A water scarcity assessment under Shared Socio-economic Pathways

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A comprehensive global water scarcity assessment for the 21st century was conducted under the latest socio-economic scenario for global change studies, namely Shared Socio-economic Pathways (SSPs). First, we developed a water use scenario which is compatible with SSPs. The SSPs depict five global situations based on substantially different socio-economic conditions during the 21st century. Water use scenarios were developed to reflect the key concepts underpinning each situation. Each scenario consists of five factors: irrigation area, crop intensity, irrigation efficiency, industrial water withdrawal, and municipal water withdrawal. The first three factors are used to estimate agricultural water withdrawal. All factors were developed using simple models based on a literature review and analysis of historical records. This scenario considers not only quantitative socio-economic factors such as population and electricity production but also qualitative ones such as the degree of technological change and overall environmental consciousness. Each factor displays a wide variation among the different global situations depicted: the irrigation area in 2085 varies between 270 and 450 km2, industrial water between 246 and 1714 km3 year-1, and domestic water withdrawal between 573 and 1280 km3 year-1. The factors are grid-based at a spatial resolution of 0.5°×0.5° and cover the whole 21st century. Then, we assessed water scarcity globally using a global water resources model called H08. H08 simulates both natural water cycle (related to water availability) and major human activities (related to water use) such as water withdrawal and reservoir operation. It simulates water availability and use at daily time interval at a spatial resolution of 0.5°×0.5°. A series of global hydrological simulations were conducted under the SSPs, taking into account different climate policy options and the projections of climate models. Water scarcity was assessed using an index termed Cumulative Withdrawal to Demand ratio, which is expressed as the accumulation of daily water withdrawal from river over the potential daily water consumption demand. This index can be used to express whether renewable water resources are available from rivers when required. The results suggested that by 2071-2100 the population living under severely water stressed conditions for SSP1-5 will reach 2588-2793×106 (39-42% of total population), 3966-4298×106 (46-50%), 5334-5643×106 (52-55%), 3427-3786×106 (40-45%), 3164-3379×106 (46-49%) respectively, if climate policies are not adopted. Even in SSP1 (the scenario with least change in water use and climate) global water scarcity increases considerably, as compared to the present day. This is mainly due to the growth in population and economic activities in developing countries, and partly due to hydrological change induced by global warming.

References

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