湖泊科学动态

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热点文章

Widespread loss of lake ice around the Northern Hemisphere in a warming world

Sapna Sharma, Kevin Blagrave, John J. Magnuson; et al.

Ice provides a range of ecosystem services—including fish harvest1, cultural traditions2, transportation3, recreation4 and regulation of the hydrological cycle5—to more than half of the world's 117 million lakes. One of the earliest observed impacts of climatic warming has been the loss of freshwater ice6, with corresponding climatic and ecological consequences7. However, while trends in ice cover phenology have been widely documented2,6,8,9, a comprehensive large-scale assessment of lake ice loss is absent. Here, using observations from 513 lakes around the Northern Hemisphere, we identify lakes vulnerable to ice-free winters. Our analyses reveal the importance of air temperature, lake depth, elevation and shoreline complexity in governing ice cover. We estimate that 14,800 lakes currently experience intermittent winter ice cover, increasing to 35,300 and 230,400 at 2 and 8 °C, respectively, and impacting up to 394 and 656 million people. Our study illustrates that an extensive loss of lake ice will occur within the next generation, stressing the importance of climate mitigation strategies to preserve ecosystem structure and function, as well as local winter cultural heritage.

（来源：Nature Climate Change, 2019, 9:227–231）

中文点评：

全球变暖导致北半球超 3.5 万个湖泊将不再结冰

据加拿大约克大学近日发表在《自然—气候变化》上的一项研究表明，由于不断上升的全球气温，冬天北半球的湖泊将失去很多冰。目前美国、加拿大和欧洲在冬季大约 1.5 万个湖泊会断断续续地出现冰盖。湖冰流失会产生巨大影响，不仅仅让人失去很多娱乐消遣，诸如冰上钓鱼、滑冰、参加各种冬季庆典，还会使北方的一些土著社群或许会失去运输系统，因为它们要依赖冬季冰封的道路获取食物和供给。该研究显示，不结冰的湖泊更容易通过蒸发损失水份，而当天气暖和，它们会更快变暖。这意味着水中的氧气水平可能下降。这不仅可能影响人类，还会影响野生动物。

该研究的第一作者萨普娜·夏尔马说："我们预计，由于天气变暖，3.94-6.56亿人或许将无法利用冰冻的湖泊。她说："气温的小幅上升，例如上升1℃都将导致另外数千个湖泊在冬天失去冰盖，并导致1亿人无法轻易接触到冰冻的湖泊。"该研究的作者之一、伊利诺伊州立大学的凯瑟琳·奥赖利说："最让我们吃惊的是这些变化发生的速度。我们突然想到在未来的冬天湖泊不再结冰，并且意识到这个未来即将来临，这让人震惊。"

相关领域的专家约翰·马格努森说："我们已经知道，在过去150年中，北半球的北方湖泊变得结冰较晚，融冰较早，并且拥有冰盖的日子变少。我们估计，目前有1.5万个湖泊在有些年份没有完整的冰盖。"

科学家们认为，这项研究是有关湖冰流失的最详细研究。这项工作的研究人员说，冬天会有更多湖泊不结冰。如果世界设法将全球升温控制在2℃，该研究认为，断续出现冰盖

的湖泊数量将增加到超过3.5万个。

（来源：根据参考消息网相关资料编译 2019-02-02）

Worldwide alteration of lake mixing regimes in response to climate change

R. Iestyn Woolway, Christopher J. Merchant.

Lakes hold much of Earth's accessible liquid freshwater, support biodiversity and provide key ecosystem services to people around the world. However, they are vulnerable to climate change, for example through shorter durations of ice cover, or through rising lake surface temperatures. Here we use a one-dimensional numerical lake model to assess climate change impacts on mixing regimes in 635 lakes worldwide. We run the lake model with input data from four state-of-the-art model projections of twenty-first-century climate under two emissions scenarios. Under the scenario with higher emissions (Representative Concentration Pathway 6.0), many lakes are projected to have reduced ice cover; about one-quarter of seasonally ice-covered lakes are projected to be permanently ice-free by 2080–2100. Surface waters are projected to warm, with a median warming across lakes of about 2.5 °C, and the most extreme warming about 5.5 °C. Our simulations suggest that around 100 of the studied lakes are projected to undergo changes in their mixing regimes. About one-quarter of these 100 lakes are currently classified as monomictic—undergoing one mixing event in most years— and will become permanently stratified systems. About one-sixth of these are currently dimictic—mixing twice per year—and will become monomictic. We conclude that many lakes will mix less frequently in response to climate change.

（来源：Nature Geoscience, 2019, https://doi.org/10.1038/s41561-019-0322-x）

中文点评:

全球湖水混合模式变化对气候变化的响应

近日，雷丁大学发表在《自然——地球科学》上的一项研究表明，由于地表温度升高和冬季冰盖减少，未来几年气候变暖将抑制某些湖泊内的水流动。该研究调查了世界各地635个大型湖泊的水混合模式，并发现到本世纪末气候变化将破坏其中约100个的混合。许多湖泊混合的频率较低，有些湖泊全年都没有混合。

本研究中科学家们使用一维数值模型来评估在21世纪预测的两种气候情景下对湖泊混合方式的影响。第一个“最佳情况”假设全球温室气体排放量将在2010-2020之间达到峰值然后下降，而第二个“最坏情况”假设排放量在2080年左右达到峰值，然后才会下降。在温度升高的情况下，到目前为止，冬季冰川覆盖的大约四分之一的湖泊将在2080年至2100年之间永久无冰。对于受影响最大的湖泊，地表水温度最高可达5.5℃。受水温和风影响的湖泊混合对于从深水输送养分到支持近地表生态系统非常重要。有些湖泊每年混合常规次数，而较浅的湖泊可以不断混合而其他湖泊则根本不混合。

本研究第一作者雷丁大学气象学系的Iestyn Woolway博士说：“深水中缺氧会对鱼类栖

息地产生不利影响，甚至导致死亡区无法维持生命。在较温暖的条件下，藻类在表面繁殖时，有毒物质被释放到水中的可能性。气候变化将如何影响湖泊的分析清楚地表明了在不久的将来对动物和人类的威胁。”雷丁大学和NERC国家地球观测中心研究的共同作者Chris Merchant教授说：“并非所有预计会出现温度升高的湖泊都会经历混合模式的变化，但全球变暖将影响湖泊世界各地，以及无数的动物，生物和依赖它们的人。”

（来源：根据新华网相关资料编译，2019-03-28）

摘要精选

Eutrophication will increase methane emissions from lakes and impoundments during the 21st century

Jake J. Beaulieu, Tonya DelSontro, John A. Downing.

Lakes and impoundments are an important source of methane (CH_4), a potent greenhouse gas, to the atmosphere. A recent analysis shows aquatic productivity (i.e., eutrophication) is an important driver of CH_4 emissions from lentic waters. Considering that aquatic productivity will increase over the next century due to climate change and a growing human population, a concomitant increase in aquatic CH_4 emissions may occur. We simulate the eutrophication of lentic waters under scenarios of future nutrient loading to inland waters and show that enhanced eutrophication of lakes and impoundments will substantially increase CH_4 emissions from these systems (+30–90%) over the next century. This increased CH_4 emission has an atmospheric impact of 1.7–2.6 Pg C-CO_2-eq y^{-1}, which is equivalent to 18–33% of annual CO_2 emissions from burning fossil fuels. Thus, it is not only important to limit eutrophication to preserve fragile water supplies, but also to avoid acceleration of climate change.

