

Interactive comment on “Evolving water science in the Anthropocene” by H. H. G. Savenije et al.

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The paper is very well written and organised and fits well in the special issue. I particularly appreciated the historical reconstruction of the relationship between water and humans and the thoughtful discussion of the interaction and feedbacks between humans and the environment.

In my view this is essentially an opinion paper and therefore I believe my review remarks should be interpreted as suggestions for further discussion. None of my notes that are listed here below are critical and I would not be disappointed if they were not addressed when revising the paper. I strongly believe in the value of opinions. I am convinced that the Authors should not be excessively conditioned by review comments when expressing them.

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1) I think that the analysis of the current situation in terms of human impact on the environment is overly pessimistic. At line 14, page 7621, is stated that “Humans have changed catchment hydrology in most catchments of the world....”. I believe the human impact is not so widespread. If one assumes that climate change is due to human intervention (like the authors do) then it is of course true that humans have altered any part of the world including the atmosphere and, to certain extent, the space. However, if one refers to human induced alterations of the hydrological cycle, I would say that a few catchments only have been significantly affected. It is a fact that the affected catchments are the most important for modern society. Therefore I agree that the human impact on hydrology is much important for society itself, but I would not fully support the assertion that most of the catchments in the world are heavily impacted.

2) I would like to see a more extended discussion on the Anthropocene. It would be appropriate to remark that, to date, the term has not been officially adopted in geology. In fact, it is still not clear whether the humans impacted geology to such an extent to justify the introduction of a new geological epoch. Moreover, an official starting date for the Anthropocene has not been agreed yet. Some scientists take the industrial revolution as the beginning of the Anthropocene (like the Authors), others go back some 14-15000 years before present and others assume that the Anthropocene coincides with the Holocene, depending on the definition of human impact.

3) The authors suggest that (page 7621, lines 4-9) “During the Holocene, complex human societies have developed in a relatively stable, accommodating environment”. I think this statement is also pessimistic with regard to present changes. I am not sure they are unprecedented (but I fully agree that they are relevant and important). Etrurians and Romans profoundly altered the river networks in large areas of Europe and reclaimed extended lands. They changed the landscape and the evaporation significantly and probably caused local climate changes. The history of the relationship between humans and water is long and the Authors rightly recall that ancient societies already exploited water resources significantly, to the extent that some of them collapsed after

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water crisis (the first dams was built around 3000 BC). I am also not convinced that the current climate change is unprecedented. There are legends saying that during the medieval period Valais people could migrate from Switzerland to Italy because during the climatic optimum (http://en.wikipedia.org/wiki/Medieval_Warm_Period) many alpine passes could be crossed for most of the year. Of course there is a lot of uncertainty in the definition of the temperatures at that time, but it is agreed that in Europe the medieval climate was warm and comparable to the actual climate. After 400 years only, the Little Ice Age (http://en.wikipedia.org/wiki/Little_Ice_Age) caused a decrease of the temperature and a remarkable increase of the extension of glaciers. The pace of the climatic change that happened at that time was dramatic and, in consideration of the uncertainty, one cannot conclude for sure that the current climate change is unprecedented. I know that this issue is controversial.

4) I think the paper may benefit from an extended discussion on modern monitoring techniques. Remote sensing observation of soil moisture is discussed at page 7634. I would suggest to add a discussion on remote sensing of water levels and groundwater, which may open interesting perspective in the estimation of global water resources (see, for instance, Munyaneza, O., Wali, U.G., Uhlenbrook, S., Maskey, S., Mlotha, M.J., Water level monitoring using radar remote sensing data: Application to Lake Kivu, central Africa, *Physics and Chemistry of the Earth, Parts A/B/C*, Volume 34, Issues 13–16, 2009, Pages 722-728).

5) I am convinced that global hydrology and large scale hydrology (Gupta, H.V., Perrin, C., Kumar, R., Blöschl, G., Clark, M., Montanari, A., and Andréassian, V.: Large-sample hydrology: a need to balance depth with breadth, *Hydrol. Earth Syst. Sci. Discuss.*, 10, 9147-9189, doi:10.5194/hessd-10-9147-2013, 2013, this issue) may open interesting perspectives for integrated water resources management. I think that the paper may benefit from a discussion of the related research questions.

6) I think data sharing may represent a significant step forward in water resources management. Until a few years ago, water data have been not shared among countries

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and researches. This situation has created a significant gap in information. In recent years the awareness is increased that data sharing is a powerful tool to enhance water knowledge and therefore a significant support is being given by institutions to promote virtual observatories and laboratories. This issue could be discussed in the paper.

7) I would like to see a more comprehensive mention of global initiatives in the paper. Besides those suggested by Dr. C. Scott, I would like to mention *Panta Rhei*, the new Scientific Decade of the International Association of Hydrological Sciences (*Hydrological Sciences Journal* (2013): “*Panta Rhei*—Everything Flows”: Change in hydrology and society—The IAHS Scientific Decade 2013– 2022, *Hydrological Sciences Journal*, DOI: 10.1080/02626667.2013.809088).

I consider this paper a very significant and instructive contribution that deserves to be published on HESS.

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