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Interactive comment on "Dissolved organic carbon concentrations vary with season and land use – investigations from two fens in Northeastern Germany over two years" *by* M. Schwalm and J. Zeitz

Anonymous Referee #1

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The paper "Dissolved organic carbon concentrations vary with season and land use – investigations from two fens in Northeastern Germany over two years" addresses an important topic, the long-term effects of rewetting of fens on DOC concentrations and export. By monitoring DOC concentrations, groundwater depth and water discharge in ditches of one agriculturally used fen and one rewetted fen Schwalm and Zeitz aimed to test the hypotheses that i) agricultural use increases DOC concentrations as a consequence of enhanced peat decomposition, ii) DOC concentrations in winter are low, while they′re high in summer, and iii) that DOC export contributed significantly to the

carbon balance of fens. In line with hypothesis i), higher DOC concentrations were found in the ditches of the agriculturally used fen than in the rewetted one. However, it is difficult to judge whether this difference in DOC concentrations is indeed related to the agricultural management or to other differences between the sampled fens because of the lack of replicates, which precludes a statistical analysis of the data. In my opinion the statistical comparison of concentrations between DOC concentrations at sites RE and AU in figure 3 violates the assumption that the measured concentrations represent an independent random sample. They are not independent because they represent a time-series of concentrations from one or few sampling points. I am aware that the authors strived to sample two sites as similar as possible in terms of site characteristics land use history and climatic conditions. However, important differences remain, for example the blocking of ditches at site AU that prevented discharge (page 7092, lines 17-19). Higher DOC concentrations at site AU could have been caused by water stagnation in the ditches, because we know that DOC release from soil organic matter into water is a kinetic process. Due to low discharge at the AU site, the results of the study also do not support the conclusion that rewetting of fens decreases DOC losses with discharge. Actually, the area-specific DOC loss (kg DOC per hectare) from site AU was even smaller than from site RE (page 7091, lines 17-18). Since the catchments differ in size by more than one order of magnitude, it is necessary in my eyes to compare DOC losses that have been normalized to catchment area and not absolute losses.

The analysis of temporal patterns of DOC concentrations in the two investigated fens is independent of replicated treatments for comparisons, but rather qualitative and not always comprehensible for me in its current form. For example on page 7088 lines 20-21 it reads that "A rise in water-table (after strong precipitation or rewetting) is accompanied by a flush of DOC-rich water from soil to ditches...", but when looking at figure 4, I spotted the highest concentrations during periods of falling water tables (e.g., April-May 2011, Oct.-Nov. 2011). I wondered if a more quantitative analysis of the time series of concentrations and potential drivers like climate and groundwater levels using

for example wavelet analysis would yield a clearer picture of the crucial factors causing temporal variations of DOC concentrations (see e.g., recent paper of Mengistu, S. G., C. G. Quick, and I. F. Creed, 2013. Nutrient export from catchments on forested landscapes reveals complex nonstationary and stationary climate signals, Water Resour. Res., 49, 3863–3880, doi:10.1002/wrcr.20302). For the interpetation of temporal variations it might be important to account for "dilution effects" as discussed by Schwalm and Zeitz on page 7090, lines 12-14. I suggest normalizing DOC concentrations to concentrations of a rather conservative ion like chloride or bromide to analyze these dilution effects more quantitatively. The figures 6 and 7 are not addressed in the text of the manuscript.

Regarding the relevance of dissolved carbon losses for the carbon budget of peatlands, Schwalm and Zeitz refer to results of Dawson et al. underlining that the contribution of dissolved inorganic carbon is negligibly small in comparison to DOC. I am not convinced that the results of Dawson et al. for rather acidic Scottish peatlands (mean pH 4.8-5.7, Dawson et al., 2002) can be transferred to fens in NE Germany, because the solubility of carbon dioxide in the form of bicarbonate and carbonate is much higher at the pH values of 6.2-8.6 encountered in the investigated sites. Our own unpublished data show average DIC concentrations of 150-170 mg /l in topsoils of agriculturally used fens. Therefore, I would suggest that total dissolved carbon losses from these fens are probably much higher than DOC losses.

In summary, I cannot recommend publication of the manuscript in its current form because the lack of replication precludes a proper testing of the land use effect on DOC concentrations and fluxes and because the data do not always support the conclusions. A more quantitative analysis of the time series might potentially justify the publication of the results as full paper. Another option might be the reduction of the size of the manuscript to the format of a short communication with one figure and one table.

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