Editorial: New tools and techniques for advanced water resource management

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Editorial on the Research Topic
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Background

Water is essential for human health, agriculture, industrial processes, and ecological balance. However, the growing global population and the urge for continuous economic development have increased the pressure on water quality (Lapworth et al., 2018), leading to water scarcity in many regions of the world (MacDonald et al., 2016). Several factors contribute to quality water scarcity, including over-extraction of groundwater (Shamsuddua et al., 2011; MacAllister et al., 2022), inefficient water management practices, climate change, and unregulated disposal of waste into the waterbodies. Water pollution is a significant challenge, as it can degrade the quality of the limited freshwater sources, making them unsafe for human consumption and harmful to ecosystems.

Degradation of water resources by salinity (Krishan et al., 2021), emerging pollutants (Lapworth et al., 2018), and legacy contaminants from point and non-point sources, are an increasingly critical issue. This concern has also been raised by various agencies including the United States Environmental Protection Agency (US EPA). There have been already an acute water scarcity and polluting these resources will be alarming for the sustainability of these resources.

There is an urgent need to find the recharge sources and recharge zone of groundwater so that the water levels in aquifers can be managed by increasing the water levels. This can be done through fingerprinting of water and getting estimates of groundwater residence times by the use of environmental isotopes or environmental tracers (Lapworth et al., 2015; Krishan et al., 2021; 2023). The isotope techniques can also be used in the groundwater pollution studies (Krishan et al., 2021; 2022).

Globally, there is an urgent need to find sustainable solutions to the increasing scarcity of freshwater resources. With more advanced tools and techniques for assessing water resources and water quality, including Artificial Neural Networks (Lohani and Krishan, 2015), Machine Learning (Ghobadi and Kang, 2023), and Artificial Intelligence (Chang et al., 2023), there are possibilities to evaluate water-related issues and find the proper optimal management solutions for their sustainability.

This Research Topic contributes to the global challenge of achieving water security by presenting new insights and tools that can strengthen water management and policy. The studies cover a wide range of topics as below:

(i) Mihu-Pintilie et al. assess the groundwater pollution potential by ethnoarchaeological evidence based saline groundwater sources in the Eastern Carpathians and Sub-Carpathians area of Romania. This study is on saline groundwater sources and will be very much useful, since worldwide this issue has been discussed at various forums. Groundwater salinity has been observed in inland as well coastal aquifers.

(ii) Xiao et al. carried out study on age dating of stream water to understand various watershed hydrological processes and biogeochemical cycle. From age dating in addition to various components of hydrological cycle, we find the residence time of the water and is useful to the water managers and policymakers.

(iii) Thomas et al. in their study found that offshore freshened groundwater as a potential unconventional water in coastal city of Shanghai;

(iv) Gladish et al. in their study assessed and managed contamination risks and health hazards in mining areas. Authors found that mining is done at various scales and there is need to carry out the risk assessment along with studying the environment impacts.

(v) Day-Lewis et al. carried out a study on spatial distribution using quantification of hydrologic exchange flows for monitoring dam-regulated rivers. It was observed that to manage the overflows as well as water scarcity, one need to understand the spatial distribution as well as monitoring of the rivers to maintain environment flows.

This Research Topic culminates in the reputation to achieve water security and espousing aims to allow end-users to meet this societal challenge. It is a compendium of research articles on water crisis assessment, managing surface and groundwater resources, isotope dating tools supplementing hydrological valuation, and other issues and its sustainable attenuation through ingenious ideas and technologies that will be highly useful to the stakeholders, water managers, policymakers and academicians.

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Conflict of interest

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