

Dear Micha,

Thank you very much for reassessing our manuscript. We appreciate the additional suggestions provided by the two reviewers and have adjusted the manuscript accordingly. As suggested by Reviewer 1, we provide a more rigorous evaluation of the approach for ten (instead of one) catchments in Switzerland, for which data on regional reservoir storage are available. In addition, we addressed the two minor points raised by the two reviewers. We hope that you find the revised manuscript suitable for publication in Hydrology and Earth System Sciences.

Best regards,

Manuela and Philippe

Reviewer 1

I would like to commend the authors on the quality and depth of their revision. I only have one major concern, and a minor suggestion.

Reply: *Thank you very much for taking the time for your re-assessment.*

Major concern:

This regards the validation. The point about the difficulty of obtaining records is well-taken, and the strategy to make up for data deficiencies (using canton-level data from Switzerland) is really interesting. Yet, only anecdotal evidence is provided that the validation strategy could work, with data from a single reservoir within a single canton. A more robust validation strategy is needed, not least to alleviate concerns about cherry-picking of the data for validation (take one reservoir for which the validation strategy works). What is more, it is not clear how reservoir-level curves and canton-level curves should necessarily correspond: the method could be perfectly sound and there might be reservoirs in a canton with a very different storage signature than the average.

My suggestion would be to compare the canton-level data with an average of reservoirs that are both in the canton, and included in the dataset. Please do that for all cantons for which you have enough data.

Reply: *Thank you for this great suggestion of how to make our evaluation more robust. We redid the evaluation for ten catchments in Switzerland located in the cantons Valais, Grisons, and Ticino, for which regional reservoir storage curves are available. We adjusted Figure 7 (see Figure 1 in this response to the reviewer) with the updated results and modified the text as follows: 'A direct evaluation of the extracted seasonal reservoir signals is unfortunately not possible because observed inflow and outflow data are not publicly available. Therefore, we evaluated the approach using an alternative validation strategy. The Swiss Federal Office of Energy provides weekly reservoir storage estimates aggregated over a larger region (i.e. canton). We use these regional storage estimates to compute seasonal changes in regional storage. We then use the regional storage change curve derived for the regions Valais, Grisons, and Ticino to evaluate the reservoir signals extracted using the GAM for all catchments located in the three regions (Figure 7). That is, we apply the GAM approach to the catchments located in the cantons Valais, Grisons, and Ticino using temperature, precipitation, and glacier mass balance changes as covariables. We then compare the extracted reservoir regulation signals to the reservoir signals extracted from the regional storage curves. The regulation signal estimates for the ten catchments using the GAM approach compare very well to the*

signals derived from observed regional reservoir storage data.'

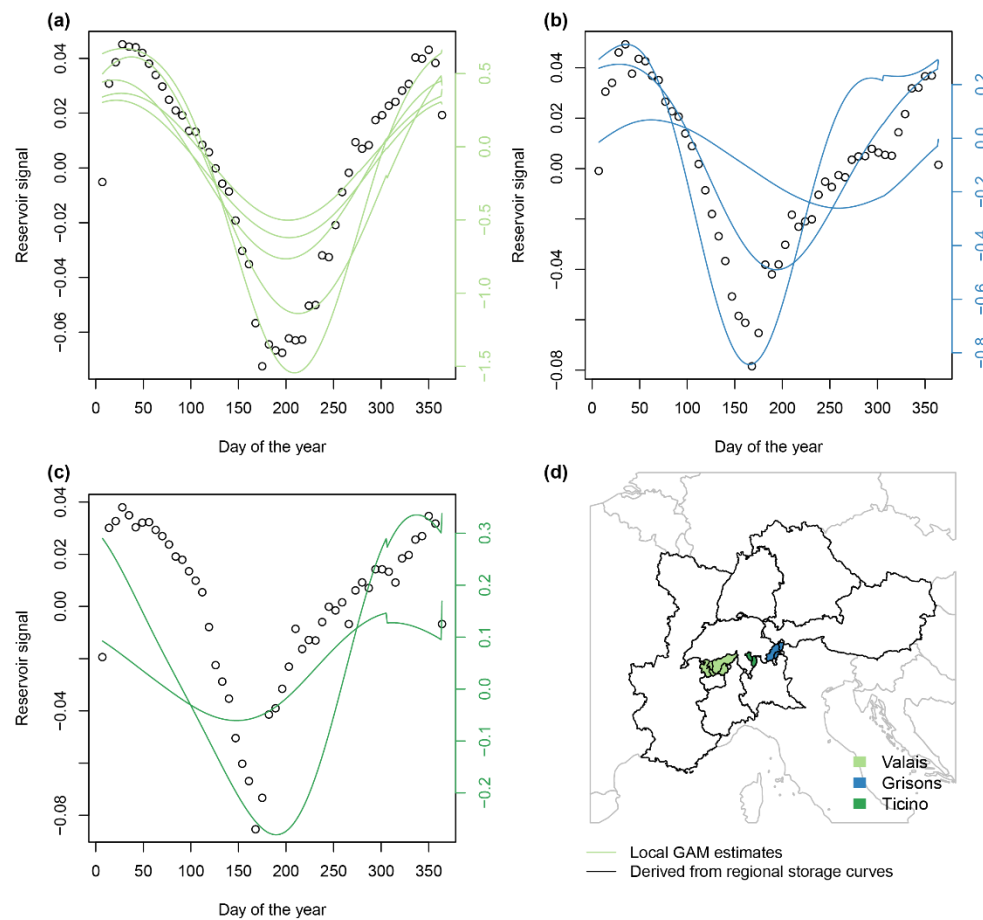


Figure 1: Observed reservoir storage change curves for the regions (a) Valais, (b) Grisons, and (c) Ticino derived from regional reservoir storage data provided by the Swiss Federal Office of Energy compared to the reservoir regulation signals estimated using the GAM of the catchments located in the corresponding cantons (d): (a) Rhône, Porte-du-Scex; Rhône, Sion; Rhône, Branson; Drance de Bagnes, Le Châble; and Vispa, Visp, (b) Inn, Tarasp; Inn, Martina; and Spöl, Punt dal Gall, and (c) Brenno, Loderio and Moesa, Lumino.

Minor suggestion:

In Table 1A, it would be great to either clarify that all records stretch to the present in the caption (and clarify that 2022 is the present year at time of writing), or if that's not the case, add a column with the start date of the record.

Reply: *We added a new column to Table 1A, that specifies the start date of all the records.*

Reviewer 2

My only edit up on the receipt of the revised draft is to change the background on figure 3 to be white and change the box color of the "simulated natural time series" to a less bright color as it clashes with the other box.

Reply: *Thank you very much for your re-assessment, which we highly appreciate. We changed the background color of Figure 3 to white and adjusted the color for 'simulated natural time series' to a less bright red, which was also used in Figures 4 and 5.*