Response to comments by first reviewer (anonymous) and by second reviewer L. Wang on "*An ecohydrological sketch of climate change impacts on water and natural ecosystems for the Netherlands: bridging the gap between science and society*" by J.P.M. Witte et al.

J.P.M. Witte et al.

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<u>First reviewer, anonymous</u>

Comment:

The paper by Witte et al. presents an ecohydrological sketch-map that enables decision-makers to assess climate change effects on ecosystems in The Netherlands. Instead of relying solely on modeling techniques (which has been shown insufficient to assess impacts of climate change at regional scale), the sketch-map is based on the combination of modeling results, literature review and process-knowledge of experts. The Authors use the Dutch delta as a representative example to investigate the impact of two climate scenarios (dry, wet) on ecohydrological systems such as heathlands, grasslands, and bogs. The paper represents a substantial contribution to the topic of decision-making in the face of climate change uncertainty (with focus on impacts on ecohydrological systems) and addresses a relevant question within the scope of HESS. The Authors present valid methods to reach substantial conclusions by providing a comprehensive literature review on merits and drawbacks of modeling techniques in the context of ecohydrological feedbacks and climate change. Further, the compilation of the map is described in detail. I recommend the manuscript for publication after minor revision with regard to the paper structure, which jumps back and forth between introduction, method, results, and discussion. While the application of a classic manuscript outline is challenging for the present paper, it should be linked to the stated study goals, which are "(1) to provide insight into the usability of current models for climate change projections, and (2) to […] compile a sketch map […]". In this context, the literature review on modeling techniques, for example, can be considered the method rather the introduction. Please refer to the attached supplementary document for further details.

Response:

We thank the reviewer for his appreciating words and valuable comments.

Major concern of this reviewer is the structure of the paper. This is an excellent comment, pointed to issues that we struggled with earlier, and we were motivated to critically reconsider our previous text. Accordingly, we decided to move section 1.2 to the section 2 (Material and Methods) and to restructure Section 1 (Introduction) and 2 (Material and Methods). We agree with the reviewer that the structure of our revised manuscript is much better now: See the attached supplementary document for the revised version of our paper. We also appreciated the proposed different headings for parts of the material section, as provided by the reviewer in the supplementary document (hessd-9-C3091-2012-supplement.pdf).

The supplementary document provided by the reviewer also has suggestions regarding the paper structure that we believe are not in the spirit of our message, and we hope to convince the reviewer of our reasons for that. In fact, we gather that the unclear structure − that was addressed above − is the cause of ambiguity and mixing with regard to methods and results (and introduction) below:

- The reviewer proposes that the modeling techniques (originally Section 1.3) can be considered the method rather than the introduction. Generally, we would have no objection to complying with this suggestion, as for modeling-focused papers that suggestion is appropriate. Our evaluation of modeling techniques was, however, meant to underpin our choice not to solely rely on model results, but to develop another approach instead, thus justifying our choice for a sketch map. To make this clear, we removed the first aim from the manuscript and instead integrated our discussion about modeling techniques in the introduction (now Section 1.1), prior to formulating the need of an alternative (now Section 1.2) and the formulation of the (revised) aim. We think, this substantially improved the flow in the manuscript.

- The comments of the reviewer on the frequency distributions of hydrological quantities (Section 2.3 page 6322, line 1-13; Section 2.3.2 in the revised manuscript) show that their role in the manuscript was not clear. These results were meant to guide our approach (the sketch map being the actual result presented in the paper). To make this clear, we removed some details (as those were indeed not essential to our approach) and moved other quantities to directly support the assumptions introduced in Section 2.4 (now Section 2.3.3).

- Finally, we did not move some sentences of Section 3.1 to the Discussion (Section 4) as these sentences are meant to explain the sketch map, rather than to discuss it.

We believe that with the revised Sections 1 and 2, the structure of our manuscript will not give rise to confusion anymore, as now we have indeed a classical and logical order:

- The aim of the paper given at the end of Section 1 is to introduce the sketch map approach;
- Section 2 describes the material and methods used to compile the sketch map;
- Section 3 (Results) presents the sketch map;
- And Section 4 discusses the sketch map, how this map was disseminated and the impact it had on policy practices.

Furthermore, the reviewer remarked that Section 4.1 suffered from a lack of discussion. We agree with this comment and drastically revised section 4.1: see the attached supplementary document. Additionally, we made sure that the resolution of Figure 5 is sufficient to read all text and we suggest HESS to publish this figure full page in the final paper. Finally, there were some minor comments, which we all accepted.

<u>Second reviewer, L. Wang</u>

Comment:

In this manuscript, the authors combined model simulation, literature review and expert knowledge to produce a sketch-map which indicates climate changes effects on the "high part" and "low part" of The Netherlands. The authors present a thoughtful review of the modelling exercises for climate change predictions and raises some compelling limitations. Then the authors bring up a combination method. The scope of the study fits HESS well and the manuscript is generally well written. I recommend publication after appropriate changes. There are some suggestions which I hope could help improve the quality and readability of the manuscript.

