湖泊流域动态

本期导读

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Globally elevated chemical weathering rates beneath glaciers

Xiangying Li; Ninglian Wang;Yongjian Ding;等.

Physical erosion and chemical weathering rates beneath glaciers are expected to increase in a warming climate with enhanced melting but are poorly constrained. We present a global dataset of cations in meltwaters of 77 glaciers, including new data from 19 Asian glaciers. Our study shows that contemporary cation denudation rates (CDRs) beneath glaciers (2174 ± 977 Σ*meq+ m−2 year−1) are ~3 times higher than two decades ago, up to 10 times higher than ice sheet catchments (~150-2000 Σ*meq+ m−2 year−1), up to 50 times higher than whole ice sheet means (~30-45 Σ*meq+ m−2 year−1) and ~4 times higher than major non-glacial riverine means (~500 Σ*meq+ m−2 year−1). Glacial CDRs are positively correlated with air temperature, suggesting glacial chemical weathering yields are likely to increase in future. Our findings highlight that chemical weathering beneath glaciers is more intense than many other terrestrial systems and may become increasingly important for regional biogeochemical cycles.

（来源：Nature Communications 卷:13 期: 1 出版年: 2022, **DOI:** 10.1038/s41467-021-26231-w）

Recently constructed hydropower dams were associated with reduced economic production, population, and greenness in nearby areas

Peilei Fan; Myung Sik Cho; Zihan Lin;等

Hydropower dams produce huge impacts on renewable energy production, water resources, and economic development, particularly in the Global South, where accelerated dam construction has made it a global hotspot. We do not fully understand the multiple impacts that dams have in the nearby areas from a global perspective, including the spatial differentiations. In this study, we examined the impacts of hydropower dam construction in nearby areas. We first found that more than one-third of global gross domestic production (GDP) and almost one-third of global population fall within 50 km of the world's 7,155 hydropower dams (<10% of the global land area sans the Antarctic). We further analyzed impacts of 631 hydropower dams (≥1-megawatt capacity) constructed since 2001 and commissioned before 2015 for their effects on economy, population, and environment in nearby areas and examined the results in five regions (i.e., Africa, Asia, Europe, North America, and South America) and by different dam sizes. We found that recently constructed dams were associated with increased GDP in North America and urban areas in Europe but with decreased GDP, urban land, and population in the Global South and greenness in Africa in nearby areas. Globally, these dams were linked with reduced economic production, population, and greenness of areas within 50 km of the dams. While large dams were related with reduced GDP and greenness significantly, small and medium dams were coupled with lowered population and urban land substantially, and large and medium dams were connected to diminished nighttime light noticeably in nearby areas.

（来源：PNAS 卷:119 期: 8 出版年: 2022, **DOI:** 10.1073/pnas.2108038119）

Globally elevated chemical weathering rates beneath glaciers Unintended consequences of climate change mitigation for African river basins

Matteo, Giuliani; Jonathan R. Lamontagne; Mohamad I. Hejazi; 等

Emerging climate change mitigation policies focus on the implementation of global measures relying on carbon prices to attain rapid emissions reductions, with limited consideration for the impacts of global policies at local scales. Here, we use the Zambezi Watercourse in southern Africa to demonstrate how local dynamics across interconnected water–energy–food systems are impacted by mitigation policies. Our results indicate that climate change mitigation policies related to land-use change emissions can have negative side effects on local water demands, generating increased risks for failures across all the components of the water-energy-food systems in the Zambezi Watercourse. Analogous vulnerabilities could impact many river basins in southern and western Africa. It is critical to connect global climate change mitigation policies to local dynamics for a better exploration of the full range of possible future scenarios while supporting policy makers in prioritizing sustainable mitigation and adaptation solutions.

（来源：Nature Climate Change 卷:12 出版年: 2022, **DOI:** 10.1038/s41558-021-01262-9）

Superlinear scaling of riverine biogeochemical function with watershed size

Wilfred M. Wollheim; Tamara K. Harms; Andrew L. Robison; 等

River networks regulate carbon and nutrient exchange between continents, atmosphere, and oceans. However, contributions of riverine processing are poorly constrained at continental scales. Scaling relationships of cumulative biogeochemical function with watershed size (allometric scaling) provide an approach for quantifying the contributions of fluvial networks in the Earth system. Here we show that allometric scaling of cumulative riverine function with watershed area ranges from linear to superlinear, with scaling exponents constrained by network shape, hydrological conditions, and biogeochemical process rates. Allometric scaling is superlinear for processes that are largely independent of substrate concentration (e.g., gross primary production) due to superlinear scaling of river network surface area with watershed area. Allometric scaling for typically substrate-limited processes (e.g., denitrification) is linear in river networks with high biogeochemical activity or low river discharge but becomes increasingly superlinear under lower biogeochemical activity or high discharge, conditions that are widely prevalent in river networks. The frequent occurrence of superlinear scaling indicates that biogeochemical activity in large rivers contributes disproportionately to the function of river networks in the Earth system.

（来源：Nature Climate Change 卷:13 出版年: 2022, **DOI:** 10.1038/s41467-022-28630-z）

Unexpectedly minor nitrous oxide emissions from fluvial networks draining permafrost catchments of the East Qinghai-Tibet Plateau

Liwei Zhang; Sibo Zhang; Xinghui Xia;等

Streams and rivers emit substantial amounts of nitrous oxide (N_2O) and are therefore an essential component of global nitrogen (N) cycle. Permafrost soils store a large reservoir of dormant N that, upon thawing, can enter fluvial networks and partly degrade to N_2O, yet the role of waterborne release of N_2O in permafrost regions is unclear. Here we report N_2O concentrations and fluxes during different seasons between 2016 and 2018 in four watersheds on the East Qinghai-Tibet Plateau. Thawing permafrost soils are known to emit N_2O at a high rate, but permafrost rivers draining the East Qinghai-Tibet Plateau

behave as unexpectedly minor sources of atmospheric N_2O. Such low N_2O fluxes are associated with low riverine dissolved inorganic N (DIN) after terrestrial plant uptake, unfavorable conditions for N_2O generation via denitrification, and low N_2O yield due to a small ratio of nitrite reductase: nitrous oxide reductase in these rivers. We estimate fluvial N_2O emissions of 0.432 − 0.463 Gg N_2O -N yr^{-1} from permafrost landscapes on the entire Qinghai-Tibet Plateau, which is marginal (~0.15%) given their areal contribution to global streams and rivers (0.7%). However, we suggest that these permafrost-affected rivers can shift from minor sources to strong emitters in the warmer future, likely giving rise to the permafrost non-carbon feedback that intensifies warming.

（来源：Nature Communications 卷:13 期: 1 出版年: 2021, **DOI:** 10.1038/ s41467-022-28651-8）

Earth's sediment cycle during the Anthropocene

Jaia Syvitski; Juan Restrepo Ángel; Yoshiki Saito;等.

The global sediment cycle is a fundamental feature of the Earth system, balancing competing factors such as orogeny, physical–chemical erosion and human action. In this Review, values of the magnitudes of several sources and sinks within the cycle are suggested, although the record remains fragmented with uncertainties. Between 1950 and 2010, humans have transformed the mobilization, transport and sequestration of sediment, to the point where human action now dominates these fluxes at the global scale. Human activities have increased fluvial sediment delivery by 215% while simultaneously decreasing the amount of fluvial sediment that reaches the ocean by 49%, and societal consumption of sediment over the same period has increased by more than 2,500%. Global warming is also substantially affecting the global sediment cycle through temperature impacts (sediment production and transport, sea ice cover, glacial ice ablation and loss of permafrost), precipitation changes, desertification and wind intensities, forest fire extent and intensity, and acceleration of sea-level rise. With progressive improvements in global digital datasets and modelling, we should be able to obtain a comprehensive picture of the impacts of human activities and climate warming.

（来源：Nature Reviews Earth & Environment 卷:3 出版年: 2022, **DOI:** 10.1038/s43017-021-00253-w）

Phenology is the dominant control of methane emissions in a tropical non-forested wetland

Carole Helfter; Mangaliso Gondwe; Michael Murray-Hudson;等

Tropical wetlands are a significant source of atmospheric methane (CH4), but their importance to the global CH4 budget is uncertain due to a paucity of direct observations. Net wetland emissions result from complex interactions and co-variation between microbial production and oxidation in the soil, and transport to the atmosphere. Here we show that phenology is the overarching control of net CH4 emissions to the atmosphere from a permanent, vegetated tropical swamp in the Okavango Delta, Botswana, and we find that vegetative processes modulate net CH4 emissions at sub-daily to inter-annual timescales. Without considering the role played by papyrus on regulating the efflux of CH4 to the atmosphere, the annual budget for the entire Okavango Delta, would be under- or over-estimated by a factor of two. Our measurements demonstrate the importance of including vegetative processes such as phenological cycles into wetlands emission budgets of CH4.

（来源：Nature Communications 卷:13 出版年: 2022, **DOI:** 10.1038/s41467-021-27786-4）

Ice velocity and thickness of the world's glaciers

Carole Helfter; Mangaliso Gondwe; Michael Murray-Hudson;等

The effect of climate change on water resources and sea-level rise is largely determined by the size of the ice reservoirs around the world and the ice thickness distribution, which remains uncertain. Here, we present a comprehensive high-resolution mapping of ice motion for 98% of the world's total glacier area during the period 2017–2018. We use this mapping of glacier flow to generate an estimate of global ice volume that reconciles ice thickness distribution with glacier dynamics and surface topography. The results suggest that the world's glaciers have a potential contribution to sea-level rise of 257 ± 85 mm, which is 20% less than previously estimated. At low latitudes, our findings highlight notable changes in freshwater resources, with 37% more ice in the Himalayas and 27% less ice in the tropical Andes of South America, affecting water availability for local populations. This mapping of glacier flow and thickness redefines our understanding of global ice-volume distribution and has implications for the prediction of glacier evolution around the world, since accurate representations of glacier geometry and dynamics are of prime importance to glacier modelling.

（来源：Nature Geoscience 卷:15 出版年: 2022, **DOI:** 10.1038/s41561-021-00885-z）

Global mapping reveals increase in lacustrine algal blooms over the past decade

Xuejiao Hou; Lian Feng; Yanhui Dai;等

Algal blooms constitute an emerging threat to global inland water quality, yet their spatial and temporal distribution at the global scale remains largely unknown. Here we establish a global bloom database, using 2.91 million Landsat satellite images from 1982 to 2019 to characterize algal blooms in 248,243 freshwater lakes, representing 57.1% of the global lake area. We show that 21,878 lakes (8.8%) spread across six continents have experienced algal blooms. The median bloom occurrence of affected lakes was 4.6%, but this frequency is increasing; we found increased bloom risks in the 2010s, globally (except for Oceania). The most pronounced increases were found in Asia and Africa, mostly in developing countries that remain reliant on agricultural fertilizer. As algal blooms continue to expand in scale and magnitude, this baseline census will be vital towards future risk assessments and mitigation efforts.

（来源：Nature Geoscience 卷:15 出版年: 2022, **DOI:** 10.1038/s41561-021-00887-x）

The impact of vegetation on meandering rivers

Alessandro, Ielpi; Mathieu G. A., Lapôtre; Martin R., Gibling; 等

The Palaeozoic evolution of land plants revolutionized river geomorphology. However, the relationships between biotic forcing and channel dynamics are still debated and, as such, the impacts of anthropogenic stressors such as climate change, reduced biodiversity and aridification on modern meandering rivers and their biogeochemical fluxes remain poorly understood. In this Review, we propose a unifying framework based on field and modelling data that describes the stability and dynamics of meandering rivers in both the presence and the absence of land plants. Based on evidence from the pre-vegetation rock record and from modern systems, we emphasize that meandering streams can indeed arise in the absence of land plants. However, plant evolution provided widespread settings suitable for stable meandering systems through retention of floodplain mud, sediment baffling and mechanical strengthening of channel banks. Altogether, these processes slowed the characteristic rates of meander growth and floodplain-soil reworking by up to an order of magnitude. Continued

anthropogenic removal of riparian and watershed vegetation due to increased urbanization, deforestation, aridification and pollution could revert streams to pre-vegetation functioning, thereby increasing their channel and sediment mobility. Future research can use this framework to constrain the pace of ancient landscape processes on Earth and Mars, in addition to modern terrestrial rivers impacted by humans.

（来源：Nature Reviews Earth & Environment 卷: 3 出版年: 2022, **DOI:** 10.1038/s43017-021-00249-6）

The human factor in seasonal streamflows across natural and managed watersheds of North America

Nitin K. Singh & Nandita B. Basu

While it is established that climate change and human activities (for example, urbanization, dams) alter streamflows, there exists considerable uncertainty regarding the relative magnitude of their contributions. Most studies have focused on annual flows and found trends to be dominated by climate. Here we compare trends in seasonal flow totals for 315 natural and 1,957 managed watersheds across North America over 60 years (1950–2009). We find an amplification of seasonal flow trends in 44% of the managed watersheds, while 48% of the watersheds exhibit flow dampening. The magnitudes of amplification (20–167%) and dampening (5–52%) are substantial and vary seasonally. Multivariate models reveal that while rainfall, slope and forest cover are the key drivers of seasonal trends in natural watersheds, canals, impervious areas and dam storage dominate the responses in managed watersheds. Our findings of human-driven seasonal flow alterations highlight the need to develop adaptation strategies that mitigate the associated negative impacts.

（来源：Nature Sustainability 出版年: 2022, **DOI:** 10.1038/s41467-021-27786-4）

A large but transient carbon sink from urbanization and rural depopulation in China

Xiaoxin Zhang; Martin Brandt; Xiaowei Tong;等

China has experienced unprecedented urbanization and associated rural depopulation during recent decades alongside a massive increase in the total population. By using satellite and demographical datasets, we here test the hypothesis that urbanization and carbon neutrality are not mutually exclusive and that sustainably managed urbanization may even be an integral part of the pathway to reduce atmospheric CO_2. We show that, although urban expansion caused an initial aboveground carbon loss of −0.02 PgC during 2002–2010, urban greening compensates these original losses with an overall balance of +0.03 PgC in urban areas during 2002–2019. We further show that a maximum increase in aboveground carbon stocks was observed at intermediate distances to rural settlements (2–4 km), reflecting the decreased pressure on natural resources. Consequently, rural areas experiencing depopulation (−14 million people yr−1) coincided with an extensive aboveground carbon sink of 0.28 ± 0.05 PgC yr−1 during 2002–2019, while at the same time only a slight decline in cropland areas (4%) was observed. However, tree cover growth saturation limits the carbon removal capacity of forests and only a decrease in CO_2 emissions from fossil fuel burning will make the aim of carbon neutrality achievable.

（来源：Nature Sustainability 出版年: 2022, **DOI:** 10.1038/s41893-021-00843-y）

摘要精选

Global meta-analysis of microplastic contamination in reservoirs with a novel framework

Guo, Zhaofeng; Boeing, Wiebke J.; Xu, Yaoyang;等

Microplastic contamination in reservoirs is receiving increasing attention worldwide. However, a holistic understanding of the occurrence, drivers, and potential risks of microplastics in reservoirs is lacking. Building on a systematic review and meta-analysis of 30 existing publications, we construct a global microplastic dataset consisting of 440 collected samples from 43 reservoirs worldwide which we analyze through a framework of Data processing and Multivariate statistics (DM). The purpose is to provide comprehensive understanding of the drivers and mechanisms of microplastic pollution in reservoirs considering three different aspects: geographical distribution, driving forces, and ecological risks. We found that microplastic abundance varied greatly in reservoirs ranging over 2-6 orders of magnitude. Small-sized microplastics (< 1 mm) accounted for more than 60% of the total microplastics found in reservoirs worldwide. The most frequently detected colors, shapes, and polymer types were transparent, fibers, and polypropylene (polyester within aquatic organisms), respectively. Geographic location, seasonal variation and land-use type were main factors influencing microplastic abundance. Detection was also dependent on analytical methods, demonstrating the need for reliable and standardized methods. Interaction of these factors enhanced effects on microplastic distribution. Microplastics morphological characteristics and their main drivers differed between environmental media (water and sediment) and were more diverse in waters compared to sediments. Similarity in microplastic morphologies decreased with increasing geographic distance within the same media. In terms of risks, microplastic pollution and potential ecological risk levels are high in reservoirs and current policies to mitigate microplastic pollution are insufficient. Based on the DM framework, we identified temperate/subtropical reservoirs in Asia as potential high-risk areas and offer recommendations for analytical methods to detect microplastics in waters and sediments. This framework can be extended and applied to other multi-scale and multi-attribute contaminants, providing effective theoretical guidance for reservoir ecosystems pollution control and management.

（来源：WATER RESEARCH 卷:207 出版年: 2021, **DOI:** 10.1016/j.watres.2021.117828）

Improving the performance of machine learning models for early warning of harmful algal blooms using an adaptive synthetic sampling method

Kim, Jin Hwi; Shin, Jae-Ki; Lee, Hankyu; 等

Many countries have attempted to monitor and predict harmful algal blooms to mitigate related problems and establish management practices. The current alert system-based sampling of cell density is used to intimate the bloom status and to inform rapid and adequate response from water-associated organizations. The objective of this study was to develop an early warning system for cyanobacterial blooms to allow for efficient decision making prior to the occurrence of algal blooms and to guide preemptive actions regarding management practices. In this study, two machine learning models: artificial neural network (ANN) and support vector machine (SVM), were constructed for the timely prediction of alert levels of algal bloom using eight years' worth of meteorological, hydrodynamic, and

water quality data in a reservoir where harmful cyanobacterial blooms frequently occur during summer. However, the proportion imbalance on all alert level data as the output variable leads to biased training of the data-driven model and degradation of model prediction performance. Therefore, the synthetic data generated by an adaptive synthetic (ADASYN) sampling method were used to resolve the imbalance of minority class data in the original data and to improve the prediction performance of the models. The results showed that the overall prediction performance yielded by the caution level (L1) and warning level (L2) in the models constructed using a combination of original and synthetic data was higher than the models constructed using original data only. In particular, the optimal ANN and SVM constructed using a combination of original and synthetic data during both training (including validation) and test generated distinctively improved recall and precision values of L1, which is a very critical alert level as it indicates a transition status from normalcy to bloom formation. In addition, both optimal models constructed using synthetic-added data exhibited improvement in recall and precision by more than 33.7% while predicting L-1 and L-2 during the test. Therefore, the application of synthetic data can improve detection performance of machine learning models by solving the imbalance of observed data. Reliable prediction by the improved models can be used to aid the design of management practices to mitigate algal blooms within a reservoir.

（来源：WATER RESEARCH 卷:207 出版年: 2022, **DOI:** 10.1016/j.watres.2021.117821）

Loads and elimination of trace elements in wastewater in the Great Lakes basin

Pinter, Jacob; Jones, Bailey S.; Vriens, Bas.

The growing use of trace elements in industrialized societies is driving an increase in the occurrence of trace elements in anthropogenic waste streams globally. Yet, the large-scale sources of many trace elements to wastewater and their elimination during treatment remain poorly understood and potential environmental impacts on freshwater systems therefore unclear. We screened 42 wastewater treatment facilities in the North American Great Lakes basin and deployed a black-box approach to calculate representative estimates for average per-capita trace element loads and basin-scale effluent discharge rates, as well as trace element removal efficiencies across different treatment technologies. Our results show different removal of specific groups of trace elements during wastewater treatment: average removal efficiencies were 25% for alkali metals, 50% for alkaline earth metals, 74% for transition metals, and 85% for rare earth elements. Higher elimination of the majority of trace elements was generally achieved by more advanced, tertiary treatment types. Elemental loads generally followed natural abundance patterns, but anomalous loading rates were observed for various trace elements across the sampled facilities. By examining geospatial attributes of the sampled sewersheds, trends in select trace element loads were qualitatively tied to possible point sources and diffuse sources. Overall, these results illustrate the potential of wastewater surveillance to inform environmental management of emerging trace element contaminants.

（来源：WATER RESEARCH 卷:209 出版年: 2022, **DOI:** 10.1016/j.watres.2021.117949）

Identifying factors that affect mountain lake sensitivity to atmospheric nitrogen deposition across multiple scales

Burpee, Benjamin T.; Saros, Jasmine E.; Nanus, Leora;等

Increased nitrogen (N) deposition rates over the past century have affected both North American and

European mountain lake ecosystems. Ecological sensitivity of mountain lakes to N deposition varies, however, because chemical and biological responses are modulated by local watershed and lake properties. We evaluated predictors of mountain lake sensitivity to atmospheric N deposition across North American and European mountain ranges and included as response variables dissolved inorganic N (DIN = N-NH4+ + N-NO3$^-$) concentrations and phytoplankton biomass. Predictors of these responses were evaluated at three different spatial scales (hemispheric, regional, subregional) using regression tree, random forest, and generalized additive model (GAM) analysis. Analyses agreed that Northern Hemisphere mountain lake DIN was related to N deposition rates and smaller scale spatial variability (e.g., regional variability between North American and European lakes, and subregional variability between mountain ranges). Analyses suggested that DIN, N deposition, and subregional variability were important for Northern Hemisphere mountain lake phytoplankton biomass. Together, these findings highlight the need for finer-scale, subregional analyses (by mountain range) of lake sensitivity to N deposition. Subregional analyses revealed differences in predictor variables of lake sensitivity. In addition to N deposition rates, lake and watershed features such as land cover, bedrock geology, maximum lake depth (Z(max)), and elevation were common modulators of lake DIN. Subregional phytoplankton biomass was consistently positively related with total phosphorus (TP) in Europe, while North American locations showed variable relationships with N or P. This study reveals scale-dependent watershed and lake characteristics modulate mountain lake ecological responses to atmospheric N deposition and provides important context to inform empirically based management strategies.

（来源：WATER RESEARCH 卷:209 出版年: 2022, **DOI:** 10.1016/j.watres.2021.117883）

Molecular weight driving bioavailability and intrinsic degradation mechanisms of dissolved organic phosphorus in lake sediment

Ni, Zhaokui; Huang, Dongling; Xiao, Mengqi;等

The sediment dissolved organic phosphorus (DOP) for the internal phosphorus (P) loading has raised intensive concern, but its bioavailability and intrinsic degradation mechanism have not been fully elucidated. In this work, multi-techniques were combined to construct the response of sediments DOP's bioavailability to molecular weight (MW) based on ten lakes of China, thereby elucidating the intrinsic degradation mechanism of sediment DOP. A high percentage (74.5% on average) and significantly positive correlations with respect to different MWs were observed, highlighting the importance of DOP to dissolved P in sediments. DOP is mainly composed of a low MW (LMW) portion (63.8%) and the substances are primarily derived from microbial sources. Bioavailable DOP species were closely related to MW, with labile monoester P and diester P decreased with decreasing MW. Analysis of environmental processes showed that microbial utilization capacity and the characteristics of dissolved organic matter (DOM) with different MWs were the dominant drivers in determining the bioavailability of DOP. That is, microorganisms exhibit high DOM utilization capacity in LMW portion, promoting the degradation and transformation of bioavailable DOP species. Furthermore, the increased humic and fulvic-like substances by microbial degradation might in turn inhibit the enzymatic hydrolysis of LMW-DOP. This pattern explains why the contents of LMW-DOP are very high, but it contains less bioavailable DOP. By studying the bioavailability of sediment DOPs with different MWs, it is found that, under natural conditions, labile monoester and diester P in LMW-DOP have a high tendency to degrade than those in HMW-DOP. The results further show that, microbial utilization and DOM characteristics, as well as their linkage with DOP's bioavailability and degradability, have important implications for assessing DOP's degradation potential. The insights from this study might shed light on more effective strategies for mitigating the risks

of internal P loading.

（来源：WATER RESEARCH 卷:210 出版年: 2022, **DOI:** 10.1016/j.watres.2021.117951）

eDNA biomonitoring revealed the ecological effects of water diversion projects between Yangtze River and Tai Lake

Zhang, Lijuan; Yang, Jianghua; Zhang, Yong;等

Water diversion has been widely used to address water shortages and security issues. However, its long-term ecological impacts, particularly on the biodiversity and structure of the local community, have often been neglected due to limitations of conventional biomonitoring. Taking the water diversion projects from Yangtze River to Tai Lake (WDYT) as examples, environmental DNA (eDNA) metabarcoding was used to investigate the potential ecological impact of water diversion on the connected basins. Firstly, 136 phytoplankton genera/ species, including 31 cyanobacteria and 105 eukaryotic phytoplankton (Euk-phytoplankton), were identified from 26 sites by metabarcoding of 16S rDNA V3 and 18S rDNA V9 regions. eDNA metabarcoding showed an obvious advantage in detecting nano/pico-plankton (< 20 mu m in size) compared with the morphological approach. Secondly, more shared taxa and higher similarity of community composition were observed in Gonghu Bay/Zhushan Bay with its connected river than with the center of Tai Lake, indicating that water diversions were accelerating the biotic homogenization between different waterbodies. Skeletonema potamos, the native species of Yangtze River (4.04% of the total Euk-phytoplankton reads) was detected in different connecting regions of Tai Lake (0.03%-0.54% of the total Euk-phytoplankton reads), where its relative abundance was consistent with the influence of water diversion from Yangtze River. Furthermore, the introduction of S. potamos significantly affected the local community compositions of phytoplankton in Tai Lake. Finally, the ecological effect (e.g., taxa richness, community composition and species invasion) of the WDYT on phytoplankton in the west of Tai Lake was more significant than that in the east, which was consistent with the scale (volume and duration) of the water diversion projects. Overall, this study highlights the value of eDNA biomonitoring in the ecological impact assessment of water transfer projects.

