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Biogeosciences Discussions

Interactive comment on "Organic carbon transport and impacts of human activities in the Yellow River" *by* L. J. Zhang et al.

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Response to reviewer #1

We thank the reviewer for the thorough feedback to the manuscript. Below are the detailed responses to all comments and suggestions.

General comments:

(1) The English is unacceptable

<Answer> We will check the revised manuscript carefully and send it to a native speaker who also has a background in the field of carbon cycle research for language modification, avoiding grammatical and typographic errors.

(2) The discussion is mostly a lengthy listing of numbers and description of conditions rather than discussing own findings related to process and putting it in the global context. The discussion remains at the surface and simply describes well-known phenomena.

<Answer> We have thought about the main scientific issues of the paper carefully and, in the revision, discussed most of them in details, with focuses on the influences of natural and anthropogenic factors (such as global warming, evaporation, irrigation, pollution, reservoirs and the water and sediment regulation scheme) on organic carbon transport in the Yellow River. Furthermore, we have added a detailed discussion part about annual variations of organic carbon transport (section 4.3 in the revised manuscript).

(3) The abstract is too long, contains too many details and too little conclusions.

<Answer> In the revision, we simplified the abstract and presented our main conclusions: (a) "increases of DOC in the Loess Plateau were dominated by global warming while those in the other regions of the basin were caused by human influences such as agricultural irrigation and pollutions" and (b) "although reservoirs can be considered as a stable carbon sink in short periods, regulations on them have totally changed the relationship between rainfall and fluxes of water and sediments."

(4) At the end of the introduction the gaps in knowledge should be deïňĄned and then the major goals of the study should be identiïňĄed. This is missing. What are the major hypotheses/objectives?

<Answer> In the revision, we now underline the importance of studying rivers in the arid and semi-arid areas, and describe goals of the paper: (a) provide basic data of a larger river in a semi-aid region for the global carbon budget; (b) discuss the organic carbon transport features of such a river under tremendous human disturbance (reservoirs, the water and sediment regulation); and, (c) remind people to find a balance between survival, development and environmental protection.

(5) In the methods section the authors describe a very unusual method for determining labile organic carbon. The described calculation simply from chemical oxygen demand appears to be inappropriate.

<Answer> We accept the advice and delete this part in the revision.

(6) The "organic carbon transport" and the "impacts of human activities" are only connected by an "and". Is there a causal link? You may rephrase it to "Impact of human activities on organic carbon transport in the Yellow River"

<Answer> Thanks for your advice and we change it to "Impact of human activities on organic carbon transport in the Yellow River."

(7) P. 14270, l. 10: What is meant by "downward Lijin station was also taken into consideration"?

<Answer> We reconsider this issue. Organic carbon transport in the tidal zone may be altered by estuarine processes and does not necessarily reflect river transport features and are not linked closely to the main conclusions of this paper. Therefore, data from the tidal/estuarine zone will not be presented in the paper.

(8) P. 14270, l. 17-24: I am concerned about the use of the terms "natural discharge" and "actual discharge". It is not yet clear to me how this "natural discharge" is calculated. I understand that you add withdrawn water to the measured discharge, but what do you mean by "reservoir variation"? Moreover, this type of calculation can only be used ator downstream of a reservoir. Anyway, I ïňĄnd the used terms misleading. P. 14373, l. 7-12: I disagree with this line of reasoning. I understand that you calculate material transport (TSS and organic carbon) with your "natural discharge". That means you do not use the amount of water that is actually running down the river, but you calculate with a discharge that would be there, if there were no reservoirs and irrigation. Is that right? To my opinion, you can only calculate ïňĆuxes with the factual amount of water that is transported by the river.

<Answer> Reservoir regulation means that if reservoirs start to impound/release water, natural discharges will decrease/increase in the lower stream. Therefore, this part should be considered in the calculation of natural discharges if there are reservoirs in the basin. However, as you pointed out, fluxes can only be calculated with actual discharges and matter concentrations. We accept your advice and only actual discharges are used in the revised manuscript.

(9) P. 14374, l. 18: What is meant by "exogenous"?

<Answer> We change it to “terrestrial input.”

(10) P. 14374, l. 19: What is meant by "POC% increased signiïňĄcantly"? Do you mean statistically signiïňĄcant?

