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EDITED AND REVIEWED BY
Varsha Srivastava,
University of Oulu, Finland

*CORRESPONDENCE
Kang Xiao,
kxiao@ucas.ac.cn

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Editorial: Advanced characterization of dissolved organic matter in natural aquatic environments and water/wastewater treatment processes

Kang Xiao[1]*, Yingxun Du[2], Xing Zheng[3] and Qing Ding[4]

[1]Beijing Yanshan Earth Critical Zone National Research Station, College of Resources and Environment, University of Chinese Academy of Sciences, Beijing, China, [2]Nanjing Institute of Geography and Limnology, State Key Laboratory of Lake Science and Environment, Chinese Academy of Sciences, Nanjing, China, [3]State Key Laboratory of Eco-hydraulics in Northwest Arid Region, Department of Civil and Environmental Engineering, Xi'an University of Technology, Shaanxi, China, [4]Faculty of Science and Engineering, Chuo University, Tokyo, Japan

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Editorial on the Research Topic
Advanced characterization of dissolved organic matter in natural aquatic environments and water/wastewater treatment processes

Dissolved organic matter (DOM) is of great significance in both natural aquatic environments and water/wastewater treatment processes. Consisting of aromatic and aliphatic moieties with various molecular structures and functionalities, DOM intimately mediates the interplay among organics, inorganics, and microbes in aquatic media. It is a potential indicator for water quality monitoring and an active participator in the physical, chemical, and biological processes related to pollutant migration and transformation. However, exploration of DOM remains a challenge due to its structural complexity. In order to fully understand DOM's composition and fate, temporal and spatial distribution, dynamic variation processes, interactions with multiple media, and eco-environmental impact, it is in urgent need to develop advanced methods for DOM characterization with higher accuracy, wider detecting range, and more abundant information.

In this context, the current Research Topic "*Advanced characterization of dissolved organic matter in natural aquatic environments and water/wastewater treatment processes*" was focused on addressing specific investigations related to new advances in DOM characterization and potential applications of these methods in natural aquatic systems and water/wastewater treatment processes. This Research Topic includes three Original Research and one Mini Review article, which are summarized below.

In the first Original Research article, Cuss and Guéguen reported an on-line asymmetrical flow field-flow fractionation (AF4) instrument with coupled UV-visible absorbance and fluorescence detectors to characterize the spectroscopic properties of DOM as a function of molecular mass distribution. Parallel factor analysis (PARAFAC) and fractogram deconvolution were applied to the measurement data to decompose and distinguish the size distributions and fluorescence excitation-emission matrices (EEMs) from different components of DOM. This approach was found successful in assessing the contributions of different sources to mixtures of leaf leachate and riverine DOM in various proportions, using the proportion of a humic-like PARAFAC component ($0.93 < R^2 < 1.00$) and the ratios of deconvoluted size distribution peaks ($0.88 < R^2 < 0.98$) as important indicators.

In the second Original Research article, the AF4-EEM-PARAFAC approach was further utilized by Xue et al. to investigate the spatiotemporal evolution characteristics of riverine DOM. The molecular size distribution of fluorescent DOM components during river mixing and the corresponding variation were detected at multiple transects of a large boreal river in Canada. It was found that the size-resolved fluorescence can sensitively explore the negligible interaction of DOM during conservative mixing of the river and its tributaries. The PARAFAC loadings of terrestrial humic-like fluorescence normalized to absorbance at 254 nm (A_{254}) were useful indicators of the variation. This provides a potential approach for tracking source contributions and their evolution in fluvial systems.

The third Original Research article by Schuster et al. contributed to real-time monitoring of drinking water quality using a combined real-time fluorescence spectroscopy and flow cytometry. The fluorescence data was decomposed via the PARAFAC method and the flow cytometric data were analyzed by creating fingerprints based on differentiation into high and low nucleic acid (HNA/LNA) cells. The effectiveness of this approach was tested in a simulated contamination event of drinking water samples. It was found that the resolved fluorescent components can sensitively reflect organic contamination and resulted cell count variation in real time, and the flow cytometry signals related to HNA cells can provide early warning of bacterial growth potential. The combination of both methods for real-time monitoring can be a powerful tool to guarantee drinking water quality, and may be also useful for DOM characterization in other sources such as surface water and wastewater.

Finally, the Mini Review article by Zhang et al. comprehensively summarized the feasible methods for DOM sampling, pretreatment, instrumental measurement, and data analysis, with special attention paid to DOM in the alpine water environments. Recently, the importance of the alpine area on the frontlines of global climate change has been increasingly underlined because of its unique geographical and climatic conditions. However, the analysis of DOM in alpine water is challenged by the low concentrations and sampling difficulties in such remote areas. This article reviewed the various DOM characterization methods, involving chemometric/spectroscopic/structural analysis, for the assessment of alpine water quality and evaluation of anthropogenic effects on DOM-induced biogeochemical cycling. They discussed the pros and cons of various methods for the context of alpine water DOM, and provide suggestions for optimized sampling and pretreatment, high-sensitivity molecular characterization, and adaptive integration of different methods, which would be helpful for future research in this field.

Author contributions

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