

Interactive comment on “Improved representation of river runoff in Estimating the Circulation and Climate of the Ocean Version 4 (ECCOV4) simulations: implementation, evaluation and impacts to coastal plume regions” by Yang Feng et al.

Anonymous Referee #1

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This is the review of “Improved representation of river runoff in Estimating the Circulation and Climate of the Ocean Version 4 (ECCOV4) simulations: implementation, evaluation and impacts to coastal plume regions” by Feng et al.

This paper proposes a new representation of global river runoff (i.e., real freshwater flux of daily, Point-source Runoff, DPR) in the ECCOV4 framework, which allows for a more realistic treatment of coastal plume dynamics and thus obtains better simu-

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lation of SSS and plume properties, compared to independent observations. Also, parallel experiments were conducted to evaluate the impacts of model grid resolution and grid type. Target diagrams were introduced to compare simulation results with SMAP observation systematically. It found that increasing model resolution from the coarse resolution LLC90 grid to the intermediate resolution LLC270 grid elevates the river plume and improves the SSS simulation, but the impacts of further increasing the resolution is subtle and regionally dependent, likely due to specific regional bathymetry and dynamic environments. Grid types seem not controlling the results.

Land-Ocean Interface is a weakly simulated component in most global-scale models. Not only because the estuaries and watersheds are usually not included, but also the spatiotemporal riverine freshwater (plumes) cannot be well resolved. This work is a significant improvement to the ECCO syntheses. Considering ECCO products world-widely used, an improvement in plume simulation will advance studies in diagnosing fate of land source pollutants (e.g. Microplastic); closing the carbon budget estimation gap and et al... I feel the proposed technology is significant and novel. The results, including the new representation of global river runoff, and the evaluations of the representation in different model setups (which are in very great detail), offer a benchmark for other global models. In fact, this representation seems very easy to be applied onto other models. This paper fits the GMD journal scope very well. The paper is well written, flows well from topic to topic, is clear and understandable. The figures are excellent. I would suggest Minor Revision to this version.

I hope the authors consider the following minor comments that I found need to be clarified or complemented.

L28: "Sea-Surface Salinity"-> "Sea Surface Salinity" L45: add a comma after "products"
L54: "Sea Surface Salinity"-> "Sea Surface Salinity (SSS)" L113:"locally isotropic"->
please make sure if they are really isotropic. L118: "The model has 50 vertical z-levels;
vertical resolution is 10 m in the...", the same for all the experiments that you run?
Please clarify. L121: GGL should be defined. L127: "ECCOv4 uses natural bound-

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ary conditions" -> "ECCOv4 uses natural boundary conditions for the river discharge"? L143: Please provide details for the " iso-neutral mixing" and "residual mean velocity". L149: What are the initial conditions and surface forcings for the ECCOv4 here? The optimized or initial fields? L182: "in at"->"at", "white boxes"->"black boxes" L198: Is this equation applied to each grid point, or to an area? L217: Eq. 7 is not correct. Reformulate it or delete it- it does not influence the analysis. L237, L243: Is the integration in the formulas bounded by specific S? L243: What is the effect of vertical resolution? L297: "grid resolution"->"river forcing"? L301: Figures 5? Figs. 4&5. Please add discussion on the reasons of the large bias over 1.5? Fig. S4: why the seasonal variations are different between R and C experiments? L377-383: please explain EOF2. L386: reference should not be italic. L389: NBC should be defined in advance. Fig. 8. Caption. "Same as Fig. 7", not. L438: "experiments ability"-> "experiments' ability"? L462, Fug11; what is "integrated freshwater transport"? Why does the transport of the 3 rivers show increasing trend over the 3 years ? Why no annual cycle for Amazon? Please explain. L484: 'stratification'-> 'stratification difference'? L591: VSF should be defined.

Interactive comment on Geosci. Model Dev. Discuss., <https://doi.org/10.5194/gmd-2020-321>, 2020.

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