（来源：Nature Communications, 2019,10:1375）

Total phosphorus-precipitation and Chlorophyll a-phosphorus relationships of lakes and reservoirs mediated by soil iron at regional scale

Tang, Quehui; Peng, Liang; Yang, Yang; et al.

Phosphorus is a critical element determining trophic status and Chlorophyll a (Chl a) level in natural lakes and reservoirs, and total phosphorus (TP) concentrations can be predicted from data on phosphorus loading, hydraulic flushing rate and sedimentation. Due to their interactions with phosphorus, iron (hydr) oxides in suspended particles, originally derived from watershed soil, can strongly influence the phosphorus sedimentation and phosphorus bioavailability in water columns. Thus, the TP-precipitation relationship and the response of Chl a to TP are likely associated with watersheds soil iron. To test this assumption, we built hierarchical linear models for summer observation of natural lakes and reservoirs across a large geographic gradient. The intercepts and slopes of TP-precipitation relationships are higher in natural lakes than those in reservoirs, and these model coefficients exhibit latitudinal variations that are

explained by the natural soil iron gradient. Soil iron, operating at a regional level, significantly mediates the effect of precipitation on TP concentration in both natural lakes and reservoirs, and drives the latitudinal variation in the Chl a-TP relationships for reservoirs. Our results imply that the increase in extreme precipitation events anticipated under future climate conditions may substantially mitigate eutrophication in tropical and subtropical reservoirs, but may worsen conditions in temperate lakes.

（来源：Water research, 2019, 154:136-143）

Characterization of CDOM in saline and freshwater lakes across China using spectroscopic analysis

Song, Kaishan; Shang, Yingxin; Wen, Zhidan; et al.

Colored dissolved organic matter (CDOM) is a major component of DOM in waters, and plays a vital role in carbon cycling in inland waters. In this study, the light absorption and three-dimensional excitation emission matrix spectra (EEMs) of CDOM of 936 water samples collected in 2014-2017 from 234 lakes in five regions across China were examined to determine relationships between lake water sources (fresh versus saline) and their fluorescence/absorption characteristics. Results indicated significant differences regarding DOC concentration and a(CDOM)(254) between freshwater (6.68 mg C L-1, 19.55 m(-1)) and saline lakes (27.4 mg C L-1, 41.17 m(-1)). While humic-like (F-5) and fulvic-like (F-3) compounds contributed to CDOM fluorescence in all lake waters significantly, their contribution to total fluorescence intensity (F-T) differed between saline and freshwater lakes. Significant negative relationships were also observed between lake altitude with either F-5 (R-2 = 0.63, N = 306) or F-T (R-2 = 0.64, N = 306), suggesting that the abundance of humic-like materials in CDOM tends to decrease with increased in lakes altitude. In high altitude lakes, strong solar irradiance and UV exposure may have induced photo-oxidation reactions resulting in decreased abundance of humic-like substances and the formation of low molecular weight compounds. These findings have important implications regarding our understanding of C dynamics in lacustrine systems and the contribution of these ecosystems to the global C cycle.

（来源：WATER RESEARCH, 2019, 150:403-417）

Distribution, pollution status, and source apportionment of trace metals in lake sediments under the influence of the South-to-North Water Transfer Project, China

Wen Zhuang, Samantha C. Ying, Alexander L. Frie; et al.

In an effort to combat the threat of drought, China constructed the South-to-North Water Transfer Project (SNWTP), the biggest water transfer project in terms of volume with the largest beneficiary population in the world. Reports have shown that massive water diversion projects have had detrimental environmental consequences including water quality decline and freshwater habitat degradation. However, few reports have assessed the impact of the transfer project on sediment quality, which is highly susceptible to allogenic and local anthropogenic pollution. We examined the distribution characteristics of Cd, Cr, Cu, Ni, Pb and Zn in surface sediment of the largest reservoir along the East Route of SNWTP, Nansihu Lake, followed by positive matrix factorization (PMF) to determine their potential sources. We utilized enrichment factor, multiple sediment quality guidelines (SQGs), and

potential ecological risk index (RI) to determine metal accumulation or pollution risk. The results show the mean concentrations of Cr, Cu, Pb, Zn were slightly lower than in samples collected in 2003, 2010 and 2012, while the mean concentrations of Cr and Ni were significantly higher than samples from previous years. Among the six metals, Cr, Cu and Ni are of higher ecological risk according to SQGs; but Cd is of higher ecological risk according to RI. PMF analysis shows that industrial production and shipping are important sources of Cr, Cu, and Ni. PMF analysis also shows that a considerable amount of trace metals, especially Cd, Cr, Pb and Zn, mainly comes from the use of pesticide fertilizers and biomass sources in farmland, and may partly enter Nansihu Lake from SNWTP. This study reveals the possible sources of trace metals to the Nansihu Lake which is part of SNWTP; the results of the study may serve as a reference for better understanding the impact of future water diversion projects on metals distribution.

（来源：Science of The Total Environment, 2019, https://doi.org/10.1016/j.scitotenv.2019.03.306）

Acid deposition induced base cation loss and different responses of soils and sediments in Taihu Lake watershed, China

Dai Dan, Yu Tao, Deng Yixiang; et al.

Acid deposition and algae blooms have resulted in great changes in the water chemistry of Taihu Lake; however, there have been few calculated results to describe these processes. Here we used a mass balance model to estimate base cation losses and evaluate the model applicability in this intensively human-impacted watershed based on a long-term database (1985–2015). The results showed that carbonate weathering induced Ca^{2+} and Mg^{2+} losses in the watershed were responsible for the increased ion net reaction (INR) of Ca^{2+} and Mg^{2+} in the lake. While the increase of K^{+} and Na^{+} were not appropriate to provide independents check on the mass balance model because they generally entered the lake as human discharges, not reflecting change of the geochemical process in the watershed as the watershed dominant bedrock is carbonate but not silicate. Acid deposition in Taihu region caused decrease in pH, lime potential, and different Ca, Mg species of surface soils. Our field measurements of sediments in the two lake parts showed that the sediment lime potential was significantly higher in the algae dominated lake area than in the hydrophyte-dominated area due to the in-lake alkalinization by algae blooms, indicating that algae blooms played a significant role in the acidification resistance. Meanwhile, the measured lime potential of the watershed soils was lower than that of the sediment, implying a potential risk of acidification in the watershed. This research helps understand the accelerated interactions between human activities and natural geochemical processes and accelerated water chemistry change at the watershed level.

（来源：Chemosphere, 2019, https://doi.org/10.1016/j.chemosphere.2019.03.136）

Determination of influencing factors on historical concentration variations of PAHs in West Taihu Lake, China

Yan Li, Genmei Wang, Junxiao Wang; et al.

