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Interactive comment on "Lateral carbon fluxes and CO_2 outgassing from a tropical peat-draining river" *by* D. Müller et al.

Anonymous Referee #2

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GENERAL COMMENTS Tropical peatlands are under tremendous pressure from extractive industries (e.g. timber, mining, etc.) and agriculture, with potentially wide-ranging consequences for regional/global C balances, climate, water quality and biodiversity loss. We have very little data on fluvial C fluxes from many tropical peatland ecosystems, particularly from Southeast Asia, where the pace of land-use change has been extremely rapid in recent decades. This manuscript is therefore interesting and novel because it is one of the few studies to provide baseline data on fluvial C fluxes prior to land-use change, and could serve as a useful touchstone for future studies of anthropogenic impacts on C fluxes from Southeast Asian peatlands.

However, there are some limitations to the research here; for example, the approach used to estimate annual fluvial C fluxes is based on the calculated difference between

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precipitation (PT) and evapotranspiration (ET) (see page 10400), and is subject to uncertainties in measured rates of ET and the assumption of steady-state conditions. Fluvial and gaseous measurements were also only conducted in a single season in both years (i.e. post-monsoon). Lastly, gas evasion measurements provide only a partial picture of water-air exchange, because there are questions as to how spatially representative the measurements were, and if water-air exchange is influenced by wind/turbulent flow (although the authors argue this is a non-issue because of relatively sheltered river conditions).

Yet despite these limitations, I believe this study makes a valuable contribution to the wider literature on tropical peatlands, because so little is known about undisturbed peatland systems, particularly in Southeast Asia. Moreover, much to the authors' credit, they have openly and transparently discussed the potential sources of uncertainty in their measurements (see section 4.4 in the Discussion). This is to be commended because it enables readers to assess the data for themselves, acknowledges any potential biases in the estimates of C flux, and also provides a starting point for identifying how future studies of this kind could be improved. In my overall assessment, this is good work, given the challenging field conditions and limited infrastructure, and will extend our knowledge of these regionally/globally important but understudied ecosystems.

Specific comments on individual sections of the text are provided in the section below.

SPECIFIC COMMENTS 1. Page 10395, line 19: Use of abbreviations like "NP". This is a subjective stylistic point, but where possible, I think the text would read more elegantly if abbreviations were only used sparingly. While in some commonly-used terms like "Peat Swamp Forest" (PSF) might be better abbreviated due to their length, other shorter terms (like "National Park") may be better referred to in full. Abbreviations tend to interrupt the flow of the text, and I prefer only using abbreviations for very wordy or long terms.

2. Page 10396, line 27 to Page 10397, line 29: In the section on sampling procedure and instrumental analysis, it would be useful for the authors to state the precision of their measurements for the TOC, AMS and IRMS (typically reported as the Coefficient of Variation for the standards). Precision is reported for the IRGA/headspace method described on page 10398, line 13 (i.e. <2.5%), so no need to discuss this further here.

3. Page 10402, lines 20-24: Do the investigators have the C/N ratio of the surrounding peats? Depending on the degree of microbial processing, many peats typically have C/N ratios similar to that of plant material (e.g. 40-60), with higer C/N values more common in forested peatlands with a larger proportion of woody debris. It is therefore likely that the DOC & POC consist of a mixture of phytoplankton, terrestrial plant material AND decomposing peat C, not simply the first 2 constituents.

4. Page 10402, line 25: Do any data exist on the 15N values of organic material? These may provide useful insights into the degree of N-limitation in the system.

5. Page 10404, lines 15-22: With respect to CO2 fluxes, it is possible that some of this apparent "spatial" variability may also be reflective of temporal variability/antecedent conditions. For example, if there were sustained winds or large gusts prior to sampling, surface waters may have become depleted in CO2 due to enhanced outgassing driven by turbulent flow. In addition, spatial and temporal variability in conditions might synergistically interact. For instance, if certain stretches of river are more protected from the effects of wind, it is possible that they will (relative to more exposed reaches) show consistently higher dissolved CO2 concentrations and higher apparent diffusive fluxes, because there could be less turbulent fluxes from the water-atmosphere interface.

6. Page 10405, lines 14-15: Consider slightly rephrasing the sentence "Enhanced CO2 is generally associated with oxygen depletion..." as this could be misinterpreted to mean that more anaerobic conditions reflect or are conducive towards greater organic matter decomposition. Revising this sentence could make the meaning clearer, e.g. "Enhanced CO2 is generally associated with oxygen depletion, with lower oxygen

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levels reflecting high levels of organic matter decomposition and subsequent oxygen consumption by heterotrophs..."

7. Page 10405, lines 16-17: Part of the "natural variability" could also arise from the fact that this is an open system, and oxygen re-charge from the atmosphere could obscure/confound the effects of heterotrophic oxygen consumption. Without direct measurements of biological oxygen demand, it would be challenging to find very strong relationships between CO2 and O2.

8. Page 10406: With respect to the 14C data, would it be possible for the authors to estimate or speculate as to what proportion of the DOC was arising from recent material and how much from older carbon? Do the authors have 14C estimates for the peat material and more recent plant compounds? The 14C data (potentially combined with 13C data) could assist in partitioning the decomposition sources into old versus recent material, depending on the precision of the 14C measurements.

9. Page 10406 – 10407, section 4.2: It would be useful, within the context of understanding the effects of land-use change, if the authors could draw some comparisons with fluvial C fluxes from managed/human-affected tropical peatlands. Simply speaking, are the fluxes from this near-pristine system on par, lower or greater than for human-affected systems?

10. Page 10407, section 4.3: Two points; first, similar to point 9 above, would be comparisons of gas evasion from this system compared to managed systems (if these data exist). Second, could the authors elaborate on this concept of short residence time and CO2 concentration/gas evasion rate? From other studies, what would be considered moderate or long residence times? How would this difference influence CO2 fluxes and what type of mathematical relationship does water residence time have on gas evasion rates? E.g. is gas evasion rate linearly related to water residence time? Etc.

11. Page 10408-10409: With respect to the uncertainty estimates, one thought I had

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is that it might be possible to show the range of estimates for the different fluxes in a table? For example, reporting the median, mean, range, minima and maxima for each of the fluxes? This might be a straightforward way of condensing this information.

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