

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

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With this paper, the authors aim to clarify and specify what resilience means, or could mean if the potential for multiple meanings is assumed, in a context of human-water systems, as studied by socio-hydrology. They want to provide clarity in the conceptual understanding of resilience so the concept becomes more useful and useable. They draw on existing literature from Socio-Ecological Systems modelling (SES) and complexity science to develop a framework for classification of the state of the human-water system under consideration, which they label ‘resilience canvas’. This, they assert, helps to describe historical, global trends in human-water relationships, as well as more ‘local’ developments e.g. towards sustainable flood management. As I have argued elsewhere (Wesselink et al., in press), socio-hydrology is a recent branch of SES so this foundation seems defensible. To create clarity on the concept of resilience also

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seems a good idea; however, I fear that for me this paper does not achieve this, it even creates more confusion. I hope the authors can fix the problems I identify below.

This paper can be assessed in three ways: 1. Its compliance with the orthodoxy, traditions and applications of resilience within SES. Since this area has a much longer pedigree, much can be learnt about resilience from SES research. 2. The internal logic of the paper and its application of SES basic principles. 3. The potential usefulness of the presented work for the application of resilience principles in policy making. The authors avoid being judged on the first criterion when they state (p.3) ‘Our aim here is not to describe this variety’ [note: they then state they want to instead ‘characterise how resilience is interpreted’. How exactly is ‘describing variety’ different from characterising interpretations?]. I believe they thereby miss an obvious chance to learn from others’ work, but it is indeed not possible to present an extensive literature review on resilience in SES literature in the current article. I hope they will publish such an extensive review elsewhere. I have therefore focussed on the second criterion, with some comments on the third.

My first major problem is that the authors state that (p. 3) ‘Resilience can be understood as a set of systemic absorptive, adaptive and transformative capacities (Walker et al., 2004, 2009)’. I do not need to go beyond reading the titles of the two references to know that Walker used the concepts ‘resilience, adaptability and transformability’. So instead of resilience as one of three system characteristics (as Walker does), the authors use resilience as overarching concept that includes the other two characteristics, and ‘absorptive capacity equates to the original concept of resilience’ (p.4). They thereby re-define a very well-known concept. This is never a good idea, and certainly not in an article whose main theme is ‘conceptual clarity’. I therefore wonder why the authors redefined resilience to mean ‘absorptive, adaptive and transformative capacities’, what their relationships are, and how they compose together resilience? Re-definitions lead to confusion rather than clarity. Since I am not an expert on resilience studies, I cannot estimate what this re-definition does in terms of changing what is studied and on what

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terms. I hope a reviewer with more knowledge in the SES-resilience domain can shed light on this.

I think the treatment of the meaning of resilience in the one way views on human-water systems (sections 3.1 and 3.2) is rather brief. I would especially like to see the application of the three elements of resilience that the authors defined, i.e. absorptive, adaptive and transformative capacities. In fact, in 31 the authors themselves the 'old' understanding of resilience when they discuss the water subsystem with anthropogenic hazards when they state that (p.5) 'the implicit goal of maintaining subsystem equilibrium or restoring it to a desired historical state' leads to 'resilience management' – surely in the authors' definitions this should read 'managing absorptive capacity'? In section 3.2 the same applies, as again in section 4.3.

Related to the above, why does transformative capacity not appear in the 'resilience canvas'? Is this maybe a possibility for coping that is beyond or against the authors' own norms and aspirations? If this is the case, it needs to be made explicit; however, the internal logic of the theoretical argument loses much strength: first resilience is three-part, then only two parts are used to assess resilience (absorptive and adaptive capacity).

My second major problem is the substitution of 'ecosystem services' for 'resilience' when assessing two-way interactions in human-water systems. In the justification that is presented, ecosystem services are clearly another way to look from the human to the natural system (p.8): 'a continuing supply of ecosystem services does not necessarily mean ecosystems are pristine or close to a 'natural' condition, but instead reflects the preference of the human subsystem to select for particular services'. It turns out that ecosystem services are hardly needed in the rest of the paper, so I suggest to remove it. However, this does leave one of the goals of the paper unfulfilled: to characterise the resilience of the human-water systems. In my view, a major re-think is needed here, or a reduction of the ambitions of the paper. The latter would be perfectly acceptable, since the conceptual content is considerable, as expressed especially in the figures.

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My final comments relate to the usefulness of the paper/the resilience canvas for policy making. One element of this discussion relates to the (perceived by the authors) need to specify what resilience means. This is commonly known as an activity of framing or structuring, with resilience classified as wicked or unstructured problem (Hisschemoller & Hoppe 1995; Hisschemoller et al 2001; Hoppe 2008). The authors seem to be aware of this (p.13): 'Resilience is not only a descriptive notion, and usually has normative (goal-setting) objectives'; also in section 3.2 'Resilience from the perspective of managing human subsystems thus emphasises particular societal norms and goals or normative aspirations in relation to hydrological hazards'. At the same time, they do not question the notion of 'desired state': desired by whom? In the conduct of research, it will be the researchers who decide what is desired (often based on ecological arguments). In other words: targets for the water system would be just as dependent on societal norms and aspirations!

Problem structuring is done when resilience is used within research, but even more so when it is stated as a policy objective, since it can be expected that stakeholders' values and interests diverge more than researchers'. I therefore question the notion that researchers should prescribe (i.e. pre-structure) how policy processes should engage with boundary or nirvana concepts like resilience – this should be done in the policy process. In fact, the literature on boundary objects (Molle 2008; Walker & Shove 2007) suggests that interpretative flexibility of goals is essential in policy making.

While I am fascinated by the way in which the authors depict pathways on the resilience canvas, I find the discussion in section 4.2 too general and too obvious. Neither the resilience canvas (or its derivation) nor the concept of socio-hydrology is necessary to make these general statements. Section 4.3 is again interesting [note: this is the only place ecosystems services make a brief appearance, not just as needing to be resilient but also sustainable (p.11 line 25): mentioning this term opens another can of worms at least as large as the resilience confusion!]. However, I do disagree that everywhere the current pathway can be described as 'people & water'. For example, the EA for

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England & Wales [NB: not UK!] approach to flood risk management in fact increases individual people's vulnerability by transferring responsibility to individuals rather than the EA.

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