The adsorption of polycyclic aromatic hydrocarbons (PAHs) by components such as elemental carbon (EC), total organic carbon (TOC), and particles is different, and EC and PAHs are good materials for reconstructing historical human activity patterns and pollution conditions. In this study, the effects of EC

(soot and char), TOC and particles of different grain size on PAHs in surface sediments were quantitatively analysed, and their historical concentrations in a sediment core from western Taihu Lake were reconstructed. The contents of soot, TOC, clay, EC and char explained 57.2%, 27.6%, 26.0%, 24.0% and 16.4%, respectively, of the PAH concentrations in surface sediments. The correlation between the soot and PAH levels was significantly higher than that between the char, TOC, and clay contents and PAH levels, and PAHs were mainly affected by the local economic development and human activity, as indicated by metrics of population, highway mileage, coal burning, and industrial output. With the development of the economy of the Taihu Lake Basin, the composition of PAHs in the sediments has changed: the proportion of low-molecular-weight PAHs decreased from 42.4% to 17.5%, and that of high-molecular-weight PAHs increased from 58.7% to 82.5%. The concentration of PAHs in pore water from Taihu Lake over the past 100 years was reconstructed and ranged from 43.1 to 961.2 μg L−1, with an average of 180.7 μg L−1. After China's reform and opening up, the concentrations of various PAHs in Taihu Lake changed from safe to chronic pollution levels. The ratios of lead (Pb) isotopes and the diagnostic ratios of PAHs showed that the main sources of PAHs in western Taihu Lake sediments were human activities such as coal and petroleum combustion.

（来源：Environmental Pollution, 2019, https://doi.org/10.1016/j.envpol.2019.03.055）

Variable responses of dissolved organic carbon to precipitation events in boreal drinking water lakes

Kate A. Warner, Jasmine E. Saros.

In boreal regions, increased concentrations of dissolved organic carbon (DOC) have been linked to extreme wet years; however, less is known about the extent to which precipitation events are altering DOC concentration and quality. We assessed the effects of rain events on a suite of six lakes in Maine, U.S.A., to better understand how events alter DOC quantity and quality. DOC concentrations and DOC quality (measured as DOC-specific absorption coefficients (Specific Ultraviolet Absorbance (SUVA254 (also a*254), a*320, and a*380)) were quantified 24 h before, and at three time points (24–48 h, 5–7 days, and 3 weeks) after five different precipitation events. Our results revealed three types of responses across the lakes: (1) an initial spike in DOC concentrations of 30–133% and in the three quality metrics of 20–86% compared to pre-storm levels, followed by return to pre-storm concentrations; (2) a sustained increase in DOC concentrations (by 4–23%) and an increase in the three DOC quality metrics (by 1–43%) through the second post-storm sampling, with concentrations falling by the third post-storm sampling compared to pre-storm levels; and (3) no change during all sampling periods. Lake residence time was a key driver of changes in DOC concentration and DOC quality in response to storm events. Our research provides evidence that precipitation events contribute to short-term abrupt changes in DOC quantity and quality that are largely driven by key landscape and lake characteristics. These changes in DOC may have important implications for management of water utilities, including alteration or implementation of treatment strategies.

（来源：Water Research, 2019, https://doi.org/10.1016/j.watres.2019.03.036）

Inversion of inherent optical properties in optically complex waters using sentinel-3A/OLCI images: A case study using China's three largest freshwater lakes

Kun Xue, Ronghua Ma, Hongtao Duan; et al.

Inherent optical properties (IOPs) play an important role in underwater light field, and are difficult to estimate accurately using satellite data in optically complex waters. To study water quality in appropriate temporal and spatial scales, it is necessary to develop methods to obtain IOPs form space-based observation with quantified uncertainties. Field-measured IOP data (N = 405) were collected from 17 surveys between 2011 and 2017 in the three major largest freshwater lakes of China (Lake Chaohu, Lake Taihu, and Lake Hongze) in the lower reaches of the Yangtze River and Huai River (LYHR). Here we provide a case-study on how to use in-situ observation of IOPs to devise an improved algorithm for retrieval of IOPs. We then apply this algorithm to observation with Sentinel-3A OLCI (Ocean and Land Colour Instrument, corrected with our improved AC scheme), and use in-situ data to show that the algorithm performs better than the standard OLCI IOP product. We use the satellite derived products to study the spatial and seasonal distributions of IOPs and concentrations of optically active constituents in these three lakes, including chlorophyll-a (Chla) and suspended particulate matter (SPM), using all cloud-free OLCI images (115 scenes) over the lakes in the LYHR basin in 2017. Our study provides a strategy for using local and remote observations to obtain important water quality parameters necessary to manage resources such as reservoirs, lakes and coastal waters.

（来源：Remote Sensing of Environment, 2019, 225: 328-346）

Negligible cycling of terrestrial carbon in many lakes of the arid circumpolar landscape

Matthew J. Bogard, Catherine D. Kuhn, Sarah Ellen Johnston; et al.

High-latitude environments store nearly half of the planet's below-ground organic carbon (OC), mostly in perennially frozen permafrost soils. Climatic changes drive increased export of terrestrial OC into many aquatic networks, yet the role that circumpolar lakes play in mineralizing this carbon is unclear. Here we directly evaluate ecosystem-scale OC cycling for lakes of interior Alaska. This arid, low-relief lake landscape is representative of over a quarter of total northern circumpolar lake area, but is greatly under-represented in current studies. Contrary to projections based on work in other regions, the studied lakes had a negligible role in mineralizing terrestrial carbon; they received little OC from ancient permafrost soils, and had small net contribution to the watershed carbon balance. Instead, most lakes recycled large quantities of internally derived carbon fixed from atmospheric CO_2, underscoring their importance as critical sites for material and energy provision to regional food webs. Our findings deviate from the prevailing paradigm that northern lakes are hotspots of terrestrial OC processing. The shallow and hydrologically disconnected nature of lakes in many arid circumpolar landscapes isolates them from terrestrial carbon processing under current climatic conditions.

（来源：Nature Geoscience, 2019, 12:180-185）

Unchanged frequency of moraine-dammed glacial lake outburst floods in the Himalaya

Georg Veh, Oliver Korup, Sebastian von Specht; et al.

Shrinking glaciers in the Hindu Kush–Karakoram–Himalaya–Nyainqentanglha (HKKHN) region have formed several thousand moraine-dammed glacial lakes1,2,3, some of these having grown rapidly in past decades3,4. This growth may promote more frequent and potentially destructive glacial lake outburst floods (GLOFs)5,6,7. Testing this hypothesis, however, is confounded by incomplete databases of the few reliable, though selective, case studies. Here we present a consistent Himalayan GLOF inventory derived automatically from all available Landsat imagery since the late 1980s. We more than double the known GLOF count and identify the southern Himalayas as a hotspot region, compared to the more rarely affected Hindu Kush–Karakoram ranges. Nevertheless, the average annual frequency of 1.3 GLOFs has no credible posterior trend despite reported increases in glacial lake areas in most of the HKKHN3,8, so that GLOF activity per unit lake area has decreased since the late 1980s. We conclude that learning more about the frequency and magnitude of outburst triggers, rather than focusing solely on rapidly growing glacial lakes, might improve the appraisal of GLOF hazards.

