Response to Anonymous Referee #1:

Dear Referee #1,

Thank you very much for your time involved in reviewing the manuscript and your constructive suggestions. To facilitate this discussion, we first retype your comments in **bold font** and then present our responses to the comments. An annotated version of the revised manuscripts is attached.

This manuscript incorporated a riverine dissolved organic carbon transport scheme to the land surface model CLM5.0 to evaluate the impacts of anthropogenic water regulation on riverine DOC discharges and transport. The paper is well written, presenting an interesting work in a clear and organized way. I have a few minor comments below.

Response: We appreciate your very encouraging comments on the merits, and hope that the response has fully addressed all your concerns.

1. **Equation (2): Please denote the unit of DOC leaching flux.**

Response: We will add the unit of DOC leaching flux (g C m^{-2} s^{-1}).

2. **Line 176: "Riverine DOC is mainly derived from organic carbon leaching processes in soil"; some literature support is required here.**

Response: We will add corresponding references as suggested.

3. **Line 189-190: where is the reference for choosing this weighting coefficient?**

Response: We chose this coefficient according to the previous studies (Liu et al., 2019; Zou et al., 2014), and we will add corresponding references at the same time.

4. **Section 3.1: I suggest adding a table to show the main datasets used for model running and validation in this study.**

Response: Thanks for your valuable suggestion. We will add a table to summarize the main datasets used in this study.

5. **Line 221: Please introduce the details for the human water use activity dataset. A description of what data sources were used?**

Response: Based on the comment, we will revise the manuscript. The human water use activity dataset was derived based on five datasets: the water use dataset from the Food and Agricultural Organization (FAO), a shape file data of national boundaries, the Global Map of Irrigation Areas, version 5 (GAMIP5; Siebert et al., 2013), the historical monthly soil moisture levels and saturated soil moisture levels(Zeng et al., 2017), and the FAO water information system for 2010, which contained the agricultural, industrial, and municipal water withdrawals.

6. **Line 205: Only the fluxes into the soil carbon pool after surface water extraction are described. What about groundwater extraction?**

Response: Because groundwater extraction usually occurs in situ and will pass through the filtering effect of the soil layer, we hypothesized the part of DOC that returned to soil with groundwater extraction was ignored in our parameterization scheme.

7. **In Section 2.1, the parameters mentioned in the developed soil and river carbon dynamics parameterization scheme are uniform or spatially varying?**

Response: The parameters mentioned in our developed schemes are uniform. In fact, it does not correspond to spatial heterogeneity, and we will further refine and modify the parameterization scheme in our future work. The current parameterization scheme has reasonable accuracy in the simulation results, so we believe that our model can be applied to global-scale riverine DOC transport simulation studies.

8. **Line 252: Figures 3a and 3c seem to underestimate. Please check carefully and modify.**

Response: Thank you so much for your careful check. We will modify it in our manuscript.

9. **Line 273: Are constants (0.3 and 0.7) in equations the same for the whole world?**

Response: Yes, we set the constant due to the limitation of data.

10. **This study developed a model to describe the soil carbon leaching and riverine carbon transport processes, which are not well described in previous land surface models. But the discussion of current uncertainties and limitations in modeling is missing. It should be discussed more.**

Response: Thank you for your advice. We will add some discussion of current uncertainties and limitations in our manuscript.

11. **Line 354-355: The authors state that the three rivers were affected by minor groundwater regulation. Please briefly explain the impact and the reasons.**

Response: In our selected rivers, only the Mississippi, Yangtze, and Ganges rivers were affected by minor groundwater regulation, which usually occurred during the dry period, where DOC export increased slightly in the Mississippi and Ganges rivers because of higher soil leaching due to irrigation, while DOC export decreased in the Yangtze River due to a significant reduction in river discharge. This also corresponds to the results in Section 4.3.

12. **In section 5, some words about future work are needed.**

Response: Thank you for your suggestion. We will add some discussion about future work in our manuscript.

Once again, thank you very much for your comments and suggestions.

Sincerely,

Yanbin You, Zhenghui Xie, Binghao Jia, et al.