Hydrol. Earth Syst. Sci. Discuss., 12, C3946–C3950, 2015
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Hydrology and Earth System Sciences
Discussions

Interactive comment on "A question driven socio-hydrological modeling process" *by* M. Garcia et al.

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Received and published: 30 September 2015

Dear Reviewer,

Thanks you for your very thorough and insightful comments. We appreciate the time and effort you put into these. We have prepared responses below.

1. Thank you, this point is well taken. In aiming for brevity we missed an important aspect of the review of modeling approaches. We will incorporate a thorough review of approaches used in socio-hydrological modeling, utilizing the cited references and others, as well as reference to recent review papers on the topic (Blair and Buyaert, 2015; Troy et al., 2015). We agree that the recent WRR Debate series provides an excellent foundation for this review and for discussion of the challenges facing the field.

2. We agree that the process presented here will be most useful for real world cases. However, we chose to illustrate the modeling process first on one hypothetical case for simplicity and brevity. We plan to build on this in future applications. While we are also working on a case-based modeling project, we found that explaining the full range of context and assumptions of the case along with the modeling process was beyond the scope of a single paper.

3. We will delete the sentence: "In this study we will focus on the frequency and maximum magnitude of shortage events." The intention was to focus the discussion of the model results on these two properties as they differ significantly between SOP and HP. However, we now see that this statement can be misleading as all three properties are relevant to the model.

4. Thank you for this comment. As you noted we aim to provide transparency of the model development process and therefore take this comment very seriously. We will expand our discussion of the determination of these three processes to clarify this step. In addition, we will include a clear explanation of how the SES framework was used in this instance.

5. Thank you for this observation. In the subsequent revision we will include a comparative discussion of the conceptual model developed here, including the feedback loops, and those in Elshafei et al. (2014), Sivapalan et al. (2015) and Liu et al. (2015).

6. This is a fair critique. The relationship of between water consumption and development is a complex one. In the case described by Kandasamy et al. (2014), as well as in other cases, an array of interacting forces, of which development is just one, lead to a change in water consumption as development increases. We will replace the Kandasamy et al. (2014) reference with a discussion of the mixed effects of development on water consumption, with reference to a series of cases and review papers, to justify why, in this case, economic development may be reasonably excluded.

7. The recommendation to discuss agent based models as an alternate approach is

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a good one. We will incorporate this suggestion into the discussion of the model's limitations.

8. Yes, land use changes are not incorporated in the current model formulation. The reason for this is that the geographical area being modeled (a city) is small relative to the size of the watershed. The land use change occurring at the watershed scale is therefore exogenous to the modeled system. In future work the impacts of land use change can be incorporated as an exogenous scenario. We will clarify this in the text.

9. Thank you, this is a good point. The current formulation applies the shortage factor to both the rate of immigration to the area (1-M) and the rate of emigration (M) which creates a non-linear effect on the net population change rate (low influence for low values of M and high for high values of M). However, you rightly note that the effect should be zero, rather than low, at some levels of shortage. We will reformulate this equation to incorporate a threshold above which population dynamics are affected, and below they are not

10. The recommendation to revise the discussion is well taken. We will revise and refocus our discussion on the question driven modeling process and the distinction between the coupled and non-coupled model. The discussion of the competing operating strategies will be trimmed and presented as the outcome of the process.

We also thank you for your careful editing. Please see our response to the suggested technical corrections:

1. Thank you for this suggestion. We will replace references to "the system" with "the coupled system" to clarify the distinction.

2. The repetitive reference on p.8294 will be deleted.

3. The reference will be corrected on p.8296, L10.

4. We will the revise sentence on p.8296 L24-25.

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5. We will add the missing apostrophe on P.8301, L2.

6. We will replace “of” with “over” on p.8305, L18.

7. The word “of” will be deleted in the sentence on p.8305, L26.

8. The word “a” will be deleted in the sentence on p.8306, L22.

9. We will replace “with a” with “using” for clarity on p.8313, L22.

10. We will replace “think creatively and innovate” with “think creatively and to innovate” for clarity.

11. We will define gpcpd for readability.

12. We will check the references for consistency.

References

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