（来源：Nature Climate Change, 2019, https://doi.org/10.1038/s41558-019-0437-5）

The Abundance, Size, and Spacing of Lakes and Reservoirs Connected to River Networks

J. R. Gardner, T. M. Pavelsky, M. W. Doyle; et al.

Descriptions of river network topology do not include lakes/reservoirs that are connected to rivers. We describe the properties and scaling patterns of river network topology across the contiguous United States: how lake/reservoir abundance, median lake/reservoir size, and median lake/reservoir spacing change with river size. Typically, lake/reservoir abundance decreases, median lake/reservoir size increases, but median lake/reservoir spacing is uniform across river size. There is a characteristic lake/reservoir size of 0.01–0.05 km2 and a characteristic lake/reservoir spacing of 1–5 km that shifts to 27–61 km in larger rivers. Climate explains more of the variance in river network topology than both glacial history and constructed reservoirs. Our results provide conceptual models for building river network topologies to assess how lake/reservoir abundance, size, and spacing effect the transport, storage, and cycling of water, materials, and organisms across networks.

（来源：Geophys. Res. Lett., 2019, https://doi.org/10.1029/2018GL080841）

Mixing and internal dynamics of a medium-size and deep lake near the Arctic Circle

Priet-Maheo, M. C.; Ramon, C. L.; Rueda, F. J.; et al.

The goal of the research was to identify the mixing features that distinguish wind forced, medium-size fjord-type lakes near the Arctic Circle from systems of similar geometry, but in a temperate climate. Experimental data and the results of 3D numerical hydrodynamic simulations were analyzed for Lake Lagarfljot (27 km long; 2 km wide; 110 m maximum depth; 65 degrees N) during the 5-month ice-free period in 2009. The results showed that probably the most distinctive feature of arctic lakes is their low water column stability, one order of magnitude lower than that of mid-latitude lakes, even in mid-summer.

The second characteristic is the high rate of energy imparted by wind in the Arctic, estimated as one order of magnitude larger than in a temperate climate. Frequent wind events with Lake and Wedderburn numbers below 1 occurred during the ice-free period, leading to a strong shear at the base of the surface mixed-layer and the upwelling of deep metalimnetic layers. As a result, nearly continuous density stratification developed in the shallowest 70 m of the water column, and longitudinal temperature gradients may therefore be very significant. On average, 15% of the wind forcing drove large-scale internal motions. This energy was rapidly dissipated, partly as a result of stronger bottom velocities, nonlinear surges, and hydraulic jumps that repeatedly formed in the lake. The initial V1H1 setup rapidly evolved into spatially complex oscillatory modes, which, given the high latitude, are affected by the Earth's rotation, even in narrow basins.

（来源：LIMNOLOGY AND OCEANOGRAPHY, 2019, 64(1): 61-80）

Simulating Climate Change Impacts on Surface Water Resources Within a Lake-Affected Region Using Regional Climate Projections

Erler, Andre R.; Frey, Steven K.; Khader, Omar; et al.

This study aims to assess the impact of climate change on water resources in a large watershed within the Laurentian Great Lakes region, using the fully integrated surface-subsurface model HydroGeoSphere. The hydrologic model is forced with an ensemble of high-resolution climate projections from the Weather Research and Forecasting (WRF) model. The latter has been extended with an interactive lake model (FLake) to capture the effect of the Great Lakes on the regional climate. The WRF ensemble encompasses two different moist physics configurations at resolutions of 90, 30, and 10km, as well as four different initial and boundary conditions, so as to control for natural climate variability. The integrated hydrologic model is run with a representative seasonal cycle, which effectively controls natural climate variability, while remaining computationally tractable with a large integrated model. However, the range of natural variability is also investigated, as are the impacts of climate model resolution and bias correction. The two WRF configurations show opposite climate change responses in summer precipitation, but similar responses otherwise. The hydrologic simulations generally follow the climate forcing; however, due to the memory of the subsurface, the differences in summer propagate throughout the entire seasonal cycle. This results in a set of dry scenarios with reduced streamflow and water availability year-round and a set of wet scenarios with increased streamflow for all times excluding the spring peak, which does not increase. Most of the analysis focuses on streamflow, but changes in the seasonal cycle of baseflow and groundwater recharge are also analyzed..

（来源：WATER RESOURCES RESEARCH, 2019,55(1):130-155）

Evaluation of eutrophication in freshwater lakes: A new non-equilibrium statistical approach

Huibin Du, Zhenni Chen, Guozhu Mao; et al.

Lake eutrophication has become a global problem of water pollution, while factors such as Chlorophyll-a (Chl-a), total nitrogen (TN), total phosphorus (TP), chemical oxygen demand (COD) and secchi depth (SD) are the main indicators to evaluate lake eutrophication level. Considering the interaction among these factors, this paper applies a new dynamic model to investigate the changes of the lake’s trophic

level. Taking Lake Fuxian, Lake Yilong and Caohai of Lake Dianchi in China as examples, we built a lake eutrophication simulation model based on maximum flux principle (MPF) and self-organised map (SOM) and analysed the relationship between environmental factors and lake eutrophication level using monthly data. The model calculates the monthly eutrophication level of each lake, which is consistent with the actual situation of these lakes, and this consistence verified the veracity of our model results. In addition, according to the relationship between environmental factors and eutrophication, the different simulation results and the original results of Lake Fuxian and Lake Dianchi, we found that the physical factors such as SD can be the accurate and intuitive observations of the trophic status in clean-state lakes with lower-mesotrophic level, while the trophic level of turbid-state lakes with hypereutrophic level are susceptibly driven by the nutrient such as N and P.

（来源：Ecological Indicators, 2019,102:686-692）

Temporal variation of major nutrients and probabilistic eutrophication evaluation based on stochastic-fuzzy method in Honghu Lake, Middle China

Fei LI, ZhenZhen, JingDong ZHANG; et al.

Honghu Lake, which is listed in the Ramsar Convention, was found to be contaminated with elevated nutrients to a certain extent. This study investigated the seasonal variation of major nutrients and probabilistic eutrophic state in surface water from Honghu Lake. Average concentrations of total nitrogen (TN), total phosphorus (TP), chlorophyll-a (Chl-a), chemical oxygen demand (CODMn) and transparency (SD) in summer and winter generally exceeded Grade III of the Chinese environmental quality standards for surface water (GB 3838-2002), with the exception of CODMn in winter. Mean concentrations of Chl-a and CODMn in summer were higher than that in winter, while mean concentrations of TN, TP and SD were slightly higher in winter. The improved probabilistic comprehensive trophic level index (PTLI) method based on stochastic-fuzzy theory was established to evaluate the eutrophic state in Honghu Lake. Compared with the Monte-Carlo sampling method, the Latin Hypercube sampling (LH-TFN) method was selected for the evaluation simulation due to its efficiency and stability. Evaluation results indicated that mean PTLI in summer (69.70) and winter (61.96) were both subordinated to Grade IV (Medium eutrophication). The corresponding reliability of eutrophication level subordinating to Grade IV in summer was of relatively low reliability (51.27%), which might mislead decision makers to some extent and suggest recheck. The probabilistic eutrophication level in summer developed with a trend from medium to severe eutrophication. Sensitivity analysis illustrated that CODMn and Chl-a were the priority pollutants in summer, with the contributions to PTLI of 43.3% and 22.5% respectively. Chl-a was the priority pollutant in winter, with the contribution to PTLI up to 51.3%.

