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Interactive comment on "Proximate and underlying drivers of socio-hydrologic change in the upper Arkavathy watershed, India" *by* Veena Srinivasan et al.

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The reviewer made several substantive points including recommendations to restructure the paper and to adopt a stylistic sociohydrologic modeling approach. We fully accept the structural critique and will substantially restructure the revised paper. However, we respectfully disagree with the reviewer's suggested sociohydrologic modeling approach. The reasons are somewhat subtle.

Firstly we agree that fully incorporating bi-directional feedbacks between human agent models and hydrologic models in either a detailed framework based on primary studies or simple conceptual model would be intriguing in the Arkavathy Basin. Developing

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such a model remains important future work. We further agree that existing sociohydrologic studies should be more extensively cited in our revision to motivate the present work. That being said, the goal of the paper is not to immediately present such a socio-hydrologic model, but instead to use a traditional hydrologic modeling approach to illuminate the lack of predictive power of such approaches in the human-dominated environment we explore.

We believe that such a demonstration is important for several reasons: 1. Motivating socio-hydrology: Socio-hydrology remains a fringes area of study amongst the water science community in India and beyond. Providing a clear illustration of the necessity for a sociohydrologic modeling framework therefore remains a necessary scientific task in this intellectual environment. Our approach is to demonstrate that models that explicitly incorporate human feedbacks are necessary to have any predictive ability. The goal of this study is to disentangle the role of human factors in explaining long term change – thus motivating the need for socio-hydrology.

2. Illuminating the importance of human factors for interrogating periods of hydrological change: A widely used approach to exploring basin-scale hydrology remains the calibration of large basin-scale hydrologic models using secondary data. These models are difficult to adapt to situations where human interventions generate changing rainfall-runoff relationships. As a solution of last resort, some hydrologists are even now making the case that model parameters should evolve over time to enable improved model calibration. Such approach makes it possible to reconstruct hydrology. However it does not provide insight into why watershed parameters are changing and offers no predictive insight or organizing principles. Our paper offers an alternative approach that prioritizes the development of process understanding over model performance metrics.

3. Informing policy: Much of the hydrologic change occurring in India can be attributed to the cumulative impacts of millions of uncoordinated actions by humans. “Watershed development” (constructing soil and water conservation structures) is the cornerstone

of both Indian water policy and rural development. In these programmes, the impacts are always measured locally; the cumulative impacts of local water harvesting at the basin scales are never understood resulting in increasing upstream downstream conflict. Multi-scale models are necessary to understand how small scale interventions scale up. It is clear that the current presentation of the paper needs to be amended to motivate the research with these challenges and to demonstrate the value the current modeling approach offers in this context. We agree with Reviewer 2 that the paper attempts to present too much information and needs to be streamlined and focused. Our proposed revision will substantially restructure the paper and simplify its argument. A skeleton outline is presented below: 1. Introduction. Human impacts are the primary drivers of change. Review the literature on how others are dealing with human drivers – either toy models, or small scale models or allowing model parameters to evolve in basin scale models. Toy models are useful to understand the broad dynamic and direction of change but not for quantitative reconstruction.

2. Conceptual Model We will then present a narrative of change drivers and a conceptual model and explain why this necessitates a multi-scale model – to accommodate millions of small changes that occur at different scales.

3. Results We will then present the results of the model – and show the trajectory of change and attribution to the main drivers.

4. Discussion We will discuss the results in terms of attribution of causes and introduce the idea of urbanization as an underlying driver and the challenges this poses for prediction.

5. Conclusion We will conclude with big picture implications for both hydrologic science and policy.

Minor points: Comment Response The narrative is very interesting and key to understand the system. However, I would propose to include this before the modelling exercise. The proposed restructuring of the paper accommodates this request.

Quality of the figures should be improved considerably OK. We will hire a professional to do this.

The reviewer offered a number of very specific edits, which will likely be obviated by the proposed restructure. Where appropriate in the restructured manuscript, these will be retained. We thank the reviewer for their helpful and careful feedback.

Please also note the supplement to this comment:
https://www.hydrol-earth-syst-sci-discuss.net/hess-2017-543/hess-2017-543-AC1-supplement.pdf

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