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Editorial: Flow, mass transport and ecological process in land-freshwater-marine ecosystems on earth

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Editorial on the Research Topic
Flow, mass transport and ecological process in land-freshwater-marine ecosystems on earth

Water is the most basic material circulating between land, freshwater, and marine environments; exerts important ecological functions; and provides significant economic products. Flow, mass transport, and ecological processes are critical determinants of flow-organism interactions in ecosystems at multiple scales and have very important impacts on the structure and function of aquatic ecosystems. Therefore, studies are needed to evaluate the mechanism analysis, process dynamic simulation, and optimal regulation of ecosystems at different scales. Particularly, ongoing climate warming and human activities have altered flow-organism interactions in different regions, including in land, freshwater, and marine ecosystems. It remains necessary to improve the understanding of the flow, mass transport, and ecological processes in land freshwater marine ecosystems on Earth.

This Research Topic aims to explore in-depth flow, mass transport, and ecological processes and their impacts on land-freshwater-marine ecosystems based on recent studies involving numerical modelling, on-site observations, lab experiments, and literature review. We hope that this Research Topic will provide a scientific basis for optimising the design and practice of different ecosystems in the context of climate change.

The Research Topic "Flow, Mass Transport and Ecological Process in Land-Freshwater-Marine Ecosystems on Earth" has brought together several articles reporting on new advances in this field.

In the opening paper of the Research Topic, "*The Effects of Accelerated Sea-Level Rise on Tidal Dynamics*", Li et al. use a long-term data series, from 1952 to 2020, to describe significant spatiotemporal variability of the tidal dynamics of the Pearl River Estuary, showing how coastal geomorphology, river discharge, and sea level together influenced the estuarine hydrodynamics.

Overall, net estuary fluxes under complex conditions have not been extensively evaluated by the scientific community. In the contribution, "*Analysis of the Influence of the Rubber Dam and Sea Ice Cover on Seawater Flux and Salinity Processes*" by Hu et al., the net inlet water inflow into the sea from 2017 to 2020 were calculated and evaluated based on field monitoring data of the water level, velocity, and salinity at the Liao River Estuary. The results provide an effective method and technical support for measuring seawater flux in other rivers.

Different heights of aquatic vegetation in natural rivers affect the hydrodynamic conditions of water flow, as shown in the study titled, "*Flow Characteristics of Double-Layered Rigid Vegetation Flow*". Wang et al. constructed a semi-analytical longitudinal flow velocity model in open-channel flows with double-layered rigid vegetation. The results of this model, verified with experimental data, provide a reference for environmental management and restoration of ecological rivers.

However, the role of polytrophic diversity in maintaining aquatic ecosystem versatility remains unclear. Xu et al. in "*Links Between the Species Richness and Ecosystem Functioning*", constructed a species addition experiment involving a diversity gradient to examine the relationship between biodiversity and ecosystem function within and across trophic levels. The results showed that the relationship between ecosystem species richness and ecosystem function at each trophic level was jointly regulated by the environment and time.

The simplified configurations of aquatic vegetation used in previous studies may mask or amplify the complex flow velocity and turbulent motion properties of submerged vegetation. The contribution "*Numerical and Analytical Methods to Study the Interaction Between Submerged Vegetation and Freshwater*" by Zhao et al. proposes an adjustment coefficient of the Karman constant to describe the complex vegetation morphology. The authors also discuss an improved mixed layer thickness formula for foliated vegetation and an expression for the Manning coefficient based on the analytical solution model of multi-layer flow velocity, providing a theoretical basis for vegetation ecological restoration.

Hydrodynamic analysis of the interaction between submerged vegetation and water flow has attracted considerable attention. The contribution "*Vertical Distribution of Water Flow Velocity in Submerged Vegetation*" by Zhang et al. proposes an analytical model for classifying water flow vertically into uniform, mixing, and logarithmic layers. The results showed that the longitudinal velocity of the model fitted well with measured values. Furthermore, the theoretical model can be applied to more complex velocity distribution cases.

However, the relationship between other commonly addressed ecological factors and macrophyte communities remains a challenge for management. In the contribution, "*Seasonal Variation and Nutrient Response Analysis on Macrophyte Community Diversity*" by Tian et al., the authors studied the composition of aquatic plant communities in lakes across different seasons and trophic states, showing that seasonal variation and nutrients jointly regulated the macrophyte community structure in lakes. These results can contribute to the management and restoration of eutrophic lakes.

Low spatial resolution limits the application of remote sensing images for conveying the surface water environment. As described in the contribution "*Super-Resolution Reconstruction of Sea Surface Pollutant Diffusion Images*", Duan et al. constructed a thermal infrared imaging dataset of thermal emission from cooling water of coastal power plants and used efficient sub-pixel convolutional neural network and enhanced super-resolution generative adversarial network models to reconstruct high-resolution remote sensing images. The two super-resolution models based on deep learning show application potential for improving water pollution detection.

Dams and large reservoirs are the main sources of suspended sediments in rivers. The contribution "*Fine Sediment and Water Retention in the Nile Damming*" by Herut et al. shows that fragmentation of the Nile River resulted in almost complete retention of fine sediments, leading to marine oligotrophication. Dissolved nutrients decreased because of anthropogenic sediment and water retention. This study provides a reference for analysing the ecological responses of other fragmented rivers worldwide.

Top-down approaches have also potential to manage the trophic state of aquatic ecosystems as shown by the study "*Phytoplankton Control Studies by Stocking Filter-Feeding Fish*" by Zhang et al., where monitoring data of filter-feeding fish stocked annually for ten years (2010–2020) were analysed in a typical subtropical highland reservoir in southwest China. The results showed that filter-feeding fish contributed significantly to reductions in the phytoplankton and zooplankton biomass. Despite further research is needed, this suggests that the optimal intensity of filter-feeding fish placement can help control phytoplankton.

The Research Topic compiled in this research theme improves the understanding of studies of flow, mass transport, and ecological processes in land-freshwater-marine ecosystems on Earth from multiple perspectives and provides a good example of the integration of multidisciplinary approaches.

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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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