湖泊流域动态

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Global prevalence of non-perennial rivers and streams

Messager, Mathis Loic; Lehner, Bernhard; Cockburn, Charlotte; 等

Flowing waters have a unique role in supporting global biodiversity, biogeochemical cycles and human societies. Although the importance of permanent watercourses is well recognized, the prevalence, value and fate of non-perennial rivers and streams that periodically cease to flow tend to be overlooked, if not ignored. This oversight contributes to the degradation of the main source of water and livelihood for millions of people. Here we predict that water ceases to flow for at least one day per year along 51-60 per cent of the world's rivers by length, demonstrating that non-perennial rivers and streams are the rule rather than the exception on Earth. Leveraging global information on the hydrology, climate, geology and surrounding land cover of the Earth's river network, we show that non-perennial rivers occur within all climates and biomes, and on every continent. Our findings challenge the assumptions underpinning foundational river concepts across scientific disciplines. To understand and adequately manage the world's flowing waters, their biodiversity and functional integrity, a paradigm shift is needed towards a new conceptual model of rivers that includes flow intermittence. By mapping the distribution of non-perennial rivers and streams, we provide a stepping-stone towards addressing this grand challenge in freshwater science.

（来源：NATURE 卷:594 期:7683 页: 66-70 出版年: 2021, **DOI:** 10.1038/s41586-021-03565-5）

The missing ocean plastic sink: Gone with the rivers

Weiss, Lisa; Ludwig, Wolfgang; Heussner, Serge; 等

Weiss, Lisa; Ludwig, Wolfgang; Heussner, Serge; 等 Plastic floating at the ocean surface, estimated at tens to hundreds of thousands of metric tons, represents only a small fraction of the estimated several million metric tons annually discharged by rivers. Such an imbalance promoted the search for a missing plastic sink that could explain the rapid removal of river-sourced plastics from the ocean surface. On the basis of an in-depth statistical reanalysis of updated data on microplastics-a size fraction for which both ocean and river sampling rely on equal techniques-we demonstrate that current river flux assessments are overestimated by two to three orders of magnitude. Accordingly, the average residence time of microplastics at the ocean surface rises from a few days to several years, strongly reducing the theoretical need for a missing sink.

（来源：SCIENCE 卷: 373 期: 6550 出版年: 2021, **DOI:** 10.1126/science.abe0290）

Differences in the temperature dependence of wetland CO_2 and CH_4 emissions vary with water table depth

Chen, Hongyang; Xu, Xiao; Fang, Changming;等

Wetland CH_4 emissions have been demonstrated to be more sensitive than wetland CO_2 emissions to increasing temperatures, which may result in a greater relative contribution of CH_4 to total GHG emissions under climate warming. However, it is not clear whether this greater sensitivity occurs globally across diverse hydrologic regimes. Here, we evaluate the temperature dependence of CO_2 and CH_4

emissions on water table depth using a global database and show similarities in the temperature dependence of CO_2 and CH_4 emissions. A lower water table is associated with a decrease in the temperature dependence of CH_4 emissions and a higher water table has the opposite effect. Water table depth does not affect the temperature dependence of CO_2 emissions. Our findings suggest the stimulatory effect of increasing temperature on wetland CH_4 emissions may not always be stronger than that on CO_2 emissions and depends on the wetland water table.

Climate change may result in larger releases of CH_4 than CO_2 from wetlands as CH_4 emissions seem to be more sensitive to temperature. Globally, CO_2 and CH_4 emissions show a similar temperature dependence but this is modulated by wetland water table depth, which affects CH_4 (but not CO_2) emissions.

（来源：NATURE CLIMATE CHANGE 卷:11 期:9 出版年: 2021, **DOI:** 10.1038/s41558-021-01108-4）

Increasing probability of record-shattering climate extremes

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Changes in extreme heat are often calculated as anomalies above a reference climatology. A different definition-week-day heatwaves surpassing the current record by large margins-shows that their occurrence probabilities depend on warming rate, not level, and are higher than during recent decades.

Recent climate extremes have broken long-standing records by large margins. Such extremes unprecedented in the observational period often have substantial impacts due to a tendency to adapt to the highest intensities, and no higher, experienced during a lifetime. Here, we show models project not only more intense extremes but also events that break previous records by much larger margins. These record-shattering extremes, nearly impossible in the absence of warming, are likely to occur in the coming decades. We demonstrate that their probability of occurrence depends on warming rate, rather than global warming level, and is thus pathway-dependent. In high-emission scenarios, week-long heat extremes that break records by three or more standard deviations are two to seven times more probable in 2021-2050 and three to 21 times more probable in 2051-2080, compared to the last three decades. In 2051-2080, such events are estimated to occur about every 6-37 years somewhere in the northern midlatitudes.

（来源：Nature Climate Change 卷:11 期:8 出版年: 2021, **DOI:** 10.1038/s41558-021-01092-9）

Rivers as the largest source of mercury to coastal oceans worldwide

Liu, Maodian; Zhang, Qianru; Maavara, Taylor; 等

Rivers transport about 1,000 Mg mercury annually to coastal oceans, which is threefold greater than the amount delivered by atmospheric deposition, according to a global analysis of mercury measurements in rivers. Mercury is a potent neurotoxic substance and accounts for 250,000 intellectual disabilities annually. Worldwide, coastal fisheries contribute the majority of human exposure to mercury through fish consumption. Recent global mercury cycling and risk models attribute all the mercury loading to the ocean to atmospheric deposition. Nevertheless, new regional research has noted that the riverine mercury export to coastal oceans may also be significant to the oceanic burden of mercury. Here we construct an unprecedented high-spatial-resolution dataset estimating global river mercury and methylmercury exports. We find that rivers annually deliver 1,000 (minimum-maximum: 893-1,224) Mg mercury to coastal oceans, threefold greater than atmospheric deposition. Furthermore, high flow events,

which are becoming more common with climate change, are responsible for a disproportionately large percentage of the export. Coastal oceans constitute 0.2% of the entire ocean volume but receive 27% of the external mercury input to the ocean. We estimate that the river mercury export could be responsible for a net annual export of 350 (interquartile range: 52-640) Mg mercury across the coastal-open-ocean boundary, although there is still high uncertainty around this estimate. Our results show that river export is the largest source of mercury to coastal oceans worldwide, and continued mercury risk modelling should incorporate the impact of rivers.

（来源：NATURE GEOSCIENCE 出版年: 2021, **DOI:** 10.1038/s41561-021-00793-2）

Large subglacial source of mercury from the southwestern margin of the Greenland Ice Sheet

Hawkings, Jon R.; Linhoff, Benjamin S.; Wadham, Jemma L.; 等

The Greenland Ice Sheet is currently not accounted for in Arctic mercury budgets, despite large and increasing annual runoff to the ocean and the socio-economic concerns of high mercury levels in Arctic organisms. Here we present concentrations of mercury in meltwaters from three glacial catchments on the southwestern margin of the Greenland Ice Sheet and evaluate the export of mercury to downstream fjords based on samples collected during summer ablation seasons. We show that concentrations of dissolved mercury are among the highest recorded in natural waters and mercury yields from these glacial catchments (521-3,300 mmol km($^{-2}$) year($^{-1}$)) are two orders of magnitude higher than from Arctic rivers (4-20 mmol km($^{-2}$) year($^{-1}$)). Fluxes of dissolved mercury from the southwestern region of Greenland are estimated to be globally significant (15.4-212 kmol year($^{-1}$)), accounting for about 10% of the estimated global riverine flux, and include export of bioaccumulating methylmercury (0.31-1.97 kmol year($^{-1}$)). High dissolved mercury concentrations (similar to 20 pM inorganic mercury and similar to 2 pM methylmercury) were found to persist across salinity gradients of fjords. Mean particulate mercury concentrations were among the highest recorded in the literature (similar to 51,000 pM), and dissolved mercury concentrations in runoff exceed reported surface snow and ice values. These results suggest a geological source of mercury at the ice sheet bed. The high concentrations of mercury and its large export to the downstream fjords have important implications for Arctic ecosystems, highlighting an urgent need to better understand mercury dynamics in ice sheet runoff under global warming.

（来源：NATURE GEOSCIENCE 卷: 14 期: 7 出版年: 2021, **DOI:** 10.1038/s41561-021-00753-w）

Global dominance of tectonics over climate in shaping river longitudinal profiles

Seybold, Hansjoerg; Berghuijs, Wouter R.; Prancevic, Jeff P.; 等

River networks are striking features engraved into the surface of the Earth, shaped by uplift and erosion under the joint influence of climate and tectonics. How a river's gradient changes as it descends along its course-its longitudinal profile concavity-varies greatly from one basin to the next, reflecting the interplay between uplift and erosional processes. A recent global analysis has suggested that climatic aridity should be a first-order control on river profile concavity, but the importance of climate relative to other factors has not been tested at global scale. Here, we show, using recent global datasets of climate, river profiles and tectonic activity, that tectonics is much more strongly expressed than climate in global patterns of river profile concavity. River profiles tend to be more strongly concave in tectonically active regions along plate boundaries, reflecting tectonically induced spatial variations in uplift rates. Rank

correlations between river profile concavity and four global tectonic proxies (basin-averaged channel gradients, distance to plate boundaries and two measures of seismic activity) are much stronger than those between river concavity and three climate metrics (precipitation, potential evapotranspiration and aridity). We explain the association between tectonic activity and increased river profile concavity through a simple conceptual model of long-term uplift and river incision. These results show that tectonics, and not climate, exerts dominant control on the shape of river longitudinal profiles globally. Spatially varying uplift rates strongly influence the concavity of river profiles worldwide, with smaller contributions from hydrological factors, according to a comparison of river profile, tectonic and climatic datasets.

（来源：NATURE GEOSCIENCE 卷: 14 期: 7 出版年: 2021, **DOI:** 10.1038/s41561-021-00720-5）

Optimized river diversion scenarios promote sustainability of urbanized deltas

Moodie, Andrew J.；Nittrouer, Jeffrey A.；

Socioeconomic viability of fluvial-deltaic systems is limited by natural processes of these dynamic landforms. An especially impactful occurrence is avulsion, whereby channels unpredictably shift course. We construct a numerical model to simulate artificial diversions, which are engineered to prevent channel avulsion, and direct sediment-laden water to the coastline, thus mitigating land loss. We provide a framework that identifies the optimal balance between river diversion cost and civil disruption by flooding. Diversions near the river outlet are not sustainable, because they neither reduce avulsion frequency nor effectively deliver sediment to the coast; alternatively, diversions located halfway to the delta apex maximize landscape stability while minimizing costs. We determine that delta urbanization generates a positive feedback: infrastructure development justifies sustainability and enhanced landform preservation vis-a-vis diversions.

（来源：PNAS 卷:118 期: 27 出版年: 2021, **DOI:** 10.1073/pnas.2101649118）

Aerobic bacterial methane synthesis

Wang, Qian；Alowaifeer, Abdullah；Kerner, Patricia；等

Reports of biogenic methane (CH_4) synthesis associated with a range of organisms have steadily accumulated in the literature. This has not happened without controversy and in most cases the process is poorly understood at the gene and enzyme levels. In marine and freshwater environments, CH_4 supersaturation of oxic surface waters has been termed the "methane paradox" because biological CH_4 synthesis is viewed to be a strictly anaerobic process carried out by O2-sensitive methanogens. Interest in this phenomenon has surged within the past decade because of the importance of understanding sources and sinks of this potent greenhouse gas. In our work on Yellowstone Lake in Yellowstone National Park, we demonstrate microbiological conversion of methylamine to CH_4 and isolate and characterize an Acidovorax sp. capable of this activity. Furthermore, we identify and clone a gene critical to this process (encodes pyridoxylamine phosphate-dependent aspartate aminotransferase) and demonstrate that this property can be transferred to Escherichia coli with this gene and will occur as a purified enzyme. This previously unrecognized process sheds light on environmental cycling of CH_4, suggesting that O2-insensitive, ecologically relevant aerobic CH_4 synthesis is likely of widespread distribution in the environment and should be considered in CH_4 modeling efforts.

（来源：PNAS 卷:118 期: 27 出版年: 2021, **DOI:** 10.1073/pnas.2019229118）

Causes, impacts and patterns of disastrous river floods

Merz, Bruno; Bloesch, Guenter; Vorogushyn, Sergiy; 等

River floods have direct and indirect consequences for society, and can cause fatalities, displacement and economic loss. This Review examines the physical and socioeconomic causes and impacts of disastrous river flooding, and past and projected trends in their occurrence. Disastrous floods have caused millions of fatalities in the twentieth century, tens of billions of dollars of direct economic loss each year and serious disruption to global trade. In this Review, we provide a synthesis of the atmospheric, land surface and socio-economic processes that produce river floods with disastrous consequences. Disastrous floods have often been caused by processes fundamentally different from those of non-disastrous floods, such as unusual but recurring atmospheric circulation patterns or failures of flood defences, which lead to high levels of damage because they are unexpected both by citizens and by flood managers. Past trends in economic flood impacts show widespread increases, mostly driven by economic and population growth. However, the number of fatalities and people affected has decreased since the mid-1990s because of risk reduction measures, such as improved risk awareness and structural flood defences. Disastrous flooding is projected to increase in many regions, particularly in Asia and Africa, owing to climate and socio-economic changes, although substantial uncertainties remain. Assessing the risk of disastrous river floods requires a deeper understanding of their distinct causes. Transdisciplinary research is needed to understand the potential for surprise in flood risk systems better and to operationalize risk management concepts that account for limited knowledge and unexpected developments.

（来源：Nature Reviews Earth & Environment 出版年: 2021, **DOI:** 10.1038/s43017-021-00195-3）

Health and sustainability of glaciers in High Mountain Asia

Miles, Evan; McCarthy, Michael; Dehecq, Amaury; 等

Glaciers in High Mountain Asia generate meltwater that supports the water needs of 250 million people, but current knowledge of annual accumulation and ablation is limited to sparse field measurements biased in location and glacier size. Here, we present altitudinally-resolved specific mass balances (surface, internal, and basal combined) for 5527 glaciers in High Mountain Asia for 2000-2016, derived by correcting observed glacier thinning patterns for mass redistribution due to ice flow. We find that 41% of glaciers accumulated mass over less than 20% of their area, and only 60% 10% of regional annual ablation was compensated by accumulation. Even without 21(st) century warming, 21% +/- 1% of ice volume will be lost by 2100 due to current climatic-geometric imbalance, representing a reduction in glacier ablation into rivers of 28% +/- 1%. The ablation of glaciers in the Himalayas and Tien Shan was mostly unsustainable and ice volume in these regions will reduce by at least 30% by 2100. The most important and vulnerable glacier-fed river basins (Amu Darya, Indus, Syr Darya, Tarim Interior) were supplied with >50% sustainable glacier ablation but will see long-term reductions in ice mass and glacier meltwater supply regardless of the Karakoram Anomaly.Glaciers in High Mountain Asia are a key water resource. The authors use remote sensing data and a regional implementation of the continuity equation to quantify glacier ablation and accumulation rates for 2000-2016, and establish current climatic-geometric imbalances that imply strong reductions in ice volume by 2100.

（来源：NATURE COMMUNICATIONS 卷:12 期: 1 出版年: 2021, **DOI:** 10.1038/s41467-021-23073-4）

Common irrigation drivers of freshwater salinisation in river basins worldwide

等 Thorslund, Josefin; Bierkens, Marc F. P.; Essink, Gualbert H. P. Oude; 等

Freshwater salinisation is a growing problem, yet cross-regional assessments of freshwater salinity status and the impact of agricultural and other sectoral uses are lacking. Here, we assess inland freshwater salinity patterns and evaluate its interactions with irrigation water use, across seven regional river basins (401 river sub-basins) around the world, using long-term (1980-2010) salinity observations. While a limited number of sub-basins show persistent salinity problems, many sub-basins temporarily exceeded safe irrigation water-use thresholds and 57% experience increasing salinisation trends. We further investigate the role of agricultural activities as drivers of salinisation and find common contributions of irrigation-specific activities (irrigation water withdrawals, return flows and irrigated area) in sub-basins of high salinity levels and increasing salinisation trends, compared to regions without salinity issues. Our results stress the need for considering these irrigation-specific drivers when developing management strategies and as a key human component in water quality modelling and assessment. Freshwater salinisation is a growing water quality problem, but impacts and drivers across regional to global scales have been lacking. A new assessment of inter-regional freshwater salinisation demonstrates the importance of irrigation as a driver of salinisation.

（来源：NATURE COMMUNICATIONS 卷:12 期: 1 出版年: 2021, **DOI:** 10.1038/s41467-021-24281-8）

Acute riverine microplastic contamination due to avoidable releases of untreated wastewater

Woodward, Jamie; Li, Jiawei; Rothwell, James; 等

The authors show how untreated wastewater laced with microplastics and raw sewage is routinely discharged into UK river flows that are too low to disperse the microplastics downstream. This discharge creates acute microplastic contamination of river beds that threatens biodiversity and the quality of riverine habitats. Wastewater discharge to rivers is a controversial practice that compromises water quality, aquatic habitats and human health worldwide. Here we show how untreated wastewater laced with microplastics and raw sewage is routinely discharged into UK river flows that are too low to disperse the microplastics downstream. These 'dry weather' spills lead to acute microplastic contamination of river bed habitats. Many aquatic fauna feed in the benthic zone, the quality of which affects the entire riverine ecosystem. All microplastic types accumulate to high concentrations on the channel bed until flushed downstream by floods. These findings pose fundamental questions about the sustainable management of urban wastewater. Treating the wastewater would shut down the major source of microplastic fragments and microbeads in such rivers and prevent their transport to the ocean. Riverine microplastic transport is primarily partitioned between: (1) continuous transport at low concentrations of synthetic fibres from treated wastewater effluent; and (2) episodic flood-driven transport of the full microplastic assemblage entrained from contaminated channel beds. Focusing only on the buoyant non-flood microplastic load can produce highly unrepresentative assessments of riverine microplastic contamination. Climate warming and urban population growth will intensify the microplastic burden on many river ecosystems as summer baseflows decline and wastewater fluxes increase.

（来源：NATURE SUSTAINABILITY 出版年: 2021, **DOI:** 10.1038/s41893-021-00718-2）

摘要精选

The changing characteristics of phytoplankton community and biomass in subtropical shallow lakes: Coupling effects of land use patterns and lake morphology

Peng, Xue; Zhang, Lu; Li, Yuan; 等

The community composition and biomass of phytoplankton in shallow lakes are impacted by many en-vironmental factors including water quality physicochemical parameters, land use in the watershed, and lake morphology. However, few studies have simultaneously evaluated the relative importance of these factors on the effect of community composition and biomass of phytoplankton. The relative importance of the water quality physicochemical parameters (water temperature [WT], total nitrogen [TN], total phos-phorus [TP], pH, dissolved oxygen [DO], electrical conductivity [EC], turbidity and Secchi depth [SD]), land use (built-up land, farmland, waters, forest, grassland, and unused land) in the watershed, and lake mor-phology (area and depth) on the composition and biomass of phytoplankton communities were assessed in 29 subtropical shallow lakes in Wuhan, China, during different seasons from December 2017 to Novem-ber 2018. The results showed that phytoplankton in all 29 lakes was mainly composed of Cyanophyta, Chlorophyta, and Bacillariophyta. Phytoplankton abundance was highest in summer and lowest in winter. We analyzed the relative importance of the three groups of variables to the community composition of the phytoplankton by variance decomposition. The results showed that the three groups of environmental variables had the highest explanation rate (> 80%) for the composition of the phytoplankton community in summer and autumn, and the explanation rates in spring and winter were 42.1% and 39.8%, respec-tively. The water quality physicochemical parameters were the most important variables affecting the composition of phytoplankton communities, followed by land use in the watershed. Through generalized additive model and structural equation model analysis, we found that the land use and lake morphology had minimal direct impact on the Chl-a and cell density of phytoplankton, mainly by altering the TN, TP, turbidity, SD, DO, and EC, which indirectly affected phytoplankton. WT and nutrients were still the main predictors of phytoplankton abundance. Built-up land was the main source of nitrogen and phosphorus in lakes. Correlation analysis found that forest and grassland had positive impacts on reducing lake nitro-gen and phosphorus contents. This showed that increasing grassland and forest in the watershed could reduce the pollutants entering the lake. Our findings will contribute to water quality management and pollution control for subtropical shallow lakes.

（来源：WATER RESEARCH 卷: 200 出版年: 2021, **DOI:** 10.1016/j.watres.2021.117235）

Estimation of total flux of polycyclic aromatic hydrocarbons facilitated by methane ebullition into water column from global lake sediments

Sun, Tingting; Li, Wenxuan; Yin, Ke

Methane ebullition and contamination are two typical characteristics from lakes, however, these two are generally studied independently. In fact, the exchange of matter and energy between methane bubbles and their surrounding environment can be very active to enhance the contaminant transport. There is limited research on understanding the characteristics and trends of gas ebullition facilitated contaminant emissions in large areas considering water and air as receptors. We herein estimate the transport capacity of methane ebullition for polycyclic aromatic hydrocarbons (PAHs) out of the sediment from

global lakes, which may reach an average of 71 (up to 159) t yr-1. Methane bubbles could transfer one third of the total PAH flux from sediments, or equivalent of 1.3-3.0 ng L-1 of additional PAHs, into the water column with the rest going into air, offsetting from 52 to 118% of dry PAH deposition flux into global lakes sediment per year. Given the PAH concentration in lake water is often in the range of 0.1-100 ng L-1, ebullition facilitated PAH flux may increase PAH concentration by a factor of 1.4 to 2.4 until 2,100, being a significant contributor for the PAH increment in lake waters.

