Biogeosciences Discuss.,
doi:10.5194/bg-2015-655-AC1, 2016

Interactive comment on "Source and flux of POC in a karstic area in the Changjiang River watershed: impacts of reservoirs and extreme drought" *by* Hongbing Ji et al.

Hongbing Ji et al.

hongbing_ji@163.com

Received and published: 13 April 2016

Comment 1: One objective of the paper is to study the impact of dams on the organic matter carried or settled in the Wujiang. However, it is not easy to identify how dams affect sampling parameters. Fig. 4 is important but not easy to read. I suggest a diagram comparing the quantitative variations of studied parameters along the river course (as a function of distance) for the two studied periods with the position of dams marked. The points that are considered as directly affected by reservoirs could be clearly identified on Figs. 4, 8, not only in Table 2. It might be more realistic to distinguish points that directly affected by reservoirs and those less affected, rather than "affected" and"unaffected" points. All points are probably more or less affected by the cascade of reservoirs. Response: Thank you for your valuable comment. According to the suggestion, we tried to make a diagram with quantitative variations of studied parameters along the river course (as a function of distance). However, this diagram was not easy to read because there were many dams and sampling sites. Moreover, some sites were too close to present them clearly. In the Fig. 4, the dams were marked in order to make it easy to read. According to the comment, we have modified the description of sampling sites as "directly affected by reservoirs" and "less affected by reservoirs".

Comment 2: The authors used combined DIC δ13C, C/N and δ15N results to identify the source of organic matter. âŚă As shown by the diagram of Fig. 5, there are more than two possible sources. It is thus not clear how the authors made simple quantitative mixing models between phytoplankton and C3 plants, and between C3 and C4 plants on the basis of δ13C alone (results shown on Fig. 6). Most δ13C in Fig. 5 are consistent with a dominant C3 plant source (after given into account the variability of the C3 plant source). The most enriched points most possibly reflect C4 soil plant input and the most depleted one phytoplankton input. It is however not possible to make quantitative estimations (on the basis of δ13C alone) as three possible sources are mixed. Response: Thank you for your valuable comment. In the present study, the linear relationship of TN and POC was relatively weak compared with other studies (see details in answer to comment 4). This could limit the usefulness of C/N ratios as a tracer of particulate organic matter source. The δ13C of POC in the suspend matters in August averaged -27.23$\pm$2.93‰ indicating that the terrestrial source was a major source of POC. While the corresponding C/N averaged 8.84$\pm$3.73, indicating that phytoplankton was a dominant source of POC. The lack of power to resolve the source of organic matter using C/N ratios was also noticed in other studies (Sarma et al., 2012; Middelburg and Herman 2007). Thus, we use δ13C to calculate the contribution of different sources of organic matter. Soil organic matter (including litterfall) is eventually a mixture of residues from the overlying vegetation, which is composed of C3 and C4 plants. Thus, the δ13C values of soil organic matter can be used to reflect the terrestrial sources of POC. In the present study, the contribution of C3 plants and C3 plant-dominated soil together represented the C3 source; C4 plants and C4 plant-dominated soil together represented the C4 source. According to the source criteria developed from the δ13C, we think that the contribution of phytoplankton, C3 and C4 source can be distinguished. Middelburg, J.J., Herman, P.M.J.: Organic matter processing in tidal estuaries, Mar. Chem. 106:127–147, 2007.

âŚą The identification of the phytoplankton end-member in the text is confusing. It is stated that it can be measured on the basis of dissolved DIC δ13C and fractionation factor of -21%(page 6, lines 10-11). A calculated range (?) of -32.6 to -24.4‰ was given although not DIC δ13C have been given. They could be supplied as supplementary material if available. It is also stated that phytoplankton δ13C is lower than -30‰ (page 6, line 5), then that it has a typical range between -42 and -24‰ (page 6 line 13). Response: Thank you for your valuable comment. Measured δ13C-DIC in the Wujiang River ranged from -11.55‰ to -3.41‰ with an average value of -8.67‰These data is included in another paper, which is under review. Thus, we do not show them in Table 1. Based on the range of δ13C-DIC and fractionation factor of -21%, the estimated δ13C values for phytoplankton (-32.6‰ $\sim$ -24.4‰ can be obtained. In order to make it uniform, the typical δ13C range of phytoplankton from Mook and Tan (1991) was corrected as Kendall et al. (2001) and references therein based on the study by Li (2009) on δ13C of phytoplankton (-29.5$\pm$5.5‰ in Maotiao River (a tributary of Wujiang River).

