

Interactive comment on “An isotopic ($\Delta^{14}\text{C}$, $\delta^{13}\text{C}$, and $\delta^{15}\text{N}$) investigation of particulate organic matter and zooplankton biomass in Lake Superior and across a size-gradient of aquatic systems” by P. K. Zigah et al.

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Responses to comments by reviewer no. 2

Comment: Review of Zigah et al. (bgd-9-4399-2012)(Anonymous 2) Using stable isotopes ratios and radiocarbon measurements, Authors aimed to delineate carbon flow through the bulk zooplankton of Lake Superior before and during summer thermal stratification. They also present data obtained previously (2004) in “small” Canadian lakes and, adding oceanic data from literature review, try to established a relation between

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the percentage of autochthonous primary production contributing to zooplanktonic diet and the size of studied ecosystems. Their working hypothesis is that greater is the size of the aquatic ecosystem, greater is the contribution of “young” autochthonous carbon to zooplanktonic biomass.

Response: We thank the reviewer for his/her valuable comments on our MS.

Comment: In their mat & met, Authors stated they have collected many physico-chemical parameters (Chla, Ph, Oxygen,...) during their cruises. These data are not presented and are not used in this paper.

Response: We have included the temperature, fluorescence, dissolved oxygen, and CDOM profiles of the various stations in Lake Superior that we sampled as supplementary fig 1 A-L. Please see pg.6 Line 128.

Comment: In the same order of idea, stable isotopes composition in the way they were measured (bulk POM, bulk zooplankton) are not very informative and they are not used for mixing model (the main part of this ms) which is run with radio-carbon data.

Response: We are interested in determining the composition of the bulk POM and the food sources of mesozooplankton so we measured the isotopic composition of these, and used the isotopic composition of the potential constituents of these to determine their relative contributions to the bulk pool. We now include the stable carbon and radiocarbon isotopes in the Bayesian model. See Section 2.4 on pg 10.

Comment: Sampling design is no represented on a map, and, it is difficult for the reader to estimate which area of the lake is covered by the sampling and how the sampling is representative of general functioning of the lake.

Response: We have included a map of Lake Superior showing the various sampling stations in the lake. See fig 1. The sampling scheme covers both nearshore and offshore sites and covers both the western and eastern basins of the lake. Given the huge expanse of the lake, even this extensive spatial coverage could be considered

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synoptic, and we have stated this in the discussion. See pg 23 lines 525-531.

Comment: It is unclear for me how many samples were used for ^{14}C analysis and if these analyses were done for each sampling point.

Response: We collected DIC, DOC, POC, surficial sediment, and bulk mesozooplankton samples at each sampling location of the lake (as shown in fig 1). Each of these samples were analyzed for their C^{14} composition. This has been made more clear now. Please see section 2.1 lines 124-131.

Comment: Authors do not discuss critically of the representativeness of their data at the scale of the Lake Superior or the possible spatial and seasonal variability in Lake Superior functioning (the largest freshwater volume in the world, Dixit et al.).

Response: Our sampling scheme is one of the most extensive radiocarbon studies performed in any aquatic ecosystem. The huge expanse of Lake Superior (and the other great lakes) however, makes a high spatial and temporal sampling resolution challenging in terms of cost, even more so for radiocarbon-based studies. We have included in the discussion that our data give a large-scale view of the ecosystem functioning of the lake, and that a high resolution spatial and temporal sampling scheme would considerably enhance our understanding of the ecosystem functioning of the lake. Please see pg 23, lines 525-531.

Comment: When comparing Lake Superior and Canadian small lakes, Authors use two very different sampling protocols (different years, different month, different sampling design, notably zooplankton net used to catch bulk zooplankton). There is no critical discussion about these differences, nor on the fact that zooplankton specific composition is different between Lake Superior and small Canadian lakes (i.e. Copepod-dominated vs. Cladoceran-dominated).

