

Interactive comment on “Lateral carbon fluxes and CO₂ outgassing from a tropical peat-draining river” by D. Müller et al.

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Received and published: 24 September 2015

Response to Anonymous Referee 1

We thank you for your constructive feedback and your detailed comments and suggestions. Please find our replies to all specific comments below.

General comments: This is an interesting paper worth publishing. Tropical peatlands are an important part of the global carbon cycle and large areas are being converted to commercial use which has an impact on the carbon storage and dynamics. This paper makes a valuable contribution by providing baseline data on concentration and age of carbon released from pristine tropical peatlands hence aiding the assessment of the effects of disturbance in other studies. The authors

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also measure pCO₂ in this river draining pristine peatland which may provide an important indicator on the peat decomposition. CO₂ efflux is influenced by water flow velocity and turbulence and therefore comparing it to more degraded systems may be difficult unless information on hydrology is also available hence pCO₂ data provided offers a better point of comparison. The paper is generally clear and well written, some minor technical corrections are listed at the end of this file. The authors also discuss uncertainty thoroughly which is important in addressing the limitations of the study.

Specific comments: My main comment relates to the upscaling of the results to an annual budget. I appreciate that detailed measurements were not available for calculating discharge and the authors handled the issue by using multiple ET values to derive an estimate. However, why was the annual precipitation for 2013 used for both 2014 and 2015? The authors mention that 2015 was particularly wet with flooding so it doesn't sound like 2013 rainfall values would be entirely appropriate. Given that year 2015 is not yet complete, what about using rainfall one year backwards from end of each sampling (April 2013-March 2014 for 2014 and April 2014-March 2015 for 2015)? Or perhaps producing just one export budget using the pooled TOC data from both sampling years and maybe a long term average rainfall? Another limitation of producing the annual budgets is that the authors used the average TOC concentrations which were solely measured during decreasing discharge whereas concentrations are expected to vary between seasons. The authors themselves mention that DOC is expected to decrease during the peak monsoon and that it was lower during the rainier 2015. They also discuss issues related to the lack of seasonal measurements. Given that there is considerable uncertainty in TOC values too, perhaps it is not worth upscaling the 2014 and 2015 values separately especially if precipitation data is only available for a single year (2013)?

Additional precipitation data were now kindly provided by the Department of Irrigation and Drainage (DID) Sarawak for the years 2012-2015. Therefore, we followed your first

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suggestion and calculated the TOC yields backwards from the end of each sampling. As a result, the TOC yields are now somewhat lower than before, so that we had to adjust our discussion on page 10407, line 15.

p. 10401 line 20 “The river was strikingly undersaturated in oxygen, ranging from 29 to 58 $\mu\text{mol/L}$ in 2014 and from 26 to 42 $\mu\text{mol/L}$ in 2015.” Could the authors report what the saturated concentration would be in study conditions either in the text or on the figure 3?

The average oxygen saturation concentration was 262 $\mu\text{mol/L}$ in 2014 and 263 $\mu\text{mol/L}$ in 2014. In-situ oxygen saturations ranged between 11 and 22 % saturation in 2014 (NP samples) and between 9 and 20% in 2015. We included the saturations in the revised text, but we would prefer not to change the Figure, as we would have to extend the vertical axis – the dissolved oxygen values in the water were nowhere near saturation.

p. 10402 line 5 “The age determination of our two samples from 2014 revealed that DOC contained $106.6 \pm 0.3\text{pMC}$ and $106.1 \pm 0.4\text{pMC}$, indicating a large contribution of modern carbon to the overall sample age.” –From which sampling points were these two samples collected?

One sample was taken at the most upstream station (river km 14) and one sample was taken further downstream (river km 8). We added this information in the Methods section of the revised manuscript.

Figure S3 what is the significance of dark blue on the graph?

Dark blue refers to the two sigma calibrated age range. We added this information in the caption.

Figure 4 a, why is there a gap in the CONTROS pCO₂ data?

There was a technical problem with the data cable, so that data storage was interrupted. We fixed the problem during our overnight stay in the Maludam national park. We added a sentence in the revised text explaining the gap in the pCO₂ data.

p. 10403 line 16 “CO₂ concentrations showed a weak negative relationship with

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DO” – Was it significant? Was this true in 2014? It does look like it on the plot.

It was significant in 2015 ($r = 0.74$, $p < 0.0001$) but not in 2014. We added this in the revised manuscript.

p. 10404 line 7 “($V = 0.2 \text{ m/s}$)” –what was the standard deviation? Did the efflux rate increase with flow velocity?

$V = 0.2 \pm 0.1 \text{ m/s}$ – we added the standard deviation in the revised manuscript. Since we measured velocity only in 2014, and we conducted floating chamber measurements only at four stations during that year (see Fig. 4b), we could not establish a relationship between flow velocity and flux.

Minor technical corrections:

page 10392 line 14 (Miettinen and Liew, 2010) is this the correct spelling of the first author? Should it be Miettinen?

This is correct, we misspelled it. This was corrected in the revised manuscript.

p. 10419 Fig 1 caption ” the diamond shows” for clarity change to “the green diamond shows”. Strictly the grey squares are not dots, this could be changed to “grey and black symbols denote sampling locations”.

This was changed in the revised manuscript.

p. 10396 line 19 “No bigger rainfall events occurred during the campaigns.” Bigger than what? Would you have information to state the maximum rainfall? If not, maybe just change to “no large rain events occurred”.

We rephrased that no large rain event occurred. There was some drizzling in 2014, but we have no means of quantifying the precipitation rate during this event.

p. 10400 line 18 “..we used the annual average precipitation for the year 2013.” Should this say total annual precipitation? As far as I can see data came from one station not as average of many.

Yes, this was to say the total annual precipitation at Maludam station. We corrected this.

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p. 10401 line 6 “In the NP, all samples contained freshwater, as indicated by a low conductivity between 72.5 and 100.3 $\mu\text{S}/\text{cm}$ (2014).” –were the samples only from 2014?

Conductivity was measured at every station in 2014 with the WTW sensor. The WTW data logger had two inlets, which were used for oxygen and conductivity in 2014, while pH was measured with the HANNA pH meter. In 2015, those two inlets were used for the oxygen sensor and a pH sensor. Therefore, conductivity was only measured on the way upstream until it was obvious that no marine influence was present. This point was already reached at the first station, which was located close to the border of the national park and exhibited a conductivity of 71.3 $\mu\text{S}/\text{cm}$. After that, we have no record of conductivity, but we assume that it is $<71.3 \mu\text{S}/\text{cm}$ as all other samples were taken further upstream from station 1. In the revised manuscript, we added the information that 2015 samples are all expected to contain freshwater, as a conductivity of 71.3 $\mu\text{S}/\text{cm}$ was detected at the station that was farthest downstream.

p. 10410 line 4 “..by employing the floating chamber..” -should it be “by deploying”?

Yes, this was corrected.

Figure 2, 3 and 4a There seems to be an error in the legend as the black and grey symbols are repeated whereas the I guess there should also be yellow symbols.
We added the yellow symbols in the Figures 2, 3 and 4a of the revised manuscript.

Figure 5 the symbols are repeated unnecessarily as there are no yellow ones on the graph.

We don't fully understand this comment. There are no yellow symbols neither in the graph nor in the legend.

Figure 4b is lacking a legend or the caption a statement that the symbols are the same as in the previous figures.

We added a statement that the legend applies to all panels in the captions of Figures

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2, 4 and 5 of the revised manuscript.

Interactive comment on Biogeosciences Discuss., 12, 10389, 2015.

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