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How climate change will exacerbate global water scarcity

Jacob Schewe (1), Jens Heinke (1), Dieter Gerten (1), Ingjerd Haddeland (2), Nigel Arnell (3), Douglas Clark (4), Rutger Dankers (5), Stephanie Eisner (6), Balázs Fekete (7), Hyungjun Kim (8), Xingcai Liu (9), Yoshimitsu Masaki (10), Felix Portmann (11,12), Yusuke Satoh (13), Tobias Stacke (14), Qiuhong Tang (9), Yoshihide Wada (15), Dominik Wisser (16), Torsten Albrecht (1), and the ISI-MIP Team

(1) Potsdam Institute for Climate Impact Research, Potsdam, Germany (jacob.schewe@pik-potsdam.de), (2) Norwegian Water Resources and Energy Directorate, Oslo, Norway, (3) Walker Institute for Climate System Research, University of Reading, Reading, UK, (4) Centre for Ecology & Hydrology, Wallingford, UK, (5) Met Office Hadley Centre, Exeter, UK, (6) Center for Environmental Systems Research, University of Kassel, Kassel, Germany, (7) Civil Engineering Department, The City College of New York, New York, USA, (8) Institute of Industrial Science, University of Tokyo, Tokyo, Japan, (9) Institute of Geographic Sciences and Natural Resources Research, Chinese Academy of Sciences, Beijing, China, (10) Center for Global Environmental Research, National Institute for Environmental Studies, Tsukuba, Japan, (11) Biodiversity and Climate Research Centre (LOEWE BiK-F) & Senckenberg Research Institute and Nature Museum, Frankfurt am Main, Germany, (12) Institute of Physical Geography, Goethe University Frankfurt, Frankfurt am Main, Germany, (13) Department of Civil Engineering, University of Tokyo, Tokyo, Japan, (14) Max Planck Institute for Meteorology, Hamburg, Germany, (15) Department of Physical Geography, Utrecht University, Utrecht, Netherlands, (16) Center for Development Research, University of Bonn, Bonn, Germany

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. Ex- pected 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.