Interactive comment on "Sources and accumulation of organic carbon in the Pearl River Estuary surface sediment as indicated by elemental, stable carbon isotopic, and carbohydrate compositions" by B. He et al.

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Response to Referee #3

Review summary for manuscript "Sources and accumulation of organic carbon in the Pearl River Estuary surface sediment as indicated by elemental, stable carbon isotopic, and carbohydrate compositions" by B. He et al. As the second largest river in China, the Pearl River discharges significant of terrestrial carbon to the northern South China Sea and plays important role affecting the carbon cycle and biogeochemical processes in the coastal region. In the past years, few papers have been published regarding the sources and burial of terrestrial carbon in the Pearl River estuarine and adjacent coastal sediments. In fact, none of these published studies have shown significant scientific interests. This study, to my knowledge, is the first study that combines elemental, stable carbon isotope and organic biomarker techniques to exam the problem in the region. In this regard, I would like to see this study to be published. After read the manuscript, however, I do have some concerns and suggestion to the authors and I think to see these questions to be clarified before its publication.

Response: We do appreciate the generally positive comments from the reviewer.

The following are some specific comments:
Comment: 1. When dealing with sedimentary geochemistry, some basic information need to be provided. Such as water depth, redox condition, sediment type (clay, silt or sandy), and sediment grain size, and so on. Without knowing the information, it will be difficult to compare chemical compositions among the study sampling sites, for example, between clay-rich sediment and sandy sediment, and oxic sediment and anoxic sediment.

Response: We have taken the suggestion and added the geochemistry information in Table 2 in the revised MS.

Comment: 2. When say surface sediment, what is the depth? 0-2 cm or 0-10cm? Are the sediments collected from the same depth at each station? This could make a big difference.

Response: Grab samplers were used to collect surface sediments in the higher deposition rate area (> 2 cm yr^{-1}). The sampling depth was ~0-10 cm, representing ~5 year's average sedimentation. Box samplers were used to collect sediment samples in the lower deposition rate area. Samples from top 3-5 cm, representing ~5 year's average sedimentation, were used as surface samples. We have added this information in the revised MS.

Comment: 3. Pearl River estuary is probably a heavily contaminated estuary since there are several high populated metropolitans connected to the low reach of the river. Studies have shown that significant fraction of sedimentary organic matter in the estuary was from anthropogenic input. If that's the case, I expect that using a two end member model to calculate the terrestrial organic carbon flux and burial in the estuarine and coastal sediments is probably too simple and risky.

Response: Although the upper reach of the estuary receives a significant amount of anthropogenic inputs. Our bulk $\delta^{13}C$ and C/N ratio of sediments showed that this portion of OM was not

preserved efficiently in the sediment (also see our responses to referee 1#). Moreover, we chose sediments collected from the freshwater part of the estuary as a riverine end-member. This riverine end-member contained both land-derived and anthropogenic sources. It may provide better representation of the bulk property of OM sourced from the upstream of the estuary. Furthermore, the modeled mixing curves overall agreed well with the observations although we used a simple two end-member mixing model (Fig. 6 in the revised MS). Note that two end-member mixing model of this kind has been successfully applied in many river dominated estuaries such as Amazon river estuary (Cai et al., 1988), the Gulf of Mexico (Hedges and Parker, 1976) and the margin off Washington (Prahl et al., 1994).

Comment: 4. For marine end member, why using central Pacific sediment? The phytoplankton produced in the northern South China Sea could have different C/N and stable carbon isotopic values than that in the central Pacific Ocean. It is better to measure the end member values collected from the northern South China Sea.

Response: We have taken the suggestion and used local net phytoplankton from the northern South China Sea as a marine end-member in the revised MS.

Comment: 5. I couldn't understand the Equation (3) on page 2903, and as a result, I couldn't understand how the Fig. 4 was generated. Is the mixing curve generated based on Equation (3)? Why the mixing line has to be curved in this case?

Response: Equation (3) is equivalent to the traditional two end-member mixing model based on $\delta^{13}C$ (δ). It is noted that the fraction of terrestrial organic matter (f_t) in this equation is based on nitrogen contents. Our mixing curve generated based on Equations (2) and (3) is as follows:

$$R = R_t f_t + (1 - f_t) R_m \quad (2)$$

$$\delta = (f_t R_t \delta_t + (1- f_t) R_m \delta_m) /R \quad (3)$$

Equation (2) was used to calculate the C/N ratio (R) of the mixture, and equation (3) was used to calculate the $\delta^{13}C$ (δ) of the mixture. The original Fig. 4 is the modeling results of δ vs R.
As shows in equation (3), δ and R are not in the linear relationship.

Comment: 6. Could some observed concentration and composition differences of carbohydrate among the stations affected by anthropogenic input?

Response: Sewage-derived POM seemed underwent extensive degradation in water column as well as in the sediment. Bulk $\delta^{13}C$ and C/N ratio as well as the carbohydrate composition did not show significant contribution of anthropogenic inputs to the sediment OM in the estuary. However, relatively high RHA was observed in the Pearl River Estuary, especially in the upper reach, suggesting significant bacterial activities, which may be well related to anthropogenic activities.

Comment: 7. The Pearl River and Amazon River are two different river systems in many ways. Simply comparing these two river systems doesn't make too much sense.

Response: We have taken the suggestion and deleted the sentence that may have misled.

Comment: 8. On page 2904, line 10. I don't agree with the statement" So carbohydrate compositions in the sediment are likely to be more dependent upon their source than on diagenetic status". These are no solid evidence to show this in this study.

Response: We accepted the reviewer's comment, and have deleted the statement.

Comment: 9. Finally, the flux calculation of terrestrial organic carbon to the sediments on page 2909 is good but is kind of weak. It is based on some uncertain assumptions and simplifications.

Response: We agreed that our TrOC flux calculation is subject to simplicity and uncertainties. However, we believe that such estimation provides useful information to help understanding terrestrial organic matter accumulation and cycling in estuarine and continental shelf.
The uncertainties associated with such calculations have been justified in the revised MS.

References:

Cai, D.L., Tan, F.C. and Edmond, J.M., 1988. Sources and transport of particulate organic carbon in the Amazon river and estuary. Estuarine Coastal and Shelf Science 26: 1-14.

Hedges, J.I. and Parker, P.L., 1976. Land-derived organic matter in surface sediments from the Gulf of Mexico. Geochimica et Cosmochimca Acta, 40: 1019-1029.

Prahl, F.G., Ertel, J.R., Goni, M.A., Sparrow, M.A. and Eversmeyer, B., 1994. Terrestrial organic carbon contributions to sediments on the Washington margin. Geochimica et Cosmochimica Acta, 58: 3035-3035.