（来源：WATER RESEARCH 卷: 204 出版年: 2021, **DOI:** 10.1016/j.watres.2021.117611）

Algal Organic Matter Drives Methanogen-Mediated Methylmercury Production in Water from Eutrophic Shallow Lakes

Lei, Pei; Zhang, Jin; Zhu, Jinjie;等.

Algal blooms bring massive amounts of algal organic matter (AOM) into eutrophic lakes, which influences microbial methylmercury (MeHg) production. However, because of the complexity of AOM and its dynamic changes during algal decomposition, the relationship between AOM and microbial Hg methylators remains poorly understood, which hinders predicting MeHg production and its bioaccumulation in eutrophic shallow lakes. To address that, we explored the impacts of AOM on microbial Hg methylators and MeHg production by characterizing dissolved organic matter with Fourier transform ion cyclotron resonance mass spectrometry (FTICR-MS) and three-dimensional excitation-emission matrix (3D-EEM) fluorescence spectroscopy and quantifying the microbial Hg methylation gene hgcA. We first reveal that the predominance of methanogens, facilitated by eutrophication-induced carbon input, could drive MeHg production in lake water. Specifically, bioavailable components of AOM (i.e., CHONs such as aromatic proteins and soluble microbial byproduct-like materials) increased the abundances (Archaea-hgcA gene: 438-2240% higher) and activities (net CH4 production: 16.0-44.4% higher) of Archaea (e.g., methanogens). These in turn led to enhanced dissolved MeHg levels (24.3-15,918% higher) for three major eutrophic shallow lakes in China. Nevertheless, our model results indicate that AOM-facilitated MeHg production could be offset by AOM-induced MeHg biodilution under eutrophication. Our study would help reduce uncertainties in predicting MeHg production, providing a basis for mitigating the MeHg risk in eutrophic lakes..

（来源：ENVIRONMENTAL SCIENCE & TECHNOLOGY 卷:55 期: 15 出版年: 2021, **DOI:** 10.1021/acs.est.0c08395）

Extreme Climate Anomalies Enhancing Cyanobacterial Blooms in Eutrophic Lake Taihu, China

Qin, Boqiang; Deng, Jianming; Shi, Kun;等.

Climate warming in combination with nutrient enrichment can greatly promote phytoplankton proliferation and blooms in eutrophic waters. Lake Taihu, China, is a large, shallow and eutrophic system. Since 2007, this lake has experienced extensive nutrient input reductions aimed at controlling cyanobacterial blooms. However, intense cyanobacterial blooms have persisted through 2017 with a record-setting bloom occurring in May 2017. Causal analysis suggested that this bloom was sygenerically driven by high external loading from flooding in 2016 in the Taihu catchment and a notable warmer winter during 2016/2017. High precipitation during 2016 was associated with a strong 2015/2016 El Nino in combination with the joint effects of Atlantic Multi-decadal Oscillation (AMO) and Pacific Decadal Oscillation (PDO), while persistent warmth during 2016/2017 was strongly related to warm phases of

AMO and PDO. The 2017 blooms elevated water column pH and led to dissolved oxygen depletion near the sediment, both of which mobilized phosphorus from the sediment to overlying water, further promoting cyanobacterial blooms. Our finding indicates that regional climate anomalies exacerbated eutrophication via a positive feedback mechanism, by intensifying internal nutrient cycling and aggravating cyanobacterial blooms. In light of global expansion of eutrophication and blooms, especially in large, shallow and eutrophic lakes, these regional effects of climate anomalies are nested within larger scale global warming predicted to continue in the foreseeable future.

（来源：WATER RESOURCES RESEARCH 卷:57 期: 7 出版年: 2021, **DOI:** 10.1029/2020WR029371）

The importance of aquatic macrophytes in a eutrophic tropical shallow lake

Swe, Thida; Lombardo, Paola; Ballot, Andreas;等.

Inlay Lake is the second largest natural lake in Myanmar. Located in Shan State, in the eastern part of the country, it is a known biodiversity hotspot. The lake is negatively affected by an increasing local human population and rapid growth in both agriculture and tourism. In recent decades, several studies have listed faunistic and floristic groups in Inlay Lake, but there is still a general lack of knowledge about the aquatic macrophyte and phytoplankton community composition and abundance, and their interactions. To fill this knowledge gap, field surveys of biological and physical and chemical parameters were carried out in the period 2014-2017. They show that Inlay Lake is a shallow, clear water and calcareous lake, with nutrient concentrations indicating mesotrophic-eutrophic conditions. However, close to the shore, nutrient concentrations are generally higher, reflecting pollution from inflowing rivers, shoreline villages and floating gardens. Both the richness and abundance of aquatic macrophytes in Inlay Lake were high, with several species forming extensive stands in most of the lake over the whole survey period. Total phytoplankton and cyanobacterial biomass were low, but cyanobacteria included toxin-producing strains of Microcystis, suggesting that cyanobacterial and total phytoplankton biomass need to be kept low to avoid potentially harmful cyanobacterial blooms. Submerged macrophyte abundance and phytoplankton biomass were inversely correlated in the heavily vegetated northern lake area. Our survey suggests a great importance of the submerged macrophytes to the general water quality and the clear water state in Inlay Lake. Maintaining high macrophyte abundances should therefore be a goal in management strategies, both for Inlay Lake and other lakes in Myanmar. It is highly desirable to include macrophytes and phytoplankton in the lake monitoring in Myanmar.

（来源：LIMNOLOGICA 卷: 90 出版年: 2021, **DOI:** 10.1016/j.limno.2021.125910）

Nonlinear pattern and algal dual-impact in N_2O emission with increasing trophic levels in shallow lakes

Zhou, Yiwen; Xu, Xiaoguang; Song, Kang;等

Shallow lakes are considered important contributors to emissions of nitrous oxide (N_2O), a powerful greenhouse gas, in aquatic ecosystems. There is a large degree of uncertainty regarding the relationship between N_2O emissions and the progress of lake eutrophication, and the mechanisms underlying N_2O emissions are poorly understood. Here, N_2O emission fluxes and environmental variables in different lakes along a trophic state gradient in the Yangtze River basin were studied. N_2O emission fluxes were -1.0-53.0mug m^{-2} h^{-1} and 0.4-102.9mug m^{-2} h^{-1} in summer and winter, respectively, indicating that there was marked variation in N_2O emissions among lakes of different trophic state. The non-linear exponential

model explained differences in N_2O emission fluxes by the degree of eutrophication ($p < 0.01$). TN and chl-a both predicted 86% of the N_2O emission fluxes in shallow lakes. The predicted N_2O emission fluxes based on the IPCC EF5r overestimated the observed fluxes, particularly those in hyper-eutrophic lakes. These findings demonstrated that nutrient-rich conditions and algal accumulation are key factors determining N_2O emission fluxes in shallow lakes. Furthermore, this study also revealed that temperature and algae accumulation-decomposition determine an N_2O emission flux in an intricate manner. A low temperature, i.e., winter, limits algae growth and low oxygen consumption for algae decomposition. The environment leaves a high dissolved oxygen concentration, slowing down N_2O consumption as the final step of denitrification. In summer, with the oxygen consumed by excess algal decomposition, the N_2O production is limited by the complete denitrification as well as the limited substrate supply of nitrate by nitrification in hypoxic or anoxic conditions. Such cascading events explained the higher N_2O emission fluxes from shallow lakes in winter compared with summer. This trend was amplified in hyper-eutrophic shallow lakes after algal disappearance. Collectively, algal accumulation played a dual role in stimulating and impeding N_2O emissions, especially in hyper-eutrophic lakes. This study expands our knowledge of N_2O emissions from shallow lakes in which eutrophication is underway.

（来源：WATER RESEARCH 卷: 203 出版年: 2021, **DOI:** 10.1016/j.watres.2021.117489）

Eutrophication decreased CO_2 but increased CH_4 emissions from lake: A case study of a shallow Lake Ulansuhai

Sun, Heyang; Lu, Xixi; Yu, Ruihong;等

Eutrophic lakes, especially shallow eutrophic lakes, disproportionately contribute to greenhouse gas (GHG) emissions. To investigate the effects of eutrophication on GHG dynamics, we conducted field measurements every three months from January 2019 to October 2019 in Lake Ulansuhai, a shallow eutrophic lake (mean depth of 0.7 m) located in a semi-arid region in Northern China. We found that Lake Ulansuhai was a predominantly source of atmospheric carbon dioxide (CO_2); however, it converted to a CO_2 sink in July due to eutrophication. It was also a strong source of methane (CH_4) with a mean CO_2 emission of 35.7 +/- 12.1 mmol m- 2 d-1 and CH_4 emission of 5.9 +/- 2.9 mmol m- 2 d-1. The CO_2 concentrations in most sites and CH4 concentrations in all sites were supersaturated, with the average partial pressure of CO_2 (p CO_2) being 654 +/- 34 mu atm and the partial pressure of CH_4 (p CH_4) being 157 +/- 37 mu atm. The partial pressures and emissions of the greenhouse gases exhibited substantial seasonal and spatial variations. The correlation analysis between the trophic level index and the partial pressure of the greenhouse gases indicated that eutrophication could significantly decrease the CO_2 emissions but increase the CH_4 emissions from the lake, resulting in a CH_4 and CO_2 emission ratio of approximately 2 in terms of global warming potential. Eutrophication decreased the pCO2 in the lake and subsequently increased the p CH_4 due to nutrient input, thereby enhancing primary production. The results indicated that shallow eutrophic lakes in arid regions are strong sources of CH_4 and that eutrophication could alter the greenhouse gas emission patterns.

（来源：WATER RESEARCH 卷: 201 出版年: 2021, **DOI:** 10.1016/j.watres.2021.117363）

Global assessment of future sectoral water scarcity under adaptive inner-basin water allocation measures

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Water scarcity has become a major threat to sustainable development under climate change. To reduce

the population exposure to water scarcity and improve universal access to safe drinking water are important targets of the Sustainable Development Goal (SDG) 6 in the near future. This study aims to examine the potential of applying adaptive inner-basin water allocation measures (AIWAM), which were not explicitly considered in previous studies, for mitigating water scarcity in the future period (2020-2050). By incorporating AIWAM in water scarcity assessment, nonagricultural water uses are assumed to have high priority over agricultural water use and thus would receive more water supply. Results show that global water deficit is projected to be similar to 3241.9 km(3)/ yr in 2050, and severe water scarcity is mainly found in arid and semi-arid regions, e.g. Western US, Northern China, and the Middle East. Future warming climate and socioeconomic development tend to aggravate global water scarcity, particularly in Northern Africa, Central Asia, and the Middle East. The application of AIWAM could significantly mitigate water scarcity for nonagricultural sectors by leading to a decrease of global population subject to water scarcity by 12% in 2050 when compared to that without AIWAM. However, this is at the cost of reducing water availability for agricultural sector in the upstream areas, resulting in an increase of global irrigated cropland exposed to water scarcity by 6%. Nevertheless, AIWAM provides a useful scenario that helps design strategies for reducing future population exposure to water scarcity, particularly in densely populated basins and regions. Our findings highlight increasing water use competition across sectors between upstream and downstream areas, and the results provide useful information to develop adaptation strategies towards sustainable water management.

（来源：SCIENCE OF THE TOTAL ENVIRONMENT 卷:783 出版年:2021, **DOI:** 10.1016/j.scitotenv.2021.146973）

Chlorophyll a estimation in lakes using multi-parameter sonde data

Liu, Xiaofeng; Georgakakos, Aris P

Algae blooms are of considerable concern in freshwater lakes and reservoirs worldwide. In-situ Chlorophyll a (Chl-a) fluorometers are widely used for rapid assessments of algae biomass. However, accurately converting Chl-a fluorescence to an equivalent concentration is challenging due to natural variations in the relationship as well as nonphotochemical quenching (NPQ) which occurs commonly in surface waters during daytime. This study is based on water quality data from a freshwater lake from October 2018 to December 2020. Initial analysis of sonde Chl-a fluorescence and laboratory extracted Chl-a concentrations shows that the two data sets exhibit a nonlinear relationship with positive correlation and significant errors. A bias correction method was next developed based on (1) concurrent sonde measurements of other water quality parameters (to account for nonlinearities) and (2) a bias correction approach for nonphotochemical quenching effects in surface waters. The new Chl-a model exhibits much improved accuracy, with a root mean square error (RMSE) less than 0.95g/L. The new method facilitates accurate Chl-a characterization in freshwater lakes and reservoirs based on readily obtainable in-situ fluorescence sonde measurements.

（来源：WATER RESEARCH 卷: 205 出版年: 2021, **DOI:** 10.1016/j.watres.2021.117661）

Water-level fluctuations regulate the availability and diffusion kinetics process of phosphorus at lake water-sediment interface

Yuan, Hezhong; Wang, Haixiang; Zhou, Yanwen;等.

Sequential extraction and in-situ diffusive gradients in thin films (DGT) techniques were used to determine phosphorus (P) fractions and high-resolution 2D fluxes of labile P-DGT, Fe-DGT(2+), and S-DGT(2-) in sediment systems. The diffusion fluxes were subsequently calculated for different scenarios.

Dynamic diffusion parameters between solid sediment and solution were also fitted using the DIFS (DGT-induced fluxes in sediments) model. The results suggested that Fe-bound P (Fe-P) was the dominant pool which contributed to the resupply potential of P in the water-sediment continuum. Significant upward decreases of labile P-DGT, Fe-DGT(2+), and S-DGT(2-) fluxes were detected in pristine and incubated microcosms. This dominance indicated the more obvious immobilization of labile P via oxidation of both Fe2+ and S2- in oxidic conditions. Additionally, these labile analytes in the microcosms obviously decreased after a 30-day incubation period, indicating that water-level fluctuations can significantly regulate adsorption-desorption processes of the P bound to Fe-containing minerals within a short time. Higher concentrations of labile P-DGT, Fe-DGT(2+), and S-DGT(2-) were measured at the shallow lake region where more drastic water-level variation occurred. This demonstrates that frequent adsorption-desorption of phosphate from the sediment particles to the aqueous solution can result in looser binding on the solid sediment surface and easier desorption in aerobic conditions via the regulation of water levels. Higher R values fitted with DIFS model suggested that more significant desorption and replenishment effect of labile P to the aqueous solution would occur in lake regions with more dramatic water-level variations. Finally, a significant positive correlation between S-DGT(2-) and Fe-DGT(2+) in the sediment indicated that the S2- oxidization under the conditions of low water-level can trigger the reduction of Fe(III) and subsequent release of active P. In general, speaking, frequent water-level fluctuations in the lake over time facilitated the formation and retention of the Fe(II) phase in the sediment, and desorption of Fe coupled P into the aqueous solution when the water level was high.

（来源：WATER RESEARCH 卷: 200 出版年: 2021, **DOI:** 10.1016/j.watres.2021.117258）

Capturing the spatial variability of algal bloom development in a shallow temperate lake

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Algal blooms can have profound effects on the structure and function of aquatic ecosystems and have the potential to interrupt valuable ecosystem services. Despite the potential ecological and economic consequences of algal blooms, the spatial dynamics of bloom development in spatially complex ecosystems such as shallow lakes remain poorly characterised. Our goal was to evaluate the magnitude and drivers of spatial variability of algal biomass, dissolved oxygen, and pH over the course of a season, in a shallow lake in order to better understand the spatial dynamics of algal blooms in these ecosystems. We sampled 98 locations in a small eutrophic lake on a 65-m grid for several parameters (chlorophyll a, phycocyanin, dissolved oxygen, pH, and temperature), weekly over 122 days. This was done to estimate the dynamics of variability and spatial autocorrelation during the course of multiple bloom events. We also compared the spatial measurements to a high frequency sensor deployed at a fixed station and estimated the optimal spatial sampling resolution by performing a rarefaction analysis. Spatial heterogeneity of algal pigments was high, particularly during bloom events, and this pattern and the overall severity of the bloom were not well captured with the fixed station monitoring. The pattern of algal pigments and other limnologically important variables (dissolved oxygen and pH) was related to the direction of prevailing winds 24 hr prior to sampling, the shallow northern basin where the main surface inlet is located, and heavy precipitation. Additionally, a dense bed of floating-leaf macrophytes contributed to local patchiness in all variables. Finally, from the rarefaction analysis we found that minimal information about the mean state of the ecosystem was gained after c. 30 locations had been sampled. This study revealed how spatially heterogeneous shallow lakes are over the course of a single season, and that the magnitude of variability was highest during biologically intensive periods such as algal

blooms. As such, continued research is needed across a range of trophic conditions to better understand the structure of horizontal variability in lakes. Overall, these data demonstrate the need for spatially explicit monitoring to better understand the dynamics and drivers of algal blooms in shallow lakes and to better manage ecosystem services.

（来源：FRESHWATER BIOLOGY 出版年: 2021 , **DOI:** 10.1111/fwb.13814）

Water level as the key controlling regulator associated with nutrient and gross primary productivity changes in a large floodplain-lake system (Lake Poyang), China

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

A floodplain lake system can be described as a water conveyance-type lake system that is subject to high water-level fluctuations (WLFs). This study investigated the effects of WLF on the nutrient status and the gross primary productivity (GPP) of phytoplankton in Lake Poyang, a large floodplain-lake system in China. This study hypothesized that WLF is the key controlling regulator of the lake's nutrient status, phytoplankton growth and GPP, driven by its influence on the lake's hydrological connectivity in combination with water-flow velocity as well as other environmental parameters. The results showed that the intra-annual water levels in this lake varied from 7.61 m to 20.82 m while inter-annual water levels significantly decreased throughout 1989-2018 ($P < 0.05$). Except for pH, most environmental variables and nutrients differed significantly each season. Mean GPP and chlorophyll a (Chl a) concentration during the water rising period was clearly higher compared to the dry season, wet season and falling period. Moreover, nutrient concentration was the main determining factor of phytoplankton growth and GPP during different periods, while water temperature (WT) also played a key role in influencing phytoplankton biomass and GPP during the water rising period. There was also a direct correlation between WLF and GPP during the water rising period, and WLF significantly affected nutrient concentration, subsequently impacting GPP. This study can benefit our overall knowledge of hydrological and ecological dynamics in floodplain-lake systems, while providing an important reference for policymakers in the management of dams and water quality in floodplain-lake systems globally.

（来源：JOURNAL OF HYDROLOGY 卷: 599 出版年: 2021, **DOI:** 10.1016/j.jhydrol.2021.126414）

The Imprint of Primary Production on High-Frequency Profiles of Lake Optical Properties

Minaudo, Camille; Odermatt, Daniel; Bouffard, Damien;等

Water inherent optical properties (IOPs) contain integrative information on the optical constituents of surface waters. In lakes, IOP measurements have not been traditionally collected. This study describes how high-frequency IOP profiles can be used to document short-term physical and biogeochemical processes that ultimately influence the long-term trajectory of lake ecosystems. Between October 2018 and May 2020, we collected 1373 high-resolution hyperspectral IOP profiles in the uppermost 50 m of the large mesotrophic Lake Geneva (Switzerland-France), using an autonomous profiler. A data set of this size and content does not exist for any other lake. Results showed seasonal variations in the IOPs, following the expected dynamic of phytoplankton. We found systematic diel patterns in the IOPs. Phases of these diel cycles were consistent year-round, and amplitudes correlated to the diurnal variations of dissolved oxygen, clarifying the link between IOPs and phytoplankton metabolism. Diel amplitudes were largest in spring and summer under low wind condition. Wind-driven changes in thermal stratification

impacted the dynamic of the IOPs, illustrating the potential of high-frequency profiles of water optical properties to increase our understanding of carbon cycling in lake ecosystems.

（来源：ENVIRONMENTAL SCIENCE & TECHNOLOGY，出版年: 2021 , **DOI:** 10.1021/acs.est.1c02585）

Quasi-decadal periodicities in growth and production of the copepod Eodiaptomus japonicus in Lake Biwa, Japan, related to the Arctic Oscillation

Liu, Xin; Dur, Gael; Ban, Syuhei;等.

Copepods are important secondary producers that support higher trophic levels in aquatic food webs. Large-scale climate events such as climate oscillations and global warming force on physical and chemical conditions in aquatic ecosystems might regulate copepod production through physiological and biochemical processes. We evaluated how large climatic and anthropogenic events impacted secondary production of copepods in Lake Biwa, the largest lake in Japan. We determined demographic traits such as body size, growth rate, biomass and production of the dominant copepod Eodiaptomus japonicus in this lake over four decades (1971-2010). To evaluate in situ food conditions and estimate growth and production for this omnivorous species, we firstly defined a size-based food index (f), that is the ratio of in situ body size to ideal body size in adult females. Values of f were mostly < 1 even during eutrophication (1970s to the early 1980s), suggesting that this copepod continuously suffered from a food shortage in this lake. Quasi-decadal periodicities were detected in f, growth and production (but not biomass) for this copepod throughout the study period. These periodicities were correlated with the Arctic Oscillation, implying that long-term trends in climate could regulate copepod food availability and production. This correlation weakened after 1990, which might be due to a regime shift in lake water temperature, which increased abruptly in the mid-1980s. Global warming might now be disrupting historical quasi-decadal periodicity in growth and production of copepods in Lake Biwa.

（来源: LIMNOLOGY AND OCEANOGRAPHY 出版年: 2021, **DOI:** 10.1002/lno.11918）

Formation and mechanisms of hydroxyl radicals during the oxygenation of sediments in Lake Poyang, China

Du, Haiyan; Cao, Yuanxin; Li, Zhe;等.

