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## ***Interactive comment on “The full greenhouse gases budget of Africa: synthesis, uncertainties and vulnerabilities” by R. Valentini et al.***

**R. Valentini et al.**

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Authors' Reply to the Anonymous Referee #1

(please note that the updated manuscript, tables and figures are uploaded in the final comment)

Referee's General Comment:

It would be good if tables and figures were more self-supported, i.e. the reader should be able to understand the main “message” of each Table/figure without consulting the bulk text. Hence would addition of references in the tables citing other papers be useful.

Author's reply: Relevant table and figures have been improved according to the sug-

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gestions of both referees (see the files with the updated tables and figures).

Referee's General Comment:

It would be very useful if additional quality information could be included when various types of up-scaling procedures are used (i.e. when applying empirical relationships from case studies). Add data on the strength of the relationship ( $r$ ,  $R^2$ , RMSE, etc), number of observations etc. used when applying these empirical relationships for a continental Africa.

Author's reply: This has been done, whenever possible. See the updated manuscript.

Referee's General Comment:

Also make sure that when comparing data valid for different time periods, this is clearly stated.

Author's reply:

We have stated this at the beginning of Section 5, where we compare different approaches. The time periods of each estimate are listed in the respective relevant sections and all together in the final summary table (Tab. 11).

Referee's General Comment:

In this paper we have 38 maps of Africa, sometimes in panels where 10 of them are squeezed together. Printed on normal size paper, these are not possible to read. On screen they can be read. We also have slightly different shapes (projections?) of Africa that makes comparison harder. Standardize this if possible.

Author's reply:

Few maps and figures have been improved (see the updated tables and figures). Due to the different methodologies used, a full standardization has been not possible.

Referee's General Comment:

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It would be nice to see more African authors in the author list, assuming that initiative like this is a good way for knowledge transfer.

Author's reply:

Yes, it would have been nice, but unfortunately it is not possible at this stage. The modeling systems efforts were developed by non-African authors and also the field research leading to these results has been carried out by non-African authors. Nevertheless a local partnership was built and further activities will be done jointly.

Referee's General Comment:

The description of experiments and calculations is not sufficiently complete and precise to allow their reproduction by fellow scientists (traceability of results). This can be improved.

Author's reply:

Relevant sections have been improved, particularly for what concerns the methodology, as requested in many different comments by both Referees. See the updated manuscript version.

Referee's Specific Comment:

Title: Consider "A full greenhouse:::" " instead of "The full greenhouse:::"

Author's reply:

Done!

Referee's Specific Comment:

Provide full references for sources mentioned in footnote 2 (Data were processed from the latest:::) so the reader can find the same information (website?) as used by the authors.

Author's reply:

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[http://unfccc.int/national\\_reports/non-annex\\_i\\_natcom/items/2979.php](http://unfccc.int/national_reports/non-annex_i_natcom/items/2979.php) (aded in the updated manuscript). This is the official website of UNFCCC.

Referee's Specific Comment:

Table 1: Make sure that references entries such as "Per capita values are estimated on the base of UN World population prospect, the 2010 revision" are matched with identical entries in the reference list (Current corresponding entry = United Nations, Department of Economic and Social Affairs: Population Division, World Population prospect: The 2010 Revision, CD-ROM Edition, 2011). Correcting discrepancies such as this facilitates for the reader and increase paper clarity

Author's reply:

The reference is correct. The 2010 revision was published in 2011 (in order to contain data from the entire 2010 year). We have added the year of publication in the text.

Referee's Specific Comment:

Section 3.1-3.2: It is somewhat unclear if spatial/GIS data used was in equal area projection while areal estimates and the integration of GlobCover and the WHRC was conducted. This may affect the outcome presented.

Author's reply:

All GIS analyses were conducted with data in sinusoidal projection, which is the original projection adopted in the WHRC biomass map.

Referee's Specific Comment:

Define the regions used in Table 1 and indicate them on a map.

Author's reply:

We have used the United Nations geographical sub-regions for Africa, from the United Nations Statistics Division. All the countries regrouped in each region are listed here:

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<http://unstats.un.org/unsd/methods/m49/m49regin.htm#africa>. We added this explanation, including the web link, in the manuscript, thus we do not think still relevant to indicate those regions in a map.