âŚćAn average δ13C of -13.4‰ is given for C4 plants in the catchment from Tao et al. (2009) (page 6, line 24), but the sigma value (with reference) is not given. The exact values and references (published in English) for the average and sigma values of C3 fresh plant and soil end-members (shown in Fig. 5) were not given. Note that the average δ13C values for C3 plants (ca. -28‰ from Fig. 5) seem a bit more depleted than expected. If measurements exist for the main C3 plants in the catchment are available, they could be added as supplementary material. Response: Thank you for your valuable comment. The δ13C of different endmembers were taken from other studies in the Wujiang River (Tao et al., 2009 and references therein; Li 2009; Wu et al., 2007). Unfortunately, we did not collect the different endmembers of organic matter in the Wujiang River. Thus, the related data were not shown in supplementary material. The δ13C of different endmembers (mean $\pm$ standard deviation) were added in Fig. 4 (new edition).

âŚč Fig. 5 clearly shows a set of points with high C/N, suggesting an important contribution of fresh terrestrial plant material, essentially from C3 plants. This point is not discussed. Response: Thank you for your valuable comment. As shown by the contribution of different organic matter, POC in the Wujiang River was mainly derived from the terrestrial source. Given the limitation of C/N in the studied basin (see details in answer to comment 4), it was difficult to distinguish the contribution of C3 plants from the C3 plant-dominated soil. In the present study, these two sources represented C3 source.

Comment 3: The discussion on sediments δ13C is not easy to read. As shown by the authors (Fig 5, 8 and page 7 lines 10-19), the sediments are enriched in 13C (relative to suspended sediments). The authors proposed that there is a relative increase in C4 plant debris in the sediment or preferential loss of light isotopes in the sediment (lines 13-4) and then later proposed a preferential biodegradation of the phytoplankton in the water column (lines 16-17). These three possible options are not discussed. The δ13C sediment/suspended sediment plot was introduced later (page 8, lines 14-15) and can be useful in that part of the discussion. Response: Thank you for your valuable comment. As mentioned in the comment, the enriched δ13C in the sediments might be attributed to three causes. Given that POC and TN contents were higher in most sediment samples than suspended sediments, we think that the biodegradation of the phytoplankton was not significant. Thus, the higher δ13C in the sediments was mainly due to the contribution of refractory allochthonous organic matter (i.e. C4 plants). The related discussion has been added in the corresponding section.

Comment 4: It is not clear why the positive relation between POC and TN (total nitrogen) suggested that a fraction of nitrogen is inorganic (page 5 line 24; page 7 line 5-6). One would expect indeed a positive relation between POC and particulate organic nitrogen, with the slope depending on organic C/N ratio. It could also be useful to specify the possible inorganic forms of nitrogen in sediments and suspended matter. δ15N is considered as a tracer of POC source throughout the text (see page 5, line 19 among others). It is actually a tracer of nitrogen source and by consequence of organic matter source. Response: Thank you for your constructive comment. Ratios of C/N have been used to distinguish sources of organic carbon in marine and coastal environments based on the assumption that all of the sedimentary TN exclusively reflects N bound to organic matter (Meyers, 1997). As mentioned in the comment, the slope of linear relationship between TN and POC content depend on organic C/N ratio and the intercept value could reflect the inorganic nitrogen. In the present study, the linear relationship of TN and POC was relatively weak (May: TN=0.07*POC+0.09, R2=0.54, P<0.001; August: TN=0.04*POC+0.23, R2=0.39, P<0.001) compared with other studies (R2=0.71 in Hu et al., 2006; R2=0.9 in Guerra et al., 2013). Thus we think that the inorganic nitrogen in the present study was relatively high in comparison with the above studies. The related discussion has been added in this part. The related reference: Meyers, P.A., 1997. Organic geochemical proxies of paleoceanographic, pleolimnologic, and paleoclimatic processes. Organic Geochemistry 27, 213-250