（来源：WATER RESEARCH 卷:210 出版年: 2022, **DOI:** 10.1016/j.watres.2021.117994）

Vertically stratified water source characteristics and associated driving mechanisms of particulate organic carbon in a large floodplain lake system

Wang, Shuoyue; Gao, Yang; Jia, Junjie;等

Particulate organic carbon (POC) is an important component of lake organic carbon (C) pools, of which different factors drive vertical distributions and sources. This study used the dual stable isotope (delta C-13 and delta N-15) approach to investigate vertical POC sources and drivers in a large floodplain lake system. Findings showed that POC composition gradually changed from endogenous dominant to exogenous dominant sequentially from the surface layer to the bottom layer of Lake Poyang. Environmental factors associated with phytoplankton photosynthesis as well as nutrient levels primarily drove surface POC. Moreover, soil erosion, sediment deposition, and resus-pension strongly affected POC distribution and composition in the middle and bottom layers of the lake. POC sources were also affected by factors associated with vertical mixing, such as wind speed and water depth. Litter from C-3 plants significantly contributed to POC concentrations in the middle and bottom layers of the lake. Results from this study can benefit our overall understanding of the potential driving mechanisms of lake

C cycling processes, aquatic ecosystem functions, and pollutant migration.

（来源：WATER RESEARCH 卷:209 出版年: 2022, **DOI:** 10.1016/j.watres.2021.117963）

Particle size-related vertical redistribution of phosphorus (P)-inactivating materials induced by resuspension shaped P immobilization in lake sediment profile

Wang, Changhui; Wei, Zhao; Shen, Xinyi;等

Lake geoengineering with phosphorus (P)-inactivating materials to reduce sediment P loading is often used for eutrophication control. The redistribution of materials in sediment, especially those induced by resuspension, is reportedly a common phenomenon during practical applications, which may interfere with the pollution control. Notably, a recent study by the authors initially found that the heterogeneous properties of materials and sedi-ments varied the P immobilization in different sized sediments which exhibited diverse movement characteris-tics. Therefore, this study hypothesizes a particle size-related vertical redistribution of materials in the sediment profile induced by resuspension, which shapes sediment P immobilization at different depths. Based on two differently sized materials, lanthanum (La)-modified bentonite clay (Phoslock) and drinking water treatment residue (DWTR), this study found a weakened reduction of mobile P and bioavailable P pool by both DWTR and Phoslock in surface sediment after resuspension. As the depth decreased from 8 mu m fraction), which tended to become enriched in surface sediment after resuspension, while relatively large materials (e.g., 63 mu m fraction) regulated their redistributions and were more likely to be buried at the bottom of the sediments. Accordingly, to design appropriate strategies for lake geoengineering, relatively small materials (e.g., <8 mu m) targeting to immobilize both mobile and bioavailable P are typically recommended to be developed for restoration of lakes with frequent sediment resuspension.

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The influence of hydraulic characteristics on algal bloom in three gorges reservoir, China: A combination of cultural experiments and field monitoring

Yang, Zhengjian; Wei, Chenyu; Liu, Defu;等

It is essential to understand the mechanism of algal bloom and develop effect measures to control the hazard in aquatic environment, such as large reservoirs. In this study, a series of experiments, along with field observation from 2007 to 2016, were carried out to identify the hydrodynamic parameters that drive the algal bloom in the Three Gorges Reservoir (TGR), China, and their threshold values were determined. The results show that algae concentration was markedly diluted with a short retention time, and the threshold value of the retention time to avoid algal bloom was approximately less than 3 days. With strong stratification, the algae concentration was able to approach to the level of algal bloom in 10 days, even when the water temperature is lower than 12 degrees C. The ratio of mixing depth to euphotic depth (Zm/Ze) had significant negative correlations with both algae concentration and algae specific growth rate (SGR). The field monitoring data indicated that Zm/Ze is an important hydrodynamic parameter which sensitively affects algae growth and concentration. This study made the first attempt to determine Zm/Ze >2.8 to restrain algal bloom in the TGR. Our findings shed light on the influence of critical depth on the algal bloom in the TGR, and the results can serve to control algal bloom in reservoirs through discharge operation.

（来源：WATER RESEARCH 卷:211 出版年: 2022, **DOI:** 10.1016/j.watres.2021.118030）

Variation in the predictability of lake plankton metric types

Kakouei, Karan; Kraemer, Benjamin M.; Adrian, Rita

Statistical and climate models are frequently used for biodiversity projections under future climatic changes, but their predictive capacity for freshwater plankton may vary among different species and community metrics. Here, we used random forests to model plankton species and community metrics as a function of biological, climatic, physical, and chemical data from long-term (2000-2017) monitoring data collected from Lake Muggelsee Berlin, Germany. We (1) compared the predictability of well-known lake plankton metric types (biomass, abundance, taxonomic diversity, Shannon diversity, Simpson diversity, evenness, taxonomic distinctness, and taxonomic richness) and (2) assessed how the relative influence of different environmental drivers varies across lake plankton metric models. Overall, the metric predictability was highest for biomass and abundance followed by taxonomic richness. The biomass of dominant phytoplankton taxonomic groups such as cyanobacteria (adjusted-R-2 = 0.53) and the abundance of dominant zooplankton taxonomic groups such as rotifers (adjusted-R-2 = 0.59) and daphnids (adjusted-R-2 = 0.51) were more predictable than other metric types. The plankton metric predictability increased when grouping phytoplankton species according to their functional traits (adjusted-R-2 = 0.37 +/- 0.14, mean +/- SD, n = 36 functional groups) compared to higher taxonomic units (adjusted-R-2 = 0.25 +/- 0.15, n = 22 taxonomic groups). Light, nutrients, water temperature, and seasonality for phytoplankton and food resources for zooplankton were the main drivers of both taxonomic and functional groups, giving confidence that our models captured the expected major environmental drivers. Our quantitative analyses highlight the multidimensionality of lake planktonic responses to environmental drivers and have implications for our capacity to select appropriate metrics for forecasting the future of lake ecosystems under global change scenarios.

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Abrupt changes in the physical and biological structure of endorheic upland lakes due to 8-m lake-level variation during the 20th century

Bjorndahl, Judith A.; Gushulak, Cale A. C.; Mezzini, Stefano;等.

Climate-induced variation in lake level can affect physicochemical properties of endorheic lakes, but its consequences for phototrophic production and regime shifts are not well understood. Here, we quantified changes in the abundance and community composition of phototrophs in Kenosee and White Bear lakes, two endorheic basins in the parkland Moose Mountain uplands of southeastern Saskatchewan, Canada, which have experienced > 8 m declines in water level since similar to 1900. We hypothesized that lower water levels and warmer temperatures should manifest as increased abundance of phytoplankton, particularly cyanobacteria, and possibly trigger a regime shift to turbid conditions due to evaporative concentration of nutrients and solutes. High-resolution analysis of sedimentary pigments revealed an increase in total phototrophic abundance (as beta-carotene) concurrent with lake-level decline beginning similar to 1930, but demonstrated little directional change in cyanobacteria. Instead, significant increases in obligately anaerobic purple sulfur bacteria (as okenone) occurred in both lakes during similar to 1930-1950, coeval with alterations to light environments and declines in lake level. The presence of okenone suggests that climate-induced increases in solute concentrations may have favored the

formation of novel bacterial habitats where photic and anoxic zones overlapped. Generalized additive models showed that establishment of this unique habitat was likely preceded by increased temporal variance of sulfur bacteria, but not phytoplankton or cyanobacteria, suggesting that this abrupt change to physical lake structure was unique to deepwater environments. Such climate-induced shifts may become more frequent in the region due to hydrological stress on lake levels due to warming temperatures across the Northern Great Plains.

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Internal seiches as drivers of fish depth use in lakes

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Inland temperate lakes undergo various physical processes, such as thermal stratification, that dictate the spatial availability of suitable temperature and dissolved oxygen conditions. Here, we use intensive limnological monitoring and acoustic telemetry transmitters implanted in wild fish to document the magnitude and frequency of thermocline deflection events (i.e., wind driven internal seiches that lead to upwelling of hypoxic hypolimnetic water) and their influence on freshwater fish depth use in a coastal embayment of Lake Ontario. The embayment experienced around 100 internal seiche events during a 3-month period and tracking of walleye (Stizostedion vitreus) vertical positions in the water column showed clear trends of avoidance of low dissolved oxygen. Quantile regression showed a significant correlation between walleye vertical position and the depth of the 3, 4, and 5 mg L-1 oxyclines, with the 3 mg L-1 oxycline having the largest effect. Upwellings of the hypoxic hypolimnion forced walleye to use the water column above these fluctuating oxyclines (5(th) percentile, $p < 0.001$), with 94.2% of detections occurring at depths above the 3 mg L-1 oxycline. Understanding how fish respond to upwelling events (both temperature and oxygen) is important for fisheries assessment, management, and habitat restoration planning as there is clear avoidance of suboptimal oxygen conditions and sampling in the overcrowded fringes of these low-oxygen zones could artificially inflate population estimates.

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Spatiotemporal dependency of resource use efficiency on phytoplankton diversity in Lake Taihu

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The dependency of resource use efficiency (RUE) on phytoplankton diversity is key for understanding aquatic ecosystem responses to eutrophication and climate change. Here, we studied RUE of nitrogen (RUEN), phosphorous (RUEP), or silicate (RUESi) and the associated abiotic and biotic explanatory variables in 3,016 samples collected from 30 sites in Lake Taihu during 2005-2017, covering cyanobacteria- and macrophyte-dominated regions. We further examined spatiotemporal dependencies of RUE on phytoplankton taxonomic and functional diversity and their underlying drivers. The annual mean RUEsi of each site exhibited an overall increasing temporal trend, while that of RUEN and RUEP displayed U-shaped patterns over the study period. RUE was affected by nutrients and water temperature, and also was related to phytoplankton diversity in terms of Shannon diversity and functional dispersion diversity. Interestingly, RUE showed negative spatial dependencies on phytoplankton diversity. These negative spatial dependencies had decreasing temporal trends for RUEN and RUESi, while a hump-shaped pattern for RUEP. The dependencies were generally related to spatial environmental mean

of nutrients, such as nitrate and total phosphorus. Furthermore, RUE showed negative temporal dependencies on phytoplankton diversity mainly in the cyanobacteria-dominated region, while it was occasionally positive in the macrophyte-dominated region. These temporal dependencies were driven primarily by temporal environmental stability of nutrients, such as dissolved total nitrogen. Collectively, the direction and strength of spatiotemporal dependencies of RUE on phytoplankton diversity were influenced by nutrient status and stability. These findings can be considered in future environmental management plans for long-term sustainability of ecosystem functioning under global climate change.

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Geochemical focusing and burial of sedimentary iron, manganese, and phosphorus during lake eutrophication

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The redistributive transport of sedimentary, redox-sensitive metals such as iron (Fe) and manganese (Mn) along depth gradients in lakes or marine basins, and in particular the concentration of these elements at local depressions, has been described as geochemical focusing. However, the impact of variable redox conditions at the sediment-water interface on this process is not entirely understood. In this study, we report that the enrichment and burial of Fe, Mn, and associated phosphorus (P) in dimictic Lake Arendsee, Germany, has been affected by a transition from oligo-mesotrophic to eutrophic conditions in the first half of the 20th century. Eleven sediment cores (<50 cm long) were obtained from water depths ranging from 38.5 to 49.5 m, and analyzed for their elemental composition. The older, non-varved section, which was deposited prior ca. 1940 during oligo-mesotrophic conditions, contains up to 10 times higher Mn and 2.5 times higher Fe contents at the deep sites compared to corresponding intervals at shallower sites. Due to their high Fe content, sediments in this interval also contain up to eight times more P, at least partly owing to vivianite authigenesis. Burial of Mn occurred via Mn-carbonate authigenesis, possibly as rhodochrosite. Since ca. 1940, calcite and diatom varves have formed under eutrophic conditions, whereas Fe enrichment decreased and finally stopped due to fixation as pyrite in the shallow sites. Our results suggest that redox-controlled geochemical focusing determines the distribution of Mn and Fe, as well as the occurrence of authigenic minerals such as vivianite and Mn-carbonate.

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Measurement of microplastic settling velocities and implications for residence times in thermally stratified lakes

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Microplastics residence times in lakes are currently poorly understood. In this work, settling experiments with pristine and biofilm-colonized microplastic particles were combined with model calculations to evaluate settling velocities, particle distributions, and residence times in the epilimnion, metalimnion, and hypolimnion of a hypothetical stratified lake broadly based on Upper Lake Constance. Settling velocities of various biodegradable and nonbiodegradable polymers of various shapes, sizes, and biofilm colonization were measured in a settling column. The settling velocities ranged between similar to 0.30 and similar to 50 mm s(-1). Particle sizes and polymer densities were identified as primary controls on settling rates. Microplastic particles that had been exposed to a lake environment for up to 30 weeks were colonized by a range of biofilms and associated extracellular polymeric substances; surprisingly,

however, the settling velocity did not vary significantly between pristine and colonized microplastic particles. Simulated microplastic residence times in the model lake varied over a wide range of time scales (10(-1) to 10(5) d) and depended mainly on the size of the particles and depth of the lake layer. Long residence times on the order of 10(5) d (for 1-mu m microplastic particles) imply that for small microplastic particles there is a high probability that they will be taken up at some stage by lake organisms. As the lake retention time (similar to 4.5 years) is considerably shorter than the residence time of small microplastics, negligible quantities of these microplastic particles should be found in the lake sediment unless some other process increases their settling velocity.

（来源：LIMNOLOGY AND OCEANOGRAPHY，出版年:2022, **DOI:** 10.1002/lno.12046）

Drivers of phytoplankton responses to summer wind events in a stratified lake: A modeling study

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Extreme wind events affect lake phytoplankton by deepening the mixed layer and increasing internal nutrient loading. Both increases and decreases in phytoplankton concentration after strong wind events have been observed, but the precise mechanisms driving these responses remain poorly understood or quantified. We coupled a one-dimensional physical model to a biogeochemical model to investigate the factors regulating short-term phytoplankton responses to summer wind events, now and under expected warmer future conditions. We simulated physical, chemical, and biological dynamics in Lake Erken, Sweden, and found that strong wind could increase or decrease the phytoplankton concentration in the euphotic zone 1 week after the event, depending on antecedent lake physical and chemical conditions. Wind had little effect on phytoplankton concentration if the mixed layer was deep prior to wind exposure. Higher incoming shortwave radiation and hypolimnetic nutrient concentration boosted phytoplankton concentration, whereas higher surface water temperatures decreased concentrations after wind events. Medium-intensity wind events resulted in more phytoplankton than high-intensity wind. Simulations under a future climate scenario did not show marked differences in the way wind events affect phytoplankton concentration. These findings help to better understand how wind impacts vary as a function of local environmental conditions and how climate warming and changing extreme weather dynamics will affect lake ecosystems.

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Summer dynamics drive the microbial response to carbon and nutrient additions in a high-altitude lake

Dory, Flavia; Cavalli, Laurent; Franquet, Evelyne;等.

The predicted increase in allochthonous dissolved organic carbon (DOC) in high-altitude lakes is expected to alter the phytoplankton-bacterioplankton relationship. However, few studies address the influence of summer phytoplankton dynamics on microbial responses to DOC additions. We sampled natural plankton assemblages during two contrasting periods of summer in a high-altitude lake in the French Alps and subjected them to glucose and nutrient enrichments under two light conditions (dark or light) and two temperature conditions (10 degrees C or 18 degrees C). Our results indicate that glucose use by bacteria differs over the summer, depending on the availability of autochthonous DOC and the nutrient limitation. Glucose was consumed by bacteria more in early summer; however, biomass

increased with glucose addition more in late summer than in early summer. This pattern arose from the greater availability of phytoplankton-derived DOC in late summer, reducing the need for alternative carbon sources in late summer, when phytoplankton biomass was high. Mixotrophic taxa were stimulated after glucose additions both in early summer and in late summer. We found greater competition between bacteria and phytoplankton in late summer after glucose addition, linked to the summer nutrient limitation pattern. Our study thus highlights a differential response depending on the timing of summer DOC inputs. The global changes forecast for the French Alps should increase heterotrophic and mixotrophic processes in planktonic communities of shallow high-altitude lakes with vegetated catchments. This experimental study provides insights that will be useful in predicting ecological trajectories and in refining predictions of sentinel lakes' responses to global changes.

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Environmental drivers of taxonomic and functional variation in zooplankton diversity and composition in freshwater lakes across Canadian continental watersheds

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Canada is home to more lakes than any other nation, but there is a fragmented and limited understanding of the ecological status of these water bodies. Zooplankton are excellent bioindicators of lake health, given their central food web position. To date, many studies have investigated the effect of individual stressors on zooplankton communities, mediated through changes in water quality (e.g., macronutrients, temperature, or chemicals). Increasingly, stressors act simultaneously in lakes, often over extended periods of time. As part of the NSERC Canadian Lake Pulse Network project, pelagic zooplankton were sampled in 624 lakes across Canada, spanning six continental drainage basins. We evaluated the effect of 40+ environmental variables on zooplankton diversity and community composition, considering both taxonomic and functional approaches. We also tested specific hypotheses on the relationships between zooplankton communities and environmental conditions, including eutrophication, calcium, chloride, and fish predation. We found that lake morphometry variables were among the most important predictors of zooplankton diversity, while water quality metrics were more critical in explaining variation in community composition. Our results also reveal significant heterogeneity across Canada, with contrasting effects of environmental drivers among continental watersheds, highlighting that response models cannot be assumed to apply universally.

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Rise of a native apex predator and an invasive zooplankton cause successive ecological regime shifts in a North Temperate Lake

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Ecosystems can undergo abrupt regime shifts as a result of many factors. Shifts between turbid and clearwater states are well understood for human-impacted shallow lakes, but are not well understood in other types of lakes. Here we use long-term data to describe abrupt shifts in water clarity in Trout Lake, an oligotrophic lake with a largely undeveloped watershed. For several decades mean summer water clarity averaged 4.5 m, but then around 2007 water clarity sharply increased and the clear water regime persisted for nearly a decade. Nutrient availability did not explain these changes, but rather they were

explained by a classic top-down trophic cascade. Around 2007, the population of the apex pelagic predator, Lake Trout, substantially increased. This was accompanied by a sharp decline in the lake's major pelagic prey fish, the zooplanktivorous Cisco. In turn, there was an increase in large-bodied zooplankton taxa (calanoids, Daphnia), which reduced algal biomass. This clear water regime was then disrupted in 2014 by the invasion of a predatory zooplankton, Bythotrephes cederstroemi. This invasion corresponded to strong impacts on lower trophic levels (decrease in large-bodied zooplankton and decreased water clarity), but more minor impacts on higher trophic levels (increased Cisco, decreased Lake Trout abundances)-in effect reversing the trophic cascade and shifting Trout Lake to a novel ecosystem state. Our study provides a long-term, empirically based example of successive ecological regime shifts that occurred from the rise of an apex predator and a mid-trophic level invasion in an undeveloped, oligotrophic lake.

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Sedimentary DNA identifies modern and past macrophyte diversity and its environmental drivers in high-latitude and high-elevation lakes in Siberia and China

Stoof-Leichsenring, Kathleen R.; Huang, Sichao; Liu, Sisi;等.

Arctic and alpine aquatic ecosystems are changing rapidly under recent global warming, threatening water resources by diminishing trophic status and changing biotic composition. Macrophytes play a key role in the ecology of freshwaters and we need to improve our understanding of long-term macrophytes diversity and environmental change so far limited by the sporadic presence of macrofossils in sediments. In our study, we applied metabarcoding using the trnL P6 loop marker to retrieve macrophyte richness and composition from 179 surface-sediment samples from arctic Siberian and alpine Chinese lakes and three representative lake cores. The surface-sediment dataset suggests that macrophyte richness and composition are mostly affected by temperature and conductivity, with highest richness when mean July temperatures are higher than 12 degrees C and conductivity ranges between 40 and 400 mu S cm(-1). Compositional turnover during the Late Pleistocene/Holocene is minor in Siberian cores and characterized by a less rich, but stable emergent macrophyte community. Richness decreases during the Last Glacial Maximum and rises during wetter and warmer climate in the Late-glacial and Mid-Holocene. In contrast, we detect a pronounced change from emergent to submerged taxa at 14 ka in the Tibetan alpine core, which can be explained by increasing temperature and conductivity due to glacial runoff and evaporation. Our study provides evidence for the suitability of the trnL marker to recover modern and past macrophyte diversity and its applicability for the response of macrophyte diversity to lake-hydrochemical and climate variability predicting contrasting macrophyte changes in arctic and alpine lakes under intensified warming and human impact.

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Dissolved organic carbon as a driver of seasonal and multiyear phytoplankton assembly oscillations in a subtropical monomictic lake

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Phytoplankton assembly dynamics in lakes are highly sensitive to variability in climate drivers and resulting physicochemical changes in lake water columns. As climate change increases the frequency of major precipitation events and droughts, many lakes experience increased inputs of colored dissolved

organic carbon (CDOC) and nutrients. How these CDOC-related changes in resources, transparency, and thermal stability affect phytoplankton assemblages, succession, and resilience is understudied, particularly in subtropical lakes. Here, we used time series, multivariate, and trait-based functional redundancy analyses to elucidate the roles of phytoplankton in ecosystem resilience and determine potential drivers of assemblage shifts in a subtropical monomictic lake with fluctuating CDOC inputs (Lake Annie, Highlands County, Florida, USA). We found that phytoplankton assemblages and successional patterns differed between two dark-water states (late 2005-mid-2007, late 2012-2019) bracketing a clear-water state (mid-2007-late 2012), caused by shifting CDOC and nutrient concentrations associated with oscillating groundwater levels. Diatoms (Bacillariophyta), which were dominant during the two dark-water states, nearly disappeared and were replaced by synurophytes during the clear-water state. Assemblages had greater interannual consistency in the dark-water states, while mean functional redundancy decreased in the clear-water state. Seasonal phytoplankton successional changes were also more pronounced and synchronized with seasonal hydrologic shifts in the dark-water states. Multiyear assemblage shifts occurred more quickly in clear-to-dark than dark-to-clear state transitions, suggesting phytoplankton in dark-water states may be more resistant to state transitions or even contribute to dark-water state resilience via feedback loops.

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Tipping points and multiple drivers in changing aquatic ecosystems: A review of experimental studies

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Natural ecosystems are experiencing unprecedented rates of change due to anthropogenic activities and global change, leading to either gradual changes in a given response or tipping points. While the tipping point concept has been tested in an array of habitats since the 1960s, the spatiotemporal superposition of multiple drivers in different ecosystems needs to be considered when investigating the response of species, communities, populations, and ecosystems along environmental gradients. Here, we (1) develop a historical and current perspective of tipping point studies in terrestrial, freshwater, and marine ecological systems; (2) portray the research effort in different freshwater and marine habitats; and (3) explore the results of experimental studies focusing on tipping points measured at the individual, communities, ecosystem level, as well as ecosystem functions and services in a context of single and multiple stressors. The number of studies mentioning the concept of tipping points increases every year, but very few studies have specific objective to identify them. Even fewer studies consider how the addition of another stressor into an ecosystem may alter a tipping point. In addition, many studies investigated multiple responses, but only one-fourth (7 out of 28) of them concentrate their effort on multiple biological or ecological levels of complexity. This review allowed us to identify shortcomings in this research field and propose ways to make this ecological concept anew.

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Significant winter CO_2 uptake by saline lakes on the Qinghai-Tibet Plateau

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Direct measuring of CO_2 flux remains challenging for global lakes. The traditional sampling and gas transfer models used to estimate lake CO_2 fluxes are variable and uncertain, and ice-covered periods are

often excluded from the annual carbon budget. Here, the first longtime (2013-2017) direct measurement of CO_2 flux by eddy covariance system over the largest saline lake (Qinghai lake) in the Qinghai-Tibet Plateau (QTP) revealed that ice-covered period draws large amounts of CO_2 from the atmosphere (-0.87 +/- 0.38 g C m(-2) d(-1)), a value more than twice the CO_2 flux rate during the ice-free period (-0.41 +/- 0.35 g C m(-2) d(-1)). The total CO_2 uptake by all saline lakes on the QTP was estimated to -10.28 +/- 1.65 Tg C yr(-1), an equivalent to approximately one third of the net terrestrial ecosystems carbon sink in QTP. Our results indicate large sink for CO_2 in winter is controlled by both seasonal hydrochemistry processes and lake ice absorption in saline lakes. This research also demonstrates decreasing CO_2 uptake from the atmosphere by saline lakes on the QTP, which may turn carbon sinks to carbon sources with future warming.

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Forest-lake ecotones in a tropical forest: Terrestrial invertebrate inputs to lakes decrease with forest distance

Dolabela, Barbara Martins; da Costa, Fernanda Vieira; Pinto, Victor Diniz; 等.

1. Ecotones between tropical forests and lakes compose an ecosystem interconnection with a high abundance of terrestrial invertebrates, which represent an outstanding resource for the aquatic fauna. However, there is still little quantitative information on tropical forest contribution in terms of invertebrate inputs into lacustrine systems and the factors controlling this flux. 2. To quantify the terrestrial invertebrate contribution into tropical lakes, we selected six lakes located in the Atlantic rainforest, south-eastern Brazil, and used pan traps placed in the lakeshore. We focused on total abundance, biomass, and richness of insect orders. To assess the influence of forest and lake morphometry on terrestrial invertebrate inputs into lakes, we measured the forest-lake distance and considered the morphometric characteristics of each lake. 3. Distance from forest negatively affected the invertebrate biomass reaching the lakes. The dissimilarity across different ecotones also increased with distance from the forest. Perimeter-to-area ratio negatively affected the invertebrate abundance, suggesting that more dendritic lakes receive more invertebrates from the forest. 4. We estimated that annually, on average 21 tons of terrestrial invertebrates fall into the studied lakes, representing a massive food resource for the aquatic ecosystem. Hence, if the distance from the forest increases due, for instance, to severe drought or deforestation, it will create an herbaceous environment unable to provide such a quantity of insects to the water ecosystems, compromising aquatic and terrestrial trophic webs dynamics.