Referee's Specific Comment:

P8349:L25-26: Add proper references or URL where these data can be found or are described.

Author's reply:

GLC2000: <http://bioval.jrc.ec.europa.eu/products/glc2000/glc2000.php> Globcover 2006 and 2009: <http://due.esrin.esa.int/globcover> These references were added in the updated manuscript version.

Referee's Specific Comment:

P8350:L1-2: "The aggregated accuracy is 66%". This is vague and unclear. Is this a combined value for all three or :::? Clarify and specify. Perhaps refs to existing evaluations (such as [http://due.esrin.esa.int/globcover/LandCover2009/GLOBCOVER2009\\_Validation\\_Report\\_2.2.pdf](http://due.esrin.esa.int/globcover/LandCover2009/GLOBCOVER2009_Validation_Report_2.2.pdf)) of these data sets can be included.

Author's reply:

That sentence has been updated to: "The accuracy level varies from 67.1% to 70.7% depending on the different land cover products. Details on the methodology to assess the accuracy are given in the Validation Reports". These are the web links, added in the Manuscript: [http://dup.esrin.esa.int/files/p68/GLOBCOVER\\_Products\\_Description\\_Validation\\_Report\\_I2.1.pdf](http://dup.esrin.esa.int/files/p68/GLOBCOVER_Products_Description_Validation_Report_I2.1.pdf) [http://due.esrin.esa.int/globcover/LandCover2009/GLOBCOVER2009\\_Validation\\_Report\\_2.2.pdf](http://due.esrin.esa.int/globcover/LandCover2009/GLOBCOVER2009_Validation_Report_2.2.pdf)

Referee's Specific Comments:

P8352:L20: "::::map has known issues". This is very vague. Please clarify these known

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issues. and P8352:L21: “:::WHRC biomass map has been built with limited ground truth”. Vague. What is limited ground truth and how much if this originate from Africa (i.e. the area of interest in this paper)? Please clarify and give a measure on the correspondence of the WHRC biomass estimates versus independent ground truth for Africa.

Author’s reply:

The entire sentence has been changed to: “We recognize that both maps have some limitations: the GlobCover 2009 map has a lower accuracy in flooded areas class (see the GlobCover 2009 validation report: [http://due.esrin.esa.int/globcover/LandCover2009/GLOBCOVER2009\\_Validation\\_Report\\_2.2.pdf](http://due.esrin.esa.int/globcover/LandCover2009/GLOBCOVER2009_Validation_Report_2.2.pdf)), while the WHRC biomass map has been built with limited ground truth, coming from three countries only (Republic of Congo, Cameroon and Uganda) and collected at a distance of years from remote sensing data (Baccini et al. 2008)”.

Referee’s Specific Comment:

P8352:L26-28. How was the combined error of 19-27% reached? Clarify and describe.

Author’s reply:

To clarify how the error was reached, the relevant sentence has been changed to: “Considering that each dataset is possibly affected by a 9–15% (min.-max.) representation error for each class, the cumulated error associated with the overall estimate of biomass in tropical Africa is in the order of 19–27 % per class, which represent the minimum and maximum range of error that classes can have”.

Referee’s Specific Comment:

P8356:L24: “they include insufficient data representation from Africa”. Specify how much flux data from Africa that was used (number of site-years or equivalent) in the study. Include the same for the ANN (Papale and Valentini, 2003) approach described later on as well.

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Author's reply:

That sentence has been changed to: "The La Thuile FLUXNET data set (www.fluxdata.org) was screened for the high quality data and the availability of required variables. Because only one African flux data were available for training at the time, uncertainties due to extrapolation to African ecosystem are likely to be substantial."

Referee's Specific Comment:

Section 3.5: Is there any DGVM estimates actually evaluated with field data (flux, NPP collections, other types of in situ data etc.)? If so include these, if not state that no such evaluations are available. Inversion data is slightly different and perhaps less understandable for the general reader. Anyhow include a short statement on DGVM model performance for Africa as based on evaluations using quantitative data. Perhaps the NPP sites in FLUXNET or the AfriTRON forest plot network could be used?

