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Editorial: Emerging talents in water science: water and critical zone 2021/22

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Editorial on the Research Topic
Emerging talents in water science: water and critical zone 2021/22

1 Introduction

The lack of coordination among different hydrologic subdisciplines has long been a hindrance to the advancement of hydrologic theory and the development of integrated models capable of accurately predicting hydrologic processes across various temporal and spatial scales. However, recent developments in the field have introduced the concept of the "critical zone" (CZ), which represents an open and dynamic system extending from the upper reaches of the canopy down to the depths of the groundwater. This innovative approach serves as a unifying framework that brings together multiple hydrological subdisciplines and integrates them with related physical and ecological sciences (Giardino and Houser, 2015).

The National Research Council (NRC) provided an initial definition in 2001, describing the critical zone as the near-surface environment where interactions between rock, soil, water, air, and living organisms regulate natural habitats and determine resource availability (NRC, 2001; Brantley et al., 2007). Hydrology, which plays a crucial role in the critical zone, specifically the study of water movement, distribution, and quality, is an essential component of understanding the functioning and processes in the critical zone (Latour, 2014). The critical zone is shown in Figure 1.

Hence, to comprehensively grasp the recent strides in the field of water and the critical zone, this Research Topic features a compilation of five papers dedicated to exploring various dimensions of this subject. The collection encompasses studies on the ecohydrology of the critical zone (Moore et al., 2015), isotope hydrology (Guo et al., 2022; Zhou et al., 2022), human impacts on the critical zone (Duan et al., 2021, 2022), and critical zone processes—encompassing physical, chemical, and biological aspects—under the influence of a changing climate (Qin et al., 2022; Zhou et al., 2022). Additionally, the Research Topic delves into critical zone processes responding to alterations in the landscape (Chen G. et al., 2023; Chen X. et al., 2023), among other relevant aspects. This diverse range of papers aims to provide a holistic understanding of the complex interactions between water and the critical zone, offering insights into both natural processes and the anthropogenic influences shaping this vital environmental domain.

The following section concludes the individual articles hosted in this topics in alphabetical order according to the first author's name.

2 Overview of contributions

The five articles included in this topic primarily discuss the role of water as a transformative agent in shaping the structure, processes, and functions of the critical zone. Additionally, they explore water as a response variable, investigating how the composition and dynamics of its flow are influenced by the Critical Zone.

The first article focuses on the biogeochemical properties of soils and their crucial role in soil and stream chemistry within a watershed. It emphasizes the need to understand where and how certain soil water chemical processes occur within a catchment to maintain water quality (Gregory et al.).

The second article highlights the importance of the vertical and lateral extent of the critical zone in providing insights into the chemical and physical processes that connect surface life with geology at depths ranging from 10 to 100 meters (Uecker et al.).

The third article examines the signals transmitted by plant canopies, such as isotopes, sediment types, organisms, and chemical compounds associated with various biogeochemical processes or human impacts. It specifically focuses on the signals conveyed by precipitation draining down the stems of plants (stemflow) (Mabrouk et al.).

The fourth article discusses the significant amount of dissolved organic matter (DOM) transported to the ocean annually from terrestrial sources. It emphasizes the impacts of abiotic and biotic reactions on DOM characteristics and their subsequent effects on biogeochemistry and ecosystem function (Danczak et al.).

The fifth article analyzes a 9-year time series of nutrient cation and anion concentration and efflux from forested catchments in the Jemez River Basin Critical Zone Observatory. It investigates the pulse of chemical denudation resulting from varying levels of stand-replacing wildfire intensity and explores the mechanisms behind this pulsed release and subsequent recovery (Sánchez et al.).

3 Prospect

The critical zone plays a significant role in the formation of extreme weather events caused by climate change in recent years.

