Biogeosciences Discuss., 9, C8859–C8865, 2013
www.biogeosciences-discuss.net/9/C8859/2013/

Biogeosciences
Discussions

Interactive comment on "Long term patterns in dissolved organic carbon, major elements and trace metals in boreal headwater catchments: trends, mechanisms and heterogeneity" *by* S. K. Oni et al.

S. K. Oni et al.

stephen.oni@slu.se

Received and published: 7 March 2013

Thanks for your comments and insights on our manuscript. We have carefully gone through your comments and provide answers under each question respectively.

I enjoyed reading this interesting and well-written analysis of the long term hydrology and biogeochemistry of the Svartberget catchments at Krycklan. The Introduction had a comprehensive overview of the widely observed stream DOC increases and its possible causes, and the Discussion nicely put the Krycklan results in this context, though

the DOC trends at this northern site are subtle. Breaking the trend analysis down by month was helpful and provided additional insight. The breadth of the paper was ambitious, trying to cover not only DOC but most of the major ion chemistry and a few trace metals as well in a normal length paper. While I think they touched on most of the highlights, one very interesting result that didn't make it into the text was the significant increasing trend in absorbance (presented in Figure 9) while the DOC trend was relatively flat. This suggests a shift over time to more humic-rich DOC. It would be interesting to reconcile this trend with a recent mercury-focused study of 19 rivers in Sweden that showed quite the opposite – DOC (actually TOC) showed an increasing trend while abs420 was unchanged, suggesting a shift away from humic DOC or that the increase was contributed by a non-humic fraction: Eklöf K, Fölster J, Sonesten L Bishop K (2012) Spatial and temporal variation of THg concentrations in run-off water from 19 boreal catchments, 2000-2010. Environ. Pollut. 164: 102-109.

Response: Thanks for this observation. We are adding the following sentence to page 19141 line 10 to further highlight the contrast in DOC-absorbance trends "The increasing trends in absorbance in most months without corresponding increase in DOC is an indication of a shift in DOC quality from labile type to a more humic-rich DOC."

We will also contrast this with Eklof et al., (2013) and/or others as you suggested and add the appropriate citation(s) to the reference list

Grammar. Numerous subject-verb agreement issues. Incomplete sentence (p. 19128, line 19-20).

Response: We will carefully read through the manuscript to address subject-verb agreement issues where necessary. The incomplete sentence has been revised and would be replace with "Differences exist between the frequency of DOC sampling in the catchments (C7>C4>C2), highest in the spring and more intense in earlier than later part of the record"

General: The text implies that sampling was weekly or biweekly but not necessarily

consistent at the three streams. Does this mean that more frequent event-based samples were excluded from this analysis? Some clarification would be helpful.

Response: Event-based sampling campaigns were excluded from this analysis (this is not part of the data from routine sampling in the database). However, several factors might contribute to the inequality in the total number of samples in each catchment over time.

p. 19131. Section 3.3.1. It is counterintuitive that flow-weighted DOC concentrations would have much higher standard deviations than the un-weighted concentrations (which as reported are unrealistically low).

Response: Thanks for this observation. We have realised the error in our previous estimates and would be updating the manuscript accordingly. Unfortunately, the new estimates still show that the standard deviation of the flow weighted is slightly higher than the un-weighted. The new estimates that would be inserted in the manuscript are:

C4 catchment Un-weighted = 31 $\pm$ 5.5 Flow weighted = 27 $\pm$ 7.1

C7 catchment Un-weighted = 21 $\pm$ 3.7 Flow weighted = 23 $\pm$ 3.6

C2 catchment Un-weighted = 15 $\pm$ 2.8 Flow weighted = 19 $\pm$ 3.8

p. 19132, line 1. This apparent decrease in discharge from first to second part of the record is misleading – grouping those four high years in the middle with the latter period would suggest an opposite trend.