（来源：SCIENCE CHINA Technological Sciences, 2019, 62(3):417-426）

Significant differences exist in lake-atmosphere interactions and the evaporation rates of high-elevation small and large lakes

Binbin Wang, Yaoming Ma, Yan Wang; et al.

Lakes impact atmosphere boundary layer processes and are thus important for catchment scale climate modeling and regional water and heat budgets. To explore the differences in lake-atmosphere interaction

parameters, meteorological variables and turbulent heat fluxes in small and large water bodies, we collected eddy covariance observations and meteorological data during ice-free periods of the Lake small Nam-Co (“small lake”) in 2012–2013 and Lake Nam-Co (“large lake”) in 2015–2016 on the Tibetan Plateau. Significant differences exist in their lake-atmosphere interaction processes due to differences in their inherent attributes and environmental backgrounds. Relative to the “small lake”, the maximum surface temperature of the “large lake” in summer is approximately 3 °C lower; “large lake” also has a larger wind speed, a higher monthly average air temperature and delayed peaks of the seasonal variation of water and air temperature. The typical values of the roughness length and standard bulk transfer coefficient for momentum are approximately 80% and 21% higher, respectively, for the “large lake”. The typical values of the roughness lengths for heat and water are one order of magnitude lower in the “large lake” while the corresponding standard bulk transfer coefficients are only 7% lower. The latent and sensible heat fluxes of the two lakes have quite different seasonal variations, with evaporation peaking in November for the “large lake” and in June for the “small lake”. The estimated evaporation during the ice-free season of the “large lake” (approximately 981±18mm) is also higher than that (812 mm) of the “small lake” and this is mainly related to the observed lower Bowen ratio in the “large lake”.

（来源：Journal of Hydrology, 2019, https://doi.org/10.1016/j.jhydrol.2019.03.066）

Influence of the three Gorges Reservoir on the shrinkage of China's two largest freshwater lakes

Yongqiang Zhou, Jianrong Ma, Yunlin Zhang; et al.

The impoundment of the Three Gorges Reservoir (TGR), the largest hydropower project in the world, has altered the sediment deposition and erosion regime of downstream-linked rivers and lakes. The extent to which the TGR impoundment has changed the surface areas of the two largest freshwater lakes in China, Lake Dongting and Lake Poyang, remains largely unknown. Here, we compared the surface areas of the two lakes pre and post the TGR impoundment as well as with a modelled non-TGR scenario. We found that the mean surface areas of Lake Dongting and Lake Poyang during the post-TGR period (2003–2016) were significantly smaller than in the pre-TGR period (1956–2002) and in the modelled non-TGR scenario (2003–2016). The impoundment of TGR has led to a shift from a sediment deposition regime to an erosion-dominated regime of the downstream-linked rivers and the two lakes. The impoundment of TGR further changed the seasonal variabilities in discharge and water level in the downstream-linked rivers and the two lakes, especially in the flood season. Our results suggest that TGR resulted in a 5.1%, 16.2%, and 12.2% decrease of the surface area of Lake Dongting in June 2003–September 2006, October 2006–September 2008, and October 2008–December 2016, respectively, and a corresponding decrease of 12.4%, 19.6%, and 15.8% for Lake Poyang. These changes cannot be attributed to variations in rainfall as no significant differences were found in the annual or monthly mean rainfall in the watersheds upstream of Luoshan and Jiujiang + Hukou between the pre-TGR and the post-TGR period. Our results call for the development of a strong holistic management plan for cascading reservoirs, including TGR, to minimize the damage of downstream lake ecosystems.

（来源：Global and Planetary Change, 2019, https://doi.org/10.1016/j.gloplacha.2019.03.014）

Evaluating Operational Hydrodynamic Models for Real‐time Simulation of Evaporation from Large Lakes

A. D. Gronewold, E. J. Anderson, J. Smith.

Methods for simulating evaporative water loss from Earth's large lakes have lagged behind advances in hydrodynamic modeling. Here, we explore use of oceanographic models to simulate lake evaporation from a long‐term water balance perspective. More specifically, we compare long‐term monthly simulations of latent heat flux from two configurations of a current operational hydrodynamic forecasting system (based on the Finite Volume Community Ocean Model, or FVCOM) for the Laurentian Great Lakes. We then compare these simulations to comparable simulations from a legacy conventional lake thermodynamics model, and from a recently‐developed statistical water balance model. We find that one of the FVCOM configurations that is currently used in operations for short‐term hydrodynamic forecast guidance is also suitable for real‐time simulation of evaporation from very large lakes. The operational versions of FVCOM should therefore be considered a readily‐available tool for supporting regional water supply management and, pending further research, extended water supply forecasting.

（来源：Geophys. Res. Lett., 2019, https://doi.org/10.1029/2019GL082289）

The Holocene salinity history of Lake Lop Nur (Tarim Basin, NW China) inferred from ostracods, foraminifera, ooids and stable isotope data

Steffen Mischke, Chengjun Zhang, Chenglin Liu; et al.

Terminal lakes without outlet respond directly to climate change and human impact, and provide important evidence for environmental conditions prior to times of instrumental monitoring. Lop Nur in northwestern China is a terminal lake which was still one of the world's largest lakes in historical times. Sediments from the excavated section YKD0301 in its presently dry basin were investigated to reconstruct the Holocene salinity history of the lake. Ostracod shells of Cyprideis torosa and Eucypris mareotica, tests of the foraminifer Ammonia tepida, and fruits of Ruppia maritima are abundant in the early Holocene part of the section. Two stratigraphic units in the middle Holocene part of the section contain ostracod shells typical of fresh to mesohaline waters such as Limnocythere inopinata, Cypridopsis vidua, Ilyocypris sp. and Darwinula stevensoni. Three units do not contain fossils or only few remains regarded as allochthonous. Ooids are abundant in the upper half of the section, and are here reported for the sediments of Lop Nur or sub-recent sediments from China for the first time. Ooids from YKD0301 are aragonitic and either subspherical around a detrital nucleus, or elongate and probably formed around fecal pellets of brine shrimps. The recorded fossils from Lop Nur indicate that lake waters were poly- to hyperhaline (20–100‰) at ca. 9.0 ka, oligo- to mesohaline (0.5–18‰) between ca. 8.7–7.5 ka and probably mesohaline (5–18‰) from 6.0–5.0 ka. In the intervening periods and after 5.0 ka, Lop Nur was a hyperhaline (>100‰) lake. The period of freshest conditions of Lop Nur (ca. 8.7–7.5 ka) coincides with wettest Holocene conditions reconstructed from other lake records in the region although a uniform temporal pattern of wettest Holocene climate conditions in NW China and adjacent regions cannot be inferred.

