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Riverine phytoplankton functional groups response to multiple stressors variously depending on hydrological periods

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Rivers and related freshwater ecosystems are facing increasing natural disturbance and anthropogenic stressors. Understanding the key ecological processes that govern the riverine biota in aquatic ecosystems under multiple pressures has crucial importance. However, there is still insufficient knowledge in quantifying of stressors interactions. Moreover, the understanding of the responses of riverine phytoplankton to multiple stressors is still scarce from interdisciplinary aspect.

As an interdisciplinary study, the catchment hydrological processes were linked to ecological responses in this study, and we chose phytoplankton functional groups (PFG) instead of taxonomic classifications of algae to examine their responses to land-use pattern (L), hydrological regime (H), and physicochemical condition (P) across two contrasting hydrological periods (dry, wet). The traits-based phytoplankton functional groups are highly suggested as robust bio-indicators for better understanding the current ecological status. The hydrological regime was described by a matrix indices of hydrological alteration (IHA) based on the outputs of a well-established ecohydrological model (SWAT).

The results from variation partitioning analysis showed that P and H dominate during the dry period and P in high flows, Structural equation models (SEM) showed that the skewness of 7 days discharge emerged as a key driver of H, and had always an indirect effect on functional group TB (benthic diatoms) during both hydrological periods. The functional group M (mainly composed by Microcystis) has directly related to phosphorous in both periods, while indirectly to L of urban area in high flow period, and water bodies in low flow period. This study emphasized that climate change and anthropogenic activities such as altering flow regime and land-use pattern affect directly or indirectly riverine phytoplankton via physicochemical conditions. In addition, our findings highlighted that biomonitoring activities require detailed investigation in different hydrological periods. SEM is recommended for improved understanding of phytoplankton responses to the changing environment, and for future studies to fulfill the increasing demand for sustainable watershed management regarding aquatic biota.