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Biogeosciences Discussions

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

Anonymous Referee #2

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Summary Comments

The paper by Bombelli et al. seeks to review and synthesize information on African carbon cycle obtained within and external to the CarboAfrica project. While potentially useful, in particular via synthesis for the African continent of country-level statistics to UNFCCC with additional and new forest and savanna biomass and soil carbon stock inventory, the paper lacks the clarity and focus that are needed in any review. In revising the paper I suggest the authors reconsider the organization and logical flow of the paper, and consider how best to highlight new (synthetic) findings and omit elements that detract from the primary points. In particular, the authors might wish to consider the following:

1. In the Introduction and all subsequent sections, highlight synthesis and results that go beyond; the earlier review by Williams et al. 2007 and the fossil fuel and land use

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change review of Canadell et al (in the same special issue). Currently we here echoes of the earlier reviews and no clear statement of what new aims or conclusions will be addressed (I think the UNFCCC country data are an advance; the new and better carbon stocks estimates; perhaps the inter-model comparisons…).

2. Tighten the focus of the analysis: it currently meanders somewhat among disparate data and approaches. Are all the figures and tables necessary? Do some repeat (Figure 2 and Table 1; and possibly parts of Table 1 and 5; the methane figure).

3. Provide a better map showing the vegetation classes used in area-weighting to estimate Africa-wide stocks and/or fluxes. This maybe Figure 1, but it is not clear if Figure 1 *is* the vegetation map used (Figure 1 needs a legend in any case). If the GlobalCover map of Figure 1 was not the vegetation map used for area-weighting, then replace Figure 1 with the actual map used (with classes clearly relating to tables/figures referring to particular vegetation classes). If figure 1 was the map used for this, then add legend and perhaps aggregate the classes displayed to better highlight the main classes used in area-weighting.

4. The equation for African carbon balance is incomplete (absence of fossil fuel for example which, in Table 1 may be less than in the developed world but appears of equal order of magnitude as the agricultural and land use signals)

5. The model-based savanna sink seems unreasonably high, whether calculated by model (Table 2) or from flux measurements (Table 3). Fires are the primary oxidation route for many, perhaps most, African savannas; at least those savannas where grass production is as large or larger than tree production. Thus in the same way we would not leave respiration out of a ‘net’ carbon balance assessment it makes little sense to report large net uptake of savannas without immediate reference to the fire losses. Given widespread wood harvest in most savannas and annual cycling of grass biomass/production (via fire, herbivory or decomposition) I think that both measurements and models should return near-neutral carbon sinks over time periods

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representative of inter-annual variability in rainfall. While savanna NEP may positive in terms of recovery from disturbance (see e.g. Sankaran et al. 2005), land use intensity is increasing, not decreasing in most areas and I would not expect regrowth of savannas to provide such globally significant sinks as 1-3 Pg yr-1. Remember that most of the sites in Table 3 are protected from harvest unlike most African savannas.

Specific Comments

1. Abstract: forest degradation is higher than deforestation. Somehow I'm not seeing this statement in Table 4 (if that's where it is supposed to be supported). I see less carbon loss that cropland and agro-forestry conversions, and the are affected is lower.

2. Page 2089, line 15: variability does not equal vulnerability

3. Page 2094, line 27: #inconsistency with expected… considered not reliable”. Should really have some more objective criteria for outlier identification/exclusion.

4. Throughout ms: replace pro-capita with per-capita

5. Page 2095, line 17: fossil fuel emissions may be low& relative to the rest of the world, but Table 1 suggests anthropogenic emissions are of similar order to agricultural and land use fluxes.

6. Page 2099, line 9: Africa is a continent dominated by vegetation fires; seems a little overstated. Africa has diverse landscapes, cultures and history not dominated by fires!

7. Page 2099, line 23: Rather than #fire frequency determines the standing biomass# I suggest that standing biomass (of grasses) determines fire frequency. Fires have little impact on woody biomass in the short-term. A better reference for importance of fire in African savanna would be Bond (Bond and Keeley, 2005; Bond et al., 2003; Bond et al., 2005). I’m not sure any savanna ecologists think more woody biomass will lead to more intense fires: since savanna fires are herbaceous, not woody; more woody biomass likely will lead to less herbaceous growth and reduced intensity.

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8. Page 2101, line 15: it would be appropriate to cite previous work on trace gas fluxes here. Other references for trace gas fluxes include papers by Luanne Otter, Mary Scholes, and several more in the various SAFARI-92 and SAFARI-2000 special issues.

9. Page 2102, line 3: repeats previous paragraph

10. Page 2102, line 18: vegetable cropland; must be agroforestry as far as I can tell from Figure 4.

11. Page 2102, line 22-23: Eastern and South Africa forests…&#; where in East Africa and South Africa do we have ‘forest?

12. Page 2103, line 25: this paragraph stating ‘no data’ appears to directly contradict the previous paragraph where the Brown et al (2005) ‘degradation’ C-loss is cited.

13. Page 2103: Error and uncertainty should be recognized in so far as possible in these budgeting exercises.

14. Page 2105, line 24: ‘first analysis’ suggests such reviews have not been done before.

15. Table 1. ‘Removals’: what does ‘removal’ mean? Please define this fully, particularly since it is such a large term.

16. Table 3: Hanan et al., Global Change Biology, 1998 would add annual numbers for a Sahelian site, with annual NPP of 3.3 Mg ha-1 y-1 and annual NEP of 0.32 Mg ha-1 y-1. The NEP number was similar to measured wood accumulation.

17. Table 4: This table was very difficult to interpret. Please clarify. Provide units for each and every line. Define ‘Central Africa’ column…

Table 18. How do the UNFCC numbers relate to table 1 data? Could Table 1 and 5 be combined.

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Figure 1: Need a legend for vegetation classes.

Figure 2: Do we need Table 2 and Figure 2?

Figure 3: It would be good if the vegetation classes in this (and other) figures and analyses could be clearly distinguished in Figure 1 (or an alternative version of it).

Figure 5: Is this figure salient to the larger goals of this paper? I think it might be deleted.

Figure 6: &Total; is what? An area-weighted sum ? ... in which region?

Bond, W.J. and Keeley, J.E., 2005. Fire as a global 'herbivore': the ecology and evolution of flammable ecosystems. Trends in Ecology & Evolution, 20(7): 387-394.

Bond, W.J., Midgley, G.F. and Woodward, F.I., 2003. The importance of low atmospheric CO2 and fire in promoting the spread of grasslands and savannas. Global Change Biology, 9(7): 973-982.

Bond, W.J., Woodward, F.I. and Midgley, G.F., 2005. The global distribution of ecosystems in a world without fire. New Phytologist, 165(2): 525-537.

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