

Interactive comment on “Large-scale water scarcity assessment under global changes: insights from a hydroeconomic framework” by N. Neverre et al.

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Please find below our replies to Anonymous Referee #1 comments.

1. Water scarcity: “The title of the paper is closely related to water scarcity assessment; this is also a reason why I’m very interested in the topic. However, after reading through the manuscript, it seems the research is almost nothing related to water scarcity assessment. It deals with the operation of reservoirs.”

> This paper looks at water scarcity, defined as the lack of sufficient water for the water uses. The developed model enables to assess demand satisfaction ratios, which are a measure of water scarcity, by assessing and comparing water demand and water

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supply. The paper deals with reservoirs operation because reservoirs “help regulate climatic variability in time and space, to distribute water when needed by demands” (Cf. p.2 I.4-5, Introduction section) and thereby help mitigate water scarcity. It is therefore important to take into account reservoirs and their operation when assessing water scarcity. To make this clearer to the reader we can add a sentence to the introductory paragraphs, with a definition of what we mean by water scarcity.

2. Figures: “There are several graphs, i.e. Fig. 1-7. But no any graph really shows the results of the present paper. They either provide theoretical background or location of reservoirs.”

> Results of the study are displayed in tables, because we found it to be the clearest way to present the results. Graphs are here to illustrate other elements. If there are more precise indications of missing figures, we could add those.

3. Tables: “For the tables, I also feel difficult to understand the results. For example, for Table 1, the sum of four categories is higher than 100%. For Table 2, for many Basins, the results are the same for scenario spA and spB (also for Table 3 and 4).”

> Table 1 does not display results of the study but data from Margat and Treyer (2004). The data are not to be summed. There is one piece of information for each row (i.e. each type of use): the consumptive share of the water used by each sector. Cf. p.5 I.8: “Water demands are not entirely consumptive (Table 1), they generate return flows that may help satisfy downstream demands.” For each sector the consumptive share plus the return flow share would be equal to 100%. We will add the definition of “consumptive rate” in the caption of Table 1.

> Scenarios spA and spB are defined in Section 5.1.2, first paragraph. They are implemented to test the sensitivity of the results to the choice of spill modelling (before vs. after allocating water to the demands). We will add a sentence to the paragraph to clarify this purpose. The results for both spill scenarios are provided in the results tables to look at this sensitivity. We will add in the first sentence of the Results sec-

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tion (Section 5.2, p.9 l.9) that both ways of modelling spill are presented in the results table to show the sensitivity of the results to the spill modelling. In the paragraph p.9 l.21-23: figures are in % points, and not %. It will be corrected. The paragraph will also be more developed, discussing the model sensitivity to the spill modelling option. Low and strong sensitivities to the spill option will be discussed. In most basins the model is not very sensitive to the spill scenario, but in some basins the two spill scenarios yield important differences in results (e.g. Table 2, basin 1192). In tables 3 and 4, the results that are presented consist in differences in satisfaction rates between two situations, which smoothens the impact of the spill option.

More generally, the Results section will be improved: basins numbers will be replaced with the name of the main river in each basin; results that are the most reliable/unreliable will be visually identified in the tables.

4. Validation: “One issue is the validation of the models used in the paper. There is no calibration or validation presented. Hence, it is difficult to know the accuracy of the results. There are too many assumptions in the entire paper, and it is difficult to know the accuracy of results.”

> We are aware that the lack of validation is a weakness of our work. As mentioned, a proper validation of the framework is limited by the lack of data. For the municipal and irrigation water demands, the methodologies were validated to the best of our ability. It was discussed in two previous papers that focussed specifically on the modelling of municipal water demand (Neverre and Dumas, 2015) and irrigation water demand (Neverre and Dumas, 2016 - which was not cited because it was previously under revision, but is now published). We will add information about the sensitivity analysis and the validation efforts that were carried out, and refer to these previous papers. For the reconstruction of demand-supply networks, the validation experiment carried out in Algeria is presented in Appendix F. It will be further discussed in the main text. For the reservoirs operation rules, unfortunately there is no adequate data for a validation (Cf. paragraph p.10 l.31). What we can do with the available data is perform a simple eval-

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uation at the country scale in historical conditions (aggregating the different basins). This evaluation will be added in the revised version of the manuscript. However, this evaluation will have serious limitations: uncertainties about the data, incomplete or different coverage (not all supply sources/all demands included in the data/in the modelling framework).

> We had to make assumptions when precise data were not available. We tried to maintain the trade-off between relevance and precision. We tried to be transparent about the assumptions made and how it would affect accuracy. The objective was that the considered assumption would improve the modelling, compared with not taking the considered element into account.

> Most results presented in the present paper consist in differences between two situations: changes in demand satisfaction rates (indicator of water scarcity) between historical and future conditions, or changes in demand satisfaction rates between different modelling scenarios (with/without operation rules based on economic criteria). Even if there are biases in the magnitude of the modelling framework's results, presenting the results in terms of difference rather than absolute values is expected to offset magnitude biases.

For further details, please also see our replies to Anonymous Referee #2 comments: comment #1-iii and comment #6.

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