Geophysical Research Abstracts
Vol. 21, EGU2019-2767, 2019
EGU General Assembly 2019

Surface water demand, supply, and connectivity across watersheds in the United States

Kai Duan, Peter Caldwell, and Ge Sun
Sun Yat-Sen University, School of civil engineering, Guangzhou, China (duank6@mail.sysu.edu.cn)

Surface water supply for a watershed relies on local water generated from precipitation and river flow connections with other watersheds. These connections are confined by topography and infrastructure, and respond diversely to stressors such as climate change, population growth, increasing energy and water demands. We categorized and quantified the natural and anthropogenic water connections among the 2,099 8-digit Hydrologic Unit Code watersheds across the conterminous United States, including upstream flows, inter-basin water transfers, water withdrawals and return flows. An integrative simulation and evaluation framework was then established to investigate the responses of regional water availability and water stress level (the ratio of demand to supply) to the changing environment. During 1981-2010, upstream water and water supplied by inter-basin transfers provided adequate freshwater supply for 12% of the country, while another 14% areas were still highly stressed. Our projections under future climate scenarios suggest that highly water-stressed areas may expand from 14% to 18% and the stressed population would increase from 19% to 24% by 2070-2099. Climate-change mitigation practices such as energy structure reform and technology innovation could largely offset these trends by reducing water demand and enhancing supply. At the watershed scale, the spatially heterogeneous responses to future changes suggest that regional water connectivity could significantly buffer the potential stress escalations due to the redistribution of water resources and diverse changes in consumptive uses and water supplies in different source areas. However, the projected future detrimental changes (e.g., depleting river discharges, larger demands of water withdrawal) may aggravate conflicts over water rights among regions and challenge our current water infrastructure systems. Our study raises questions about the potential over or under-estimation of climate change impact on water supply stress in areas where water connectivity is not properly accounted for. Further research should focus on the nonstationary role of water connectivity in affecting water supply security and also the interactions among water supply and multiple environmental and anthropogenic stressors.