（来源：Global and Planetary Change, 2019, 175:1-12）

Holocene climate records from lake sediments in India: Assessment of coherence across climate zones

Pavani Misra, S.K. Tandon, Rajiv Sinha.

Holocene lake records constitute an important archive for the reconstruction of paleoclimate. Despite the overall climatic stability of the Holocene, the monsoons in India, both summer, and winter, show various episodes of weakening and strengthening during this time interval. As the Holocene lake records are distributed across the various geomorphic and climatic zones of India, they offer the possibility of understanding regional scale variations in terms of both qualitative and quantitative assessment of the available proxy data. The present-day precipitation in India varies from <200 to ~3800 mm (IMD), and the climate changes from arid to humid generally from west to east. The compiled lake records were aggregated into eight different zones based on their climatic and geomorphic settings. Data has been compiled from 76 lake records from India and then classified as per the various geomorphic-climatic zones of the country. The multiple lake proxies indicate fluctuating lake levels throughout the Holocene and also show regional scale coherence for specific climatic events. A majority of the records witness a peak in monsoon strength between 9 and 5 kyr BP, corresponding to the globally recorded warm and wet period of the Holocene Climate Optima. After 4 kyr BP, a general trend in aridity is recorded throughout India. This assessment shows that 17 lake records have a reasonable stratigraphic resolution, and only 9 other lake records provide paleoclimate information for a duration extending more than ~8 kyr. This study also emphasizes the importance of assessing the sensitivity of the lakes with respect to their geomorphic-climatic settings. We suggest that several sites across the different geomorphic-climatic zones should be re-occupied to generate high fidelity records with a stronger chronological framework to strengthen the Holocene climatic reconstructions of the Indian sub-continent.

（来源：Earth-Science Reviews, 2019, 190: 370-397）

Long-term variation of phytoplankton biomass and physiology in Taihu lake as observed via MODIS satellite

Huang, Changchun; Zhang, Yunlin; Huang, Tao; et al.

Estimation of phytoplankton biomass (noted as phytoplankton carbon, Cphyto) and evaluation of phytoplankton physiology is central to the estimation of primary productivity and the carbon cycle. This issue has been widely considered in oceans but not in inland water. Here, we develop experiential and semi-analytical models, which validated by independent in situ measurement data, respectively, to derive Cphyto and phytoplankton absorption coefficient at 675 nm (aph(675)) from MODIS. The effects of nutrients and temperature on the seasonal variation of phytoplankton physiology were assessed through a novel proxy of Cphyto to aph(675) ratio (Cphyto/aph(675)) over the Lake Taihu, the third largest lake in China. Significant seasonal climatological cycles of Cphyto, aph(675) and Cphyto/aph(675) were observed in Lake Taihu, especially in Meiliang Bay and Zhushan Bay, where algal blooms occur frequently. The highest Cphyto and aph(675) values were observed in summer due to the growth of phytoplankton biomass and chlorophyll-a concentration. Lower values were observed in winter and spring, which are characterized by relatively high total nitrogen levels and low irradiance, owing to the low temperature astricts the algae growth. However, the Cphyto/aph(675) shows an opposite trend compared to Cphyto and aph(675), which have high values in winter and low values in summer. The

analysis of Cphyto, aph(675) and Cphyto/aph(675) with total phosphorus (TP) levels and temperature indicates that TP are the main positive driver of the increase in Cphyto and aph(675) and negatively regulate Cphyto/aph(675). Warming promotes an increase in Cphyto and aph(675) and restricts Cphyto/aph(675) in summer. Biomass and nutrient levels are the primary drivers of the decrease of Cphyto/aph(675) in such a typical eutrophic lake. The results present some new findings compared to previous oceanic studies and expand our knowledge in the study of phytoplankton biomass and physiology in eutrophic lakes.

（来源：Water research, 2019, 153:187-199）

Spatial and temporal variation in nitrogen fixation and its importance to phytoplankton in phosphorus-rich lakes

Hayes, Nicole M.; Patoine, Alain; Haig, Heather A.; et al.

Limnological theory posits that phosphorus (P) limits primary production in freshwater lakes, in part because fixation of atmospheric nitrogen (N-2) can compensate for limitations in nitrogen (N) supply to phytoplankton. However, quantitative estimates of the degree to which N-2 fixation satisfies planktonic N demand are rare. Here we used biweekly sampling during summer in seven lakes over 2 decades to estimate both planktonic N-2 fixation and phytoplankton N demand. We further assessed the ability of biologically fixed N to satisfy N needs of primary producers in productive hardwater lakes. Phytoplankton N requirements, derived from estimates of phytoplankton productivity and N content, were moderately synchronous (S = 0.41) among lakes (ca. 0.1-9.2 mg N m(-3) hr(-1)). In contrast, rates of N-2 fixation determined using isotopic natural abundance method (NAM; 0.002-3.2 mg N m(-3) hr(-1)), or heterocyte-based calculations (0.10-1.78 mg N m(-3) hr(-1)), varied asynchronously (S-NAM = -0.03 and S-Heterocyte = -0.11) among basins, accounted for a median of 3.5% (mean 11.3% +/- 21.6) of phytoplankton demand, and were correlated to the abundance of Nostocales cyanobacteria when analysed using generalised additive models. Overall, the total mass of fixed N accounted for a median of only 3.0% of the spring standing stock of total dissolved N in study lakes (mean 7.5 +/- 12.1%), with higher relative importance of fixed N in highly productive downstream lakes. Thus, while fixed N helps sustain primary productivity, particularly in years with high rates of N-2-fixation, it does not appear to eliminate N limitation of phytoplankton growth in these P-rich hardwater lakes.

（来源：FRESHWATER BIOLOGY, 2019, 64(2): 269-283）

Teleconnection between phytoplankton dynamics in north temperate lakes and global climatic oscillation by time-frequency analysis

Xiao, Xi; He, Junyu; Yu, Yan; et al.

We are still facing the knowledge gap of how the water-quality extremes (i.e. phytoplankton blooms), their causes, severity or occurrence could be directly related to the climatic oscillation. Considering that the climatic and phytoplankton concentration time series are highly non-stationary, we applied the advanced time-frequency analysis - Ensemble Empirical Mode Decomposition (EEMD), Hilbert-Huang Spectrum (HHS) and Wavelet Analysis (WA) - to examine the variability of long term phytoplankton dynamics from 1986 to 2014 in five North Temperate Lakes (NTLs). These analysis techniques isolated five separate time series for the surface Chlorophyll a concentrations (CHL) of the five NTLs and a time

series for the global climate oscillation (denoted by multivariate ENSO index, MEI), and showed that these time series generally operated at similar time scales. The long-term residual trends of decreasing were found in three lakes (i.e., BM, SP and TR lakes), which are the same to global climate dynamics (MEI). The wavelet analysis reveals strong coherency between MEI and CHL data sets for all lakes, with a periodicity of 64-months. Intuitive associations between the CHL and MEI data set showed that two types of ENSO (El Nino and La Nina) differ in their influences to CHL. Potential mechanisms relating the phytoplankton dynamics in NTLs to climatic oscillation (ENSO) were also discussed.

