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Interactive comment on "High Riverine CO$_2$ Outgassing affected by Land Cover Types in the Yellow River Source Region" *by* Mingyang Tian et al.

Anonymous Referee #2

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The manuscript by Mingyang Tian and co-authors investigates the riverine partial pressure of CO2 and CO2 efflux in the source region of the Yellow River and differenciates between landscape types (glacier, permafrost, wetland and grassland). This approach is different than the most studies about CO2 in rivers. Commonly studies compare streams/rivers by size or by climate zone (Marx et al. 2017, Lauerwald et al. 2015, Raymond et al. 2013). Thus, this study aims to improve the understanding of carbon dioxide emissions in alpine rivers, particularly in the Tibetan Plateau. Further, different methods to determine CO2 degassing were applied: floating chambers and headspace equilibrium method. Unfortunately, the uncertainties of results from the different methods are hardly discussed.

C1

Overall, in my opinion the work has a high potential to make a good contribution to the understanding of CO2 emission in rivers. However, at present several aspects require extensive revision. That is why I cannot recomment this manuscript for publication in its present form. I recommend re-submission after thourough revision according to the points below.

Major comments:

(1) This promising paper is restricted to the Yellow River source regions and lacks moving beyond that. I recommend showing results in a global context.

(2) The final version of the paper would benefit from editing for language. While it is generally understandable, several idiomatic expressions and mistakes hamper the readability. For instance, make sure the text is in past-tense and use "the" before plural and delete it if singular follows.

(3) I strongly recommend to discuss the reliability of your data. For instance, how were fluxes determined by chamber method compared to fluxes by equilibrium headspace method?

Specific comments:

Abstract

Ln. 1: Don't use the same sentence to start the abstract and the introduction

Ln. 25: They mostly were a CO2 source. I remember that you also showed negative fluxes.

Ln. 32: Be careful with "significant" as it indicates a statistical significance. Is that the case here? Otherwise replace.

Ln. 32-33: Rephrase sentence it is difficult to understand.

Ln. 33-37: These sentences include general knowledge. Give some numbers or state-

ments derived from you research, as this increases the impact of the paper.

Introduction

Ln. 45: Researcher should not believe. General agreement/ consensus/ ...?

Ln. 48-52: Please revise sentence as it is hardly readable.

Ln. 55-57: Check Swakuchi et al. 2017. They included lower reaches of the amazon to global estimate by Raymond et al. (2013). This led to values of 2.58 petagrams (Pg) CO_2 yr-1 for rives and streams. See also Marx et al. (2017).

Ln 57-60: This sentence is not clear. Do you mean there is a lack of direct measurement data? That is true. The studies you mention calculate pCO_2 from DIC/Alkalinity, pH and T, as this is the common method. There is a decent database (Hartmann et al. 2014), that was basis for global CO_2 emission estimates (Raymond et al. 2013; Lauerwald et al. 2015).

Ln. 61: What do you mean by global river systems?

Ln. 73: Wrong word. This was not "concluded" but determined/measured.

Ln. 86: Statistically significant? Can you give a number?

Ln. 87-88: Do you compare autumn values here?

Ln. 102: In the alpine rivers of the Yellow River?

Ln. 107-112: Good!

Material and methods

Later in the text you mention carbonate rocks/limestone. I recomment to provide data on bedrock geology in this section.

Ln. 138: analyses?

Ln. Accuracy of 0.004 for pH measurements in the field. Is that really realistic?

Ln. 150: This is basic knowledge: inorganic carbon species distribution dependency on pH (and temperature).

Ln. 153: Be consistent and add the country behind the company.

Ln. 57: "Specific bottle" be more precise! Brown glass bottle? Volume?

Ln 159: Germany

Ln. 160: Not less. "... precision better than ..."

Ln. 162: Use Determination instead of calculation here.

Ln. 164-165: Can you give a precision of the Li-7000 analyzer?

Ln. 175-176: Were 6-10 mins sufficient to get data for a linear flux estimation?

Ln. 181-190: A better describtion is needed here. The first equation is a linear approximation of CO_2 flux from chamber measurements. The second is mostly applied when pCO_2 is calculated from DIC/Alkalinity, pH and T. However, here it can be used to estimate kH.

Ln. 200: "... blow $\pm$ 3

Ln. 195-208: Good method. Did you ever apply chambers until equilibrium was reached? It would be interesting to see if results match.