Seasonal flooding-drought transformation process of lake sediments lead to changes of dissolved oxygen and redox conditions and the resultant generation of hydroxyl radical (HO'). To date, information on HO' formation and its regulators in seasonal lake sediments is largely unexplored. In this study, a total of nineteen sediments were collected from Lake Poyang, China, with the formation and mechanisms of HO' during the oxygenation process exploring via the incubation experiments, Fe K-edge X-ray adsorption spectroscopy, ultrafiltration, and fluorescent spectroscopy. Results showed that the concentrations of HO' generated ranged from 3.75 +/- 1.13 to 271.8 +/- 22.81 mu mol kg-1, demonstrating high formation potential and obvious spatial heterogeneity. The yield of HO' formed was positively correlated with the contents of Fe(II), sedimentary organic carbon, and dissolved organic carbon, showing a general contribution of these reduced substances to HO' formation. Furthermore, application of Fe K-edge X-ray adsorption spectroscopy revealed the key species of sedimentary Fe-smectite for HO' formation due to its high peroxidase-like activity. Besides inorganic Fe(II), the sedimentary dissolved organic matters (DOMs) represented an important regulator for HO' formation, which contributed about 2-11% of the total HO' generation. Moreover, the DOM-induced formation

potential was found to be highly related to the molecular weight distribution that the low molecular weight-(LMW, <1 kDa) fraction exhibited higher HO' formation potential than the bulk and high molecular weight-(HMW, 1 kDa-0.45 mu m) counterparts. In addition, the omnipresent mineral Fe(II)-DOM interaction in sediment matrix exhibited another 2-6% of contribution to the total HO' production. This study highlighted the importance of contents and species of Fe(II) and DOM in manipulating the HO' yield, providing new insight into understanding the formation mechanisms of HO' in the seasonal lake sediment.

（来源：WATER RESEARCH 卷: 202 出版年: 2021, **DOI:** 10.1016/j.watres.2021.117442）

Forecasting water temperature in lakes and reservoirs using seasonal climate prediction

Mercado-Bettin, Daniel; Clayer, Francois; Shikhani, Muhammed;等.

Sequential Seasonal climate forecasts produce probabilistic predictions of meteorological variables for subsequent months. This provides a potential resource to predict the influence of seasonal climate anomalies on surface water balance in catchments and hydro-thermodynamics in related water bodies (e.g., lakes or reservoirs). Obtaining seasonal forecasts for impact variables (e.g., discharge and water temperature) requires a link between seasonal climate forecasts and impact models simulating hydrology and lake hydrodynamics and thermal regimes. However, this link remains challenging for stakeholders and the water scientific community, mainly due to the probabilistic nature of these predictions. In this paper, we introduce a feasible, robust, and open-source workflow integrating seasonal climate forecasts with hydrologic and lake models to generate seasonal forecasts of discharge and water temperature profiles. The workflow has been designed to be applicable to any catchment and associated lake or reservoir, and is optimized in this study for four catchment-lake systems to help in their proactive management. We assessed the performance of the resulting seasonal forecasts of discharge and water temperature by comparing them with hydrologic and lake (pseudo)observations (reanalysis). Precisely, we analysed the historical performance using a data sample of past forecasts and reanalysis to obtain information about the skill (performance or quality) of the seasonal forecast system to predict particular events. We used the current seasonal climate forecast system (SEAS5) and reanalysis (ERA5) of the European Centre for Medium Range Weather Forecasts (ECMWF). We found that due to the limited predictability at seasonal time-scales over the locations of the four case studies (Europe and South of Australia), seasonal forecasts exhibited none to low performance (skill) for the atmospheric variables considered. Nevertheless, seasonal forecasts for discharge present some skill in all but one case study. Moreover, seasonal forecasts for water temperature had higher performance in natural lakes than in reservoirs, which means human water control is a relevant factor affecting predictability, and the performance increases with water depth in all four case studies. Further investigation into the skillful water temperature predictions should aim to identify the extent to which performance is a consequence of thermal inertia (i.e., lead-in conditions).

（来源 Water research 卷:201 页: 117258 出版年: 2021-July-15, **DOI:** 10.1016/j.watres.2021.117286）

Application of environmental DNA metabarcoding in a lake with extensive algal blooms

Wu, Qianqian; Sakata, Masayuki K.; Wu, Deyi;等.

Recently, environmental DNA (eDNA) metabarcoding techniques have been applied to biodiversity investigations in aquatic ecosystems. However, no study has yet tested whether this technique is

effective for water bodies in which extensive algal blooms break out. In this study, fish eDNA metabarcoding was carried out in Lake Taihu, which experiences extensive algal blooms, to confirm whether the technique is also effective for fish diversity research in ecosystems with frequent and extensive blooms. In December 2016, three samples were collected, including one collected in the presence of algal blooms and two collected in the absence of algal blooms. In August 2017, six samples were collected, including three collected in the presence of algal blooms and three in the absence of algal blooms. Equal amount of water samples (1 L) was collected from each site; however, the actual amount of filtrate varied with the site. Twenty-seven freshwater fish species were detected from the water samples collected in Lake Taihu. The results showed that the composition of the detected species did not differ whether or not blooms were present. However, the amount of filtration could influence the number of species detected. The results suggest that future eDNA metabarcoding studies under similar water environments should increase the amount of filtration to maximize number of species detected.

（来源：LIMNOLOGY 卷:22 期: 3 出版年: 2021 , **DOI:** 10.1007/s10201-021-00663-1）

An 1800-year record of lake level and climate change from alkaline lakes in southern Inner Mongolia, China

Tian, Fei; Wang, Yong; Dong, Jin;等.

Paleoclimatic records from the East Asian summer monsoon (EASM) margin are regarded as a direct reflection of the intensity and northern extent of the EASM. Here, we focus on reconstructing climatic evolution over the past 1800 years from two alkaline lakes, Chagan Nuur and Sangin Dalai Nuur, in southern Inner Mongolia. With age control provided by 13 Accelerator Mass Spectrometry radiocarbon ages and Pb-210/Cs-137 dating, analyses of grain size, X-ray diffraction, magnetic susceptibility, carbonate content, total nitrogen, total organic carbon and the stable isotopic composition of carbon (delta C-13) and nitrogen (delta N-15) in sedimentary organic matter and calculation of organic carbon to nitrogen atomic ratios have been performed to investigate hydrodynamic processes, ecological conditions and corresponding lake-level fluctuations, in response to climate change. Our results show that the lake level of Changan Nuur frequently fluctuated since 546 CE, with four centennial-scale intervals of lake expansion at around 755, 1178, 1350 CE, and after 1950 CE, and one interval of lake recession from 1593 to 1782 CE. Sangin Dalai Nuur experienced mainly low-amplitude lake-level fluctuations since 212 CE, except for severe lake shrinkage from 1417 to 1872 CE. A regional comparison shows that three warm and humid intervals (640-800 CE, 1088-1288 CE, and after 1950 CE) and one cold and dry interval (1417-1872 CE) recognized from our records could correspond to the Sui-Tang Warm Period, the Medieval Climate Anomaly, the Current Warm Period and the Little Ice Age, respectively. Moreover, our results are roughly synchronous with moisture conditions revealed by proxy records from monsoonal northern China, demonstrating that the highly variable lake levels and climatic conditions in southern Inner Mongolia were controlled by centennial-scale variations in EASM over the past 1800 years.

（来源：JOURNAL OF PALEOLIMNOLOGY 出版年: 2021, **DOI:** 10.1007/s10933-021-00221-w）

Occurrence and ecotoxicological risk assessment of perfluoroalkyl substances in water of lakes along the middle reach of Yangtze River, China

Leng, Yifei; Xiao, Henglin; Li, Zhu;等.

Polyfluoroalkyl substances (PFASs) are widely distributed in aquatic environment, and the potential ecological risk of PFASs has become a new challenge in recent years. But there were few integrated studies about the distribution, source appointment and risk assessment of PFASs in water of lakes along the middle reach of Yangtze River, China. Hence, this study investigated the pollution characteristics, source apportionment, ecological risks assessment of eleven PFASs from the surface water in this region. The total concentrations of PFASs (Sigma PFASs) ranged from 12.43 to 77.44 ng L-1 in this region. The Sigma PFASs in Hong and Poyang Lakes were higher than those in Dongting Lake and middle reach of Yangtze River ($p < 0.05$). The compositions of PFASs in the middle reach of Yangtze River and along three lakes were similar, being with a larger proportion of short-chain PFACs. The food packaging and metal plating sources were identified as the main sources by two models. The total risk quotients (Sigma RQs) showed the ecological risk for algae in the middle reach of Yangtze River, Dongting and Poyang Lakes were negligible, but the low risk in some sites of Hong Lake. The EDIs of Sigma PFASs were much lower than the tolerable daily intake recommended by the European Food Safety Authority. The results of this study were significant for developing effective strategies (e.g. short-chain substitution and restriction) of controlling PFASs pollution in the middle reach of Yangtze River and along lakes.

（来源：SCIENCE OF THE TOTAL ENVIRONMENT 卷:788 出版年: 2021, **DOI:** 10.1016/j.scitotenv.2021.147765）

Phosphorus concentrations into a subtropical lake strongly influence nitrogen accumulation, nitrogen export, and Chl a concentrations

Turner, R. Eugene; Lee, James M.; Milan, Charles S.;等.

We measured water quality monthly for 22 years in water entering, within, and exiting a 65 km(2) shallow polymictic and eutrophic freshwater lake in the northern Gulf of Mexico. Fertilizer use in the watershed is the dominate source of phosphorous (P) going into the lake and controls the lake's P concentrations, but nitrogen (N) fertilizer use was not related to total nitrogen concentration in the lake. Half of the particulate P entering the lake is trapped within it and there is a net accumulation of N that appears to be from the stimulation of nitrogen fixation. The lake's concentration of Chlorophyll a (mu g Chl a l(-1)) and increase in N in the lake was directly related to the concentration of P in water entering the lake. Variations in the Chl a concentration within a freshwater lake downstream are also directly related to the annual use of P fertilizer, but not to N fertilizer use. Reducing agriculture-sourced P runoff will lower (but not eliminate) both the frequency of algal blooms within Lac des Allemands and the amount of N delivered to the estuary.

（来源：HYDROBIOLOGIA 卷:848 期:20 出版年: 2021, **DOI:** 10.1007/s10750-021-04673-z）

Timescale of reduction of long-term phosphorus release from sediment in lakes

Rippey, Brian; Campbell, Julie; McElarney, Yvonne;等.

Due It is important for lake management and policy to estimate the timescale of recovery from long-term P release from sediment after a reduction in the external load. To provide a scientific basis for this, a condensed model was elaborated, applied and evaluated in four lakes. The model is based on first order kinetics, with an overall rate constant composed of the rate of diagenesis of labile P (kd,2) and rate of burial of P (kb) below an active sediment layer. Using the variation of P fractions in dated sediment cores, kd,2 varied from 0.0155 to 0.383 yr(-1), kb from 0.0184 to 0.073 yr(-1) and the overall rate constant from 0.0230 to 0.446 yr(-1). The active layer depths, 8 to 29 cm, and kd,2 values are within the ranges found

by others. The time for a 75% reduction (t(75)) of labile P in the active layer is 60 years in Lough Melvin, 3 in Ramor, 33 in Sheelin and 41 in Neagh, although P release is only important in Ramor and Neagh. Combining the kd,2 values with other estimates (mean 0.0981 yr(-1), median 0.0426; n=14) produces a t(75) value of less than 14 and 33 years. A review of other models indicates a timescale of one to two decades and from lake monitoring also of one to two decades. It is desirable to estimate the timescale directly in all lakes if sediment P release is important, but, generally, it should take between one and three decades.

（来源：WATER RESEARCH 卷:200 出版年: 2021, **DOI:** 10.1016/j.watres.2021.117283）

Temperature, phytoplankton density and bacteria diversity drive the biotransformation of micropollutants in a lake ecosystem

Chalifour, Annie; Walser, Jean-Claude; Pomati, Francesco;等.

For most micropollutants (MPs) present in surface waters, such as pesticides and pharmaceuticals, the contribution of biotransformation to their overall removal from lake ecosystems is largely unknown. This study aims at empirically determining the biotransformation rate constants for 35 MPs at different periods of the year and depths of a meso-eutrophic lake. We then tested statistically the association of environmental parameters and microbial community composition with the biotransformation rate constants obtained. Biotransformation was observed for 14 out of 35 studied MPs for at least one sampling time. Large variations in biotransformation rate constants were observed over the seasons and between compounds. Overall, the transformation of MPs was mostly influenced by the lake's temperature, phytoplankton density and bacterial diversity. However, some individual MPs were not following the general trend or association with microorganism biomass. The antidepressant mianserin, for instance, was transformed in all experiments and depths, but did not show any relationship with measured environmental parameters, suggesting the importance of specific microorganisms in its transformation. The results presented here contribute to our understanding of the fate of MPs in surface waters and thus support improved risk assessment of contaminants in the environment.

（来源：WATER RESEARCH 卷:202 出版年: 2021, **DOI:** 10.1016/j.watres.2021.117412）

Flood hydrograph coincidence analysis of the upper Yangtze River and Dongting Lake, China

Zhang, Chao; Ji, Changming; Wang, Yi; 等.

In hydrological research, flood events can be analyzed by flood hydrograph coincidence. The duration of the flood hydrograph is a key variable to calculate the flood hydrograph coincidence risk probability and determining whether flood hydrograph coincidence occurs, while the actual duration of the flood hydrograph is neglected in most of existing related research. This paper creatively proposes a novel method to analyze the flood hydrograph coincidence risk probability by establishing a five-dimensional joint distribution of flood volumes, durations and interval time for two hydrologic stations. More specifically, taking the annual maximum flood of the upper Yangtze River and input from Dongting Lake as an example, the Pearson Type III and the mixed von Mises distributions were used to establish the marginal distribution of flood volumes, flood duration and interval time. Subsequently, the five-dimensional joint distribution based on vine copula was established to analyze the flood hydrograph coincidence risk probability. The results were verified by comparison with a historical flood sequence, which show that during 1951-2002, the hydrograph coincidence probabilities corresponding to its flood event coincidence

volumes of 2.00 x 10(11) m(3), 4.00 x 10(11) m(3), and 6.00 x 10(11) m(3) are 0.213, 0.123, and 0.049, respectively. It has provided theoretical support for flood control safety and risk management in the middle and lower Yangtze River. This study also demonstrates the significant beneficial role of regulation by the Three Gorges Water Conservancy Project in mitigating flood risk of the Yangtze River. The hydrograph coincidence probability corresponding to its flood event coincidence volume of 2.00 x 10(11) m(3) has decreased by 0.141.

（来源：NATURAL HAZARDS 出版年: 2021, **DOI:** 10.1007/s11069-021-04993-2）

Can reservoir regulation mitigate future climate change induced hydrological extremes in the Lancang-Mekong River Basin?

Yun, Xiaobo; Tang, Qiuhong; Li, Jiabo;等.

Hydrological extremes both dry extremes and wet extremes can be exacerbated by climate change and threat water security in Lancang-Mekong River Basin (LMRB). Reservoirs can be managed effectively mitigate the risks of these extreme events. However, current knowledge about changes in hydrological extreme events under climate change and the effectiveness of reservoir regulation in LMRB remains limited. This study fills the knowledge gap by evaluating the effectiveness of reservoir regulation for changing hydrological extremes in the 21st century. The VIC-Reservoir hydrological model forced by the bias-corrected CMIP6 climate forcing data were used to project the future streamflow changes in LMRB, and the copula-based joint Standardized Streamflow Index (SSI) was adopted to identify basin-wide dry and wet hydrological extremes. Our results indicate that the streamflow in LMRB will first decrease until 2038 and then increase under the SSP5-RCP8.5 scenario (Similarly, 2020 in the SSP1-RCP2.6 scenario and 2042 in the SSP3-RCP7.0 scenario), which will lead to a substantial increase in basin-wide dry hydrological extremes (up to 33% in the 2040s) and wet hydrological extremes (up to 363% by the end of the 21st century). Reservoir regulation can mitigate the basin-wide dry extreme events by 100% and the wet extreme by 32%. While the future dry hydrological extreme can be mitigated by reservoir regulation, the lack of the reservoir storage capacity to deal with wet hydrological extreme poses a challenge to transboundary water management in the basin.

（来源：SCIENCE OF THE TOTAL ENVIRONMENT 卷:785 出版年: 2021, **DOI:** 10.1016/j.scitotenv.2021.1473221）

The interplay of nutrients, dissolved inorganic carbon and algae in determining macrophyte occurrences in rivers

Kaijser, Willem; Lorenz, Armin W.; Birk, Sebastian; 等等.

Nitrogen and phosphorous concentrations are widely considered to drive macrophyte assemblages in rivers. However, Dissolved Inorganic Carbon (DIC) - available for plants as CO_2 and HCO_3^- is also of major relevance. Based on literature, we present a conceptual model on the interaction between algae, macrophytes, DIC, pH, light, N, P and the surface water and sedimental compartment. Analysing two separate datasets (i) on river physico-chemistry and chlorophyll-a, and (ii) on river physico-chemistry and macrophytes we quantify three connections within this concept: (1) the correlation of chlorophyll-a versus pH, (2) the correlation of TP versus chlorophyll-a and (3) the occurrence of HCO_3^--users and CO_2-only-users among macrophytes along the DIC gradient. Chlorophyll-a correlated positively with pH (R-squared = 77%, $p < .001$) due to increased carbon dioxide uptake of phytoplankton. Surface water TP did not linearly correlate with chlorophyll-a concentrations. Obligate and optionally submerged macrophyte species that utilise HCO_3^- were separated from CO_2 -only-users by HCO_3^- concentrations,

with an area under the curve (AUC) of 68% and 70% (both p < .001) between groups. Obligate and optionally submerged macrophyte assemblages only composed of HCO_3^- users and those exclusively composed of CO_2 only-users showed an even stronger separation based on the HCO_3^- concentration, with both an AUC of 82% and 78% (both p < .001). Our results underline that DIC can greatly affect riverine macrophytes. However, absolute concentrations of HCO_3^- are less relevant, while the connection to pH is more important, reflecting CO_2 concentrations. River monitoring and management should consider the interaction between nutrients DIC, surface water and sedimental compartment as important factors affecting macrophyte occurrence, rather than solely focussing on surface water nutrients.

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Characterizing the river water quality in China: Recent progress and on-going challenges

Huang, Jiacong; Zhang, Yinjun; Bing, Haijian; 等.

Food production systems, urbanization, and other anthropogenic activities dramatically alter natural hydrological and nutrient cycles, and are primarily responsible for water quality impairments in China's rivers. This study compiled a 16-year (2003-2018) dataset of river water quality (161,337 records from 2424 sites), watershed/landscape features, and meteorological conditions to investigate the spatial water quality patterns and underlying drivers of river impairment (defined as water quality worse than Class V according to China's Environmental Quality Standards for Surface Waters, GB3838-2002) at a national scale. Our analysis provided evidence of a distinct water quality improvement with a gradual decrease in the frequency of prevalence of anoxic conditions, an alleviation of the severity of heavy metal pollution, whereas the cultural eutrophication has only been moderately mitigated between 2003 and 2018. We also identified significant spatial variation with relatively poorer water quality in eastern China, where 17.2% of the sampling sites registered poor water quality conditions, compared with only 4.6% in western China. Total phosphorus (TP) and ammonia-nitrogen (NH3-N) are collectively responsible for >85% of the identified incidences of impaired conditions. Bayesian modelling was used to delineate the most significant covariates of TP/NH3-N riverine levels in six large river basins (Liao, Hai, Yellow, Yangtze, Huai, and Pearl). Water quality impairments are predominantly shaped by anthropogenic drivers (82.5% for TP, 79.5% for NH3-N), whereas natural factors appear to play a secondary role (20.5% for TP, 17.5% for NH3-N). Two indicator variables of urbanization (urban areal extent and nighttime light intensity) and farmland areal extent were the strongest predictors of riverine TP/NH3-N levels and collectively accounted for most of the ambient nutrient variability. We concluded that there is still a long way to go in order to eradicate eutrophication and realize acceptable ecological conditions. The design of the remedial measures must be tailored to the site-specific landscape characteristics, meteorological conditions, and should also consider the increasing importance of non-point source pollution and internal nutrient loading.

（来源：Water research 卷:201 页: 117235 出版年: 2021, **DOI:** 10.1016/j.watres.2021.117309）

The challenge of micropollutants in surface water of the Yangtze River

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The Yangtze River, the third largest river and supporting nearly one-third of Chinese population, has been severely polluted in recent decades. Among the numerous pollutants, organic micropollutants, as one kind of important emerging contaminants, are currently key contaminants of concern. However, few

studies have focused on their mixture environmental impacts, especially for the complex environmental mixtures. In the current study, four categories of organic micropollutants, including 16 polycyclic aromatic hydrocarbons (PAHs), 32 polychlorinated biphenyls (PCBs), 27 organochlorine pesticides (OCPs) and 20 pharmaceutical and personal care products (PPCPs) are analyzed in 10 study sites on the Yangtze River. Subsequently, comprehensive risk assessment for micropollutant mixtures was conducted by risk quotient based on the sum of PEC/PNEC values (RQ(MEC/PNEC)) and risk quotient based on the toxic units (RQ(STU)). The mixture risk evaluation based on the detected environmental concentrations indicates that micropollutant mixtures in surface water of the Yangtze River exhibited relative high risks for aquatic organisms. The observed results revealed that mixture risk assessments have to consider the complexity of environmental samples; PCBs dominated main mixture risks in the upper stream; PAHs contributed major comprehensive risks in the middle stream; and OCPs were the key micropollutants in the downstream. The outcomes of the present study here can serve for pollution control in the Yangtze River, which provide the scientific underpinnings and regulatory reference for risk management and river protection.