Response:

We thank reviewer L. Wang for these appreciating words and the valuable comments below.

Comment:

1. Page 6313 Line 10-13 This sentence makes the work look like "published" and "old". I would suggest remove this sentence or put it in the Discussion section.

Response:

We agree with this assessment, of course, and considered how to avoid the negative connotation. Our point is that only a preliminary sketch-map had been released, in a non-peer reviewed Dutch professional journal, i.e., with a limited readership and non-scientific status. We emphasize this in the revised manuscript. The second issue is that despite its 'preliminary' status, it was picked up rapidly by policy and decision makers, and even a commercial (!) atlas publisher, which indicates the relevance of the material for the broader community. As 'bridging the gap between science and society' is crucial in our paper, we have to explicitly recognize that the preliminary version resulted in a discussion in society, and is in fact one of its strengths. See the attached supplementary document for the revised version of our paper.

Comment:

2. Page 6321 Line 7 Why 1967 and 1949 were chosen? I believe there are better quality data in recent years. This requires further justification and explanations.

Response:

We explain in the manuscript that we chose these years to characterize an average (1967) and a dry year (1949). Justification of the return periods of both years is given in Beersma et al. (2005). For the Netherlands, there is no reason to believe the data quality of these years is less than the data quality of recent years. We made this explicit in the revised manuscript.

Comment:

3. Are the vegetation types in the current vegetation map the same as the early years (1949 and 1967)? If not, what are the consequences?

Response:

Excellent point! We indeed assume that the natural vegetation is in equilibrium with weather conditions of the prevailing climate. This assumption, though, is well supported by

Bartholomeus et al. (2008; reference added to the revised manuscript), who found that the species composition of natural vegetation best corresponds to environmental conditions over a very long period (30 years). Therefore, vegetation will represent the current climatic conditions. The conditions in the two years were selected to represent average and dry conditions of the current climate are therefore also reflected in the vegetation.

In the revised manuscript (attached supplementary document) we have better motivated the selection of the two years.

Comment:

4. Section 2.4 It would be helpful to clarify which parts are from literature survey and which parts are from expert knowledge?

Response:

In our revised manuscript, we made sure that for each of our nine basic assumptions, we clearly differentiate the assumptions as derived from expert knowledge, from literature and those from the results of the national hydrological model and of additional simulations (i.e. figure 4).

Comment:

5. What's the "validation" procedure of this new approach?

Response:

This is an interesting point! Actually, of course, there is no validation procedure yet: the future will tell whether our sketch map was right or not, just as the validation of climate projections with global circulation models, hydrological models and ecological models is only possible in the future, as soon as observations in a changing world and climate become available.

Comment:

6. The section 4.1. It would be helpful to discuss not only model uncertainties, but uncertainties in general, e.g., what are the uncertainties/limitations in literature survey and expert knowledge and what are the repercussions of the uncertainties?

Response:

Again, a good point and to accommodate it, we drastically revised section 4.1: see the attached supplementary document.

Comment:

7. I think adding some societal implications of the projected change would strengthen the paper. We have a recent synthesis paper in HESS dealing with natural and societal aspects of ecohydrological processes in water-limited systems. Some of the issues and technical advances such as water demand, food and water security could be relevant here as well. Wang, L., D'Odorico, P., Evans, J., Eldridge, D., McCabe, M., Caylor, K., and King, E.: Dryland ecohydrology and climate change: critical issues and technical advances, Hydrology and Earth System Sciences, 16, 2585-2603, 10.5194/hess-162585-2012, 2012.

Response:

We thank you for sharing this interesting paper, that we were not (all) aware of earlier. To go into detail regarding this paper is not well possible, considering that it focusses on drylands, rather than temperate climates.

Minor comment:

Page 6316 Line 16 Change "directly of use" to "direct use"?

Response:

With the words "rather than directly of use" we tried to express that the modeling approach is, in its current state, not applicable. To avoid any misunderstanding, we changed this sentence: see the attached supplementary document.

Minor comment:

Page 6317 The first paragraph. I think it would be useful to bring up the fact about some network efforts to generate large scale ET dataset (e.g., FLUXNET) for model validation. In addition, there are ongoing efforts to partition large scale ET into E and T (e.g., Evapotranspiration partitioning with woody plant cover: assessment of a stable isotope technique, Geophysical Research Letters, 37, L09401, 10.1029/2010GL043228), which will provide more constraints for model exercises.

Response:

Done; reference to FLUXNET (and SEBAL) and Geophysical Research Letters paper added: see the attached supplementary document.

Minor comment:

Page 6320 Line 10 Remove "only"?

Response:

Done, see the attached supplementary document.

Minor comment:

Page 6322 It is not typical to start a sentence with many references and it makes the sentence hard to follow. I would suggest rewrite this sentence.

Response:

Done, see the attached supplementary document.