

Interactive comment on “Can we reconcile differences in estimates of carbon fluxes from land-use change and forestry for the 1990s?” **by A. Ito et al.**

A. Ito et al.

Received and published: 9 May 2008

We thank the referee for his/her constructive suggestions for improving the paper.

General comments 1) It seems that authors used data from the 2000 UNFCCC database (e.g. page 3486, page 3852 line 16 for EMI2). I strongly recommend author to use the latest available data (2005). The latest compilation of GHG data is available at <http://unfccc.int/resource/docs/2007/sbi/eng/30.pdf> (Annex I GHG countries, submission 2007) and <http://unfccc.int/resource/docs/2005/sbi/eng/18a02.pdf> (non-Annex I GHG countries). Furthermore, the UNFCCC secretariat released a new version of its GHG data interface, very easy to use. Since 2000, numbers have changed due to recalculation and (hopefully) more accurate and complete estimates. Thus, estimates

Full Screen / Esc

Printer-friendly Version

Interactive Discussion

Discussion Paper

at beginning at page 3846 are old: e.g., according to the latest submissions, average annual LULUCF sink (in Tg CO₂ eq.) for the 1990s (1990-1999) is -789 for USA and -276 EU-15 (offsetting, respectively, 12 percent and 7 percent of total non-LULUCF emissions for the same period). I suggest to update these data throughout the paper. In addition, I suggest explain more clearly that UNFCCC data means only that it is archived in the UNFCCC database: the data itself come from the countries. It may be obvious for many, but not for all.

We corrected the references for the UNFCCC. We used the latest version of the data to calculate the annual LULUCF sinks of -832 Tg CO₂-eq. yr⁻¹ and -126 Tg CO₂-eq. yr⁻¹ for the USA and the 15 Annex I European countries, but they are averaged over the period 1990 - 2002. We corrected them for the averages in the 1990s. In subsection 2.2.1, we refer to the national inventories (i.e., Brazil Ministry of Science and Technology, 2004; U.S. Environmental Protection Agency, 2007) and used the latest version of the data. This was not clearly stated in the introduction, but appeared later in the subsection 2.2.1. We added the following text in the introduction: These countries compile national greenhouse gas inventory data (e.g., Brazil Ministry of Science and Technology, 2004; U.S. Environmental Protection Agency, 2007) which are reported to the UNFCCC and archived in the UNFCCC database (UNFCCC, 2005, 2007).

2) I see a risk of comparing apples with oranges. Authors seems to be aware of this risk (e.g. page 3846 lines 16-18), some doubts remains in my mind when reading at page 3845: "The terrestrial flux can be split into that part specifically attributable to changes in land use (+1.6 ´s 1.1 PgC yr⁻¹) and a residual component (-2.6 ´s 1.7 PgC yr⁻¹) that accounts for other environmental changes The residual terrestrial flux can be associated with a range of environmental changes (ENV) that include climate change (water and temperature), disease outbreaks, added nutrients (CO₂ and nitrates), pollution damage (O₃), and re-growth of vegetation in natural (unmanaged) land which is not included under the UNFCCC reporting guidelines for LUCF " What does it mean can be associated? The residual terrestrial flux is not only

[Full Screen / Esc](#)[Printer-friendly Version](#)[Interactive Discussion](#)[Discussion Paper](#)

associated with ENV changes in natural (unmanaged) land which is not included under the UNFCCC, but also with changes due to management (i.e. the LU and F terms in LULUCF) actually reported to UNFCCC in the LULUCF sector. Furthermore, LULUCF inevitably contains also a component due to ENV changes (for this reason sinks from forest management were reduced by 85% and capped under Kyoto). Maybe it is just a misunderstanding, but please make more clear these concepts and also if/how the various models considered are comparable in terms of processes and definitions.

