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Human-water interface in hydrological modeling: Current status and future directions

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The Earth's surface has undergone drastic changes due to the human-driven alteration of land use and vegetation patterns and the management of surface water and groundwater systems. Over the last century, the global population has quadrupled and currently exceeds 7 billion, half of which live in urban areas. Human needs for water are ever-increasing, dominated currently by agricultural irrigation for food production worldwide, while rapid urbanization and economic development are likely to be the main drivers for increasing water demands in coming decades. The phenomenal growth of the human footprint has significantly modified hydrological processes in various ways (e.g., irrigation, artificial dams, and water diversion) and at various scales (from a watershed to the globe). During the early 1990s, awareness of the potential for increased water scarcity led to the first detailed global water resource assessments. Shortly thereafter, in order to analyse the human perturbation on terrestrial water resources, the first generation of large-scale hydrological models (LHMs) was produced. However, at this early stage few models considered the interaction between terrestrial water fluxes and human activities, including water use and reservoir regulation, and even fewer models distinguished water use from surface water and groundwater resources. Since the early 2000s, a growing number of LHMs have incorporated human impacts on the hydrological cycle. Notwithstanding such growing sophistication, most current-generation of LHMs still fall short of simulating the direct human influence on the terrestrial freshwater systems, leaving the task of representing human land-water management activities within these models, and consequently in Global Circulation Models and Earth System Models, as one of the grand challenges for the hydrologic research community. In this talk I would like to provide a synthesis of progress in the development and application of human impact modeling in LHMs. Importantly, I would like to highlight possible ways forward for LHMs linking to emerging socio-hydrology that currently focus on understanding the detailed local and regional processes that integrate humans and water in a coupled hydrological-social system. This talk highlights a number of key challenges and discusses possible improvements in order to better represent the human-water interface in hydrological models.