How climate change will exacerbate global water scarcity

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Water scarcity, in particular the dearth of renewable water resources for agricultural, industrial and domestic purposes, severely impairs food security and economic prosperity in many countries today. Expected future population changes will, in most countries as well as globally, increase water scarcity through increased demand. On the supply side, renewable water resources will be affected by projected changes in precipitation patterns, temperature, and other climate variables. The magnitude and pattern of hydrological changes however depend on complex interactions between climate, biosphere, and surface properties. Here we use a large ensemble of global hydrological models (GHMs) driven by five global climate models (GCMs) in the framework of the Inter-Sectoral Impact Model Intercomparison Project (ISI-MIP) to show that climate change is very likely to exacerbate the global water scarcity problem significantly. In particular, the simulation ensemble average projects that beyond a global warming of 1°C above 1980-2010 levels (approx. 1.5°C above pre-industrial), each additional degree of warming confronts an additional 7-10% of global population with a severe (>20%) decrease in water resources. A warming of 3°C is projected to enhance the global increase in absolute water scarcity, expected from population changes alone, by about 25%, together amounting to more 13% (5-30%) of the world population living at less than 500m3 annual runoff per capita by the end of this century. The projected impacts at different levels of global warming are similar across different climate change scenarios, indicating that dependence on the rate of climate change is low. At the same time, the study highlights significant uncertainties associated with these projections, resulting both from the spread among climate projections and from the GHMs.