

## ***Interactive comment on “Annual follow-up of carbon dioxide and methane diffusive emissions from two boreal reservoirs and nearby lakes in Québec, Canada” by M. Demarty et al.***

**Anonymous Referee #1**

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General comments This study provides robust and useful results for greenhouse gases studies and assessment in reservoirs, supported by a substantial amount of data. This manuscript is therefore publishable but I do have several concerns that induce a revision of the paper.

Results from the second reservoir and lakes (Robert-Bourassa and . . .) are scarce (not GHG profiles for instance) and not enough treated in the study. The authors must give more information or results on these reservoirs or limit the study to the first reservoir. The aim of the study was to compare emissions from reservoirs to the emissions of nearby lakes. The idea is of interest but the authors must demonstrate that system

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were equivalent and that they could be compared. For instance, the age of the reservoir is not the only criterion if the authors compared gross emissions. Mean depth and residence time must be assessed or discussed. CH<sub>4</sub> emissions are highly variable and depends on many factors. The authors may add a chapter in the discussion about high surface values in their study. The authors must precise in the title and in the methodology that GHG results are gross emissions. The averaging of parameters (temperature, DO) between stations for a given depth may be misleading and can only be made if the differences between stations are small. This points must be discussed. The authors state several time that the increase of GHG concentration with depth is a result of the accumulation under the ice cover. However, such features are commonly observed in tropical lake whit no ice. The evidence for an accumulation under ice is mostly the increase in GHG pressure in surface water after the ice start to cover the reservoir.

Details comments

Abstract Line 2: Robert-Bourassa follow up was conducted only on 2006 and not from 2006 to 2008 as mentioned. Line 11: One important finding was CH<sub>4</sub> no under ice accumulation. That must appear in the abstract.

Introduction Page 5430 Line 18: could be add the 2 main processes (emissions and storage) Line 25: replace “freshwater” by lakes or reservoirs. Freshwater is a generic term for all aquatic systems. Page 5431 Line 2: Delete “for some time” Line 6: first time that GHG appeared in the text. Replace by “Greenhouse gas (GHG)”. Line 11: Delete “hydroelectric” as all man made reservoirs had the same pathways. Line 16: Avoid terms like “Generally speaking, It was not surprising, In fact. . .”, please check all the manuscript. Line 19: Delete “This statement may be revised in the future according to preliminary studies on degassing”. This not published data and brings no useful information to the study. Line 29: the authors must indicate what are the gases (CO<sub>2</sub> and CH<sub>4</sub> ?). If CH<sub>4</sub> is known to accumulate under ice, that must be discussed as the results of the study were different. Page 5432 Line 8: point (3) this is an evaluation of the

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annual gross GHG diffusive fluxes. Line 12-14. This is an important point of the study and the authors must give more information on that issue (see general comments). For instance, Eastmain reservoir is only 5 years old. How the authors could justify this ?

Methodology Line 26: It will be better to find another reference (study, report. . .). Page 5433 Line 5: please give more information on the limitation of stations due to weather conditions (for instance what are the station eliminated from the monitoring. . .) as well as information on the localisation of the stations. Line 8: If I understand well, there was no water quality profiles on the 3 other lakes ? please clearly indicate this. Line 14: Explain what do you mean by "mean". It is on an annual, seasonal basis or only for the replicates ? see the general comments Line 17: Explain how the station and depth were chosen. Page 5434 Line 17: remove "degrees" Page 5435 Line 8: flux can be calculated by directly using the partial pressure, see Gu erin et al., Journal of Marine Systems 66 (2007) 161–172 for instance. Remove this sentence. Line 17: remove "degrees" Page 5436 Line 3: unit of t, also try to be consistent: so far temperature was expressed with T (capital letter) Line 8-9: remove: ". . . basis using. . .16.04276 g.mol-1)

Results Page 5436 Line 20: is the difference significant?? p value ?? Page 5437 Line 4: Idem, indicate the statistical test that was used. Line 19: should be Fig 3f and h ? Also rewrite this figure caption, it is no clear (reservoirs, lakes. . .) Lines 22 to the end of the paragraph: a long discussion for only one measurement! This paragraph on Mistumis Lake is before the paragraph of the Eastmain 1 reservoir while it was the contrary for CO<sub>2</sub> (previous paragraph). Be consistent. Page 5438 Line 4: It does not seems to have any gradient of dissolved oxygen in the study lakes and reservoirs. Please, check the results or change the sentence. Line 13-15: It should be of interest for the reader to have more information on these stations. Where were they located ? what were the total surfaces of the reservoir presenting such depths ? etc. . . Also try to modify the text to clarify. Page 5439 Line 1 to 6: the chapter must appear in the discussion and not in the result section. Page 5440 Line 7: is a linear increase justified? Maybe once the CO<sub>2</sub> concentration reaches a too high value, the accumulation starts

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to slow down ?? Add a reference if available (?) Line 21: the figure 5 is clear and should be called in the previous paragraph to also explain how you interpolate GHG surface concentration during the ice cover period. Page 5441 Line 1-3. I expect to have the main results and not only methodology in this section.

Discussion Line 19: precise for CO<sub>2</sub>. Line 20: the authors must give more information on that statement and why using gas concentrations lead to an overestimation of the annual diffusive fluxes. Page 5443 Line 24: reference should be (Tremblay et al., 2009). Page 5444 Line 7-21: See general comments. The authors must discuss their results on high CH<sub>4</sub> concentration in some part or the reservoir. How could it be explain and the authors must assess the amount of CH<sub>4</sub> regarding the morphology of the reservoir.

Tables Table 1: title: replace site by sites. The authors may also indicate the residence time. Table 2: the sampling period could be replace by the season or "ice free/ ice" period to be consistent with the text and other figures. . . The authors must indicate if the number of sampling was for water quality and GHG measurement or not. Table 3: Please indicate the number of replicates. Table 4: check the title as there was not only the results for 2 lakes ! I would like to have a maximum and minimum potential pCO<sub>2</sub> reached (15 May) as the measurements present high standard deviation.

Figures Figure 3: The figures were too small to read correctly the results. I wonder why there were only the results for one reservoir and one lake ? Please give information. I cannot see any dashed and dotted lines on the graph. Rewrite the figure caption to indicate which plot correspond to which system for CO<sub>2</sub> and CH<sub>4</sub>. Why the scale for pCH<sub>4</sub> (fig 3h) is so large ?? Figure 4: Duncan lake is missing on the graph. Can you explain why ?

Summary Line 1: please delete "exhaustive" as it could not be reach.

References Houghton et al., was 2001 and not 2007 in the text page 5431.

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