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Interactive comment on “Biogeochemistry of a large and deep tropical lake (Lake Kivu, East Africa): insights from a stable isotope study covering an annual cycle” by C. Morana et al.

Anonymous Referee #2

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General comments:

The authors present a fairly well written manuscript reporting on the seasonal and spatial variations of the concentration and isotopic signature of different carbon and nitrogen pools of a large African lake (Lake Kivu), which shown contrasting patterns across both space and time. While the study presents extensive data on the major C pools of the lake, I was left wondering however if many of the isotopic patterns described were of any significance. For example, there was only a 1 per mill change in the DIC isotopic signature, both across season and lake depth, and the authors make a series of inference on the lake functioning based on such little variation. What is the actual experimental error on these values, and why the authors suggest that the

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change in $\delta^{13}\text{C}$ -DIC is significant, but not the change in $\delta^{13}\text{C}$ -DOC although the latter pool also varied by one per mill? I also had a hard time reconciling the conclusion that the lake is net autotrophic, yet a net C source to the atmosphere based on the isotopic evidence presented. The authors suggest that allochthonous inputs are of minor importance, so my question is then where is the excess C coming from? Also, I wouldn't be surprised if the gradual and small enrichment of the DIC isotopic signature during the rainy season may simply reflect a return to the equilibrium of the DIC pool isotopic signature with the atmosphere after the intrusion of a more depleted pool during the dry season, which would have little to do with biological processes (PP>R), but more with simple physical mixing. In this regard, the study would have greatly benefited from gas evasion (or invasion) or metabolism (PP vs. R) measurements. Finally, I was not totally convinced by the importance of the methane-based biomass production for the lake food web as suggested by the authors. Per the authors calculation, about 5% only of the oxidized methane could be incorporated into biomass, in line with other lake studies (Jones and Lennon. 2010. AME 58:45-53), and I would thus suggest toning down the conclusions accordingly.

Specific comments:

P17236L219: Maybe this has been observed in temperate lakes, but here the data show a complete opposite pattern: more depleted $\delta^{13}\text{C}$ -DIC values were found at times i.e., during the dry season (Fig.2b) when the Chla (and potentially PP) values peaked in the lake, suggesting only a limited impact of PP on the seasonal dynamics of the DIC pool isotopic signature.

P17236L23: Again, perhaps I am missing something, but it seems to me that the enrichment of the $\delta^{13}\text{C}$ -DIC during the rainy season could simply be reflecting a re-equilibration with atmospheric CO_2 after the DIC became depleted due to deeper water mixing (P17234L24 and Fig.2b). Did the authors take this into account at all? What would be the expected $\delta^{13}\text{C}$ -DIC values if fully equilibrated with the atmosphere?

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P17237L17: Yet, total or bacterial respiration may also be enhanced (for example, see Amado et al. Front Microbiol. 2013; 4: 167.), and perhaps even more so than primary production, resulting in a higher probability of experiencing net heterotrophy in tropical systems. I am not saying that it will be the case, but the authors' argument should be better supported.

P17240L6: I would not call a 4-6% a significant part of the POC pool. Also, I am not sure what is meant by POC here as it seems to be either referring to algae or bacteria alternatively thorough the manuscript. Please be consistent for clarity.

Fig.2b: While the patterns as present are quite clear, I find that expanding the Y axis to show a 1 per mill difference a bit misleading.

Technical comments:

P17232L21: The IO analytical Aurora 1030W does not provide d13C values, only organic and inorganic C concentrations. Please specify which instrument was used for isotopes.

P17237L4: Please correct "could have resulted"

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