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Identifying dominant environmental predictors of freshwater wetland methane fluxes across diurnal to seasonal time scales

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While wetlands are the largest natural source of methane (CH_4) to the atmosphere, they represent a large source of uncertainty in the global CH_4 budget due to the complex biogeochemical controls on CH_4 dynamics. Here we present, to our knowledge, the first multi-site synthesis of how predictors of CH_4 fluxes (FCH_4) in freshwater wetlands vary across wetland types at diel, multiday (synoptic), and seasonal time scales. We used several statistical approaches (correlation analysis, generalized additive modeling, mutual information, and random forests) in a wavelet-based multi-resolution framework to assess the importance of environmental predictors, nonlinearities and lags on F CH_4 across 23 eddy covariance sites. Seasonally, soil and air temperature were dominant predictors of F CH_4 at sites with smaller seasonal variation in water table depth (WTD). In contrast, WTD was the dominant predictor for wetlands with smaller variations in temperature (e.g., seasonal tropical/subtropical wetlands). Changes in seasonal FCH_4 lagged fluctuations in WTD by similar to 17 +/- 11 days, and lagged air and soil temperature by median values of 8 +/- 16 and 5 +/- 15 days, respectively. Temperature and WTD were also dominant predictors at the multiday scale. Atmospheric pressure (PA) was another important multiday scale predictor for peat-dominated sites, with drops in PA coinciding with synchronous releases of CH_4. At the diel scale, synchronous relationships with latent heat flux and vapor pressure deficit suggest that physical processes controlling evaporation and boundary layer mixing exert similar controls on CH4 volatilization, and suggest the influence of pressurized ventilation in aerenchymatous vegetation. In addition, 1- to 4-h lagged relationships with ecosystem photosynthesis indicate recent carbon substrates, such as root exudates, may also control FCH_4. By addressing issues of scale, asynchrony, and nonlinearity, this work improves understanding of the predictors and timing of wetland FCH_4 that can inform future studies and models, and help constrain wetland CH_4 emissions.

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Global riverine nitrous oxide emissions: The role of small streams and large rivers

Marzadri, Alessandra; Amatulli, Giuseppe; Tonina, Daniele; 等.

Nitrous oxide, N_2O, is the leading cause of stratospheric ozone depletion and one of the most potent greenhouse gases (GHG). Its concentration in the atmosphere has been rapidly increasing since the green revolution in the 1950s and 1960s. Riverine systems have been suggested to be an important source of N_2O, although their quantitative contribution has been estimated with poor precision, ranging between 32.2 and 2100 GgN(2)O - N/yr. Here, we quantify reach scale N_2O emissions by integrating a data-driven machine learning model with a physically-based upscaling model. The application of this hybrid modeling approach reveals that small streams (those with widths less than 10 m) are the primary sources of riverine N_2O emissions to the atmosphere. They contribute nearly 36 GgN($_2$)O - N/yr; almost 50% of the entire N_2O emissions from riverine systems (72.8 Gg($_2$)O - N/yr), although they account for only 13% of the total riverine surface area worldwide. Large rivers (widths wider than 175 m), such as the main stems of the Amazon River (similar to 6 GgN($_2$)O - N/yr), the Mississippi River (similar to 2 GgN($_2$)O - N/yr), the Congo River (similar to 1 GgN($_2$)O - N/yr) and the Yang Tze River (similar to 0.7 GgN($_2$)O - N/yr), only contribute 26% of global N_2O emissions, which primarily originate from their water column. This study identifies, for the first time, near-global N_2O emission and NO_3 removal hot spots within watersheds and thus can aid the development of local- to global-scale management and mitigation strategies for riverine systems with respect to N_2O emissions. The presented framework can be extended to quantified biogeochemical, besides N_2O emissions, processes at the global scale.

（来源：SCIENCE OF THE TOTAL ENVIRONMENT 卷:776 出版年: 2021, **DOI:** 10.1016/j.scitotenv.2021.145148）

Response of fish assemblages to restoration of rapids habitat in a Great Lakes connecting channel

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Rapids habitats are critical spawning and nursery grounds for multiple Laurentian Great Lakes fishes of ecological importance such as lake sturgeon, walleye, and salmonids. However, river modifications have destroyed important rapids habitat in connecting channels by modifying flow profiles and removing large quantities of cobble and gravel that are preferred spawning substrates of several fish species. The conversion of rapids habitat to slow moving waters has altered fish assemblages and decreased the spawning success of lithophilic species. The St. Marys River is a Great Lakes connecting channel in which the majority of rapids habitat has been lost. However, rapids habitat was restored at the Little Rapids in 2016 to recover important spawning habitat in this river. During the restoration, flow and substrate were recovered to rapids habitat. We sampled the fish community (pre- and post-restoration), focusing on age-0 fishes in order to characterize the response of the fish assemblage to the restoration, particularly for species of importance (e.g. lake whitefish, walleye, Atlantic salmon). Following restoration, we observed a 40% increase in age-0 fish catch per unit effort, increased presence of rare species, and a shift in assemblage structure of age-0 fishes (higher relative abundance of Salmonidae, Cottidae, and Gasterosteidae). We also observed a transition period in 2017, in which the assemblage was markedly different from the pre- and post-restoration assemblages and was dominated by Catostomidae. Responses from target species were mixed, with increased Atlantic salmon abundance, first documented presence of walleye and no presence of lake sturgeon or Coregoninae.

（来源：JOURNAL OF GREAT LAKES RESEARCH, 卷:47 期: 4 出版年: 2021, **DOI:** 10.1016/j.jglr.2021.05.009）

Quantify phosphorus transport distinction of different reaches to estuary under long-term anthropogenic perturbation

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Typical diffuse pollutants such as phosphorus (P) have long been a hot topic in the surface-water research field. As the fifth-largest river in the world, the Yellow River Basin (YRB) suffers from significant soil erosion and relatively high intensity of agricultural activities, which bring large amounts of P loads. However, owing to the large drainage area, few studies have investigated the transport and attenuation dynamic processes or provided a precise calculation of the total phosphorus (TP) load for the entire YRB. In this study, the SPAtially Referenced Regressions on Watershed Attributes (SPARROW) model was used to simulate and investigate the spatial variation and transport mechanism of P in the YRB. The YRB was divided into 60 sub-basins, and the data of drainage area, spatial attribute, streamflow, and monitored flux were integrated into the model correspondingly. Calculated R-2 values confirm that 84% of the spatial variability in annual TP loads can represent regional processes. The estimated YRB TP load was 41,760 tons per year, contributed by farmland (64%), construction land (27%), grassland (5%), and forest (4%). In addition, the P transport dynamic process, contribution, and sensitivity of different P flux sources in different reaches were represented and identified. Our study highlights the significance of farmland as the most significant factor exacerbating TP pollution. As the study conducted the first attempt to develop a SPARROW model, integrated management strategies that consider the spatially varying P sources and associated TP transport were proposed. Additionally, to improve the ecological health of basin, it is critical to further increase P utilization efficiency and enhance cross-regional cooperation throughout the basin.

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Current and future carbon stocks in coastal wetlands within the Great Barrier Reef catchments

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Australia's Great Barrier Reef (GBR) catchments include some of the world's most intact coastal wetlands comprising diverse mangrove, seagrass and tidal marsh ecosystems. Although these ecosystems are highly efficient at storing carbon in marine sediments, their soil organic carbon (SOC) stocks and the potential changes resulting from climate impacts, including sea level rise are not well understood. For the first time, we estimated SOC stocks and their drivers within the range of coastal wetlands of GBR catchments using boosted regression trees (i.e. a machine learning approach and ensemble method for modelling the relationship between response and explanatory variables) and identified the potential changes in future stocks due to sea level rise. We found levels of SOC stocks of mangrove and seagrass meadows have different drivers, with climatic variables such as temperature, rainfall and solar radiation, showing significant contributions in accounting for variation in SOC stocks in mangroves. In contrast, soil type accounted for most of the variability in seagrass meadows. Total SOC stock in the GBR catchments, including mangroves, seagrass meadows and tidal marshes, is approximately 137 Tg C, which represents 9%-13% of Australia's total SOC stock while encompassing only 4%-6% of the total extent of Australian coastal wetlands. In a global context, this could represent 0.5%-1.4% of global SOC stock. Our study suggests that landward migration due to projected sea level rise has the potential to enhance carbon accumulation with total carbon gains between 0.16 and 0.46 Tg C and provides an opportunity for future restoration to enhance blue carbon.

（来源：GLOBAL CHANGE BIOLOGY 卷:27 期: 14 出版年: 2021, **DOI:** 10.1111/gcb.15642）

An automatic classification algorithm for submerged aquatic vegetation in shallow lakes using Landsat imagery

Dai, Yanhui; Feng, Lian; Hou, Xuejiao;等.

Submerged aquatic vegetation (SAV) is one of the main producers in inland lakes. Tracking the temporal and spatial changes in SAV is crucial for the identification of state changes in lacustrine ecosystems, such as changes in light, nutrients, and temperature. However, the available SAV classification algorithms based on remote sensing are highly dependent on field survey data and/or human interventions, prohibiting the extraction of large-scale and/or long-term patterns. Here, we developed an automatic SAV classification algorithm using Landsat imagery, where the thresholds of two key parameters (the floating algae index (FAI) and reflectance in the shortwave-infrared (SWIR) band) are automatically determined. The algorithm was applied to eight Landsat images of four Yangtze Plain lakes and obtained a mean producer accuracy of 82.9% when gauged against field-surveyed datasets. The algorithm was further employed to obtain long-term SAV areal data from Changdang Lake on the Yangtze Plain from 1984 to 2018, and the result was highly consistent with lake transparency data. Numerical simulations indicated that our developed algorithm is insensitive to the Chl-a concentration of the water column. Yet, it has a detection limit of similar to 0.35 m below the water surface, and such a limit changes with different fractions of vegetation coverage within a pixel. The automatic classification algorithm proposed in this study has the potential to obtain the temporal and spatial distribution patterns of SAV in other shallow lakes where SAV grows in lakes sharing similar hydrological characteristics as the lakes in the Yangtze Plain.

（来源：REMOTE SENSING OF ENVIRONMENT 卷:260 出版年: 2021, **DOI:** 10.1016/j.rse.2021.112459）

Different storm responses of organic carbon transported to Lake Taihu by the eutrophic Tiaoxi River, China

Liu, Dong; Yu, Shujie; Duan, Hongtao

Low-frequency high-magnitude storms can flush disproportionate amounts of terrigenous dissolved organic carbon (DOC) and particulate organic carbon (POC) into rivers during a short period. However, previous studies focused on the impacts of storms on organic carbon transport in headwater streams that are minimally influenced by human activities and are far from lakes. To better estimate the lake carbon budget and manage lake water environments, we need to understand the transport of storm-induced organic carbon into lakes by eutrophic rivers. Based on daily and hourly time-series monitoring data, this paper systematically studied the influences of storm precipitation on DOC and POC transport in the eutrophic Tiaoxi River entering Lake Taihu, the 3rd largest freshwater lake in China. The results showed that seven storms transported 59% of the annual total organic carbon into Lake Taihu in 2019, and all storms resulted in transport peaks. During the storm period on August 9-16, 2019, DOC was negatively related to the water level ($r = -0.44$, $p < 0.05$), but POC responded positively ($r = 0.52$, $p < 0.05$); allochthonous organic carbon contents were elevated, but the autochthonous components were diluted. Moreover, the storm-induced input of riverine organic carbon influenced the lake water environment across a large region, and the impacts lasted more than 10 days. These findings have important implications for accurately estimating riverine organic carbon fluxes into lakes and making better-informed decisions about when to pump drinking water from lakes.

（来源：SCIENCE OF THE TOTAL ENVIRONMENT 卷:782 出版年: 2021, **DOI:** 10.1016/j.scitotenv.2021.146874）

Deep hydrothermal and shallow groundwater borne lithium and boron loadings to a mega brine lake in Qinghai Tibet Plateau based on multi-tracer models

Kong, Fancui; Yang, Yingkui; Luo, Xin; 等

Brine lakes are good natural laboratories to investigate groundwater influences on the hydrologic and chemical evolutions in arid environments, and the mineralization processes under intensive evaporation. Lacustrine groundwater discharge (LGD) is the vital conveyor for the loadings of resource elements in the brine lakes. Da Qaidam Lake, located in the Qaidam basin of the Qinghai-Tibet Plateau (QTP), is one of the largest brine lakes for boron and lithium resources in China. Lithium and boron in the lake are considered to be dominantly sourced from deep hydrothermal groundwater and shallow groundwater, but the partitioning of deep and shallow components to the lake and the derived lithium and boron loadings remain unknown, LGD derived boron and lithium provide the primary source of the salt lake. vitally regulates the formation, evolution and mineralization of Li and B resources in the brine lake. This study performs systematical investigations of radium isotopes (Ra-226, Ra-228, Ra-224 and Ra-223), lithium, boron, and other hydrogeochemical parameters in different water endmembers around the brine lake. The results indicate that radium isotopes are significantly enriched in the hydrothermal groundwater and will be removed by co-precipitation with barite precipitates in the lake water. The multi-tracer models coupled radium bass balance, conservative tracer buildup and water budget were deployed to precisely constrain radium co-precipitation rates, and to quantify the deep and shallow LGD (total LGD = LGD(D) + LGD(S)) and the derived lithium and boron loadings. Radium co-precipitation coefficient is obtained to be 4.7-6.1 $y(^{-1})$. LGD(D) and total LGD are estimated to be 8.8 x $10(^{6})$ and 3.3 x $10(^{7})$ $m(^{3})$ $y(^{-1})$, respectively, which account for 11.9% and 57.2% of the total water input. LGD(D) and total LGD derived lithium/boron loadings constitute up to 70.2/60.1%, and 79.0/77.7% of the total loadings, respectively, indicating the significance of disproportionate LGD(D) in delivering resource elements into the brine lake. This study presents the first attempt to partition the deep hydrothermal and shallow LGD to a mega the QTP brine lake by multi-tracer models and the findings contribute to the understanding of lithium and boron budgets in the brine lakes of the QTP and worldwide.

（来源：JOURNAL OF HYDROLOGY 卷:598 出版年: 2021, **DOI:** 10.1016/j.jhydrol.2021.126313）

Detecting changes in water level caused by climate, land cover and dam construction in interconnected river-lake systems

Liang, Jie; Yi, Yuru; Li, Xiaodong;等

There is a growing recognition of the broader environmental significance of exploring the relative importance of climate change and anthropogenic impacts on hydrologic fluctuations in river-lake systems. In the case of Dongting Lake, the typical river-lake system, we collected the water level from 1990 to 2019, spanning before and after the operation of the Three Gorges Dam (TGD) in 2003. This study was conducted to detect water level fluctuations in Dongting Lake and to quantify the relative influence of climate, land cover and dam construction on water levels. We defined the impact of the dam construction as the three inlets inflow of Yangtze River (In-YR), and four waters inflow of Hunan (In-HN). The Mann-Kendall (M-K) test revealed the trends and change points of water level fluctuations. Structural Equation Model (SEM) was used to detect the direct and indirect effects of these factors on water level

and quantify their relative importance. The MIKE21 hydrodynamic model reflected the spatial-temporal variability of water levels under the action of key driver. The results showed that the water level appeared a downward trend during 1990-2019 and the change point appeared in 2003; During 1990-2002, the significant factors were: precipitation (V = 0.469, P = 0.013), evaporation (V = -0.424, P = 0.029), non-agricultural cover (V = -0.334, P = 0.025), and agricultural cover (V = 0.235, P = 0.033); During 2003-2019, the significant factors were: In-YR (V = 0.436, P = 0.007), In-HN (V = 0.431, P = 0.012), and precipitation (V = 0.349, P = 0.045); The In-YR was the key factor affecting the changes of the water level during 1990-2019; Under the influence of In-YR, the most obvious fluctuation of water level was in the flood adjustment period (Jun-Aug) and the impoundment period (Sep-Nov) when the average declined by about 0.50 and 0.67 m, respectively. Our findings provide a new insight into how to better maintain the stability of river-water system water resources under the influence of multiple factors.

（来源：SCIENCE OF THE TOTAL ENVIRONMENT 卷:788 出版年: 2021,**DOI:** 10.1016/j.scitotenv.2021.147692）

Assessing the spatiotemporal variability of lake water quality using A novel multidimensional shape - Position similarity cloud model

Yao, Jiping; Wang, Guoqiang; Wang, Libo;等

Cloud model theory provides a reliable method to effectively solve the problem of uncertainty associated with lake water quality assessments. To accurately match water quality parameters obtained from water samples and water quality standards, water quality parameters from water samples and water quality class levels were used as inputs to a reverse cloud generator algorithm to derive corresponding sample and level clouds. A multidimensional shape-position similarity cloud model (MSPSCM) was then developed to accurately evaluate lake water quality by considering shape and position similarities between the sample and level clouds. Using monthly water quality monitoring data from 2017 to 2019, spatiotemporal variability of water quality parameters of Nansi Lake in Shandong Province was analyzed, and the MSPSCM was used to further study the spatiotemporal variability of water pollution in Nansi Lake. Results showed that total nitrogen and total phosphorus were the main sources of pollution in Nansi Lake. Except for the severe pollution of the upper lake and its inflow waters (Class V water quality standard) in November 2017 and September 2019, Nansi Lake waters meet Class III water quality standard, and are suitable for drinking after being treated by a sewage treatment plant. Concentration of residential areas and industries around the upper lake is relatively high; large quantities of pollutants are discharged into the upper lake, resulting in considerably severe pollution of the upper lake (Class IV). Difference between water quality of Nansi Lake and that of its inflow water indicates that the purification ability of Nansi Lake should not be underestimated. In addition, compared with the existing cloud model used to evaluate lake water quality, the MSPSCM can more accurately reflect lake water quality, and provides a more flexible and effective method for lake water quality evaluation.

（来源：JOURNAL OF HYDROLOGY 卷:599 出版年: 2021, **DOI:** 10.1016/j.jhydrol.2021.126379）

Linking reservoir ecosystems research to the sustainable development goals

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Reservoirs account for about 10% of the freshwater stored in lakes worldwide. These reservoirs are home to 'reservoir ecosystems', that is, the aquatic and non-aquatic interactive ecosystems associated with artificial lakes where water is stored, typically behind a dam, for human purposes. While reservoir

ecosystems provide various ecosystem services for sustainable development, their significance in research and policy has not been well understood and not well defined in the 2030 United Nation's (UN) Agenda for Sustainable Development. To advance understanding of reservoir ecosystems and their impact on policy, here we provide an overview of research on reservoir ecosystems and link it to UN SDGs and their Targets. Based on 5280 articles published in the last three decades, we applied network visualization to construct a framework for research addressing reservoir ecosystems. The framework covers four major themes: (1) ecosystem structure and function, (2) environmental pollution and stress effects, (3) climate impacts and ecological feedbacks, and (4) ecosystem services and management We have found that sustainable reservoir ecosystems synergistically support 121 Targets of UN SDGs (71% of all). Reservoir ecosystems have both negative and positive implications for 15 targets (9%) and negative trade-offs for only 3 targets (2%). Thirty SDG Targets (18%) are unrelated to sustainable reservoir ecosystems. The synergies and trade-offs exist in three fields, securing basic material needs (SDGs 2, 6, 7, 14 and 15), pursuing common human well-being (SDGs 1, 3. 4, 5, 8 and 10), and coordinating sustainable governance policies (SDGs 9, 11, 12, 13, 16 and 17). Exploring these linkages allows better integration of reservoir ecosystems into the UN SDGs framework and guides sustainable management of reservoir ecosystems for sustainable development.

（来源：SCIENCE OF THE TOTAL ENVIRONMENT 卷:781 出版年: 2021,**DOI:** 10.1016/j.scitotenv.2021.146769）

Historical changes of sedimentary P-binding forms and their ecological driving mechanism in a typical grass-algae eutrophic lake

Ding, Shuai; Liu, Yan; Dan, Solomon Felix; 等

With the transformation of lake ecosystem from clear water to turbid water, the residual phosphorus (P) accumulated in sediments may slow down the process of aquatic ecological restoration, and the related mechanisms are complex and need to be better understood. In this study, high-resolution systematic investigation and analysis of P-binding forms in the sediments showed that Lake Dianchi, the largest plateau lake in Southwest China, was enriched with NaOH-rP, HCl-P and Res-P, but depleted in NH4Cl-P, BD-P and NaOH-nrP. The BD-P, NaOH-nrP and NaOH-rP were the main contributors to potential P release from sediments, while the release potential of NH_4Cl-P was relatively weak (<1%). When the external P loading gradually decreased, the internal P loading of Lake Dianchi was estimated to be 522 mg P/(m2a) in the past 30 years. The succession of grass-algae type in Lake Dianchi coincided with reduced absorption and transformation of potential mobile P and decreased accumulation of stable P, especially the Res-P. Meanwhile, the temporal variation of potential mobile P was a good predictor of ecological degradation and reduced ecosystem sustainability in Lake Dianchi.

（来源：WATER RESEARCH 卷:204 出版年: 2021, **DOI:** 10.1016/j.watres.2021.117604）

A data-driven framework for spatiotemporal characteristics, complexity dynamics, and environmental risk evaluation of river water quality

Deng, Chenning; Liu, Lusan; Li, Haisheng; 等.

To evaluate the evolution of river water quality in a changing environment, measuring the objective water quality is critical for understanding the rules of river water pollution. Based on the sample entropy theory and a nonlinear statistical method, this study aims to identify the spatiotemporal dynamics of water quality and its complexity in the Yangtze River basin using time series data, to separate the contributions

of human activity and climate change to water quality, and to establish a data-driven risk assessment framework for the spatial (potential risk) and temporal (direct risk) aspects of water pollution. The results demonstrate that the spatiotemporal dynamics of water quality and sample entropy in each monitoring section are closely related to the characteristics of the corresponding location. The water quality of the main stream is superior, and its complexity is less than that of the tributaries. Cascade reservoir operation and vegetation status, agricultural production, and rainfall patterns exert great influences in the upper, middle, and lower reaches, respectively. Dam construction, urban agglomeration development, and interactions between river and lake are also influencing factors. An attributional analysis found that climate change and human activities negatively contributed to the evolution of NH_3-N concentration in most of the monitored sections, and the average relative contribution rates of human activities to changes in water quality in the main and tributary streams were -55.46% and -48.49%, respectively. In addition, the construction of data-driven risk assessment framework can efficiently and accurately assess the potential and direct water pollution risks of rivers.

