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Interactive comment on "Catchment-scale carbon exports across a subarctic landscape gradient" *by* R. Giesler et al.

Anonymous Referee #3

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The manuscript addresses the spatio-temporal dynamics of stream DOC and DIC across 6 catchments in northern Sweden providing valuable insides on the role of hydrological cycle on the partition of different C pools and the overall C export. Authors show that stream DOC concentrations were highest during high flow conditions associated mostly with spring snowmelt while highest DIC concentrations occurred during winter baseflow conditions. Although all aquatic systems are characterized by very low and comparable DOC and DIC, both concentrations and fluxes, authors suggest that DIC is a significant component of aquatic C flux accounting for more than 50% of the annual C export. To my opinion, this is a bit questionable since large errors may be expected from a number of assumptions used in the overall estimation of annual fluxes (i.e. daily concentrations estimated (interpolation) from weekly and monthly measured values and some long-term patterns; daily flow rates were measured only

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for one stream and extrapolated for the others).

Overall, this is an innovative work which can provide a valuable contribution to the worldwide efforts towards improving the scientific understanding of C dynamics in rivers and stream and their importance in global C cycles. Data generated here could be of major current interest, and the subject is likely to attract a wide group of readers from the growing field of inland water carbon cycling. The paper is well-written, relevant scientific database is cited, the structure and layout can be further improved by re-organizing same tables and figures (some can go to the Supplementary material) (see Specific comments).

I recommend the manuscript for publication after authors address properly a number of issues listed below.

Specific comments P7954 L25: I thought that CH4 release in relation to global warming is of potentially higher importance than CO2 in the northern latitude ecosystems It is worth mentioning the CH4 at least. P7955 L26: What is the reference period of the decrease in summer DOC export in the Yukon River? P7956, paragraph starting at L13: not clear who is an important sink for terrestrial C. P7958 L8: Perhaps a short description of major geological formations in the region would be useful. P7958 L17: The irregularity in the sampling frequency (from couple of times per week to weekly and monthly) could results in large errors associated with latter flux calculation and/or seasonal patterns which will incorporate additional errors associated with a lot of assumptions used to estimate individual flow rates (P7959 L9). Perhaps an additional paragraph describing the relationship between water levels and rating curves, etc would give the reader better inside. P7959 L12: Even the 7 months period where flow rates were estimated may account for only 10% of the annual flow, the influence of those potential errors would be mostly reflected in the annual DIC loads as DIC concentrations over this period are highest compare to DOC. P7960 L6: Same as discussed above: 1. potentially large errors associated with estimates of daily concentrations (interpolation) from real measurements at 2/3 times per week frequency to weekly and monthly; 2.

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large potential errors resulting from daily flow rate estimates. So, estimated DOC and DIC loads would carry all those errors which should be at least discussed appropriately if not presented somewhere is the main text or in tables. P7960 L13: Where are those weighted average concentrations displayed? Which table, graph? How different/similar are those values compared to normal averages? P7962 L21: Either or not using /yr when referring to annual load or flux, unit should be g/m2 (or g m-2) and not g x m2 (g m2) here and everywhere else in the main text, tables and graphs. P7963 L1: Would be more interesting and perhaps more appropriate to see the relation between those predicting variables and DOC and DIC concentrations and not DOC and DIC fluxes for reasons discussed above. P7963 L5, L8: I don't think anyone would consider $p<0.1$ as a significant level. P7964 L14-15: "...not a strong relationship of increasing DOC export with higher flow." While this seems to be true for long-term data, a good and positive relation exist for the 6 catchments as shown in Figure 6. How do you explain the difference? P7964 L18: I think the authors must be careful with the interpretation of data and the use of strong words such as "substantial component" since both DOC and DIC are very low, even for subarctic or boreal ecosystems. DOC and DIC values are rather comparable despite that the relative contribution of DIC to the total C flux seems slightly higher. Data need error range. P7964 L20: Perhaps the geology may explain part of the discrepancy. P7965 L6-10: The paragraph needs some brushing/re-writing. P7965 L10-13: There is a repetition of the message suggested in the first paragraph of the page (L1-4). P7965 L10: The biogenic vs geogenic origin of DIC could be settled by looking at stable isotope data. Any δ13C measurements? P7965 L27: Positive trends in relation to what? P7966 P17-23: Perfectly true. P7970 L7-18: Instead of creating hypothesis around the source/fate of CO2, a great exercise would have been to quantify the CO2 emissions from the 6 studied streams since pCO2 has been measured anyway, and compare CO2 fluxes with the total C export.

Tables: Table 1. It should be specified in the table capture if not in the table itself that Total Flow is in fact Total Annual Flow with the unit expressed as m3 yr-1 and that Daily Flow represent the Average Daily Flow I believe that Table 2 should go first as

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it describe more general catchment characteristics. Also it should be specified in the table caption that Area represent Catchment Area, while Elevation, Slope, Aspect, etc, represent average values as mentioned in the text. Table 3. Concentrations should be better expressed in mg L-1 instead of mg dm-3. Similarly, I believe that "Mass Fluxes" refer here to annual fluxes so the unit should be gC m-2 yr-1 and not g C m2. Also, values should be followed by error range (±) as beside being small, they are rather comparable with each other (DOC with DIC, both concentrations and fluxes). The need of error range is even more evident as one of the major conclusion of the study (DIC export is higher than DOC) is based on these small differences. Table 4. I don't agree that p<0.1 is significant. Overall, I don't know how much novelty this table brings. Perhaps it can better go to Supplementary Material to save space if necessary. Same for Table 6.

Figures: Figure 1 has no coordinates system. The Torne River should be indicated on the map rather than Road E10. Figure 2 should specified if displayed concentrations are directly measured values or the figure show also estimated data based on interpolation. Same for the other figures displaying concentrations to create a separation between measured and assumed values. Not sure what is the main message of Figure 4. Perhaps it can better go to Supplementary Material Figure 6. kg is unit of mass not of a flux. Similarly, annual discharge – m3 yr-1 (or m3/yr), not m3. Overall, one may expect such positive correlations between discharge and loads. Why the relation between DOC load and discharge for the six catchments (filled triangles) has only 2 points?

Editing comments: 7955 L20, comma after "ecosystems" Figure 4. Delete "other" after "during" in the 2nd line.

Interactive comment on Biogeosciences Discuss., 10, 7953, 2013.