Hydrol. Earth Syst. Sci. Discuss., 4, S184–S189, 2007
www.hydrol-earth-syst-sci-discuss.net/4/S184/2007/

Hydrology and Earth System Sciences Discussions

Interactive comment on "Fluvial organic carbon flux from an eroding peatland catchment, southern Pennines, UK" *by* R. R. Pawson et al.

Anonymous Referee #1

Received and published: 20 April 2007

General comments:

This review has been prepared by the invited reviewer and another unnamed colleague at my institute who has worked in this field for a number of years. The invited reviewer is indebted to his colleague for their large (main) contribution to this review.

This is an interesting article which tackles the topical issue of carbon cycling in understudied, yet important, eroding peatland catchments. The paper calculates a particulate organic carbon and dissolved organic carbon yield from a small eroding catchment. While it is a challenge in itself to monitor these variables there are some major problems regarding the sampling strategies and the subsequent analysis.

Specific comments:

Sampling time-period:

The major limit of this paper is the short-time period over which samples were taken. The paper appears to be based on samples taken from November to 11 April. It is well known that there is a seasonal trend in DOC. While less extensively studied, a priori reasoning suggests there will also be a seasonal trend in POC. The seasonal trend will be a result of the ratio of autochthonous and allochthonous POC production, different flow regimes (longer periods of low flow in summer, convective storms, versus generally higher flow conditions in winter etc.), and different sediment preparation processes (e.g. freeze thaw). While the analysis for the intensively monitored two week period is rigorous we do not believe you can extrapolate such data to the annual time-scale. Unless the authors have unused and unreferenced data the extrapolation modelling is not valid. Furthermore it was not explained why the specific two week intensive monitoring period was chosen.

POC determination:

P724 line 25. It is mentioned that the reproducibility of POC analysis was assessed. What were the results of this? Also, were there any measures of the reproducibility of samples $<$ 50 mg? Assessing the carbon content of such small samples is challenging. The likely errors should be stated.

P728 line 26. It is documented that samples were taken from a range of baseflow conditions, storm samples and rising stage samples. We are not sure what exactly is meant here. It could well be that 'rising stage samples' are the same as 'storm samples' so can you clarify this please. Was there a sampling bias towards rising stage? Given that organic matter is buoyant it can be assumed that rising limb samples should contain a higher proportion of POC than falling limb samples. This could explain the difference in the proportion of POC and DOC for the two week and annual estimates. The authors could try to develop rating curves for the falling and rising limb individually if they have not already done so. On the same note we question the use of the

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45 min lag for POC in the POC prediction model. POC will be entrained preferentially over mineral sediment given its buoyancy and more fibrous/disc shape in comparison to mineral particles.

Have the authors considered the fraction of POC which is larger than the sampler inlet pipe diameter? Some peat will be transported which is too large to be sampled.

Flux equations:

There is no justification for why the method used was chosen and yet this could have a major impact on the load estimates. Phillips et al 1999, Hydro Proc, 13, 1035-50 contains an extensive range of flux calculation methods.

DOC predictions:

A calibration between pH and DOC is plotted in Figure 4. This relationship is used to predict DOC over a year as pH was permanently monitored while DOC was only periodically sampled over short periods. However, Figure 4 shows that the relationship between DOC and pH breaks down below pH 4. Most of the samples appear to be below pH 4 and presumably a large proportion of the DOC flux occurs under flow conditions with pH $<$4. Therefore the equation developed and applied to the annual pH and discharge dataset is flawed.

Context issues:

It would be useful if we could place this study into context. For example, it is mentioned that 'much' of the UK upland peatland resources are significantly eroded. It would be useful to know what proportion of peats are eroded to the same extent as the study catchment. There are many peatlands that are uneroded (Scottish bogs etc).

Miscellaneous problems:

P725 line 25. It is stated that DOC coincides with discharge peaks. We are not convinced by this. They are coincident sometimes, but not consistently. Indeed the rela-

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tionship looks inverse for the third largest discharge peak. Scatter plots of discharge versus DOC would be more revealing.

P710-1 reviews various studies examining POC but does not mention the major short-coming of many, fixed-interval sampling regimes. Clear mention of this would help set-up the study better. The authors note the importance of sampling over a variety of events and antecedent conditions later in the paper and this is good justification for their work. They should mention it earlier as this will then tie in with conclusion 2 in which short-coming of sampling is noted.

P728 line 22. It was noted that smearing was used to correct for bias. However, the paper does not mention whether the variables were transformed.

Technical corrections

Abstract - This says that 40.8 t OC is exported on an annual basis. This should be reworded to note that OC export was predicted at that level and not actually measured at this value.

P720, line 26 - 'on' not 'upon'

P722 line 9 - peat is less dense than mineral sed and therefore buoyant. As a result organic sed is rapidly flushed out the system and is far less likely to fall out of suspension. Therefore is not just a function of stream power but also very strongly controlled by supply.

P723 line 2 - rephrase to 'which in the upper reaches occur solely in a peat stratigraphy which is often several metres deep'.

P723 various lines and check other pages too - use of the word 'extraction' seems to mean taking samples. Instead use the word 'sampled' or 'taken'. Extraction implies a chemical procedure in this context.

P723 line 16 - 'suspended sediment' not 'suspended sediments'

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P723 line17 and P724 lines 1-3 - what interval were Q and pH logged at? You should be specific and not simply say ‘quasi-continuous’.

P274 line 3 - why was pH measured in 2004 and the other variables in 2005/6? Is this just a typographical error.

P724 line 6 - what is meant by ‘sediment carbon’? Also in other sections you use phrases such as ‘peat-sourced carbon’. You need to clarify this. Do you mean organic and mineral carbon? If so use these terms because as it stands it is unclear what you mean.

P724 line 25 onwards - this is a bit unclear. Clarify that samples $>$ 50 mg were ground up because the instrument only requires $<$ 50 mg (if this is the case)

P725 line 15 - sentence beginning ‘Stream water samplesĚ’ is a repeat from p724 lines 1 onwards.

P727 and 728 - should the ‘model inputs’ sections go in the methods section and the ‘model outputs’ sections simply be part of the results.

P729 line 26 - this sentence is unclear. May relate to comment re P724 line 6.

P731 - all the results from the lists of DOC and POC comparison studies would be better in a table.

P733 line 26 - sentence beginning ‘For example, three days a small peakĚ’ does not make sense.

P735 Conclusion 3 is not a direct conclusion from your paper.

P736 line 6 - Armstrong PhD undertaken at Durham not Leeds

It is surprising that Francis’ (1987) PhD and subsequent papers are not cited (Blanket peat erosion in Mid-Wales: two catchment studies. PhD thesis, University of Wales, Aberystwyth).

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Interactive Comment

Table 1 - Can you provide the dates of the 6 storms sampled in the penultimate row?

Figure 3. Put actual dates on x axis.

Figure 4 and 5. Note equations on the graphs and also what about the significance values?

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 4, 719, 2007.