（来源：SCIENCE OF THE TOTAL ENVIRONMENT 卷:785 出版年: 2021,**DOI:** 10.1016/j.scitotenv.2021.147134）

Impacts of phosphorus loading temporal pattern on benthic algae growth in Lake Ontario

Hui, Yuan; Zhu, Zhenduo; Atkinson, Joseph F.; 等

Nuisance growth of the alga Cladophora has been a critical issue in the Laurentian Great Lakes for decades. Although loading of total phosphorus (TP) has been below target values since the 1990s, the nearshore of the lakes still experience Cladophora blooms. This study explores the effects of TP loading temporal pattern on Cladophora growth in Rochester Embayment in Lake Ontario, where Cladophora blooms are frequently observed. Long-term TP loadings from the Genesee River, which is the primary tributary to the embayment, are calculated with a hydrological model, and Cladophora indicators based on beach closures and satellite data are collected for 2008-2017 to analyze the TP loading temporal patterns and their relation with Cladophora abundance. Using time series clustering for both TP loading and Cladophora indicators, it is found that besides total annual TP loading, the timing of high TP loading also plays an important role for Cladophora growth. High TP loading in mid-March to mid-June, compared to that in January to mid-March, is found to produce higher Cladophora abundance in summer. This finding is supported and explained using an integrated hydrodynamic and ecological modeling framework that includes a state-of-the-art Cladophora module. This study suggests that future Cladophora control should consider not only the total annual TP loading mass, but also the temporal loading patterns.

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Recording and response of persistent toxic substances (PTSs) in urban lake sediments to anthropogenic activities

Gong, Xionghu; Ding, Qiqi; Jin, Miao;等.

Owing to the intensification of human activities, urban lakes serving as important freshwater resources are becoming seriously deteriorated, especially due to persistent toxic substance (PTS) pollution. Therefore, the spatial distribution and sediment record of PTS in urban lake sediments in the middle Yangtze River Basin were inves-tigated to indicate its response to anthropogenic emission and pollution reduction actions. Spatial distribution of typical PTSs (polycyclic aromatic hydrocarbons (PAHs),

polychlorinated biphenyls (PCBs) and organochlorine pesticides (OCPs) included) showed that pollutants were concentrated in the southeast and center of the urban lake due to riverine inputs suffering from both petrochemical and municipal wastewaters. The sedimentary record of PAH concentrations indicated an increase from the 1960s to a peak level in the 2000s, which was induced mainly by increased PAH emissions, with PAH levels decreasing subsequently due to craft improvement of waste -water treatment plants (WWTPs). Source apportionment results revealed that historical PAH emissions trans-ferred from petrogenic sources to a mixture of energy combustion and petrochemical industry. Furthermore, OCP and PCB pollutions reached peak levels in 1980s, which is consistent with their historical usage for agricultural and industrial production. From the synthetic sediment quality index (SeQI) analysis, sediment quality in nearly half of sites was poor, while the sediment record suggested that sediment quality had turned better since 2000s maybe due to the WWTP improvement. Furthermore, significant correlations ($p < 0.05$) between PTS levels and the ratio of PAH emissions to the number of WWTPs documented the PTS levels in response to the surrounding anthropogenic pollution and WWTPs in urban lakes.

（来源：SCIENCE OF THE TOTAL ENVIRONMENT 卷:777 出版年: 2021,**DOI:** 10.1016/j.scitotenv.2021.145977）

Habitat coupling mediated by the multi-interaction network linked to macrophyte meadows: ponds versus lakes

Puche, Eric; Rodrigo, Maria A.; Segura, Matilde; 等

Morphometric differences between ponds and lakes have implications in habitat-dimensioning and coupling. The prevalence of pelagic over benthic habitats in lakes differs from ponds, where macrophytes dominate, offering both within-meadow free water and support for benthic organisms. We assessed four Mediterranean waterbodies (two ponds and two lakes) situated along an environmental-morphometric gradient, combining a model based on taxonomic composition with a multi-interaction network perspective of habitat coupling. The communities' composition (both regarding taxa and their corresponding nodes) fits to this gradient. The composition of benthic and within-meadow habitats was similar in the ponds, while in the lakes, the highest similarity occurred between planktonic habitats (pelagic and within-meadow), and the benthic habitat had unshared populations. The network approach suggests two contrasting patterns of habitat coupling between ponds and lakes. Three functional modules, coupled by macrophytes, herbivores, and mixotrophs, emerged in the ponds: a microbial loop, an autotrophic food chain, and macrophytes hosting benthic microalgae. In the lakes, two disconnected modules appeared: the pelagic plankton plus the within-meadow connector herbivores, and the benthos plus the within-meadow primary producers. Within-meadow herbivores and small phytoplankton nodes were central in the pond and lake networks. Furthermore, benthic nodes showed high functional redundancy and were highly influential in spreading the disturbances' effects. These results demonstrate: (1) the diversity of functional structures in ponds emerging from a mixed composition; (2) the importance of within-meadow organisms as connectors, and (3) the relevance of benthos which has the greatest diversity and redundancy, as well as the most influential network's elements.

（来源：AQUATIC SCIENCES 卷:83 期:3 出版年: 2021, **DOI:** 10.1007/s00027-021-00809-4）

Spatial and seasonal patterns of dissolved organic matter hydrophobicity in Lake Taihu revealed by the aqueous two-phase system

Cui, He; Wang, Jiaxue; Liu, Tao;等.

The hydrophobicity of dissolved organic matter (DOM) is a key property influencing the environmental risks of organic pollutants. Our understanding of the spatial and seasonal pattern of DOM hydrophobicity in aquatic systems and the major controlling factors is still limited. In this study, the hydrophobicity of 124 DOM samples collected from northern Lake Taihu, a typical eutrophic lake, was quantified using the partition coefficient of DOM in the aqueous two-phase system (K-ATPS). The results revealed high-resolution spatial patterns and seasonal variations of DOM hydrophobicity in Lake Taihu. The riverine input, algae activity, and photodegradation were identified as important processes shaping the spatial and seasonal pattern of DOM hydrophobicity. The riverine input and algae activity strongly affected DOM hydrophobicity in the west part and the central area of the lake. Photodegradation process played a significant role in DOM hydrophobicity in the east part of the lake in summer. The high-resolution spatial and seasonal pattern of the hydrophobic organic pollutant partition affinity of DOM (K-OC) was assessed based on the two-phase system model and the K-ATPS dataset. The K-OC values vary significantly in Lake Taihu between spring and summer, especially in the Zhushan Bay and east coast areas, highlighting the need for considering DOM dynamics in sorption assessment. Our results detailly profiled the spatial and seasonal patterns of DOM hydrophobicity and sorption behavior and elucidated the major controlling factors, which is crucial for environmental risk assessment.

（来源：SCIENCE OF THE TOTAL ENVIRONMENT 卷:776 出版年: 2021,**DOI:** 10.1016/j.scitotenv.2021.145892）

Modeling the effects of temperature on the migration and transformation of nitrate during riverbank filtration using HYDRUS-2D

Pan, Weiyan; Huang, Quanzhong; Huang, Guanhua; 等.

Riverbank filtration is a natural aquifer-based process. The nitrogen dynamics in a riverbank filtration system are affected by many factors, including temperature, water quality, and travel time, which cannot be quantified easily. In this study, a field experiment was conducted to investigate nitrogen transport during riverbank filtration. The HYDRUS-2D software package was used to investigate and quantify the factors that affect the fate of nitrogen. The effects of temperature, water quality, and travel time on nitrate transport were considered. The model was calibrated and validated using field experimental data from the river water and groundwater during riverbank filtration at different periods. The results showed that HYDRUS-2D adequately simulated nitrate transport during riverbank filtration. The denitrification rate constant exhibited a positive exponential relationship with temperature. An empirical formula describing this relationship in riverbank filtration was developed and validated. In addition, the denitrification rate can be quantified within a specified temperature data range under field conditions. Compared with indoor experimental conditions, for the same temperature, there was a 10-fold increase in the denitrification rate constant under field conditions. The results showed that most of the nitrate removal occurred in the riparian zone at high temperatures during riverbank filtration. We concluded that the fate of nitrate in the riparian zone is strongly controlled by groundwater temperature. Travel time also plays an important role in nitrate removal during riverbank filtration.

（来源：SCIENCE OF THE TOTAL ENVIRONMENT 卷:783 出版年: 2021, **DOI:** 10.1016/j.scitotenv.2021.146656）

Biomass Production Potential in a River under Climate Change Scenarios

Orlinska-Wozniak, Paulina; Szalinska, Ewa; Jakusik, Ewa; 等.

Excessive production of biomass, in times of intensification of agriculture and climate change, is again becoming one of the biggest environmental issues. Identification of sources and effects of this phenomenon in a river catchment in the space-time continuum has been supported by advanced environmental modules combined on a digital platform (Macromodel DNS/SWAT). This tool enabled the simulation of nutrient loads and chlorophyll a for the Nielba River catchment (central-western Poland) for the biomass production potential (defined here as a TN:TP ratio) analysis. Major differences have been observed between sections of the Nielba River with low biomass production in the upper part, controlled by TN:TP ratios over 65, and high chlorophyll a concentrations in the lower part, affected by biomass transport for the flow-through lakes. Under the long and short-term RCP4.5 and RCP8.5 climate change scenarios, this pattern will be emphasized. The obtained results showed that unfavorable biomass production potential will be maintained in the upper riverine sections due to a further increase in phosphorus loads induced by precipitation growth. Precipitation alone will increase biomass production, while precipitation combined with temperature can even enhance this production in the existing hot spots.

（来源：ENVIRONMENTAL SCIENCE & TECHNOLOGY 卷:55 期: 16 出版年: 2021, **DOI:** 10.1021/acs.est.1c03211）

中国极端降水对气候变化的热力学响应机理及洪水效应

尹家波, 郭生练, 顾磊 等

全球变暖改变了气候系统的热力和动力环境，影响了陆地-大气系统的能量收支和水循环过程，对降水、湿度、径流等水文要素产生显著影响。大气边界层水汽是降水形成的物质基础，现有研究主要关注饱和水汽压对极端降水的影响，发现了呈“抛物线”形状的 Hook 气候响应结构，但是未能定量阐明其形成原因，也较少分离大气热力和动力作用对极端降水演化的贡献分量，制约了未来气候灾害风险预测及水文过程模拟精度。本文以中国大陆和 151 个典型流域为研究区域，通过扩展的克劳修斯-克拉珀龙方程评估了极端降水和地表径流对近地气温的响应强度，采用 ERA5 再分析数据集评估了整层气柱水汽含量、对流有效位能和相对湿度对极端降水的促进/抑制作用，基于能量收支和水分平衡分离了极端降水的热力项和动力项，并解释了 Hook 结构的形成原因；基于 CMIP6 框架下 21 个全球气候模式输出数据，通过偏差校正和流域水文模拟方法预估了未来气象水文过程，研究了 Hook 结构的迁移路径及其暴雨洪水效应。研究发现动力学约束造成高温下极端事件的水汽输送能力受限，进而形成了 Hook 结构，但极端降水和地表径流的 Hook 结构并不稳定，其峰点温度未来随气候变暖升高 3-5℃，造成响应曲线右移，可能使本世纪末中国暴雨、洪水量级增长 20-30%。

（来源：科学通报, https://doi.org/10.1360/TB-2021-0438）

富营养化条件下浙江象山港可溶性有机质的光谱和分子特征初探

赵辰 ，周玉萍, 庞宇 等

最利用碳稳定同位素、紫外-可见吸收和三维荧光光谱和傅里叶变换离子回旋共振质谱等手段，分区域研究了 2019 年 5 月浙江象山港这一代表性的半封闭富营养化港湾水体可溶

性有机质(DOM)的组成、来源，并初步推断了其迁移转化过程. 通过三维荧光建模识别出一个类蛋白荧光组分(C1)和两个类腐殖质荧光组分(C2 和 C3)，利用高分辨率质谱获得了各类分子的数量和相对强度. 可溶性有机碳(DOC)浓度, C2、C3 和黑碳类分子组分的相对强度均和盐度呈显著负相关，指示象山港存在海水对陆源信号的稀释作用. 象山港在空间上光透射能力存在差异从而导致光降解程度不同，光降解作用可能在象山港惰性有机质转化中发挥了重要作用. C1 组分和盐度的弱相关性表明自生源不能主导象山港地区的类蛋白荧光组分，富营养化条件下外源(如人类输入、孔隙水释放)均影响了类蛋白荧光组分的分布. 将象山港和我国其他代表性沿海港湾对比，可发现象山港的类蛋白荧光组分在荧光溶解有机质(FDOM)中的相对占比处于中等水平. 在富营养化背景下，人类活动输入可能是我国港湾 DOM 的重要来源。

（来源：中国科学: 地球科学, 2021,51(8): 1258-1274 , https://doi.org/10.1360/SSTe-2020-0292）

黄河水生态承载力的流域整体性和时空连通性

周广胜 , 周莉, 汲玉河 等

黄河流域是我国重要的生态屏障和经济区，其生态保护和高质量可持续发展直接关系到我国生态文明建设的成败。目前，黄河流域水资源短缺，自然生态脆弱，经济社会发展滞后，是我国生态安全和经济社会发展的重点和难点地区。本文总结了新中国成立以来，特别是近年来，黄河流域水土流失综合防治取得的一系列重大生态工程的实施等显著成就。这些重大生态工程是根据黄河流域上、中、下游地区的不同特点实施的。然而，黄河流域的生态功能并没有得到根本的解决。这主要有三个原因。一是黄河流域水土流失治理的范围和空间不平衡。黄河上游生态系统质量下降，水土保持能力下降，中游水土流失严重，下游生态流量低，部分河口湿地萎缩。第二个原因是水沙调节对三角洲和海岸系统的不利影响。黄河源区植被覆盖度下降；草原荒漠化严重，次生裸地面积增加。一些退化的黑土海滩发生了二次退化，相关灾害也有所增加。第三个原因是大型煤矿开采引起的水沙问题，如严重的地形地貌变化。土地沙漠化和水资源短缺加速，上游原有地貌遭到破坏，部分植被消失；地表塌陷和严重的水土流失导致黄河中游泥沙流入增加。地表沉降变形、水分积累和次生盐渍化是导致下游土地生产力下降的主要原因。是提出解决当前突出问题的关键限制生态保护和高质量的黄河流域的可持续发展是流域的水生态系统的完整性,时空连接和生态系统健康意识到生态的科学配置水资源，气候变暖背景下的工业/采矿、生命、农业、水和泥沙调节。要实现这一科学目标，迫切需要开展三项研究任务。首先，明确数字黄河信息平台的理论和技术，及时、准确地确定黄河的现状，是认识和科学开发管理黄河流域的关键。二是要开展全黄河流域水资源监测和云水资源开发利用，这需要充分利用人工影响天气、合理开发利用云水资源等先进技术， 建设水资源监测和云水资源尽快开发利用，促进水资源的有效利用。最后，重大生态灾害风险的识别和预测是必要的，这需要空间-空-地立体观测相结合；大数据和机器学习；融合 5G、人工智能、物联网等技术手段，建立重大灾害前兆的智能感知和识别；灾害情景

模拟与风险预测；建立灾害风险防控技术体系，增强生态保护和高质量可持续发展的风险识别和管理能力。

（来源：科学通报, 2021,66(22): 2785-2792, https://doi.org/10.1360/TB-2021-0039）

基于微藻多量度指标法提高河流和湖泊生物学状态评价准确性的研究进展

刘波 ，李丹敏 ，陈硕 等

多量度指标法(Multimetric Index，MMI)是一种广泛应用于淡水生态系统生态评价的方法，因为它能综合各种与生态有关的量度信息，并为进一步评价和管理提供一个易于理解的分值。准确评估淡水生态系统生物学状态必须扣除自然变异的影响和解决自然环境因子与人为干扰因子之间的协变问题。最近几年，研究人员在上述两个方面取得了诸多进展。当下主要利用三种方法提高湖泊和溪流生物评价的准确性：将样点按生态区或藻类物种组成进行建模前分类、对样点的参考状态进行样点特异性建模分析以及在不同的样点组中采用不同的量度指标。所有已有的研究结果都支持对样点进行特异性建模可以有效地扣除自然变异的影响，并最终通过模型计算出具有良好表现的 MMI。然而，没有强有力的证据表明依据硅藻/蓝藻物种组成的样点分类法在扣除湖泊或河流中的自然变异方面优于依据生态区的分类法。将由样点特异性建模法和不同样点组中采用不同量度指标法所解释的自然变异百分数区分开，对于全面、准确地评价按藻类物种组成进行样点分组方法的作用是十分必要的。不同样点组中采用不同量度指标法在溪流和湖泊中的表现不同，这很可能是由于硅藻量度指标对溪流和湖泊的生物学状态代表性不足，而不是由溪流和湖泊中复杂的多重胁迫因子造成的。最近的一项研究表明，在中高人为干扰水平下，加入蓝绿藻量度指标可提高基于硅藻的 MMI 在确定湖泊生物学状态方面的表现。另一方面，随着统计学在 MMI 建模中的应用越来越广泛和深入，我们也讨论了生态评价领域中研究人员面临的统计学方面的挑战，特别是在评价 MMI 表现时有关统计检验显著性水平的设定问题和评价 MMI 表现时的多重比较问题。

（来源：中国科学: 生命科学, 出版年：2021, https://doi.org/10.1360/SSV-2021-0236）

拉萨河流域典型区域保护、修复、治理技术示范体系

安宝晟 ，姚檀栋 ，郭燕红 等

“第二届青藏高原科学考察与研究计划”(STEP Program)在世界最具影响力的前沿科学领域取得重大进展。基于 STEP 项目，科学家能够开展理论和实践地球系统科学研究，为实施流域保护(如大气、水和土壤)、重建(如建设扰动地区、生态系统退化)和治理(如：水环境退化、土地荒漠化和水土流失)，特别是生态脆弱的高海拔地区。拉萨河流域位于西藏社会经济的中心地带，包括地球系统科学的六个领域，一直受到自然气候变化和人类活动的双重严重环境影响。因此，开展自然过程-人类活动重叠区、自然过程-人类活动区域的保护、恢复和治理的基础应用科学研究十分重要。本研究以拉萨河流域典型支流察巴郎小流域为研究对象，系统评价早期综合治理示范区建设对流域生态环境的影响。结果表明:2010 - 2012

年综合示范区建设期间，虽然区域降水量较低，但由于采取了坡阶地化、人工种植、引水灌溉等一系列工程措施，流域植被盖度显著提高。根据2005年和2015年的土壤侵蚀强度数据，流域重度土壤侵蚀和轻度土壤侵蚀面积也略有减少。综合示范区存在缺乏系统观测(如仅进行自动气象观测和坡面径流观测)、缺乏基础科学研究(如产沙过程和机理不明确)、缺乏有效管理(如: 自动气象观测和人工模拟降雨观测设备损坏严重)，缺乏综合恢复和治理一体化(如恢复和治理因不同部门进行而分散、混乱)。针对综合示范区存在的问题，提出科学的解决方案，完善流域保护、恢复和治理的科学方案。茶巴郎小流域保护、恢复和治理技术体系应包括大气、水、土壤保护、建设干扰区和生态系统退化恢复、水环境退化治理、土地荒漠化和水土流失治理。我们提出以下建议: 完善流域观测、研究和技术示范体系，加强基础科学研究，建立多部门协调机制，加强流域到青藏高原技术示范体系的应用和推广。这将填补多维观测研究的空白，为青藏高原生态环境研究提供参考。

（来源：科学通报,2021, 66(22): 2775-2784, https://doi.org/10.1360/TB-2021-0022）

水生环境中微塑料自身及负载有机污染物的生物富集效应

俞海睿 ，陈启晴 ，施华宏

微塑料广泛存在于水体环境中，由于其具有较高的疏水性而能够负载有机污染物，同时影响它们在生物体内的累积与毒性。目前在微塑料对污染物生物富集过程的作用方面尚有分歧，其根源在于大部分的室内暴露研究往往缺乏对复杂环境介质的考量，而野外场景的模型分析又少了验证环节。生物富集和生物放大效应通常是对于传统污染物而言的，对于微塑料来说暂无明确的界定，本文就此展开详细讨论。本文归纳了野外或室内暴露的不同环境条件下，微塑料在水生生物体内的生物富集特点；分析了影响微塑料生物有效性的关键因素；探索了微塑料对共存有机污染物生物有效性的影响和规律；评估了关键水环境化学因素对微塑料和共存有机污染物在生物体内累积的影响。本文将有助于我们深入认识微塑料在水生生态系统中的累积情况，及其对共存有机污染物在生物体内运移的贡献和可能存在的生态风险，也将为微塑料风险评估及政策导向提供重要依据。

（来源：科学通报，2021, 66(20): 2504-2515, https://doi.org/10.1360/TB-2020-1426）

科学视点

Science:科学家发现降水变率将随气候增暖而增强

中国科学院大气物理研究所 LASG 国家重点实验室副研究员张文霞等与英国气象局学者合作，以“降水变率将随气候增暖而增强”为题在《科学进展》发表文章指出，随着气候增暖，全球湿润区（主要包括热带、季风区、中高纬地区）在因总降水增多而变得更为湿润的同时，降水在时间上的分配也将变得更为不均匀，干湿时期间的波动将更为剧烈。

