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Hydrology and Earth System Sciences
Discussions

Interactive comment on "Socio-hydrological spaces in the Jamuna River floodplain in Bangladesh" *by* Md Ruknul Ferdous et al.

A. Wesselink

a.wesselink@un-ihe.org

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Reply to the comments of Anonymous Referee #1

We would like to thank our anonymous reviewer for his insightful and constructive comments. We apologize for our long silence; the lead authors were not aware of the HESS interactive method so we waited for all reviews to have been sent before replying. The comments from the reviewer have been reproduced in italic below, interspersed with our responses.

Referee comment: This is an interesting work based on a strong empirical and field based work. While I enjoyed reading the work, I was bothered by the concept of "socio-hydrological space" that the authors are pushing for. Why not just call it "social-

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hydrological system"? By calling it a "socio-hydrological space," what new things become possible that couldn't be achieved when you just simply call it socio-hydrological system? The notion of system has been around for long and it is exactly what the authors are trying to do. A system refers to an "integrated whole" and is composed of several interacting parts or elements. Of course, this assumes the presence of a boundary delineating which parts are inside the system and which are outside of it. And this boundary can be of different forms: spatial boundary, organizational boundary, ecological boundary, you name it. People specify these boundaries in an attempt to analyze and address specific research questions. So, system boundary is arbitrary and a system can be also nested within a higher level system. Let me challenge the authors. Can you define a larger socio-hydrological space that includes those three socio-hydrological spaces you described in the paper? I'm sure you could if you're comparing larger-level spaces between two very different regions. So, why not just use the term system? In social ecology, they use the term "social-ecological system." They don't use "social-ecological space."

Response: From all four reviewers' comments, we have come to the conclusion that the article in its current form does not yet convincingly define (and explain the need for) the concept of socio-hydrological spaces (SHS). We think SHS provides a methodological (and possibly paradigmatic) bridge between two contrasting approaches to studying human-water interactions: hydrosocial research based in sociology and human geography, and socio-hydrology based in hydrology and physical geography. These are described and discussed in Wesselink, A., Kooy, M. and Warner, J. (2017) "Socio-hydrology and hydrosocial analysisâĂŕ: toward dialogues across disciplines", WIREs Water 4(2) 1–14. Hydrosocial research take the messiness of the socionatural world as a given and results in location-specific narrative case study analyses with limited or no attempt at generalisation. Socio-hydrology looks to generalise findings from case studies through a system-approach using conceptual and mathematical models. "Socio-hydrological system" is thereby an abstract entity detached from the reality on the ground. We propose "socio-hydrological space" as a tool that helps to make the

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necessary intermediary step between the messy reality of the specific location (space) and the abstract system of conceptual and mathematical models. The primary function of SHS is as a lens through which to view the complex reality of specific cases in order to find patterns in human-river interactions, which can then be compared to patterns in other locations to see if further generalisation towards universal models is possible. Its use invites the researcher to have an open mind to the existence of expected or unexpected patterns in location-specific data using a thorough understanding of the location: society, economics, natural system, technical interventions, etc. Subsequently, other cases may be analysed in order to explore whether the same or different patterns occur. These patterns can then be generalised through the more formal conceptualisation of socio-hydrological systems. On the one hand SHS thereby relates to a specific space, on the other hand it helps to find general patterns of human-river interactions: it serves as a methodological intermediary step or bridge between hydrosocial research and socio-hydrology. We are not familiar enough with SES research to be able to identify a similar concept that could be useful in SES research. Also, we are not aware that research on socio-ecological systems includes an alternative paradigm besides SES research but are happy to be informed differently. One reason for launching SHS is the existence of two research paradigms and our wish to bring these together; if SES research does not have a second paradigm then one of reasons for proposing SHS is thereby obsolete. The importance of such an intermediary step is illustrated by the differences between our findings on human-river relations in the Jamuna floodplain and those by Di Baldassarre et al. published in several papers for the Po valley. From Di Baldassarre et al.'s analysis of human-river relations in the Po valley it appears that two alternative responses exist in time and space (levees or adaptation). This same pattern would also be broadly recognisable in other high income countries where control of the river is a financial and technical possibility, such as The Netherlands (levees) or USA (some locations have levees, at others adaptation is required). However, society along the Jamuna show both responses at the same time in one region, but at different locations (SHS1 and SHS2), with a third intermediary response (SHS3). We

