

## ***Interactive comment on “A prototype framework for models of socio-hydrology: identification of key feedback loops with application to two Australian case-studies” by Y. Elshafei et al.***

**Anonymous Referee #2**

Received and published: 12 March 2014

The manuscript titled "A prototype framework for models of socio-hydrology: identification of key feedback loops with application to two Australian case-studies" presents a broad review of social-hydrological interactions for the purpose of developing a deterministic model to simulate the long-term regional to national scale dynamics of a co-evolving system. After a very long review of the literature, a community sensitivity state variable is proposed to couple an economic positive feedback (focusing on water usage) with the community sensitivity to water stress. Equations for the societal aspects of the model are presented and minimum requirements for the hydrological model are specified. Two qualitative case studies are then outlined.

C415

Overall, I found the review of social-ecosystem interactions to be impressive, well written and a welcome addition to that of the resilience and social-ecological-systems (SES) literature; which too often overlooks much of the material presented. However, I feel it is very long and at the expense of adequate attention being given to the quantitative significance of viewing ecosystems as coupled to society. For many readers this point would be missed and, hence, the perceived significance of the manuscript would be diminished. I urge the authors to present some clear examples. Additionally, the focus of the manuscript appears to be coupled positive feedbacks and nonlinear thresholds (as inferred by the model structure being based on a positive feedback, see Fig. 1). However, inappropriate depth has been given to this field of research. There was no discussion of the types of hydrological or societal positive feedbacks that have been proposed (or observed), their likely prevalence within hydrological systems, the phenomena that positive feedbacks may only arise when ecosystems and society are coupled and alternative approaches for modeling such coupling (e.g. game theory, continuation analysis) and how the proposed framework fits in with these methods. Lastly, considering the manuscript is proposing a hydrological coupled approach, there is an insufficient attention given to what, if anything, makes the study of hydrological systems different to other coupled investigations. For example, does the continuous disturbance from climate cause any challenges?

The manuscript introduction contrasts Integrated Water Resource Management with SES and, while not clearly stated, the focus of the manuscript appears to be SES (please make this clear). To date, SES modeling has often used relatively simple models that allow the exploration of specific social-ecological interactions (often using nonlinear dynamics techniques). However, in this manuscript a relatively complex model is proposed for exploring a wide range of social-hydrological interactions. So, while the concept of a sensitivity state variable was interesting (and to my knowledge, novel), I am not convinced that a relatively complex model could be applied to produce meaningful insights into social-hydrological coupling by way of either numerical calibration and simulation or be amenable to application of various SES and resilience techniques

C416

for exploring the feedbacks, thresholds and steady states.

With regard to the calibration and simulation, I am skeptical that a model with so many parameters can be calibrated using annual data. Unfortunately the manuscript does not present any demonstration of the framework to the case studies (note, the abstract is misleading in this respect). Site descriptions are presented but there is minimal reference back to the proposed framework. This severely weakens the paper and provides no means to evaluate the modeling framework. I appreciate that this work is ongoing but urge the authors to make some effort to address this weakness. If complete trials cannot be undertaken for the sites then I encourage the authors to guess parameters for each site and demonstrate the steady states and thresholds that may exist and the possible system trajectories that could result. If the latter was presented then I think it would significantly strengthen the argument of the manuscript and provide a basis for evaluation of the framework.

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Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 11, 629, 2014.