Response: We realized that this statement needs clarification and would be refined in the manuscript. We were talking about the magnitude of daily variability here, so we agree that contrasting with the annual average in parenthesis can be confusing and misleading.

p. 19135, Discussion section, general comment. In general the Discussion is well organized, but I was expecting early on some discussion/ explanation of the relatively subtle

DOC trends (in contrast to the prominent increasing DOC trends found elsewhere in the region and beyond). This did not come until section 4.3 and 4.4 – though it is very well presented there.

Response: We will revise this section by bringing the discussion of subtle DOC trend that we observed up so as to come up in the earlier part of discussion section. Thanks

P 19137, line 25. Couldn't the increasing stream DOC trend in April be explained by trend of earlier snowmelt?

Response: Yes, snowmelt could explain part of the observed trend in April. This was stated categorically in page 19138, line 26-27. Since this is in different section, we will like to include additional statement to clarify this in P 19137 Line 25.

Table 1. There appear to be some mistakes. Sulfate shows 11 of 12 months with a decreasing trend but an increasing trend overall. Also for sulfate the units should be specified as for SO4-S as in the text. The annual value for conductivity is neither bold nor italic – it needs to be one or the other. Why was nitrate (or DIN) trend not analyzed? In the header, "relative to DOC" confused me.

Response: Thanks for carefully looked through the table to point out some the hidden mistakes. The SO4-S is now added to the new table that would be uploaded later. Yes, sulphate should be negative overall. We have implemented the changes in the Table 1 that would be uploaded later. Annual trend for conductivity should also be in italics and these changes have been made in the table. We excluded DIN due to unavailability of the data as at the time of preparing this report. Also, the word 'relative to' has been removed and the entire caption in the new table that would be uploaded would read like this:

"Table 1. The significance of monthly and overall Mann-Kendall trend statistics for climate, runoff, stream [DOC], in-stream chemical parameters, base cations as well as trace metals in Svartberget catchment. Except stream [DOC] that were available in

the three headwater streams (C2, C4 and C7), other chemical parameters (and runoff) were available from C7. The values in italics represent statistically significant declines and the values in bold represent statistically significant monotonic increasing trend."

Figure 3. I'm intrigued by whether there is a trend in ET as P-R. By eye it looks like the lines diverge implying an increasing ET trend. At Hubbard Brook and other sites in the northeastern USA we are seeing the opposite.

Response: We made a quick plot of ET (P-R) as you suggested (see the attached figure). It appears there is no significant trend

Figure 4: All of these decreasing deposition trends look like they would be flat if you removed the first few years.

Response: Yes, they would be flat if the first few years are removed.

Figure 6: Why was DOC plotted with daily runoff rather than instantaneous discharge

Response: We do not have instantaneous discharge but daily averages. Also, only C7 has flow data, so we prorated C7 to C2 and C4. Therefore, we thought it would be reasonable to present the data like this.

Figure 7: The caption is not consistent with the individual subpanel legends

Response: Thanks for this observation. We would update the figure accordingly and the new caption would read:

"Fig. 7. Riparian soil solution profile from S4 lysimeter and C7 stream [DOC] at the depths of 10-25 cm (a), 35-45 cm (b) and 55-65 cm (c)"

Figure 9: Add a trend line?

Response: We do not think adding a trend line will add more information than Table 1. Table 1 has all information on the trend results including long term annual trend of absorbance.

Interactive comment on Biogeosciences Discuss., 9, 19121, 2012.

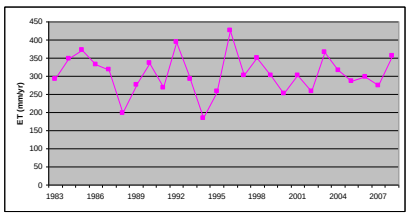
ET (mm/yr)
450
400
350
300
250
200
150
100
50
0
1983
1986
1989
1992
1995
1998
2001
2004
2007

Fig. 1.