

Interactive comment on “Seasonal contribution of terrestrial organic matter and biological oxygen demand to the Baltic Sea from three contrasting river catchments” by H. E. Reader et al.

Anonymous Referee #1

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This paper presents a year-long study of dissolved organic matter (DOM) in three river catchments in Sweden that differ climate and hydrology. Arctic and sub-Arctic region is sensitive to climate change, and the future changes in terrestrial DOC quantity and quality might have potential to affect local water quality and global carbon cycle. This paper contributes to the growing science community on how effect of climate changes takes place in Sweden rivers and Baltic Sea. The most interesting finding of this paper is that the northern river with lower temperature has higher BOD yield and BOD/DOC ratio. However, this paper also have analytical and data analysis issues that need major changes: Analytical issues: BOD and organic matter quality. BOD is a common measurement for community oxygen demand, and generally unfiltered whole

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water samples are used for this measurement. Here, the authors adapted this method to measure oxygen demand of filtered water samples. Because bacteria causes DOM decomposition and filtration removes a large fraction of bacteria, this adapted method may underestimate BOD of DOM. In addition, BOD can be used as an indicator of labile DOM, but BOD is not exact the same as BDOM because other components (e.g., oxidation of ammonium) may also consume oxygen. To overcome this problem, DOC changes (before and after bioassays) are also determined along with DO measurement. In doing so, a linear regression between bioavailable DOC (BDOC) and BOD can be set up, and BDOC can be estimated from BOD using this regression. However, BDOC has not measured in this study. Lastly, although BOD is an indicator for organic matter quality, BOD measurement is done in lab in dark. In nature, photochemical oxidations (or sunlight bleaching) can break down refractory molecules to small labile DOM. This mechanism for BDOM generation should be mentioned in discussion section. Data analysis can be improved in a few places in this paper: 1) DOC and BOD flux calculations. Current flux calculations use one concentration data for a whole month, and large errors may be generated because DOC/BOD concentration may change with flow even within a month. Since there are relationships between DOC or BOD concentration and river flow, these relationships can be used to improve DOC/BOD flux estimations. There are many established approaches (e.g., US Geological Survey's Load Estimator or LOADEST) for flux calculation with continuous flow but discrete DOC data. LOADEST can be downloaded and is free to the public. 2) The linkages of DOC and BOD fluxes or yields with watershed land-use, climate parameters (air temperature, precipitation and river flow) have not been explored quantitatively. Once such a linkage have been established (e.g., linear regression with multiple variables), it can be used to predict changes in DOC and BOD exports with future climate and land-use changes. 3) This paper has not analyzed evolution of DOC (and aromaticity and BOD/DOC ratio) with river flow changes to test there is any hysteresis or not. Such analysis (even with monthly data) may provide insight on DOC transport in watershed. See Strohmeier et al. 2013, Biogeosciences, 10, 905–916. Finally, this paper did not present hypothesis

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in introduction, I would add it to clarify why 3 study sites were selected. I also suggest the author read more literature on DOC export, DOC quality and climate change, and compare the results of this paper with other watersheds.

Details: 1. Abstract, line 5-9, this sentence is too long and cannot catch the main idea than need to highlight. 2. Abstract, line 13-14, "... was twice as high in the northern catchment", as high as what? Please complete. 3. Abstract, line 21-22. Do not under what the conclusion really means. It would be better to say something on the contribution of this paper on the DOC increases in Arctic region. 4. Page 1357, line 12-14, it's unnecessary to mention DOC cycles in lakes because this paper does not deal with lakes. 5. Page 1359, line 8-11, it would be better to have hypothesis here, e.g., quality of DOC, or controls on DOC quantity or quality of the three rivers. 6. Page 1359, line 19. Do these hydro dams affect DOC quality, quantity and seasonality? It might be another reason for high BOD in this river, due to algal input. I have not seen any discussions later on these dams. 7. Page 1359, line 24, what is Baltic Proper? Please explain. 8. Page 1360, line 7-11, this method for BOD of DOM needs references. What causes BOD? Actually, when you filter water with GF/F, you probably remove a fraction of bacteria from the water, and thus BOD was probably under-estimated. 9. Page 1361, line 17-22, curious on why there is a large difference in hydrology (summer flow peak) between Emån and Lyckeby, because they are so close to each other. Please provide additional evidence (e.g., mean river flow for a few years) to support this difference is repeatable and not special in that year. 10. Page 1362, page 1-2. There are no DOC concentration data in Table 2, please add. Add p value and statistic method for difference test when you say higher or lower. 11. Page 1362, page 4-6. It's better to examine the evolution of DOC, aromaticity and BOD/DOC with river flow changes, and see if there is hysteresis. Then you can discuss possible reason for the seasonal variations in DOC and DOC quality. 12. Page 1362, page 1-16, the main point of this paragraph is that DOC is flow controlled, but slight different for the Ume River. I am wondering if the hydro dams of the upper Ume may have some effect on this relationship. 13. Page 1363, page 4-8, BOD/DOC < 514. Page 1364, line 2-24. Although it is

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possible that labile organic carbon from river source may cause coastal hypoxia, this mechanism has not been total proved yet. The author may need to mention that decay of marine phytoplankton is an important reason. 15. Page 1364, line 27, "216. Page 1365, line 19-20, I am wondering if it is possible that labile organic leachate from autumn deciduous leaves can be preserved in colder temperature and released in spring, if there are deciduous trees in watersheds. 17. Page 1380-1381, Figure 2-3 are not clear, I would increase the size of dots for DOC and CDOM.

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