

Major Comments:

In their manuscript, Gao et al. investigate the role of contemporary river fluxes for alleviating bias of the ocean biogeochemistry model, as well as the impacts of potential future changes in riverine fluxes for ocean biogeochemistry. The authors find improved model performance on the global continental shelf after introducing riverine fluxes, as well as counteracting effects of individual impacts of increased carbon and nutrients inputs to the ocean. As mentioned in the previous reviews, the material is new and the analysis was well performed, although the chosen setup is still clearly very limited. As one of the authors of one of the two rather critical reviews, I believe that the manuscript is now immensely improved in other aspects over the previous submitted version:

- The introduction is now a very nice review of state-of-art knowledge and implementations of riverine exports in the ocean (for which remain many uncertainties)
- The methods and results are better structured and clear to follow
- The interpretation and discussion of results are now more complete and clearer. In particular, a discussion on model limitations due to simplified relationships of riverine stoichiometries, degradation and shelf circulation are all now included. The authors included an well-thought back-of-the envelope calculation on the impacts of too low shelf mineralization rates on the change in primary productivity.

Overall, it was a very enjoyable read. I thus approve accepting the manuscript for publication and have only minor specific comments and edits.

Specific Comments:

L28 *“while in the more plausible riverine configurations the river inputs cause a net C source of $\sim 0.1 \pm 0.03$ Pg C yr⁻¹ „*. In my opinion, this is quite an interesting result being that the effect of increased riverine carbon is stronger than increased nutrient inputs for the future projections. For the historical perturbations, it is usually assumed the nutrients are the dominant component (e.g. as the authors mention in the Lacroix et al., 2021) because of the large relative change in the past. But this indeed might not hold for the future, and there is very little work on the impacts of changing riverine C fluxes. I however leave it to the authors whether they would like to perhaps underline this more strongly.

Edits

L14 *“So far, this contribution is represented in the state-of-the-art Earth system models with limited effort.”* Sounds a bit awkward.

L243 maybe formulate like this: *“...are aggregated within catchment basins defined by the NEWS 2 study for every river.”?*

L245 *“..up to...”*

L251-253 *“First, we calculate the riverine organic P-N-C ratios for both dissolved and particulate forms, then add the least abundant species (scaled by the Redfield ratio) to the DOM and DET pools, respectively. „* I understand what is meant, I wonder however if this could be formulated more clearly however.

L384 if -> when

L447 and no riverine C input -> no varying riverine C input

L487 *“Given that the riverine nutrient and carbon inputs account for only a small proportion of the total amount of nutrients and carbon in the euphotic zone of the ocean”* I assume this refers to “yearly inputs”, but the sentence also feels out of place and doesn’t relate to what comes next.