

## ***Interactive comment on “Recycling and fluxes of carbon gases in a stratified boreal lake following experimental carbon addition” by H. Nykänen et al.***

**Anonymous Referee #1**

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I am sorry but this is a very weird manuscript. Not that I had only difficulties to understand what the purpose of this study is I also had to read sentences several times to understand what the authors wanted to say. A lake was fueled with cane sugar in two consecutive years, however, the comparison to the state of the lake before that addition is missing relevant data like CH<sub>4</sub> measurements. The data basis has much to low of a resolution to answer questions that are raised by the authors. We know that processes at the redoxcline are functioning on a millimeter scale (Kirf et al 2014, Aquatic Geochem.) but authors took samples at a 1 m, at best 0.5 m scale, this is not sufficient to address the raised question. I also question that in this lake anaerobic methane oxidation takes place (as quoted by the authors there is no isotopic signal suggesting this). It is most probably all aerobic oxidation since it is where oxygen and methane met where oxidation is seen (heavier isotopes in the remaining methane but this is very

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little as stated by the authors) (it is difficult to judge from figures 2 and 6 but resolution is too low). Calculation of fractionation based on this few data (resolution) is at best very coarse and it is very speculating to infer which kind of methanogenesis or oxidation took place. 2.2.1. Weather data is from a 18 km away, a long way, is this representative for the region? What is the detection limit for the O<sub>2</sub> probe? This is absolutely essential to decipher oxygenated from anoxic layers. New sensors go down to nmolar concentrations, normal sensors are in the umolar range at best. Mentioned by authors that device does not give zero oxygen BUT this is essential here 2.2.5. were the samples treated with HCl to eliminate carbonate before <sup>13</sup>C measurement? 2.3.1 I do not understand how methane oxidation was determined. I do not see a concentration gradient really, also isotopes do not show oxidation. How were predicted (?) and observed concentrations compared. Why weren't syringe incubations not done in 2008 and 2009 to compare them to values before carbon addition (2007)? 2.3.2. What is an oxidation based estimate of production? The fractionation factors from Whiticar are now almost 30 years old and there are much more relevant fractionation factors in the literature which should be used 2.3.3. This is not a method part but an introduction into how methane is formed. This should be clear to the reader. Why would sulfate be the oxidant? This is known from the marine environment. Is there any indication here? 2.3.4. This whole description does not help the ms. since no values were measured but only some fractionation factors are used to estimate <sup>13</sup>C of organic matter. Why haven't the authors filtered the water and measured the biomass directly? As it stands now it is a whole discussion based on some theoretical values. It is also not clear whether there is any anaerobic oxidation and hence biomass calculation rather questionable. The O<sub>2</sub> detection limit of 0.33mg/L is a huge amount of oxygen for microbes and not at all anoxic.

The result section is a very detailed description of what is seen in the figure. It leads to no real conclusive results but is only a strung together of sentences. It is very hard to read/understand. What is the message? Could be at least cut by 50% Again a separation of aerobic and anaerobic methane oxidation based on the shown data is not

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possible I have not seen any data that suggest methanogenesis in the water column, does this exist? References? Why use alpha and epsilon for fractionation, stick to one please There are very limited data on POM three depth once per year, an algae, some larvae, biomass floating around above the bottom. .this is a very limited data base and now real interpretation can be done. Also the  $^{13}\text{C}$  values of those different species are then very different from what is estimated by using a fractionation factor and  $^{13}\text{C}$   $\text{CH}_4$  which questions the estimation very much. Discussion Again here we find an omnium gathering of long interpretations which are not based on data. Whole paragraphs are copied from references and jumps back and forth from sugar addition to methane efflux to oxidation to biomass depletion are put together on a string. Sorry to say but this ms. is in my view only a first draft. The manuscript should be rewritten with a very clear focus and a red line to follow. Own data should be discussed in detail and not conclusions taken from other work and described in detail. I think there are some interesting data here, however, as it is presented now it is impossible to understand which point the authors want to make.

Examples for sentences which need a native English speaking person -there is a need for better understanding of the carbon cycling in the lakes - DOC are presented to the first open water measurement - there is low stable temperature - minimum conc. of oxygen during the open water period were at the end of July - water was acidic but less so in the hypolimnion - pH decreased slightly from the 2007 value -lots of typos, check spelling of references,

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