<Answer> This expression is probably not clear and not appropriate. We just meant POC content increased in the winter. Therefore, significantly should be deleted.

(11) P. 14375, l. 2: What is the difference between "periods during which reservoirs started to release water" and a WSR event?

<Answer> The difference is that during the water and sediment regulation (WSR) period, reservoirs not only release water but also eject sediments, but in the water release period, only water is released. This expression is probably not clear, and we have changed it to “if reservoirs upstream just released water, with not sediments.”

(12) P. 14375, l. 14-15: What are the drainage and desilting periods?

<Answer> The drainage periods is characterized by large amount of water discharged from the Xiaolangdi reservoir, and the desilting period is featured by the deposited matters in the reservoir were flowed out. In the revised manuscript, we have changed them to the water releasing period (period I) and the sediment releasing (period II), respectively.

(13) P. 14376, l. 5: The date must be wrong. I suppose, you mean 6 July, don’t you?

<Answer> Yes, it was wrong and we have changed it to 6 July. Sorry about this and thank you.

(14) P. 14376, l. 24: What is meant by "some ïňĆoods happened"? Were these periods of strong rainfall.

<Answer> Yes, strong rainfalls happened during these periods. We have changed the expressions to “due to heavy rainfalls before our sampling time” in the revised manuscript.

(15) P. 14377: These are only comparisons and descriptions of conditions. What are the conclusions/inferences? P. 14378, l. 11-14. How much is it? What is the reason for the difference? This is where the interesting part starts. Expand on this. And in the following three possible reasons are presented, but no discussion/justiïňĄcation is following. Is there a speciïňĄc reason that you compare to the Mississippi and Nivelle rivers? It looks arbitrary

<Answer> We have revised this section extensively with more discussion of why POC content is low in the Yellow River and made comparisons with other world rivers, especially the Tana River, another high turbidity river. The POC content was only about 0.7% along the Yellow River mainstream, much smaller than that of other rivers. Two reasons are responsible for this: (a) low POC content of the loess, which is the main source of POC in the Yellow River; (b) small autochthonous contributions due to high TSS concentrations. In addition, comparisons with the Mississippi and Nivelle rivers are inappropriate, and we now put more attention on the Tana River, another high turbidity river.

(16) P. 14378, l.27-29: Quite unfortunate discussion. You probably have a dominance of small sized particles (which contain the higher amount of POC) simply because of the loss of energy in the resrevoir. The river enters the reservoir, energy dissipates and ïňĆow reduces, hence, the energy is lost that is needed to hold large particles in suspension. As a consequence the large particles with low POC settle and the small

particles remain in the water column.

<Answer> We absolutely agree with this statement. We have rephrased the expressions to “POC% was very high in the reservoirs, even exceeded 20%, probably due to the settlement of large particles and TSS with small grain size contains higher amount of POC” in the revised manuscript.

(17)P. 14379, l. 1-2: A POC of 2% is not very high. Moreover, this is a circular argument ("POC% high: : :due to high organic material content")

<Answer> We meant that POC content in reach (I) is higher compared with other reaches, due to high soil organic matter content. We have changed the expression to “POC content in the reach (I) was the highest along the mainstream” in the revised manuscript. In addition, we changed this circular argument to “this was probably caused by high soil organic matter content.” Sorry about this and thank you.

(18) P. 14379, l. 21-23: Previously, you mentioned (and show in your ïňĄgures) much higher POC% contents. What is correct?

<Answer> Because the investigation of 2006 was carried out almost in the winter, impacts of rainfalls and human disturbances (irrigations return flow, high polluted tributaries input) were insignificant, the POC content denoted the actual feature of POC in the middle and lower reaches that POC here mainly originates from loess. Considering that we have already presented this before, here we don’t have to present it again. Therefore, we delete it in the revision.

(19) P. 14379+14380: "Several possible reasons: : :"; This is no discussion, just a listing of processes/reasons, not more.

<Answer> In the revision, we not only have given possible reasons but also discussed and supported them with evidences and references. For example, we have discussed impacts of irrigation return flow, pollution and high ratios of evaporation to precipitation on organic carbon transport.

(20) P. 14380, l. 7: What is meant by the "severe human disturbances"? In which way did they affect DOC transport?