Author's reply:

Several DGVMs have been evaluated against AfriTRON data in this review article: Lewis, S.L., J. Lloyd, S. Sitch, E. T. A. Mitchard & W. F. Laurance (2009) Changing Ecology of Tropical Forests: Evidence and Drivers, *Annu. Rev. Ecol. Evol. Syst.*, 40:529–49. Global evaluation of these DGVMs: Piao SL, S Sitch, P Ciais, P Friedlingstein, P Peylin, XH Wang, A Ahlström, A Anav, JG Canadell, C Huntingford, M Jung, S Levis, PE Levy, JS Li, X Lin, MR Lomas, M Lu, YQ Luo, YC Ma, RB Myneni, B Poulter, ZZ Sun, T Wang, N Viogy, S Zaehle, N Zeng. Evaluation of terrestrial carbon cycle models for their response to climate variability and to CO<sub>2</sub> trends. *Global Change Biology*. 19(7), 2117-2132. Some evaluation of vegetation distribution for LPJ: Doherty, R. M., Sitch, S., Smith, B., Lewis, S. L., and Thornton, P. K.: Implications of future climate and atmospheric CO<sub>2</sub> content for regional biogeochemistry, biogeography and ecosystem across East Africa, *Global Change Biol.*, 16, 617–640, doi:10.1111/j.1365-2486.2009.01997.x, 2010 For Orchidee, LPJ, LPJ-Guess and JULES: Weber, U, M

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Jung, M Reichstein, C Beer, MC Braakhekke, V Lehsten, D Ghent, J Kaduk, N Viovy, P Ciais, N Gobron, C Roedenbeck, The interannual variability of Africa's ecosystem productivity: a multi-model analysis Biogeosciences, 6, 285–295, 2009

Referee's Specific Comment:

Section 3.9: Please add some data on the strength of the relationship, number of observations etc. used when applying empirical relationships (P8370:L18-19)

Author's reply:

Done. See the updated manuscript.

Referee's Technical Correction

Table 3: Mismatch in column headings?

Author's reply:

Yes, there was a mismatch, probably happened during the conversion to PDF (our original file was fine). We have underlined this issue in the updated file with tables.

Referee's Technical Correction

Table 8: (Thompson et al., 2013) missing in ref list.

Author's reply:

Table 8 has been updated with improved values and 'Thompson et al., 2013' removed.

Referee's Technical Correction

Fig 2. Use (P)g as unit for consistence instead of GtC. Legend hard to read, increase font size.

Author's reply:

Done (see the updated Fig. 2). The consistency among units was checked along the

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entire manuscript.

Referee's Technical Correction

Fig 3a. Make the 2 maps in identical size.

Author's reply:

Done (see the updated Fig. 3).

Referee's Technical Correction

Fig 4&5: Unit should be g C instead of kg C?

Author's reply:

Yes, they should be g C. It is corrected in the updated manuscript.

Referee's Technical Correction

Fig 4. Add ref so the reader don't need to consult the bulk text to understand where these simulation originate.

Author's reply:

Sitch, S, P. Friedlingstein, N. Gruber, S. Jones, G. Murray-Tortarolo, A. Ahlström, S. C. Doney, H. Graven, C. Heinze, C. Huntingford, S. Levis, P. E. Levy, M. Lomas, B. Poulter, N. Viovy, S. Zaehle, N. Zeng, A. Arneeth, G. Bonan, L. Bopp, J. G. Canadell, F. Chevallier, P. Ciais, R. Ellis, M. Gloor, P. Peylin, S. Piao, C. Le Quéré, B. Smith, Z. Zhu, R. Myneni, Trends and drivers of regional sources and sinks of carbon dioxide over the past two decades, Biogeosciences Discussions, in prep.

Referee's Technical Correction

Fig 8. The maps and the legend in this figure can't be read properly.

Author's reply:

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Unfortunately we had a problem in retrieve the original file. We will try to provide you with the updated figure before the publication of the definitive version of the paper.

Referee's Technical Correction

P8371:L14 and Table 8: Castaldi et al., 2013 is missing in the reference list.

Author's reply:

Table 8 has been updated with improved values and 'Castaldi et al., 2013' was removed where relevant, while another Castaldi et al 2013 added (this is the update of the previous Castaldi et al. 2012).

Referee's Technical Correction

References: First entry = "UN, Population Division of the Department:::", should come later on.

Author's reply:

Done!

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Interactive comment on Biogeosciences Discuss., 10, 8343, 2013.

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