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Editorial: Advances in fluvial, coastal, wastewater, and hydro-environment systems, volume II

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Editorial on the Research Topic
Advances in fluvial, coastal, wastewater and hydro-environment systems, volume II

1 Introduction

Urban expansion, altered precipitation regimes, and the legacy of rigid infrastructure have intensified flash flooding, pollutant loading, and ecological fragmentation in riverine and coastal zones. Simultaneously, advances in analytical chemistry, satellite observation, numerical hydraulics, and spatial optimization now permit multi-scale investigation of coupled hydro-environmental processes. The Research Topic of "*Advances in Fluvial, Coastal, Wastewater and Hydro-Environment Systems*" brings together four recent studies spanning molecular water chemistry, catchment hydrology, wetland ecology, and economic optimization of rehabilitation to elucidate the interaction mechanisms of hydrology, land use, and engineered or nature-based structures. These efforts can help determine water quality, flow performance, and ecosystem integrity.

2 Methods overview

2.1 DOM characterization via spectroscopy and mass spectrometry

In Singapore's Kallang River and the Murderkill River in the USA, DOM was characterized using a suite of optical and chemical tools. UV–visible absorbance (e.g., A_{254} and A_{365}), excitation–emission matrix (EEM) fluorescence, and PARAFAC were employed to resolve

protein-like and humic components. Fluorescence index (FI), humification index (HI), and biogenic index (BIX) were calculated to infer the DOM source and reactivity. For the Murderkill study, 21 T FT-ICR mass spectrometry offered ultra-high-resolution insights into molecular formula distributions (e.g., CHON, CHOS, and CHONS classes) (Ouyang et al.).

2.2 GIS-based runoff forecasting

On Tsushima Island, Japan, researchers used 10 years of Landsat 8 imagery, Normalized Difference Vegetation Index (NDVI), and Digital Elevation Model (DEM) layers to classify land cover and estimate runoff coefficients. Runoff trends were extrapolated from 2014 to 2034, using hydrological modeling integrated into ArcGIS. Flood risk was zoned by overlaying the runoff potential with slope and proximity to urban centers (Tallar et al.).

2.3 Wetland loss assessment in rural Ghana

Using three epochs of Landsat imagery (2000, 2015, and 2020), NDVI differencing, and the InVEST Habitat-Quality model, wetland loss and habitat degradation in the Greater Amanzule Wetland (Ellembelle District) were quantified under accelerating community and industrial expansion (Dawuda et al.).

2.4 Marxan cost–benefit optimization

The cost for fencing, planting, and maintaining a 40-m riparian buffer across 75,500 km of NSW streams was estimated. Marxan (100 runs; boundary-length modifier = 0.6) compared *ad hoc*, working-with-recovery (WWR) and corridor scenarios for current and 15-year recovery-potential rasters (Agnew et al.).

3 Cross-study synthesis

A common thread is the dominance of event-scale hydrological pulse-storms in DOM dynamics, vegetation loss in runoff escalation, and vortex shedding at bridge piers-in driving system instability. Vegetation is a dual regulator: it shapes DOM composition and runoff attenuation and can enhance pollutant deposition when incorporated into riparian rehabilitation. Economic optimization (Marxan) demonstrates that geomorphic and ecological information can be monetized, achieving large-scale rehabilitation at a fraction of the *ad hoc* costs.

4 Conclusion

Event-driven hydrology, land-cover conversion, and engineered nature-based structures jointly determine river system resilience. Molecular analytics refine pollutant fingerprints; satellite hydrology quantifies runoff trajectories; and optimization frameworks translate geomorphic insights into cost-efficient action. The Research Topic has shed light on future research trends, which should couple machine learning approaches with real-time sensor networks, embed habitat quality metrics in participatory planning, and improve the practicality of environmental–hydraulics knowledge in scalable nature-based solutions.

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