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Interactive comment on "Importance of within-lake processes in affecting the dynamics of dissolved organic carbon and dissolved organic and inorganic nitrogen in an Adirondack forested lake/watershed" *by* P.-G. Kang et al.

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Dear Referee#1,

Thank you for your comments. We have responded to your general and detailed comments for the manuscript entitled "Importance of within-lake processes in affecting the dynamics of dissolved organic carbon and dissolved organic and inorganic nitrogen in an Adirondack forested lake/watershed".

Included in this communication are our comments and tables with responses.

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Interactive Discussion
Discussion Paper

Please, let me know if you require anything else regarding this revision.

Sincerely yours,

Phil-Goo Kang

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1. Responses to general comments.

#A. (Referee's comment) This paper describes long-term data series of dissolved organic carbon (DOC, years 1984-2009) and dissolved organic and inorganic nitrogen (DON and DIN, years 1994-2009) concentrations, and comparison of calculated mass balances (2000-2009) of these species between in- and outlets of a lake belonging to the Adirondack Long-term Monitoring Program. Data seems to be of high quality, rather frequent, and continuous. Input-output comparison based on concentrations measured on weekly basis. Authors found that the lake is sink of DOC and DIN (retention), but varying between a small sink or source of DON. No long-term trends were found in concentrations or input or output fluxes. The data may be valuable to document even though no long-term changes in flux patterns were seen. ==> Thanks for your comments. This is consistent with the focus of this paper.

#B. (Referee's comment) However, the within-lake processes determining the output to input ratio were only discussed on literature basis. ==> There are several ways to estimate unknown specific processes, e.g., direct measurements, modeling, statistical analysis, etc. In this paper, we combined results obtained from previous studies with new measurements to help evaluate within-lake processes.

#C. (Referee's comment) I let the editors decide whether the Biogeosciences could be the forum for this paper. The manuscript would benefit from a revision. ==> You will note that we have recommended a number of changes in the manuscript that should improve the clarity and findings of our study.

#D. (Referee's comment) Inorganic carbon was not included nor much discussed in this

BGD

12, C9513–C9519, 2016

study, opposite to inorganic nitrogen. However it could have significant role when pondering the meaning of lake as a DOC sink. Many lakes are known to emit substantial amounts of carbon as CO2 to the atmosphere. ==> As we mentioned in Introduction and Conclusion, many studies have focused on DOC but few have also included evaluation of DON. Also the end product of DOC due to retention/decomposition is certainly DIC. Due to length considerations we did not focus on DIC dynamics. The evaluation of DIC would necessitate a different set of analyses and goals. The DIC of Arbutus Lake has a mean of ∼115 μmol C L-1 and DIC ranges from ∼50 to 250 μmol C L-1. DIC constitutes about 25% of total dissolved carbon. The reviewer is correct. Across the ALTM lakes they are uniformly oversaturated with respect to the solubility of atmospheric CO2. This was summarized in another paper for Adirondack lakes, which included Arbutus Lake (Fakhraei and Driscoll, 2015). For further details see: The Adirondack Long-Term Monitoring Lakes: A Compendium of Site Descriptions, Recent Chemistry and Selected Research Information. 2011. NYSERDA Report 11-12. Albany, NY, USA.

#E. (Referee's comment) I am also concerned how relevant some of the statistical testing was, particularly if not testing a hypothesis. Therefore hypothesis formulation and modification of the text (introduction, discussion) accordingly could improve the readability and make the text more interesting. ==> We will add more details on specific hypotheses. Regarding modification of the text the editor's comments will be helpful in revising the paper.

For example, we will add: We hypothesized that changes of DOC and DON within the Lake differ due to different importance of internal processes between these two solutes, i.e., that DOC is decomposed to DIC which may be released to the atmosphere as carbon dioxide or retained as DIC, while DON is decomposed to DIN which may be utilized in a range of biotic processes including uptake and denitrification.

#F. (Referee's comment) I feel that the paper is lengthy relative to its content, but cannot give exact advice how to organize it. ==> This issue seems to be related to the editor's

BGD
12, C9513–C9519, 2016

comments as well. On the other hand, some of the comments by the editor and the referees ask for additional information. We feel that we have considered the balance between length, information covered and detailed. If the editor wants us to further detail certain areas in the manuscript, some suggests of places to reduce the text would be appreciated. You will note as described in later comments that we are merging some of the figures and tables.

2. Responses to detailed comments #2.1 (Referee's comments) Abstract l. 5. in aquatic systems? (Revision) Accepted Original version: dissolved inorganic nitrogen (DIN) in the Arbutus Lake Watershed to evaluate how Modified version: dissolved inorganic nitrogen (DIN) in aquatic ecosystems of the Arbutus Lake Watershed to evaluate how (Page/line) 17287/5

#2.2 (Referee's comments) Abstract l. 7. be more specific. (Revision) Accepted Original: how a lake nested in a forested watershed affects the dynamics of DOC and DON Modified: how a lake nested in a forested watershed affects the source (i.e., production) and sinks (i.e., retention) of DOC and DON (Page/line) 17287/7

#2.3 (Referee's comments) P. 17291, l. 24. Delete palustrine (Revision) Accepted Original: The wetland, a plaustrine peatland (Greenwood Mucky peats) Modified: The wetland (Greenwood Mucky peats) (Page/line) 17291/24

#2.4 (Referee's comments) Could you give dominant vegetation also for the peatland? (Revision) Accepted(added) Speckled Alder (Alnus incana ssp. rugosa) is the dominant vegetation in the wetland (Bischoff et al., 2001). (Page/line) 17297/25

