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Interactive comment on "The effect of land-use change on the net exchange rates of greenhouse gases: a meta-analytical approach" *by* D.-G. Kim and M. U. F. Kirschbaum

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Dear Reviewer for bg-2013-646:

Please accept our revised version of manuscript bg-2013-646 with the modified title "The effect of land-use change on the net exchange rates of greenhouse gases: a global compilation of estimates" (Please find the revised manuscript in the supplement). We also submit our detailed responses to your comments.

We thank you for their constructive suggestions that have substantially improved the manuscript.

The main changes to the manuscript were:

1. Title was changed to "The effect of land-use change on the net exchange rates of greenhouse gases: a global compilation of estimates".

2. Biomass carbon stocks (2.2.1 Quantifying changes in biomass carbon stocks) were newly determined using the information from FAO (2010), IPCC (2001) and WBGU (1998) and the newly applied methodology, news results and relevant discussion were incorporated in text, tables, figures, and references accordingly.

3. Results (3. Results) and Discussion (4. Discussion) sections were combined into a new section (3. Results and Discussion) and the discussion was enhanced throughout the manuscript.

4. Figure 2 was omitted since Table 6 provided very similar information already.

Further detailed responses to your comments have been given in the below message. Finally, we have acknowledged your constructive and valuable comments in the 'Acknowledgments' section.

This study has not been published and is not under review in any other journal or book. All authors have approved the manuscript and agree with its submission. We hope you share our enthusiasm for this study and consider it for publication in Biogeosciences.

Sincerely,

Dong-Gill Kim on behalf of all authors

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Response to the reviewer 2's comments

The authors claim that their study is the most comprehensive, I am not sure that this statement is justified.

Response: We stated that we used a "comprehensive approach" in the Introduction

(see below) but we did not claim that this study is “the most comprehensive”. “This review is novel in that it takes a comprehensive approach in dealing with the effect of LUC on the exchange of GHGs between land and atmosphere through quantifying changes in biomass C, SOC, CH4 and N2O fluxes (line 24-26, page 1056).” We believe that this is a correct description of our work.

My main criticisms of this study are 1) Lack of information of the data shown in the supplement: You need to introduce this data set and supplement at the beginning of the method section. In the main paper you should include the stats of your data: fraction of data points per climate zone; per gas; per land use change category.

Response: Details of the information on the Supplementary Information (SI) were given in the section ‘2.2.4 Quantifying changes in soil CH4 and N2O emissions’, but we agree that this was probably too brief. We have therefore added further information about the Supplemental Information as follows: “To quantify changes in soil CH4 and N2O emissions following land-use change, data were acquired by searching the existing peer-refereed literature published between 1970 and 2013 using the Web of Science and Google Scholar with search terms such as “land-use change”, “land-use conversion”, a description of different land use types (e.g., natural forest, cropland, grassland, or secondary forest), and the name of different GHG emissions (CH4 or N2O). We compiled CH4 (n = 34) and N2O (n = 37) emissions data obtained from paired study sites with different land-use types (Supplementary Information Tables A to E).”

(2) Poor structure/presentation: One normally does not discuss data in the method and result sections; but one normally does discuss data in the discussion section. So please edit your manuscript accordingly. The subscripts in equations are not explained adequately.

Response: As suggested, we have moved some paragraphs of discussion from the Materials and Methods to the (newly combined) Results and Discussion. However, we could not see what subscripts the reviewer thought were not explained adequately.

We checked through them again, and all symbols including applicable subscripts have been described where they are first used.

(3) Omissions and poor clarity: You need to support your statements with data from the literature in a much clearer way. For example: Section 2.2.1: We assumed that 75% of the biomass C stock in the biomass of 2ndary forests can accumulate over 100 years: Please tell us how you have derived this 75%.

Response: The estimates for both natural and secondary forests have now been re-calculated based on the numbers provided in WBGU (1998) and FAO (2010). The assumptions underlying these calculations have been described in “2. 2. 1. Quantifying changes in biomass carbon stocks”.

