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# Editorial: Pollution and environmental water quality of river and streams

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Editorial on the Research Topic
Pollution and environmental water quality of river and streams

Pollution of rivers and streams is primarily the result of human activities, leading to significant environmental damage and health risks. Despite industrial-scale activities and inadequate wastewater treatment, many regions still maintain lenient policies regarding the permissible limits of contaminants in water bodies. This pollution causes chemical and biological changes in freshwater ecosystems, underscoring the need for regular monitoring in accordance with government regulations, particularly when rivers are sources of drinking water. This Research Topic, "*Pollution and environmental water quality of river and streams*," features contemporary research on the assessment of water quality in rivers and streams. The contributions include studies on multi-year assessments of phytoplankton fluorescence, impacts of mountain top removal coal mining on streams, monitoring of water quality disturbances, plastic monitoring and remobilization, modeling frameworks for water environment simulation, and machine learning estimations of nutrient concentrations (Figure 1).

In the article "*A multi-year assessment of phytoplankton fluorescence in a large temperate river reveals the importance of scale-dependent temporal patterns associated with temperature and other physicochemical variables*" by Mimouni et al., a long-term ecological study was conducted on the St. Lawrence River utilizing high temporal resolution data collected hourly, daily, and weekly from 2014 to 2018. This research utilized uninterrupted high temporal resolution data to examine phytoplankton fluorescence variables and their environmental drivers. The study identified large, yearly-scale patterns driven by seasonal changes in temperature and water discharge, with finer-scale patterns related to dissolved organic matter and weather variables. Overall, this study outlines a method to relate changes in phytoplankton abundance in a large river system, as indicated by pigment fluorescence (phycocyanin, chlorophyll a), to environmental variables across multiple observational scales, ranging from daily to annual. The applied variation partitioning approach can address sociologically relevant issues such as identifying conditions that closely relate to the onset of harmful Cyanobacteria blooms, which negatively impact water quality for human consumption, and understanding large-scale changes in water quality due to land use practices and climate change.

Burke et al. focused on understanding the impacts of mountaintop removal (MTR) coal mining on stream ecosystems in the Central Appalachians, USA. MTR coal mining significantly alters the landscape, affecting stream hydrology, channel geomorphology, and water quality, which can severely impair stream ecological integrity.

The results showed that five of the eight structural parameters had significant responses, with higher means in the MTR-impacted streams than in the forested streams. These changes were attributed to alterations in the source or augmentation of the original source of C and N due to MTR coal mining. The most effective structural indicators were nitrate concentration and the stable carbon isotopic ratio of dissolved inorganic carbon. In contrast, only three of the 14 functional indicators measured showed significant responses to MTR coal mining, with higher means in the forested streams. This suggests that MTR-related stressors reduced some aspects of microbial cycling, but resource subsidies might have mitigated some of the inhibitory effects, leading to no observable changes in most functional indicators. The detritus base, which contributes to functional stability, was likely maintained in the MTR-impacted streams by channel storage and leaf litter inputs from largely intact riparian zones. Overall, the study supports the hypothesis that certain functional processes are more resistant to stress-induced changes than structural properties. However, it also highlights the challenge of identifying suitable functional indicators for assessing ecological integrity.

In their method article Tunby et al. developed a protocol for rapid response research teams to monitor water quality disturbances caused by events such as wildfires and mine spills. Their study assessed the longitudinal propagation of disturbances from the 2022 Hermit's Peak—Calf Canyon wildfire in New Mexico using high-resolution data collected hourly and daily. The specific

