

Benefits from a geographers' perspective on human-water systems - the waterscape concept

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Recently a couple of theoretical foundations and concepts were developed such as hydro-sociology, hydro-economics and integrated water resources management in order to structure and process parameterizations of hydrological research and reflect human-water-interrelations. However, a remaining challenge in human-water-system research is that approaches like socio-hydrology still struggle to formalize hypotheses which are capable to capture the basic driving mechanisms of the dynamic human-water system beyond optimizing algorithms or the principle of optimality or entropy as the societal values and experiences may unfold diverging policy and society responses (cf. Troy et al. 2015).

Another challenge that we see is the integration of physical and social sciences with regard to the different epistemologies and perspectives: positivist thinking common in natural sciences and engineering and constructivist conceptualisation common in the social sciences.

Here, geographic research seeks to acknowledge multi-spatial perspectives of the different actors and entities and their integration into the physical system that needs mutual recognition of natural and social sciences concepts, theories and methods. We suggest for human-water system research a more geographic perspective, which we call waterscape concept. Water can be regarded as a key structuring element for landscape and its management and, hence, from our perspective, the dynamics in water resources and interrelation of actors and entities in its management also helps to better understand current landscape patterns, their developments and interrelations, respectively.

By our definition, a waterscape includes sources and users of water, their interactions, feedbacks and external influencing factors. It is therefore not only the physical space but rather includes the arena of actors and entities interacting. Against this understanding, waterscapes are defined by reciprocal boundary conditions which allow integrating the knowledge of natural and social sciences by acknowledging their different epistemologies, concepts and methods at the same time, hereby, fostering a true integration of the disciplines. Space and time and feedback loops are the three key factors to understand human-water interactions. Especially, by recognizing the degree of feedback sensitive system parameters can be detected and allow for emerging a set of multiple framings and possible development paths. Therefore, the geographical perspective on the waterscape concept proposes a search apart from one solution or best practice as, in our assumption, there are no single best answers because the human dimension and their action and reaction are guided also beyond perceptions, preferences, benefits and costs.

Our waterscape concept allows a multi-spatial and multi-disciplinary perspective on water and its projection into space by acknowledging multiple meanings, alternative framings and possible development paths, hence fostering an integrative perspective on human-water systems. It further provides a fruitful framework for transdisciplinary research approaches since it is open and supports societal co-production and reframing of knowledge and policies.

Troy, T. J., Pavao-Zuckerman, M., and Evans, T. P.: Debates Perspectives on socio-hydrology: Socio-hydrologic modeling: Tradeoffs, hypothesis testing, and validation, *Water Resour Res*, 51, 4806-4814, 10.1002/2015WR017046, 2015