“对全球大部分区域而言，降水变率的增加意味着全球增暖正在或将使得气候系统变得更加多变和不均匀。这与近二十年来从全球到区域尺度我们所经历的洪涝与干旱事件均频繁发生的事实是一致的。”该文通讯作者、中国科学院大气物理研究所研究员周天军告诉《中国科学报》，未来更“善变”的气候，对气候变化的应对工作提出了新的挑战。

随着气候增暖，大气持水能力增加，全球水循环将持续增强。在全球尺度上，这表现为总降水量的增加和降水极端性的增强两方面。同时，降水变率的变化是水循环变化的重要组成部分，但以往国际科学界却鲜有关注。

降水变率是指降水事件可能的波动或振荡范围，变率越大，异常降水发生越频繁、气候的不均匀性越强，极端事件也越强，对民生和社会经济发展的影响也越大。在增暖背景下，降水变率的变化会影响到社会和生态系统的气候可恢复力，是气候变化应对工作必须考虑的重要环节。

该研究利用英国气象局参数扰动大样本集合模拟和预估试验结果，研究了从天气到年际尺度的多尺度降水变率对全球增温的响应。结果表明，在天气尺度到月、季节内和年际等各个时间尺度上，降水变率均将随全球增温而增强。降水变率的变化在全球呈现出非均匀分布特征，其增强主要发生在气候态湿润区，因此降水变率的变化主要表现为“湿区的变率更为剧烈”。

全球增温 1℃，全球平均的降水变率将增加约 5%，这一速率约为平均降水变化的 2 倍。在物理机制上，该研究提出了一种简约的动力诊断方法，发现降水变率的增强由增温所引起的大气水汽含量增加起主导作用，且该热力作用在全球较为均匀。其次，水汽和环流共同变化的非线性作用也使得降水变率增加，这与垂直上升运动和凝结潜热释放之间的反馈有关。另一方面，动力作用则使得降水变率减小，这是由增暖背景下环流变率减弱导致的。

“结合降水平均态和变率的变化，我们提出了一种新的、更全面的描述和研究降水变化型式的方式。全球约有三分之二陆地未来将面临“更湿润且波动更大”的水文状况（即降水平均态和变率均增加）。此外分别约有 16%的陆地面积将面临“更干且波动更大”（即平均降水减少但变率增加，）和“更干和波动减小”（即降水平均态和变率均减少，）的状况。” 张文霞说。她认为，这几类典型的降水变化型式的划分，对于气候变化应对策略的制定具有重要的参考意义，因为降水平均态和变率变化的不同组合，将在不同地区造成不同类型的水文、农业和生态影响。我国大部分地区的降水变化型式属于“更湿润且波动更大”意味着降水的极端性将增强，这需要引起我们重视。

（来源：中国科学报，http://paper.sciencenet.cn/htmlpaper/2021/8/20218219591088365396.shtm）

Nature：亚马孙流域正失去大量栖息地

英国《自然》杂志近期发表的一项生态学研究表明，由于森林砍伐和野火，亚马孙地区高达 85%被列为“受威胁物种”的生物，在过去 20 年里可能失去了大量栖息地。据估计，每 10000 平方公里森林被烧毁，就有额外的 27 个到 37 个植物物种和 2 到 3 种脊椎动物在亚马孙的分布受到影响（影响范围超过 10%）。随着野火越来越靠近亚马孙盆地的核心地区，那里的生物多样性水平更高，预计火灾对生物多样性的影响还会上升。

亚马孙盆地对调节地球气候至关重要，且这一地区生物多样性令人惊叹，是全球 10%已知物种的家园。但可惜的是，森林退化正威胁到这一庞大生态系统的恢复能力。此前一项研究预计，至 2050 年亚马孙将丧失约 21%—40%的森林覆盖，这对亚马孙地区的生物多样性影响深远。

此次，为更好地理解这些影响，美国佛罗里达州立大学研究团队调查了过去 20 年里，11514 种植物和 3079 种动物的地理分布范围受到野火影响的程度。从 2001 年开始，103079 平方公里到 189755 平方公里的亚马孙雨林（总面积的 2.2%—4.1%）遭受野火，研究团队估计这影响了该地区受威胁物种名录上 77.3%—85.2%的物种。他们指出，野火增加的时间段，与放宽了旨在减缓森林砍伐与森林燃烧的政策有关。在巴西，21 世纪 00 年代中期曾实施减少森林砍伐的政策，在 2019 年这一政策被放松，这一年火灾影响区域增加了（比预计多 20%—28%），估计影响了 12257 种到 13245 种植物及脊椎动物的分布范围。研究人员总结道，这些发现表明了政策和森林火灾间的关联，以及这些因素如何影响生物多样性。

（来源：中国科学院院网，http://www.cas.cn/kj/202109/t20210910_4805305.shtml，根据相关资料编译）

气候变暖与富营养化协同影响浅水湖泊浮游动物群落结构

中国科学院水生生物研究所关于全球气候变暖与富营养化协同作用影响浅水湖泊浮游动物群落结构的研究论文以 Synergistic effects of warming and eutrophication alert zooplankton predator-prey interactions along the benthic–pelagic interface 为题，发表在 Global Change Biology 上。

淡水生态系统正面临气候变化及其他多重环境因子的胁迫，如水体富营养化。但是，关于气候变化及富营养化如何共同影响水生生物群落及生物间营养关系的研究较匮乏，尤其缺少实验研究。鉴于此，中科院水生所研究人员选取浮游动物群落为研究对象，通过中宇宙模拟控制实验系统（http://mesocosm.org/mesocosm/wuhan-warming-mesocosm-facility-wwmf/）研究气候变暖和富营养化单独及联合作用，并对浮游动物中的小型牧食者轮虫和其捕食者剑

水蚤群落动态及相互作用关系的影响开展研究。实验过程中监测了浮游动物群落在水体中的丰度以及从沉积物中复苏的变化过程。

研究发现，富营养化单独作用减弱了捕食者（剑水蚤）对小型牧食者（轮虫）的下行控制作用。相反地，气候变暖则会增强捕食者对小型牧食者的下行控制作用，导致浮游动物群落中小型牧食者丰度降低。然而，这两个环境因子联合作用会使富营养化加强气候变暖对浮游动物群落相互作用的影响效应，进一步增强捕食者对小型牧食者的下行控制作用。作用机制主要有两方面：一是气候变暖通过对浮游捕食者（剑水蚤）和浮游小型牧食者（轮虫）二者的休眠体复苏过程产生差异化影响，导致捕食关系提前；二是气候变暖和富营养化协同作用通过增加捕食者幼体阶段的优势，极大增加了其幼体发育成成体过程中的存活率，包括增加所需的食物丰度和缩短发育时间。该发现对于认识气候变暖与其他多重环境胁迫联合作用对水域生态系统结构和功能的影响具有重要意义。

（来源：中国科学院院网，http://www.cas.cn/syky/202108/t20210818_4802383.shtml）

青藏科考显示：三江源典型湖泊面积总体呈增加态势

从青海省气象科学研究所获悉，由该所参与的中国第二次青藏高原综合科学考察研究(二次青藏科考)三江源区水汽输送通道野外综合考察分队日前结束了三江源水汽输送通道野外考察工作。考察显示，2003年以来，三江源国家公园典型湖泊面积总体呈阶段性增加态势。 据了解，此次考察分队由中国工程院院士徐祥德为总指挥，主要围绕中国第二次青藏高原综合科学考察研究(二次青藏科考)十大任务之一的“西风—季风协同作用及其影响”任务，组建了冻土、退化湿地、高寒湖泊、无人机等4支科考小组。先后调研了门源、玛多等基层气象台站冻土观测设备，考察了青藏高原东部山谷地形与河湾区云降水形成原因，了解了沿线不同海拔梯度下高寒植被与季节性冻土环境变化情况，探讨了西风—季风影响区季节性冻土形成维持机制，全面了解了“亚洲水塔”三江源及其周边区域河流、湖泊、冻土、冰川、雪山、草地、湿地等生态气象本底现状，从水汽源输送视角认识了亚洲水塔区三江源水汽输送结构及其各影响分量的变化状态。

考察显示，近年来，青海省气象科学研究所依托各类项目先后在三江源地区开展湖泊、草地、冻土等生态气象监测评估工作。 2003年-2019年，三江源地区植被NDVI、植被覆盖面积呈增加趋势，植被覆盖度主要以高覆盖度为主。而气温升高，降水增加是草地覆盖度增加的重要原因，2003年-2019年间，三江源地区草地返青日期提前，黄枯日期推迟，草地生育期长度略延长，气温对草地返青期影响显著，降水对草地黄枯期影响明显。 通过对三江源生态气象监测评估显示，2003年以来，三江源国家公园典型湖泊面积总体呈阶段性增加态势，其中2003年-2008年缓慢增加，2009年-2012年快速增加，2013年-2016年平稳增加，2017年以来进一步增加。 此次科学考察提升了对西风—季风协同作用下“亚洲水塔”三江源区生态气象的认知水

平，进一步扩大、提升了气象科技工作者在第二次青藏高原综合科学考察任务中的影响力和公信力，为青藏高原生态保护和高质量发展提供坚强的气象保障和科技支撑。

（来源：中国新闻网，https://baijiahao.baidu.com/s?id=1709248321173518152&wfr=spider&for=pc）

江淮地区过去千年降水变化呈“暖干—冷湿”态

中国科学技术大学周鑫教授课题组与国内外学者合作，对江淮地区女山湖沉积物进行多年研究，重建了该地区过去 1800 年以来的高分辨率季风降水演变记录，发现江淮地区小冰期降水较中世纪暖期偏多，降水变化呈现“暖干—冷湿”模态，与华北地区降水变化趋势相反。该成果日前发表于《Geology》。

探究江淮地区季风降水的演变规律和驱动机制，对于应对未来可能出现的旱涝灾害有着重要意义。然而，由于气象观测开始时间晚，该地区降水的长期演变历史仍不清楚，限制了对较长时间尺度降水驱动机制的探讨。

周鑫课题组对女山湖沉积物进行细致分析，构建了精准的年代学框架，进而运用多种水文代用指标进行对比分析和相互验证，成功重建了江淮地区过去 1800 年高分辨率季风降水演变记录，发现小冰期（公元 1400~1850 年）降水相对于中世纪暖期（公元 1000~1300 年）明显增多，过去千年降水变化呈现“暖干—冷湿”模态。

该课题组进一步探讨了过去千年江淮地区季风降水变化的驱动机制。基于现代气象观测数据显示的赤道东太平洋海温与江淮降水的紧密联系，他们对比了过去千年降水记录和赤道太平洋厄尔尼诺—南方涛动重建记录，发现中世纪暖期的“类拉尼娜”态对应江淮偏干，小冰期的“类厄尔尼诺”态对应江淮偏湿。

他们认为，小冰期太阳和火山等产生的辐射减弱，全球温度降低，在“海洋自动调温器”的作用下，赤道太平洋呈“类厄尔尼诺”态，更多水汽汇聚到江淮地区，最终造成该地区降水增多。而在中世纪暖期，太阳和火山等产生的辐射增加，导致了相反的变化。

（来源：中国科学报，http://paper.sciencenet.cn/htmlpaper/2021/7/20217262148151966525 2.shtm）

水生态治理工程有助于减缓快速城市化对水生态环境的破坏

中国科学院水生生物研究所、中国环境科学研究院、华中农业大学、英国利兹大学、日本北海道大学等合作，在各类水生态治理工程如何在大的空间格局和较长时间尺度上联合作用，并减缓城市化对水生态系统影响的研究中取得进展。相关研究成果以 Mitigation of urbanization effects on aquatic ecosystems by synchronous ecological restoration 为题，发表在 Water Research 上。

经济发展和城市化等人类活动加剧自然生态系统破坏和生物多样性丧失，为了解决经济发展和生态环境破坏之间的矛盾，生态治理/恢复工程已得到较高程度的重视和推广。然而，经济发展要以生态环境破坏为代价？人类社会经济发展和自然生态如何取得平衡？水生所选取宜兴市作为典型区域，收集 2007 年至 2017 年宜兴市实施和维护的水生态治理工程相关信息、土地利用数据及野外采样调查的水质、底栖动物数据，剖析了城市化进程、不同类型水生态治理工程、水质和底栖动物多样性三者之间的量化相互作用关系。

研究发现，2007 年至 2017 年间宜兴城市化和 GDP 增速明显，水质的改善和不同类型的治理工程之间存在不同，且和投资量不一定成正比的相关关系；而实施大量不同类型水生态治理工程，河网水体中的氨氮、总氮、总磷及大型底栖动物多样性均有显著提升。由于治理前所处的生态系统基础状态不同以及生物再定殖需要更久的时间，结果显示生物指标对水生态治理的响应似乎滞后于非生物指标。这对于深入认识生物及非生物指标对不同类型的水生态治理工程的响应力度，理解不同类型水生态治理工程所发挥的不同作用具有重要意义，并对指导水生态治理工程类型分配及投资管理等方面具有参考价值。

（来源：中国科学院院网，http://www.cas.cn/syky/202109/t20210907_4804805.shtml，根据相关资料编译）

不同水文时期洞庭湖水质变化动态及驱动机理研究

湖泊是全球水文和生物地球化学循环的重要组成部分，影响生态环境、经济发展和人类福祉等方面。通江湖泊由于存在显著的周期性水文节律，其水质对于复杂的水文环境变化更为敏感。了解不同水文时期通江湖泊水质变化、识别关键水质影响因子，对改善湖泊水质具有重要意义。

近日，中国科学院亚热带农业生态研究所湿地生态课题组在不同水文时期洞庭湖水质变化动态及其相关驱动机理方面研究取得进展。研究发现，湖相水位是引起不同水文年间水位差异的主要因素。丰水年总氮浓度显著高于枯水年，主要受外源污染物输入和水文条件的叠加影响。湖相对污染物入湖量贡献率由丰水年 64.54%下降至枯水年 59.47%，河相则呈相反趋势。另外，不同水文年水质对水位波动的响应不同，而不同水文阶段则明显区分了湖相水质和河相水质，反映了水位波动对湖泊年际、年内水质变化的巨大影响。为改善洞庭湖水质，应在年内不同水文阶段积极开展水文调控工作，同时加大入湖污染物的排放管控措施。该研究可为全球其他通江湖泊的水环境管理提供有效参考。

（来源：中国科学院院网，https://www.cas.cn/syky/202109/t20210907_4804984.shtml，根据相关资料编译）

青藏高原水资源供给研究取得进展

中国科学院成都生物研究所生物多样性与生态系统服务领域地表过程与生态系统管理项目组博士熊勤犁、生态恢复与生态保护项目组副研究员肖洋与中山大学、重庆文理学院等合作，以青藏高原为研究对象，系统揭示 1980 年以来全球变化（增温、冰川消退）与生态工程及政策对青藏高原水资源供给的影响，并利用地理信息系统等工具研究该地区水资源供给变化，评估这些变化的潜在风险。

研究表明，青藏高原的水资源供给量在过去 36 年整体有所增加，这主要归因于该地区气候变化导致冰川融水以及降雨增加。在生态工程中种植的大量人工草地和人工林，改变了该地区的水供给，部分生态工程项目对用水资源供给产生负面影响。水资源供给不足风险区域除了植被退化引发的雅鲁藏布江上游高海拔地区外，主要分布在森林茂密、供水充足、海拔低、人口稠密、村庄林立、人类活动密集的区域（如班玛地区以及雅鲁藏布江下游西藏察隅、墨脱地区）。研究认为，应在较大的生态工程/项目中进行生态系统耗水量管理和监测，包括但不限于筛选低耗水植被、种植乡土植物、监测植被蒸散量。

该研究还提供了全球变化背景下的生态端和社会端水资源供需平衡参考图，并划定了可能存在的水资源供给“失衡”的风险区域。

（来源：中国科学院院网，https://www.cas.cn/syky/202108/t20210831_4804043.shtml，根据相关资料编译）

黑河流域系统模型的发展与应用研究

国家自然科学基金委重大研究计划“黑河流域生态-水文过程集成研究”（2010-2019 年）执行过程中，黑河流域模型集成研究经历了从对特定生态-水文过程的改进到全面发展新的、能够反映内陆河特征的流域系统模型的转变，最终建成了黑河流域系统集成模型。该模型在功能的完备性、模型性能、模拟和预测能力、对遥感数据的应用等方面领先于现有模型。

黑河流域系统模型主要包括 4 大模块：上游地区的分布式生态-水文模型和中下游地区的分布式生态-水文模型 HEIFLOW 集成的流域生态水文模型、宏观水经济模型 WEM 和微观代理人模型 ABM 组成的社会经济模型，以及两个连接生态水文模型和社会经济系统的两个界面模型，即土地利用模型和水资源模型。模型在流域多尺度水量平衡的精细闭合、用水效率和水生产力分析、中长期生态水文模拟和预测、关键水资源管理措施的生态响应研究，以及流域可持续发展决策支持系统构建等方面实现应用。

相关研究成果以 Novel hybrid coupling of ecohydrology and socioeconomy at river basin scale: A watershed system model for the Heihe River basin 为题，近日发表在 Environmental Modelling & Software 上。

（来源：中国科学院院网，https://www.cas.cn/syky/202108/t20210826_4803472.shtml，根据相关资料编译）

融合水环境模拟与图像分析的水体浊度新型监测方法

水体浊度/透明度是影响河湖水生态系统健康的重要因素，其高效快捷监测是水环境管理的迫切需求。在中国科学院青年创新促进会项目、国家自然科学基金等联合资助下，中国科学院南京地理与湖泊研究所黄佳聪副研究员、高俊峰研究员等科研人员，发展了一种针对河湖水体浊度的新型监测方法，该方法深度融合了贝叶斯实时建模与图像分析等交叉学科的研究技术，构建了基于后台数据库实时提升浊度监测可靠性的创新模式，实现了基于不同型号手机图像的水体浊度高效快捷监测，拓展了水环境模拟技术在水质监测领域的应用。

长江、黄河、珠江、太湖等河湖的野外现场校验结果表明：该方法可有效监测河流、湖泊、沟塘等自然水体的浊度。与传统监测方法（浊度仪等）相比，研发的浊度新型监测方法具有高效便捷、监测精度智能提升的优势，有望在监测仪器自主研发、水环境智能监测、环境大数据挖掘等领域发挥更大作用，成果以 A novel framework to predict water turbidity using Bayesian modelling 为题，发表在环境领域知名期刊 Water Research。

（来源： http://www.niglas.ac.cn/xwdt_1_1/yjjz/202107/t20210720_6142944.html，根据相关资料编译）

多维度审视太湖生态系统的前世今生

全球湖泊生态系统在气候变化和人类活动的双重胁迫下经历着前所未有的变化，特别是大型浅水湖泊，其退化和功能丧失的速率和幅度超越了地质历史时期，已经严重制约到流域社会经济的发展和区域可持续性。尽管我国在湖泊治理和生态修复方面投入了大量人力和财力，且水环境整体得到改善，但蓝藻水华暴发态势难以得到有效遏制，湖泊生态修复进入瓶颈期。目前对湖泊生态环境退化的研究主要基于湖泊调查和观测数据，时间较短（<50 年）且多发生在环境退化之后，对湖泊生态系统长期演化的历史过程不甚清晰，制约了对当前环境问题形成机理的深入认识。因此，获取可靠的湖泊生态系统长期变化证据，揭示其演化轨迹和机制，可以为制定湖泊修复路径和目标提供关键科学信息。

湖泊沉积记录可以有效拓展湖沼学研究的时空尺度，是揭示湖泊生态系统演化机理、阐明流域人-地互作机制的重要手段之一。在国家重点研发计划、国家自然科学基金和中科院人才引进项目等资助下，湖泊沉积与环境演化研究室张科研究团队特别研究助理林琪等，联合英国诺丁汉大学、法国国家科学研究中心（CNRS）同行，

通过多指标沉积记录、流域气候-社会经济资料、以及人与自然耦合框架模型等多学科交叉研究，在太湖生态系统近百年演变特征和机理方面取得了系列新认识，相关成果已发表于国际期刊 Limnology and Oceanography、Anthropocene 和 Science of the Total Environment。

（1）反演了过去 100 年来太湖不同湖区藻类群落的演化历史，阐明气候和营养盐的协同驱动机制。通过沉积物叶绿素和类胡萝卜色素重建了太湖不同湖区过去百年来藻类群落的历史演化过程。结合营养指标以及现代监测数据和流域历史资料的综合分析，研究发现太湖典型湖区水质和初级生产者群落呈现出相似的退化趋势，但表现出不同的变化轨迹、速率和时间节点。藻型-梅梁湾和草型-东太湖的富营养化分别始于 1950s 和 1990s，前者的幅度和强度均更大；近百年，人为营养超过了自然变率主导时期气候条件对藻类丰度和群落组成的主控作用，而当湖泊富营养化之后，浮游藻类群落变化显著响应于升温、降低的风速和极端天气等气候因子。在富-高营养的北部湖区，蓝藻水华的持续暴发主要受控于人为营养和气候变化的协同作用机制，即通过促进藻类生长、群落演替及营养盐循环利用的直接作用与破坏水下光环境的间接影响。同时，草/藻湖区类型和流域水文地貌特征在湖泊水质、生态响应多重环境驱动的过程中起到调节作用。

（2）揭示了流域社会经济发展、公共政策及水文背景共同塑造太湖人为污染的时空异质模式。 基于古湖沼重建，研究系统分析了太湖重金属污染过去百年来的时空差异性及驱动因素，发现近百年来三个典型湖区呈现出非同步的（始于 1940s 至 1990s）污染过程及强度，其中镉、锑和铅是主要污染元素，人为贡献率可分别高达 79%，62%和 36%，主要受到各湖区子流域社会经济发展状况和产业结构差异的影响。研究进一步利用地球化学模型（如 PMF）和数理统计手段，定量区分了不同历史阶段流域工业点源、大气沉降、农业和渔业对湖泊污染的贡献量，结果强调了农业面源和“环境遗留”（Environmental legacy）效应对湖泊生态系统健康的持续影响，需要管理工作着重关注。同时，沉积物和监测记录也反映出太湖近 20 年来的污染减少趋势，表明近年环境保护政策和工程措施已取得一定成效。

