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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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Replies to Anonymous Referee #2

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: Ferdous and colleagues developed a new concept called 'socio-hydrological spaces' which they define as a geographical area with distinct hydrological and social features that give rise to distinct patterns and emergent behavior. They

then apply this concept to an analysis of the Jamuna River floodplain in Bangladesh. In case study they identify three distinct socio-hydrological spaces defined by geographical features and support this delineation with primary and secondary data. The example application is well supported by primary data collection. The application of mixed-method approaches is important in socio-hydrology and the topic is of interest to HESS readers. However, I do have a series of concerns that if addressed would strengthen the paper. I believe that with certain revisions it would be suitable for publication. The definition of 'socio-hydrological spaces' hints at two different types of spaces. The first is space as a geographical area. The second is space as a portion of the parameter space which leads to a distinct set of emergent dynamics. (The examples of the adaptation space and levy effect space on page 4 further raise the question of the second type of space.) In the case presented, geographical features (e.g. embankment) are used to divide the case area into three sub-areas with different dynamics. Because these geographic features define the dynamics of the system all of the unions exhibiting similar dynamics are spatially clustered. However, I can envision cases in which the features defining the socio- hydrological dynamics are social not physical features. In these cases, I am not sure the 'spaces' would be contiguous. How would this approach be applied to a case where geographical features are poorly aligned with system dynamics? Or is this tool suitable for only the cases where geographical features are aligned with system dynamics?

Response: We indeed use the concept of SHS in the two ways suggested by the reviewer. 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 necessary intermediary step between the messy reality of the specific location (space) studied by hydrosocial research and the abstract system of conceptual and mathematical models in socio-hydrology. 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 by distinguishing different types of interactions, i.e. the second use of SHS as parameter space within all types of human-river interactions. 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 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. To use the concept of SHS empirically, we propose a two-step approach. First, a thorough understanding of a specific floodplain system (geography, history, technology, societal occupation etc.) results in a preliminary classification of the study area into distinct SHS. Second, the classification is tested for statistical significance using available or newly collected data. If the classification is not statistically significant, merging or splitting of categories should be considered where different social dynamics may be the reason for splitting (repeat step 1). The concept suggests that the interactions between society and water are place bound because of differences in social processes and river dynamics, but also generalisable since similar SHS patterns may be found elsewhere. Rather than a generalized model for understanding how such interactions occur, the concept draws analytical attention to how flood dynamics co-evolve with societal dynamics. Such attention is useful anywhere in the world and for other socio-hydrological systems than floodplains.

Referee comment: In the definition section (pages 3-4), the authors present this concept/tool as an alternative to either narratives or mathematical models. However, in the case that follows the authors present both the ‘socio-hydrological space’ delineation

with a case narrative, which I think was effective. Rather than serving as an effective standalone tool, 'socio-hydrological spaces' compliments these other approaches. I think the author's argument for this tool would be more convincing if they could frame it as part of a broad research plan. For example, the authors note that SHS is descriptive not explanatory. If combined with other approaches could it enhance the explanatory power of a study?

Response: We agree with the referee that SHS is complementary to narrative and mathematical approaches; in fact we believe it can (or even should) serve as a bridge between them, as we have explained in our previous answer. From a policy perspective, as we mentioned in our paper the distinction of SHS 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. This would be useful for developing interventions under disaster management, but also other development goals.

Referee comment: While it is important to expand the approaches used to address socio-hydrological questions and to synthesize quantitative and qualitative data, this is not the first study to do so. The authors should acknowledge other efforts in this space such as data-driven narratives (Treuer et al. 2017) and the pairing of statistical analysis and narratives (Hornberger et al. 2015), and articulate what 'socio-hydrological spaces' adds.

Response: Thank you for pointing out some relevant narrative-cum-statistical studies that we should discuss. We will refer to these in our revised paper, with the caveat that these two papers discuss transitions in urban water management, which could be argued to relate to theory about socio-technical systems (as both papers acknowledge) with different drivers and conceptual models than those recognised in socio-hydrology research (see Van Staveren and Van Tatenhove, 2016: Hydraulic engineering in the social-ecological delta: understanding the interplay between social, ecological, and technological systems in the Dutch delta by means of 'delta trajectories'. Ecology and

Society 21(1):8). In fact, with SHS we are proposing a tool to help the comparison across cases which Treuer et al. (2015) identify as necessary next step: "Eventually, these narratives should be compared across cases". SHS offers the bridge between a specific case study, to identify patterns that can be compared to cases elsewhere.

Referee comment: I think there is potential for this concept to be used comparatively across say multiple flood plain cases. Please speak to this potential.

Response: We agree with you that there is potential for this concept to be used comparatively across multiple flood plain cases. We already referred to this in our answer to the first comment. 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, and whether other SHS patterns exist in other floodplains.

Referee comment: Lastly, there are some typographic errors and awkward phrasing in the manuscript and it would benefit from a thorough review.

Response: We will make corrections of the errors in our revised manuscript.

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