（来源：FRESHWATER BIOLOGY，出版年:2022, **DOI:** 10.1111/fwb.13902）

The wind-driven distribution of nearshore zooplankton in a stratified lake varies with their body size

Cyr, Helene; Sprules, William Gary

Wind-driven forces are expected to concentrate zooplankton along downwind shores in lakes and provide food subsidy to nearshore food webs, but the bathymetric complexity of nearshore areas could result in high spatial variability. Here we test: (1) whether zooplankton accumulate downwind on windy days, and whether the magnitude of accumulation varies with zooplankton body size and with nearshore bathymetric slope; and (2) whether nearshore zooplankton are more spatially variable than offshore zooplankton, and whether their spatial variability is related to wind conditions and to zooplankton body size. This study focuses on zooplankton distribution at the whole-lake basin and at intermediate (10 m-1

km) spatial scales. Zooplankton were sampled repeatedly along four c. 1 km transects at each of the upwind and downwind ends of a 22.1-km(2) stratified lake basin. Two transects were oriented perpendicular to shore and two were parallel, one close to shore and the other further offshore. Zooplankton were sampled along each transect using an optical plankton counter morning and afternoon over 3 consecutive days, under a range of wind conditions, during early stratification (early June), mid-stratification (mid-July) and late stratification (late September). A 3D-hydrodynamic model was used to help interpret the results. Small-bodied zooplankton accumulated downwind during windy periods, reaching 8%-34% higher biomass than the basin-wide average. This downwind accumulation of biomass was best explained by a partial (metalimnetic) upwelling displacing the epilimnion to the downwind end of the lake basin. Active upward movement of zooplankton is required to explain near-surface biomass accumulation in this displaced water mass. Large-bodied zooplankton accumulated in nearshore areas, regardless of wind conditions. Higher nearshore accumulation of large zooplankton was observed along transects following a shallow (1.9%) bathymetric slope but not along a steep (6%) slope. Large-bodied zooplankton are more patchily distributed than small-bodied zooplankton, both nearshore and offshore. The spatial variability of large zooplankton declined with increasing wind speed, but only at upwind sites. The patchy distribution of large-bodied zooplankton is driven, or at least strongly influenced, by biological processes. The spatial distribution and patchiness of zooplankton varies with wind speed, zooplankton body size and nearshore bathymetry. Planktonic organisms are not passive drifters, and their patchiness and influx to certain parts of the lake during windy periods are both expected to affect the efficiency of trophic transfers in lake food webs.

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Effects of ancient allochthonous and contemporary autochthonous organic carbon on the growth and reproduction of lake zooplankton

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Carbon with a radiocarbon age above 200 years before present (bp) generally is referred to as ancient carbon. Ancient organic carbon (OC) stored in glaciers, permafrost and unperturbed soil has been released with increasing temperatures resulting from climate warming and anthropogenic activities. Evidence suggests that ancient terrestrial OC can be incorporated by heterotrophic bacteria and consumers in many aquatic systems. However, it remains unknown whether ancient terrestrial OC promotes growth and reproduction of consumers. Ancient dissolved organic carbon (DOC) was extracted from frozen soils in the catchments of Lakes Tsochuolong (-216.9 parts per thousand, 1,960 years bp) and Zhangnaitso (-384.1 parts per thousand, 3,895 years bp) on the Tibetan Plateau, and was further degraded by heterotrophic bacteria. Degraded ancient DOC (containing bacteria) and Auxenochlorella (-161.6 parts per thousand) were used exclusively or in combination as food (total 6 mg C/L) for Daphnia magna (D. magna) to compare their body length, mortality rate and offspring production. The mixed diets consisted of ancient DOC converted by bacteria at 4 mg C/L and Auxenochlorella at 2 mg C/L. The radiocarbon isotope (increment C-14) value of D. magna fed on mixed diets was -293.0 parts per thousand for Lake Tsochuolong (group CA) and -265.9 parts per thousand for Lake Zhangnaitso (group CB), which was depleted than those fed exclusively on Auxenochlorella (-187.3 parts per thousand, group 6C). This result suggests that C-14-depleted DOC can be assimilated by zooplankton. Daphnia magna in group CB had the highest intrinsic rate of population increase (0.33/day) and number of neonates per individual (15.97/ind). The higher growth rate and offspring production in group CB than in CA (0.21/day and 7.68/ind) probably were because D. magna utilised more Auxenochlorella and

phosphorus from diets in CB. However, there was no significant difference in the two indicators between CA and 6C (0.24/day and 12.30/ind) or between CB and 6C. Daphnia magna fed exclusively on degraded DOC plus bacteria had the lowest growth rate and offspring production. The results demonstrate that in the presence of algae with high nutritional value, degraded ancient DOC could support the growth and reproduction of zooplankton. Our findings extend the understanding of carbon sources and carbon cycling in food webs in lakes, particularly in high-altitude and polar lakes in the context of climatic and environmental changes.

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Nutrient loading effects on fish habitat quality: Trade-offs between enhanced production and hypoxia in Lake Erie, North America

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Across diverse systems, nutrient loading from anthropogenic sources into aquatic systems has increased over the past century. Such nutrient inputs may enhance system productivity and thereby increase resource availability but may also lead to undesirable conditions such as hypoxic zones. We examined the habitat quality trade-offs associated with increases in phosphorus in a model system (Lake Erie, North America) with a history of anthropogenic nutrient loading. Using a water quality model and a bioenergetics growth rate potential model with fine vertical and temporal resolution, we assessed how the quality of habitat for multiple species of adult and juvenile fish changed across a range of phosphorus loading scenarios and across 19 different meteorological years. Increases in phosphorus loading increased invertebrate prey biomass, but also increased the duration and extent of the mid-summer hypoxic zone. In general, phosphorus loading caused overall habitat quality to decline and only increased peak habitat quality (i.e., spatio-temporal locations where temperature and prey abundance were already above average), but responses were species- and life-stage specific. One challenge in ascertaining the effects of nutrient loading on fish habitat quality is separating the negative effects of hypoxia from the potential positive effects of increased prey densities. Through various model scenarios, we evaluated the individual effects of hypoxia and increased prey availability on fish habitat quality, demonstrating their potentially counter-balancing effects. That is, the negative effects of low oxygen on fish habitat quality appear more severe if the prospect that increased hypoxia is accompanied by altered prey densities is not accounted for. Despite modelled responses to altered phosphorus loads, habitat quality responded more strongly to variation in annual meteorological conditions. Annual meteorological conditions such as temperature, vertical mixing, and timing of phosphorus loading had a greater effect on habitat quality for all species and life-stages than changes in annual amount of phosphorus loading. This limited effect of changes in phosphorus loading on habitat quality probably partially reflects our focus on short-term (1-year) changes in loading. Thus, nutrient abatement programmes may not lead to obvious, rapid positive habitat quality responses, as short-term meteorological effects may overwhelm effects related to nutrient reduction and changes in prey densities may partially offset the benefits of decreased hypoxic conditions.

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Impacts of shelter on the relative dominance of primary producers and trophic transfer efficiency in aquatic food webs: Implications for shallow lake restoration

Jin, Hui; van Leeuwen, Casper H. A.; Temmink, Ralph J. M.;等.

Wind-induced turbulence can strongly impact ecological processes in shallow lake ecosystems. The creation of shelter against wind can be expected to affect both primary producers and herbivores in aquatic food webs. Shelter may benefit particular primary producers more than others by changing relative resource availabilities for different primary producers. Herbivore community compositions may be affected either directly or indirectly as a consequence of changes in their food quantity and quality that, in turn, may affect the transfer efficiency between primary producers and herbivores. A reduction in trophic transfer efficiency resulting from wind-induced turbulence potentially can lead to declines of higher trophic levels, but is generally understudied. Here, we focus on the impact of wind on aquatic primary producers and trophic transfer efficiency. We hypothesised that reducing wind-induced turbulence will stimulate higher trophic production in shallow lakes. However, the multitude of impacts of wind-induced turbulence on aquatic food webs make it challenging to predict the direction of change when creating sheltered conditions. We tested our hypothesis in the shallow waters of a newly constructed archipelago named Marker Wadden in lake Markermeer in the Netherlands. Lake Markermeer has experienced declining numbers of birds and fish. These declines have been related to wind-induced sediment resuspension that potentially limits primary production and trophic transfer efficiency. Marker Wadden is a large-scale restoration project that aims to add sheltered and heterogeneous habitat to the otherwise mostly homogeneous lake, thus targeting the potential problems associated with wind-induced turbulence. We executed a 2-month manipulative field mesocosm experiment in the shallow waters of Marker Wadden to study the effect of reduced wind-induced turbulence (i.e., shelter) on aquatic food webs. Specifically, we studied the effects on primary producers, trophic transfer efficiency between phytoplankton and zooplankton (using zooplankton biomass divided by phytoplankton Chl a as a proxy), and benthic fauna. The experiment consisted of three treatments: no shelter, shelter without macrophytes and shelter with submerged macrophytes (Myriophyllum spicatum) present at the start of the experiment. Our results clearly showed that under unsheltered conditions phytoplankton was the dominant primary producer, whereas in sheltered conditions submerged macrophytes became dominant. Interestingly, submerged macrophytes appeared rapidly in the sheltered treatment where first no macrophytes were visibly present; hence, at the end of the experiment, there was little difference among the sheltered treatments with and without initial presence of submerged macrophytes. Despite that phytoplankton concentrations were 23-fold higher under the unsheltered conditions, this did not result in higher zooplankton biomass. This can be explained by a five-fold greater trophic transfer efficiency between phytoplankton and zooplankton under the sheltered conditions. Furthermore, under the sheltered conditions the Gastropoda density reached 746 individuals m(-2), whereas no Gastropoda were found under the no shelter treatment. These findings indicate that for shallow lakes that are negatively affected by wind-induced turbulence, measures aimed at ameliorating this stressor can be effective in facilitating submerged macrophyte recovery, increasing Gastropoda densities and restoring trophic transfer efficiency between phytoplankton and zooplankton. Ultimately, this may support higher trophic levels such as fish and water birds by increasing their food availability in shallow lake ecosystems.

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Non-native freshwater snails: a global synthesis of invasion status, mechanisms of introduction, and interactions with natural enemies

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Non-native freshwater snails can play important roles as consumers, hosts, and prey. Despite their potential ecological importance, global patterns in non-native snail taxonomy, geography, and ecology have not been documented. Our objectives were to use a semi-quantitative systematic review to describe non-native freshwater snail global diversity, distribution, mechanisms of introduction, and interactions with natural enemies, including parasites and predators. Based on 506 relevant publications, we recorded 95 non-native freshwater snail species from 16 families. Six taxonomic families, and pulmonate snails as a group, were over-represented relative to the number of species expected by chance. Eight snail species represented 63% of the research records. A few snail taxa (15%) were widespread global invaders, reported from four or more continents, while most invasions were limited to a single continent. Australia and the Pacific Islands were the largest 'sink' for non-native snails, with the greatest difference in the number of non-native taxa relative to native taxa that had spread to other continents. Aquarium hobby sales were implicated as the most common mechanism of introduction (41% of species), followed by hitchhiking on aquatic vegetation, human consumption, use for biocontrol, transportation in canals, commercial shipping, and outdoor recreation. A search of internet sales posts indicated that four of the six over-represented snail families were readily available for purchase online. Non-native snails hosted parasites of wildlife, livestock, and human health importance, yet on average had 80% lower parasite richness in their non-native compared to native range. At least 65 taxa were documented as consumers of non-native snails, including native predators of conservation concern. These findings suggest that non-native snails often are released from parasitism, but may commonly experience biotic resistance from predators. Our synthesis emphasizes the relatively high diversity of non-native snails, but the disproportionate role of a few taxonomic groups in driving ecological, economic, and public health challenges. Moving forward, it will be important to limit new snail introductions through policy, education, and monitoring, particularly as the effective control of established snail invasions remains challenging in most ecosystems.

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Altitudinal diversity of aquatic plants in the Qinghai-Tibet Plateau

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1. Altitudinal diversity of terrestrial plants has been widely studied, whereas little is known for the patterns of aquatic plants. Here, we used a standardised field dataset to quantify the altitudinal patterns in the diversity and structure of aquatic plant assemblages, as well as the relationships between diversity indices and environmental variables. 2. Large-scale field investigations were carried out in 128 sites ranging from 2,280 to 5,020 m above sea level across the southern part of Qinghai-Tibet Plateau, China. In total, 102 species of aquatic plants were recorded, belonging to 67 genera, 31 families. Five taxonomic, phylogenetic, and functional indices were calculated for each collection site. We firstly examined altitudinal patterns of these diversity indices, then quantified the variations of indices across water areas, water flow, and soil matrix, respectively. We also explored the relationships between diversity indices and environmental variables using redundancy and variance partitioning analysis, to detect the ecological variables that drove the diversity. 3. The results showed that taxonomic, phylogenetic, and functional diversity of aquatic plants decreased with increasing altitude. Net relatedness index of aquatic plants

showed a hump pattern along the altitude gradient, with a peak around 3,800 m above sea level. There was no obvious trend in the net functional relatedness index of aquatic plants with altitude. Annual mean temperature was the most important variable associated with the taxonomic, phylogenetic, and functional diversity. Water area and water flow were significantly associated with functional structure, but not phylogenetic structure. Soil matrix also correlated with aquatic plant diversity. 4. A large-scale altitudinal gradient can influence aquatic plant diversity. Environmental filtering and niche convergence might have played dominant roles in the increasing and decreasing stages of phylogenetic structure of aquatic plant assemblages, respectively, along the altitudinal gradient. Phylogenetic and functional structure of aquatic plant assemblages showed different patterns along the altitudinal gradient, and the environmental variables better explained the change of functional structure than did the phylogenetic variables. 5. This is the first comprehensive study on the species, phylogeny, and function of aquatic plant assemblages along a large-scale altitudinal gradient. We found an altitudinal decline in the diversity of aquatic plants and different patterns in the phylogenetic and functional structures of aquatic plant assemblages. These findings indicate that functional traits have high phenotypic plasticity and are more affected by environments than phylogenetic relationships which are mainly shaped by evolutionary processes.

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Factors regulating lake periphyton biomass and nutrient limitation status across a large trophic gradient

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Because of the historical focus of limnology on pelagic processes, the factors controlling lake periphyton growth and nutrient limitation are understudied compared to the phytoplankton. We deployed nutrient-diffusing substrata at 28 sites spanning a wide trophic status gradient in Lakes Superior and Michigan to assess periphyton biomass accrual on control substrata and the response of periphyton to single and combined phosphorus (P) and nitrogen (N) additions. Periphyton growth was unimodally related to a composite metric of site trophic status, with highest biomass at mesotrophic sites and lower growth at oligotrophic and highly eutrophic sites. Contrary to expectations, P limitation was rare. Instead, several lines of evidence pointed to primary N or N + P co-limitation of periphyton. Limitation extent was negatively related to site trophic status, with stronger nutrient limitation at oligotrophic sites. Our results support the hypothesis that phytoplankton and periphyton biomass respond differently to nutrient enrichment and suggest that different nutrients may limit pelagic and benthic primary production, even in the same system. Our findings also support the use of periphyton as an early warning indicator of nutrient pollution and help explain why large, oligotrophic lakes may be especially susceptible to localised benthic algal blooms.

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Long-term acclimation might enhance the growth and competitive ability of Microcystis aeruginosa in warm environments

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The positive effect of global warming on the growth of cyanobacteria has been widely predicted, but long-term studies targeting their adaptive potential to higher temperature have not been carried out so far. Predicting the magnitude and impact of cyanobacterial blooms in the future as a response to global warming requires an understanding of how cyanobacteria might change in the long term due to climate

change. Here we examined the effect of exposing three Microcystis aeruginosa strains isolated in Romania to ambient (22 degrees C) and high (26 degrees C) temperature for 6 months. Then, the competitive ability of the strains after heat acclimation was evaluated, by analysing their impact on plankton community composition. One of the three strains displayed significantly higher growth rates after 6 months of cultivation at higher temperatures. Following inoculation into a natural plankton community, the overall cyanobacterial abundance significantly increased in the cultures inoculated with this heat-acclimated strain of M. aeruginosa as compared to the ambient-acclimated version. The structure of eukaryotic communities was impacted by both inoculated cyanobacteria and temperature during the experiments. The results of this study emphasise the high potential of cyanobacteria to respond to stressors, and highlight the fact that previous acclimation to warming is a critical factor in shaping the overall structure of plankton communities. Our study strongly advocates for including a step of culture acclimation to future experimental conditions in research programmes aiming to better understand the long-term impact of climate change on aquatic ecosystems.

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Cyanobacterial bloom associated with a complete turnover of a Daphnia population in a warm-temperate eutrophic lake in Eastern China

Ma, Xiaolin; Deng, Zhixiong; Blair, David;等.

The effect of cyanobacterial blooms on aquatic ecosystems has received wide attention, yet little is known about their impacts on zooplankton genetic structure. For 26 months (April 2012-May 2014), we monitored zooplankton in a warm-temperate ice-free lake in Eastern China, with an emphasis on seasonal population dynamics of the cladoceran, Daphnia galeata. There was a seasonal succession in the zooplanktonic community (composed of Cladocera, Copepoda, and Rotifera). Genetic analysis (based on 14 microsatellite loci) of the 21 monthly samples in which D. galeata was present demonstrated that several clones could successfully overwinter and/or persist for many months. However, all clones, including these long-lived clones, were completely replaced by new ones after October 2013, probably due to cyanobacteria blooms in that summer. A high clonal richness coupled with high turnover rate was observed in the D. galeata population overall, suggesting frequent sexual reproduction. Daphnia galeata experimentally fed with a diet of Microcystis aeruginosa (the most abundant toxic cyanobacterial species in the lake) had a substantially reduced survivorship, consistent with the field observations. Our findings highlight the changes of zooplanktonic population dynamics in terms of both community and clonal structure in a warm-temperate ice-free lake, and call for further investigation on ecological responses of zooplankton to cyanobacterial blooms.

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Hydroclimate Variability Affects Habitat-Specific (Open Water and Littoral) Lake Metabolism

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Lakes integrate the signals of changing hydroclimate in their surrounding basin, which substantially influence gross primary production (GPP), respiration (R), and net ecosystem production (NEP). Most research focuses only on the changes to the open water habitat despite the littoral habitat's importance to lakes and its sensitivity to hydroclimatic variability. We analyze how years with different ice-out dates and

snow water equivalent (SWE) triggered different metabolism responses in the open water and littoral habitats of a subalpine lake. The dry (early ice-out date and low SWE) and wet (late ice-out date and high SWE) years had lower GPP and R rates in both habitats compared to the average hydroclimatic year. Furthermore, consumer biomass decreased during dry and wet years. GPP and R reduced the most in the littoral habitat. Consequently, the relative contribution to total lake GPP and R of the littoral habitat decreased, and the contribution of the open water habitat increased during the dry and wet years. We demonstrate that hydroclimatic conditions affect productivity and consumer biomass and show that within-lake habitats do not experience equivalent responses to climate forcing. Our study has implications for how ecosystem scientists and managers quantify the absolute and relative contributions of the littoral habitat to whole lake production in the context of climate variation.

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What Drove Regional Changes in the Number and Surface Area of Lakes Across the Yangtze River Basin During 2000-2019: Human or Climatic Factors?

Cheng, Xing; Xu, Yuyue; Gun, Zhao.

The spatiotemporal distribution of lakes in the Yangtze River basin (YRB) has changed tremendously; however, research on how and why lakes changed across this basin is limited. In this study, based on Google Earth Engine, Landsat images were used to track lakes (>1 km(2)) across the YRB from 2000 to 2019. Then, the anthropogenic and climatic impacts on the evolution of lakes were fully discussed. Results showed that the distribution of lakes across the YRB was extremely uneven. From 2000 to 2019, the total number and the area (referring to the surface area) of lakes increased by 30 and declined by 885 km(2), respectively, but the trends of them were unobvious. In contrast, these changes and related causes exhibited high spatial heterogeneity. Lakes in the upper reaches significantly increased ($P < 0.01$). The expanded and new lakes were mainly distributed in the headwater catchment of the Yangtze River, which was closely related to increased precipitation. The number of lakes in the middle reaches decreased significantly ($P < 0.05$), which was primarily affected by intense human activities, such as land reclamation and agricultural irrigation. Precipitation played a dominant role in the fluctuation of the lake area here. In the lower reaches, the number of lakes increased ($P < 0.01$) as a result of the policy of returning farmland to lakes, while the expansion of area ($P < 0.05$) was closely related to the precipitation and runoff. These findings have important policy implications for the conservation of lake resources.

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Climate Variability Masked Greening Effects on Water Yield in the Yangtze River Basin During 2001-2018

Zhang, Jiehao; Zhang, Yulong; Sun, Ge;等.

Rapid global vegetation greening has been observed for the past two decades, but its implications to the hydrological cycle are not well understood in many regions, including the Yangtze River Basin (YRB). This study used a remote sensing-driven ecosystem model, the Coupled Carbon and Water model, to fully examine the individual and combined hydrological effects of vegetation and climate changes through a series of modeling experiments. During the study period (2001-2018), the vegetation showed a significant greening trend with the mean annual normalized difference vegetation index increasing at a rate of 0.4% per year ($p < 0.001$). In contrast, climate exhibited a marginal wetting trend with annual

precipitation increasing at a rate of 6.7 mm/yr (p = 0.08). Annual evapotranspiration (ET) in the YRB significantly increased (3.1 mm/yr, p = 0.01) primarily due to enhanced ecosystem productivity associated with vegetation greening, rather than climatic factors. However, the enhancement in ET did not lead to a significant decline in total water yield at the YRB scale. The large inter-annual variability of precipitation masked the effects of vegetation greening on water yield. Overall, our study indicated that the recent land greening up has accelerated the regional hydrological cycle through increasing ET and resulted in enhanced risks of water resource shortage. Our findings highlighted the close connection between land cover dynamics and hydrological cycle under climate variability in one of the world's largest river systems. Effective basin water resource management must consider hydrological response to vegetation greening and climate change.

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Seasonal dynamics of chromophoric dissolved organic matter in Poyang Lake, the largest freshwater lake in China

Huang, Qi; Liu, Lizhen; Huang, Jiacong;等.

Chromophoric dissolved organic matter (CDOM) plays a vital role in the biogeochemical cycles of elements in aquatic ecosystems. Seasonal dynamics of CDOM of the lake are sensitive indicators of the biogeochemical processes and water quality, which are critical to the water security of the lake. Thus, a field investigation of the CDOM and dissolved organic carbon (DOC) properties was conducted during four hydrological seasons in 2016 to track the temporal variability of CDOM and DOC properties and to explore the influence of rivers and wetlands on the quantity and quality of CDOM in Poyang Lake. The results showed that the alternations of flood and dry periods have a different influence on the quantity and quality of CDOM and DOC in the main lake and the river mouths districts. DOC and aromaticity in the main lake district were more influenced by seasonal variations, while CDOM concentrations and molecular weight in the river mouths were more affected. CDOM fluorescent components in both these districts varied obviously across the hydrological seasons. More terrestrial humic-like substances with higher aromaticity and lower DOC in the rising and flood season than in the dry and retreating season. The contributing rate of CDOM and its terrestrial humic-like substances from input rivers to the lake in the rising season can account for more than 50%, which was more than that in the flood season. Flooding causes wetlands to contribute a higher abundance of CDOM and DOC with lower aromaticity to the lake, contrary to the CDOM features in the flood season, highlighting the important role of wetlands in the organic carbon pool. The DOC can be modeled using CDOM fluorescent and optical parameters by the Support Vector Regression (SVR) method, which provides a tool for DOC dynamic monitoring and water quality management.

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Critical factors for the use of machine learning to predict lake surface water temperature

Yousefi, Azadeh; Toffolon, Marco

Models based on Machine Learning (ML) are pervading all fields of science and practical applications, including the problem of forecasting water temperature in lakes, a crucial variable for ecosystems and a proxy of climate change. Here, we review the most used ML algorithms in this field and highlight some physical constraints that should be carefully considered when adopting a black-box approach. To

illustrate them, we refer to an artificial case study representing a temperate lake simulated by means of a physically based model, for which we take full control of input and output variables, and restrict the analysis to lake surface water temperature (LSWT). Three main factors are relevant for a successful prediction of LSWT by means of ML models: the choice of the predictors (mostly, meteorological variables), their pre-processing (we tested three approaches), and the specific ML algorithm (nine different algorithms). We show that selecting the suitable physical inputs plays the most important role. In our case study, which is the product of a numerical model and not a real lake, the minimum amount of information that is needed to obtain acceptable results is to consider air temperature (AT) and day of the year. The use of additional predictors does not substantially improve the performances (the relative improvement of RMSE was 7.75% for the test data set). We also demonstrate that better results than the normal case are obtained by either pre-processing air temperature data averaging them over a time window or including values from previous days as inputs in the model. Considering the recent history of the forcing (AT) allows one to comply with the physical fact that the large water mass makes lakes acting as filters in their thermal response (thus, influenced also by AT from previous days), which changes depending on the lake's depth. Eventually, we did not find a definite answer about a single optimal ML algorithm when using the same inputs (although artificial neural network had slightly better results), suggesting that the insight into the physical dynamics is still the most important factor for a successful exploitation of ML.

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Long-term succession of Microcystis genotypes is driven by hydrological conditions and anthropogenic nutrient loading in a large shallow lake

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Microcystis blooms that are caused by intensified human activities and global warming have become a challenging environmental problem in global lakes and reservoirs. Research has focused on Microcystis genotypes to understand their proliferation and the development of blooms, although knowledge gaps exist regarding how Microcystis genotype succession occurs over long-term time scales. In this study, high-throughput sequencing was used to investigate decade-long successional patterns of Microcystis genotypes in the large shallow Lake Chaohu that has long suffered from Microcystis blooms. Microcystis populations exhibited high overall genetic diversity, with 11,431 genotypes, and these were relatively stable over the last similar to 70 years, with 339 shared core genotypes and 1 dominant genotype. Microcystis genotype succession exhibited three distinct historical phases corresponding to 1944-1960, 1964-1973, and 1976-2015. These successional patterns were clearly influenced by dam construction in 1963, and subsequent nutrient enrichment following the 1970s. After dam construction, increased hydraulic retention times and slowing of hydrodynamic conditions influenced Microcystis genotype diversity by altering population composition and decreasing genotype richness. Populations and dominant genotypes rapidly returned after dam construction, combined with increased inferred interactions among genotypes. Network analysis also indicated that low abundance Microcystis genotypes, rather than dominant genotypes, may be keystone taxa across the decadal-scale co-occurrence network of Microcystis population.

