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# *Interactive comment on* "Regional-scale lateral carbon transport and $CO_2$ evasion in temperate stream catchments" *by* Katrin Magin et al.

**Anonymous Referee #2**

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Accurate estimation of aquatic carbon export is essential to understand the role of natural ecosystems and geochemical processes in global carbon cycles in the context of climate change and increasing anthropogenic activities. In this manuscript, the authors integrate the analysis of downstream export of riverine carbon and CO2 evasion to the atmosphere from more than 200 local catchments of variable sizes in temperate Europe along with the model estimation of ecosystem production. Based on this large dataset, the authors try to establish a carbon budget in a local scale and discuss the ecologic factors controlling the aquatic carbon export. Overall, the integration of the large dataset of riverine carbon concentrations spanning over last several decades is technically sound and strengthens the arguments in the manuscript.

My biggest concern arises from the estimation of the downstream export of riverine carbon. The riverine carbon concentrations adopted in this investigation were obtained



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during 1977-2011, which is significantly longer than NPP of 2000-2013. Investigations have already showed a decadal increasing DIC export in boreal and subtropical rivers due to the climate change and anthropogenic activities (Walvoord, M. A., and R. G. Striegl, 2007, Increased groundwater to stream discharge from permafrost thawing in the Yukon River basin: Potential impacts on lateral export of carbon and nitrogen, Geophys. Res. Lett., 34, L12402, doi:10.1029/2007GL030216; Raymond, P.A., Oh, N.-H., Turner, R.E., Broussard, W., 2008. Anthropogenically enhanced fluxes of water and carbon from the Mississippi River. Nature 451, 449-452). Therefore, I would suggest using the environment monitoring dataset during the last 10 years or so, which is consistemt with NPP estimation, to estimate the riverine carbon export.

Secondly, it seems that the data points for the flux estimation is sparse as indicated in the section 2.2 (see Page 3 Line 83-86: "……at least one measurement was available for each season……"). Therefore, I will be happy to see the error or uncertainty analysis of the flux estimation with the method using the mean concentration and total river discharge (see Page 4 Line 94-95). Moreover, a comparison with other flux estimation methods, such as the one using flow-weighted mean concentration and discharge, the one based on the regression of instantaneous flux and discharge, and other methods (see Warnken, K.W., Santschi, P.H., 2004. Biogeochemical behavior of organic carbon in the Trinity River downstream of a large reservoir lake in Texas, USA. Sci. Total Environ. 329, 131-144), will be helpful to validate the flux estimation.

What do you mean "interpolating pCO2 for all river segments without direct measurement" (Page 4 Line 95-97)? Please clarify in the text.

For DOC, there are 64 observations (Table 1) in 54 sampling sites (Page 3 Line 90-91). On average, there are less than 2 observations in each site. Usually, DOC concentrations in rivers could vary seasonally with river discharge by couples of times. Therefore, the representativeness of the single DOC data in each catchment remains a critical question which may induce the great deviation of DOC flux estimation from the real value. Before resolving this issue, the statements that DOC load only made up

4% total carbon load (Page 5 Line 146-148) and that the error would be comparably small when neglecting the DOC term (Page 6 Line 159-162) seem arbitrary.

The authors extensively discuss the aquatic carbon export/NPP ratio in the manuscript (See Table 3 and text in Section 4.1s). They state in the manuscript:" By combining CO2 evasion and downstream C-export by stream discharge, we estimated that 2.7 % of terrestrial NPP (13.9 g C m2 yr-1) are exported from the catchments by streams and rivers, in which both evasion and discharge contributed equally to this flux (Page 7 Line 193-195)". Then they compare their results with some other studies of catchment ecosystems (see text in Section 4.2). However, what I understand is riverine DIC export flux is closely related to the weathering regimes and intensity in catchments (See Cai, W.-J., Guo, X., Chen, C.-T.A., Dai, M., Zhang, L., Zhai, W., Lohrenz, S.E., Yin, K., Harrison, P.J., Wang, Y., 2008. A comparative overview of weathering intensity and HCO3- flux in the world's major rivers with emphasis on the Changjiang, Huanghe, Zhujiang (Pearl) and Mississippi Rivers. Continental Shelf Research 28, 1538-1549; and Raymond, P.A., Bauer, J.E., Caraco, N.F., Cole, J.J., Longworth, B., Petsch, S.T., 2004. Controls on the variability of organic matter and dissolved inorganic carbon ages in northeast US rivers. Marine Chemistry 92, 353-366) although NPP could contribute part of DIC export flux through the respiration of DOM. Therefore, the aquatic carbon export/NPP ratio would be expected to be larger than the real contribution of NPP.

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