

Interactive comment on “Storage water value as a signature of the climatological balance between resource and uses” by B. François et al.

Anonymous Referee #3

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The paper describes an interesting approach to explore the outputs of reservoir optimisation with dynamic programming to better understand system's behaviour, time variability and impacts of changes in climatic forcing on the storage water value (SWV). A case-study in France is used in the study. I found the paper interesting and within the scope of HESS. The topic is very broad and I think the authors found a careful way to present the content in a concise way. In general, it is well written although I agree with the previous reviewers that some English language review is necessary. Mainly the lack of punctuation in long sentences makes reading sometimes difficult (eg., page 8995 lines 10-15). A proper use of comma, for instance, would be enough to solve this problem and favour fluid reading.

Additionally, I have the following main issues that I would like to be addressed by the
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authors:

- I like concise papers but here sometimes I found it too concise! In many parts the reader is sent to a reference without much explanation: for instance, what is actually in these studies mentioned by the authors: page 9003, lines 13-14, Paiva et al., 2010; Page 9003, line 25, Ward et al., 1996; Page 9004, line 21, Hingray et al., 2007; page 9006, lines 2-3, Paiva et al., 2010 again? A sentence or two about what is to be found in the cited reference would be much appreciated.

- Also related to this issue, I agree with reviewer 2 that some terminology needs to be explained. For instance, page 8995 line 4, I do not see clear what “inflows from past hydrological regimes” means. Should not a catchment have only one hydrologic regime (under stationarity at least)? Later on line 7, what is a “rule curve”?

- I agree with reviewer 2 that the introduction needs a major revision, together with the conclusions section.

I think the introduction is too concise and fails in telling the reader what the major achievements in the field are. More information on the literature is needed in the paper: what other recent studies applied deterministic dynamic programming? What studies show operational applications of dynamic programming for reservoir control? What are their main achievements/conclusions? What has been done of innovative in dynamic programming and what are the current challenges in the field (isn't there something more recent than the review of Yakowitz, 1982?) How the study presented in the paper searches to fill the existing gaps and/or answer remaining challenges? This would highlight the contribution of the authors to the topic, which, although the study is an interesting one, is not clear in the paper. In my opinion, the topic of uncertainties (nor pertaining only to future inflows in real time operation of reservoirs, but also to observed flows and expected climate changes), which is very quickly treated in the conclusion, should be presented already in the introduction. This would help in justifying, for instance, the choice of the authors for a determinist dynamic programming,

instead of a stochastic approach.

In the conclusions, I think the authors could discuss more about how their modelling approach could be used in real-time forecasting, mainly considering the use of probabilistic or ensemble-based predictions of future inflows: can it be directly used? How? What adaptations would be needed? Also, page 9013, lines 27-29, for instance, the sentence “The SWV is known to increase in this case when compared to the SWV obtained with perfect foresight, as a result of inflow variability and forecastability.” is not clear to me: it is known by whom? What studies/results are you referring to? Also, Page 9014, line 3: when you talk about “changes in the variability of future inflows”, I was wondering if these would not already have been captured (under the hypotheses of stationarity) in the control period. What changes otherwise are you talking about? Finally, Page 9014, line 5-7, last sentence: “Analysing these signature changes would probably improve our understanding of modifications of system performance classically reported on the basis of a variety of performance criteria in climate change impact analyses.”, what reports are you talking about? What performance measures?

- About the data and the use of a hydrological model: Why do you need a model to apply the dynamic programming and discuss on the variability of SWV as you did in the study? Couldn't you have used the long time series of observations (instead of “control simulations”)? Besides, are the observed data stationary? If not, couldn't any changes in observed data be used to test the effects of inflow changes on SWV? Since you used a hydrological model, can you add a sentence or two on the quality of the simulations of the model? How good/bad is the model in reproducing discharges? Also, why did you use meteorological reanalyses (Page 9004, line 13-14) and not observed data for the control period, i.e., why not use the same data used for the calibration of the model? What is the quality of the reanalyses in this catchment?

- Page 9004 “climate scenarios”: when using the scenarios of changes in precipitation and temperature together, did you take into account correlations between the variables?

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Minor points:

The last sentence of the abstract seems to be missing something (or “with” is to be replaced by “if”?)

Page 8997, lines 10 and 14: is t_0 and t_{i+1} the same thing? Shouldn't it be equal in these lines?

Page 8997, line 12: “(including costs of failures)”: here you need to precise what failures you are talking about. It is indicated later on lines 17-19, so I suggest putting these lines previously.

Page 8997, lines 21-22: something seems to be missing in the sentence

Page 8999, line 2: “. . . dimension of the problem is quite small”. How do you define “quite small”? What do you mean by that?

Page 8999, line 10: “Different methods were. . .”, what are these methods?

Page 8999, lines 12-16: can you rephrase/explain this sentence? Not clear to me.

Page 9000, lines 21-22: can you rephrase/explain this sentence? Not clear to me.

Page 9001, line 23: change to “. . .the real resource management system of the lake Serre-Ponçon of the Durance River.

Page 9002, line 7-8: “To the cost of complexity of the result analysis, we decided to avoid”: can you explain this sentence? Not clear to me.

Page 9003, line 7: “. . .due to the important depth/width ratio of the reservoir.”: can you say what this ratio is?

Page 9003, line 16: what is “an empirical rule”? How is it defined?

Page 9003, line 20: what do you mean by “. . .will be balanced on the midterm.”?

Page 9003, 25-27: “A more precise formulation was not possible in the present case

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due to lack of appropriate data in the region.”: what do you mean by “more precise” and what data are lacking?

Page 9004, line 1: “. . .with objectives of equivalent value, . . .”: what do you mean? Economic value or equal priority?

Page 9004, line 17-19: not clear. I think you have to take out the world “turn”.

Page 9005, line 1: say also that the figure contains the control regime

Page 9005, lines 14-16: can you rephrase/explain this sentence? Not clear to me.

Page 9006, line 1: as expressed here, I think that you should be careful to use HEPI as “Hydroelectric production interest” Index all over the paper. Sometimes it is confusing.

Page 9006, lines 15-16: can you explain why they were set to unit and justify the arbitrary higher value?

Page 9007, lines 12-13: Why the chosen 4-year period? Were the other years the same?

Page 9009, line 10: change to “The SWV signature is expected to be different in this case”

Page 9009, lines 19-20: Fig. 5 should be mentioned first, before describing its results.

Page 9010, lines 18-19: “The most significant residuals are observed for the winter season at low reservoir levels.”: can you give an explanation for that?

Page 9011: suggestion: maybe separate into sub-sections for better reading: 5.1 Effects of warmer temperatures; 5.2. Effects of precipitation decrease; 5.3 Conjugated effects of warmer temperature and precipitation decrease.

Page 9011: Fig. 7 needs to be mentioned together with its results.

Page 9011, lines 9-10: in the sentence: For example, for the 50% storage level, the large SWV decrease observed in 10 the control climate during the six first months of C4645

the year tends to disappear...”, which year are you talking about?

Page 9011: some more sentences helping the reader to read and understand fully the figures would be nice here.

Page 9020, Fig. 3: should it be HPEI instead of EP in the legend? Figures 4 to 7: Could you use also different colours to facilitate reading the different information?

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