this discrepancy may suggest a need to reassess the mean <oceanic> carbon sinks?

Le Quéré et al - The text was revised to capture the reviewer's suggestions. It now reads: "This could reflect issues with the vertical diffusion in ocean models, although as the data products also support a lower mean CO2 sink, this discrepancy may suggest a need to reassess estimates of the mean ocean carbon sinks."

Referee - Page 561 Line 10 - (Table 7)

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Le Quéré et al - Corrected.

Referee - Line 13 - IAV? Interannual variability?

Le Quéré et al - We removed the 'IAV' acronym and spelled out interannual variability.

Referee - Line 15 - ensembles compare well or ensemble compares well?

Le Quéré et al - Corrected (ensemble compares well).

Referee - Page 562 Line 2 - This region also shows the largest variability?

Le Quéré et al - The text was modified to say: "This region also shows the largest variability, both on interannual and decadal time scales."

Referee - Line 7 - again IAV?

Le Quéré et al - We removed the 'IAV' acronym and spelled out interannual variability.

Referee - Line 17 - have we explicitly defined IFF prior to this point? I do not remember seeing it.

Le Quéré et al - It is defined in Section 2.1.4 just above Eq. (3).

Referee - Page 567 Line 20 - REgional?

Le Quéré et al - 'by the project REgional Carbon Cycle Assessment and Processes (RECAPP; Canadell et al., 2012-2013)', was clarified as shown here – the 'RE' in REgional is part of an acronym.

Referee - Page 571 Line 11 - Supplement. I see the list of ocean CO₂ data included in the supplement and understand why the authors did not want to include such a long list as a table in the text. But I understand ESSD or Copernicus does not archive supplemental materials? This list will get lost after publication? Could the supplement go on the CDIAC site?

Le Quéré et al - We find the most natural place for the supplementary information is to

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be together with the paper as it does not have direct value on its own. We have thus included it as an Appendix inside the main manuscript.

Referee - Page 597 Table 8 - If a reader wants to follow the anchored decade (e.g. 1970-1979, 2000-2009) pattern with individual years of the current decade starting from 2010, they have to look back into prior versions to. Add annual data from 2010, 2011, 2012? Thinking from a graphical point of view, those individual year data for the most recent years might prove more useful than data from the most recent sliding decade (e.g. 2004-2013)?

Le Quéré et al - All data are available in an Excel spread sheet made available with the paper. We have added text to the caption of Table 8, to make this clear to the reader, rather than adding a new table. It reads: "A dataset containing data for each year during 1959-2013 is available on <http://cdiac.ornl.gov/GCP/carbonbudget/2014/> . Please follow the terms of use and cite the original data sources as specified on the dataset."

Referee - Page 600 Figure 1 - Very interesting with seasonal cycles removed.

Le Quéré et al - Thank you.

Referee - Page 609 Figure 8 - Very hard to imagine a slight increase (?) of the southern latitudes CO₂ sink (as in text on page 561) from this figure? 1.3 to 1.6 GtC yr⁻¹ from the text, but doesn't seem consistent with lower panel?

Le Quéré et al - Thank you for spotting this mistake. We had used the wrong data to plot the figure, excluding the contribution of the oceans. All panels have now been corrected and the text is consistent with the figure, which shows an increasing CO₂ sink with low variability in the Southern Ocean. We have also expanded the text in Section 3.1.3 to include a more detailed interpretation of the results.

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

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