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## ***Interactive comment on “Spatial and temporal dynamics of CO<sub>2</sub> partial pressure in the Yellow River, China” by L. Ran et al.***

### **Anonymous Referee #1**

Received and published: 20 November 2014

The manuscript of Ran et al. analyzes the spatial and temporal dynamics of pH, alkalinity and calculated pCO<sub>2</sub> data in the Yellow River catchment (China). In order to explain the found dynamics, they use information about geology, soil characteristics and past anthropogenic activities. The found results underline the high spatial and temporal variability of the investigated variables. Furthermore, they found an interesting correlation between pCO<sub>2</sub> and total suspended solids (TSS) with a threshold of 100 kg m<sup>-3</sup>. It's a nice study and an interesting approach to consider the whole catchment instead of just the main stem of a river. The setup is mostly well thought and most of the needed analyses are done. Furthermore, I like how the influence of dams on TSS, pH, total alkalinity (TALK) and pCO<sub>2</sub> is presented. The strength of the long-term data set is striking. These findings would make a good contribution to the literature and the subject matter is thus, of interest to a broad sweep of Biogeosciences readers. However, the

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discussion is a mixture of results and discussion (it includes 4 additional figures which are not mentioned in the results). I would suggest transferring all results integrated in the discussion into the results part, so the discussion gets less comprehensive and the manuscript would profit from a clearer red line. Moreover, the discussion is too wordy and should be written in a more rigorous manner. Furthermore, a comparison of the measured values to other river systems would be helpful. The conclusions consist mainly of a summary. In general the conclusions are too weak and ambiguous, some parts of the discussion should be added there (see specific comments). Finally, the manuscript should be thorough restructured. Below you will find some more specific comments which should be solved before publishing:

Specific comments:

The title does not reflect completely the story and is only partly succinct. There is also a strong focus at the end of the discussion on TSS and man-made influences/human impacts. Also the story should be glued better together in respect of pCO<sub>2</sub>, TSS and human impacts. A clear take home message should be elaborated. Furthermore, the use of the expressions total suspended solids (TSS) and total dissolved solids (TDS) should be clear and constant throughout the entire manuscript. Moreover the acronyms TSS/TDS and TAlk should be written out in full in every chapter.

Abstract:

Line 9/10: “This indicates a strong CO<sub>2</sub> outgassing across the water-air interface.” Since this was not measured in this study and is somehow redundant to the last sentence of the abstract, this sentence should get removed.

Introduction:

In general the statements should be better underlined by references and I am missing a paragraph about the applied method in the manuscript. Furthermore, the background of TSS/TDS could be explained much more in detail. What are the consequences

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already know from such a high load (four times more than worldwide average)?

Page 14065, first sentence: Please add a reference to that statement

Page 14065, line 9: Since the manuscript is not dealing with sedimentation I would remove this remark; the references should be reordered according to the year of publication

Page 14065, line 11: Please add a reference to that statement and write CO<sub>2</sub> out in full

Page 14065, line 13: References should be reordered according to the year of publication

Page 14065, line 18: This is a really ambiguous sentence, please rewrite and add a reference

Page 14065, line 19: It's ambiguous what refers to "its", please rewrite

Page 14066, line 1: I do not understand the connection between strong turbulence and rapid mixing and turbulence and the biogeochemically activity. According to your arguments there is a stronger exchange with the atmosphere (because of a higher piston velocity), which is a physical process but not higher biogeochemically activity. Please specify.

Page 14066, line 14: Please specify what you mean exactly with "hillslope ecosystem respiration"

Page 14066, line 16: If there are few studies like that, please cite them and make sure that they not overlap with yours.

Page 14066, line 20: Please add some explanations why this study is relevant and innovative and how it will contribute to the existing knowledge gap.

Materials and methods:

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Page 14067, line 7: Ambiguous sentence. To which year refers the value of 49 km<sup>3</sup> yr<sup>-1</sup>?