Response: We have now clarified in the MS that we studied mesozooplankton in Lake Superior based on the net size we used. We have also included the small lake data

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as literature data included as suggested by the other reviewer. We have also included discussion on the zooplankton composition in the lakes and their potential influence on the observed zooplankton allochthony vs autochthony. See pg 25 & 26 lines 576-592.

Comment: Authors use Bayesian mixing model to calculate contributions of different C source to the diet of bulk zooplankton. They use only their ^{14}C data (one isotopic ratio). But basically, such models are conceived for multi-(stable) isotopes (generally $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$) data (and sometimes forced by elemental data). They do not discuss about the influence on model calculation of this choice.

Response: We now use dual isotope, C^{14} and C^{13} in the Bayesian model as also suggested by the other reviewer. See pg 10, section 2.4.

Comment: Authors try to make very general relation between lake size and origin of carbon used by zooplankton. But I think it is too general considering they compare lakes from same latitude and globally sharing main feature (except the size). Moreover, they use only their data for lake and no data from literature inside or outside North America. Therefore, their very general conclusion is not so general or, at least, representative of lake diversity and variability (other than size). Discussion should be more critical about that and/or would gain in generalisation if literature data from lake were used.

Response: The cross-system dataset we used is not representative of global lake diversity and/or variability and are only from North America as we cannot find the radiocarbon composition of zooplankton in aquatic systems in other parts of the world. We searched for published work from other regions but could not find such data. We have critically discussed this in the discussion as suggested by the reviewer. See pg 23 & 24. Lines 536-542. In addition, the focus on a similar region with similar geography and climate allows us to focus upon the effect of size, which in itself is an important relationship to explore.

Comment: Globally, I found the ms original, notably, by combining the use of radiocarbon data with mixing model application. But I think that some aspect must be more

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critically discussed in relation to existing literature.

Response: We thank the reviewer for the comment on the originality of our study. We believe we have critically discussed the limitations of the study as suggested by the reviewer.

Comment: specific Fry 1991 missing (check for other reference)

Response: We have included Fry 1991 citation in the reference list. See pg 30, line 689.

Please also note the supplement to this comment:

<http://www.biogeosciences-discuss.net/9/C3193/2012/bgd-9-C3193-2012-supplement.pdf>

Interactive comment on Biogeosciences Discuss., 9, 4399, 2012.

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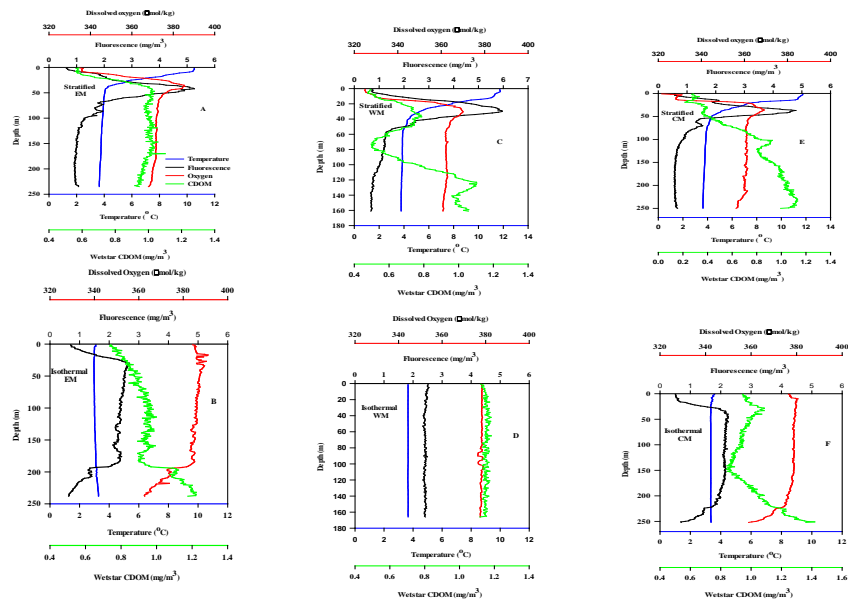


Fig. 1. Supplementary Figure 1

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