（来源：Water research, 2019, 154:267-276）

Food-web structure and ecosystem function in the Laurentian Great Lakes-Toward a conceptual model

Ives, Jessica T.; McMeans, Bailey C.; McCann, Kevin S.; et al.

The relationship between food-web structure (i.e., trophic connections, including diet, trophic position, and habitat use, and the strength of these connections) and ecosystem functions (i.e., biological, geochemical, and physical processes in an ecosystem, including decomposition, production, nutrient cycling, and nutrient and energy flows among community members) determines how an ecosystem responds to perturbations, and thus is key to understanding the adaptive capacity of a system (i.e., ability to respond to perturbation without loss of essential functions). Given nearly ubiquitous changing environmental conditions and anthropogenic impacts on global lake ecosystems, understanding the adaptive capacity of food webs supporting important resources, such as commercial, recreational, and subsistence fisheries, is vital to ecological and economic stability. Herein, we describe a conceptual framework that can be used to explore food-web structure and associated ecosystem functions in large lakes. We define three previously recognised broad habitat compartments that constitute large lake food webs (nearshore, pelagic, and profundal). We then consider, at three levels, how energy and nutrients flow: (a) into each basal resource compartment; (b) within each compartment; and (c) among multiple compartments (coupling). Flexible shifts in food-web structures (e.g., via consumers altering their diet or habitat) that sustain these flows in the face of perturbations provide evidence for adaptive capacity. We demonstrate the conceptual framework through a synthesis of food-web structure and ecosystem function in the Laurentian Great Lakes, with emphasis on the upper trophic levels (i.e., fishes). Our synthesis showed evidence of notable adaptive capacity. For example, fishes increased benthic coupling in response to invasion by mussels and round gobies. However, we also found evidence of loss of adaptive capacity through species extirpations (e.g., widespread collapse in the abundance and diversity of ciscoes, Coregonus spp., except in Lake Superior). In large freshwater lakes, fishery managers have traditionally taken a top-down approach, focusing on stocking and harvest policy. By contrast, water quality managers have focused on nutrient effects on chemical composition and lower trophic levels of the ecosystem. The synthesised conceptual model provides resource managers a tool to more systematically interpret how lower food-web dynamics influence harvestable fish populations, and vice versa, and to act accordingly such that sustainable resource practices can be achieved. We identify key gaps in knowledge that impede a fuller understanding of the adaptive capacities of large lakes. In general, we found a greater uncertainty in our understanding of processes influencing energy and nutrient flow within and among habitats than flows into the system.

（来源：FRESHWATER BIOLOGY, 2019, 64(1): 1-23）

Coalescent models characterize sources and demographic history of recent round goby colonization of Great Lakes and inland waters

Nicholas Sard, John Robinson, Jeannette Kanefsky; et al.

The establishment and spread of aquatic invasive species are ecologically and economically harmful and a source of conservation concern internationally. Processes of species invasion have traditionally been inferred from observational data of species presence/absence and relative abundance. However, genetic‐based approaches can provide valuable sources of inference. Restriction site‐associated DNA sequencing was used to identify and genotype single nucleotide polymorphism (SNP) loci for Round Gobies (Neogobius melanostomus) (N = 440) from 18 sampling locations in the Great Lakes and in three Michigan, USA, drainages (Flint, Au Sable, and Cheboygan River basins). Sampled rivers differed in size, accessibility, and physical characteristics including man‐made dispersal barriers. Population levels of genetic diversity and interpopulation variance in SNP allele frequency were used in coalescence‐based approximate Bayesian computation (ABC) to statistically compare models representing competing hypotheses regarding source population, postcolonization dispersal, and demographic history in the Great Lakes and inland waters. Results indicate different patterns of colonization across the three drainages. In the Flint River, models indicate a strong population bottleneck (<3% of contemporary effective population size) and a single founding event from Saginaw Bay led to the colonization of inland river segments. In the Au Sable River, analyses could not distinguish potential source populations, but supported models indicated multiple introductions from one source population. In the Cheboygan River, supported models indicated that colonization likely proceeded from east (Lake Huron source) to west among inland locales sampled in the system. Despite the recent occupancy of Great Lakes and inland habitats, large numbers of loci analyzed in an ABC framework enable statistically supported identification of source populations and reconstruction of the direction of inland spread and demographic history following establishment. Information from analyses can direct management actions to limit the spread of invasive species from identified sources and most probable vectors into additional inland aquatic habitats.

（来源：Evol. Appl., 2019, https://doi.org/10.1111/eva.12779）

Impoundment intensity determines temporal patterns of hydrological fluctuation, carbon cycling and algal succession in a dammed lake of Southwest China

Wang, Jiaoyuan; Chen, Guangjie; Kang, Wengang; et al.

Hydrological control of lakes has been increasingly practiced in many parts of the world, however, the long-term ecological impact of hydrological regulation and their dependence on lake impoundment intensity has been rarely examined. We combined a spatial survey of surface sediments with sediment core analyses to quantify the limnological changes over the last two centuries for an oligo-mesotrophic lake, which was dammed in 1957 and reinforced during 1987-1990, respectively. A water depth inference model constructed from surface sediment clay components was applied to a well-dated sediment core for water level reconstruction. The inferred water depth increased from 6.2 +/- 0.9 m to 8.7 +/- 1.7 m after dam construction and further to 13.6 +/- 2.6 m after dam enforcement, resulting in an increase in the magnitude of water level fluctuation (WLF). Accordingly, bulk sediment C/N ratio and median grain size spiked in similar to 1957 and similar to 1990, respectively, reflecting a large input of terrestrial sources

due to impoundment. With a consistent loss of littoral zone and benthic diatoms over time, a significant decrease in C/N ratio and an abrupt depletion of carbon isotopic signal suggested a shift of carbon transfer towards a pelagic pathway after similar to 1990. While there was a significant increase in algal production since similar to 1990, the accumulation rate of carbon and nitrogen burial displayed an accelerating drop since similar to 1957, reflecting a diluting effect derived from expanding water storage. Furthermore, there was a significant increase in both the ratio between inorganic and organic carbon fluxes and sediment burial of inorganic carbon, reflecting enhanced degradation and low storage of aquatic organic carbon in stratified deep waters since similar to 1990. Hydro-morphological variables were found to exert strong impact on diatom communities, with an increasing interplay with nutrient and climate variables over time. While there existed a significant shift of diatom composition in similar to 1960, species richness and community dissimilarity showed a significant decrease when water depth was raised to above similar to 10 m or the magnitude of WFL was above similar to 2 m. Thus, our sediment surveys provide evidence on the significant impact of lake regulation on hydro morphology, carbon burial and ecological shift over time, as well as its stronger interaction with other forcing with increased impoundment intensity.

