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Hydrology and Earth System Sciences
Discussions

Interactive comment on "A conceptual framework for assessing socio-hydrological resilience under change" *by* Feng Mao et al.

Anonymous Referee #2

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Review of Mao et al.

Summary: The authors propose a conceptual framework for assessing socio-hydrological system (SHS) resilience under change. It is based on distinguishing 3 resilience concepts, 2 of which are based on the hydro and the socio- sub-system of a socio-hydrological system while the third one focuses on the interactions between the two. The authors propose to understand resilience in terms of absorptive, adaptive and transformative capacities of a system. The authors also develop the notion of resilience as a way to identify SHS pathways to resilience states.

Comments: This is an interesting perspective on conceptualizing resilience of SHS. The concept is almost entirely borrowed from the broad literature of socio-ecological systems and eco-hydrology (wherever applicable). However, this are amenable to the

nature of the science of socio-hydrology, which is open to multiple interpretations of the same phenomenon. This paper is therefore a valuable contribution to socio-hydrology. Below are my main concerns.

1) The authors appear to treat hydro-sociology and socio-hydrology as if these two fields are similar in their demand to understand resilience (or possible instability) in coupled human water systems. The concept proposed by the authors is more formal and requires a post-positivist approach, which seeks regularities and generalizable relationships between human and their water system contingent on disciplines involved. It is not clear where hydro-sociology stands in this context, if it is anti-positivist (i.e. not seeks generalizable relationships) then it will be difficult to interpret outcomes of non-linear system dynamics such as instability and resilience. Socio-hydrology offers not only a quantitative framework but such a framework that allows for bi-directional feedbacks. I wonder if hydro-sociology is more oriented towards impact assessment and implementation of social objectives or outcomes – and bi-directional feedbacks may be key to understanding resilience of SHS. The authors may want to clarify the positioning and capacity of hydro-sociology in being able to implement the formal concept of resilience that is being presented here.

2) Why should we consider the resilience and stability of the hydro and socio sub-systems of a SHS if it doesn't affect the bi-directional feedbacks. It runs very contrary to the philosophy of socio-hydrology which emphasizes that endogenization of human agency as its key consideration. Why should we even be bothered to study instabilities isolated to certain sub-systems when it does not spread to the larger system through its coupled dynamics? Why should we study instabilities in hydrological systems when they are of no concern to humans – current or future! If such instabilities are of concern to humans then we are talking about resilience of the entire SHS, not isolated subsystems. I therefore encourage the authors to phrase all 3 types of resilience given in section 2 in context of the larger SHS and to not isolate them.

3) Same as in point 2, the notion that hazard such as pollution (section 3.1) is a short-

term exogenous perturbation is incorrect in my opinion. It is caused by humans, and human respond to that through community sensitivity and change their norms. Thus hazard is not an exogenous perturbation but an endogenous one as a result of human agency. It is also not a short term perturbation since its effect through community sensitivity can be over decades, even centuries. See for van Emmerik et al. (2014, HESS) and Kandasamy et al. (2014, HESS). I therefore think isolating the concept of resilience to hydro and socio sub-systems is contrary to socio-hydrology and misguided.

4) The discussion of absorptive, adaptive and transformative capacity is not clear. I am surprised that the authors decided to discuss such formal concepts in a qualitative manner. To ensure tractability of concepts, I would encourage authors to present a mathematical toy problem and express these concepts more formally.

5) Page 6, Line 27, "..resilience is to use a more theoretically pluralist perspective..": totally agree, and socio-hydrology welcomes such a perspective.

6) Section 3.2, line 3, page 7 ".. argue that the dynamics of social change should be better framed as part of socio-ecological research.": if you extrapolate it to socio-hydrological systems, then this is more about coupling and bi-directional feedbacks between human and their water system, contrary to the idea of the section that resilience should be treated in (social sub-system) isolation with hydrological hazards as (exogenous) boundary conditions.

7) When I come to section 3, it is not clear where the authors stand in terms of how resilience should be studied (whether in isolation or not). They evoke arguments against the compositional approach but their resilience framing appears to be compositional in nature! The authors should clarify this, I hope in favor of abandoning studying resilience of sub-systems.

8) Lines 3-4, page 8: "..human preferences for the resulting coupled system.." It appears that the authors have limited themselves to a normative/prescriptive perspective. This is more common with impact oriented studies such as hydro-economics and

hydro-sociology, that operationalize economic and social impact concepts respectively. To broaden it and incorporate the notion of bi-directional feedbacks, I would suggest to replace the word preference by dependence.

9) By the time one reached section 4, very little opinion has been offered on how one should go about assessing resilience of socio-hydrological systems. All that has been provided is a literature review. I therefore think that the authors should present a simple mathematical toy model and opine, based on the literature presented, on how the authors would go about assessing its resilience. This will also help better explanation of section 4.

10) The notion of how adaptation exactly increases resilience is not clear, especially because a clear definition of resilience has yet to be provided. The mathematical toy example would be a great asset here. Also, how is adaptation capacity different from absorptive capacity.

11) Section 4.3: Please discuss this in context of progress made in socio-hydrological literature. Many socio-hydrology case studies have documented that coupled systems have progress through era of development followed by preservation, e.g. pendulum swing, see Kandasamy et al. (2014, HESS), van Emmerik et al. (2014, HESS) and many more!!

12) Line 6,page 12: Enhancing adaptability under climate change is a difficult problem to tackle. Just stating that one should adapt is not enough, how one can do so using socio-hydrology is needed in this opinion piece. Again, the paper appears to be a literature review of resilience concepts borrowed from other fields (which is welcome). The authors should try to go to the next level and give us some insights on how one can learn from these ideas of resilience and plan for the Knightian uncertainty ahead (under climate change) using socio-hydrology. What is unique about socio-hydrology that can help us better prepare for the future ahead (e.g. endogenization of human agency implies less dependence on scenarios of e.g. population, land cover etc. that

may help us resolve some of the uncertainty)?

Overall, the paper appears to be a bit incoherent. It has brought ideas from other disciplines but it still has to provide an opinion based on the literature review. The paper should be made more formal, e.g. by using a mathematical toy model of SHS and all the concepts, including policy implications, should be discussed in its terms.

References: Kandasamy, J., Sounthararajah, D., Sivabalan, P., Chanan, A., Vigneswaran, S., and Sivapalan, M.: Socio-hydrologic drivers of the pendulum swing between agricultural development and environmental health: a case study from Murrumbidgee River basin, Australia, Hydrol. Earth Syst. Sci., 18, 1027–1041, doi:10.5194/hess-18-1027-2014, 2014.

van Emmerik, T. H. M., Li, Z., Sivapalan, M., Pande, S., Kandasamy, J., Savenije, H. H. G., Chanan, A., and Vigneswaran, S.: Socio-hydrologic modeling to understand and mediate the competition for water between agriculture development and environmental health: Murrumbidgee River basin, Australia, Hydrol. Earth Syst. Sci., 18, 4239-4259, doi:10.5194/hess-18-4239-2014, 2014.

Also please see the HESS special issue on Predictions under change.

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