（3）重建了太湖近 100 年来的生态系统服务演化序列，揭示了流域社会-生态系统长期动态耦合过程和机理。综合太湖多源沉积记录与流域社会经济、气候环境数据，研究揭示了过去百年湖泊生态系统服务的变化轨迹、风险和动力学特征，探讨了社会系统和生态系统的协同演化关系，阐述如何将长尺度湖泊生态系统服务研究纳入环境修复和管理及生态安全评估中。研究结果表明，1950s 以来，北太湖流域供给服务呈上升趋势，而水、沉积物、土壤和空气等调节服务显著下降，并在 80 年代以后到达危险等级；供给服务与调节服务表现出权衡作用，主要受控于流域社会经济转型和气候变化影响，包括人为土地利用、污染排放及升温和极端气候事件等。年代际尺度的调节服务动态分析显示出不同的线性、非线性和突变特征，为湖泊生态

修复和管理提供了重要启示，如合理运用生态修复参考本底和阈值、纳入弹性管理及早期预警等。通过进一步的环境库兹涅茨曲线分析，研究揭示了区域社会-生态系统的耦合阶段和内在反馈机制，包括初级发展（1950~1970）、退化（1970~1990）、转型（1990~2000）和重组（2000~）阶段，对应于不同的社会经济结构和生态系统服务供给模式。

上述阶段性研究成果为认识以太湖为代表的大型浅水湖泊生态系统退化过程及成因提供了理论基础，对于深入理解流域社会-生态系统长期耦合动态和机理、科学确立湖泊修复目标及路径具有参考意义。

（来源：http://www.niglas.ac.cn/xwdt_1_1/yjjz/202107/t20210723_6145092.html，根据相关资料编译）

蒙新高原湖泊透明度时空变化趋势及成因分析

透明度是反映湖泊物理、化学、生物和流域过程的综合表征指标，是体现大尺度气候变化和土地利用的指示指标。在国家自然科学基金面上项目和重大项目等资助下，中国科学院南京地理与湖泊研究所张运林研究组近日基于全国五大湖区 1133 对星地同步数据，构建和验证了全国湖泊透明度遥感估算模型，并将模型应用于蒙新高原湖泊透明度反演及时空变化分析和驱动机制研究，相关成果发表在 Water Research 和 Science of The Total Environment 杂志上。

一、蒙新地区湖泊透明度时空变化分析

首先，基于构建的透明度遥感估算模型，我们获取了蒙新高原 594 个面积在 0.1 km^2 以上湖泊透明度时空分布。从空间分布来看，较高的湖泊透明度主要分布在 75°~93° E 范围，少量高值分布在 118°~122° E 范围。相比较而言，在 93°~118° E 之间湖泊透明度值相对较低。从 1986-2018 年透明度长时间变化来看，355 个湖泊透明度呈现上升的趋势，205 个湖泊透明度呈现下降的趋势。其中，205 个湖泊透明度呈现显著上升的趋势，75 个湖泊透明度呈现显著下降的趋势，在这些显著上升的湖泊中，透明度上升速率均值为 0.15 m/10 年，而这些显著下降的湖泊中，透明度下降速率均值为 0.08 m/10 年。整体来看，所有湖泊透明度均值呈上升趋势，透明度上升速率为 0.14 m/10 年。

二、湖泊透明度影响因素时空变化分析

蒙新高原湖泊透明度主要影响因素时空变化分析结果表明，降雨整体呈上升趋势（0.76±0.23mm/year），在内蒙古东部地区降雨呈下降趋势。温度整体呈上升趋势（0.04±0.14℃/year），蒙新高原各地区均呈不同程度的上升趋势。干旱指数整体呈现下降趋势，速率为-0.04±0.07/year，朝着干旱方向在发展。除了内蒙古在显著下降（干旱）外，大部分地区变化并不显著。NDVI 整体上升趋势，平均速率为 0.04±0.11%/year。湖泊面积呈现显著上升的趋势，平均整体上升速率为 12.17km^2/year，新疆 92%的湖泊呈现显著上升趋势，面积下降的湖泊主要分布在内蒙古干旱地区。

三、蒙新地区湖泊透明度时空变化机制分析

通过分析蒙新高原地区降雨、温度、植被指数、干旱指数以及湖泊面积对每个湖泊水体透明度的影响，对 1986-2018 年各湖泊透明度与各因子进行相关性分析（图 5）。结果表明，70%的湖泊透明度与降雨量呈正相关，其中 87 个湖泊的透明度与降雨量呈显著性正相关，表明降雨对湖泊水体的稀释作用是这些湖泊变清的重要原因。63%的湖泊植被指数与透明度呈正相关（其中 76 个湖泊植被指数和透明度呈显著性正相关），表明蒙新高原地区植被的变化可能是导致透明度上升的一个重要的间接因素。植被指数与温度呈极显著正相关（$r=0.65$，$p<0.001$），说明温度升高导致海陆温差加大和季风增强，诱发降水增加，进而促进植被生长，降低流域侵蚀对湖泊水体透明度的影响。干旱指数代表植被的生长环境，69%湖泊周边干旱指数与湖泊的透明度呈正相关（108 个湖泊呈显著性正相关），表明湖泊流域湿润环境对植被生长具有促进作用，进而对水质改善起到正反馈的作用。241 个湖泊的年透明度与湖泊面积显著正相关，以及 94 个湖泊透明度和温度显著正相关，说明湖泊扩张和变暖都会导致这些地区透明度的增加。空间上将蒙新高原湖泊分为四组（I、II、III 和 IV）。在第 I 组和第 III 组中，由于植被的绿化和降雨的增加以及湖泊面积的扩展，大多数湖泊的透明度是增加的。对于第 II 组湖泊，干旱引起的湖泊面积衰退主要发生在该地区，最终引起湖泊透明度的下降。第 IV 组湖泊的透明度呈现上升趋势，主要是由高温引起的冰川融化导致湖泊扩张引起。

多元线性分析表明，年植被指数、年干旱指数、降雨、温度以及湖泊面积五个变量可以解释 68%的透明度变化，其中湖泊面积的单因子贡献最大，可以解释 0～83%的透明度变化，平均解释率为 25%，干旱指数、降雨、气温以及 NDVI 的平均解释率分别为 10%、10%、12%和 10%。干旱指数、降雨和温度 3 个变量可以解释 42%的植被指数变化，其中温度对植被指数的贡献最大（27%），其次是 PDSI（8%）和降雨（7%）。降雨和气温对湖泊面积变化的解释率为 47%，其中单个因子温度解释率最高为 39%，降雨为 8%。降雨和温度解释 73%的干旱指数变化，其中降雨为 52%，温度为 22%。总的来说，降雨、温度上升通过形成暖湿的气候、改变植被覆盖率，加强植被过滤作用，同时通过扩大湖泊面积，对湖泊水质变清起到促进作用。

（来源：http://www.niglas.ac.cn/xwdt_1_1/yjjz/202108/t20210803_6150654.html，根据相关资料编译）

湖泊沉积物羟基自由基的形成特征及机理研究

羟基自由基(HO・)是氧化性极强的活性氧物种，可通过直接或间接作用氧化环境水体中的生源要素及污染物质，对碳氮元素循环和水体环境质量具有显著影响。探明 HO・形成特征及机理是揭示其环境行为和生态效应的基础。已有研究表明，光化学反应是环境水体 HO・的重要来源。然而，近年来研究者发现黑暗条件下富

含铁和有机质的沉积物在氧化过程可产生数量可观的 HO•，其 HO•的生成量甚至是光化学过程产生 HO•的 1~2 个数量级。

鄱阳湖是典型季节性湖泊，在水位高幅度变化下大面积洪泛区洲滩暴露于空气中，使得沉积物中溶解氧和氧化还原电位升高，这为沉积物 HO•的形成创造了有利条件，然而目前关于该方面的研究未有报道。

在国家优秀青年基金及江苏省杰出青年基金等项目资助下，中国科学院南京地理与湖泊研究所徐华成研究组杜海岩博士选取我国典型季节性湖泊鄱阳湖为研究对象，采集了不同区域沉积物，在室内条件下模拟了湖泊沉积物干/湿转换及厌氧再曝气过程，计算了 HO•的形成潜力和特征，明确了沉积物铁和有机质的含量及形态变化过程，揭示了沉积物铁和有机质等还原性物质调控 HO•的形成机制。相关成果发表在环境领域知名期刊 Water Research 和 Science of The Total Environment 期刊上。

1.鄱阳湖干/湿转换过程中沉积物 HO•的形成特征

选取鄱阳湖吴城和南矶沉积物，比较了干/湿转换过程中沉积物 HO•生成潜力。结果表明，鄱阳湖吴城和南矶点位沉积物在淹水期 HO•产生量几乎为零。然而，在干/湿转换过程中，由于溶解氧含量的增加，沉积物 HO•含量迅速增加。吴城沉积物 HO•的最高浓度为 2.45±0.19 μmol kg^{-1}，而南矶沉积物 HO•的最高浓度为 0.69±0.25 μmol kg^{-1}，表明吴城点位沉积物具有更大 HO•生成潜力。淹水期间吴城点位表层沉积物中 Fe(II)的含量（589.3±37.29 mg kg^{-1}）约为南矶点位表层沉积物中 Fe(II)含量（308.4±94.01 mg kg^{-1}）的两倍，干/湿转换过程中沉积物聚集体表面 Fe(II)的氧化对 HO•的形成起重要作用。除 Fe(II)外，沉积物有机质包括溶解态和胶体态有机质对 HO•形成也起到重要作用。吴城点位表层沉积物溶解有机质（DOM）含量（14.38±2.19 mg kg^{-1}）明显高于南矶点位（6.82±0.37 mg kg^{-1}）。荧光光谱结果表明，两种沉积物 DOM 中类蛋白物质荧光强度在淹水期间持续升高，但在干旱期间略有下降；对于类腐殖荧光峰，其在吴城沉积物中同样呈现淹水增强和干旱下降趋势，而南矶沉积物在整个干/湿转换过程中无明显变化。与类蛋白物质相比，类腐殖物质具有更多高活性基团，电子转移速率快，因而更易促进 HO•形成。所以，鄱阳湖干/湿转换过程中沉积物 DOM 中类腐殖组分的氧化作用也是 HO•形成的重要原因。

2.鄱阳湖干/湿转换过程中沉积物 HO•的形成机理

进一步，采集了鄱阳湖 19 个点位沉积物，通过模拟沉积物厌氧再曝气过程，揭示鄱阳湖沉积物 Fe(II)和有机质等还原性物质调控 HO•的形成机制。结果表明，鄱阳湖沉积物厌氧再曝气过程生成的 HO•存在明显的空间异质性，浓度范围为 3.75±1.13~271.8 ± 22.81 μmol kg^{-1}，其与 Fe(II)、可溶性有机碳(DOC)的含量呈显著正相关。然而，点位 S1、 S2、 S5、 S6、 S12 及 S15 沉积物具有相似的 DOC (~120

mg kg^{-1}) 和 Fe(II) (~3200 mg kg^{-1})含量，而 HO•产量却表现出极大差异性(73.13 ± 12.25~271.8 ± 22.81 μmol kg^{-1})，说明除还原物质含量外，其种类和形态也是影响 HO•形成的重要因素。选取上述 6 种沉积物，利用上海光源同步辐射中心 X 射线吸附光谱分析沉积物中铁形态特征，发现沉积物中铁物种主要由铁氧化物(如针铁矿)、硅酸盐铁(如铁基蒙脱石)以及少量可溶性/可交换态铁组成，其中铁基蒙脱石含量与 HO•的形成潜力呈现高度一致。结合沉积物厌氧再曝气过程中类过氧化物酶活性(反映铁物种 HO•形成潜力)的差异，推测铁基蒙脱石具有较高类过氧化物酶活性，是 HO•形成的关键因素。除铁矿物外，沉积物 DOM 也是 HO•形成的重要因素，对 HO•生成的贡献约为 2~11%。DOM 诱导的 HO•生成潜力与分子量分布高度相关，沉积物 DOM 中低分子量(<1 kDa)组分比高分子量(1 kDa~0.45 μm)具有更高的 HO•生成潜力。最后，沉积物矿物 Fe(II)和 DOM 相互作用对 HO•的生成有明显的协同效应，发现其对 HO•生成的贡献率约 2~6%。

上述研究揭示了 Fe(II)和 DOM 的含量和种类对 HO•产生的重要性，为理解 HO•在季节性湖泊沉积物中的形成机制提供了新的见解，也对湖库水环境元素循环以及污染物环境行为和迁移归宿解析具有重要意义。

（来源：http://www.niglas.ac.cn/xwdt_1_1/yjjz/202108/t20210810_6155504.html，根据相关资料编译）

我国东部浅水湖泊沉水植被历史演化模式

大型水生植被是维持湖泊生态系统健康的关键要素，也是湖泊从“浊水态”到“清水态”修复过程中的核心修复目标之一。而科学地理解大型水生植被，尤其是沉水植被退化的历史演化进程、规律和模式是确立水生植被修复目标及路径的重要前提，可以为湖泊生态恢复和管理提供重要的参考依据。目前，对我国东部平原湖泊历史时期大型水生植被的 “多”与“少”仍然存在较大的争议。相关研究主要局限于野外调查记录或者遥感影像记录（<50 年），缺乏长期变化数据，制约了我们对水生植被演化过程的系统认识；另外，现有研究多以单个湖泊为主，缺乏区域层面上水生植被演化的综合对比分析，尤其是对其长期变化规律和模式的探讨较少。

针对上述问题，在国家重点研发计划等项目的资助下，湖泊沉积与环境演变研究室张科研究团队通过分析湖泊沉积钻孔数据，结合历史文献资料的系统收集整理，获取了 18 个湖泊及 1 个湖群过去百年来水生植被的演化研究资料，并整合分析了其中 14 个浅水湖泊的水生植被历史演化过程的定量数据，在东部地区浅水湖泊水生植被长期演化过程方面取得了新认识：提出了过去百年来该区域湖泊沉水植被呈现“少-多-少”的演化模式，该模式与传统认识中沉水植被由“多”到“少”的变化具有明显的差异。在此基础上，深入对比分析了产生两种认识的原因和机制。相关成果发表于《中国科学：地球科学》期刊及其英文版期刊 Science China Earth Sciences。

该研究对于深入理解东部地区湖泊水生植被历史提供新视角和认识，对科学确立湖泊水生植被修复路径，尤其是确立水生植被的历史本底与参考目标具有重要的现实意义。

（来源：http://www.niglas.ac.cn/xwdt_1_1/yjjz/202108/t20210830_6177307.html，根据相关资料编译）

陆基高光谱多参数水质遥感创新与应用

准确快速的地表水环境监测是掌握地表水水质变化特征，开展水环境成因机制分析、评价评估、治理修复和管理考核的重要基石，无论是科学研究还是环境管理以及政府决策很大程度上都非常依赖水环境监测结果。人工断面采样监测费时费力且时空频次非常低，数据离散；水下高频监测探头易于污染和损耗、监测精度和指标有限，维护成本高昂，高度依赖进口；卫星和无人机遥感由于时空和光谱分辨率、云雨天况以及大气校正影响，监测参数和精度存在很多不确定性；与此同时，2015 年国务院发布的《生态环境监测网络建设方案》提出：强化高新技术、先进装备与系统的应用，提高生态环境监测立体化、自动化、智能化水平。因此，迫切需要发展新的技术手段和方法，研制高时空分辨率、自动化和智能化的多参数水环境监测设备，构建关键水质参数准确、实时的提取算法并开展应用，补充和完善现有监测体系的不足。

中国科学院南京地理与湖泊研究所张运林研究组 2018 年率先提出近地面离水高光谱多参数水质陆基（地基、岸基）遥感监测理念和实施路径，后联合杭州海康威视数字技术股份有限公司和南京中科深瞳科技研究院有限公司首创近水面非接触式陆基（地基、岸基）高光谱、多参数水质遥感监测仪，仪器集成高光谱采集、视频监控、毫米波雷达水位测定、水质参数反演和深度学习等技术，可以实现复杂天况下总氮、总磷、叶绿素、高锰酸盐指数、悬浮物、透明度和有色可溶性有机物吸收等 11 个关键水质参数实时秒-分钟尺度高频监测。陆基高光谱多参数水质遥感监测仪既克服了以往水下探头的易污染、难维护、精度低的问题，又解决了卫星遥感监测中时间和光谱分辨率低以及受天气和大气尘埃干扰的影响，实现遥感和断面监测的深度融合。部分研究成果近日发表在 Science of The Total Environment 杂志上（文章链接：https://www.sciencedirect.com/science/article/pii/S0048969721048804）。

首先，基于太湖、梁溪河和富春江水库的现场获取的光谱反射比与实测水质参数数据，分别使用经验算法、半分析模型和机器学习等构建和验证了水质参数遥感估算模型，遴选各参数最优模型植入水质遥感监测仪。结果表明基陆基（地基、岸基）遥感与机器学习算法相结合，在监测内陆水域的水质方面有很大的潜力。

其次，基于植入的水质多参数遥感估算模型，我们实时获取了太湖、梁溪河和富春江水库的水质动态变化状况。对于太湖和梁溪河，受藻类水华影响水体总氮和总磷的浓度在分钟-小时尺度上会发生快速变化。因此，对于每日、每周、每月或季

节性采样的常规水质监测，可能由于采样频次不够会造成许多关键过程的缺失，给环境管理带来误判。

相比于航空/航天/近地无人机载的水环境遥感，陆基水环境遥感由于离水面比较近（5-10 m），离水辐射信号强，大气的影响基本上可以忽略，无需进行大气校正，因此可以实现阴天、多云和晴朗等更复杂天况下更高精度的水环境遥感监测。同时，陆基遥感监测仪覆盖 400-1000 nm 可见光和近红外波段，光谱分辨率为 1 nm，为地表水质监测提供了更多的光谱通道，可以应用于包括水色参数在内的更多水质参数更精准的遥感反演和监测。当前，仪器内置了总氮、总磷、高锰酸盐指数、叶绿素、透明度和有色可溶性有机物吸收系数等 11 个关键水质参数算法，未来还需继续开展大范围陆基高光谱遥感同步实验，积累覆盖范围更宽的反射率和水质数据集，优化和提升现有算法精度和适用性，构建更多水质参数深度学习算法，如颗粒和溶解性有机碳等，支撑河流湖库碳输移和迁移转化过程监测，服务于国家“双碳”计划。

陆基高光谱多参数水质遥感监测仪适合生态环境、水利、市政、自然资源监测等行业部门，可以广泛应用于全国地表水监控断面、集中式饮用水源地及其他敏感水域开展连续高频水环境监测，弥补现有的人工和自动监控断面监测在观测频次、观测参数、观测精度和观测成本上的不足。同时，也可以用于科研院所、高等院校等开展监测科研研究，仪器安装简单方便、可移动。此外，目前的陆基高光谱多参数水质遥感监测仪还可以开发手持式移动观测以及船载和无人机载观测系列产品及成像系统，支撑全国地表水体水环境监测与应用研究，为水环境治理与修复提供监测与诊断的系统化解决方案，服务水环境管理。目前已在江苏太湖、陕西西安、江西赣州、广东深圳、浙江杭州和浙江安吉等地河流湖库布设了 11 台套，能很好捕捉太湖蓝藻水华快速变化过程。

（来源：http://www.niglas.ac.cn/xwdt_1_1/yjjz/202109/t20210906_6190997.html，根据相关资料编译）

湖库水量季节性变化的全球与典型流域尺度遥感监测

湖泊与水库（下文简称湖库）作为陆地水圈的重要组成，以水量收支与陆气水交换等方式参与自然界的水循环；同时也是人类社会经济不可或缺的水资源，在灌溉、维系水产、调蓄洪水等方面发挥重要作用。然而，由于湖库现有站点观测资料的时间连续性与空间覆盖度有限，难以在全球尺度或区域尺度对湖库季节性水量收支及变化开展定量研究，因此借助遥感手段开展大尺度湖库水储量季节性变化估算及其蓄洪与削峰能力评估成为研究突破口，特别是不受云雨天气影响的卫星雷达高度计观测发展与高时空分辨率 SAR 影像的海量数据云获取为这方面研究提供了便利。

针对上述研究问题和目标，在国家重点研发计划项目、中科院战略性先导科技专项等资助下，中国科学院南京地理与湖泊研究所宋春桥研究员课题组联合美国堪

萨斯州立大学、河海大学、香港大学等机构的科研人员利用多源遥感数据首次估算了全球大中型湖库的季节性水量变化及东亚季风区典型流域——鄱阳湖流域的所有湖库的水储量年内时序变化及蓄洪能力。相关研究结果发表在 Journal of Hydrology 和 Science of The Total Environment 期刊上，论文第一作者为该课题组的特别研究助理陈探博士。

遥感估算全球 463 个面积 10 km^2 以上的湖库（约占全球湖泊总面积的 64%，占全球湖泊蓄水量的 93%）季节性水量变化。研究结果表明：其季节性水量变幅为 1390.91 ± 78.91 km^3，其中自然湖泊季节性水量变化为 869.44 ± 67.35 km^3，水库季节性水量变化为 521.46 ± 41.11 km^3。全球湖泊季节性水量变化的纬向与经向地带性比较显著，季节性水量变化在北半球集中在 30° N - 60° N 之间，在南半球集中在赤道和 30° S 之间。在全球范围内对湖库季节性水量的初步估计将极大地帮助我们更好地理解湖泊和水库在调节全球和区域水循环方面的季节性行为，以及陆地储水量变化对海平面上升在年内尺度的贡献。全球湖泊季节性水量变化较大的湖泊群集中在北美洲和非洲的流域，此类湖泊群受气候变化和人类活动的叠加影响具有较大的季节性波动。

