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Model Informed Data Collection in Coupled Human-Water Systems: An Exploratory Application of a Hydrological and Agent-Based Model

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Hydrological systems in the Anthropocene have shown substantial shifts from their natural processes due to human modifications. Consequently, deploying coupled human-water modeling is a critical tool to analyze observed changes. However, the development of socio-hydrological models often requires extensive qualitative data collection in the field and analysis. Despite the advances in developing inter-disciplinary methodologies in utilizing qualitative data for coupled human-water modeling, there is a need to identify influential parameters in these systems to inform data collection. Here, we present an exploratory socio-hydrological model to systemically investigate the feedback system of public infrastructure providers, resource users, and the dynamics of water scarcity at the catchment scale to inform data collection and analysis in the field. Specifically, we propose a novel socio-hydrological model by employing and integrating a top-down hydrological model and an extension of Aqua.MORE Model (an Agent-Based Model designed to simulate dynamics of water supply and demand). Specifically, we model alternate behavioral theories of human decision-making to represent the agents' behavior. Then, we perform sensitivity analysis techniques to identify key socio-economic and behavioral parameters affecting emergence patterns in a stylized human-dominated catchment. We apply the proposed methodology to the Lake Mendocino Watershed in Northern California, US. The results will potentially point which parameters are influential and how they could be mapped to a particular interview or survey question. This study will help us to identify features of decision-making behavior for inclusion in fieldwork, that be might be overlooked in the absence of the proposed modeling. We anticipate that the proposed approach also contributes to the current Panta Rhei Research Initiative of the International Association of Hydrological Sciences (IAHS) which aims at improving the interpretation of the hydrological processes governing the socio-hydrological systems by focusing on their changing dynamics in connection with rapidly changing human systems.