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Temporal prediction of algal parameters in Three Gorges Reservoir based on highly time-resolved monitoring and long short-term memory network

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Many dammed rivers throughout the world have experienced frequent harmful algal blooms (HABs) in the context of climate change and anthropogenic activities. Accurate forecasting of algal parameters (i.e., algal cell density and microcystin concentration) has great practical significance for taking precautions against HABs risks. Long short-term memory (LSTM) networks have recently shown potential in predicting water quality parameters. However, there is still little known about the robustness of the LSTM in forecasting highly time-resolved measurement of algal parameters. This study developed a hybrid deep-learning architecture (XG-LSTM) composed of one XGBoost module and two parallel LSTM models to predict algal cell density and microcystin concentration in the Three Gorges Reservoir (TGR). The proposed model was validated by in situ multi-sensor-system monitoring data at four bloom-impacted tributaries in the TGR. Each modelling process utilized the antecedent information of the algal parameters and the corresponding environmental variables as inputs for forecasting the algal parameters for the coming hours and days. As expected, the presented model achieved better performance than those without special feature extraction procedures, providing that the use of selected environmental parameters can improve LSTM performance. In addition, the hybrid XG-LSTM model successfully captured the time-series patterns of both algal cell density and microcystin concentration compared with other data-driven models, further suggesting the reliable utilization of this model in early warnings of bloom toxicity. Thus, the results presented demonstrate the potential of deep learning technology for real-time prediction of algal parameters in the TGR, and possibly for rapid detection of developing HABs in other aquatic ecosystems.

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Storm and floods increase the duration and extent of phosphorus limitation on algal blooms in a tributary of the Three Gorges Reservoir, China

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Excessive anthropogenic nutrient input has resulted in eutrophication and algal blooms which have severely impacted the function and sustainability of aquatic ecosystems, underscoring the need to implement nutrient management strategies. It was assumed that the increasing rainfall during flood season would affect the stoichiometric ratio of total nitrogen (TN): total phosphorus (TP), driving the nutrient limitation of algal growth. In order to test this concept and explore corresponding nutrient management strategies, nutrient addition bioassays were carried out in Xiangxi Bay, one of the largest tributaries of the Three Gorges Reservoir (TGR), China. Results indicated that nutrient limitation on algal growth fluctuated from nitrogen (N) to phosphorus (P) limitation. N limitation dominated in the early flood season. However, the reduction of dissolved P, accompanied with an increase of TN: TP caused by an increase in extreme rainfall events intensified P limitation throughout the bay. Then P limitation was alleviated due to the reduction of rainfall and the process of impoundment after the flood season. The variation of TN: TP caused by the increasing of rainfall and flooding could be the main driving factor of the nutrient limitation shift in aquatic ecosystems mainly affected by external nutrient inputs. Nutrient dilution and enrichment bioassays showed that TN and TP concentration thresholds should be targeted

at below 0.55 mg/L and 0.057~0.064 mg/L respectively, to limit the growth of algae and maintain chlorophyll a below 30 μg/L. Dual nutrient (N & P) reductions were required for long-term bloom mitigation in the entire basin. This study provided a scientific basis for a nutrient management strategy to combat eutrophication and reduce algal bloom potentials in the tributaries of the TGR. We recommend that long-term determinations of nutrient limitation and nutrient threshold will be needed to control algal growth, considering future anticipated changes in land use, population density and the impacts of climate change.

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Diatom response to environmental gradients in the high mountain lakes of the Colombia's Eastern Range

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A survey of 60 high mountain lakes of Colombia's Eastern Range was performed to evaluate the response of surface-sediment diatoms to environmental variables. In each one of these lakes, water samples were taken for physical and chemical characterization, and diatoms were collected from the superficial bottom sediment at the deepest part. Multivariate statistical analyses were made to determine the relationships between environmental and biological data, specifically which environmental variables explain the diatom distribution. For each of these significant environmental variables, optima and ecological tolerances were calculated using the weighted-average method, which allowed for the classification of the species according to their environmental preferences. The lakes showed a wide range of environmental gradients in variables such as pH, alkalinity, and nutrients. In addition, the depth of the lakes was a direct determinant of the light environment of the water column. A total of 339 diatom taxa were identified belonging mainly to the genera Eunotia and Pinnularia. Variables related to pH-alkalinity gradient, trophic condition (nitrates and phosphorus), and physical factors (radiation at the bottom) had a significant effect on diatom composition. Despite the fact that the total organic carbon environmental range was high, the effect of this variable on diatom species composition was not significant. In conclusion, the diatoms of the studied lakes showed a significant ecological relationship with environmental variables which are potentially important in environmental reconstruction. Diatoms in the study sites can provide useful and independent quantitative information to investigate the recent impacts of global change on tropical high mountain ecosystems.

（来源：AQUATIC SCIENCES 卷: 84 期:1 出版年:2022, **DOI:** 10.1007/s00027-021-00838-z）

Understanding controls on stanols in lake sediments as proxies for palaeopopulations in Mesoamerica

Keenan, Benjamin; Imfeld, Anic; Gelinas, Yves;等

Faecal stanols in lake sediments have been used as a proxy for human populations in the past in a variety of contexts, with the assumption that variability in faecal stanol concentration or ratios is a reliable proxy for relative catchment-scale human populations. Despite that, the specific controls on faecal stanol concentrations and ratios in lake sediments remain poorly understood. In this study we analyse faecal stanol concentrations in lake surface sediments across Guatemala and the Yucatan Peninsula of Mexico in order to constrain geographical and biogeochemical variables controlling stanol concentrations and ratios in lake sediments in this region. We propose and test the hypothesis that the stanol ratios coprostanol:(coprostanol + stigmastanol) and coprostanol:(coprostanol + cholestanol) scale according to

the proximity to and size of nearby population centres. The key controls on stanol concentrations that we identify are the proximity to human population centres and the human population within 5 km of the sampling point. Based on a transect across Lake Peten Itza, the ratio coprostanol:(coprostanol + cholestanol) does not appear to be an accurate proxy for proximity to human population centres, nor does it correlate with catchment human population. We suggest that normalising stanol concentrations to TOC is an appropriate way to take into account the effects of mineral dilution as well as the potential effects of organic matter deposition and preservation, and that the ratio coprostanol:(coprostanol + stigmastanol) does not scale with human population but may be an effective approach to determine the relative contribution of coprostanol-producing mammals and herbivores. Further, we discuss the current limitations of the proxy as well as its future directions, including the implications of our results for sediment core siting, the use of stanol ratios in palaeolimnology, as well as the storage, transport, and diagenesis of stanols.

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Magnetic properties of core sediments from an alpine lake in Southwest China: implications for glacier melting

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Variations in the extent of glaciated areas are among the most distinct natural responses to climate change. To explore the response mechanism of sediment magnetic properties to glacial-area variation, detailed environmental magnetism investigations were performed on a sediment core from Lake Heihai, an alpine lake located on Haba Snow Mountain in Yunnan Province. We discuss the changes in sediment magnetic properties in the past century and their response mechanism to variations in glacial area caused by climate change, especially air-temperature change, based on the published chronological data. Results of magnetic mineralogy showed that single- and multi-domain magnetite and a small amount of high coercivity magnetic minerals dominated the sediment magnetic properties throughout the core. Magnetic particles within the sediments of Lake Heihai mainly originated from the terrigenous input of the lake basin discharged by glacial meltwater. Significant positive correlations were found among the annual average air temperature in the study area and concentration-dependent magnetic parameters (chi(lf)) while negative correlations occurred among the annual average air temperature and particle size-dependent magnetic parameters (chi(ARM)/SIRM), indicating that the sediment magnetic properties of alpine lakes were sensitive to glacial-area variations caused by air-temperature change. Increased input of coarse magnetic particles was a result of glacial-area shrink, while decreased coarse-grain input and occurrence of finer magnetic particles corresponded to glacial-area expand. In addition, we identified three glacial-area shrink and expand cycles based on the variations in sediment magnetic properties in the study area. We propose that the sediment magnetic properties of alpine lakes can be used for monitoring variations in glacial area caused by climate change.

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Stability of midge assemblages in productive shallow lakes exposed to point and diffuse nutrient inputs

Campbell, J. M.; Libera, N.; Smol, J. P.;等

Human activities in the headwaters of the Carleton River Watershed (southwest Nova Scotia, Canada) are suspected to have led to nutrient enrichment of freshwaters, resulting in downstream effects.

However, the presence of multiple nutrient sources in the headwaters, including mink fur farming and land-based aquaculture, have made it difficult to distinguish the dominant stressor(s). We used sedimentary chironomid and chaoborid remains and visible reflectance spectroscopy of sedimentary chlorophylla (VRS chl-a) to assess the timing and nature of limnological changes in two shallow eutrophic-hypereutrophic lakes that have been directly monitored for water quality since 2008. The catchment of eutrophic Hourglass Lake contains one mink farm and an aquaculture operation, and the outlet of Hourglass Lake flows into hypereutrophic Placides Lake through a watershed with several mink fur farms. Midge assemblages at Hourglass Lake showed a compositional shift (ANOSIM: 0.65, $P < 0.001$) coincident with the start of aquaculture in similar to 1990. However, the Chaoborus:chironomid (chaob:chir) ratio and midgeinferred volume-weighted hypolimnetic oxygen (VWHO) did not reflect decreased concentrations of dissolved oxygen. Midge assemblages at hypereutrophic Placides Lake showed no significant compositional shift and the chaob:chir ratio and inferred of dissolved oxygen were stable over the similar to 80-year record. It is likely that hypolimnetic oxygen concentrations have not decreased markedly in these productive lakes. Trends in VRS chl-a were also relatively stable at Placides Lake despite decades of nutrient inputs from the upstream watershed. High water colouration of these eutrophic-hypereutrophic shallow lakes may have increased their resilience to nutrient inputs from the catchment. Moreover, our study confirms that midge assemblage composition does not respond directly to phosphorus inputs in these shallow, stratified lakes. We highlight the stability of midge assemblages to decades of nutrient inputs from a land-based aquaculture operation and mink fur farms.

（来源：JOURNAL OF PALEOLIMNOLOGY 卷: 67 期:3 出版年:2022, **DOI:** 10.1007/s10933-021-00230-9）

Variation in the seasonal response to climate change during the past 1000 years as inferred from a Maar Lake sediment record, northeast China

Luo, Hai; Li, Jie; Li, Peng;等

Diatoms are universally recognized as good bio-indicators due to their high diversity and rapid response to environmental and climate changes. This paper explores whether the sedimentary diatom record from Sanjiaolongwan Maar Lake (SJML), northeastern China, reveals variations in seasonal pattern over the past 1000 years. The observed succession in diatom assemblages reveals that between 980 and 1310 CE the small-celled planktonic diatom Discostella pseudostelligera was abundant. Its relative abundance peaked during 1020-1060 CE, indicating that the duration of summer conditions over this interval was the longest within the last millennium. By contrast, the interval between 1470 and 1850 CE was marked by an increase in benthic diatoms pointing to a shortened duration of the ice-free season, and generally cold conditions. During the twentieth century warm period, the succession of eutrophic diatoms and changes in diatom cell size also reveal temperature-controlled seasonal variations in limnological conditions. The differences observed between the diatoms assemblages associated with the two warm periods indicate that the summers of the warmest part of the Medieval Climate Anomaly were longer than that of the current warm period. This result is supported by the diatom record from Erlongwan, another maar lake in the region that differs from SJML by its topographic features and in the level of human impact on its catchment.

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Exploring Great Lakes benthoscapes: can we visually delineate hypoxic habitats?

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Benthic macroinvertebrate communities are useful indicators for biological assessment of environmental and anthropogenic stressors, but our ability to quantify benthic populations is constrained by small spatial scales of traditional grab sampling and labor-intensive processing. During the 2019 assessment of Lake Erie's benthic community we studied lake benthoscapes by enhancing the traditional collection of grabs at 68 stations with underwater imagery, water quality, and sediment nutrients data. Four major habitats were identified from video data including Dreissena aggregations, Hexagenia burrows, and biogenic structures (chimneys and tubes). All four habitats differed in near-bottom dissolved oxygen (DO) concentration, with the highest DO found above dreissenids and the lowest in chimney habitats. DO, turbidity, and chlorophyll concentration provided the largest contribution to the MaxEnt model and predicted benthoscape distribution. There was a significant separation of benthic species by selected benthoscapes confirmed by independent cluster analysis. Suitable habitat for Dreissena was limited to normoxic areas, and Hexagenia habitats to the western basin. The central basin, subject to summer hypoxia, was mostly characterized by tube and chimney habitats. The agreement among biological, video, and abiotic data confirmed that video analysis can provide a novel, quick, and reliable method to detect benthic habitats affected by periodic hypoxia.

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Taking a macroscale perspective to improve understanding of shallow lake total phosphorus and chlorophyll a

Cheruvelil, Kendra Spence; Webster, Katherine E.; King, Katelyn B. S.;等

We conducted a macroscale study of 2210 shallow lakes (mean depth <= 3 m or a maximum depth <= 5 m) in the Upper Midwestern and Northeastern USA. We asked the following: What are the patterns and drivers of shallow lake total phosphorus (TP), chlorophyll a (CHLa), and TP-CHLa relationships at the macroscale, how do these differ from those for 4360 non-shallow lakes, and do results differ by hydrologic connectivity class? Spatial patterns and Bayesian hierarchical models indicated that shallow lakes had higher TP and CHLa than non-shallow lakes, connected shallow lakes were more productive than unconnected shallow lakes, and there was regional variation in these patterns. Important predictors of TP and CHLa included lake-specific watershed:lake area ratio, forested land use/cover, and baseflow; unconnected lakes were more difficult to predict than connected lakes; and region-specific predictors were mostly unimportant. Shallow lake TP-CHLa relationships were less steep than for non-shallow lakes and these relationships varied regionally. Our results, combined with the facts that only 23% of lakes in the study extent have depth data and that shallow and unconnected lakes are undersampled, have important implications for estimates of lake contributions to global cycles that are based mainly on large (and deeper) lakes.

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Ecosystem services provided by freshwater macrophytes

Thomaz, Sidinei Magela

Macrophytes are considered key components of aquatic ecosystems and they also provide multiple benefits for humans. In this review, I identified and exemplified 26 types of ecosystem services provided

by macrophytes. The most important supporting services provided by these plants are related to nutrient cycling and provisioning of habitat, but macrophytes also participate in water cycling and gases production. The presence of macrophytes and their activity enhance water purification and disease control which are important regulating services. Provisioning services are provided in the form of food at the local and global scale (e.g., rice), fiber, biochemicals, natural medicine and ornamental resources. Cultural services are provided in the form of spiritual and religious artifacts and local knowledge systems of communities which depend on macrophytes for surviving. Other cultural services are associated with educational activities, art inspiration, esthetic values in aquatic gardens and ponds, uses for leisure, recreation and ecotourism. There is evidence that the efficiency of ecosystem functioning, the provision of ecosystem services and ecosystem stability is enhanced by macrophyte diversity. Because macrophyte communities provide important benefits for humans, their conservation and restoration, where necessary, are important for human well-being.

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Opportunities for bipartisanship: Comparing water and energy policy in the Great Lakes region

Randall, Abigail M.

The Great Lakes contain most of the United States' surface freshwater and provide deep personal and economic connections for the residents of the region. These connections create an opportunity for bipartisanship in environmental policies with the potential to permeate energy policies. To explore that possibility, this paper examines how party affiliation affects support for water policy and energy policy in the Great Lakes region of the United States. Data from the Great Lakes Region Public Opinion Survey asked 696 Republicans, Independents, and Democrats from the Great Lakes region to respond to a range of environmental policy prompts. Responses to the policy prompts are grouped into four components: Water Quality, Water Diversions, Traditional Fuels, and Renewables. The results find that there is bipartisan support for the Water Quality and Water Diversions components. Energy policies do not receive the same bipartisan support, with Democrats and Independents having more support for the Renewables component while Republicans have more support for the Traditional Fuels component. However, when the fuel source is tied to its pollutants of the Great Lakes, then reactions to that fuel source receive a bipartisan response. The results of this research suggest that embedding water policy in energy policy may allow those policies to receive more bipartisan support. Combining water policy and energy policy can depolarize some of the politics surrounding environmental policy broadly.

（来源：JOURNAL OF GREAT LAKES RESEARCH 卷: 48 期:1 出版年:2022, **DOI:** 10.1016/j.jglr.2021.11.007）

DNA metabarcoding of the phytoplankton of Great Salt Lake's Gilbert Bay: Spatiotemporal assemblage changes and comparisons to microscopy

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The Great Salt Lake (GSL) is a unique hypersaline system with an understudied phytoplankton assemblage supporting a productive open water ecosystem in the largest embayment of the lake, Gilbert Bay. Determination of phytoplankton by microscopy has practical limitations that can constrain the scope of a study, but DNA metabarcoding may improve upon this through higher taxonomic resolution and the capacity to generate a large volume of assemblage data in comparatively little time. To determine if

metabarcoding could replicate microscopy and expand the assessment of GSL phytoplankton, a 23S SSU rRNA metabarcoding and microscopy survey of Gilbert Bay was conducted in 2017 and 2018. Assemblage composition and relative abundances from each method were compared, and spatial and temporal assemblage changes from metabarcoding data were investigated using nonmetric multidimensional scaling. Metabarcoding differed from microscopy in multiple taxonomic assignments and relative abundances, with poor correlation for most categories. Diatoms were overrepresented by metabarcoding relative to microscopy, and chlorophytes underrepresented. However, metabarcoding revealed seasonal and spatial patterns in assemblage, detected seasonal patterns within phytoplankton sequences of very low abundance, and detected potential cryptic speciation within the lake's dominant Dunaliella viridis. Phylogenetic analysis revealed greater phytoplankton diversity than observed before in GSL, but demonstrated the need to improve taxonomic assignment of the resulting sequences, particularly within the diatoms. The expansion of detectable diversity and isolation of DNA sequences that can be traced through time and analyzed against environmental variables make metabarcoding a potentially effective tool for parallel use with microscopy in future GSL research.

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What are the main environmental predictors of differences in the community structure of periphytic desmids in a semi-arid floodplain lake?

dos Santos, Maria Aparecida; Ferragut, Carla; Simoes, Nadson Ressye;等

The desmids constitute a highly diverse group with potential as a bioindicator of the conservation status of freshwater environments. We evaluated the changes in the desmid community on macrophytes with different structural complexities within mixed stands in a floodplain shallow lake in the Brazilian semi-arid region. Our main question was whether the environmental variables that best predict desmid structure among macrophyte species in mixed stands. Samplings were performed at each two months at four fixed stations during one year in a shallow tropical lake. To assess the changes in community structure, we sampled the periphyton on three macrophytes species (Cabomba caroliniana, Nymphaea amazonum, and Utricularia foliosa) with different complexity levels, which were quantified by their fractal dimension. Multivariate analysis showed that the structure and composition of the periphytic desmids were influenced by fractal dimension, nutrient availability, and temperature. The richness, density, and diversity of desmids differed between macrophytes with complex structure (U. foliosa and C. caroliniana) and simple structure (N. amazonum). We also observed that more complex macrophytes have a greatest contribution of desmids with small cell (< 40 mu m) in the community, suggesting that the substrate complexity affects the use of habitat. Our results suggest that the substantial fractal differences between host macrophytes are a major determining factor in the structure of periphytic desmid communities.

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An integrated analysis of pond ecosystem around Poyang Lake: assessment of water quality, sediment geochemistry, phytoplankton and benthic macroinvertebrates diversity and habitat condition

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Pond ecosystem not only provides essential agricultural irrigation and washing water, but also stores rainwater in rainy seasons. However, the pollution status of pond system around Poyang Lake was

seldom studied. Here, we investigated the water and sediment chemical characteristics, phytoplankton and benthic macroinvertebrates, as well as habitat conditions of 23 rural ponds around Poyang Lake. Results showed that water quality of 91.3% rural ponds was inferior V (National Surface Water Environmental Quality Standard of China) with the main pollutants of total nitrogen (TN) and total phosphorus (TP). In rural ponds, fifty-nine species of phytoplankton and nineteen benthic macroinvertebrates were identified, Cyanophyta and Chlorophyta were the dominant phytoplankton groups, and oligochaetes and aquatic insects were the most dominant taxa among all benthic macroinvertebrates. And an integrated evaluation system based on chemical, biological and physical index was set up to assess the pollution status of rural ponds. According to the composite integrity index, 2 rural ponds (8.70%) were classified as Very poor, 9 rural ponds (39.13%) were classified as Poor, 9 rural ponds (39.13%) were classified as Fair, and 3 rural ponds (13.04%) were classified as Good. And the composite integrity index in 4 counties followed the sequence of Xingzi County (0.598, Fair) > Jinxian County (0.425, Fair) > Xinjian County (0.379, Poor) > Nanchang County (0.335, Poor). Therefore, measures should be taken for improving the water quality, habitat conditions and biotic community of rural ponds, especially for the severely polluted rural ponds in Xinjian and Nanchang County.

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Experiments on invertebrate predation on cladocerans and its relationships with lake data

dos Santos Ferreira, Tania C.; Arcifa, Marlene S.

Until recently, knowledge of the impact of invertebrate predators on cladocerans in the Brazilian Lake Monte Alegre was limited to a few species. In order to assess the effects of predation on other cladoceran species, experiments were carried out with different pair-wise combinations of prey species. The experiments tested predation by fourth instar larvae of the dipteran Chaoborus brasiliensis Theobald on neonates and adults of the cladocerans Daphnia gessneri Herbst, Diaphanosoina hi,gei Kotinek, and Ceriodaphnia richardi Sars, and predation by the water mite Krendowskia sp. on neonates and adults of C. richardi and D. gessneri. In replicated treatments, the prey was offered alone or in combination with neonates and adults of two species and kept in bottles on a plankton wheel under controlled temperature, photoperiod, and light conditions. Chaoborus larvae preyed on neonates of D. birgei and D. gessneri and on adults of the former species. They preyed preferentially on neonates and adults of D. birgei over neonates and adults of C. richardi. The mite Krendowskia sp. preyed on only one species: neonates and adults of D. gessneri. Data on the distribution and strategies of prey in the lake are discussed in light of the experimental results, in an attempt to establish a link between laboratory data and field conditions.

（来源：JOURNAL OF LIMNOLOGY 卷: 81 期:1 出版年:2022, **DOI:** 10.4081/jlimnol.2021.1987）

Optical characteristics and factors that influence representative Lakes in the Taihu Lake basin, China

Ren, Weixiang; Wu, Xiaodong; Chao, Jianying;等

From 2018 to 2019, a survey of a typical lakes system in the Taihu Lake basin, China, was carried out. To provide reference values for the restoration and management of submerged vegetation in the lakes, the optical attenuation coefficient (K-d) and euphotic depth (Z(eu)) of the water body were calculated, and the distribution characteristics and factors that influenced the underwater optical field lands with different nutrition levels in the basin were analyzed. The main factor affecting the distribution of photosynthetically

active radiation (PAR) in lakes in the Taihu Lake basin is suspended solids (SS), dominated by inorganic suspended matter (ISS). Chlorophyll a (Chl-a), dissolved organic carbon (DOC), and chromophoric dissolved organic matter (CDOM) all affect, although weakly, the optical characteristics of lake wetlands. In CDOM, humic-like components have a more significant impact on K-d. The K-d of lakes in the Taihu Lake basin is closely related to permanganate index (CODMn) and especially total phosphorus (TP); The growth of aquatic vegetation is increased in Shanghu, Dianshan-Yuandang, Yangcheng, and Wuli Lakes that have higher Z(eu) and Z(eu)/Depth values.

（来源：JOURNAL OF FRESHWATER ECOLOGY 出版年: 2022, **DOI:** 10.1080/02705060.2022.2045231）

p Caribbean Lead and Mercury Pollution Archived in a Crater Lake

Cooke, Colin A.; Curtis, Jason H.; Kenney, William F.;等

Lead and mercury have long histories of anthropogenic use and release to the environment extending into preindustrial times. Yet, the timing, magnitude, and persistence of preindustrial emissions remain enigmatic, especially for mercury. Here, we quantify tropical lead and mercury deposition over the past similar to 3000 years using a well-dated sediment core from a small crater lake (Lake Antoine, Grenada). Preindustrial increases in lead and mercury concentrations can be explained by varying inputs of watershed mineral and organic matter, which in turn reflect climate-driven changes in the lake level. We find no evidence that preindustrial lead and mercury use raised deposition rates in this remote ecosystem, and our results underscore the need to carefully evaluate common normalization approaches for changing lithogenic inputs and sedimentation rates. Industrial-era lead and mercury accumulation rates in Lake Antoine have been accelerated by land use and land cover change within the crater rim, yet global industrial pollution remains evident. After correcting for watershed inputs, we find that recent atmospheric lead and mercury deposition rates averaged 2925 and 24 mu g/m2/y, respectively, which are in close agreement with monitoring data. Our results challenge recent assessments suggesting preindustrial mercury use raised atmospheric deposition rates globally, highlighting the unique nature of 20th Century industrial pollution.

