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Interactive comment on "Old carbon contributes to aquatic emissions of carbon dioxide in the Amazon" *by* L. E. Vihermaa et al.

Anonymous Referee #2

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Comments to the manuscript by Vihermaa et al. bg-2013-641, "Old carbon contributes to aquatic emissions of carbon dioxide in the Amazon".

Overview:

The study present direct measurements of 14C age of emitted CO2 from two streams and two rivers within the Western Amazonian Basin. The authors found that except from in one of the streams (which was not perennial) the degassed CO2 was depleted in 14C compared to the contemporary atmosphere. They suggest that this is due to a fossil carbon source contributing to the CO2 degassing. By using an end-member analysis they show the most likely theoretical C source composition for the different streams/rivers. They suggest that between 3 and 9% of the degassed CO2 has a fossil origin as they interpret being derived from weathering of carbonate containing bedrock.

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Interactive Discussion
Discussion Paper

They further claim that this contribution of old C needs to be considered and interpreted correctly in the Amazonian C cycle.

The manuscript focus on an important topic that is very suitable for publication in Biogeosciences. The loss of C via aquatic systems has repeatedly been concluded during the last decade as a highly significant component when estimating landscape C budgets at various scales and biomes. More recently the importance of CO2 emissions from fluvial systems has been shown at the global scale. In order to correctly incorporate this large source term in C budgets, knowledge about the origin and age of the emitted C is crucial. The different time scales of the including components of the C cycle is often neglected with questionable interpretations as a result.

General comments:

With this background the manuscript is an important contribution to the research field, especially since the Amazon region is poorly represented (although it's potential importance) in the literature. The relatively new technique used by the authors enabling age and source determination of emitted CO2 is a great step forward in the work on aquatic C emissions. Despite the relatively small dataset (which is understandable given the costs for 14C analysis) presented in the manuscript the study is very interesting in itself but also highlight an important issue that needs further research efforts. The manuscript is well written but I have some points that need to be clarified prior to a publication. These issues should however be quite easy to address by the authors.

Detailed comments:

Ln 1 p.1775. I have problems with the wording "ecosystem-derived carbon". I understand that the authors would like to exclude fossil carbon, but I don't think the wording ecosystem-derived does.

Ln 10-14 p. 1778. I am not familiar with this method and think it definitely needs to be better explained. The relationship between silicate weathering and 14C age of the

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emitted CO2 is a major finding that is presented in figure 3. Due to that I find the method description very poor, and why is not Silica measured??? It is hard to redo a study but at least the method/assumptions used need much better support.

Ln 12 p.1779. It is said that the SIAR package was developed for stable isotope end-member analysis (in this case 13C) and then the authors just use it for radioactive isotopes (in this case 14C). This should be clarified. I am not familiar with the analysis tool but I assume also 14C data is suitable to use...

Ln22 p1779. Waldron et al., 2007 is not in the reference list.

Ln 1 p. 1782. "reflect young", what is young and how can a 13C signature indicate the age. It is obviously of biogenic origin but could still be up ~10,000 years old even though these environments probably have a quicker cycling rate. Still think this need to be clarified though.

Ln 15-20 p. 1784. Even though a change in C source could be expected with a raising water level in the stream/soil, the change in 13C signature with increasing water level could also be linked to a change in emission rate with subsequent fractionation.

Discussion: This paper identifies a very important pathway for mobilized old carbon to be transferred to the atmosphere. The authors provide a complementing picture of the different C sources and processes in the Amazon Basin and make a valuable effort to integrate the finding of the manuscript within the existing literature on the Amazon Basin. In addition to justify the conclusions of the manuscript and even though the dataset it relatively small, I think the authors could expand the discussion a bit to also include comparison to other systems in a more global context. What are the likelihood for this old carbon contribution to be observed in other river systems and if it has already been observed or not? Is this to be expected for all areas with carbonate containing bedrock?

Figure 1: Why is the EC tower noted in the figure and mentioned in the caption? If not

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relevant for the study I suggest remove it. Please note the distance of the scale bar in the figure, not just in the caption.

Interactive comment on Biogeosciences Discuss., 11, 1773, 2014.