

Interactive comment on “The Sub-Saharan Africa carbon balance, an overview” by A. Bombelli et al.

A. Bombelli et al.

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Author Reply to the Referee #2 Summary Comments: As explained in the Author Replies to the Referee#1 General Comments and Referee #1 Technical Corrections 3, the introductions has been simplified and partially rewritten, detracting sentences have been removed, and the focus and logical flow improved. The paragraphs sequence now follows this scheme: 1) general short introduction on the carbon cycle and climate change; 2) Africa’s role in the global carbon and climate systems; 3) Land use change and carbon stock and fluxes in Africa; 4) Current gaps and need for new improved data in Africa; 5) why CarboAfrica; 6) aims of this paper.

Author Reply to the Referee #2 Summary Comment 1: We believe that in this updated version we have better highlighted the new aims and conclusions, emphasizing the advances of this paper, as suggested by both referees.

Author Reply to the Referee #2 Summary Comment 2: As said above in the Author

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Reply to the Referee #2 Summary Comments, the focus of the analysis has been improved. As said below in the Referee #2 comment on Figure 2, Figure 2 has been removed because it was a duplication of Table 1. Figure 5 has been removed because not necessary to the paper main aim. However, we kept both Table 1 and Table 5, because Table 5 include a synthesis of Table 1 data, with elaborations and the conversion of the units of measure from g eq CO_2 to g C . This new elaboration is useful for the final comparison with the CarboAfrica data contained in the same Table 5.

Author Reply to the Referee #2 Summary Comment 3: In accordance with this comment and the following Referee #2 comments on Figure 1 and 3, we have updated Figure 1 using the same vegetation classes of Figure 3 (i.e. the FAO Forestry classification Global Ecological Zones <http://www.fao.org:80/geonetwork?uuiid=baa463d0-88fd-11da-a88f-000d939bc5d8>) and we have overlapped the major eco-regions of Sub-Saharan Africa from Weber et al. (2009) (based on the broad distribution of ecosystem types).

Author Reply to the Referee #2 Summary Comment 4: See the Author Reply to the Referee#1 Specific Comment 9

Author Reply to the Referee #2 Summary Comment 5: The savanna sink of table 3 is an average of 8 different scientific articles published in international peer reviewed journals. 7 out of 8 papers showed a sink for savannas. Se we are confident that this result cannot be considered unreasonable. About the model based savanna sink we agree that is overestimated. In the previous Author Reply to the Referee#1 Specific Comment 1 and 6 we show the possible reasons and we explain why it is worth to publish this preliminary data. About the fire component, it is included in the final equation used to calcite the SSA carbon budget. About respiration, it is included in the NEP value: when NEP is negative the respiration is higher than net photosynthesis.

Author Reply to the Referee #2 Specific Comment 1: The referee comment is correct. We have gone again through all data and calculations ad we found a major problem

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in the calculation of forest degradation. There was a mistake in the time scale of the degradation process. In particular the estimates of degradation from logging was a prediction for the next 40 years, therefore the value had to be divided for the years. Now the new value of the estimated annual forest degradation is almost ten times less (0.08 Pg C y⁻¹ versus 0.77).

Author Reply to the Referee #2 Specific Comment 2: See the Author Reply to the Referee #1 Technical Corrections g.

Author Reply to the Referee #2 Specific Comment 3: Here is the justification for each country data not considered. In any case we used all available and reliable information. Data from Uganda and Sierra Leone are not included because the total emission declared are unreasonably too high: Total emissions for Uganda 9.4 Tg CO₂ eq.; total emissions for Sierra Leone 1205 Pg CO₂ eq.!!! These unreasonable values are confirmed also by the per-capita data. Average per-capita emissions in Sub-Saharan Africa = 0,006 Kt CO₂; per-capita in Uganda = 0.424 Kt CO₂ eq. (7.582,91% more than the average value!); per-capita in Sierra Leone = 242136 Kt CO₂ (4.386.203.366,77% more than the average value!). This is surely due to some errors during the reporting process. The GHG data from NCI of Guinea Bissau are not included because the removals declared are not reliable compared to other nation's removals. For examples removals by Sierra Leone are higher that the Democratic Republic of Congo! The figures below show this inconsistency: Democratic Republic of the Congo Forest Area (1000 ha)*: 133610 % of land area*: 58.9 removals declared (Kt CO₂ eq)**: 118413.8 removals for unit of forest area: 0.89 Guinea Bissau Forest Area (1000 ha): 2072 % of land area: 73.7 removals declared (Kt CO₂ eq): 11286615.0 removals for unit of forest area: 5447 * data from FAO 2009, State of the World's Forests; ** data from National Communication to UNFCCC. Benin was not considered because in its national communication there are not specified emissions and removals per sectors and the global warming potential used. Zimbabwe was not considered because there were missing significant data in its national communication. Probably it is not

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necessary to specify all these details in the paper. We have also simplified the sentence in the text, just saying: "We have not considered some data because they were not reliable". Angola, Central African Republic, Equatorial Guinea, Liberia, Somalia and Zambia were not considered because their NC are not yet available. However new data are now available, therefore we have added the data from Kenya (previously missing), and the C-balance from the UNFCCC estimates has now a little decreased, from 0.58 to 0.16 (excluding fossil fuel emissions).

Author Reply to the Referee #2 Specific Comment 4: Done as requested.