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Mass Balance of Perfluoroalkyl Acids, Including Trifluoroacetic Acid, in a Freshwater Lake

Bjornsdotter, Maria K.; Yeung, Leo W. Y.; Karrman, Anna;等

Perfluoroalkyl acids (PFAAs) are highly persistent chemicals that are ubiquitously found in the environment. The atmospheric degradation of precursor compounds has been identified as a source of PFAAs and might be an important pathway for contamination. Lake Vattern is one of Sweden's largest lakes and is an important source for drinking water. In addition to contamination via atmospheric deposition, the lake is subject to several potential contamination sources via surface water inflow. The relevance of different sources is not well understood. A mass balance of selected PFAAs was assembled based on measured concentrations in atmospheric deposition, surface water from streams that constitute the main inflow and outflow, and surface water in the lake. The largest input was seen for trifluoroacetic acid (150 kg/year), perfluoropropanoic acid (1.6 kg/year), perfluorobutanoic acid (4.0 kg/year), and perfluoro-octanoic acid (1.5 kg/year). Both atmospheric deposition and surface water inflow was found to be important input pathways. There was a positive correlation between the input of most perfluoroalkyl carboxylic acids via atmospheric deposition and global radiation and between the input via surface water

inflow and catchment area. These findings highlight the importance of atmospheric oxidation of volatile precursor compounds for contamination in surface waters.

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Contrasting Impacts of Photochemical and Microbial Processing on the Photoreactivity of Dissolved Organic Matter in an Adirondack Lake Watershed

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Photochemical and microbial processing are the prevailing mechanisms that shape the composition and reactivity of dissolved organic matter (DOM); however, prior research has not comparatively evaluated the impacts of these processes on the photoproduction of reactive intermediates (RIs) from freshly sourced terrestrial DOM. We performed controlled irradiation and incubation experiments with leaf and soil samples collected from an acid-impacted lake watershed in the Adirondack Mountain region of New York to examine the effects of DOM processing on the apparent quantum yields of RIs (Phi(app,RI)), including excited triplet states of DOM ((DOM)-D-3*), singlet oxygen (O-1(2)), and hydroxyl radicals ((OH)-O-center dot). Photodegradation led to net reductions in Phi(app, 1O2), Phi(app, 3DOM*), and Phi(app, center dot OH), whereas (photo-)biodegradation resulted in increases in Phi(app, 1O2) and Phi(app, 3DOM*). Photodegradation and (photo-)biodegradation also shifted the energy distribution of (DOM)-D-3* in different directions. Multivariate statistical analyses revealed the potential relevance of photo-biodegradation in driving changes in Phi(app, 1O2) and Phi(app, 3DOM*) and prioritized five bulk DOM optical and redox properties that best explained the variations in Phi(app, 1O2) and Phi(app, 3DOM*) along the watershed terrestrial-aquatic continuum. Our findings highlight the contrasting impacts of photochemical and microbial processes on the photoreactivity of freshly sourced terrestrial DOM and invite further studies to develop a more holistic understanding of their implications for aquatic photochemistry.

（来源：ENVIRONMENTAL SCIENCE & TECHNOLOGY 出版年: 2022, **DOI:** 10.1021/acs.est.1c06047）

Analysis of surface temperature variation of lakes in China using MODIS land surface temperature data

Xie, Cong; Zhang, Xin; Zhuang, Long;等

China has a great wealth of lake resources over a great spatial extent and these lakes are highly sensitive to climate changes through their heat and water budgets. However, little is known about the changes in lake surface water temperature (LSWT) across China under the climate warming conditions over the past few decades. In this study, MODIS land surface temperature (LST) data were used to examine the spatial and temporal (diurnal, intra-annual, and inter-annual) variations in LSWT of China's lakes during 2001-2016. Our results indicated that 169 large lakes included in the study exhibited an overall increasing trend in LSWT, with an average rate of 0.26 degrees C/decade. The increasing rate of nighttime LSWT is 0.31 degrees C/decade, faster than that of daytime temperature (0.21 degrees C/decade). Overall, 121 (71.6%) lakes showed an increase in daytime temperature with a mean rate of 0.38 degrees C/decade, while the rest 48 (28.4%) lakes decreased in temperature with a mean rate of -0.21 degrees C/decade. We also quantitatively analyzed the relationship of the lake surface temperature and diurnal temperature differences (DTDs) with geographical location, topography, and lake morphometry by utilizing multivariate regression analysis. Our analysis suggested that the geographical

location (latitude and longitude) and topography (altitude) were primary driving factors in explaining the national lake water temperature variation (P < 0.001), which were also mediated by morphometric factors such as lake surface area and volume. Moreover, the diurnal lake temperature variations were significantly correlated with altitude, latitude, and lake surface area (R-2 = 0.426, P < 0.001). Correlation analyses of LSWT trend and air temperature trend for each lake indicated that LSWT was positively correlated with air temperature in both daytime and nighttime for most lakes.

（来源：SCIENTIFIC REPORTS 卷: 12 期:1 出版年:2022, **DOI:** 10.1038/s41598-022-06363-9）

Climate-related drivers of nutrient inputs and food web structure in shallow Arctic lake ecosystems

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In order to predict the effects of climate change on polar ecosystems, disentangling mechanisms of nutrient transfer in food webs is crucial. We investigated sources of nutrients in tundra lakes, tracing their transfer through the food web and relating the observed patterns to runoff, snow coverage, and the presence of migratory geese in lake catchments. C and N content (elemental and isotopic) of several food web components including Lepidurus arcticus (Notostraca, at the top of the lake food webs) in 18 shallow Arctic lakes was compared. Terrestrial productivity and geese abundance were key biotic factors that interacted with abiotic variables (snow coverage, lake and catchment size) in determining the amount and origin of nutrient inputs, affecting the trophic interactions among aquatic species, food chain length and nutrient flow in Arctic lake food webs. Decreasing snow coverage, increasing abundance and expansion of the geese's range are expected across the Arctic due to climate warming. By relating nutrient inputs and food web structure to snow coverage, vegetation and geese, this study contributes to our mechanistic understanding of the cascade effects of climate change in tundra ecosystems, and may help predict the response of lakes to changes in nutrient inputs at lower latitudes.

（来源：SCIENTIFIC REPORTS 卷: 12 期:1 出版年: 2022, **DOI:** 10.1038/s41598-022-06136-4）

Central Mongolian lake sediments reveal new insights on climate change and equestrian empires in the Eastern Steppes

Struck, Julian; Bliedtner, Marcel; Strobel, Paul;等

The repeated expansion of East Asian steppe cultures was a key driver of Eurasian history, forging new social, economic, and biological links across the continent. Climate has been suggested as important driver of these poorly understood cultural expansions, but paleoclimate records from the Mongolian Plateau often suffer from poor age control or ambiguous proxy interpretation. Here, we use a combination of geochemical analyses and comprehensive radiocarbon dating to establish the first robust and detailed record of paleohydrological conditions for Lake Telmen, Mongolia, covering the past similar to 4000 years. Our record shows that humid conditions coincided with solar minima, and hydrological modeling confirms the high sensitivity of the lake to paleoclimate changes. Careful comparisons with archaeological and historical records suggest that in the vast semi-arid grasslands of eastern Eurasia, solar minima led to reduced temperatures, less evaporation, and high biomass production, expanding the power base for pastoral economies and horse cavalry. Our findings suggest a crucial link between temperature dynamics in the Eastern Steppe and key social developments, such as the emergence of pastoral empires, and fuel concerns that global warming enhances water scarcity in the semi-arid regions of interior Eurasia.

（来源：SCIENTIFIC REPORTS 卷: 12 期:1 出版年:2022, **DOI:** 10.1038/s41598-022-06659-w）

Diversity of prokaryotic microorganisms in alkaline saline soil of the Qarhan Salt Lake area in the Qinghai-Tibet Plateau

Wang, Yaqiong; Bao, Guoyuan

The composition of microbial communities varies considerably across ecological environments, particularly in extreme environments, where unique microorganisms are typically used as the indicators of environmental conditions. However, the ecological reasons for the differences in microbial communities remain largely unknown. Herein, we analyzed taxonomic and functional community profiles via high-throughput sequencing to determine the alkaline saline soil bacterial and archaeal communities in the Qarhan Salt Lake area in the Qinghai-Tibet Plateau. The results showed that Betaproteobacteria (Proteobacteria) and Halobacteria (Euryarchaeota) were the most abundant in the soils of this area, which are common in high salinity environments. Accordingly, microbes that can adapt to local extremes typically have unique metabolic pathways and functions, such as chemoheterotrophy, aerobic chemoheterotrophy, nitrogen fixation, ureolysis, nitrate reduction, fermentation, dark hydrogen oxidation, and methanogenesis. Methanogenesis pathways include hydrogenotrophic methanogenesis, CO2 reduction with H-2, and formate methanogenesis. Thus, prokaryotic microorganisms in high salinity environments are indispensable in nitrogen and carbon cycling via particular metabolic pathways.

（来源：SCIENTIFIC REPORTS 卷: 12 期:1 出版年: 2022, **DOI:** 10.1038/s41598-022-07311-3）

Microbial diversity in intensively farmed lake sediment contaminated by heavy metals and identification of microbial taxa bioindicators of environmental quality

Custodio, Maria; Espinoza, Ciro; Penaloza, Richard;等

The cumulative effects of anthropogenic stress on freshwater ecosystems are becoming increasingly evident and worrisome. In lake sediments contaminated by heavy metals, the composition and structure of microbial communities can change and affect nutrient transformation and biogeochemical cycling of sediments. In this study, bacterial and archaeal communities of lake sediments under fish pressure contaminated with heavy metals were investigated by the Illumina MiSeq platform. Despite the similar content of most of the heavy metals in the lagoon sediments, we found that their microbial communities were different in diversity and composition. This difference would be determined by the resilience or tolerance of the microbial communities to the heavy metal enrichment gradient. Thirty-two different phyla and 66 different microbial classes were identified in sediment from the three lagoons studied. The highest percentages of contribution in the differentiation of microbial communities were presented by the classes Alphaproteobacteria (19.08%), Cyanophyceae (14.96%), Betaproteobacteria (9.01%) y Actinobacteria (7.55%). The bacteria that predominated in sediments with high levels of Cd and As were Deltaproteobacteria, Actinobacteria, Coriobacteriia, Nitrososphaeria and Acidobacteria (Pomacocha), Alphaproteobacteria, Chitinophagia, Nitrospira and Clostridia (Tipicocha) and Betaproteobacteria (Tranca Grande). Finally, the results allow us to expand the current knowledge of microbial diversity in lake sediments contaminated with heavy metals and to identify bioindicators taxa of environmental quality that can be used in the monitoring and control of heavy metal contamination.

（来源：SCIENTIFIC REPORTS 卷: 12 期:1 出版年: 2022, **DOI:** 10.1038/s41598-021-03949-7）

Restoration of aquatic macrophytes with the seed bank is difficult in lakes with reservoir-like water-level fluctuations: A case study of Chaohu Lake in China

Wang, Heyin; Zhang, Xiaoke; Peng, Yu;等

Aquatic vegetation in lakes along the middle and lower reaches of the Yangtze River has been seriously degraded by human disturbances such as river-lake disconnection and water eutrophication. Chaohu Lake is a typical lake with reservoir-like water-level fluctuations (WLFs). Since a sluice was built in 1962, the coverage of aquatic vegetation in Chaohu Lake has been very low (0.77%). In this study, field investigations of the aquatic vegetation and seed bank of Chaohu Lake were conducted, and aboveground vegetation diversity was found to be low. Forty-eight species were recorded, of which submerged, floating-leaved, and emergent macrophytes were 1, 5, and 10, respectively. Currently, artificially planted Phragmites australis and Salix communities have become the main community types. A total of 18 aquatic macrophytes were identified in the seed bank, of which the number of submerged, floating-leaved, and emergent macrophytes and hygrophytec were 2, 2, 3, and 11, respectively; the seed density was 2.05, 2.05,16.93, and 9.30 ind./m(2), respectively. The seed density of aquatic macmphytes was much lower in Chaohu lake than in the lakes with quasi-natural WLFs, and the seeds were mainly distributed in the estuary area. Only two emergent macrophyte species (Typha) germinated in the open water area. Spearman correlation analysis showed that the distance to bank was the main environmental factor that affected aquatic macrophyte diversity and seed density in the seed hank. It is not feasible to promote the natural reconstruction and restoration of aquatic macrophytes in Chaohu lake by decreasing the water level or increasing water transparency, but the area near the estuary can he identified as a priority restoration area (PRA) for aquatic macrophytes. Artificial transformation of the micm-topography can he used to guide some hydrochorous seeds in the tributaries to the PRA and restore aquatic vegetation in the local area.

（来源：SCIENCE OF THE TOTAL ENVIRONMENT 卷:813 出版年: 2022, **DOI:** 10.1016/j.scitotenv.2021.151860）

Geomorphic processes of a dammed palaeo-lake in the middle Yarlung Tsangpo River, Tibet

Hu, Hai-Ping; Liu, Jin-Hua; Feng, Jin-Liang;等

The failure of a natural dam is an extreme geological event. Palaeo-lake sediments were discovered in the broad Xigaze valley and Dazhuka-Yueju gorge in the middle reach of the Yarlung Tsangpo River in Tibet. However, the sedimentary processes, dam failure, and peak flood of the Xigaze dammed palaeo-lake are poorly understood. Hence, we conducted a field survey of eight lacustrine sedimentary terraces in the area. We divided the sedimentary processes of the palaeo-lake into five stages and deposit types: pre-palaeo-lake sediments (fluvial or aeolian deposits); early stage sediments of the palaeo-lake (coarse sand); main stage palaeo-lake sediments (clayey silt and sand), sediments following the discharge of the palaeo-lake (sand and gravel-cobbles); and cover deposits (aeolian sediments and colluvium). Additionally, the water level along the palaeo-lake was almost constant (3811 m a.s.l.). The dam was likely located at the eastern end of the Dazhuka-Yueju gorge. Based on the water level, dam location and 30-m ASTER GDEM2 data, the capacity of the palaeo-lake was estimated as 22.55 km(3). To separate the water volume and sediment volume, the sediment surface elevation along the palaeo-lake was simulated based on the elevations of the six lacustrine sedimentary terraces. The volume of the sediment was similar to 11.56 km(3), which was calculated from the dam location,

sediment surface elevation, and the ASTER GDEM2 data. Finally, subtraction of the sediment volume from the capacity of the palaeo-lake gave a backwater volume of 10.99 km(3). The peak flood possibly exceeded 3.4 x 10(5) m(3)/s as a moraine dam joined the discharge during the dam failure. However, the dammed event probably had a limited effect on the landforms at downstream because of the presence of another dammed palaeo-lake in the broad Zetang valley; moreover, the bedrock upstream of the dam was protected from erosion.

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Influence of temperature and pH on phosphate removal efficiency of different sorbents used in lake restoration

Kang, Li; Mucci, Maira; Lurling, Miquel

Phosphorus sorbents (PS) are viewed as a powerful tool to manage eutrophication. Here, we tested three commercially available PS - lanthanum-modified bentonite (LMB), aluminium-modified zeolite (AMZ) and aluminium salts (Al) on their capacity to chemically inactivate soluble reactive phosphorus (SRP) at six different temperatures (5 to 35 degrees C) and five pH values (6 to 10). We also evaluated if the SRP bound at a neutral pH would be released if pH increases to pH 10. Results showed that temperature affected the SRP binding behavior differently for each PS. For instance, the highest SRP binding capacities of LMB, AMZ and Al were 14.0, 29.9 and 251.1 mg P g(-1) at 30 degrees C, 35 degrees C and 30 degrees C, respectively; and the lowest was at 35 degrees C for LMB, 25 degrees C for AMZ and 20 degrees C for Al (6.3, 4.0 and 205.2 mg P g(-1), respectively). The pH also affected the SRP binding differently. When pH increased from pH 6 to pH 10, LMB and Al decreased their binding capacity from 10.0 to 4.9 and from 571.7 mg P g(-1) to 21.3 mg P g(-1), respectively. The SRP adsorption capacity of AMZ was similar at pH 7 and 10 (6.3 and 6.2 mg P g(-1)). We observed that in high pH, LMB did not release the SRP precipitated. In contrast, AMZ and Al desorbed around 39%, and 71% of the SRP adsorbed when pH changed from 7 to 10. Abiotic factors such as pH should be considered when selecting the most promising material in lake restoration.

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DNA-SIP reveals an overlooked methanotroph, Crenothrix sp., involved in methane consumption in shallow lake sediments

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Methanotrophs are the main consumers of methane produced in lake sediments. In shallow lakes suffering from eutrophication, methanogenesis is accelerated by the excess organic carbon input, and thus methanotrophs play a key role in regulating this methane flux as well as carbon cycling. Here, we applied nucleic acid stable isotope probing (SIP) to investigate the active methanotrophic microbial community in sediments of several shallow lakes affected by eutrophication. Our results showed that an active methanotrophic community dominated by gamma-proteobacterial methanotrophs, as well as abundant beta-proteobacterial methanol-utilizers, was involved in methane-derived carbon assimilation. Crenothrix, a filamentous methanotroph, was found to be a key methane consumer in all studied lakes. The ecological role of Crenothrix in lacustrine ecosystems is so far poorly understood, with only limited information on its existence in the water column of stratified lakes. Our results provide a novel ecological insight into this group by revealing a wide distribution of Crenothrix in lake sediments. The active methane assimilation by Crenothrix also suggested that it might represent a so far overlooked but crucial

biological sink of methane in shallow lakes.

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A unified model for high resolution mapping of global lake (> 1 ha) clarity using Landsat imagery data

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Lake clarity, usually measured by Secchi disc depth (SDD), is a reliable proxy of lakes trophic status due to its close link with total suspended matter, chlorophyll-a, and nutrients. Trained with in-situ measured SDD and match-up Landsat images, we established various regression models to estimate SDD for global lakes. We selected a unified model which demonstrated good spatiotemporal transferability, and has potential to map SDD in different years with good quality of Landsat top-of-atmosphere (TOA) images embedded in Google Earth Engine (GEE). The unified model was successfully calibrated (n = 3586 data points, R-2 = 0.84, MAPE = 29.8%) against SDD measured in 2235 lakes across the world, and the validation (n = 1779, R-2 = 0.76, MAPE = 38.8%) also exhibited stable performance. The unified model was tuned to historical SDD measurements coincident with different Landsat sensors (L5-TM, L7-ETM+, L8-OLI) launched over the past four decades (1984-2020), thus confirming its temporal stability. Global SDD was mapped using GEE with OLI TOA products mainly acquired in 2019 to examine the spatial variation of lake water clarity (lake surface area >= 1 ha) all over the world. Worldwide, lake water clarity averaged 3.13 +/- 1.71 m in 2019, but exhibited remarkable spatial variability due to catchment hydrological and landscape settings, lake morphology, elevation and anthropogenic impact. Inland waters in Europe (4.18 +/- 1.82 m) and North America (3.84 +/- 1.77 m) had the highest clarity due to greater water depth combined with less human disturbance in the high latitude regions. Lakes in South America (2.50 +/- 2.33 m), Asia (2.44 +/- 1.63 m) and Africa (2.36 +/- 0.72 m) displayed intermediate clarity. Lakes in Oceania (1.97 +/- 1.48 m) exhibited the lowest clarity for all continents except Antarctica. Further, we used the mapped SDD to evaluate water trophic status using the Carlson trophic state index. Our results indicate that, in 2019, about 63.6% of the lake areas and 47.8% of total lake numbers (2,219,627/4,646,056) were oligotrophic for global lakes, while about 23.6% areal percent and 37.1% of lake numbers are eutrophic mostly as a result of their being located in agricultural and urban-dominated drainage basins. This study, for the first time, provides water clarity information for lakes with area >= 1 ha all over the world with 30-m resolution and facilitates the understanding of the water clarity relevant to TSM (r = 0.95), Chl-a (r = 0.73), total phosphorus (r = 0.75), total nitrogen (r = 0.60), which could further provide water clarity data and technical support for trophic level evaluations as well. This unified model could serve as a powerful research tool for long-term monitoring of aquatic ecosystems and assessing their resilience to anthropogenic disturbance and climate change-related stressors.

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Comparing the effects of algae and macrophyte residues' degradation on biological nitrogen fixation in freshwater lake sediments

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The degradation and mineralization of organic residues are important factors that drive biochemical processes in lake ecosystems. However, the effect of organic matter's degradation on biological nitrogen fixation (BNF) in freshwater lake sediments remains poorly understood. This study investigated the response of sediment nitrogen fixation to the degradations of algae and macrophyte residues through

continuous flow mesocosms combined with nifH sequencing analysis and isotope tracing. The results suggested that the active nitrogen fixation of sediments only occurred in the first two weeks of the rapid degradation of organic residues. Degradation of algae and macrophytes residues quickly increased the nifH abundance and the nitrogenase activity (NA) in sediments; however, the maximum NA triggered by algae's degradation (658.2 +/- 16.8 ng g(-1) day(-1)) was six times higher than that induced by the degradation ofmacrophytes residues. There was no significant difference in NA of sediments with the degradation of Potamogeton and Phragmites. Redundancy analysis (RDA) showed that the variation of diazotrophic community in sediment was significantly ($p < 0.01$) correlated with the concentrations of SO42- and NH4+ in overlying water and the Fe(II) content and Eh in sediment. Overall, the BNF of sediments can quickly respond to the degradation of organic residues, and the degradation of algae has a stronger promoting effect on the nitrogen fixation in sediments than that of macrophyte residues.

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Phosphorous partitioning in sediments by particle size distribution in shallow lakes: From its mechanisms and patterns to its ecological implications

Deng, Peiyao; Yi, Qitao; Zhang, Jin;等

This study revealed a general pattern of P partitioning onto sediment particles that has ecological implications for shallow lakes. Six individual sediment samples from two large shallow lakes in eastern China were sieved into five sediment particle size classes ranging from 0.5 mu m to 50 mu m. These particle size groupings were subjected to P fractionation and P adsorption isotherm analyses as well as bioavailable P bioassays. A P-adding experiment was used to validate the initial P partitioning onto the sediment particles. Multiple lines of evidence revealed that P partitioning onto the particles was dependent on the amounts of P adsorbents or P-containing compounds in the sediments, such as iron and aluminum oxides, organic matter, and calcium compounds. An exponential equation, c(x) = c(max)exp(-k(d)x), was proposed to describe the relationship between the partitioning of bioavailable P and particle size. In the equation, c(max) represents the maximum P concentration adsorbed by the finest particles, and k(d) is a constant reflecting the decrease in the P concentration with particle size (x).

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Monitoring glacial lake outburst flood susceptibility using Sentinel-1 SAR data, Google Earth Engine, and persistent scatterer interferometry

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Continuous monitoring of glacial lakes, their parent glaciers and their surroundings is crucial because possible outbursts of these lakes pose a serious hazard to downstream areas. Ongoing climate change increases the risk of this hazard globally due to recession of glaciers leading to formation and expansion of glacial lakes, and permafrost degradation which impacts the stability of glaciers, slopes and moraines. Here, we demonstrate the capability of our approach for monitoring lake outburst susceptibility using time-series of Sentinel-1 Synthetic Aperture Radar (S-1 SAR) data. We selected Lunana in the Bhutanese Himalayas as an example region as it is highly susceptible to glacial lake outburst floods and suitable baseline data were available. We used Google Earth Engine (GEE) to calculate average radar backscatter intensity (ARBI) of glaciers, lakes, basins, and moraines. To determine the periodicity of the highest and the lowest radar backscatter intensity, we denoised the ARBI data using a Fast Fourier

Transform and autocorrelated using a Pearson correlation function. Additionally, we determined glacier melt area, basin melt area, lake area, open water area, and lake ice area using radar backscatter intensity data. The Persistent Scatterer Interferometry (PSI) technique was used to investigate the stability of moraines and slopes around glacial lakes. The PSI results were qualitatively validated by comparison with high-resolution digital elevation model differencing results. Our approach showed that glaciers and basins in the region underwent seasonal and periodic changes in their radar backscatter intensity related to changes in ice and snow melt. Lakes also showed seasonal changes in their radar backscatter intensity related to the variation of lake ice and open water area, but the radar backscatter intensity change was not periodic. We could also infer lake area change using a time-series radar backscatter intensity data such as the rapid expansion of Bechung Tsho. The PSI analysis showed that all the terminal moraines were stable except Drukchung Tsho. Its terminal moraine showed subsidence at the rate of -5.18 mm/yr. Sidewalls of lakes were also stable with the exception of Lugge Tsho at site 4. Due to the free availability of S-1 SAR data, the efficiency of processing a large amount of imagery within GEE, and the PSI technique, we were able to understand the outburst susceptibility of glacial lakes in the region at great detail. The regular acquisition of S-1 SAR data enables continuous monitoring of glacial lakes. A similar approach and concept can be transferred to any geographic region on earth that shares similar challenges in glacial lake monitoring.

（来源：REMOTE SENSING OF ENVIRONMENT 卷:271 出版年: 2022, **DOI:** 10.1016/j.rse.2022.112910）

Climate- and human-induced changes in suspended particulate matter over Lake Hongze on short and long timescales

Cao, Zhigang; Duan, Hongtao; Feng, Lian;等

The changes in global climate drivers have multiple impacts on lake ecosystems, as rain and wind conditions control catchment surface runoff and lake mixing regimes. However, human activities in lakes and their watersheds may have direct and indirect impacts on aquatic optical properties. Therefore, identifying key drivers that can be controlled (human) from those that cannot (climate) represents an important objective. In the present study, we develop an algorithm to estimate the concentrations of suspended particulate matter (SPM) in Lake Hongze (the fourth largest freshwater lake in China) using MODIS/Aqua images with concurrent data collected from six cruise surveys. The algorithm resulted in root mean square errors (RMSEs) of 7.64–7.86 mg/L for SPM ranging from 10 to 80 mg/L. The algorithm was applied to 1602 cloud-free MODIS/Aqua images from 2002 to 2015. Our results show: (1) inter-annual and seasonal variations of SPM concentrations in Lake Hongze are divided into two distinct periods between 2002 and 2011 and 2012–2015, with the transition associated to intensive dredging activities that were initiated in 2012. (2) SPM concentrations exhibit four typical patterns of spatial distribution which depend on local meteorological (wind speed and wind direction) and hydrological conditions (catchment rainfall and Huai River flowrate). Based on these results, a new spatial zoning of the lake is derived to support government and agency monitoring. The study shows additive and synergistic effects of climate change and human activities on SPM concentrations over short and long timescales and the possibility to monitor these changes by remote sensing in shallow optically complex lakes.

