Reply to reviewer comments on "Temporary and net sinks of atmospheric CO_2 due to chemical weathering in subtropical catchment with mixing carbonate and silicate lithology" (bg-2019-310)

Dear Editor and Reviewers,

Thank you very much for your letter and for the reviewers' comments concerning our manuscript entitled "Temporary and net sinks of atmospheric CO_2 due to chemical weathering in subtropical catchment with mixing carbonate and silicate lithology" (bg-2019-310). Those comments are all valuable and very helpful for revising and improving our manuscript, as well as the important guiding significance to our researches. We have checked the manuscript and revised it according to the comments very carefully. All the changes have been indicated in an annotated version of the revised manuscript (submission item "Revision, changes marked"). The item-by-item responses to the reviewer comments are followed. Thank you very much for all your help, and we are looking forward to hearing from you.

Please find the following response to the comments of referees:

Responses to Reviewer #1:

Question 1: * alkalinity, DIC and [HCO_3^-]

I understood the calculation method of alkalinity, DIC and [HCO_3^-] and that these values are similar at pH 7.5–8.5 in this river. However, this explanation is only shown in the response letter. I think concurrent use of these three parameters without special meanings or explanations in the manuscript

makes readers confused. For example, equation (26) can be simply described as $[HCO_3^-]_{CCW}=\alpha_{CCW}\times[HCO_3^-]_{riv}$.

Answer 1: Thank you very much for your suggestion. The explanation of DIC and $[HCO_3^-]$ has been added in the revised manuscript (Lines 189-192). The equations (27), (28) and (29) have been corrected as followed, and the corresponding modifications can be seen in Lines 220-222.

$$[HCO_3^-]_{CCW} = \alpha_{CCW} \times [HCO_3^-]_{riv} \quad (27)$$

$$[HCO_3^-]_{SCW} = \alpha_{SCW} \times [HCO_3^-]_{riv} \quad (28)$$

$$[HCO_3^-]_{CSW} = \alpha_{CSW} \times [HCO_3^-]_{riv} \quad (29)$$

Question 2: * analytical errors

Thank you for showing the analytical errors of each ion (5%). I think these errors can propagate to the following calculations such as CCW or CCR. In the current manuscript, significant digits of these parameters (as well as ions in Table 1) seem to be too large.

Answer 2: Thank you very much for your suggestion. The analytical error of 5% for each ions is an acceptable criterion for major ion analysis. In our lab, the analytical errors are less than 5% and is well controlled within 1%. So the uncertainties of chemical weathering rates introduced by propagation of error is small in the study. In addition, few studies discussed the uncertainties of chemical weathering rates. For example, in the work by (Gaillardet et al., 1999), no discussion on uncertainties. Also in recent works such as (Zeng et al., 2017), (Li et al., 2019) (Wang et al., 2016) and so on.

The significant digits of parameters in Table 1, Table 3 and other part of this manuscript have been reduced. The modified parts have been labelled by red in the manuscript.

Question 3: L. 35-37

In the first, second, third, and fourth paragraph in the introduction section, the authors describes the mechanisms of silicate/carbonate weathering, human impact on the chemical weathering, problems in the previous studies in various global rivers, and study area and objectives of this study, respectively. The lines 35-37 are about areas, and should be noted in the third or fourth paragraph.

Answer 3: Thank you very much for your suggestion. The sentence "About half of the global CO2 sequestration due to chemical weathering occurs in warm and high runoff regions (Ludwig et al., 1998), so called the hyperactive regions and hotspots (Meybeck et al., 2006)." has been moved to the front of fourth paragraph. The corresponding modifications can be seen in Lines 75-77.

Question 4: L. 139-140

The chemical compositions of the rain water should be noted in the result section.

Answer 4: Thank you very much for your suggestion. The chemical compositions of the rain water have been added in the result section. The corresponding modifications can be seen in Lines 307-311.

Question 5: L. 141

"expert for" reads as "except for".

Answer 5: Thank you very much. The "expert for" has been corrected as "except for". The corresponding modifications can be seen in Line 140.

Question 6: L. 151

"Fig. 11" reads as "Fig. 2". This figure about stoichiometric analysis is the second figure referred in the manuscript. Please also correct numbers of the following figures.

Answer 6: Thank you very much. "Fig. 11" has been corrected as "Fig. 2". The numbers of following figures have also been corrected. The corresponding modifications can be seen in Lines 153-154.

Question 7: L. 202/208

There are still two equations numbered as (23). Please correct numbers of the following equations.

Answer 7: Thank you very much. The numbers of equations have been corrected.

Question 8: L. 517-520

I think these lines and Fig. 12 added in this revision are very important to suggest human impact on the chemical weathering and net sink of CO_2. However, the relationship between $[SO_4^{2-}]_{riv}$ and net sink of CO_2 seems to be statistically insignificant. Furthermore, I have no idea why the authors use $[SO_4^{2-}]_{riv}$ in this figure. To check the human impact, I think $[SO_4^{2-}]_{scw}$ and $[SO_4^{2-}]_{ssw}$ should be compared.

Answer 8: Thank you very much. The correlations between CO_2 net sinks and $[SO_4^{2-}]_{SCW}$ or $[SO_4^{2-}]_{SSW}$ have been added in Fig, 12. The corresponding modifications can be seen in Line 523-527.

References:

Gaillardet, J., Dupré, B., Louvat, P., Allègre, C.J., 1999. Global silicate weathering and CO2 consumption rates deduced from the chemistry of large rivers. Chemical Geology, 159(1–4): 3-30.

Li, X. et al., 2019. Hydrochemistry and Dissolved Inorganic Carbon (DIC) Cycling in a Tropical Agricultural River, Mun River Basin, Northeast Thailand. International journal of environmental research and public health, 16(18): 3410.

Wang, L., Zhang, L., Cai, W.-J., Wang, B., Yu, Z., 2016. Consumption of atmospheric CO2 via chemical weathering in the Yellow River basin: The Qinghai–Tibet Plateau is the main contributor to the high dissolved inorganic carbon in the Yellow River. Chemical Geology, 430: 34-44.

Zeng, Q. et al., 2017. Carbonate weathering-related carbon sink fluxes under different land uses: A case study from the Shawan Simulation Test Site, Puding, Southwest China. Chemical Geology, 474: 58-71.