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Using probabilistic methods in water scarcity assessments: A first step towards a water scarcity risk assessment framework

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Globally, water scarcity and its societal consequences is recognized as one of the most important global risks for the present and the near future, both in terms of likelihood and impact. Governments and institutions managing water resources have to adapt constantly to regional water scarcity conditions, which are driven by climate change, climate variability, and changing socioeconomic conditions. Whilst a wide range of studies have assessed the role of long term climate change and socioeconomic trends on global water scarcity, the impact of inter-annual climate variability is less well understood. Moreover, the interactions between different forcing mechanisms, and their combined impact on changes in water scarcity conditions, are often neglected.

To address this issue, we provide a first step towards a framework for global water scarcity risk assessments, applying probabilistic methods to estimate water scarcity conditions for different return periods under current and future conditions while using multiple climate and socioeconomic scenarios. Using probabilistic methods not only enables us to integrate and evaluate the interactions between the different driving forces of water scarcity, and their influence on current and future water scarcity conditions. It also provides insights in the severity, distribution and impacts (population/GDP exposed) of low probability water scarcity events, events that are not easily studied in the conventional time-series analysis. Within this contribution we present the first insights of our study and discuss the opportunities and added value of a water scarcity risk assessment framework for water managers when evaluating adaptation strategies coping with water resources scarcity.

We carried out this assessment through the following steps: (1) Calculated yearly water availability (0.5º x 0.5º) over the period 1971-2099 using daily discharge and run-off fields from the global hydrological model PCR-GLOBWB, forced with different climate change scenarios; (2) Used statistical methods to fit probability density functions to time-series of yearly water availability covering the current, 2030, and 2050 conditions and estimated water availability for a number of return periods, varying from 2 up to 1000 years; (3) Calculated water scarcity conditions by assembling the water availability results with scenario estimates of population density and water consumption; (4) Assessed the impact of climate change, climate variability and socio-economic development on the severity and impact of water scarcity events under current and future conditions.