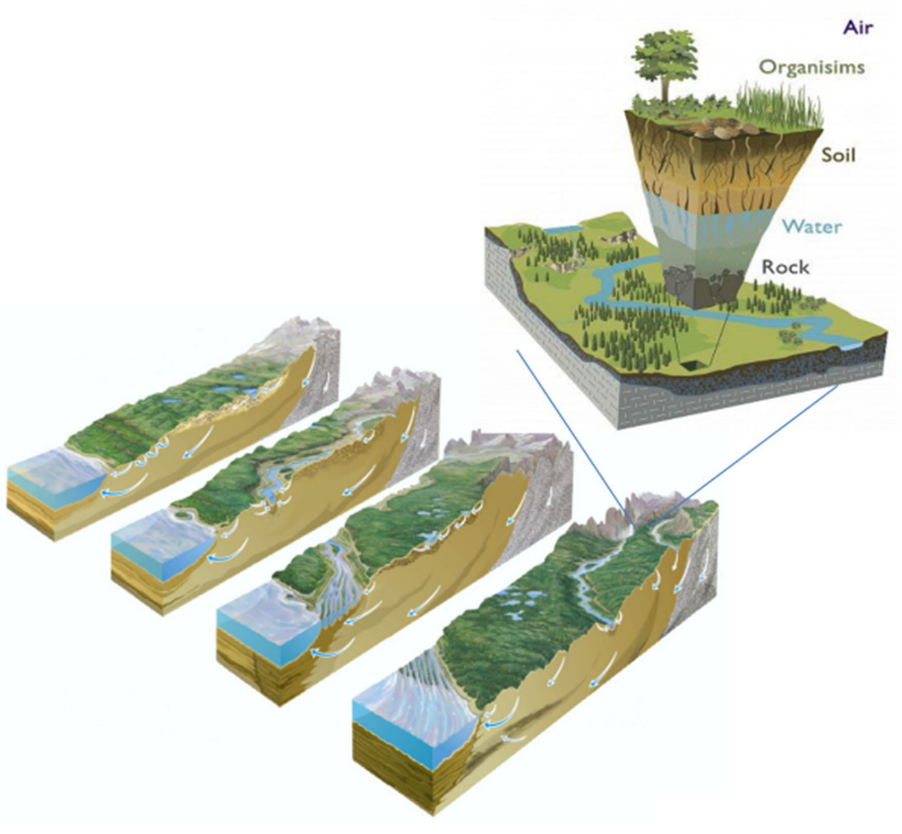

FIGURE 1
Schematic representation of the critical zone (Giardino and Houser, 2015).

The critical zone plays a crucial role in regulating water and nutrient cycles and supporting biodiversity, so any disruption due to extreme weather events can have lasting consequences (Wang X. et al., 2023). In the context of extreme weather events, critical zones are closely related to climate change, resulting in many problems such as Hydrological Cycle Disruption (Wang S. et al., 2023), Soil Erosion and Landslides (Wang et al., 2022), Wildfires, Sea Level Rise, Carbon Cycling (Kong et al., 2023), Biodiversity Loss (Weiskopf et al., 2020), Feedback Loops (Qiu et al., 2021).

Overall, the critical zone's interactions with climate change can contribute to the formation and exacerbation of extreme weather events. Understanding these interactions is crucial for developing effective strategies to mitigate the impacts of climate change and enhance the resilience of ecosystems and communities in the face of extreme weather events.

4 Conclusions

The focus on water in this Research Topic acknowledges its multifaceted impact on the Critical Zone. It goes beyond merely viewing water as a passive element affected by the Critical Zone; instead, it emphasizes the reciprocal relationship wherein the Critical Zone actively shapes and is shaped by water dynamics. By delving into this interplay, researchers contributing to this topic aim to enhance our understanding of the intricate connections between water and the Critical Zone, ultimately advancing knowledge in the fields of hydrology, geology, ecology, and beyond.

Author contributions

PL: Writing – original draft, Writing – review & editing. YuZ: Writing – original draft. YiZ: Writing – review & editing. KW: Writing – review & editing. JC: Writing – review & editing. QP: Writing – review & editing.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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