Abstract line 21: put 5.5 Gt CO2 eq/y into the context of overall annual global emissions

Response: We believe that it would be inappropriate to add such further elaboration to the Abstract. Abstracts need to contain precise information that gives an insight into the information contained in the paper, and adding such further elaboration as asked for by the reviewer would use some valuable space. We also expect that most readers would have a reasonable appreciation of the size of global GHG emissions so that such extra information would not be required. We have, however, given such a global context in the Results and Discussion section where space is not so tight.

Section 1 Page 4: nitrous oxide processes: change bacteria to microorganisms, as fungi also contribute to N2O

Response: We have revised the sentence as follows: 2) denitrification, the stepwise conversion of NO_3^- to N2O and ultimately N2, by anaerobic bacteria that use NO_3^- as electron acceptors for respiration under anaerobic conditions (Knowles, 1982) Section 1 Page 4: add references for LUC influences CH4, N2O Response: We have revised the sentence as follows: A growing number of studies have also reported the effect of LUC on CH4 and N2O fluxes (e.g., Lin et al. 2012; Galbally et al. 2010; Allen

et al. 2009). Allen, D., Mendham, D., Cowie, A., Wang, W., Dalal, R., and Raison, R.: Nitrous oxide and methane emissions from soil are reduced following afforestation of pasture lands in three contrasting climatic zones, Soil Research, 47, 443-458, 2009. Galbally, I., Meyer, C., Wang, Y., and Kirstine, W.: Soil-atmosphere exchange of CH4, CO, N2O and NOx and the effects of land-use change in the semiarid Mallee system in Southeastern Australia, Global Change Biol., 16, 2407-2419, 2010. Lin, S., Iqbal, J., Hu, R., Ruan, L., Wu, J., Zhao, J., and Wang, P.: Differences in nitrous oxide fluxes from red soil under different land uses in mid-subtropical China, Agric. Ecosyst. Environ., 146, 168-178, 2012.

Section 2.1: Which category includes the intensively managed grasslands typical for Western Europe and New Zealand?

Response: Intensively managed grasslands were included under the grasslands category. To make that clearer, we have added the extra clarification: “Grassland includes both extensively and intensively managed grasslands”.

Section 2.2 do you use the 100 year time horizon GWP?

Response: In this study, we have chosen to analyse the changes over a time frame of 100 yr, as this is a commonly used time frame in GHG accounting, such as in the calculation of GWPs, and, yes, consistent with our 100-year calculation horizon, we have also used 100-year GWPs We have added that extra qualifying detail to Section 2.2.4.

Table 4: the explanation how delta S was calculated is not clear. Generally the legends could all be improved.

Response: We have revised the relevant sentence in the Legend of Table 4 as follows: Pre-revision ΔS was calculated as the product of the numbers in the preceding columns. Post-revision ΔS after 100 years was calculated by multiplying SOC in pre-LUC by the percentage change after 100 years in the preceding column.

Section 4.3: I can’t see why compaction should decrease N2O reductase. I thought the opposite would be the case; compaction increases anaerobicity so should increase N2O reduction to N2.

Response: We have revised the sentence as follows: Pre-revision In addition, increase in soil acidity due to excessive synthetic fertilizer use (Barak et al., 1997; Bulluck et al., 2002), and increased soil compaction by intensive soil management (e.g., Bilotta et al., 2007) can further increase N2O emissions by decreasing N2O reductase activity (e.g., Christensen, 1985; Struwe and Kjøller, 1994; Raut et al., 2012). Post-revision In addition, any increase in soil acidity due to excessive synthetic fertilizer use can increase N2O emissions by decreasing N2O reductase activity (Barak et al., 1997; Bulluck et al., 2002). Increased soil compaction by intensive soil management can further increase N2O emissions by increasing the rate of denitrification (e.g., Luo et al., 1999; Bilotta et al., 2007). Luo J, Tillman RW, Ball PR. Grazing effects on denitrification in a soil under pasture during two contrasting seasons. Soil Biol Biochem 31:903–12. 1999.

Please also note the supplement to this comment:
http://www.biogeosciences-discuss.net/11/C2248/2014/bgd-11-C2248-2014-supplement.pdf

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Interactive comment on Biogeosciences Discuss., 11, 1053, 2014.