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Low nitrous oxide concentration and spatial microbial community transition across an urban river affected by treated sewage

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Urban rivers receive used water derived from anthropogenic activities and are a crucial source of the potent greenhouse gas nitrous oxide (N_2O). However, considerable uncertainties still exist regarding the variation and mechanisms of N_2O production in response to the discharge of treated sewage from municipal wastewater treatment plants (WWTPs). This study investigated N_2O concentrations and microbial processes responsible for nitrogen conversion upstream and downstream of WWTPs along the Tama River flowing through Tokyo, Japan. We evaluated the effect of treated sewage on dissolved N_2O concentrations and inherent N_2O consumption activities in the river sediments. In summer and winter, the mean dissolved N_2O concentrations were 0.67 μg-N L−1 and 0.82 μg-N L−1, respectively. Although the dissolved N_2O was supersaturated (mean 288.7% in summer, mean 240.7% in winter) in the river, the N_2O emission factors (EF5r, 0.013% – 0.025%) were significantly lower than those in other urban rivers and the Intergovernmental Panel on Climate Change default value (0.25%). The nitrate (NO_3^-) concentration in the Tama River increased downstream of the WWTPs discharge sites, and it was the main nitrogen constituent. An increasing trend of NO_3^- concentration was observed from upstream to downstream, along with an increase in the N2O consumption potential of the river sediment. A multiple regression model showed that NO_3^- is the crucial factor influencing N_2O saturation. The diversity in the upstream microbial communities was greater than that in the downstream ones, indicating the involvement of treated sewage discharge in shaping the microbial communities. Functional gene quantification for N_2O production and consumption suggested that nirK-type denitrifiers likely contributed to N_2O production. Structural equation models (SEMs) revealed that treated sewage discharged from WWTPs increased the NO_3^- loading from upstream to downstream in the river, inducing changes in the microbial communities and enhancing the N_2O consumption activities. Collectively, aerobic conditions limited denitrification and in turn facilitated nitrification, leading to low N_2O emissions even despite high NO_3^- loadings in the Tama River. Our findings unravel an overestimation of the N_2O emission potential in an urban oxygen-rich river affected by treated sewage discharge.

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Reservoirs change pCO_2 and water quality of downstream rivers: Evidence from three reservoirs in the Seine Basin

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The global increase in the construction of reservoirs has drawn attention given its documented hydrological and biogeochemical impacts on downstream rivers; however, the impact of reservoirs on downstream pCO2 (partial pressure of carbon dioxide) is still poorly understood. To evaluate these impacts, the interactions between reservoirs and their corresponding upstream and downstream rivers were analyzed for three reservoirs in the Seine Basin based on monthly measurement during two hydrological years. The seasonal variations of water quality in the reservoirs were mainly driven by the entering water and the biogeochemical processes occurring in the reservoirs. Our results unravel the crucial role of reservoir in downstream water quality, which significantly increased DOC (dissolved organic carbon) and BDOC (biodegradable DOC) concentrations, while lowered DSi (dissolved silica) concentrations during emptying period ($p < 0.01$). Furthermore, the impacts of reservoirs on the annual

fluxes of DOC, BDOC, and DSi were quantified and suggested that the three reservoirs respectively increased 20% and 23% of annual fluxes of DOC and BDOC, while decreased 33% of annual DSi fluxes in their downstream rivers. Additionally, the reservoirs significantly decreased downstream riverine pCO2 ($p < 0.01$), and enhanced the gas transfer coefficient of CO2 in downstream rivers by 1.3 times during the emptying period, which highlights the necessity to consider the potential impact of reservoirs on riverine CO2 emissions. Overall, our results highlight the importance of combining biogeochemical and hydrological characteristics to understand the impacts of reservoirs on downstream rivers, and emphasize the need of similar studies under the current context of increasing reservoir.

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Runoff changes in the major river basins of China and their responses to potential driving forces

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Identifying the effect of climate variability and human activities on runoff changes is scientifically essential for understanding hydrological processes and sustainable water resources management. This study selected 64 catchments located in the mainland of China to quantify the effects of different driving forces on runoff changes. Results showed that annual runoff in the Haihe river basin, Liaohe river basin, and Yellow river basin exhibited significantly decreasing trends from 1965 to 2018 ($P < 0.05$), whereas the Northwest river basin had positive trends in the annual runoff. Meanwhile, the Pettitt test method was applied to detect abrupt changes in annual runoff. Compared to the rivers in Southern China, the northern rivers had significant abrupt changes in annual runoff and mostly occurred in the 1990 s. The Choudhury-Yang equation based on the Budyko hypothesis was used to assess the sensitivity of runoff to precipitation (P), potential evapotranspiration (ET0), and the land surface (n) changes. The results showed that runoff was more sensitive to P and n, compared to ET0. Attribution analysis revealed that P was the dominant factor in the Northwest river basin, Southwest river basin, Yangtze river basin, Southeast river basin, and Pearl river basin, whereas the changes in n were responsible for runoff changes in the Liaohe river basin, Haihe river basin, Yellow river Basin, Songhuajiang river basin, and Huaihe river basin. The land surface changes (n) were resulted from vegetation restoration, urbanization expansion, construction of reservoirs/check dams, and surface water withdrawals, leading to significant changes in river runoff in recent years. The findings can provide good insight for water resources management across China.

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Mechanisms behind the uneven increases in early, mid- and late winter streamflow across four Arctic river basins

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The increasing winter streamflow of major Arctic rivers has been well documented. However, the contribution of climate change to winter streamflow and associated mechanisms of streamflow generation during early, mid- and late winter are not fully understood. Among the Arctic rivers, we selected four rivers with relatively few dam effects (Lena, Kolyma, Yukon and Mackenzie rivers) and analysed their climate change-related responses in streamflow during early, mid-, and late winter. Our results showed that the winter streamflow (Qwin) of the Lena, Kolyma, Yukon and Mackenzie rivers

increased from 1980 to 2019 by approximately 43%, 72%, 16% and 16% (1.7-5.2 times greater than increases in annual streamflow), respectively. In general, the rate of streamflow increase was the greatest in early winter, followed by mid- and late winter. The streamflow in late winter was particularly sensitive to air temperature changes, and permafrost degradation due to rising temperatures is likely a major factor driving late winter streamflow increases. In contrast to late winter streamflow, the larger rate of increase in early winter streamflow can be mainly attributed to the additional influence of increased late summer precipitation on streamflow generation. The different change rates in winter streamflow among the four river basins are highly determined by permafrost degradation and related baseflow discharge processes. Under warming climate conditions, winter streamflow generation is strongly associated with the enhanced hydrological cycle that is apparent in both the surface (e.g., precipitation and river ice) and the subsurface (the active layer and groundwater discharge).

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Excess energy theory for river curvature and meandering

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It is shown that the imbalance between the valley slope and the regime channel slope is the primary cause of river meandering when the sediment load is less than the load transporting capacity and if bank erodibility permits. When a river reach is confronted by a steep valley-slope it tries to maintain uniformity in energy-expenditure by expending the excess energy through channel curvature. Novel equations are analytically developed for the channel radius of curvature, sinuosity, wave length, arc length, initial arc angle, the meander path and a modified sine-generated curve based on width, depth, flow, sediment load, and roughness. These equations are more general than geometrical correlations between meander variables and width that were previously proposed in the literature. The developed channel sinuosity and wave length equations compare well with the available field data. Meandering in both alluvial and tidal channels, as well as in sediment-less environments (supraglacial channels) could be explained by the theory.

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Impacts of future climate on the hydrology of a transboundary river basin in northeastern North America

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Climate change introduces substantial uncertainty in water resources planning and management. This is particularly the case for the river systems in the high latitudes of the Northern Hemisphere that are more vulnerable to global change. The situation becomes more challenging when there is a limited hydrological understanding of the basin. In this study, we assessed the impacts of future climate on the hydrology of the Saint John River Basin (SJRB), which is an important transboundary coastal river basin in northeastern North America. We also additionally performed model benchmarking for the SJRB using four different meteorological forcing datasets. Using the best performing forcing data and model parameters, we studied the water balance of the basin. Our results show that meteorological forcing data play a pivotal role in model performance and therefore can introduce a large degree of uncertainty in hydrological modelling. The analysis of the water balance highlights that runoff and evapotranspiration account for about 99% of the total basin precipitation, with each constituting approximately 50%. The

simulation of future flows projects higher winter discharges, but summer flows are estimated to decrease in the 2041-2070 and 2071-2100 periods compared to the baseline period (1991-2020). However, the evaluation of model errors indicates higher confidence in the result that future winter flows will increase, but lower confidence in the results that future summer flows will decrease.

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Streamflow decline threatens water security in the upper Yangtze river

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The annual streamflow in the upper Yangtze River (UYR) declined by 36.6 billion m3 from 1961 to 2015. However, the contributions to this streamflow decline from different tributaries and the underlying causes remain unclear. Here we quantify the streamflow decline in the UYR and the impacts of climate change and human activities using a distributed hydrological model and statistical methods. Results show that the streamflow decline increased from the upstream to downstream regions. Combining hydrological simulation and statistical analysis, the contributions of climate change, human water consumption, reservoir impoundment and human-induced vegetation change on streamflow decline are estimated to be 62.5%, 19.7%, 18.4% and 1.8%, respectively. Specifically, human water consumption growth is consistent with the spatial pattern of population growth and industrial development, and the reservoir impoundments are mainly located in the middle and lower parts of the mainstream. In the Jialingjiang, the tributary with the largest drainage area in the UYR, human activities account for 63.6% of the streamflow decline, with the largest decline induced by human water consumption growth. Under climate change and population growth, the population under water stress (water resources available less than 1000 m3/capita/yr) increases in the Mintuojiang and Jialingjiang, where the major cities are centralized and the population density is high. This study provides a new perspective for understanding the status of water resources in the UYR and offers insights into the sustainable utilization of water resources in the future.

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Last two millennia of streamflow variability in the headwater catchment of the Yellow River basin reconstructed from tree rings

Wenzhuo Wang; Zengchuan Dong; Mukund Palat, Rao; 等

The headwater catchment of the Yellow River Basin (HCYRB) controls 35% of the streamflow of the Yellow River (YR) which faces increasing water shortages. To better understand streamflow variability in the region we require a better understanding of high and low flow characteristics. This study presents a new annual (Nov-Oct) streamflow reconstruction at the Tangnaihai station in the HCYRB for the last two millennia (159-2016 C.E.) using 12 tree-ring chronologies. The nested principal component regression model combined with the stepwise best subset selection method was proposed to improve the temporal length and model skill of reconstruction. The stepwise best subset selection method was presented to select the best principal components subset, instead of a confidence test, based on k-fold cross-validation error and Akaike's information criteria (AIC). The model assessment results verify that the proposed model exhibits strong reconstruction skills. Besides, the magnitude and duration of both high and low flow periods were analyzed. The results show that (1) the significant high-flow periods are the early 3rd century, circa 300 C.E., early 13th century, 16th century and circa 1900 C.E., while the low-flow periods are the late 5th century and late 15th century; (2) the durations and magnitudes of

low-flow periods are longer and larger than high-flow periods and the severities of high-flow periods are greater than low-flow periods. The reconstruction also suggests that a warm climate is more likely accompanied by a high-flow period and low-flow periods are more likely to occur in cold periods associated with the Asian Summer Monsoon and solar activity.

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The increasing contribution of potential evapotranspiration to severe droughts in the Yellow River basin

Yaping Wang; Shuai Wang; Wenwu Zhao; 等

Under global warming, droughts have become more severe and more frequent. In this context, it is widely accepted that both water supply (e.g., precipitation, PRE) and demand (e.g., potential evapotranspiration, PET) should be considered in drought assessments due to increasing evapotranspiration. China's Yellow River basin is located mainly in arid and semi-arid regions that suffer severe droughts. Analyzing the temporal and spatial patterns of droughts in this area and exploring the relative effects of supply and demand on drought occurrence and variations are thus necessary to adapt to increased droughts. Here, we compared three kinds of drought indices, including the standardized precipitation evapotranspiration index (SPEI), the standardized precipitation index (SPI), and the standardized evapotranspiration deficit Index (SEDI), and used SPEI to identify droughts in the Yellow River basin during the six decades from 1956 to 2016. We identified droughts and described drought dynamics based on drought duration, intensity, frequency, and spatial extent. We then evaluated the relative contributions of PRE and PET to droughts of varying severity and long-term trend, as well as the relationships between ocean signals and droughts. Our results show that most of the basin has undergone progressively drier conditions since the 1950 s. This increased drought occurrence has manifested as longer, more frequent droughts affecting a larger spatial extent. PRE was the dominant driver (64%) of drought occurrence in an area of 86% of the basin, whereas PET was the main driver (55%) in the remaining 14% of the basin. However, changes in PET contributed more than PRE to drought variation, i.e., long-term SPEI trends, in about 60% of the area. And effects of PET increased during severer droughts due to the intensive interaction between soil moisture and atmospheric water demand in highly arid conditions. Physically, droughts were closely related to several ocean signals, such as the Multivariate ENSO Index (MEI), the North Atlantic Oscillation (NAO), the Atlantic Multidecadal Oscillation index (AMO), and the Arctic Oscillation index (AO), at different time scales. Understandings of drought dynamics, their physical mechanisms, and the effects of PRE and PET on droughts of varying severity are essential for water resource management, especially in arid regions.

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科学视点

冰川退缩加速全球化学风化

近日，西北大学研究团队联合中科院西北生态环境资源研究院、美国宾夕法尼亚州立大学、中科院成都山地灾害与环境研究所等，找到了冰川化学风化速率升高的确凿证据，相关成果发表于《自然—通讯》。

该研究基于全球 77 条冰川 5465 个径流样品的水化学资料，首次评估了全球冰川的化学风化速率，并揭示了冰川风化速率的时空变化规律和影响机制。

该研究以阳离子剥蚀速率作为化学风化速率的代用指标，发现全球冰川的平均风化速率是 20 年前的 3 倍，是冰盖流域的 10 倍，是整个冰盖的 50 倍，是非冰川流域的 4 倍；冰川化学风化速率与气温、降水和径流呈正相关关系，与纬度反相关。

据悉，该课题系第二次青藏高原综合科学考察研究项目“亚洲水塔动态变化与影响”任务“水资源演变与适应性利用”专题和“冰川、积雪、冻土变化与影响及应对”专题研究团队。

以往研究指出，侵蚀作用增强也会引起化学风化增强并伴随着风化速率升高，据此可知冰川在化学风化过程中吸收/排放 CO_2 的能力也会增强。同时，由于消融加速，冰川融水每年向下游输送了大量的生物活性元素（如铁、硅、磷、有机碳）和有毒有害元素（如汞、砷）。当这些元素进入下游以后会影响陆地或水生生态系统的初级生产力，最终可能影响区域或全球的元素循环（如碳循环）并反馈气候系统。

需要指出的是，上述研究均基于一个科学假设，即当前全球冰川的化学风化速率相比以前明显升高了，但遗憾的是一直没有定量的证据来证实这个假设。而该研究表明，未来全球的冰川和冰盖在融水径流量达到峰值（拐点）以前，其化学风化速率会一直升高，碳汇或碳源能力会一直增强，化学风化的物质产量会一直增加，对陆地和水生生态系统的影响会进一步增大，在区域或全球元素生物地球化学循环中的重要性会越来越显著。

（来源：科学网，https://news.sciencenet.cn/htmlnews/2022/1/473223.shtm,根据相关资料编译）

全球湖泊藻华遥感研究取得新进展

随着全球气候变化和人类活动的干扰，湖泊藻华问题不断加剧，已经成为一类全球性的生态环境问题，湖泊面临的严峻水环境问题不容忽视。

目前，全球湖泊藻华整体时空格局还缺乏系统性评估，藻华驱动因素也有待进一步阐明。中国科学院东北地理与农业生态研究所水环境遥感学科组科研人员借助

遥感技术手段，基于 1982-2018 年 Landsat 影像，明确了全球面积大于 1 km^2 湖泊中藻华的空间分布格局。研究表明，在 1982-2018 年间，全球共有 863 个湖泊遭受过藻华问题的困扰，其中 708 个湖泊有多年藻华暴发情况发生。进一步分析这些长时序藻华数据，发现 66%的湖泊藻华暴发情况呈现为增加趋势，其余 34%为下降趋势。30 多年间，全球各大洲湖泊藻华爆发情况有明显差异，大部分都表现为明显的增加趋势，其中亚洲最为明显，其次是南美、非洲和欧洲。大洋洲无明显趋势，而北美洲则呈现先上升后下降的趋势（2000 年为界）。同时，本研究探讨了在不同气候分区内湖泊藻华频发的主要驱动因素，人类活动的影响（化肥 16.5%、GDP 19.4%和人口 18.7%）要略高于气候要素（气温 10.1%、风速 11.7%、气压 16.8%和降水 11.6%）。

本研究为藻华暴发机理研究提供了理论基础，对评估历史和未来气候模式下藻华发生趋势具有指导意义，可为国内外湖泊藻华及富营养化治理提供数据支撑。

（来源：中国科学院院网，https://www.cas.cn/syky/202203/t20220303_4826828.shtml,根据相关资料编译）

湖泊光伏电站环境能量平衡特征研究

近十年来，湖面光伏是一种新型太阳能光伏布设方式。湖面和陆面的水热条件差异较大，光伏面板布设后会将地表接收到的部分太阳短波辐射转换为电能，势必会影响原有湖泊系统的辐射及能量平衡。

近期，中国科学院西北生态环境资源研究院高晓清课题组基于原位观测试验，以江苏扬中 10 MW 湖面光伏电站为研究对象，通过光伏电站内外的观测数据，分析了湖面布设光伏电站后对于局部水域的辐射及能量收支平衡影响。研究表明，光伏电站布设后湖面向上的长波辐射变大，间接证实湖面光伏电站热效应的存在，但仅仅从平均温度来看，这种热效应并不是十分明显。从对水温的影响来看，夏季光伏面板表现为遮蔽效应，冬季表现为加热效应。该研究为湖面发展光伏电站提供了数据支撑。

（来源：中国科学院院网，https://www.cas.cn/syky/202203/t20220307_4827262.shtml,根据相关资料编译）

中亚天山极端降水变化及其相关大尺度气候遥相关指数研究

极端降水（EP）常常引发洪水、山体滑坡、泥石流等自然灾害，对人类社会构成巨大威胁。统计表明，哈萨克斯坦 13.5%的国土面积受洪水、山体滑坡、泥石流等自然灾害影响，塔吉克斯坦 85%的国土面积面临泥石流风险，其中 32%受强泥石流影响。中亚天山不仅是丝绸之路经济带中部的生态屏障，更是主要的水源地，深刻影响着中亚和中国西北地区（新疆）的社会经济发展。全面了解该区域 EP 的时空变化特征及其相关的大尺度气候遥相关机制，对于理解极端事件对全球变暖的响应，找寻适宜的水资源管理策略至关重要。

中国科学院新疆生态与地理研究所研究员陈亚宁团队基于高分辨率、长期日格点降水数据，通过 25 个 EP 指数反映了历史时期中亚天山 EP 的持续时间、强度和频度的变化，并基于地理探测器（GMD），定量评价对 EP 影响最为关键的大尺度气候遥相关指数。

研究结果表明，1951 年至 2014 年中亚天山 EP 朝湿润化发展，并表现出明显的海拔依赖性。其中，EP 事件越罕见，其频度变化越强烈。GMD 发现，SAM、AMO、NINOB、NSI、SF、AO、30ZW 是影响 EP 变化最重要的因子。总体而言，500hPa 和 1000hPa 纬向环流的增强加速了自西向东的气流，伴随着西太平洋副热带高压的西伸和蒙古反气旋活动的增强，为中亚天山带来充足的外源水汽（北大西洋和印度洋）。

（来源：中国科学院院网，https://www.cas.cn/syky/202202/t20220217_4825511.shtml,根据相关资料编译）

面源污染径流实时在线监测

近期，中科院精密测量院杜耘课题组面源污染研究团队联合中国农科院农业资源与农业区划研究所、北京航空航天大学科研人员，在径流总氮（TN）实时在线监测技术方面取得重要进展。

面源污染是指降雨条件下污染物随径流汇入受纳水体引起富营养化等水污染的现象。氮磷是水体富营养化的关键指标。降雨条件下，面源污染径流水量水质短期内呈分钟尺度变化，现有技术难以捕获径流氮磷的浓度峰值和变化过程。智能水站运维复杂、成本高，且TN检测采用化学法，监测频次偏低；水环境遥感技术受时空及光谱分辨率、云雨天况等因素影响，监测精度不确定性大，制约了其在降雨条件下小微水体环境监测中的应用。

针对上述问题，研究团队重点面向面源污染径流水体，基于指标之间的生物、物理和化学关联，解析传感器可测的水量水质常规指标（如电导率、氧化还原电位、pH、温度、氨氮、硝氮等）与TN浓度之间的定量关系；通过判定系数（R2）、准确度（Acc）、平均相对误差（MRE）以及对缺失数据的容忍度等多项指标进行算法优选，确定极端决策树（Extra Tree Regression，ETR）为TN反演最佳算法；在此基础上开发了基于多源传感器及智能算法的TN高频监测技术。结果表明：新方法可实现径流TN分钟级（<5min）监测；在田间出口、沟渠等相似背景环境下，反演精度高（r2>0.9，Acc>85%）；结合均值填补算法，实现部分变量缺失条件下（缺失变量数n≤2、缺失值比例P≤75%）的TN反演，弥补了野外传感器损坏所导致的数据异常等问题，提高技术适应性。

科研人员介绍，TN实时高频监测技术将传感器“快速检测”和智能算法“数据处理”的优势相结合，数据获取稳定、监测频率高、精度高，不受云雨、夜间天况

限制，且适用于沟塘等小微水体，可为面源污染的应急预警和精准溯源提供重要的技术支持。依托上述成果自主研制了可调式、下沉式多参数地表径流监测装备，并在江西、河南、湖北等地推广应用。

（来源：科学网，https://news.sciencenet.cn//htmlnews/2022/1/472814.shtm?id=472814,根据相关资料编译）

人类世全球湖泊生态系统突变研究

湖泊作为全球生态系统的重要组成部分，包含了地球上近 90%的表层液态淡水资源，发挥着重要的经济、社会以及生态效益。进入人类世以来，在多重胁迫下，全球湖泊生态系统弹性持续下降，引发一系列突出的生态环境问题，成为制约全球和区域可持续发展的重要因素；另一方面，全球范围内湖泊修复治理进入瓶颈期，大量生态恢复投入但水环境未发生根本性转变，甚至水生态持续退化。传统的湖泊生态修复的理念和方法面临新的挑战和质疑，退化湖泊生态系统的可恢复性如何，恢复需要多长时间，以及能恢复到何种程度等成为当前科学界亟需回答的难题。

随着系统弹性降低，湖泊生态系统会跨过阈值而发生系统突变，具有速度快、难预测、难恢复等特征。例如，频繁的湖泊蓝藻水华暴发是湖泊生态系统退化的外在“症状”，但其内在的原因是湖泊生态系统结构和功能发生了根本性转变。因此，科学理解全球范围内湖泊生态系统突变的过程、时空模式及驱动机制，对于全面深入理解当前湖泊的健康状态，评估湖泊生态环境安全，设置合理修复目标等具有重要的科学价值。

近期，中科院南京地理与湖泊研究所张科研究员团队基于元分析和网络分析方法，综述了全球范围内 72 个湖泊的系统突变时间-驱动因子数据，首次从全球尺度揭示过去两百年来不同类型湖泊生态系统突变的时空模式，厘清了导致湖泊突变的主要驱动因子和潜在机制，揭示出各驱动因子及多重驱动对全球湖泊突变影响的相对重要性，进一步提出了基于全球湖泊生态系统突变来界定人类世开端的新思路。该研究为准确评估应对未来气候变暖和人为扰动带来的生态风险，发展生态系统动态变化的评估和预测模型具有重要意义。

研究发现，全球湖泊生态系统在过去两百年来突变时间不同步，但在二十世纪五十年代后全球湖泊突变频率明显增加，超过三分之二的湖泊在 1950s 之后发生系统突变。不同类型湖泊因自身特性、地理位置以及受人类影响程度不同，突变时间也具有一定差异。因此，为便于对比不同湖泊之间突变时间的差异性，研究将 72 个湖泊分别按照不同水深、不同海拔和纬度梯度以及受人类影响程度分为三大类。

分析表明，全球范围内不同深度的湖泊突变时间较为接近（~1960s），而处于不同纬度和海拔的湖泊，突变时间具有明显差异。如高山、极地湖泊其突变时间是明显早于温、热带湖泊。另外，在不同人类影响强度作用下，湖泊突变时间也呈现

出差异性变化。比如，位于低人类影响强度地区的湖泊，其突变时间要早于那些受人类影响较强地区的湖泊。

湖泊突变驱动因子分析表明导致湖泊突变的驱动因素也各不相同，但在五十年代以前，湖泊生态系统突变主要受控于气候变化，而在五十年代之后，气候变化和人为的营养和污染输入成为湖泊突变的主导因素。受人类活动影响较强的温、热带地区湖泊，主要受到营养和污染的影响，而远离强人类活动扰动位于高海拔、高纬度的湖泊，更易受到气候变化的影响。此外，驱动共现网络分析揭示出多重驱动的交互作用更易导致湖泊突变的发生，其中气候变化最频繁地与其他驱动因子发生交互作用，从而导致湖泊生态系统突变。

研究认为，全球变暖和日益加剧的人为扰动已经使得全球湖泊生态系统逐渐偏离安全操作空间。因此，亟需从全球角度形成湖泊管理策略，以此来降低由多重驱动导致的人类世湖泊生态系统突变风险。