<Answer> In the revision, we have discussed the impacts of irrigation return flow, pollutions and highly polluted tributaries input on organic carbon transport.

(21) P. 14380, l. 22-24: This is a poor correlation and in the ïňĄgure it looks more like a point cloud. How can you draw the conclusion on "dilution" from that?

<Answer> We accept the advice and delete it in the revision.

(22) P. 14380, l. 28: You mention the "end of the winter" and the "beginning of spring". As these seem to be periods which have some characteristic differences it needs to be very clear how they are deïňĄned and why they are deïňĄned like that.

<Answer> This expression is probably not clear, and we have changed it to "later winter" and "early spring." We define seasons according to rainfalls, discharges and local temperature variations. We present a figure (Fig. 8) in the revised manuscript to present rainfalls and discharges of each month.

(23) P. 14381, l.1-2: But what is the reason for the DOC increase? This should be the starting point of the discussion, not the end.

<Answer> DOC at the Huayuankou station increased during the water and sediment regulation period, probably due to high DOC water discharged from the upstream reservoir. We discussed variations of organic carbon in the annual level in a separate part (section 4.3 in the revised manuscript), focusing on the impacts of natural and human activities.

(24) Chapter 4.3 does not provide any information required for the purpose of the paper. It would be sufïňĄcient to mention the variation in the DOC/POC ratio in one or two sentences.

<Answer> In the revision, we have revised this part and redrawn the figure with data of

other rivers. In addition, we presented the ratios of DOC/POC in the upper stream, middle and lower reaches of the Yellow River as well as those in the reservoirs, underlining the complexity of organic carbon transport in the Yellow River.

(25) Chapter 4.4 also adds little to the story of this paper. Moreover, the method of deïňĄning "labile organic carbon" is rather doubtful. Also, the statement that "90 % of POC and 70 % of DOC cannot be degraded" lacks any rationale.

<Answer> We accepted the advice and deleted it.

(26) P. 14384, 1st paragraph: What does that mean in the global context? Are these numbers high or low? Why did you calculate them? Why did you compare to the Verde River? Where is that? It seems to be an arbitrary choice.

<Answer> We have rephrased this part as "POC trapped in the reservoirs, located in the reach (II), amounted to 0.0033Gt/a, which was about 8 times larger than the POC flux transported by the Yellow River and accounted for nearly 21% of organic carbon accumulated in world reservoirs . In addition, POC in the Yellow River is mainly the refractory natural humus and very hard to degrade. Therefore, POC deposited in the reservoirs in the middle reach of the Yellow River can be considered as a stable carbon sink in a short period." The Verde River, situated in the Arizona, is a low turbidity river. It is not appropriate to make a comparison between these two rivers here and we delete it.

(27) P. 14385, l. 15: What is meant by "a transformation from POC to DOC"?

<Answer> DOC correlated very well with POC (R2 = 0.7) in the sediment release period (period II), and POC during this period was higher than 100 mg/L (TSS>10000 mg/L). Therefore, we believe that DOC increase was due to the OC desorption from sediment.

(28) P. 14386, l.1-2: In which way? Now we need a discussion, else it is just pure speculation

<Answer> We have rephrased this part as "although the WSR scheme can reduce

channel aggradations, improve the flowing capacity (Xu et al., 2005) and increase the freshwater supply and eco-environmental qualities in the estuarine zone (Wang, 2005), its potentially negative impacts on the ecosystems in the middle and lower reaches, estuarine and coastal regions are enormous. May to July are the breeding seasons for the aquatic organisms in the Yellow River, the WSR scheme results in a more than 50% decrease in fish resources, and fish population diversities declined sharply during the 2011 WSR period (Zhu et al., 2012)." We added this information to our discussion. Wang, K. R.: Impact and evaluation of water and sediment regulation in the Yellow River on the estuary and its delta, Journal of Sediment Research, 6, 29-33, 2005. Xu, G. B., Zhang, J. L., and Lian, J. J.: Effect of water-sediment regulation of the Yellow River on the lower reach, Advance in water science, 16, 518-523, 2005. Zhu, G. Q., Zhao, R. L., Hu, Z. P., and Hou, X. L.: Impacts of water and sediment Diversion in Xiaolangdi Reservoir on fish and ecologically sensitive areas in the middle Yellow River, 33, 7-12, 2012.

