Biogeosciences
Discussions

Open Access

Interactive comment on "Impact of forest harvesting on water quality and fluorescence characteristics of dissolved organic matter in Eastern Canadian Boreal Shield lakes" *by* P. Glaz et al.

Anonymous Referee #2

Received and published: 18 August 2015

Thank you for the opportunity to review "Impact of forest harvesting on water quality and fluorescence characteristics of dissolved organic matter in Eastern Canadian Boreal Shield lakes" by Glaz et al. The authors have submitted a novel study looking at the effects of forest harvesting on water quality and DOM composition in northern boreal lakes. The unique aspect of this study is that they have used a before-after control-impact style of design (although they did not identify it as such). Few studies on the impacts of landuse on DOM composition and DOC quantity have done this – many opt for space for time substitution (e.g. Yamashita et al. 2011, Burrows et al. 2013).

Full Screen / Esc

Printer-friendly Version

Interactive Discussion

Discussion Paper

Furthermore, the authors express an interest in evaluating and using DOM composition as an indicator of forestry impact. Such indicators are sorely needed and are likely to be an important future area of research. However, I do have a few concerns about the paper in its current form.

General comments: 1. Please explain CLAAG in more detail and contextualize this in terms of other forestry practices that a broad audience might be familiar with. What may facilitate this is if you add a figure showing CLAAG in a watershed and an aerial of a non/CLAAG watershed.

2. Write out your specific hypotheses. It will help us to understand the purpose of the study and how/why you undertook the study.

3. A sentence or two on the history of forestry around each of these lakes would be useful. Is this old growth, second growth, third...? Has the harvest method changed? The legacies of past landuse can be long (and hard to find) and may explain some of the variance in your dataset.

4. Although you have employed a generally commendable experimental approach (BACI), your pre and post sampling is very short and gives us very little idea of the temporal dynamics and broader environmental variability. This makes it difficult to distinguish environmental drivers (climate and hydrology) from land use drivers. Was the rainfall for that month/season/year above or below normal? Similar for the temperature. Was winter snowfall higher/lower? Because your pre and post sampling is so sparse it is critical that you include these climatic and environmental variables so that those sources of variation can be evaluated. For example the data you provide do suggest that a good bit more 'precipitation' fell in 2009 than in 2010. Is that snow and rain? A 54mm difference is not huge, but it may depend on when it fell and how intense it was when it fell and what the difference in rainfall vs snowfall is.

5. Can you tell us a little more about sampling. You talk about littoral stations for your sampling – was sampling done from a vessel or from the shore? In some of your

Interactive
Comment

Full Screen / Esc

Printer-friendly Version

Interactive Discussion

Discussion Paper

lakes the littoral zone would probably represent the entire lake, in other lakes, I am more skeptical that the littoral zone would be representative of the entire lake. The assumption that, within a stratum, lakes are evenly mixed is often made by managers, and in some lakes this holds true. However, when lakes become small or more complex this rule of thumb tends to break down. This is particularly tur when comparing littoral and pelagic zones. You also say that sampling was random, but some of these lakes are reasonably medium – was sampling random near the point of access or random around the entire lake? If it isn't random, that is ok, just be specific about how you selected the sites.

6. I have some concerns/questions/comments about sample handling and analysis – these are collected in the following more specific comments.

6a.   Freezing TP samples will change the concentration observed 10.1016/j.scitotenv.2007.11.027 you might comment on this briefly, it may not be a huge effect.

6b. The use of the NPOC (I am assuming, you might mention if it was NPOC or TC-IC) method on the 5000a can bias high DOC measurements low. Lowering the pH, especially below 2 as this method is supposed to do, can change the solubility of DOM driving more hydrophobic DOM to the walls of the glass containers it is being sampled from. This effect can be readily observed on the 5000a (and even the new TOC-L) if you run the TC-IC and then the NPOC. The Hansell reference materials may or may not be affected by this because much of the humic matter may already be absent as those are marine-derived CRMs.

6c. (FYI) The concentration in your CRM is low relative to the range you test in the instrument. This means that you may have large absolute errors at the higher end of measurement. It is better if your CRMs are in the range of your samples.

6d. How long between collection and analysis of refrigerated samples for DOC and fluorescence?

6e. More information is needed on your fluorescence procedure. Did you correct for instrumental bias (See Cory et al. 2010 in L&O methods)? List integration time, PMT voltage/gain, and cuvette size. Did you dilute your samples prior to analysis to avoid inner-filter effects or did you ensure that your samples were in an appropriate absorbance range for a mathematical inner filter effect calculation (see Ohno 2002 in ES&T)? At 10+ mg L-1 DOC you almost certainly had inner filter effects. Both of instrumental bias and inner filter effects will significantly change the shape of your EEM and the fluorescence indices you calculate – sometimes enough to change your interpretation from microbial source to terrestrial source.