由于湖库水储量的季节性变化带来的调蓄功能可以使湖泊生态系统通过洪水蓄积和径流补给实现水资源的再分配，进而减轻洪涝灾害。近年来，世界各地的洪涝灾害频发。本研究介绍了一种基于高时空分辨率 SAR 遥感监测与湖库库容曲线方法量化流域尺度湖库水量年内时序变化的方法。基于 Sentinel-1 雷达卫星影像、GRACE 重力卫星、SRTM 数字高程模型等多源遥感数据对鄱阳湖流域水域面积 1 km2 以上所有湖库的面积与水量由枯转洪的年内时序变化进行了定量重建。针对 2020 年 7 月长江中下游流域受强降雨影响，引发的百年一遇严重洪水事件为例，遥感观测数据显示，2020 年汛期鄱阳湖及流域内其他湖库的总调蓄量约为 151 亿 m^3，约占鄱阳湖流域陆地水储量变化的 45%，鄱阳湖的调蓄能力在所有湖库中贡献比例高达 80%。因此，准确掌握我国典型流域湖库的高时空分辨率动态变化，定量评估湖库洪水调蓄和水资源调节功能，对我国洪水管理及水资源保护具有科学指导意义。

（来源：http://www.niglas.ac.cn/xwdt_1_1/yjjz/202110/t20211012_6221425.html，根据相关资料编译）

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2021 年青海湖流域综合科学考察 7 日在青海省西宁市启动，科研人员将利用星载遥感、传统地面调查等技术，对中国内陆最大咸水湖青海湖开展研究。

地处青藏高原的青海湖是中国面积最大的内陆咸水湖，处于青藏高原高寒区和黄土高原干旱区的过渡地带，是研究气候响应、水量平衡及水文过程的理想场所。

中国科学院空天信息创新研究院研究员刘少创介绍说，2021 年青海湖流域综合科学考察将借助星载遥感技术、传统地面调查、环境包络线模型、最大熵模型，对青海湖水位、青海湖水域面积、流域内植被变化、普氏原羚家域估算及活动节律等进行研究，以揭示高山内陆湖泊水量变化规律及气候响应、青海湖地区物种时空变化情况等，为青海湖流域生态环境保护提供科学依据。

据悉，本次综合科学考察将历时 15 天，范围包括青海湖水体、湖中岛屿及湖周沼泽、草原等，地跨青海省二州三县。2021 年青海湖流域综合科学考察由三江源生态保护基金会、三江源国家公园管理局等组织中国科学院三江源国家公园研究院、中国科学院空天信息创新研究院等单位实施。

（来源：中国新闻网，https://m.gmw.cn/2021-09/07/content_1302559905.htm）

太湖流域排查确认入河（湖）排污口

记者 6 日从江苏省生态环境厅获悉，经过无人机航测、人工排查、技术核查三级排查，江苏太湖流域入河（湖）排污口排查工作基本完成，共确认各类排污口 20876 个。

太湖治理的关键在于“外源减量、内源减负、生态扩容”，而排污口排查整治，是实现外源减量的关键环节。今年 3 月中旬，江苏太湖流域入河（湖）排污口排查整治工作启动，涉及 163 条骨干河流、106 个湖泊。

“确定排污口的位置及数量只是第一步，还要进行采样监测和溯源核查，目前相关工作已有序开展。”江苏省生态环境厅有关负责人表示，有口必查、有水必测、有源必溯、有污必治，这将有利于从源头上有效管控入河（湖）污染物排放，提升太湖流域“减磷控氮”水平，推动太湖流域生态环境质量持续改善。

（来源：新华网，http://csj.xinhuanet.com/2021-09/07/c_1310172276.htm）

甘肃四川签订黄河流域横向生态补偿协议

为加快建立黄河流域横向生态补偿机制，推动黄河上游川甘青水源涵养区生态保护和高质量发展，省生态环境厅联合省财政厅等部门，积极与四川省相关部门沟通协商，两省政府正式签订了《黄河流域（四川-甘肃段）横向生态补偿协议》。这是我省第一份与相邻省份签订的横向生态补偿协议。

根据协议，2021 年 1 月至 2022 年 12 月期间在黄河干流四川、甘肃段（黄河干流甘肃省、四川省为左右岸）开展首轮试点。其间，设定的考核目标为两省境内黄河流域国控跨省考核断面水质稳定达到国家考核标准，两省境内流域生态流量得到

有力保障。其中黄河干流玛曲断面水质稳定达到国家考核Ⅱ类水质标准，水质考核指标为《地表水环境质量标准》，水质数据以中国环境监测总站公布的水质监测数据为准。资金方面，四川、甘肃两省按照 1∶1 的比例共同出资 1 亿元设立黄河流域川甘横向生态补偿资金，专项用于流域内污染综合治理、生态环境保护、环保能力建设等方面。若玛曲水质监测断面当年未达到国家考核Ⅱ类水质标准，一方能举证为对方污染造成，则由污染方向举证方支付补偿资金。

协议同时规定，依托流域横向生态保护补偿机制平台，两省各级政府间加强区域协作，统筹开展产业、科教、人才、旅游和生态环境保护等方面合作，推动流域经济社会高质量发展，并积极开展流域精细化管理和多元化、市场化补偿方式的探索和实践。两省各级生态环境、水利等部门建立联合监测、生态环境信息共享机制，联合查处和打击跨界违法行为，实行流域左右岸重大规划、项目环评会商及生态环境污染事故应急联动，深入协同开展流域水资源保护、水污染防治和生态环境保护等工作。甘肃省、四川省共同落实各项目标任务，联合开展绩效评估工作。

（来源：新华网，http://www.gs.xinhuanet.com/news/2021-09/08/c_1127838274.htm）

贵州率先完成珠江流域国家地下水环境质量考核点位样品采集

承担珠江流域国家地下水环境质量考核点位样品采集贵州部分的贵州省地质环境监测院精心组织考核点位样品采集工作，成为全国第一个完成珠江流域国家地下水环境质量考核点位采样工作的省份。

根据生态环境部珠江流域南海海域生态环境监督管理局生态环境监测与科学研究中心统筹部署，该院抽调 12 名骨干技术人员、6 辆专用汽车，组成两个样品采集小组，于 8 月 6 日至 8 月 25 日，经过省 9 个地州市 37 个县，历经 20 天不间断野外工作，全面完成了贵州省 2021 年珠江流域国家地下水环境质量考核点位样品采集任务，共采集“十四五”国家地下水环境质量考核点位样品 48 组，按要求所有样品均在采集后 24 小时内送至测试机构。

两个小组分别由具有国家地下水监测工程运行维护与样品采集工作丰富经验的工程师担任组长，大家克服了水样不能空运的难题，采用样品保温箱外套冰袋保鲜泡沫箱快递陆运方式，保质保量地完成了 5 个国家级外部平行样质控和 5 个流域级外部平行样质控。样品采集全过程均严格按照《地下水环境监测样品采集、保存和流转技术规定》要求实施，所有考核点样品采集均开展了线上资料检查，院总工办安排专家组对 10 处考核点样品采集进行了现场质量检查，确保了样品采集质量。

（来源：新华网，http://www.gz.xinhuanet.com/2021-08/31/c_1127814059.htm）

《第三次全国国土调查主要数据公报》发布

国务院第三次全国国土调查领导小组办公室、自然资源部、国家统计局近日发布《第三次全国国土调查主要数据公报》，并于 8 月 26 日召开第三次全国国土调查（以下简称“三调”）主要数据成果新闻发布会，记者从会上获悉，2019 年末全国耕地 12786.19 万公顷（191792.79 万亩）。据介绍，2018 年 9 月，国务院统一部署开展“三调”，以 2019 年 12 月 31 日为标准时点汇总数据。“三调”全面采用优于 1 米分辨率的卫星遥感影像制作调查底图，广泛应用移动互联网、云计算、无人机等新技术，创新运用“互联网+调查”机制，全流程严格实行质量管控，历时 3 年，21.9 万调查人员先后参与，汇集了 2.95 亿个调查图斑数据，全面查清了全国国土利用状况。

“三调”数据显示，园地 2017.16 万公顷（30257.33 万亩）、林地 28412.59 万公顷（426188.82 万亩）、草地 26453.01 万公顷（396795.21 万亩）、湿地 2346.93 万公顷（35203.99 万亩）、城镇村及工矿用地 3530.64 万公顷（52959.53 万亩）、交通运输用地 955.31 万公顷（14329.61 万亩）、水域及水利设施用地 3628.79 万公顷（54431.78 万亩）。坚持最严格的耕地保护制度守牢 18 亿亩耕地红线

《公报》称，“三调”数据成果全面客观反映了我国国土利用状况，也反映出耕地保护、生态建设、节约集约用地方面存在的问题，必须采取有针对性的措施加以改进。

关于耕地，自然资源部党组成员、副部长，国务院第三次全国国土调查领导小组办公室主任王广华表示，党中央、国务院始终高度重视耕地保护。2017 年国务院印发公布的《全国国土规划纲要（2016-2030）》，按照保障国家粮食安全的总体要求，统筹平衡支撑经济社会发展、脱贫攻坚、农业结构调整和生态建设等目标，确定了 2020 年和 2030 年的耕地保有量目标，分别是 18.65 亿亩和 18.25 亿亩。“三调”结果显示，2019 年末全国耕地 19.18 亿亩，从全国层面看，实现了国家规划确定的耕地保有量目标。

从“三调”数据看，“二调”以来的 10 年间，全国耕地地类减少了 1.13 亿亩，王广华分析，在非农建设占用耕地严格落实了占补平衡的情况下，耕地地类减少的主要原因是农业结构调整和国土绿化。过去 10 年的地类转换中，既有耕地流向林地、园地的情况，也有林地、园地流向耕地的情况，结果是，耕地净流向林地 1.12 亿亩，净流向园地 0.63 亿亩。

王广华说，耕地流向园地等农用地中，有的破坏了耕作层，有的没有破坏，“三调”专门对此进行了调查标注，全国共有 8700 多万亩即可恢复为耕地的农用地，还有 1.66 亿亩可以通过工程措施恢复为耕地的农用地，如果需要，这部分农用地可通过相应措施恢复为耕地。因此，只要统筹安排，严格管控，完全可以守住 18 亿亩耕地红线。但绝不能掉以轻心，必须坚持最严格的耕地保护制度，守牢耕地红线。

王广华介绍，将结合各级国土空间规划编制，以“三调”成果为基数和底图，按照应保尽保原则，合理确定各地耕地保有量，严格划定永久基本农田，确保完成国家规划确定的耕地保护目标；压实地方各级党委和政府耕地保护目标责任，实行党政同责。把耕地保有量和永久基本农田保护目标任务带位置逐级分解下达，作为刚性指标严格考核：对耕地特别是永久基本农田实行特殊保护，耕地主要用于粮食和棉、油、糖、蔬菜等农产品生产，永久基本农田按粮田管理，同时，严格用途管制，坚决遏制耕地“非农化”、严格管控“非粮化”，从严控制耕地转为其他农用地；规范完善耕地占补平衡，确保补充耕地数量相等、质量相当。

坚持最严格的生态环境保护制度统筹生态建设

“三调”结果显示，10 年间，生态功能较强的林地、草地、湿地、河流水面、湖泊水面等地类合计净增加了 2.6 亿亩，生态建设取得了积极成效。

同时，全国有 2.29 亿亩耕地流向林地、草地、湿地、河流水面、湖泊水面等生态功能较强的地类，而又有 2.17 亿亩上述地类流向耕地，反映出生态建设格局在局部地区不够稳定，一些地方还暴露出生态建设的盲目性、生态布局不合理等问题，必须坚持最严格生态环境保护制度，统筹生态建设。

对此，国务院第三次全国国土调查领导小组办公室常务副主任朱留华表示，要坚持系统观念，在“三调”形成的数据库基础上，科学划定生态保护红线，合理安排生态建设布局，纳入各级国土空间规划并严格实施；尊重自然规律，对“三调”发现的不符合自然地理格局的土地利用方式，按照“宜耕则耕、宜林则林、宜草则草、宜湿则湿、宜荒则荒、宜沙则沙”的原则，逐步进行调整；通盘安排未来生态退耕、国土绿化等生态建设，依据“三调”形成的统一底图，按照“宜乔则乔、宜灌则灌、宜草则草”的原则，科学确定并带位置下达新的绿化任务。

坚持最严格的节约用地制度推动集约高效用地

“三调”结果显示，全国建设用地总量 6.13 亿亩，较“二调”时增加 1.28 亿亩，增幅 26.5%，同期国内生产总值增长 109.4%，常住人口城镇化率从 48.34%提高到 62.71%，建设用地的增加与经济社会发展的用地需求总体相适应。

但从“三调”数据看，城镇建设用地总规模达到 1.55 亿亩，节约集约程度不够问题依然突出，一些地方存在大量低效和闲置土地。全国村庄用地规模达 3.29 亿亩，总量较大，布局不尽合理。城乡建设用地盘活利用具有较大潜力。

我国人多地少的国情和现代化建设的进程决定了土地供需矛盾还将持续相当长的时间，实现高质量发展，必须坚持最严格的节约用地制度，全面提升用地效率。

一是结合国土空间规划编制，合理确定新增建设用地规模，严格规划管控，城镇建设必须严格限定在城镇开发边界之内，农村一二三产业融合发展应当在县域内统筹。二是着力推动城乡存量建设用地开发利用，完善政府引导市场参与的城镇低效用地再开发政策体系，全面提升各类园区集约用地水平。三是科学编制村庄规划，

推动全域土地综合整治，盘活农村存量土地。四是强化土地使用标准和节约集约用地评价。调整完善产业、基础设施、公共服务领域建设用地使用标准。加强项目生成阶段节约用地审查，建设项目可研报告要对节约集约用地情况做出专章分析，新上项目用地节约集约化程度应努力达到国内同行业先进水平。五是大力推广节地技术，培育出一批新型节地模式和节约用地典型，发挥示范引领作用。

《公报》强调，“三调”成果是国家制定经济社会发展重大战略规划、重要政策举措的基本依据。要加强“三调”成果共享应用，将“三调”成果作为国土空间规划和各类相关专项规划的统一基数、统一底图，推进国家治理体系和治理能力现代化。

（来源：新华社，https://baijiahao.baidu.com/s?id=1709122194574920731&wfr=spider&for=pc）

鄂湘赣三省打造长江中游城市群协同创新共同体

由湖北省科技厅、湖北省知识产权局主办的“长江科技创新要素大会暨首届湖北技术成果交易会”23 日在武汉举行。鄂湘赣三省科技部门共同签署《长江中游鄂湘赣三省区域协同创新合作框架协议》(简称《协议》)，打造长江中游城市群协同创新共同体。

《协议》聚焦推进区域创新联动、加强技术协同攻关、共享科技创新资源、促进科技成果转化、强化科技创新创业、对接科技金融服务、携手国际与区域合作创新等七个方面。根据《协议》，鄂湘赣三省将共同推进“三区”(东湖国家自主创新示范区、长株潭国家自主创新示范区、鄱阳湖国家自主创新示范区)“三走廊”(光谷科技创新大走廊、长株潭科技创新走廊、赣江两岸科创大走廊)合作对接；共同申报国家重大科技专项，共同组织参与“揭榜挂帅”科技项目，开展“卡脖子”关键核心技术攻关；共同建设一批重大科技创新平台，推进重大科技基础设施、重点实验室等研发服务平台和大型科学仪器设备实现开放共享。

在加强国际与区域合作创新方面，支持三省高校院所和企业积极参与中非创新合作中心、粤港澳科创产业园、亚欧水资源研究和利用中心等国家与区域科技创新合作平台建设，共享国际与区域科技合作资源。作为科教大省和重要工业基地，今年第一季度，湖北高新技术产业增加值同比增 102.7%，技术合同成交额同比增长 370.21%，12 家国家级高新区生产总值同比增长 81.86%。

湖北省科技厅党组书记、厅长王炜表示，鄂湘赣三省科技部门将加快技术、人才、资本等创新要素在长江中游城市群聚集融合，打造“政产学研金服用”热带雨林式科技创新生态。推动科技领域取得一批区域合作成果，形成一批改革创新经验，突破一批体制机制障碍。

（来源：中国新闻网，https://baijiahao.baidu.com/s?id=1703344426172776091&wfr=spider&for=pc）

立法保护发展长三角最大人工淡水湖

记者从杭州市人大常委会 7 日召开的《杭州市淳安特别生态功能区条例》新闻发布会上获悉，为保护长三角最大人工淡水湖千岛湖“量身定制”的这部地方性法规，将于 2022 年 1 月 1 日起正式施行。

千岛湖是长三角最大的人工淡水湖，位于浙皖交界处的新安江段，是钱塘江乃至整个杭州水系的重要源头。近年来，千岛湖出境断面水质持续保持Ⅰ类标准。2019 年 9 月，浙江省政府正式批复同意设立淳安特别生态功能区，范围覆盖包括千岛湖在内的全县域。

条例分总则、规划与管控、生态保护、绿色发展、民生保障、支持与监督和附则七章，共 42 条。条例明确要求，生态环境状况指数稳定在优，保持千岛湖总体水质稳定，并逐步提高。条例特别支持淳安特别生态功能区建立健全生态产品价值实现机制，支持探索拓展政府主导、企业和社会各界参与、市场化运作、可持续的生态产品价值实现路径，既要保护好千岛湖一湖秀水，又要保障好淳安 40 多万老百姓的民生福祉促进共同富裕。据了解，目前杭州市已成立了杭州黄山合作跨新安江流域生态环境保护专家委员会。

（来源：新华社，https://m.gmw.cn/2021-09/08/content_1302562119.htm）

“20 世纪 50 年代以来中国北方湖泊变化及其生态效应研究”项目中期检查会顺利召开

8月22日，国家重点研发计划“20世纪50年代以来中国北方湖泊变化及其生态效应研究”项目中期检查会顺利召开。来自科技部全球变化专项办、中科院前沿科学与教育局、武汉大学、华东师范大学、中国水科院、中国林科院以及中科院地理科学与资源研究所、东北地理与农业生态研究所、南京地理与湖泊研究所等单位的领导、专家及项目组全体成员共约60人参加会议。会议采用现场会议（南京、长春、北京）和视频会议相结合的形式，由项目首席科学家薛滨研究员和项目跟踪专家夏军院士、丁平兴教授、王苏民研究员共同主持。

会上，中科院南京地理与湖泊研究所副所长张运林研究员代表项目依托单位致欢迎辞，感谢各位专家对该项目的关心和帮助，表示研究所将一如既往地高度重视项目的组织实施和过程管理，并给予大力支持。中科院前沿科学与教育局地学处段晓男处长对项目已取得的成绩予以充分肯定，希望项目组能够心系“国家事”、肩扛“国家责”，产出具有前沿性和引领性的亮点工作。

随后，中科院东北地理与农业生态研究所王宗明研究员、中科院地理科学与资源研究所王训明研究员、中国林科院李迪强研究员、中科院南京地理与湖泊研究所孙占东副研究员分别汇报了课题中期进展报告，项目负责人薛滨研究员汇报了项目

阶段性成果总结报告。汇报完毕后，由武汉大学夏军院士、华东师范大学丁平兴教授、中科院南京地理与湖泊研究所王苏民研究员、中科院东北地理与农业生态研究所姜明研究员、中国林科院崔丽娟研究员、中国水利水电科学研究院严登华教高、中科院地理科学与资源研究所宋献方研究员共同组成的专家组对各个课题进展情况进行了详细评议。

专家组充分认可项目组所取得的成绩，一致同意各个课题通过中期考核，并对项目层面的成果凝练和下一步工作提出要求：一是进一步聚焦项目指南要求，围绕北方湖泊应对全球变化的适应性调控机制与途径这一关键科学问题，开展理论与方法攻坚；二是打破课题间的壁垒，在野外调查、数据共享、模型开发等方面加强项目组内部合作；三是加强成果凝练，特别是在北方湖泊的时空变化格局、面向北方湖泊的气候变化-水文-生态耦合模型以及北方湖泊适应性调控机制等方面能够形成具有显示度的研究成果，并能为北方地区的生态文明建设提出重大咨询建议。最后，薛滨研究员总结发言，并代表项目表态将认真消化、超前部署，高质量高效率完成项目下一阶段的研究工作。

国家重点研发计划项目“20世纪50年代以来中国北方湖泊变化及其生态效应研究”由中国科学院南京地理与湖泊研究所牵头，中国科学院东北地理与农业生态研究所、中国科学院地理科学与资源研究所、中国林业科学研究院森林生态环境与保护研究所、兰州大学、内蒙古大学6家单位共同参与。项目计划通过5年时间阐明我国北方湖泊的时空变化格局及其规律；揭示湖泊水文-生态系统对气候变化的响应机制，定量区分人类活动对湖泊生态系统变化的影响，构建适合我国北方湖泊演变和生态效应研究的气候变化-水文-生态耦合模型；评估湖泊变化对湖泊生态系统、水生植被和鸟类多样性的影响，为北方湖泊应对全球变化的适应性调控机制与途径提供科学支撑。项目自2019年10月立项以来，已发表第一标注学术论文36篇，申请专利8项，完成软件著作权6项，出版专著2本，科普书1本，提交重要咨询报告5份。

（来源：中科院南京地泊所，http://www.niglas.ac.cn/xwdt_1_1/zhxw/202108/t20210825_6168505.html）