基于古生态记录集成研究分析发现，二十世纪五十年代全球湖泊生态系统突变频率的加快与地球系统的“大加速”时期相对应。五十年代之后，全球人口的快速增长，以及人类日益增长的物质需求导致全球农业用地的大幅扩张，全球氮磷化肥使用量急剧增加。因此，大量的外源营养和污染输入导致湖泊水质持续降级，生态系统突变频繁发生。本研究揭示了过去两百年来，在全球变暖背景下，前所未有的人为扰动对全球湖泊生态系统产生了重大影响，同时也从全球湖泊生态系统突变的角度为定义人类世提供了重要的参考和证据。

（来源：http://www.niglas.ac.cn/xwdt_1_1/yjjz/202203/t20220328_6408377.html,根据相关资料编译）

食物链长度改变了湖泊生态系统对增温的响应

湖泊生态系统对全球变化的响应及其应对策略是湖沼学研究的热点之一。基于温带湖泊的理论和经验研究均表明，增温会加剧捕食者的下行级联效应，促进浮游植物的生长，进而影响湖泊生态系统功能。然而，对于亚热带或热带地区浅水湖泊，相关研究还主要集中在气候变化与营养盐（N、P 等）循环的叠加或交互作用方面，多从上行效应（营养盐富集）的角度考察气候变化（如增温）对富营养化的放大作用。从食物网结构的角度揭示湖泊生态系统对气候变化的响应及其机理的研究还相对较少。

食物链长度是刻画食物网结构的一个重要指标。在热带或亚热带地区，大多数浅水湖泊的食物网可从功能上简单认为是三个营养级，即浮游植物、浮游动物和食浮游生物鱼类。而在生态修复中，通过工程手段调控鱼类，食物网能够在短期内表

现为两个营养级，即浮游动物和浮游植物。在气候变化的背景下，两种长度的湖泊食物链对增温的响应及其机理还有待研究。

中国科学院南京地理与湖泊研究所刘正文研究员团队通过受控实验比较了两种食物链长度（有鱼 vs 无鱼）系统中浮游生物生物量和物候对模拟增温（+3 ℃）的响应规律。结果显示：在三营养级（有鱼）系统中，增温促进了鱼类生长，其对浮游动物的捕食释放了浮游植物的牧食压力；同时增温促进了沉积物磷释放，生态系统最终转为浊水态；与之相反，在二营养级（无鱼）系统中，增温对浮游动物的负面影响较弱，大型浮游动物对浮游植物的牧食使得生态系统一直保持着清水态。研究结果表明，食物链长度可以调节温暖地区湖泊生态系统对增温的响应。因此，在实际的湖泊管理与修复工作中，加强鱼类调控可能是抑制气候变暖对湖泊富营养化影响的有效策略之一。

在种群和群落水平上，增温同样影响了浮游生物春季物候，实验结果表明在二营养级系统中，增温条件下浮游动物关键属种溞（Daphnia）的孵化时间明显提前，但由于食物资源的限制，其种群增长率和环境容纳量均较低，最终溞的春季高峰到达的时间（4 月中旬）和对照组相比并没有显著提前，同时由于溞在增温条件下对浮游植物的强力牧食，浮游植物春季高峰在增温条件下消失；对于三营养级系统，增温极大的抑制了溞的种群发展，导致浮游植物呈几何级数增长，最终形成一个迟到但是暴发幅度显著增加的春季水华过程。研究第一次从多营养级角度探讨亚热带湖泊浮游生物物候对增温的响应，强调了食物网结构（食物链长度）对生物物候的影响。

（来源： http://www.niglas.ac.cn/xwdt_1_1/yjjz/202203/t20220323_6402322.html,根据相关资料编译）

我国亚热带湖泊鱼类群落随富营养化发展的变化趋势研究

鱼类是湖泊生态系统的重要组成，往往位于食物链的顶端，在维持食物网结构与功能稳定中发挥重要作用。鱼类主要通过摄食活动影响其饵料生物的群落结构（例如浮游植物、浮游动物和底栖动物的群落结构等）和水体的各项理化因子（例如水体营养盐浓度和透明度等），但不同食性（生活习性）的鱼类对生态系统的影响程度和途径不同。

湖泊中合理的鱼类群落结构有利于维持较低的藻类密度和较高的水体透明度。肉食性鱼类通过捕食可降低其它鱼类（小型浮游动物食性鱼类和杂食性鱼类）的生物量，间接地促进浮游动物生物量上升，增强浮游动物对浮游植物的牧食压力，抑制浮游植物生物量上升。因此湖泊中肉食性鱼类的比例较高时，其通过下行效应（top-down effects）维持较高的透明度和较低的水体营养盐浓度。反之，在缺少有效肉食性鱼类或肉食性鱼类在鱼类群落结构中的占比较低时，浮游动物食性鱼类和

底栖杂食性鱼类的丰度和生物量均将大幅增加，这些鱼类通过捕食浮游动物、扰动沉积物、摄食沉水植物、加速营养循环速率等途径，促进浮游植物生物量快速增加，导致水体长期处于浑浊、浮游藻类生物量长期高位运行的状态。

湖泊富营养化可通过影响鱼类生境与饵料资源等途径影响鱼类群落结构。在温带湖泊，鱼类的总丰度和总生物量随湖泊总磷浓度和浮游植物生物量的上升而增加；其中，肉食性鱼类的渔获量及其在鱼类群落结构中的比例随湖泊富营养化程度的加重而逐渐下降，而浮游动物食性鱼类与杂食性鱼类的比例上升。目前，有关鱼类群落结构对湖泊富营养化响应的研究多集中在欧、美等地区的温带湖泊。

为了解我国亚热带不同营养状态湖泊的鱼类群落结构特征，中科院南京地理与湖泊研究所刘正文研究员团队于谨磊副研究员通过多网目丝网（刺网）调查了 36 个亚热带湖泊敞水区的鱼类群落结构，解析了影响鱼类群落结构组成、鱼类丰度及生物量和不同功能群鱼类比例等的主要环境因子。

研究结果显示：（1）浮游动物食性鱼类、小型杂食性鱼类是调查湖泊的绝对优势种；（2）湖泊的初级生产力（以水体叶绿素 a 含量代替）是决定鱼类捕获量（单位时间内每网捕获的鱼类总数量或总重量）、物种丰度、优势鱼类数量和不同功能群鱼类比例的主要因子；（3）单位时间内捕获的鱼类数量（NPUE，尾/网/小时）和重量（BPUE，g/网/小时）均与湖泊叶绿素 a 浓度呈显著的正相关线性关系；（4）鱼类捕获的物种数量也随湖泊叶绿素 a 浓度的升高而增加；（5）随着湖泊叶绿素 a 浓度的升高，浮游动物食性鱼类的数量和生物量占比上升，而肉食性鱼类的比例则显著下降；底栖杂食性鱼类的生物量占比随湖泊总氮（TN）浓度的升高而降低。

（来源：http://www.niglas.ac.cn/xwdt_1_1/yjjz/202203/t20220318_6400969.html,根据相关资料编译）

我国长江干流及东部湖群 DOM 组成及生物活性格局与驱动机制

陆地生态系统每年承接、储存及输移的碳通量可达 51 亿吨，尽管内陆水域只覆盖了地球两极冰盖除外陆域面积的 3.7%，其转移、转化的碳通量却十分巨大。溶解性有机物（DOM）主要成分为碳，是天然水体中有机质最重要的赋存形态及活跃成分，其来源组成能影响水处理工艺与流程、重金属及有毒有害物迁移、毒性及生物有效性。DOM 矿化也能释放大量有机及无机营养盐，从而影响湖泊富营养化进程及生态系统健康。溪流源头等系统中 DOM 组成来源直接受制于森林、湿地及农业用地覆盖比例，污水管网损坏及面源输入等因素。而流域人类活动导致的非点源输入及湖泊物理水文等诸多因素如何制约湖泊 DOM 来源组成，尤其是其分子组成，进而影响其微生物活性的研究进展却鲜有报道。

鉴于此，中国科学院南京地理与湖泊研究所张运林研究员团队周永强副研究员等结合第二次全国湖泊调查（丰、枯季节）数据及 2018 年丰、平、枯三种水文情景下调查的我国东部湖群 DOM 来源组成特征，首次全面揭示了我国东部湖群 DOM 组成对湖泊物理水文等自然特征及流域人类活动强度等因素的响应机制。

研究结果表明，近十余年来我国东部湖群综合富营养水平 TLI 及叶绿素 a（Chl-a）有上升趋势。TLI 及 Chl-a 水平与流域范围内城市人口用地比重及 GDP 水平呈显著正相关，并直接影响湖泊溶解性有机碳（DOC）浓度及细菌丰度。由于人类生产生活废水及降水过程携带的非点源 DOM 输入加之藻类等水生生物降解能释放丰富的类蛋白荧光信号。类蛋白组分与类腐殖酸组分荧光信号比值（Protein : Humic）能有效表征人类活动引发的非点源 DOM 输入。相关分析结果表明我国东部湖群 DOM 中 Protein：Humic 与流域城市用地比重、GDP 及人口密度呈显著正相关，却与对应湖泊:流域面积比值、流域总初级生产力 GPP、湖泊水力滞留时间、稳定性同位素值 δ18O-H2O（亦可反映水力滞留时间）、细菌丰度等指标无显著关系。运用室内好氧生物 28 天培养实验，可确定此间微生物活性较强 DOC 比重，即 BDOC，其变幅为 0.1%~38%。BDOC 在太湖流域内高度富营养的滆湖、阳澄湖及太湖与类蛋白组分荧光强度及 Protein：Humic 存在显著正相关，意味着人类活动非点源类废水排放比重越高，对应 DOC 的微生物活性越强。

我国东部湖群跨越范围广，该区域湖泊通常是特大及大中型城市集中供水源地，我国东部地区与其他发展中国家和地区一样经历着快速的城市化过程，这意味着可预见的未来随着城镇化快速发展，更多微生物活性强的脂肪族类 DOM 将被排入湖泊，这也将加速该类湖群碳循环过程。

大江大河是全球陆地碳输移的大动脉。长江流域面积可达 18×10^6 km^2，长江起源于青藏高原各拉丹冬峰，向东流经 6300 km 并注入东海。然而在大江大河连续体层面上水文过程及人类活动强度如何影响 DOM 来源组成依然有待进一步探究。依托第二次青藏科考项目及国家自然科学基金重点项目等资助下，南京地理与湖泊研究所张运林研究小组周永强等人员以长江源沱沱河至入海口的样品采集结合长江下游大通站逐周野外观测结果，结合长江干流国控站点 2006-2018 年逐周自动监测结果，揭示了长江干流 DOM 来源组成及微生物活性格局与驱动机制。

（来源：http://www.niglas.ac.cn/xwdt_1_1/yjjz/202203/t20220314_6389607.html,根据相关资料编译）

青藏高原地区全新世温度重建的季节性印记

全新世是距现今最近，与现代人类社会关系最密切的地质时期。了解全新世以来气候变化对于理解现代全球变暖至关重要。然而，目前学术界对全新世温度变化趋势的认识还存在重大分歧。大量古气候重建记录显示，全新世温度变化多呈整体

下降的趋势；但是古气候模拟结果却表明，全新世温度变化呈整体上升趋势。这一现象被称之为“全新世温度谜题”。对于这一矛盾，有研究认为可能与古气候重建使用的代用指标的季节性偏差有关。

为此，中国科学院南京地理与湖泊研究所薛滨研究员团队张灿博士，选取青藏高原东南缘横断山脉-小型高山冰蚀湖-错恰湖，基于甘油二烷基甘油四醚酯（GDGTs）指标，利用湖泊单点校正方程，定量重建了末次冰消期以来（19 ka BP）温度变化序列。由于本文研究点地处低纬度高海拔地区（~3960 m a.s.l.），冬季存在结冰现象（冰层将隔离水温与气温），因而湖泊自生的 GDGTs 主要记录无冰期（春夏秋季）的温度变化。重建的结果显示，19 ka 以来温度整体呈变暖趋势，升温幅度~4 ℃，其中冰消期升温~3 ℃，全新世升温~1 ℃。

为了调查全新世季节性温度变化的模式及机制，研究综述了青藏高原地区 16 条定量温度记录，其中 6 条覆盖冰消期（图 1）。在冰消期时段，重建的古温度不存在季节性差异，均呈现一致的升温趋势，这可能受控于全球冰量消减和温室气体增加。但是在全新世期间，不同季节温度变化的趋势差异显著，如夏季温度呈整体下降的趋势，冬季温度呈整体上升的趋势，而年均温变化趋势则较为复杂。

通过比对年均温数据，发现这些年均温记录的不一致性主要与湖泊冰封期长短有关。对于低海拔地区的非结冰湖泊，代用指标重建的温度可以真实地反映年均温变化，呈现一致的升温趋势。相反，高海拔地区的结冰湖泊，由于结冰季节的湖泊水温与气温隔离，代用指标重建的温度实际仅反映无冰季节的温度变化。譬如海拔相对较低的湖泊（如错恰湖和听命湖），无冰季节主要覆盖 3-10 月（约春夏秋季节），重建的温度呈微弱升温趋势；而海拔更高的湖（如陵苟错、班公错等），无冰季节主要为 5-9 月，重建的温度呈早/晚全新世高温、中全新世低温模式。

此外，研究根据代用指标重建温度的季节性差异，集成了全新世不同季节的温度变化序列，并与研究点平均的 TraCE21ka 瞬态模拟结果非常一致。通过 TraCE21ka 全强迫与单强迫模拟结果对比，发现青藏高原地区全新世温度变化主要受当地季节性太阳辐射驱动，而长期增加的温室气体对温度变化起到调控作用（如增强升温、抵消降温甚至反转温度变化趋势）。

研究利用“结冰现象”梳理了青藏高原地区目前已有的较为零散的全新世温度重建记录，并发现指标重建的温度记录存在明显的季节性差异，即随着海拔的增加，重建的温度记录从“类年均温”模式逐渐过渡至“类夏季温”模式。最终，青藏高原地区全新世不同季节的温度变化受到当地季节性太阳辐射和二氧化碳协同调制。研究强调青藏高原地区全新世温度重建的季节性偏差。

（来源：http://www.niglas.ac.cn/xwdt_1_1/yjjz/202203/t20220307_6385756.html,根据相关资料编译）

全球变化下的山地微生物组和生态系统功能的研究

山地主要是由造山运动等地质过程形成，常具有明显的海拔落差和气候环境差异。山地覆盖了 25%的地球表面，是陆地 80%以上淡水资源的发源地；具有复杂多样的自然景观与丰富的生物多样性，居住着地球上超过 80%的两栖动物和 1/3 的陆地植物。然而，山地生态系统也是地球上典型的脆弱生态系统之一，正处在受全球环境变化影响的最前沿，其生态环境破坏与恶化的趋势十分明显，如冰川消融加速、土地利用增加、富营养化加剧、生物多样性丧失等，是全球环境变化研究的热点地区、生态保护与恢复的关键区域。

山地环境微生物是介导碳氮磷硫等生源要素地球化学循环的重要引擎和全球变化的调节器；在气候变化加剧和人为干扰与日俱增的背景下，微生物群落结构和功能研究的重要性和紧迫性日趋凸显。250 多年来，山地环境为植物和动物群落梯度研究提供了经典的自然系统模型。近 10 多年来，山地环境微生物组的探索也取得了长足的进展。山地环境微生物多样性和生态系统功能的研究得到广泛关注，相应的群落分布规律、形成机制及其对全球环境变化的响应等方面的研究成果，亟需整合和归纳。

中国科学院南京地理与湖泊研究所王建军研究员等研究检索了涉及山地湖泊、河流或土壤生境中细菌、真菌、古菌和硅藻等微生物多样性的文献资料，系统整合分析和综述了文献所报道的 238 个数据集，通过归纳比较山地水体和陆地生态系统，揭示了微生物群落的垂向分异规律和形成机制，并对相应的前沿关键科学问题进行初步展望。

研究发现，微生物群落组成常常具有沿着山地垂直气候带（即温度梯度）分布的生物区系，表现出经典的距离衰减规律，即空间距离越近的微生物，其群落结构越相近。此外，微生物群落的特异性呈现 U 型的垂向分异规律，即高海拔和低海拔的群落结构最为特殊；然而，微生物 alpha 多样性的垂向分异规律在不同生境和生物类群之间仍存在差异。整体而言，陆地和水体微生物的群落形成均主要受到确定性过程的影响；通过建立一种新的关键环境因子定量方法，研究揭示了陆地生态系统多样性的驱动因子主要为 pH、温度和植被特征，而水体生态系统中则为温度、pH 和磷酸盐。

最后，研究展望了山地微生物组潜在的前沿研究方向和相关的关键科学问题；包括但不限于下述研究方向：围绕生物多样性理论，考察多类型生境和关键驱动要素，依托野外实验和功能性状等新方法，通过模型模拟等，揭示微生物多样性-功能的形成和耦合机制，最后建模并预测微生物群落和功能对全球环境变化的响应。整体而言，研究成果为山地环境微生物组和功能的研究现状提供了系统回顾、总结和

展望，为山地生态环境保护和可持续发展提供了科学参考。山地系统作为全球变化研究的重要组成部分，全面认识其微生物及功能对全球环境变化的响应与反馈，将为全球山地生态系统的保护、水土资源和生物资源的可持续利用等提供决策参考。

（来源： http://www.niglas.ac.cn/xwdt_1_1/yjjz/202203/t20220302_6380559.html,根据相关资料编译）

我国南北方湖泊沉积物多环芳烃污染地理格局、历史变化及溯源解析

多环芳烃（Polycyclic aromatic hydrocarbons, PAHs）是一类具有致畸、致癌、致突变效应的毒害性有机污染物。环境中 PAHs 来源广泛，包括森林火灾和火山喷发等自然源、化石燃料燃烧和工业生产污废水排放等人为源，其中人为源是其主要来源。PAHs 的疏水亲脂性和持久性使得湖泊沉积物成为流域 PAHs 污染输入的“汇”，沉积物 PAHs 污染蓄积特征是流域人类活动强度、削减治理等的集中体现。我国幅员辽阔，南北方在气候环境、能源构成和消费、工业发展程度等方面均存在较大的空间异质性，系统识别南北方湖泊沉积物 PAHs 污染空间地理分布、历史赋存及来源特征，是开展湖泊沉积物环境质量综合评价的基础，也是因地制宜制定湖泊流域毒害性有机污染治理和管控措施的重要依据。

中国科学院南京地理与湖泊研究所薛滨研究员等选择美国环保总局 USEPA 规定的 16 种优控 PAHs 为目标污染物，通过南北方 89 个湖泊现场调查评估和历史基础资料收集，阐明了我国南北方湖泊沉积物 PAHs 污染空间地理格局和历史变化，解析了区域湖泊沉积物 PAHs 来源差异，评价了复合污染下沉积物环境质量，基于源解析提出了南北方湖泊 PAHs 污染削减管控的初步建议。

首先，湖泊沉积物 PAHs 污染时空格局表明，南方地区能源消耗量大和工业更为发达，其湖泊 PAHs 污染普遍较北方湖泊严重。北方湖泊 PAHs 历史变化分析显示，自新中国成立初期至 21 世纪初，PAHs 含量呈现上升趋势，其主要受控于我国经济发展和能源消费量的增加；自 2010 年以来，随着我国能源消费结构转变和污水处理工艺升级，PAHs 污染程度有所缓解。

其次，正向（排放因子法）和逆向（PMF 受体模型）溯源解析表明，南方湖泊 PAHs 主要来源于交通运输部门的石油燃烧（42.0%）和工业部门的煤炭燃烧以及生产排放（25.4%）；家庭燃煤（37.6%）则是北方地区 PAHs 最主要的污染源，其次为农业和住宅生物质燃烧（25.6%）。此外，近百年来北方湖泊 PAHs 来源已由生物质燃烧源转变为石油和煤炭燃烧源。

最后，沉积物环境质量综合指数（SeQI）评价显示，我国南方湖泊沉积物质量有 38.2%处于 poor-very poor 水平，而北方湖泊仅 15.2%处于 poor 状态。综合南北方

沉积物 PAHs 溯源和综合风险评估结果，对我国南北方湖泊 PAHs 污染提出区域污染治理措施和建议。

（来源：http://www.niglas.ac.cn/xwdt_1_1/yjjz/202202/t20220226_6378441.html,根据相关资料编译）

砾石底质好氧河流甲烷产生机制

甲烷是一种重要的温室气体。传统上，人们认为甲烷主要通过产甲烷菌在严格缺氧条件下产生。然而，越来越多的研究发现，甲烷也可以在好氧环境中产生。一些产甲烷菌已被报道对氧具有显著耐受性。此外，大量研究表明，在有氧水体中，甲烷浓度与叶绿素 a 浓度呈正相关，表明藻类可能是好氧水体产甲烷的媒介。最近的几项研究表明，藻类可以在有氧条件下通过光合作用将碳酸盐转化为甲烷。目前关于水体好氧产甲烷的研究主要集中在深水湖泊和水库中，这些研究指出好氧产生的甲烷对这些水域的总甲烷排放量具有很大贡献。在河流系统中，沉积物被认为是甲烷产生的热点区域，是水柱中甲烷的重要来源。然而由于地质背景的原因，很多河流是砾石底质的河床，此类河流水柱中的甲烷浓度可能较低。然而，由于频繁的人类活动，城市河流是营养盐污染的重点区域，也是藻类生物量较高的区域，这可能会影响此类河流溶解甲烷的浓度。因此，此类河流中甲烷的浓度可能被低估。然而，到目前为止，此类砾石底质好氧河流中甲烷的浓度和产生机制还不清楚。

中国科学院南京地理与湖泊研究所朱广伟研究员团队选择新安江上游河流作为研究对象，开展了从新安江源头六股尖到安徽屯溪和歙县的甲烷浓度季节监测，比较研究了森林区和城市区砾石底质河流甲烷浓度及其潜在影响因素。研究发现少淤泥的砾石底质城市好氧河流依然是大气甲烷的潜在排放源，且浮游植物和人类活动的直接排放可能共同影响此类河流水体溶解甲烷的浓度。

研究发现，尽管新安江黄山段河流水体的甲烷平均浓度要远低于全球河流甲烷浓度的平均值，但是其较高的饱和度表明砾石底质的好氧河流依然是大气甲烷的潜在排放源。城市区河流甲烷浓度要显著高于城市上游区河流，且距离污水处理厂（WWTP）较近的下游点位甲烷浓度远远高于其他点位，表明沿途的人类活动对水体甲烷浓度具有重要影响。季节性监测结果发现，夏季溶解甲烷浓度要显著高于其他季节，且甲烷饱和度与叶绿素 a 的浓度呈现出显著的正相关关系。进一步采集新安江水体浮游植物，河底砾石和河岸土壤开展模拟培养实验，研究水体甲烷的潜在来源。结果显示河流藻类能在好氧环境下促进甲烷产生，而河流底部的砾石没有促进作用，不是水体甲烷的重要来源。岸边土壤能够显著促进甲烷的产生，表明底部淤泥少或许是此类河流溶解甲烷浓度相对较低的原因之一，丰水期部分河段滨岸带土壤对甲烷的产生将具有重要影响。尽管团队发现了藻类是此类河流溶解甲烷的潜

在来源，但是其对整个水体溶解甲烷的贡献还不清楚，有待进一步的研究。该研究结果进一步丰富了我们对河流甲烷产生机制的认识。

（来源： http://www.niglas.ac.cn/xwdt_1_1/yjjz/202202/t20220223_6370969.html,根据相关资料编译）

激光测高卫星观测揭示 21 世纪来全球湖泊水量变化时空特征

湖泊是地球表层主要淡水资源库，在维持生态系统稳定性和人类社会可持续性发展方面发挥着重要作用。在气候变化和人类活动影响日益增强的背景下，全球湖泊水文情势稳定性及其服务功能发挥面临挑战。由于地面监测资料时空代表性不足，且传统的雷达测高卫星观测仅限于少数大型湖泊，制约了全球湖泊水储量变化的定量评估以及时空分异特征规律的认识。

中国科学院南京地理与湖泊研究所宋春桥研究员课题组，首次联合激光测高卫星 ICESat 及其第二代卫星 ICESat-2 形成长时序高程观测资料，对全球 10 km^2 以上的自然湖泊水位-水量在近二十年（2003-2020）变化特征开展了定量研究，并分析了 21 世纪以来全球湖泊水文变化的空间格局。研究发现：两代测高卫星能监测到约 6500 个湖泊（>10 km^2）水位-水量变化，被观测到的湖泊其总水量占全球湖泊总水量的 94%。其中，约 54%数量的湖泊水位在 2003-2020 年时期变化趋势显著（$p < 0.05$），水位变化趋势明显的湖泊中有 80%呈上升趋势。被观测湖泊在 2003-2020 年以总水量 10.88 ±16.45 Gt/yr 的变化速率增长。通过将被观测湖泊水位变化速率面积加权外推到同一流域其他未被观测湖泊，估算出全球约 14700 个自然湖泊（>10 km^2）水量在研究时段内以 16.12±20.41 Gt/yr 的变化速率增长。其中，青藏高原内流区、北美五大湖地区、东非的大裂谷、北欧以及亚马逊河流域湖泊群是水量增加最为显著的地区，这五个地区的水量增加总和占被观测湖泊水量总和的 60%。

尽管全球大部分湖泊其水位变化在研究时段呈不同程度上升状态，但位于干旱/半干旱和高需水压力地区的许多湖泊仍出现水位显著下降、水量严重损失的情况。在未来气候持续变暖以及人类社会经济发展的用水需求增加的情景下，如果缺乏对湖泊水资源的进一步保护政策和行动，这些处于萎缩的湖泊会更加干涸。

（来源：http://www.niglas.ac.cn/xwdt_1_1/yjjz/202202/t20220216_6355727.html,根据相关资料编译）

