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HPSEC reveals ubiquitous components in fluorescent dissolved organic matter across aquatic ecosystems

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Absorbance and fluorescence spectroscopy are efficient tools for tracing the supply, turnover and fate of dissolved organic matter (DOM). The fluorescent fraction of DOM (FDOM) can be characterized by measuring excitation-emission matrices and decomposing the combined fluorescence signal into independent underlying fraction using Parallel Factor Analysis (PARAFAC). Comparisons between studies, facilitated by the OpenFluor database, reveal highly similar components across different aquatic systems and between studies. To obtain PARAFAC models in sufficient quality, scientists traditionally rely on analyzing dozens to hundreds of samples spanning environmental gradients. A cross-validation of this approach using different analytical tools has not yet been accomplished. In this study, we applied high-performance size-exclusion chromatography (HPSEC) to characterize the size-dependent optical properties of dissolved organic matter of samples from contrasting aquatic environments with online absorbance and fluorescence detectors. Each sample produced hundreds of absorbance spectra of colored DOM (CDOM) and hundreds of matrices of FDOM intensities. This approach facilitated the detailed study of CDOM spectral slopes and further allowed the reliable implementation of PARAFAC on individual samples. This revealed a high degree of overlap in the spectral properties of components identified from different sites. Moreover, many of the model components showed significant spectral congruence with spectra in the OpenFluor database. Our results provide evidence of the presence of ubiquitous FDOM components and additionally provide further evidence for the supramolecular assembly hypothesis. They demonstrate the potential for HPSEC to provide a wealth of new insights into the relationship between optical and chemical properties of DOM.