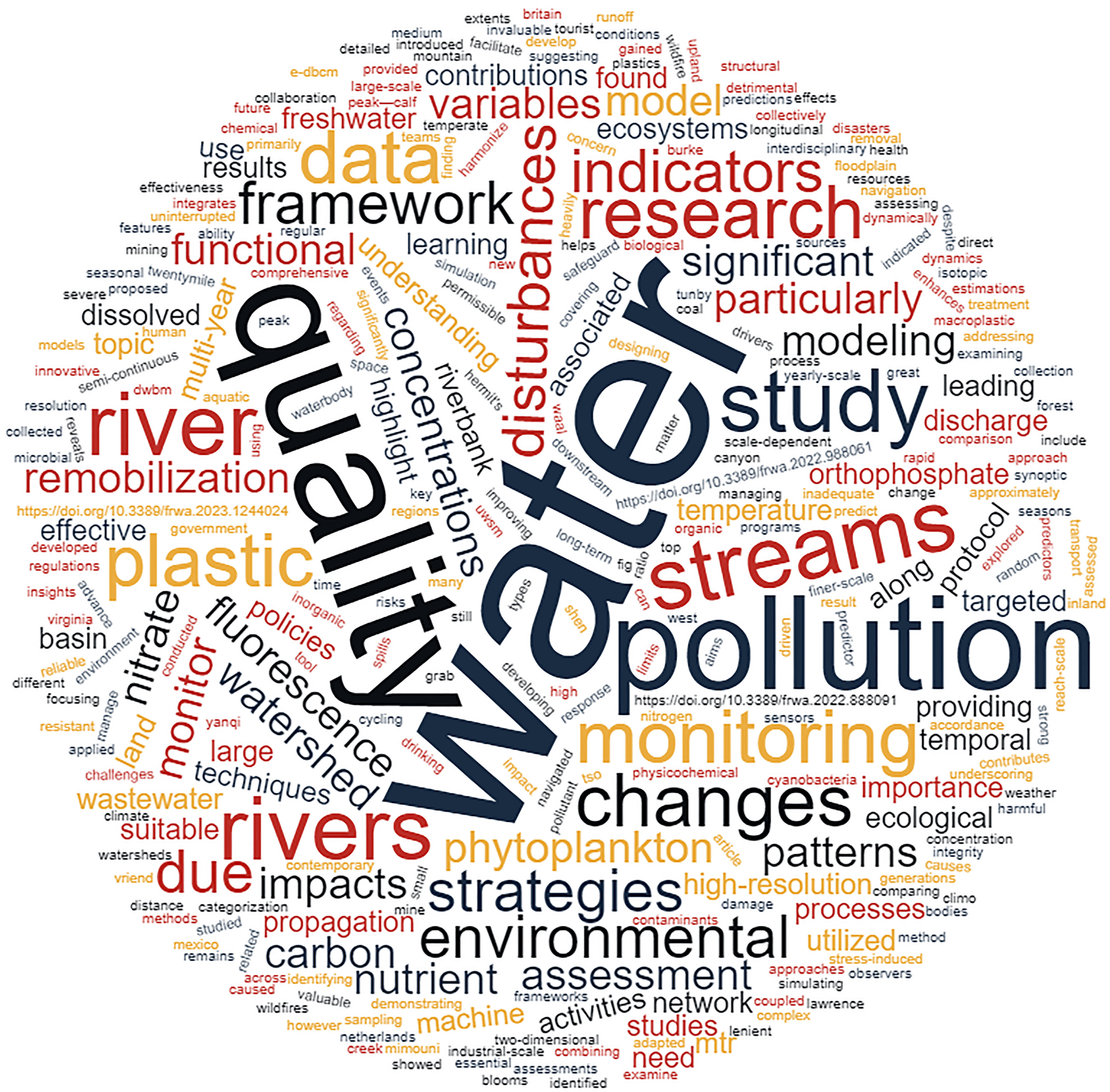


FIGURE 1
Word cloud generated from the abstract and conclusion from the seven papers contributed toward the Research Topic.

water quality (WQ) parameters studied included temperature, pH, turbidity, and concentrations of dissolved oxygen, nitrates, and heavy metals. High-resolution water quality data were collected using semi-continuous sensors and synoptic grab sampling, covering a propagation distance of approximately 190 km. This protocol can be adapted to monitor other types of environmental disasters, providing valuable data for managing water quality.