7. In general the use of optical metrics could be expanded to improve the analysis of how DOM in the system may or may not change following forestry. 7a. 9321ln27-28 Simple CDOM absorption is not a measure of DOC quality, it is a measure of quantity. Normalizing it to an independent measure of quantity (e.g. Shimadzu DOC) is a measure of quality. The slope of the relationship between CDOM and DOC among treatments would also be an indicator of quality and could be calculated.

7b.The fluorescence index. This is a relative indicator of source – relative to your known DOM characteristics and relative to your instrument (if it hasn't been corrected for bias). Also, for some reason the McKnight et al. 2001 values of the FI persist as reference benchmarks in the modern literature. Those values were generated without instrumental bias correction and are much higher than values collected on the same instrument corrected for bias - see Cory et al 2010 in L&O Methods for a thorough discussion of this and better FI reference benchmarks.

7c.Why did you use the Ratio of A/C? What is it telling you? See Coble 2007 (DOI: 10.1021/cr050350+) for an updated view of what those letters can be attributed to – there is a lot of variability and little consensus.

7d.Calculate the HIX index – the humification index - as this has direct bearing on the type of DOM you have in a boreal forest.

7e.Why did you calculate the spectral slope? What would it tell you?

7f.Calculate the slope ratio (See Helms et al. 2008 in L&O). It can provide information on relative differences in composition and may indicate photo-bleaching. Given that you have incredibly shallow systems, I would be surprised if photodegradation was not at work.

7g.Lastly, and this is optional, consider fitting your data to a PARAFAC model – Cory and Mcknight would probably be appropriate for your context – the Fellman 2009 model would also be appropriate if you can get ahold of it. It is better to generate your own if you have enough eems and enough variance in your eems, >50 can usually give you a valid model.

Specific comments: 9309.5: Name the design as Before After Control Impact (BACI). 9309.8-10: This is unclear. What do you mean by 'when all sampling dates were considered.' 9309.18-19: You cannot conclude this with your dataset. 9309.21-22: Awkward, rearrange to: 'Boreal forest, which contain. . ..' 9310.1-4: Here and else-where, you might consider reading and citing some of the Hubbard Brook literature as that study was designed around the impact of logging on water quality. 9310.4-6: This is too much detail, move this sentence down. 9310.4-7: Aren't hydrologic impacts also important? 9311.2-4: Delete this sentence, it is redundant with 9310.18-20 9312.21: Why July? Explain why you selected this month and not a month when there is more rainfall and the terrestrial area might be better connected to the aquatic environment. 9313.22-25: This is full of forestry jargon and makes no sense. "Preserving advanced growth" sounds like preserving large trees, but you later say that the method removes all trees over 10cm. What is 'site stocking'? What is 'seed source (larger trees)'. I looked at the Landsat imagery for these sites and this just looks like a clearcut / heavy partial cut. 9314.2: 0.22 um filters are almost always membrane and not GFF. I cannot find a 0.22 um sartorious GFF. 9314.11: Consensus not Certified 9314: Eqn 2. What is 1, 9314.24 what is l, I don't see that in eqn 2. 9315.6-eqn(3): I would delete this for two reasons. First, you do not really use these data in subsequent analyses. Second, such

Full Screen / Esc

Printer-friendly Version

Interactive Discussion

Discussion Paper

linear transformations of data add little to the analysis because they do not change the variance of the data. Most statistical analyses focus on the variance in the data. A linear transformation does not change the variance so any results will be the same. It is sufficient to say that higher values of SUVA reflect more aromatic DOM. 9316.21-22: Have you tested for overdispersion? The problem with PERMANOVAs is that they tend to confound location effects and disperion effects. That is to say you could have a significant difference because you have different means (locations), or because you have different variances (dispersion). 9317.1: A range can't have a standard deviation. It can have 1 minimum and 1 maximum value. 9317.9: I think this underscores the problem of insufficient characterization of natural environmental variability in this manuscript. 9319.19-25: This is a very awkward section. Please revise to clarify your meaning. 9321.27-28: Simple CDOM absorption as you have presented it is not a metric of DOC quality. 9325.14-16: Why is this hidden here at the end? This needs to be in the site description, also report it for all 3 years of study. 9325.28-9326.2: Your data are not strong enough to support such a strong statement.

Technical comments: 9312.11: add 'forested' after 'on the' and delete 'and all areas is forest land' on line 9312.15. 9311.23: complementary not supplementary. 9317.1:statistically not statistical -Limit numbers in all tables to 2 or fewer sig figs. -I am not sure the purpose of figure 4, I would delete it. The [DOC]-UV absorbance relationship is pretty well established.

Interactive comment on Biogeosciences Discuss., 12, 9307, 2015.

Full Screen / Esc

Printer-friendly Version

Interactive Discussion

Discussion Paper