(29) P. 14386, l. 13: This could be a nice conclusion of the paper. However, from the discussion as is this cannot be concluded

<Answer> We have revised the discussion part extensively, with focuses on influences of natural and anthropogenic factors (such as global warming, evaporation, irrigation, pollution, reservoirs and the water and sediment regulation scheme) on organic carbon transport in the Yellow River. We derived the conclusion that organic carbon transport in the Yellow River is mainly controlled by the human activities.

(30) The conclusion chapter is simply a summary and does not contain any conclusion.

<Answer> In the revision, we summarized the organic carbon transport features of the Yellow River and the impacts of natural and human activities and concluded that "Variations of DOC in the Loess Plateau were dominated by global warming while those in the other regions of the basin were controlled (or caused) by human interruptions such as agricultural irrigation and pollutions."

(31) Fig. 1: The map is too small, font size needs to be increased.

<Answer> We accept the advice and redraw the figure.

(32) Figs. 2+3: The X axis is hard to read. Just a few dates and too little ticks are given.

<Answer> We accept the advice and redraw the figure.

(33) Fig. 5: I don't see the necessity of this ïňĄgure.

<Answer> I think what you mean is Fig. 6. We delete it.

(34) Fig. 6: You should think about plotting the world rivers from Ludwig et al. (1996) to have a comparison, particularly as you mention that the Yellow River POC-TSS relation is different from Ludwig's.

<Answer> I think what you mean is Fig. 5. We accept the advice and redraw the figure.

(35) Fig. 8: What does it tell us? I see point clouds.

<Answer> We accept the advice and delete it in the revision.

(36) Fig. 9 can be deleted. It simply says that POC is dominant. That can be mentioned in one sentence in the text.

<Answer> We redraw this figure with data of world rivers. In addition, we also discuss the ratios of DOC/POC in the upper stream, middle and lower reaches of the Yellow River as well as those in the reservoirs, underlining the complexity of organic carbon transport in the Yellow River.

(37) Fig. 10: What is the use of it? It shows simple linear relationships. Moreover, as the f-COD and m-COD parameters are highly questionable, I wouldn't use it.

<Answer> We accept the advice and delete it.

Please also note the supplement to this comment:
http://www.biogeosciences-discuss.net/9/C7315/2013/bgd-9-C7315-2013-

supplement.pdf

Interactive comment on Biogeosciences Discuss., 9, 14365, 2012.

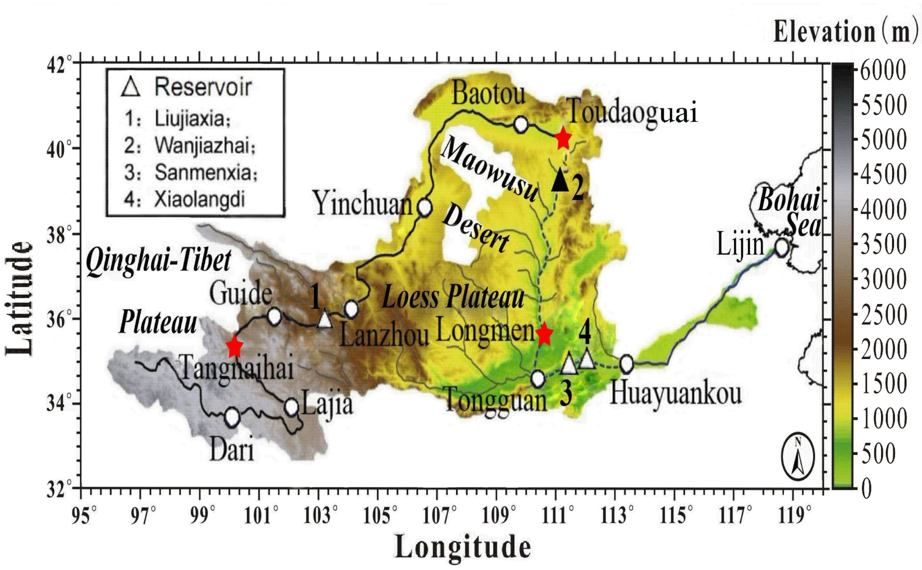

Fig. 1. Map of The Yellow River basin, which consists of two main geographical units, the Qinghai-Tibet Plateau and the Loess Plateau. Sampling stations are indicated by open symbols.