We denote "changes in land use", including agricultural and forestry practices, collectively under the term land-use change and forestry (LUCF). We followed the standard terminology, instead of using "changes in land use". We added the IPCC (2000) reference for a discussion in terms of different processes and definitions. The text in the first paragraph has been revised as follows: The terrestrial flux can be split into that part specifically attributable to Land Use, Land Use Change and Forestry (LULUCF) and a residual component that accounts for other environmental changes (ENV). These LULUCF fluxes are mainly attributable to human activities and are reported for managed lands under the United Nations Framework Convention on Climate Change (UNFCCC) reporting guidelines, although LULUCF inevitably contains a component due to ENV changes (for this reason sinks from forest management were reduced by 85% and capped under the Kyoto protocol). Over the past two decades, tropical deforestation has been the dominant component of the global LUCF CO₂ flux, which excludes the CO₂ fluxes from agricultural practices (Denman et al., 2007). Since the global CO₂ flux from agricultural land use practices is much smaller than that from LUCF (UNFCCC, 2005, 2007), tropical deforestation is also the dominant component of LULUCF. The residual terrestrial flux can be associated with a wide range of environmental changes which include climate change (water and temperature), disease outbreaks, added nutrients (CO₂ and nitrates), pollution damage (O₃), and re-growth of vegetation in natural (unmanaged) land that is not included under the UNFCCC reporting guidelines for LULUCF. Interpretation of the guidelines needs cautions. For instance, the Intergovernmental Panel on Climate Change (IPCC) and Food and Agriculture Organization

[Full Screen / Esc](#)[Printer-friendly Version](#)[Interactive Discussion](#)[Discussion Paper](#)

(FAO) definitions and methodologies differ slightly as discussed in the IPCC Special Report on LULUCF (IPCC, 2000).

3) I am a bit puzzled by the huge differences in these estimates in Fig.1: do they mean that LUC 2 to LUC 5 indicate that forests expanded globally during the 1990s? This contrasts with most other estimates from the literature, how do the authors explain this discrepancy (which inevitably affects most of subsequent estimates)?

It does not mean "forests" expanded globally during the 1990s, because the changes in forests caused by abandonment of crop and pasture lands and by deforestation for crop and pasture land expansions do not equal to the changes in "forests". In Fig. 1, we did not include shifting cultivation, short-rotation forestry, wild fires, woody invasion, flooding, and so on. Thus we need to pay attention to it when we compare them with other estimates from the literature. Here, we briefly described the contrast to LUC1 and LUC6 in subsection 3.1. In subsection 3.4.2, the data sets associated with each LUC type in Brazil are analyzed in detail. We added the following text in subsection 3.1: LUC2 - 5 indicate that the increases in forest areas from crop and pasture land abandonment are larger than the decreases in forests areas due to deforestation driven by expansions of crop and pasture land during the 1990s, in contrast to LUC1 and 6. These differences are related to the primary data sets and secondary assumptions. FAOSTAT reported the changes in the agriculture and pasture land at a national scale. HYDE allocated them to a 0.5 degree grid, using a population density map. LUC2 to LUC5 employed the FAOSTAT/HYDE data for their calculations of LUC areas. In these processes, the changes in forest areas are not directly constrained by the measurements, which may include other driving forces such as woody invasions, wild fires and so on. This contrasts with LUC1, which was based on the changes in deforestation areas, and LUC6, which did not use the FAOSTAT/HYDE data based on the comparison between HYDE and GLC2000. The latter assumed that the historical expansion of pasture was mostly due to conversion of natural grassland (e.g., Houghton, 1983, 1999, 2003; Klein Goldewijk and Ramankutty, 2004).

Full Screen / Esc

Printer-friendly Version

Interactive Discussion

Discussion Paper



- the paper contains a lot of information, perhaps even too much, and although it is well written it is sometimes difficult to follow. I suggest authors considering if it is possible focusing on the most relevant points and eliminating what is not strictly necessary.

We added the following guideline in the introduction. The reader may skip some sections and go to sections they are interested in. Sections 3.1 - 3.3 show comparisons between different data sets at the global or near-global level, while Section 3.4 presents the two case studies for the USA and Brazil. Specific issues that we will address for a quantitative interpretation of the USA data in terms of differences in LUCF emissions include (1) the soil organic carbon (SOC) pools, (2) the effects of including fire suppression, and (3) the discrepancies in the amount of sinks between bottom-up and top-down estimates. Specific issues that we will focus on for the Brazilian data with regard to differences in LUCF emissions include (1) the land-use changes areas, (2) the origin and fate of carbon released into the atmosphere, and (3) the discrepancies in the inter-annual variability between bottom-up and top-down estimates.