Vriend et al. introduced a framework designed to improve and standardize riverbank macroplastic monitoring strategies. The study highlights the importance of monitoring river plastic pollution to develop effective mitigation and removal strategies. This framework is the first systematic effort to compare and harmonize current monitoring protocols. Their framework identifies four key elements (space, time, observers, plastic categorization) essential to riverine monitoring protocols. They also identify trade-offs made in current monitoring protocols during their design processes. Regular and long-term monitoring using such a protocol would yield scientifically sound and objective data on global plastic pollution. This data is crucial for understanding how plastic is transported within river systems, where it accumulates, and how to remove it efficiently. Ultimately, these insights can inform the development of targeted and effective policies to reduce plastic pollution and mitigate its adverse effects on the environment.

Climo et al. examined the impact of plastic pollution on riverine systems, focusing on how rivers act as pathways for plastic transport to the sea. The study specifically investigated the process of plastic remobilization from riverbanks, which is poorly understood. The researchers focused on the wave action caused by inland navigation, a significant factor in anthropogenic rivers, to assess its effect on the remobilization of land-based plastics. They conducted their study along the riverbank of the River Waal in the Netherlands, a heavily navigated river, providing a real-world context for assessing remobilization. In their experiment, plastic pieces were placed at standardized distances from the average waterline at various locations along the riverbank. The study found that wave action from inland navigation significantly contributed to the remobilization of plastics on the riverbank. Several factors were identified as significantly affecting the probability of remobilization, including the distance of the plastic object from the waterline, wave height, riverbank slope, and plastic size. The strongest remobilization effect was observed for plastics located within 1.0 meter from the waterline. With a wave height of 0.5 meters or more, all plastics within 3.0 meters from the waterline were remobilized, potentially leading to downstream transport through the river. This research enhances the fundamental understanding of how inland navigation influences plastic pathways and highlights the importance of addressing these drivers to tackle plastic pollution effectively.

Shen et al. introduced a dynamically coupled modeling framework (E-DBCM) that integrates an upland watershed model (UWSM) with a two-dimensional downstream waterbody model (DWBM). The specific water quality parameters measured included nutrient concentrations (nitrates, phosphates), dissolved oxygen, and various pollutants (e.g., heavy metals and organic contaminants). This framework was applied to the Yanqi River Basin, demonstrating its effectiveness in simulating pollutant transport processes. The study found that water pollution in the basin was particularly severe during peak tourist seasons due to direct wastewater discharge. This model is particularly suitable for small and medium watersheds, providing a reliable tool for water quality assessment.

Tso et al. utilized machine-learning techniques to predict nutrient concentrations in the river network of Great Britain. By combining a high-resolution reach-scale river network with random forest models, the study provided detailed predictions of nitrate and orthophosphate concentrations. The results indicated that land use was a strong predictor for nitrate, while floodplain extents and runoff were key predictors for orthophosphate. This approach enhances the ability to monitor nutrient pollution and develop targeted strategies for improving water quality. Their model showed slightly better performance for higher Strahler stream orders, highlighting the challenges of making predictions in small streams. The results revealed that arable and horticultural land use is the strongest and most reliable predictor for nitrate, while floodplain extents and standard percentage runoff are stronger predictors for orthophosphate. Nationally, higher orthophosphate concentrations were observed in urbanized areas. This study shows how combining a river network model with machine learning can easily provide a river network understanding of the spatial distribution of water quality levels.

The contributions to this Research Topic collectively advance our understanding of pollution dynamics and water quality in rivers and streams. They highlight the importance of innovative monitoring techniques, comprehensive modeling approaches, and interdisciplinary collaboration in addressing the complex challenges associated with water pollution. The insights gained from these studies are invaluable for developing effective policies and strategies to safeguard our freshwater resources for future generations.

## Author contributions

LP-C: Conceptualization, Investigation, Methodology, Supervision, Writing – original draft, Writing – review & editing. SG: Conceptualization, Methodology, Software, Supervision, Writing – original draft, Writing – review & editing.

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