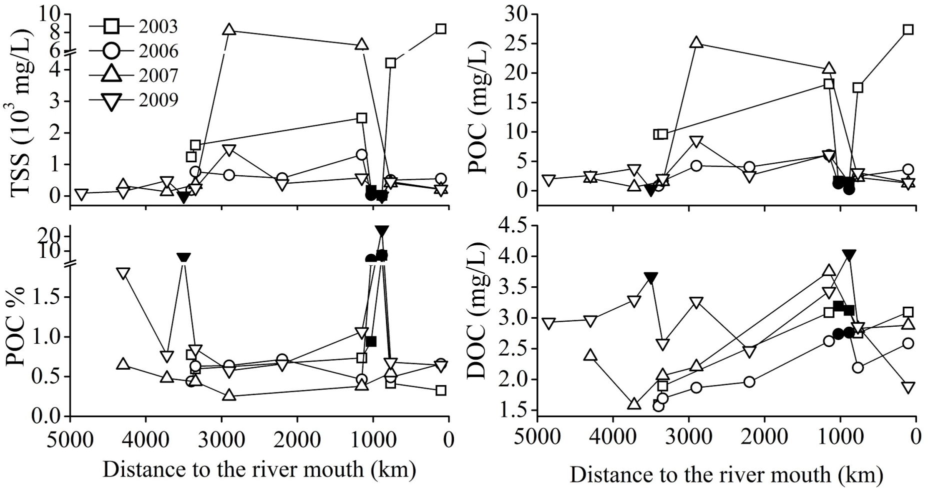

Fig. 2. Spatial and temporal variations of TSS, POC, DOC and POC% along the mainstream of the Yellow River (solid symbols represent the reservoirs of our investigation).

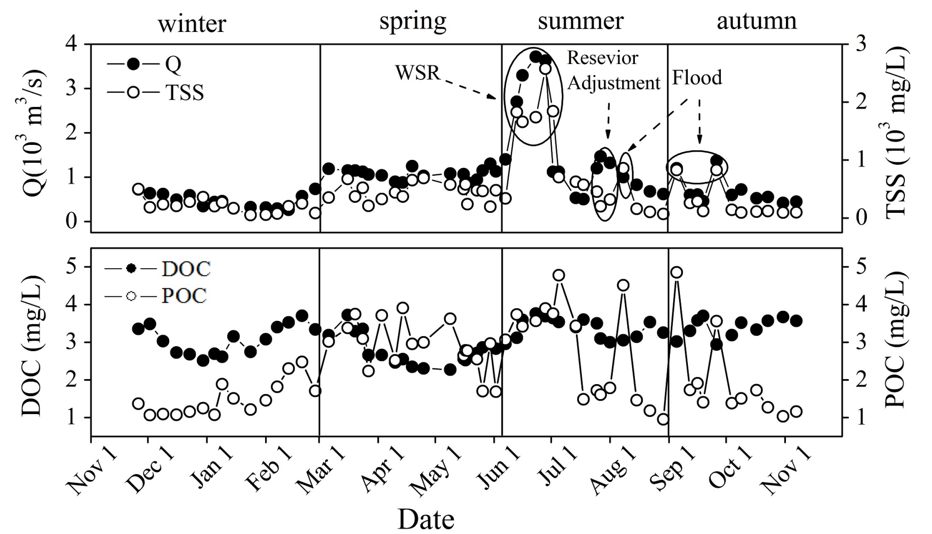

Fig. 3. Distributions of discharge (Q), TSS, POC and DOC at the Huayuankou hydrological station during November 2005 to November 2006.