太湖水体光环境变化削弱了湖泊蓝藻水华治理成效

作为一种光合作用生物，湖泊浮游植物的生长状况既受氮磷等生源要素影响，也受温度、光照等物理生境的影响。对于浅水湖泊而言，底泥再悬浮强烈且非藻类浊度高，加之相对较高的氮磷水平，常使得整个水柱中营养盐不能被浮游植物充分利用，而相对下层的水体中，光的不足限制了藻类生长。中国科学院南京地理与湖泊研究所邹伟博士等人通过分析太湖 2005~2020 年逐季观测数据发现，光是太湖藻

类生长的关键限制因子之一。风速下降显著改善了太湖浮游植物光生态位，使得单位营养盐能够支撑了更高藻类生物量，对太湖蓝藻水华产生促进效应，部分抵消了近年来流域氮磷削减对蓝藻水华的控制效果。该发现表明，除了增温等气候变化因素外，水体光环境变化也是太湖等浅水湖泊生态修复中不容忽视的影响因素。

湖泊生态系统是非线性响应的复杂系统，湖泊中浮游植物生长是多因素综合影响的结果。利用简单线性模型构建浮游植物叶绿素 a（Chla）与总氮（TN）或总磷（TP）的响应关系时，模型结果往往会表现出很大的不确定性。本研究利用 95%分位数回归法分别量化 2005～2020 年 2 月、5 月、8 月和 11 月的 logChla~logTN 和 logChla~logTP 定量方程，有效反映了研究期间不同季节最宜生长环境条件下藻类对氮、磷的最敏感响应，然后利用残差分析识别了影响特定营养盐水平下藻类达到最大生长潜力（即藻类氮磷敏感性）的影响因素。

（来源：http://www.niglas.ac.cn/xwdt_1_1/yjjz/202202/t20220211_6354242.html,根据相关资料编译）

“孪生流域”平台构建关键技术研究

受计算机软硬件条件的限制，现有的流域信息化平台难以实现流域地理空间全要素“实景三维”场景构建和高效可视化，且平台功能侧重数据展示、实用性普遍不强，在地理空间要素逼真表达和流域精细化管理决策支撑方面还存在诸多不足。

近年来，“数字孪生”技术发展迅猛，通过集成多物理量、多尺度的仿真过程，可在虚拟空间中完成地理实体映射，从而反映实体的全生命周期过程，正逐渐被应用与智慧城市、数字医疗、工业设计等领域，但面向流域综合管理的“数字孪生”技术研究还鲜有相关报道。

中国科学院南京地理与湖泊研究所段洪涛研究员团队以巢湖流域为研究对象，对流域尺度的地理空间要素快速三维重建、多元监测监控数据的智能分析、流域多过程机理模型耦合集成等关键技术进行了深入研究，在提升现有流域信息化平台的“好看”（可视化效果）和“好用”（决策支撑能力）方面取得了较大进展。本研究的主要贡献包括三方面：

（1）在不需要特殊软硬件支撑的条件下，实现了对流域地理要素的逼真模拟、高效可视化和三维空间分析。设计了基于“四叉树”的三维模型数据组织和存储方法，并基于剔除渲染（CR）、多细节层次（LOD）以及 Web 异步加载等技术实现了流域虚拟场景在浏览器端的动态、高效渲染。

（2）实现了流域水环境异常信息的智能诊断和自动报警。构建了面向流域多源水环境监测数据的时空数据模型和智能分析算法，可以快速感知水环境现状分布、变化趋势和超标报警信息。

（3）在“实景三维”环境中实现了流域的精细化管理。集成了面向流域污染物精准减排的成套机理模型，在流域水质目标的约束下，实现了流域污染物优化减排方案的空间表达。

（来源： http://www.niglas.ac.cn/xwdt_1_1/yjjz/202202/t20220207_6352572.html,根据相关资料编译）

氨氧化古菌在淡水生态系统的分布格局及演化

氮素生物地球化学循环主要由微生物驱动，包括固氮、硝化、反硝化和氨化过程。其中硝化过程包括氨氮氧化和亚硝酸盐氧化，氨氧化是一个重要的限速过程，主要由有氧氨氧化细菌、厌氧氨氧化细菌、有氧氨氧化古菌和完全氨氧化细菌四类生物参与完成。

氨氧化古菌属于奇古菌门(Thaumarchaeota)，是自卡尔·乌斯于 1977 年定义古菌域以来首个被发现在非极端环境下生存的古菌类群之一。氨氧化古菌可在有氧条件下将氨氮氧化为亚硝酸盐以获取能量并广泛分布在水生和陆生环境中。前期研究工作搜集了公共数据库中全球不同生境奇古菌基因组序列，基于系统发生学和分子定年分析揭示了氨氧化古菌的演化和古地球氧气含量变化紧密相关(Ren et al., 2019, 13:2150–2161, The ISME Journal)，且发现已有氨氧化古菌基因组多来源于海洋和陆地环境，而对淡水环境中氨氧化古菌的分布格局、基因组多样性及演化历史等问题尚不清楚。

中国科学院南京地理与湖泊研究所王建军研究员等基于高原深水湖泊泸沽湖沉积物宏基因组，构建了高质量氨氧化古菌基因组，进一步整合来自全球深水湖泊、河流和海洋等多类型环境的 102 个基因组，发现淡水氨氧化古菌主要属于 Nitrosopumilaceae 科，分布在 Nitrosopumilus, Nitrosoarchaeum 和 Nitrosotenuis 三个属水平类群中。其中淡水 Nitrosopumilus 仅存在于深水湖泊，而 Nitrosoarchaeum 分布在深水湖泊和河流中，Nitrosotenuis 则主要在河流、河口和深水湖泊分布。研究发现，在深水湖泊中，Nitrosopumilus 在上层水体中占优势，而 Nitrosoarchaeum 随水深呈现丰度增加的趋势，揭示了氨氧化古菌呈现垂向生境分化的现象。此外，在 Nitrosopumilaceae 科中的淡水氨氧化古菌，至少经历了一次淡水到海洋和两次海洋到淡水的生境转移进化事件；这些生境转移事件均伴随着不同古菌类群中功能基因的获得和丢失，比如淡水 Nitrosopumilus 中鞭毛合成和离子转运相关基因的丢失、淡水 Nitrosoarchaeum 中尿素合成及机械敏感性离子通道等基因的获得。上述成果丰富了氨氧化古菌在淡水生态系统的生态分布特征和进化机制研究，为进一步开展其介导的碳氮生物地球化学循环提供科学参考。

（来源：http://www.niglas.ac.cn/xwdt_1_1/yjjz/202201/t20220130_6350934.html,根据相关资料编译）

集团内捕食削弱亚热带湖泊食物网的营养级联效应及其对湖泊生物操纵技术的启示

集团内捕食（Intraguild predation，简称 IGP）是指捕食者之间即存在食物资源的竞争，同时也存在着捕食关系。例如在湖泊生态系统中，鱼、虾等捕食者都能捕食浮游动物，同时某些鱼类也能捕食虾类。集团内捕食作为一种特殊的杂食模块，理论研究认为其会削弱食物网的营养级联效应（Trophic cascade）。因此，在农田生态系统上，集团内捕食相关理论被广泛应用于病虫害的生态防治中（如引入害虫天敌的种类配置），在浅水湖泊生态系统的应用较少。

生物操纵是浅水湖泊生态修复的常用措施之一，其理论依据即是食物网的营养级联效应。通过放养鱼食性鱼类，达到控制小型鱼类，刺激大型枝角类浮游动物（Daphnia）生长，抑制浮游植物，控制富营养化的目的。但是亚热带湖泊食物网中杂食者较多，集团内捕食现象普遍，多种捕食者之间的拮抗可能会削弱营养级联效应，这也可能是温暖地区湖泊生物操纵技术应用效果不佳的原因之一。

中国科学院南京地理与湖泊研究所刘正文研究员课题组基于我国亚热带湖泊常见的“鱼（虾）-大型枝角类（Daphnia）-浮游植物”的三营养级食物链，通过中宇宙实验构建了一个集团内捕食模型。结果表明当黄颡鱼、秀丽白虾单独存在时，会引起一个明显的营养级联效应，即大型枝角类消失，浮游植物生物量剧增；而当鱼虾同时存在时，两者之间存在明显的拮抗作用，即鱼对虾的捕食削弱了营养级联，导致大型枝角类的存活率反而会高于单一捕食者的处理，浮游植物的生物量的增幅较低。同时，两种捕食者共存条件下，浮游动物对浮游植物的下行控制能力也强于单一捕食者的处理组。实验结果表明在浅水湖泊的生物操纵工作中，除了要关注营养级生物的数量外，各营养级的多样性也要予以关注，通过捕食者种类和年龄结构的合理配置，达到增强浮游动物牧食压力的效果。

（来源：http://www.niglas.ac.cn/xwdt_1_1/yjjz/202201/t20220105_6334139.html,根据相关资料编译）

业界动态

全国首部黄河流域生态保护和高质量发展地方性法规 3 月实施

3 月 1 日起，《宁夏回族自治区建设黄河流域生态保护和高质量发展先行区促进条例》正式实施。作为全国首部关于黄河流域生态保护和高质量发展的地方性法规，该条例的出台将为宁夏守护黄河安澜提供有力法治保障。条例共分为十章八十条，对生态环境保护治理、水资源节约集约利用、高质量发展等作出专章规定，鼓励先行先试，严格黄河岸线管控、明确“四水四定”“四权改革”、助力九个重点产业发展、建立容错机制，确保先行区建设重大改革于法有据；以生态优先、绿色发展为主线，将生态环境保护治理作为先行区建设的前提和支撑，对山水林田湖草沙综合治理、系统治理以及农业、工业、城乡生活污染防治等作出严格规定。针对土地、能源、水资源利用比较粗放，多领域多类型多层次生态环境问题累积叠加，经济结构矛盾突出、资源环境约束趋紧等问题，条例对形成保护生态环境和节约资源能源的空间格局、产业结构、生产方式、生活方式等作出制度安排，并对新能源建设毁损土地复垦、违规取水、耗水造景、破坏生态等问题作出专门规定。

（来源：http://www.stdaily.com/index/kejixinwen/202202/00c3c10a70834344bebe93606094ad0a.shtml）

洪水风险与气候变化适应性国际研讨会在京举办

2022 年 2 月 11 日，由“一带一路”国际科学组织联盟（ANSO）联合研究合作专项、牛顿高级学者基金和中国科学院地理科学与资源研究所联合主办的“洪水风险与气候变化适应性国际研讨会”在线上成功召开。来自 ANSO、哥德堡大学、诺丁汉特伦特大学、国际山地综合发展中心、墨尔本大学、设拉子大学、孟加拉工程技术大学、印度理工学院甘迪纳格尔、尼泊尔特里布文大学、越南荣市大学、中国科学院西北生态环境与资源研究院、卡内基科学研究所、新加坡国立大学、牛津大学、美国大学大气研究联盟、清华大学、云南大学、高地和群岛大学、北京师范大学的 120 余名专家学者参加会议。

会议围绕恒雅梅流域的洪水风险与气候变化适应性展开交流研讨。ANSO 秘书处执行主任曹京华研究员、中国科学院地理科学与资源研究所对外合作处张明副处长、英国诺丁汉特伦特大学 Nigel Wright 教授分别致开幕词。中国科学院地理科学与资源研究所 ANSO 联合研究项目负责人介绍了恒雅梅流域的洪水风险与气候变化适应性项目概况。来自印度理工学院甘迪纳格尔、孟加拉工程技术大学、尼泊尔特里布文大学、牛津大学、墨尔本大学、新加坡国立大学、中国科学院西北生态环境与资源研究院、设拉子大学、国际山地综合发展中心、美国大学大气研究联盟、清华大学的专家学者先后围绕洪水风险在空间和时间上的变化、气候变化之间的联系

和应对气候变化的适应性服务的科学前沿热点做了精彩的报告。瑞典皇家科学院院士、中国科学院外籍院士、哥德堡大学教授陈德亮致闭幕辞。

（来源：http://www.igsnrr.cas.cn/news/zhxw/202202/t20220216_6356064.html,根据相关资料编译）

柴达木盆地盐湖资源综合开发利用成果达到国内领先水平

12 月 27 日，柴达木盆地盐湖资源综合开发利用研究项目验收和成果评价会在青海盐湖所召开。海西州人民政府副州长张银廷及海西州盐湖管理局、水利局、自然局和生态局等主要负责同志参加了会议。

盐湖管理局局长海吉忠首先对项目背景进行了介绍，青海盐湖所王建萍副所长对项目研究工作进行了汇报，各参研单位项目负责人进行了补充汇报。专家组及州直各部门负责人对项目完成情况提出了建议和意见。专家委员会认为，该项目利用文献调研、野外实地调查采样、企业收集数据、遥感影像分析和卤水动态模拟等方法，全面分析了青海盐湖资源开发面临的问题与挑战，分析评价了资源开发的生态环境影响，并在资源环境承载力评价的基础上提出了盐湖资源开发的合理规模和产能。一致同意通过项目验收。

专家委员会认为该项目通过资源、产业、技术和环境等多个角度的研究，提出目前盐湖开发对环境影响低于干旱区河流改道等自然因素的影响，为盐湖资源可持续开发提供了依据。针对盐湖资源属性和生态属性并存、固液共存、多组分、动态可采储量、河流尾闾等特点，提出了卤水开采、固液转化及元素分离总体技术与产业规模的发展潜力。项目“以生态定红线”“以水定产”“以资源定规模”，通过对盐湖区的干旱区水约束背景、洪水资源化利用潜力、水资源承载力、水资源利用效率以及盐湖生态用水、能耗、环境影响范围和路径等的计算和评估等量化研究，提出了预期产业规模和服务年限，具有重要的参考价值。一致同意通过成果评价，认为该成果达到国内领先水平。

张银廷指出该项目政治站位高、思想认识统一，坚持问题导向，聚焦目标任务。从盐湖资源可持续利用、水资源、生态环境、生产工艺技术与产品、盐湖相关资源配置及循环经济等方面，系统地对目前盐湖资源开发存在的问题进行了深入分析，并就盐湖合理产能、盐湖资源合理开采方式与开采强度、盐湖区生态环境保护、盐湖科技与产业发展以及未来盐湖发展路径等方面全面系统的提出了具体建议。

项目承担单位青海盐湖所、中国无机盐工业协会、中国地质科学院矿产资源研究所、青海省第三地质勘查院、柴达木综合地质矿产勘查院、青海省水文地质工程地质环境地质调查院等参研单位负责人等 40 余人以线上和线下的方式参加了会议。

（来源：http://www.nieer.cas.cn/xwdt/kydt/202112/t20211231_6331965.html, 根据相关资料编译）

新冠疫情带来的减排或助推 2020 年长江流域降水破纪录

2020 年，我国长江流域夏季破纪录的降水让人印象深刻。24 日，记者从南京信息工程大学获悉，该校环境科学与工程学院杨洋教授团队的一项研究成果表明，新冠肺炎疫情期间的人为排放减少，对当年的降水有较大贡献，该成果论文近日已在国际期刊《自然通讯》发表。

2020 年夏季我国经历了一次超强梅雨季，降水量突破了过去 60 年以来的历史纪录，受灾面积及损失较大，因此，这次极端降水事件被称为“超强暴力梅”。过去一些研究从自然变率的角度探讨了 2020 年超级暴力梅的可能成因，但却忽视了人类活动变化对极端降水的可能影响。

这次极端降水发生在 2020 新冠疫情期间，由于疫情期间人类活动的减少，温室气体和大气污染物排放量出现显著降低。杨洋教授团队前期的研究作为全球首个提出疫情期间的排放变化会对全球和区域气候产生影响的工作，被 IPCC 第六次评估报告多次引用。后受邀作为全球数十个团队中的中国数值模拟团队参与了 CMIP6 框架下的疫情模拟比较计划，并探究了疫情导致的人为排放变化和我国极端降水之间的联系。研究发现疫情期间减排通过影响地气系统辐射平衡，加强了中国东部地区的大气对流，并导致西北太平洋出现海平面气压的正异常，增强了向我国的水汽输送，最终导致长三角地区降水增加。该研究首次深入探究了新冠疫情期间排放变化对我国区域极端降水事件的贡献，揭示新冠疫情期间气溶胶和温室气体排放量大幅减少对我国区域极端降水的影响机制，为我国极端降水评估和预测提供科学支撑。

（来源，http://www.stdaily.com/index/kejixinwen/202202/c3200436e08448e1a75b93207874cafc.shtml）

《长江中游通江湖泊江湖关系演变及其效应与调控》专著顺利出版

《长江中游通江湖泊江湖关系演变及其效应与调控》一书最近由科学出版社顺利出版。

长江是亚洲第一大河，是中华民族的母亲河。中游地区是长江流域的核心区域，长江中游水安全和生态安全问题关系着以“生态优先和绿色发展”为核心的长江经济带国家发展战略的推进实施。洞庭湖与鄱阳湖作为长江中游仅存的两个与长江自然连通的大型湖泊，年径流量占长江年径流总量的四成以上，不仅为长江中下游提供了可靠的优质水源，而且也是中下游洪水的巨大调蓄库，对中下游地区的社会经济发展和生态安全维护有着不可替代的作用。

20 世纪中叶以来，一系列江湖整治和水资源利用工程等人类活动使长江中游的江湖关系发生了深刻变化。如 60 年代的大规模围垦开发和荆江调弦口封堵、70 年代的下荆江裁弯、80 年代葛洲坝水利工程运行、90 年代末的退田还湖工程和本世纪初以来三峡工程等上游控制性水利枢纽建成运行。这些资源开发和水利建设改变了

长江中游的水文情势，给长江水安全保障带来了新的挑战。特别是进入本世纪以来，受气候变化、长江三峡水利工程蓄水运行以及采砂等人类活动影响，长江与鄱阳湖和洞庭湖两湖江湖关系剧烈调整，均出现了湖泊退水加快、枯水期提前且延长的问题。这些问题成因、影响及其应对策略引发了政府、社会和学术界的关注和讨论。特别是在鄱阳湖、洞庭湖湖口兴建水利枢纽工程来应对水情变化引起的潜在水安全和生态风险等设想，受到了社会各界的热议。

在此背景下，国家科学技术部于 2012 年启动了国家重点基础研究发展计划（973 计划）项目“长江中游通江湖泊江湖关系演变及环境生态效应与调控”，期待解决长江中游江湖关系变化的基础性问题，同时也为两湖地区水安全提供解决路径。该项目在国家水安全保障的重大需求以及大型江河湖水系统变化条件下水文-环境-生态交互作用关键科学问题引导下，以长江中游的洞庭湖和鄱阳湖为研究区，重点就江湖关系的演变过程与机制、重大水利工程影响机理、江湖关系变化对两湖水文情势、水环境和水生态影响、江湖关系的优化调控等方面开展了深入系统的研究。该项目的实施，系统科学回答了各界普遍关心的江湖关系相关热点问题，解决了长江中游大型江湖水系统江湖关系演变与三峡工程影响机理及其湖泊水文、水环境和水生态响应机制这一重大科学问题，丰富和发展了河湖健康评价和水库群联合优化调度理论和方法，研究成果在支撑长江中游江湖综合整治规划、三峡工程优化调度、洞庭湖和鄱阳湖重大控湖工程论证以及平息三峡运行对通江湖泊极端干旱事件频发影响争论等国家重大需求方面发挥了实质性指导作用，取得了良好的社会和生态效益。

本书集合了“973 计划”的核心成果及原项目研究团队近年的持续跟踪研究成果，全面展示了长江中游通江湖泊江湖关系演变过程及重大水利工程影响机理、湖泊水文、水环境和水生态对江湖关系改变的响应机制以及江湖关系健康评价与优化调控的原理和方法三个核心科学问题上取得的进展，对于重大水利工程与大型河湖系统相互作用过程与动力学机制理论与方法，在国际同类研究中具有先导性和重要的学术价值。

《长江中游通江湖泊江湖关系演变及其效应与调控》是一部全面、系统阐释通江湖泊江湖关系的著作，在当前长江大保护的背景下，本书的出版可为长江中下游生态系统保护与修复、江-河-湖系统综合治理与保护、长江防洪减灾综合体系建设、长江经济带高质量发展等国家战略的实施提供重要的科技支撑。

（来源：http://www.niglas.ac.cn/xwdt_1_1/zhxw/202203/t20220304_6385545.html）

云南首家高原湖泊研究中心成立

近日，阳宗海高原湖泊研究中心揭牌成立，并组建了一支由 34 名专家组成的专业技术团队。该中心立足阳宗海生态系统特征和生态保护实际需要，强化科学化治

水、智慧化治水，将建设成为具有区域影响力的综合性环境、水利科技研发和服务机构，成为云南重要的高原湖泊科学研究前沿阵地。阳宗海湖泊研究中心是按照云南省委、省政府“湖泊革命”要求成立的第一个高原湖泊研究中心，昆明阳宗海风景名胜区将与云南省生态环境科学研究院、水利部、交通运输部、国家能源局、南京水利科学研究院建立常态化合作机制，为阳宗海保护治理提供长期、稳定、系统、全面的科技支撑。昆明阳宗海风景名胜区党工委书记、管委会主任、阳宗海管理局局长杨泽松表示，下一步，阳宗海高原湖泊研究中心将开展长时间序列的科研观测、调查、监测和基础研究工作，推进阳宗海生态环境智慧化、智能化、信息化研究，推动政策研究、GEP 核算、规划编制、决策咨询等方面项目合作，持续开展生态环境保护科学技术研究。此外，阳宗海湖泊研究中心将大力推广环保应用技术工程示范，加强管理机构及相关部门科学治湖理念，提升公众湖泊保护意识，促进阳宗海生态环境“共建”与“共享”；统筹整合国内、省内优秀专家及科研资源，建立联合研究机制，为阳宗海提供持续的、专业的、系统的专家支撑和服务。

（来源：新华网，http://www.news.cn/local/2022-01/05/c_1128234911.htm）

我国推动建立太湖流域生态保护补偿机制

国家发展改革委、生态环境部、水利部近日印发指导意见，为加快改善太湖流域水环境，构建太湖流域生态治理一体化格局，推动建立太湖流域生态保护补偿机制。

根据意见，到 2023 年，建立健全太浦河生态保护补偿机制，太湖流域治理协同性、系统性、整体性显著提升，太湖流域水质得到持续改善，区域高质量发展的生态基础进一步夯实。到 2030 年，太湖全流域生态保护补偿机制基本建成，太湖全流域水质稳定向好，山清水美的自然风貌生动再现，为全国流域水环境综合协同治理打造示范样板。

（来源：新华网，http://www.news.cn/2022-02/01/c_1128320703.htm）

四川在 10 大流域设立水旱灾害联防联控专业机构

日前，四川省在其境内嘉陵江、涪江、沱江、岷江、青衣江、大渡河、雅砻江、安宁河、长江（金沙江）、渠江10大流域正式设立水旱灾害联防联控监测预警中心。四川省水利厅相关负责人介绍，各流域水旱灾害联防联控监测预警中心成立后，将切实担负起水旱灾害联防联控工作中的联合监测、联合预报预警和为流域水资源调度提供技术支撑等职责，进一步做好水旱灾害防御工作，筑牢水安全底线。四川是千河之省，江河水系发达，洪涝灾害易发多发。2021年，四川省按照“流域一盘棋、共御大洪水”的工作思路，探索建立了四川省嘉陵江、涪江、沱江、岷江等流域水

旱灾害联防联控机制，此次联防联控监测预警中心的设立是该工作的进一步实质化运行。

（来源：新华网，http://www.news.cn/local/2022-03/08/c_1128451920.htm）

国家开发银行支持黄河流域生态保护和高质量发展

服务黄河流域生态保护和高质量发展，是开发性金融服务国家战略的重点领域。2021 年，国家开发银行深入贯彻党中央、国务院决策部署，全年发放贷款 1496 亿元，积极助力黄河流域综合治理、水安全等生态保护重点领域建设，支持现代产业体系、保护传承弘扬黄河文化、民生补短板等领域高质量发展。

在服务黄河流域生态保护方面，国家开发银行围绕水安全、流域综合治理等重点领域，2021 年发放贷款 173 亿元，助力保护母亲河。水安全方面，开发银行支持了山西中部引黄等水资源调配工程，推动甘肃庆阳、山东青岛等城市开展海绵城市试点建设。向兰州水源地建设工程提供 10.2 亿元贷款，支持建成新的水源和水厂，解决 436 万居民用水问题。支持内蒙古中以（中国-以色列）防沙治沙生态产业园等荒漠化防治项目，助力水土保持；支持一批河湖综合治理项目，范围覆盖黄河一二级支流和运城鸭子池等城市内河（湖）。污染治理方面，实施“百县千亿”专项金融服务，建设覆盖县城、辐射农村的高标准垃圾污水处理设施。创新模式提供 24.5 亿元贷款推动泰安市全域垃圾分类项目落地，惠及当地群众 558 万人。

在服务流域高质量发展方面，开发银行 2021 年围绕基础设施、现代产业、民生补短板等重点领域，发放贷款 1323 亿元支持沿黄省区发展。基础设施方面，重点支持了静宁至天水等高速公路，郑济铁路濮阳至济南段等铁路项目，推动跨区域交通互联互通。在青海，开发银行贷款支持青海—河南高压直流输电工程建设，该工程作为我国第一条专门外送清洁能源的特高压通道，对保障华中地区电力安全可靠供应有着重要意义。现代产业方面，支持山西省级百万亩高标准农田建设项目以及青海青藏高原农副产品集散中心、陕西（杨凌）农产品加工贸易示范园等农业园区建设，助力发展生态特色产业。民生补短板方面，支持武山县人民医院异地迁建、陕西子洲黄芪综合开发等贫困地区医疗教育建设。文化保护传承弘扬方面，推动了黄河壶口瀑布、开封宋都古城等知名景区的更新改造。

国家开发银行有关人士表示，下一步，开发银行将继续深入贯彻党中央、国务院决策部署，充分发挥金融排头兵作用，咬定目标、脚踏实地，埋头苦干、久久为功，为推动黄河流域生态保护和高质量发展贡献开发性金融力量。

（来源：新华网，http://www.news.cn/money/20220215/fa49b11e5e1c4263878bc90bd48c08b6/c.html）