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Global River Discharge and Water Temperature under Climate Change

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Climate change will affect the hydrologic and thermal regimes of rivers, which will have a direct impact on human water use and freshwater ecosystems. Here we assess the impact of climate change on river flows and water temperatures on a global scale, and identify regions that might become more critical for freshwater ecosystems and water use sectors. We used a global physically-based water temperature model linked to the macro-scale VIC hydrological model. The modelling framework was forced with an ensemble of bias-corrected Global Climate Model (GCM) output, resulting in global projections of daily river discharge and water temperature for the 21st century. Our results show a projected increase in the seasonality of river discharge (increase in high flow and decrease in low flow) for about one-third of the global land surface area. The largest water temperature increases are projected for river basins in Europe, North America, Southeast Asia, South Africa and parts of Australia. In these regions, the sensitivities for warming are exacerbated by projected decreases in summer low flows (resulting in a reduced thermal capacity). Large increases in river temperature combined with decreases in low flows were found for the southeastern U.S., Europe and eastern China. These regions could potentially be affected by increased deterioration of water quality and freshwater habitats, and reduced water available for beneficial uses such as thermoelectric power and drinking water production. Furthermore, we quantified how climate change will affect thermoelectric (nuclear and fossil fueled) power production potential in Europe and the U.S. over the next 20-50 years. The results show that the combination of lower summer flows and higher water temperatures under future climate will result in substantial reductions in thermoelectric power production potentials.