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speculate that the greater variety in Bangladesh is due to less government budget and more difficult technical circumstances (the Jamuna is of a scale that renders most civil engineering works unsuccessful), but this remains for now an unexamined suggestion. If Di Baldassarre's findings are therefore taken to derive a general conceptual model for socio-hydrological systems along rivers, as in his subsequent publications with co-workers, the resulting models may be applicable to other rivers in similar conditions, but not to the Jamuna floodplain. Distinguishing socio-hydrological spaces in the field is therefore an important step in the search for generalisation of human-river interactions as they combine a place-based analysis with a presumption of the existence of generalisable patterns, without assuming that these patterns will be the same across the world. The proposition of using SHS to examine field data thereby also helps to overcome a bias towards high income, moderate climate regions in the study of (socio-) hydrology that was identified by James Linton (2008) in "Is the Hydrologic Cycle Sustainable? A Historical-Geographical Critique of a Modern Concept". Annals of the Association of American Geographers 98(3) 630-649. Regarding the question of boundaries, we agree that boundaries around a system are always arbitrary and selected in an attempt to analyse and address specific research questions, and a system can be also nested within a higher level system. However, the field data do suggest some boundaries as more logical or useful. In our case, the number of SHS that we found (three) is in first instance a result of the scale at which we explored the Jamuna human-river interactions (i.e. it is a result of the research scope/funding, not of the research question). However, we observe that the same pattern occurs along most of the Jamuna going downstream, until physical circumstances change too much and the river becomes tidal and under influence of cyclones. Going upstream, too, the pattern continues into India. While the three SHS we found are therefore first of all based on patterns in location-specific data, they can be generalised and used as a typology that can be applied elsewhere – but like the Po SHS they cannot be applied everywhere. It remains to be seen whether the same pattern of these three SHS occurs along other rivers and in other socio-economic conditions. Grouping the three SHS into one space

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does not make sense because the three SHS describe three distinct human responses to distinct hydrological conditions; grouping them would eliminate the usefulness of the SHS concept for distinguishing between these different relations. Conversely, we will be publishing further research that finds differences in human-river interactions within SHS1, depending on the level of protection offered by the levee and the degree of urbanisation. These differences could be argued to constitute different SHS, but here it is the research objective that indeed determines whether further splitting up of one SHS is useful. So the scale of analysis to some extent determines the level of detail included in the SHS that are recognised, but not absolutely since merging the three SHS we distinguish does not make sense. However, patterns of SHS (such as the two options proposed by Di Baldassarre, or our three SHS) can be used to compare two different regions, as suggested by the reviewer. We could then find some regions where the options are similar to the Po valley, and other where they are similar to those in the Jamuna floodplain. And we think other patterns will exist. We contend that these patterns do not constitute (formal, mathematically conceptualised) systems, but this may be an matter of vocabulary only.

Referee comment: I also would like to see more discussion on how flood coping strategies vary by SHS1-SHS3. The authors do describe something, but not detailed enough. More details on how individual level strategies (cropping pattern, migration strategies, home floodproofing) and group-level strategies (activities organized by communities) should be provided.

Response: We recognise that more detail how flood coping strategies vary by SHS1-SHS3 is of interest. However, the purpose of this paper is to introduce the concept of SHS and provide illustrations of its use. Unfortunately there is no space in the current article to present all detailes research that we are conducting on human-rover interactions in the Jamuna floodplain. We are currently preparing a publication that addresses this topic in much more detail, including the historical developments that we cannot properly address here. We hope that reviewer is prepared to wait for this other

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publication.

Referee comment: Figure 2 needs some improvement. Hard to see dotted line (levee). Hard to see boundaries of SHS1-3. If printed in B&W, these can't be distinguished.

Response: We will provide a clearer map in the revised manuscript.

Referee comment: I am also bothered by expressions like "adaptation space" and "levee effect space" in page 4. Adaptation and levee effect are emergent phenomena generated by system dynamics. I don't know what you mean by these can be rendered in terms of SHS.

Response: We agree that this terminology is not clear. We will reconsider this terminology in our revised paper.

Referee comment: Quite a few awkward grammars here and there. E.g., "channels more and more move into" (page 8).

Response: We apologize and will carefully review our language in the next version of the paper.

Referee comment: In page 15, the authors say "the concept provides a methodological and theoretical advance in the socio-hydrology." I am not convinced why this is so.

Response: We hope we have answered this concern in our reply to the first comment. In addition, because SHS are place bound, and can only be found (literally) on the ground, the use of SHS forces the researcher to actually go to the field, talk to inhabitants and officials, and obtain a thorough understanding of the specifics of the location. This also means that the use of SHS will make socio-hydrological analyses more policy-relevant. In terms of practical use, it can for instance be added as additional element to rapid rural appraisals, or other social assessments, to draw attention to how material conditions (hydrological and technical/infrastructure) co-shape social situations.

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