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# Editorial: Environmental isotopes for water resource management

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Editorial on the Research Topic
Environmental isotopes for water resource management

In addition to physical and chemical hydrogeology, environmental isotopes have made significant contributions to the field in recent decades. Isotopes of the water molecule are used in many hydrogeological investigations (both surface water and groundwater) to learn about the water's quality, origin, recharge methods, rock-water interactions, hydrological processes, estimated ages, sources, channels, and current chemical tracers. For example, groundwater recharge in each area will develop a distinctive isotopic signature due to the change of oxygen and hydrogen isotopes of water by the meteoric process. Isotopes of nitrogen and sulfate can be used to trace the origin of pollution, while radon can be used to trace the path of weathering. Due to its capacity to effectively incorporate the small-scale variability of the physical and chemical behavior of water throughout multiple stages, isotope tracers have proven to be an invaluable tool for shedding light on hydrological processes at the watershed scale. Isotopes have been used as a valid tool to determine the residence time of groundwater in the aquifer matrix and to address the influence of climate change in groundwater. The recent studies have also indicated the use of isotopes in groundwater vulnerability assessments under changing climate. The microclimatic changes and their interrelationship to subsurface urban heat islands were linked to green house gas emissions like $N_2O$, which were studied using the stables isotopes of $^{15}N$ and $^{2}H$ in $N_2O$. The UN sustainable goal 6 focuses on water for all, this has been addressed by the International Atomic Energy Agency by emphasizing the use of isotopes for solving the basic human needs.

Several hydrogeological uses of environmental isotopes have been noted in arid and semiarid regions, where water shortage is particularly severe and hinders both economic growth and effective water management. Thus, the purpose of this Research Topic is to bring together experts from a wide variety of disciplines, practices, and environmental sectors to address global challenges on the quality and quantity of surface and groundwater resources utilizing environmental isotopes. The diversity of submissions received in this special issue is an indication of emerging and growing importance of environmental isotopes in hydrogeology research. The articles received in this Research Topic were critically discussed and analyzed the problems through innovative approaches.

This special issue features articles chosen to shed light on the wide range of environmental challenges now being investigated and addressed by scientists around the world.

To establish an isotopic baseline for Massachusetts, USA, Cole and Boutt presented the findings of regional and temporal isotopic analyses of precipitation, surface water, and groundwater across the state of Massachusetts. Water samples were collected and tested for $^{18}O$ and $^{2}H$ isotopes at a total of 516 surface water sites, 409 ground water sites, and 14 precipitation sites. The study has indicated that management and water resource assessment in the region can benefit from an understanding the impact of groundwater recharge and surface water storage effects throughout the hydrologic year affect the isotopic composition of surface and groundwater.

Water's chemical characteristics and its origin were evaluated using hydrodynamic, geochemical, and isotopic methods near the Ilaló volcano in Quito in order to pinpoint recharging zones and calculate the transit time in Tumbaco – Cumbayá – Los Chillos aquifer (Ecuador). They adopted a simple technique and Minimal Data (Manciati et al.). Based on the findings, it was inferred that the volcanic aquifer has low radiocarbon concentrations (<20 pmc), a recharge zone between 2,400 and 3,100 m above sea level and has a high mineralization. It appears that the volcano-sedimentary aquifer is highly heterogeneous and partially disconnected between the northern and southern parts of the Ilaló volcano and this heterogeneity may be attributed to volcanic ash lenses.

The significance of groundwater in the water balance of headwater catchments in northern Bavaria, Germany was investigated by Kaule and Gilfedder. The results of this study indicate that groundwater becomes an important component of aquatic ecosystems in headwaters during dry spells. According to the forecasts, this reliance will peak in the summer.

During the 41 days spanning May and July of 2019, researchers monitored a small tile-drained agricultural stream to assess the potential risk posed by Plant Protection Products (PPPs) to surface water quality (Cecilia et al.). The findings show that PPPs in aquatic ecosystems are dynamic, with the latter becoming more common due to climate change.

## Author contributions

PM: preparation of original draft. CS, VS, and SS: editing. All authors contributed to the article and approved the submitted version.

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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.

## Publisher's note