Page 14067, line 9-19: Nice informative paragraph

Page 14068, line 1: Please specify the major ions

Page 14068, line 5+6: Please indicate the methods used to measure pH, discharge and TSS

Page 14068, line 7-12: The timing of investigation is crucial (due to diurnal changes of pH). Were the water samples for pH taken in a similar time period? Please specify

Page 14069, line 14: Also here: Were the water samples for pH taken in a similar time period? Please specify

Page 14070, line 5ff: Specify why this program was chosen and which pH scale was chosen

Page 14070, 11+12: Please specify K1 and K1 (like done for KCO<sub>2</sub>) Chapter 2.4: The way the methods are presented is nearly identical to the method section of Li et al. 2012. Please try to present them in a more different way.

Results: In general, the results should be accompanied by statistical tests wherever possible. This would increase the quality of the manuscript significantly.

Page 14071, line 23: Please provide an exact number including standard deviation (avoid “about”)

Page 14071, line 25: “but in the reverse direction with high TALK coinciding with low pH” is not very clear for me. Please provide a correlation figure of these two variables in the supplement material and discuss this finding in more detail

Page 14072, line 4-5: Can you please provide the p value for this non-significance? Which statistical test has been applied?

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Page 14072, line 26/27: “The seasonal ratio of pCO<sub>2</sub>, defined as the ratio of pCO<sub>2</sub> in the dry season over that in the wet season, ranged from 0.8 to 2.3 with > 55% ratios between 0.9 and 1.5.” What is the knowledge gain of this ratio?

Page 14073, line 4-8: Please provide standard deviation to the mean

Discussion:

The discussion could be strengthened and more focused on the main outputs. In general, bring one paragraph at the beginning about your main findings and the connection of those. Furthermore, try to bring your study in a bigger context, e.g. by answering questions like: how relevant is the high alkalinity in respect of rivers globally? Or is this phenomenon more catchment specific? How many similar rivers are existing and how is there the TSS transport? How representative is the Yellow River catchment?

Page 14074, line 11-15: This paragraph should be reversed: highlight first your finding and discuss it afterwards with existing literature, not the other way around. Please consider this comment throughout the entire discussion.

Page 14074, line 22-27+page 14075, line 1+2: Paragraphs which do not discuss results should be avoided, consequently this paragraph should be removed

Page 14075, line 16+17: This is a major finding and should be presented already in the results

Page 14075, line 18+19: This exponential trend cannot be seen in figure 6 (there it is a linear trend). Please clarify this statement.

Page 14075+14076: Nice explanation of the TSS vs. pCO<sub>2</sub> relationship including the threshold of 100 kg m<sup>-3</sup>

Page 14076: In line 6 you talk about low pCO<sub>2</sub> caused by low TAlk and high pH, in line 25 you talk about high pCO<sub>2</sub> resulted by high TAlk. You stated that you used HCO<sub>3</sub><sup>-</sup> as proxy for TAlk (chapter 2.4). If you consider the classic DIC species vs. pH graph

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(Fig. 1; source: Wetzel, R.G. 2001. Limnology. Lake and River Ecosystems. Third Ed. Academic Press, San Diego. xvi, 1006 pp. ISBN 0-12-744760-1.): How can you explain your findings? Please discuss this aspect in more detail.

Page 14076, line 29: This sentence is scientifically not relevant, please remove

Page 14077, line 10-12: This finding should be presented already in the result part

Page 14077, line 13: Do you have evidences for that? Please underline this statement with data if possible

Page 14077, line 22-26: Please avoid paragraphs where you do not discuss your results directly

Page 14078, line 16-18: I am not convinced from this argumentation and I doubt that the indicated references support the made statement sufficiently. Why it cannot be the other way around? Extended residence time combined with sufficient organic carbon availability may lead to a higher pCO<sub>2</sub>. Please revise, precise and extend this argumentation.

Page 14078, line 18: Please avoid starting sentences beginning with “Figure X presents. . .”

