

Interactive comment on “Controls of longitudinal variation in $\delta^{13}\text{C}$ -DIC in rivers: A global meta-analysis” by K. A. Roach et al.

Anonymous Referee #1

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MAJOR COMMENTS

I suggest that the authors make their data-base public (as a supplement) for future studies and comparisons. The compilation is far from complete, the authors missed numerous papers (see below). I was not convinced from such a broad analysis that cyanobacteria have a major influence on the delta13C-DIC distribution in rivers.

SPECIFIC COMMENTS

I suggest the authors use the term "isotopic composition" instead of "isotopic signature". A signature is individual and invariable, which is not the case of stable isotopes.

L 23 : What's the difference between "decomposition" and "respiration" ?

L55 : HCO_3^- is also formed from weathering of silicate rocks

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L55 : CaCO_3 precipitation can also occur in rivers at travertines (Herman & Lorah 1987) or in highly eutrophic rivers (Abril et al. 2003).

L 269: replace "carbonate dissolution" by carbonate rock weathering

L 284 : statement "pCO₂ in rivers tends to decline downstream" is to some extent correct in temperate rivers with limited wetlands. It is not correct in tropical rivers where the presence of floodplains and wetlands in lowlands leads to increases in pCO₂ downstream (Abril et al. 2014; Borges et al. 2015a;b).

L 286 : statement "tropical rivers typically have higher concentrations of CO₂ (aq) than temperate rivers" is not entirely true (anymore). Since the Aufdenkampe paper there have several studies rivers that show that pCO₂ is very variable in tropical rivers (e.g. Borges et al. 2015a), and values are frequently lower than the "tropical average" given by Aufdenkampe.

L 301-303 : this statement is incorrect. The two largest rivers in the world (Amazon and Congo) have extremely low carbonate alkalinity values. The carbonate alkalinity is strongly function of latitude (that co-varies with lithology). Refer to classic work by Meybeck or Gaillardet.

L 310: This is not entirely true. While there's abundant organic carbon, black water rivers have also very low nutrient concentrations (N,P) that limit bacterial growth (Castillo et al. 2003) in addition to low pH and low O₂ conditions that are not favorable to bacteria. What is important for delta 13C-DIC is that these rivers have very low HCO_3^- and most of the DIC is CO₂.

L 336 : Abril et al. (2014) showed that root respiration by living macrophytes also contributes directly to CO₂ in the water. Regarding the importance of C₄ inputs in tropical watersheds refer to Marwick et al. (2014).

It could useful to try to include wetlands/floodplains into Figure 8.

There are numerous studies that were missed in the data compilation that should be

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updated. A much more scrupulous search of literature is needed. Here's a list that came from the top of my mind:

Abril et al. (2013)

Balagizi et al. (2015)

Borges et al. (2014)

Brunet et al. (2009)

Darling et al. (2016)

Dubois et al. (2010)

Polsenaere & Abril (2012)

Teodoru et al. (2015)

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Abril, G. et al. (2014). Amazon River carbon dioxide outgassing fuelled by wetlands. *Nature* 505, 395-398

Balagizi et al. (2015) River geochemistry, chemical weathering and atmospheric CO_2 consumption rates in the Virunga Volcanic Province (East Africa), *Geochemistry, Geophysics, Geosystems (G-Cubed)*, 16, 2637–2660, doi:10.1002/2015GC005999

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Borges et al. (2015a) Globally significant greenhouse gas emissions from African inland waters, *Nature Geoscience*, 8, 637-642

Borges et al. (2015b) Divergent biophysical controls of aquatic CO_2 and CH_4 in the World's two largest rivers, *Scientific Reports*, 5:15614, doi: 10.1038/srep15614

Brunet et al. (2009) Terrestrial and fluvial carbon fluxes in a tropical watershed: Nyong basin, Cameroon, *Chemical Geology*, 265, 563–572

Castillo et al. (2003) Bottom-up controls on bacterial production in tropical lowland rivers. *Limnol. Oceanogr.* 48, 1466-1475.

Darling et al. (2016) A long-term study of stable isotopes as tracers of processes governing water flow and quality in a lowland river basin: the upper Thames, UK, *Hydrological Processes*, DOI: 10.1002/hyp.10779

Dubois, K. D., D. Lee, and J. Veizer (2010), Isotopic constraints on alkalinity, dissolved organic carbon, and atmospheric carbon dioxide fluxes in the Mississippi River, *J. Geophys. Res.*, 115, G02018, doi:10.1029/2009JG001102.

Herman SH and MM Lorah (1987) CO_2 outgassing and calcite precipitation in falling spring creek, Virginia, U.S.A. *Chemical Geology*, 62, 251-262 251

Marwick et al. (2014) Disproportionate contribution of riparian inputs to organic carbon pools in freshwater systems, *Ecosystems*, 17: 974–989, doi:10.1007/s10021-014-9772-6

Polsenaere & Abril (2012) Modelling CO_2 degassing from small acidic rivers using water pCO_2 , DIC and $\delta^{13}\text{C}$ -DIC data. *Geochimica et Cosmochimica Acta*. 91: 220–239.

Teodoru et al. (2015) Dynamics of greenhouse gases (CO_2 , CH_4 , N_2O) along the Zambezi River and major tributaries, and their importance in the riverine carbon budget, *Biogeosciences*, 12, 2431–2453

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