Author Reply to the Referee #2 Specific Comment 5: Yes, that is true. Therefore we have considered also fossil fuel emissions in the final overall SSA carbon balance.

Author Reply to the Referee #2 Specific Comment 6: We have changed the sentence in "Africa GHG emissions are highly affected by vegetation fires".

Author Reply to the Referee #2 Specific Comment 7: We agree with the referee and we have simplified the sentence as following: "There are different theories about the relationship between fire frequency and standing biomass, but a better prevention of fires could lead to a much higher above and below ground biomass gain (Grace et al., 2006)".

Author Reply to the Referee #2 Specific Comment 8: We agree and we have updated the citations as below: "These findings are in accord with previous studies from seasonally-dry ecosystems (Delmas et al., 1992; Levine et al., 1996; Zepp et al., 1996; Scholes et al., 1997; Otter and Scholes, 2000; Castaldi et al., 2006)". Obviously we have added these papers in the bibliography.

Author Reply to the Referee #2 Specific Comment 9: This was true. Now we have deleted duplications.

Author Reply to the Referee #2 Specific Comment 10: Yes, but the agroforestry definition was not fully correct. The column A of Fig. 4 correspond to cucumber based

croplands (Kanmegne, 2004) and we have clarified this in the text.

Author Reply to the Referee #2 Specific Comment 11: Significant forested areas are both in Eastern and Southern Africa, as it is shown (for example) in the FAO publication State of the World's Forests 2009, The Food and Agriculture Organization of the United Nations, Rome, 152 pp., 2009 (<http://www.fao.org/docrep/011/i0350e/i0350e00.HTM>).

Author Reply to the Referee #2 Specific Comment 12: The first paragraph (mentioning Brown et al. 2005) refers to forest degradation due to selective logging, while the following paragraph was referred to the degradation due to forest encroachment. Therefore 'no data'; is referred only to forest encroachment. We have made it clearer now in the text.

Author Reply to the Referee #2 Specific Comment 13: For the modelling approach error and uncertainty are discussed in the same special issues (Weber et al., 2009). The other value of savanna NEP is an average (with standard deviation) of the values taken from 8 scientific papers published in peer reviewed journals. See the Author Replies to the Referee#1 General Comments and to the Referee#1 Specific Comment 5.

Author Reply to the Referee #2 Specific Comment 14: In effect this is the first time we use all the currently available CarboAfrica data for a comprehensive overview of the SSA C-budget.

Author Reply to the Referee #2 Specific Comment 15: 'Removal'; is referred to any form of carbon capture and storage from the atmosphere. It is the carbon sequestered from the atmosphere through land-use change, afforestation, reforestation, and practices that enhance soil carbon in agriculture (IPCC 2007). In the UNFCCC language the following sentence is generally used 'emissions by sources and removals by sinks of GHGs'. Obviously in this paper, and also for UNFCCC national communication, we use the term removal for the C capture and storage in terrestrial ecosystems. We have specified this the first time we mention 'removal'; in the text. IPCC, 2007: Climate Change 2007: Mitigation.

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Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [B. Metz, O.R. Davidson, P.R. Bosch, R. Dave, L.A. Meyer (eds)], Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA., 852 pp.

Author Reply to the Referee #2 Specific Comment 16: we have added the numbers from Hanan et al. 1998 and changed our results accordingly. This lead to a little decrease of our NEP mean, from 0.89±1.67 to 0.82±1.56 MgC ha⁻¹y⁻¹, reducing a little also the standard deviation. We have used this number also in the new final carbon budget!

Author Reply to the Referee #2 Specific Comment 17: We have improved the table, specifying units for each group of lines. Now should be clearer. Central Africa correspond to the Congo Basin. This has been clarified as well.

Author Reply to the Referee #2 Specific Comment 18: If this comment is related to Table 1 (table 18 does not exist) this is the answer: Table 1 contains data from the African countries national communication to UNFCCC, while Table 5 is a comparison between some of the Table 1 data and other data. Therefore we believe the 2 tables can not be combined.

Author Reply to the Referee #2 comment on Figure 1: We have updated Figure 1 according to the Referee #2 Summary Comment 3 (above) and the Referee #2 comment on Figure 3 (below). In the new version we have also reported the legend for vegetation classes.

Author Reply to the Referee #2 comment on Figure 2: Probably the referee meant: do we need Table 1 and Figure 2. If so, the question is relevant. This was a duplication, so we have deleted Figure 2.

Author Reply to the Referee #2 comment on Figure 3: As specified in the Author Reply to the Referee #2 Summary Comment 3, in accordance with the Re-

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viewer #2 suggestions, we have updated Figure 1 using the same vegetation classes of Figure 3 (i.e. the FAO Forestry classification Global Ecological Zones <http://www.fao.org:80/geonetwork?uuid=baa463d0-88fd-11da-a88f-000d939bc5d8>).

Author Reply to the Referee #2 comment on Figure 5: Figure 5 has been deleted as indeed it does not add any critical value to the text and would need to be discussed in more details in a focused paper just on this experiment.

Author Reply to the Referee #2 comment on Figure 6: This comment cannot be related to Figure 6. We believe it is referred to Table 1. If so 'Total' means 'total emissions': this is the sum of the emissions from Anthropogenic sources, Agriculture and LUCF, as defined by UNFCCC. We have specified 'Total emissions' in the table.

Interactive comment on Biogeosciences Discuss., 6, 2085, 2009.

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