Page 14079, line 17-23: This conclusion paragraph should be moved to the conclusions part

Page 14079, line 27+28: This sentence is too ambiguous and not correct like that. Please specify or remove

Page 14080, line 2-11: If you discuss CO<sub>2</sub> outgassing you must consider the piston velocity (k). Beside the pCO<sub>2</sub> value this is a crucial factor and must be taken into account here.

Page 14080, line 17-26: May put a shortened and concise version of this paragraph in the conclusions

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## Conclusions:

The conclusion consists mainly of a summary. In general the conclusions are too weak and ambiguous. The conclusion would profit from a shortened summary of the highlights and the addition of the concluding parts of the discussion (see my comments above).

## Figures:

Fig. 2: Add in the figure legend the division of the 7 sub-basins and indicate the acronyms

Fig. 3a: This is not the optimal way to present the data. May show it better as a boxplot or a bar figure (including SD); I do not understand what "Raw sampling data were added to the left." exactly means, please specify

Fig. 4: Only one legend and x-axis needed, please revise

Fig. 5: Please standardize the layout of the 3 subfigures and indicate the p value of the regression

Fig. 6: Please indicate the meaning of the two different trend lines in the figure text. Bring data from other studies into this figure. It would be awesome to see still a correlation.

Fig. 8: Indicate the acronyms

## References:

The references in the text are not arranged properly (not chronologically in respect to the year). Additionally: Wu et al., 2008 and Lewis and Wallace, 1998 are cited in the text but do not appear in the references. Furthermore, Hu et al., 1982 is in the references but not mentioned elsewhere. Please revise the references carefully.

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Interactive comment on Biogeosciences Discuss., 11, 14063, 2014.

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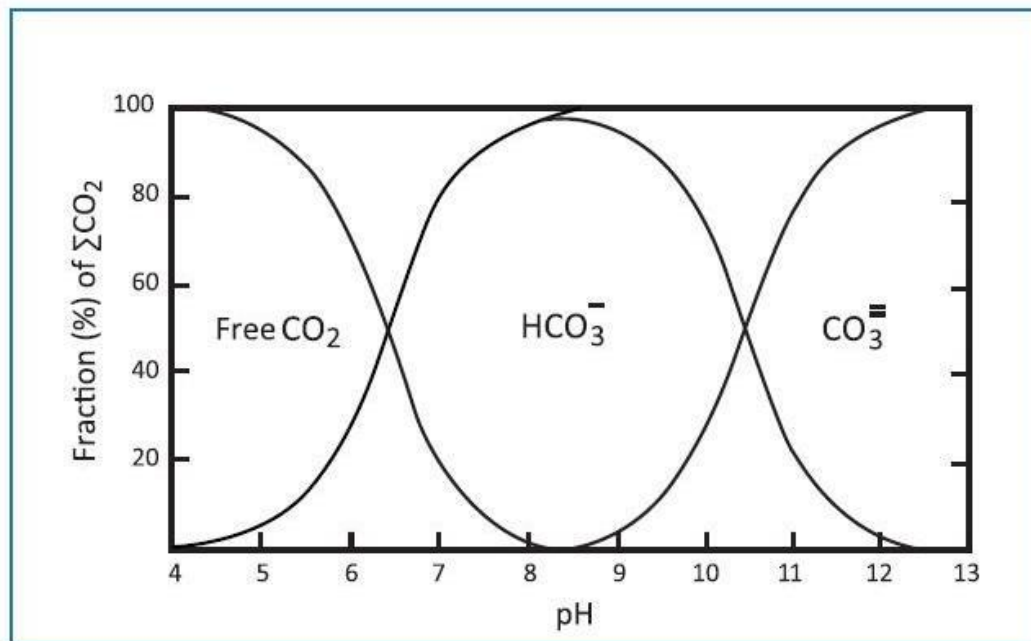
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**Fig. 1.** DIC species vs. pH graph

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