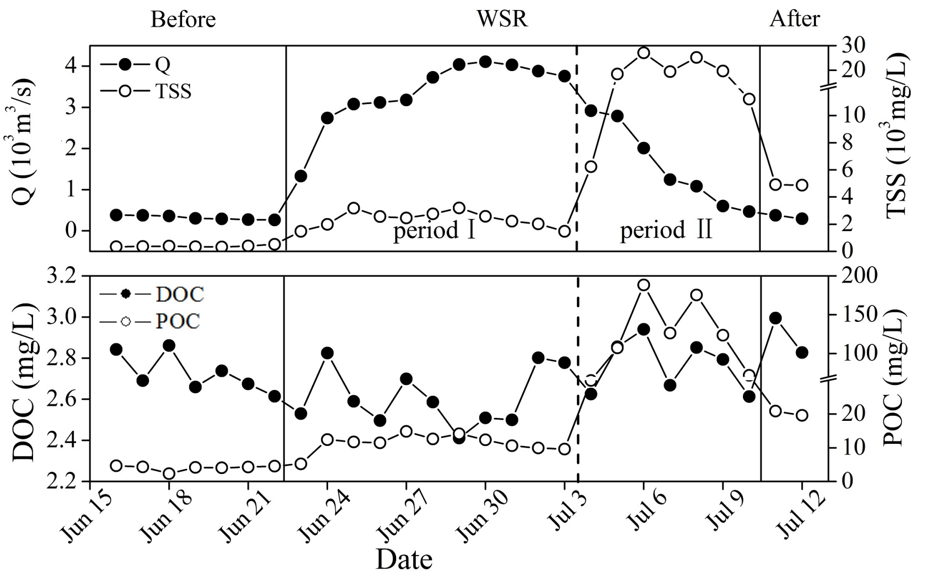

Fig. 4. Distributions of discharge (Q), TSS, POC and DOC during the 2008 water and sediment regulation (WSR) period at the Lijin station.

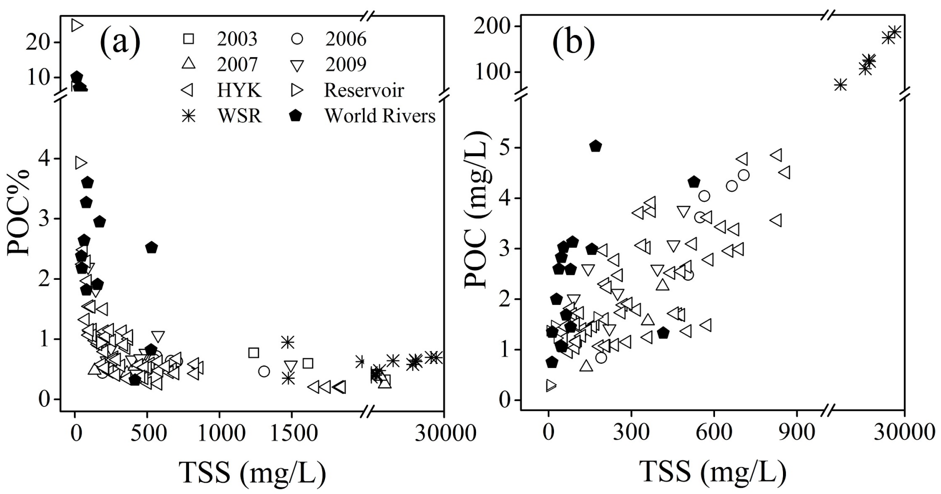

Fig. 5. Relationship between POC% and TSS (a), POC and TSS (b) of the Yellow River and world rivers

