

Multi-type global drought projection using multi-model hydrological simulations

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A multi-drought projection that covers several drought types is required to better understand future drought. Although IPCC AR5 and SREX report state that drought is likely to intensify in several regions, overall confidence on drought is still low to medium in global scale projections. One of the reasons for such confidence levels stems from the divergent drought definition. Nonetheless, very few studies comprehensively discussed future drought taking several drought types into account within a single study, hence leaving a gap on the holistic picture of future drought.

This study presents a comprehensive multi-drought-type assessment on a global-scale until 2099. Using a set of multiple global hydrological model (GHM) simulations forced by four bias-corrected GCM projections, meteorological (precipitation), agricultural (soil moisture) and hydrological (runoff, discharge) droughts are investigated. The multi-model data set, which was developed in the Inter-Sectoral Impact Model Inter-comparison Project phase2b under a consistent simulation protocol, provides finer and detailed hydrological simulations at 0.5°x0.5° resolution. To explore potential pathways of drought changes, this study examined the Representative Concentration Pathways (RCP) 2.6, 6.0 and 8.5 scenarios. For each case, four drought features; drought intensity, spatial extent, the number of events, dry spell length, were studied, compared to those of the period before the 1960s.

The results highlight the hotspots of future droughts and show the development of each drought type for each RCP scenarios. As well as consistencies, differences among drought types were found in change trends and drought features. These differences indicate that it is crucial to clearly define drought type in discussing the phenomenon, and it is critical to properly select drought types and index for one's interest. Also, differences among RCP scenarios pose a question for climate target discussion from the viewpoint of drought. Two types of uncertainties in this projection with respect to model (GHMs and GCMs) uncertainty and parameter uncertainty in the drought analysis methods are also presented along with the drought projections.

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