#2.5 (Referee's comments) P. 17292, chapters 2.2, 2.3. 2.4 could be combined. ALTM in the heading is not very informative. (Revision) Accepted Three subchapters will be combined as recommended. Original: 2.2 Hydrological data 2.3 ALTM measurements of DOC 2.4 Chemistry data collected by SUNY-ESF Modified: 2.2 Hydrological and chemistry data (Page/line) 17292

BGD
12, C9513–C9519, 2016

#2.6 (Referee's comments) p. 17293, l. 12. How many inlets there are in total or do you mean here some other water and matter input routes? Unclear. (Revision) (Comments) The inlet site is a major source of water to the Lake. Please see p17291. L15. There are less important ephemeral water sources that we assumed have the same chemistry of the major lake inlet. So we mentioned the statement of L12 in p17293.

#2.7 (Referee's comments) p. 17294. l. 22. Why the monthly dischargeweighted concentrations were tested? See my general comments. (Revision) (Comments) This statistical analysis is linked to Figure 5. Since we used weekly samples, in order to evaluate monthly variation of DOC, DON, and DIN in the inlet and outlet, respectively, we analyzed discharged-weighted concentrations.

#2.8 (Referee's comments) p. 17297, l. 5-10, move to the discussion (Revision) Accepted (changed) We will move the sentence that you pointed out to the Discussion to replace other sentence (p17304, l. 7 to 9). Original: The decrease of the molar C:N ratio from the inlet (mean: 55) to the outlet (mean: 40) is consistent with the pattern for other studies of Adirondack Lakes (Ito et al., 2005, 2007). Modified: The pattern of decreasing C:N ratios in our study with an inlet value of 55 and an outlet value of 40 is consistent with previous studies of Adirondack Lakes (including Arbutus Lake) (Ito et al., 2005, 2007) and lakes in other regions of the world (Kopáček et al., 2003; Schindler et al., 1992; Wetzel, 2001). (Page/line) P17304/7-9

#2.9 (Referee's comments) P. 173021, l. 10-15. Discuss what is the fate of decomposition end products and how much actually is retained in the lake? (Revision) (Comments) As stated previously for our study we wanted to focus on DOC, DON and DIN. Our paper is one of the few papers that includes analyses of DOC, DIN and DON for a lake/watershed system. Note DOC has received more attention than DON in the DOM study area (Please see the last sentence in Conclusions). All ALTM lakes are oversaturated with respect to the solubility of atmospheric CO2. This was summarized in another study for this group of Adirondack lakes, which include Arbutus (Fakhraei

BGD

12, C9513–C9519, 2016

and Driscoll, 2015). If desired, we will add information on the importance of the future study of DIC including the possible contribution of the decomposition of DOC. Also as you suggested, Figure 8b will be changed to show the release (an arrow addition) of DIC from the lake to the atmosphere.

#2.10 (Referee's comments) Table 1. "with r value 0.5 or greater" (Revision) Partly accepted In the first sentence in the title, the abbreviation of "r" is the correlation coefficient and we wanted to focus on those results with relatively high "r" values. Original: Note that correlation results with 0.5 or greater in monthly analysis are shown. Modified: Note that r values with 0.5 or greater in monthly analysis are shown to emphasize the most important correlations.

#2.11 (Referee's comments) Table 4. You may consider leaving the I-O column away, because you also give the retention%. (Revision) Accepted

#2.12 (Referee's comments) Figure 2. Show discharge data also as a scatter plot. (Revision) Accepted In the figure, discharge data will be shown as a scatter plot (open circle).

#2.13 (Referee's comments) Figure 6. . . .and share of the annual flux (%). (Revision) Accepted Original: Figure 6. Monthly average flux (circle, left horizontal axis; error bars, SE) and monthly % flux of the annual flux (bar, right horizontal axis) of DOC, DON, and DIN at the inlet and outlet of Arbutus Lake Modified: Figure 6. Monthly average flux (circle, left horizontal axis; error bars, SE) and share of the annual flux (%; bar, right horizontal axis) of DOC, DON, and DIN at the inlet and outlet of Arbutus Lake

#2.14 (Referee's comments) Modify the y-axis title (%) (Revision) Accepted Original: % DOC flux % DON flux % DIN flux Modified: DOC flux (%) DON flux (%) DIN flux (%)

#2.15 (Referee's comments) Figure 7. ..significant difference from the zero? (Revision) Accepted Original: Asterisk indicated significant difference with zero Modified: Asterisk indicated significant difference from the zero

BGD
12, C9513–C9519, 2016

#2.16 (Referee's comments) Figure 8. Part of the DIC is likely released from the system to the atmosphere. Shall you include that direction too. (Revision) Accepted

#2.17 (Referee's comments) Potentially useful reference Sarkkola, S., Nieminen, M., Koivusalo, H., Laurén, A., Kortelainen, P., Mattsson, T., Palviainen, M., Piirainen, S., Starr, M. & Finér, L. 2012: Trends in concentrations and export of nitrogen in boreal forest streams. Boreal Env. Res. 17: 85–101. (Revision) Accepted We added this reference in Introduction. Thanks for letting us know about this paper. It will be helpful for future studies as well. Original: very few have simultaneously investigated the changes in DON. Modified: very few have simultaneously investigated the changes in DON (Sarkkola et al., 2012). (Page/line) P17289/5

Interactive comment on Biogeosciences Discuss., 12, 17285, 2015.

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