

***Interactive comment on “Carbon dioxide and methane annual emissions from two boreal reservoirs and nearby lakes in Quebec, Canada” by M. Demarty et al.***

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One of the reviewers was unable to submit on time the evaluation of the paper due to field work without e-mail access. However, this reviewer has raised issues that the authors need to address when revising the ms and a detailed reply to the comments is requested.

Alberto Borges

Handling editor

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Anonymous reviewer #3

Review of Demarty et al. This MS presents CO<sub>2</sub> and CH<sub>4</sub> concentrations measured during one year in two artificial reservoirs and in two lakes in Canada, together with ancillary data (temperature and oxygen). CO<sub>2</sub> and CH<sub>4</sub> fluxes to the atmosphere are then calculated. The dataset represents quite a lot of field work. The MS itself is however relatively poor, interpretation of data is superficial and the most important literature is ignored. The authors minimize in their discussion the role of boreal lakes and reservoirs as CH<sub>4</sub> sources. Finally, the CH<sub>4</sub> concentration data might be affected by problems due to the sampling methodology. In the present version of the paper, it is not possible to check the quality of the CH<sub>4</sub> data due to a lack of detailed information in the material and method section (reference to another submitted paper). In its present form this MS is quite far from the quality standards of Biogeosciences. Compare for instance with the recent paper by Juutinen et al. BG 6, 209–223, 2009, on the same subject, and not even cited here.

Methodological problem: CH<sub>4</sub> has a low solubility. The water sampled after the gas extraction system has lost most of its methane to the gas phase and contains much less CH<sub>4</sub> than the lake water. Because of the low solubility of CH<sub>4</sub>, it might take hours for complete equilibration of the gas phase in the extraction system and for the water to recover the in situ CH<sub>4</sub> concentration.

CH<sub>4</sub> concern in boreal lakes and reservoirs: P2950 The authors write “Our results clearly show the diffusive CH<sub>4</sub> emissions are not of concern in the studied systems”. Such strong statement must be supported by more discussion. Highlighting low CH<sub>4</sub> diffusion in given lakes is possible only in comparison with the potential high CH<sub>4</sub> ebullition, the high diffusion in the littoral zone and during lake overturn in these lakes and in other boreal lakes and reservoirs (see literature below). From this literature, it is clear that CH<sub>4</sub> emission from the pelagic part of deep boreal lakes is minor (except during overturn). The data presented here must be interpreted in the light of this literature and one conclusion will probably be that either these data miss most of the CH<sub>4</sub> flux, or the

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studied systems are different for a given reason. In addition the authors have some data that show the importance of overturn (L13P2949) but do not present nor discuss them.

P2946The authors write “no difference in surface pCH<sub>4</sub>. . . ANOVA and Tukey test,  $p > 0,05$ ). However, in Table 2, the high CH<sub>4</sub> concentration and heterogeneity in East-main1 reservoir in March 2008 (287+/-982 ppmv) is not discussed at all, why? Dissolved CH<sub>4</sub> concentration reaching 1000ppmv in lake oxic waters is something special that deserves discussion.

The section from L25P2950 to L5 P2951 is pure speculation and refers to only one paper

In the M&M section it is stated that the studied reservoirs have flooded peats. Are the authors aware of the following study: Scott et al 1999. The importance of floating peat to methane fluxes from flooded peatlands. *Biogeochemistry* 47, 187-202 ?

Details and presentation A map of the lakes and reservoir, showing sampling stations Surface area, depth, etc. . . Residence time of water in the reservoirs Figure 2 difficult to read Section 3.3 very difficult to understand, CO<sub>2</sub> accumulation is observed but no CH<sub>4</sub> accumulation? What is a “baseline pCO<sub>2</sub>”? referring to submitted data make the section not understandable

P2950L10 Define “the return to natural aquatic ecosystem value”

Literature to refer to (see also references therein): Bastviken, D., J. Cole, M. Pace, and L. Tranvik (2004), Methane emissions from lakes: dependence of lake characteristics, two regional assessments, and a global estimate, *Global Biogeochem. Cycles*, doi:10.1029/2004GB002238. Søvik A K; Augustin J; Heikkinen K; Huttunen J T; Necki J M; Karjalainen S M; Kløve B; Liikanen A; Mander U; Puustinen M; Teiter S; Wachniew P. Emission of the greenhouse gases nitrous oxide and methane from constructed wetlands in europe. *Journal of environmental quality* 2006;35(6):2360-73.

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Huttunen Jari T; Alm Jukka; Liikanen Anu; Juutinen Sari; Larmola Tuula; Hammar Taina; Silvola Jouko; Martikainen Pertti J Fluxes of methane, carbon dioxide and nitrous oxide in boreal lakes and potential anthropogenic effects on the aquatic greenhouse gas emissions. *Chemosphere* 2003;52(3):609-21.

JUUTINEN Sari ; ALM Jukka ; LARMOLA Tuula ; HUTTUNEN Jari T. ; MORERO Micaela ; MARTIKAINEN Pertti J.; SILVOLA Jouko ; Major implication of the littoral zone for methane release from boreal lakes *Global biogeochemical cycles* 2003, vol. 17, no4, pp. 28.1-28.11

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