

RC2: 'Comment on gmd-2021-75', Anonymous Referee #2, 20 Apr 2021

The authors developed T-CHOIR that freely adjusts the spatial resolution of river-lake model that explicitly represents the energy and water balances in global scale. To achieve the objective, an improved flow upscaling algorithm, a hydrography dataset, and lake-reservoir dataset are tightly coupled. The authors identified and addressed many issues, which will help not only future users of the model but also general audiences working on the model and dataset developments. The manuscript was very well written, so it was great pleasure to read the manuscript. I only have several questions.

Response: We appreciate your encouragement to improve our paper, and we want to reflect on all your suggestions. In particular, your comment on our dataset is highly critical and we reconfirmed the dataset in detail.

Line 63: What is the basis of saying “lower” and “higher”? These terms are comparative, but it is not straightforward to infer the comparisons. It would be also nice to briefly mention the reasons of lower water volumes and higher temperature.

Response: We corrected the ambiguous explanation; Vanderkelen et al. (2020) concluded that the heat capacity of rivers has been decreasing due to a decrease in water volume, and that of lakes has been increasing due to a warm-up of water temperature. However, their model does not represent the temporal change in water volume in lakes.

Section 2.1: In case of lakes in a very upstream region, it is commonly found that the water body data of HydroLAKES lies between two basins of MERIT Hydro that drain to very different downstream. It is a universal problem that can exist in any DEM-derived flow direction dataset. How the T-CHOIR deal with this case? Do you correct the flow directions as done in MERIT-Hydro?

Response: Thank you for your raise of an issue with the dataset. We would like to answer your comment from two perspectives.

1) Technical implementation. We modified the flow direction to reach a selected outlet for all the grids in each lake, so all the grids in each lake belong to the same basin. This modification changes basin size from a river-only upscaled map if a lake lies between two basins.

2) Actual situation for 369 lakes resolved in 15' resolution. We compared the spatial distribution of the lakes and that of basins in a river-only map upscaled only from MERIT Hydro, and it was found that 20 lakes lie between multiple basins. It was reasonable that six out of them are inland lakes (lakes without an outlet, e.g., the Caspian Sea and Lake Chad), and the river-lake network dataset deals with them as one basin. For most (13) of the other lakes, they are allocated the basin which has the most grids in each lake in the river-only map. Finally, there is only one exception,

30 Laguna Salada (HydroLAKES ID is 834). It is connected to the Colorado River basin, but the river occupies only 0.6% of the lake on the river-only map, but fortunately the river–lake network dataset reproduces the connection. As a result, we did not modify the dataset anymore from the first manuscript.

We added the above discussions to the manuscript.

Line 223: A lake may have multiple inflow paths. Does the model remember and update those inflows at every time step to calculate the “20% of inflow to lake”?

35 **Response:** Yes, we updated at every CFL timestep the sum of the inflow from all the inlets for each lake, then calculated the environmental flow with the total inflow at the previous timestep. We added the description there.