Results

Ln. 218-219: Please add the year.

Ln. 229: The last part of the sentence is interpretation and belongs to the discussion section.

Ln. 244: This is new. You did not mention with in the MaterialMethods section! I thought you determined k600 by rearranging equation (2)? This belongs to the MaterialMethods section.

Ln. 245: Computed? From what? Chamber measurements? I guess with model results you refer to model 5 by Raymond et al. (2012).

Ln. 246: This belongs to the discussion, not results.

Ln. 249-251: This sentence is not understandable. Please rephrase. Be more precise: did you apply a statistical approach to determine relationships?

Ln. 251-255: This belongs to the discussion, not results.

Ln. 279: Statistically significant? Otherwise don't use "significant".

Discussion

Ln. 294: This is a poor beginning. Better describe the key result in a larger context "This study shows/demonstrates..." to create a red line for the forthcoming discussion.

Ln. 295: Be aware that not all the riverine CO_2 is derived from land. Your statement is not correct.

Ln. 310-312: Please revise this sentence.

Ln.314: Replace "not easy".

Ln. 325-326: This sentence is vague and insignificant. Rephrase with details.

Ln. 326: Use past-tense.

Ln. 327-229: Rephrase sentence to increase readability.

Ln. 335: "highlights"

Ln. 341-344: Rephrase this sentence.

Ln. 346-...: Use past-tense.

Ln. 355: Sufficient for what?

Ln. 366: "Analyses"

Ln. 367-368: The relationship between pCO_2 and pH is well known. This sentence is not correct, as the pH (and T) determines the species of inorganic carbon in water.

Ln. 375-381: What makes you think that groundwater input is higher in grassland regions? If you give a statement like this, you need references. Groundwater samples are not sufficient evidence for this statement, as groundwater pCO_2 typically are higher than stream pCO_2.

Ln. 384: see comment Ln. 294:

Ln. 401-403: There are several other potential reasons. How about pH changes (higher pH means less carbon in the form of CO_2)(Stets et al. 2017)? And how about decreasing proportion of groundwater distribution with increasing stream/river size (Marx et al. 2017)?

Ln. 411: "Easily neglected"?

Conclusions

Ln. 445: Revise sentence. Verb missing?

Ln. 451: Is this flux for the study area or the whole Yellow River?

Ln. 452: What is the number in Ran et al.? Is the number for the whole Yellow River?

Table

Add the year somewhere. The table has to be understandable for itself. Revise subscripts and superscripts, as there are many mistakes.

Figure

Figure 1: Good!

Figure 2: (a) Are these mean values for all your data? Add a small paragraph in the MaterialMethods section where you explain your values? Use same names in the Figure title than for the axes labels. Add reference for modeled k600 (Raymond?). (b)

Which k600 did you display here? Measured or modeled ones? Please clearify. The last sentect in your Figure title should be explained in the MaterialMethods section.

Figure 3: Add the dimension for fluxes. What for is the box (red, green) under the legend? Delete? Figure 4: Write "Figure" with a capital letter at the beginning. Add the year in the Figure title.

Figure 5 and 6: Be consistent with brackets: Dimensions either inside or outside brackets.

Figure 7: (d) the a-axis label is not correct.

References

Hartmann, J., R. Lauerwald, and N. Moosdorf (2014), A brief overview of the Global River Chemistry database, GLORICH, Proc. Earth Planet. Sci.,10, 23–27.

Marx, A., J. Dusek, J. Jankovec, M. Sanda, T. Vogel, R. van Geldern, J. Hartmann, and J. A. C. Barth (2017), A review of CO2 and associated carbon dynamics in headwater streams: A global perspective, Rev. Geophys., 55, doi:10.1002/2016RG000547.

Lauerwald, R., G. G. Laruelle, J. Hartmann, P. Ciais, and P. A. G. Regnier (2015), Spatial patterns in CO2 evasion from the global river network, Global Biogeochem. Cycles, 29, 534–554, doi:10.1002/2014GB004941.

Raymond, P. A., et al. (2013), Global carbon dioxide emissions from inland waters, Nature, 503(7476), 355–359.

Sawakuchi, H. O., et al. (2017), Carbon dioxide emissions along the lower Amazon River, Front. Mar. Sci., 4(76).

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Striegl (2017), Carbonate buffering and metabolic controls on carbon dioxide in rivers,

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