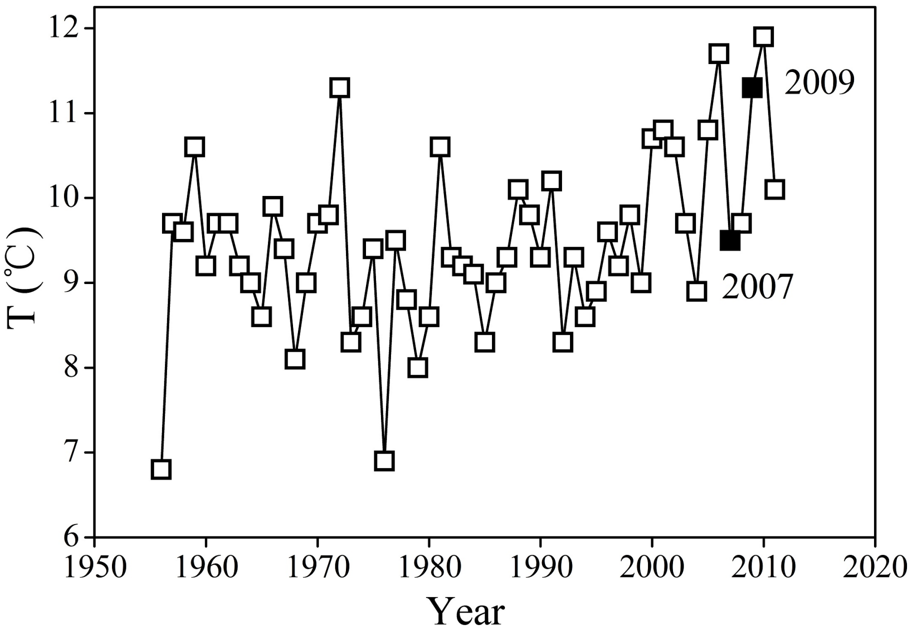

Fig. 6. Temperature variations of July at the Dari station in the Qinghai-Tibet Plateau (data quoted from http://cdc.cma.gov.cn)

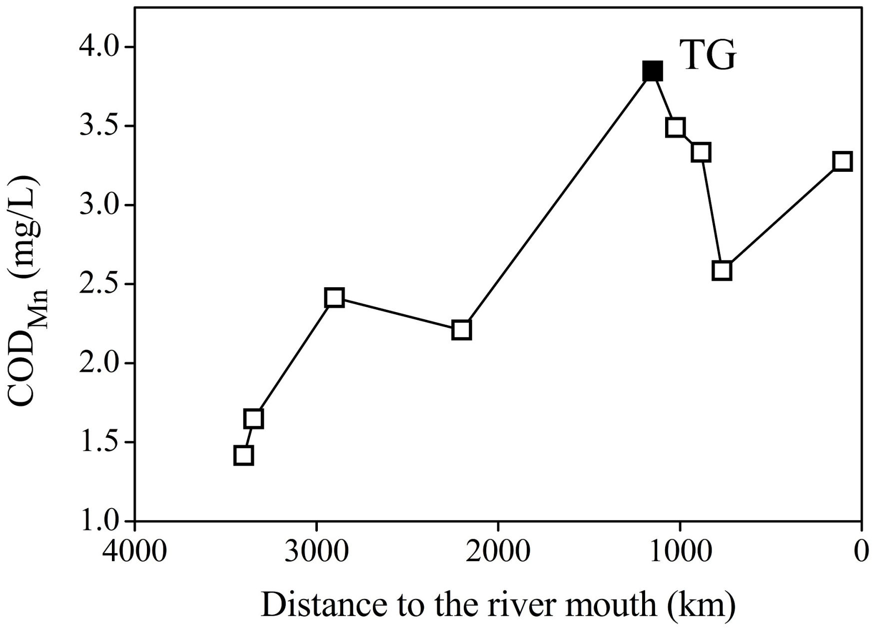

Fig. 7. Anthropogenic influences on the organic carbon in the Yellow River indicated by CODMn ,TG denotes the Tongguan station (data from the 2006 investigation).