- the authors conclude that significant efforts are still needed: can they provide some hints on which are the best steps forward in their view?

We added the following text in the section 4: Because there are different sources of errors at the country level, a country specific approach with spatial and temporal detail is needed to reconcile different estimates of carbon fluxes. Specific issues that will need to be addressed for the USA data for LUCF emissions include a more accurate quantification of the SOC and its changes due to the effects of fire suppression, and a better constraint on estimates of the long-term ENV. Specific issues that will need to be focused on to improve the Brazilian data for LUCF emissions include a more accurate quantification of the rate of deforestation and AR in each specific LUC activity.

Specific comments Page 3846, line 8 (and elsewhere in the paper): I suggest using consistent units: moving from Tg to Pg and from CO₂ to C does not help the reader.

The flux from LULUCF in the line 8 includes only CO₂, while the flux in the unit of

[Full Screen / Esc](#)[Printer-friendly Version](#)[Interactive Discussion](#)[Discussion Paper](#)

"CO₂-eq." includes CH₄ and N₂O in addition to CO₂. The unit of "Tg CO₂-eq. yr⁻¹" is corrected to "Pg C yr⁻¹". The "reported flux from LULUCF" in the line 8 is corrected to "reported flux of only CO₂ from LULUCF".

Page 3848, lines 10-12. I do not fully agree: submission to UNFCCC (which includes all information on C pools reported by the countries) are downloadable from UNFCCC web site, and the reporting format is uniform within Annex I countries (or within non-Annex I).

The sentence has been revised as follows: Since individual countries are allowed to use different methods to estimate the carbon flux from LULUCF, a careful reading of the national reports and auxiliary materials are required to interpret the estimates for carbon pools, carbon pool changes, and land cover change areas from individual countries in the UNFCCC data base.

Page 3848, line 17. I suggest to write : because of the ongoing negotiations on a mechanism of positive incentives for

The sentence has been revised as follows: In addition, Brazil is chosen because of recent estimates of large area changes in land use and because of the ongoing negotiations on a mechanism of positive incentives for Reducing Emissions from Deforestation and Degradation (REDD) initiated at the request of several forest-rich developing countries (Gullison et al., 2007; Oliveira et al., 2007).

Fig. 1: the term crop and pasture land conversions is not fully clear to me; do (-) signs mean conversions (of forests) to crop and pasture land? and (+) signs mean expansion of forest to cropland and pasture ? I suggest to make it more clear. On the y-axis it should be km² and not km⁻² (also in fig. 5)

The sentence has been revised as follows: The negative (-) signs indicate a decrease in forest areas and the positive (+) signs represent an increase in forest areas. The units in Figs. 1 and 5 are corrected.

[Full Screen / Esc](#)[Printer-friendly Version](#)[Interactive Discussion](#)[Discussion Paper](#)

Interactive
Comment

Table 6, I suggest to check EMI2 data with the latest available data in UNFCCC database (see above). Also, please consider that data from many non-Annex I countries is highly un-reliable.

We corrected the references for the UNFCCC (see above). The sentence has been revised as follows: Houghton and Ramakrishna (1999) have reviewed some of the first emissions inventories from non-Annex I countries and showed that there were significant discrepancies between the data used in the emissions inventories and the data available in international surveys. The disparity of results between the estimated emissions reported to the UNFCCC and modeling approaches such as the carbon cycle models used by McGuire et al. (2001) may be caused by the definition of "managed lands" used by the UNFCCC, by differences in the estimated carbon pools, carbon pool changes, or areas involved in LUC, or even by processes such as CO₂ fertilization which are as yet poorly quantified.

Page 3869, line 11 I suggest using compatible instead of consistent

This has been corrected. The global estimate of LUCF emissions in the consolidated estimate (i.e. 0.9 with a range from -0.6 to 1.8 Pg yr⁻¹) is compatible with AR4 assessment (1.6 ± 1.2 PgC yr⁻¹).

Interactive comment on Atmos. Chem. Phys. Discuss., 8, 3843, 2008.

[Full Screen / Esc](#)[Printer-friendly Version](#)[Interactive Discussion](#)[Discussion Paper](#)