Biogeosciences Discussions

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Comment on bg-2021-69

Scott Winton (Referee)

Referee comment on "Partitioning carbon sources between wetland and well-drained ecosystems to a tropical first-order stream – implications for carbon cycling at the watershed scale (Nyong, Cameroon)" by Moussa Moustapha et al., Biogeosciences Discuss., https://doi.org/10.5194/bg-2021-69-RC3, 2021

The authors have been compiling a large carbon data set from a river in Cameroon (monitored since 1993!) and use it to weigh in the hot topic of river metabolism and C budgeting. Their main goal is to assess the relative contributions of wetlands and uplands to river carbon, finding that wetlands are somewhat more important with a 60/40 split. The authors also conclude that upland forests, in addition to being less important than the wetlands for C export, apparently only export some 4% of their net C uptake, suggesting that they are indeed potent carbon sinks and not simply "leaking" carbon away to be re-emitted by streams.

Beyond the trendy C attribution angle, the authors also have a loosely-defined goal of describing spatial and temporal variations in their river C data set as part of assembling an overall budget for the catchment and they devote much of the results section to describing different trends and patterns. These deep technical dives are not so well-conceived, lack a conceptual framework and are largely divorced from the broader narrative arc of the paper. There is no doubt important information here, but the reader has little help gleaning it from paragraphs without topic sentences.

Overall, this dataset is definitely worthy of publication and makes an important contribution to understanding riverine C dynamics in a poorly understood region (tropical Africa). Below I point out a few key issues to address and make some recommendations for improving the narrative structure.

Major comments

Issues of narrative

The idea of assessing relative contributions of wetlands/uplands to the river C is well-grounded in active literature discussions and effectively pitched as a topic of interest (and is rightfully highlighted in the title).

In contrast, the goal of: [describing spatial and temporal variations in river C], absent any problem statement or hypothesis is not well-conceived and sets up a results section that is largely strings of facts. There are plenty of significant patterns to be found in such a large data set, but what do they mean? How are they useful? What questions do they answer? Without any of this framing the reader is left wondering: what is the point of all this work and analysis? After re-reading these sections several times I had an idea of why this information was useful, but this was not so easy. There is no problem with the mechanics writing (few typos aside), but rather an issue of conceptualization and paragraph design.

The discussion subsection topics similarly lack a thread holding them together. They give detailed glimpses into specific parts of the system: forest groundwater, headwater stream, catchment scale patterns… They could really us a narrative arc that ties them together—a clear objective or a question. The descriptions are great, well-supported with data and references, but lacking an overarching motivation or glue.

I would suggest laying out a framework in the introduction that explains why looking in detail at these different components of the catchment C system are important for understanding the functioning of the whole and then referring back to the framework with topic sentences. Give the reader some guidance as to why this all matters.

Terminology for wetlands vs. non-wetlands

In the introduction and throughout the manuscript, take care with terminology. The authors might try using "upland" to refer to well-drained ecosystems/forests. They occasionally use "Terrestrial" to refer to non-wetlands, but this would likely would include within it many types of wetlands (room for interpretation/confusion in the mind of the reader) and even "forests" will likely also include many wetlands since they are treed with palms. This is quite important to define clearly since distinguishing between the role of

wetlands and non-wetlands within the catchment is main goal of the study.

How solid is the estimation of catchment wetland area?

Is there no more localized data source for the wetland area? Gumbricht et al. 2017 is a global-scale wetland map and probably is not very accurate at such a small spatial scale. Check if there are better wetland maps for the region, if not then make some sort of a statement that local/regional maps are unavailable and that using a global map is the only option. How sensitive are the results to accurate delineation and counts of areal coverage of wetlands vs. uplands?

Logic of transport pathways (Fig. 6)

The authors model two C transport process between terrestrial ecosystems independently: Forest -> Stream; and Swamp -> Stream. But in a high percentage of cases will these not be linked? i.e. Forest -> Swamp -> Stream ? It seems that this logic opens the possibility that some important portion of wetland C export might have been "inherited" for surrounding hillside forests. This might mean that the importance of wetland C export relative to forest C export might be exaggerated by this analysis.

Framing of conclusions

"The current paradigm…"

I had to refer back to the introduction, to try to figure out where this paradigm comes from and can find no sign of it. This appears to be a bit of a "straw man" argument? Yes, the paradigm is that headwater streams are heterotrophic, but I don't see any sources stating that the DIC/CO2 is produced exclusively or dominantly through heterotrophy, rather than inherited in inorganic form from groundwater…

Minor comments

Line 58: “anthropogenic budget”? So far the processes being described do not involve human activities…

Methods: Describe handling times of samples, preservation methods (kept cool?) and analysis location (Europe somewhere?)

Statements of precision/repeatability

“The repeatability was better than 0.1 mg/L”

“Precision was +/- 0.1 mg/L”

It isn’t totally clear what parameters these statements refer to or what exactly they mean. Is it analytical precision (ie the balance measures to the nearest 0.1 mg?) Or did the authors take replicates and calculate standard errors?

Lateral inputs.

I struggled to follow the logic in this paragraph regarding a 0.48 km2 “hillside.“ Unclear how this relates spatially to or represents behavior of a catchment of 27,800 km2. How does a hillside have “base flow” ?

Line 310 (data not shown)

Why not add to supplement? If important enough to mention in the text, the authors should somehow report the data.

Line 323 why reverse order here? DIC, DOC, POC vs POC, DOC, DIC… best to be consistent…

Section 4.1

The key information is buried way down on line 350. The authors are interested in understanding whether groundwater CO2 is coming from rock-water interactions, deep soil respiration or surface soil respiration. Based on their evidence, they posit the latter. Make the goal of this section clear from the start. The reader is left wondering for 22 lines of evidence what the point is…

Section 4.2

Lots of descriptions here, but not connected to any explicit goals. What's the point of all of this?

Section 4.3

Same as above. The authors reach several conclusions in this section… "It confirms…" "This confirms…" But there was never any explanation of what tests were being done or any specific hypotheses. This is both a challenge for readability (lots of evidence is presented before the research question has been explained, making the logic difficult to follow); and also scientifically: we should be laying out tests, with clear possibilities that the data and other evidence from literature can support or refute. Just describing the data and then saying it confirms something is not exactly the scientific method.