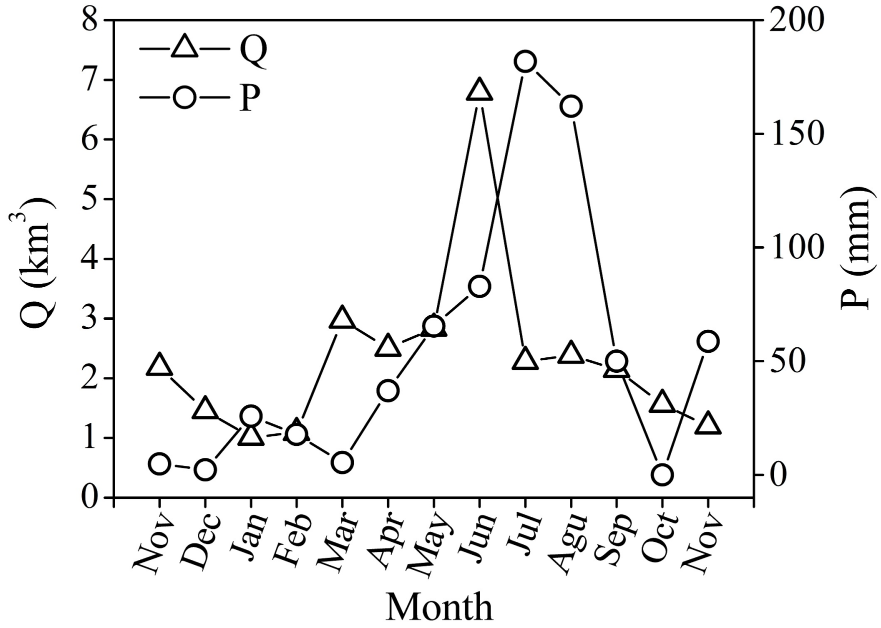

Fig. 8. Monthly precipitation (P) and discharges (Q) during the one-year observation (2005.11-2006.11) at the Huayuankou station

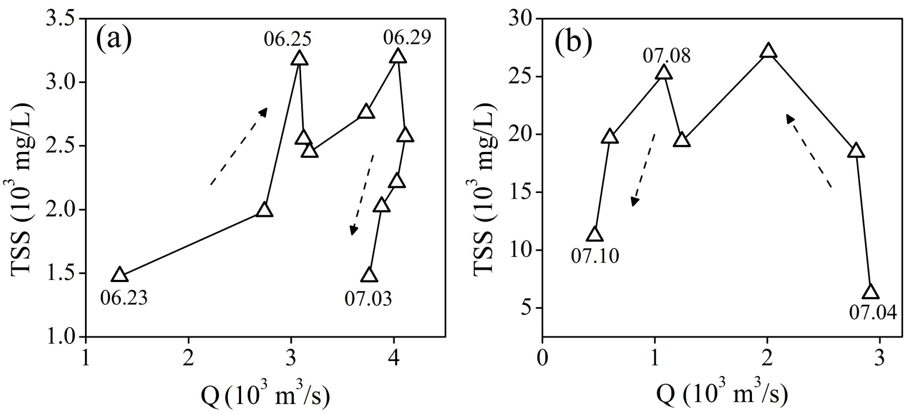

Fig. 9. Relationship between discharge (Q) and TSS during the 2008 water and sediment regulation (WSR) period at Lijin station.

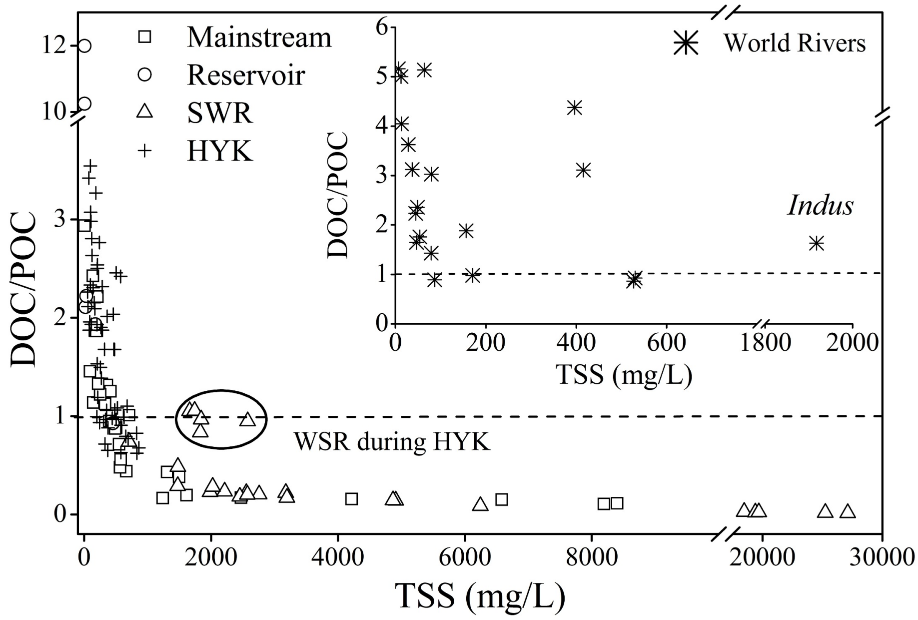

Fig. 10. Relationship between DOC/POC and TSS in the Yellow River and other world rivers.