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Syndromes of the global water crisis – exploring the emergent dynamics through socio-hydrological modeling

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There is a great variety of human water systems at the global scale due to the types and timing of water supply/availability, and the high diversity in water use, management, and abstraction methods. Importantly, this is largely driven by differences in welfare, social values, institutional frameworks, and cultural traditions of communities. The observed trend of a growing world population in combination with changing habits that generally increase our water consumption per capita implies that an increasing number of communities will face water scarcity. Over the years much research has been done in order to increase our understanding of human water systems and their associated water problems, using both top-down and bottom-up approaches. Despite these efforts, the challenge has remained to generalize findings beyond the areas of interests and to establish a common framework in order to compare and learn from different cases as a basis for finding solutions. In a recent analysis of multiple interdisciplinary subnational water resources case studies, it was shown that a suite of distinct resources utilization patterns leading to a water crisis can be identified, namely: 1) groundwater depletion, 2) ecological destruction, 3) drought-driven conflicts, 4) unmet subsistence needs, 5) resource capture by elite and 6) water reallocation to nature (Srinivasan et al., 2012). The effects of these syndromes on long-lasting human wellbeing can be grouped in the following outcomes: unsustainability, vulnerability, chronic scarcity and adaptation. The aim of this group collaboration is to build on this work through the development of a socio-hydrological model that is capable of reproducing the above syndromes and outcomes, ultimately giving insight in the different pathways leading to the syndromes. The resulting model will be distinct compared to existing model frameworks for two reasons. First of all, feedback loops between the hydrological, the environmental and the human agency components of the model are central to the model structure, thereby accounting for the co-evolutionary nature of human-water systems. Second, the model is designed to be general and integrative aimed at the simulation of emergent qualitative dynamics of the human-water system. The explicit inclusion of feedbacks and the aim of the model to capture the general dynamics as opposed to case-specific trajectories will allow us to deepen our fundamental understanding of the causal pathways leading to water crises across multiple locations.
All authors contributed equally to this work.

Srinivasan, V., Lambin, E.F., Gorelick, S.M., Thompson, B.H., Rozelle, S., 2012. The nature and causes of the global water crisis: Syndromes from a meta-analysis of coupled human-water studies. Water Resources Research 48(10), doi:10.1029/2011WR011087