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RESOURCE

Review article: Drought as a continuum – memory effects in interlinked hydrological, ecological, and social systems

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Description / Abstract

Droughts are often long-lasting phenomena, without a distinct start or end and with impacts cascading across sectors and systems, creating long-term legacies. Nevertheless, our current perceptions and management of droughts and their impacts are often event-based, which can limit the effective assessment of drought risks and reduction of drought impacts. Here, we advocate for changing this perspective and viewing drought as a hydrological–ecological–social continuum. We take a systems theory perspective and focus on how “memory” causes feedback and interactions between parts of the interconnected systems at different timescales. We first discuss the characteristics of the drought continuum with a focus on the hydrological, ecological, and social systems separately, and then we study the system of systems. Our analysis is based on a review of the literature and a study of five cases: Chile, the Colorado River basin in the USA, northeast Brazil, Kenya, and the Rhine River basin in northwest Europe. We find that the memories of past dry and wet periods, carried by both bio-physical (e.g. groundwater, vegetation) and social systems (e.g. people, governance), influence how future drought risk manifests. We identify four archetypes of drought dynamics: impact and recovery, slow resilience building, gradual collapse, and high resilience–big shock. The interactions between the hydrological, ecological, and social systems result in systems shifting between these types, which plays out differently in the five case studies. We call for more research on drought preconditions and recovery in different systems, on dynamics cascading between systems and triggering system changes, and on dynamic vulnerability and maladaptation. Additionally, we advocate for more continuous monitoring of drought hazards and impacts, modelling tools that better incorporate memories and adaptation responses, and management strategies that increase societal and institutional memory. This will help us to better deal with the complex hydrological–ecological–social drought continuum and identify effective pathways to adaptation and mitigation.

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