Comment 5: The discussion of δ15N is confusing (page 8, lines 1-10). âŚă To explain the variation in δ15N in suspended matter, the authors refer to dissolved nitrate δ15N (Fig. 8a). These data are however not given in Table 1. They used these data to assess that high δ15N of N in suspended sediments indicated manure and domestic sewage (page 8, lines 1-2), but then to confirm nitrogen input from phytoplankton (line 4-10). The importance of sewage organic matter / phytoplankton N derived from sewage-nitrate is not at all discussed. Response: Thank you for your valuable comment. The dual isotopes of dissolved nitrate are included in another paper which is under review. Thus, we do not show them in Table 1. The discussion about anthropogenic source

Printer-friendly version

Discussion paper

has been rewritten.

âŚą...... the good correlation between 15N in sediment and suspended matter (Fig. 8c) is not really discussed. Relative high δ15N values are observed in both the sediment and suspended sediment. This is not in agreement with previous assumptions made by the authors that high δ15N is essentially tied to the phytoplankton input and that phytoplankton is mainly decomposed in the water column. This might suggest an enriched source of "recalcitrant" N or an incorporation of phytoplankton-N in recalcitrant sediment nitrogen. Response: Thank you for your constructive comment. The discussion about the correlation of sediment and suspended matter has been rewritten in the corresponding section.

Comment 6: Figures (3, 9 and may be 7) and tables (1, 3, 5) might be supplied as supplementary materials. The information from table 2 can be given in the text. It is better to put the measurements for a given site on one given line in Table 1. For Fig. 6, see above point 2. Response: Thank you for your valuable advice. As suggested by the reviewer, Figure 3, table (1, 3, 5) were put in the supplementary materials. Considering that the Figure 7 and Figure 9 are meaningful for comparison with the world rivers, we put them in the paper. In order to make it easy to understand the comparison of parameters between dam-affected sites and less dam-affected sites, the information in Table 2 was shown as a table.

Comment 7: I suggest a revision of the paper by native English speaker. page 1, line 27 "characterized" instead of "charactered" ...... Page 4 line 8 and throughout the text "cascade of reservoirs" instead of "cascade reservoirs" Response: Thank you for careful work. We have accepted the suggestion and made corresponding corrections according to the comment.

Interactive comment on Biogeosciences Discuss., doi:10.5194/bg-2015-655, 2016.

Response to Comments from Referee #2

Comment 1: One objective of the paper is to study the impact of dams on the organic matter carried or settled in the Wujiang. However, it is not easy to identify how dams affect sampling parameters. Fig. 4 is important but not easy to read. I suggest a diagram comparing the quantitative variations of studied parameters along the river course (as a function of distance) for the two studied periods with the position of dams marked. The points that are considered as directly affected by reservoirs could be clearly identified on Figs. 4, 8, not only in Table 2. It might be more realistic to distinguish points that directly affected by reservoirs and those less affected, rather than "affected" and "unaffected" points. All points are probably more or less affected by the cascade of reservoirs.

Response: Thank you for your valuable comment. According to the suggestion, we tried to make a diagram with quantitative variations of studied parameters along the river course (as a function of distance). However, this diagram was not easy to read because there were many dams and sampling sites. Moreover, some sites were too close to present them clearly. In the Fig. 4, the dams were marked in order to make it easy to read. According to the comment, we have modified the description of sampling sites as "directly affected by reservoirs" and "less affected by reservoirs".

Comment 2: The authors used combined DIC $\delta^{13}C$, C/N and $\delta^{15}N$ results to identify the source of organic matter.

①As shown by the diagram of Fig. 5, there are more than two possible sources. It is thus not clear how the authors made simple quantitative mixing models between phytoplankton and C3 plants, and between C3 and C4 plants on the basis of $\delta^{13}C$ alone (results shown on Fig. 6). Most $\delta^{13}C$ in Fig. 5 are consistent with a dominant C3 plant source (after given into account the variability of the C3 plant source). The most enriched points most possibly reflect C4 soil plant input and the most depleted one phytoplankton input. It is however not possible to make quantitative estimations (on the basis of $\delta^{13}C$ alone) as three possible sources are mixed.

Response: Thank you for your valuable comment. In the present study, the linear relationship of

Fig. 1.

Printer-friendly version

Discussion paper