

Interactive comment on “Carbon leaks from flooded land: do we need to re-plumb the inland water active pipe?” by Gwenaël Abril and Alberto V. Borges

Anonymous Referee #1

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COMMENT- The manuscript by Abril and Borges discusses existing conceptions of inland waters in the global C cycle and presents an updated view with a stronger focus on inland water- wetland interactions. While traditional conceptions see upland terrestrial ecosystems as only allochthonous source of C to inland waters, wetlands are known to be an important source of C to inland waters while having a specific ecology which is distinct from both terrestrial ecosystems and inland waters. This new conception is timely as it finally allows for a more complete perception of C cycling through the terrestrial-aquatic continuum of the continental surface.

Both authors have a great international reputation in the field of inland water and wetland biogeochemistry, and their own work has in the past largely contributed to the growing awareness of the importance of wetland-inland water interactions for the biogeochemistry of inland waters. Their long-standing expertise becomes quite apparent in the presented manuscript. The review of existing literature in the field is very complete and their own ideas and perspectives are clearly described in a comprehensive and logically sound manner. I am sure that this manuscript will be of great interest for the readership of Biogeochemistry, and I recommend publication after minor revisions.

ANSWER- We thank the reviewer for her/his encouraging comments and positive evaluation of our MS.

General comments

COMMENT- L38-39: “primary production and respiration in air” What do you mean by “in air”? Above ground/water table?

ANSWER- We will change the text to “submerged and emerged parts of the plants”

COMMENT- L59-60: You need a reference for that.

ANSWER- We will cite Ciais et al. 2013 here.

COMMENT- L73-78: Here you should quickly mention that reservoirs are an important form of man- made inland waters.

ANSWER- We will write here “streams, lakes, reservoirs, rivers and estuaries”

COMMENT- L90-91: However, Garrels and Mackenzie 1971 were also among the first to show the general CO₂ oversaturation in rivers.

ANSWER- Indeed, Garrels and Mackenzie (1971) computed pCO₂ in a few large rivers based on pH and HCO₃⁻ data from Durum et al. (1960), using a simplified and approximate computation scheme. They mention briefly (in the legend of the figure) that the pCO₂ values in rivers are above atmospheric equilibrium. However, they did not estimate the emission of CO₂ to the atmosphere from global rivers, not put this number into perspective with regards to other components of the carbon cycle such as organic

carbon transport to the ocean. This was only done from the 1990's onwards, first with paper of Cole et al. (1994) in lakes, then the Cole & Caraco (2001) paper on rivers that were then synthesized with additional data in the Cole et al. (2007) paper.

COMMENT- Eq. 1: E and Fother should be net fluxes, as ecosystem can for instance take up atmospheric CH₄ and as there can also be lateral imports from upstream.

ANSWER- Yes indeed. In fact all fluxes are net fluxes (positive and negative) including also NEE, NECB. We will specify this in the text

COMMENT- L146-148: Does this exclude or include weathering related fluxes of DIC? Please, clarify.

ANSWER- Indeed, this deserves a clarification, because DIC from carbonate rock should be excluded from this statement. New phrasing will be: "One process that makes -NEE diverge from NEP and NECB is when significant amounts of inorganic C enter or leave the ecosystem as DIC in the aquatic phase with horizontal hydrological transport rather than through atmospheric exchange (Chapin et al. 2006). However, DIC from mineral source of carbonate rock weathering will not contribute to the difference between NEP and NECB. In addition to this divergence between NEE and NEP, NECB deviates from NEP when C enters or leaves the ecosystem in forms others than CO₂ or DIC (Eq. 1). This includes horizontal transport of particulate and dissolved OC..."

COMMENT- L189-191: Here, make clear that the weathering of carbonate rocks also involves a mineral source of DIC. That is trivial, but may not be that obvious to the broad readership.

ANSWER- New phrasing will be "Weathering of carbonate and silicate rocks is mediated by soil CO₂ derived from respiration, so that weathering is also a component of ER; however, the weathering of carbonate rock involves another mineral source of DIC which contributes to half of the alkalinity produced".

COMMENT- L244-248: Lauerwald et al. used a 0.5 grid

ANSWER- Corrected in the revised version

COMMENT- L291-293: I don't think that Krinner et al. 2005 is an adequate reference here. That's the paper describing the standard version of ORCHIDEE which does not include fluvial C fluxes. Only very recently, models have been developed which include fluvial C fluxes: e.g. DLEM (Tian et al., 2015) and ORCHILEAK (Lauerwald et al., 2017). JULES-DOCM (Nakhavali et al., 2018) is a land surface model that accounts at least for the leaching of DOC from soils.

ANSWER- In the revised MS, we will remove the Krinner et al. 2005 ref and add the Tian et al., 2015 Lauerwald et al., 2017 and Nakhavali et al., 2018 references.

COMMENT- L416-425: Here I find it a bit odd to report "-NEE", and not just NEE with their negative values. But that's maybe a question of taste.

ANSWER- We find easier and clearer to use "-NEE" because it avoids any confusion in the phrasing when comparing with NEP and NECB: "-NEE is higher than NEP" is easy to understand.

COMMENT- L450-451: I think there is a word missing in that sentence.

ANSWER- New sentence reads: "One problem with NPP data is that it does not account for all the C transferred by the plants from the atmosphere to the soil and water."

COMMENT- Eq. 13: You should define the meaning of, like "fraction exported laterally", or something similar. It's obvious from the equations, but it would be nice to have it written in words.

ANSWER- we define β in the revised MS, and we will also write " $\alpha\beta$ is thus the fraction of ecosystem respiration that is exported laterally from the wetland in water masses."

COMMENT- L550: What do you mean by "community"? An ecological community, i.e. the assembly of organisms in one ecosystem?

ANSWER- we remove the ambiguous term "community"