（来源：WATER RESEARCH, 2019,148:162-175）

Integrating long-term dynamics of ecosystem services into restoration and management of large shallow lakes

Qi Lin, Ke Zhang, Ji Shen; et al.

Adequately understanding the dynamics of ecosystem services (ES), a practical framework for analyzing social-ecological systems (SES), is crucial for sustainable environmental management and decision-making. However, the interactions among multiple ES at multi-decadal scales are less explored, and many challenges remain to integrate long-term dynamics of ES into ecological restoration and management. Here, we combined socioeconomic data with synthesized paleolimnological records to assess the dynamics of 12 critical ES and regional SES in the Taihu Lake Basin (China) over the past century. Our results indicated that multiple provisioning services showed upwards trends while major regulating services in terms of water, sediment, soil and air regulation had sustained downwards trends since the 1950s, and reached dangerous status after the 1980s. This dynamic trade-off was mainly attributed to the effects of continued socioeconomic transitions including agriculture intensification, industrialization and urbanization. Anthropogenic land use change, pollution input, and climate changes are considered as major drivers of long-term environmental degradation. Regulating services exhibited various dynamical properties including different linear and nonlinear trends, and abrupt changes, which underlined the comprehensive consideration of legacy effects, ecological baseline, thresholds, and resilience into lake management. Environmental Kuznets curve analyses suggested that the regional SES started significant disorder from the 1970s driven by the transition between ES and non-ES (socioeconomic) supply, and then underpinned a gradual shift to reorganization stage after the 1990s. Our study highlights the significance of ES assessment from historical perspective to understand the major processes and underlying mechanisms of lake SES. With adaptive policy interventions on pollution control, efficient resource-use, and targeted environmental investment, the sustainability of regional SES can be expected.

（来源：Science of The Total Environment, 2019, https://doi.org/10.1016/j.scitotenv.2019.03.307）

Light and nutrient control phytoplankton biomass responses to global change in northern lakes

Ann‐Kristin Bergström , Jan Karlsson.

Global change affects terrestrial loadings of colored dissolved organic carbon (DOC) and nutrients to northern lakes. Still, little is known about how phytoplankton respond to changes in light and nutrient availability across gradients in lake DOC. In this study we used results from whole‐lake studies in northern Sweden to show that annual mean phytoplankton biomass expressed unimodal curved relationships across lake DOC gradients, peaking at threshold DOC levels of around 11mg L−1. Whole‐lake single nutrient enrichment in selected lakes caused elevated biomass, with most pronounced effect at the threshold DOC level. These patterns give support to the suggested dual control by DOC on phytoplankton via nutrient (positively) and light (negatively) availability and imply that the lakes location along the DOC axis is critical in determining to what extent phytoplankton respond to changes in DOC and/or nutrient loadings. By using data from the large Swedish Lake Monitoring Survey, we further estimated that 80% of northern Swedish lakes are below the DOC threshold, potentially experiencing increased phytoplankton biomass with browning alone, and/or combined with nutrient enrichment. The results support previous model results on effects of browning and eutrophication on lake phytoplankton, and provide important understanding of how northern lakes may respond to future global changes.

（来源：Glob. Change Biol., https://doi.org/10.1111/gcb.14623）

Functional shifts in lake zooplankton communities with hypereutrophication

Moody, Eric K.; Wilkinson, Grace M.

Functional variation among consumer communities can alter ecosystem nutrient cycling. These impacts on ecosystem function can be specifically driven by interspecific variation in stoichiometric traits; thus, functional trait-based approaches can be used to explain the processes controlling ecosystem stoichiometry. However, eutrophication may reduce the functional importance of consumers in ecosystems by eliminating heterogeneity in nutrient recycling among taxa. To test whether zooplankton functional diversity, i.e. aspects of the stoichiometric trait space occupied by zooplankton communities, varies over gradients in trophic state and nutrient stoichiometry, we examined functional and taxonomic variation in the zooplankton communities of 130 lakes in the agriculturally dominated state of Iowa (U.S.A.) over 7 years. Stoichiometric functional dispersion decreased with trophic state index, supporting the trait abundance shift hypothesis that hypereutrophic lakes are characterised by different combinations of functional traits than their less eutrophic counterparts. Zooplankton communities became increasingly N-rich relative to P as TSI increased. Specifically, P-poor Bosmina, Chydorus, and cyclopoid copepods increased in abundance with eutrophication. Stoichiometric trait distributions of zooplankton shift with eutrophication, which implies that the unique functioning of hypereutrophic lakes could be due in part to the consumers inhabiting them. As zooplankton N:P increased with trophic state while lake total nitrogen to total phosphorus ratio decreased with trophic state, P-poor zooplankton taxa may exacerbate excess P availability in these hypereutrophic systems by differentially recycling P at higher rates.

（来源：FRESHWATER BIOLOGY, 2019, 64(3): 608-616）

Analysis of environmental drivers influencing interspecific variations and associations among bloom-forming cyanobacteria in large, shallow eutrophic lakes

Kun Shan, Lirong Song, Wei Chen; et al.

Non-diazotrophic Microcystis and filamentous N2-fixing Aphanizomenon and Dolichospermum (formerly Anabaena) co-occur or successively dominate freshwaters globally. Previous studies indicate that dual nitrogen (N) and phosphorus (P) reduction is needed to control cyanobacterial blooms; however, N limitation may cause replacement of non-N2-fixing by N2-fixing taxa. To evaluate potentially counterproductive scenarios, the effects of temperature, nutrients, and zooplankton on the spatio-temporal variations of cyanobacteria were investigated in three large, shallow eutrophic lakes in China. The results illustrate that the community composition of cyanobacteria is primarily driven by physical factors and the zooplankton community, and their interactions. Niche differentiation between Microcystis and two N2-fixing taxa in Lake Taihu and Lake Chaohu was observed, whereas small temperature fluctuations in Lake Dianchi supported co-dominance. Through structural equation modelling, predictor variables were aggregated into ‘composites’ representing their combined effects on species-specific biomass. The model results showed that Microcystis biomass was affected by water temperature and P concentrations across the studied lakes. The biomass of two filamentous taxa, by contrast, exhibited lake-specific responses. Understanding of driving forces of the succession and competition among bloom-forming cyanobacteria will help to guide lake restoration in the context of climate warming and N:P stoichiometry imbalances.

（来源：Harmful Algae, 2019, 63(6):84-94）

科技热点

中国科学家呼吁开展第三极水循环研究

1月3日，中科院院士、第二次青藏高原综合科学考察研究（STEP）首席科学家、泛第三极环境变化与绿色丝绸之路建设战略性先导科技专项（以下简称“丝路环境”专项）首席科学家、第三极环境（TPE）国际计划主席姚檀栋团队在《自然》杂志发表题为《冰崩威胁亚洲水安全》的科学评论文章，旨在阐明第三极地区正在经历的加速水循环过程及其影响和建立系统的气象—水体稳定同位素观测网的重要性，呼吁全球自然科学家和社会科学家投身到第三极水循环研究中，构建聚焦水问题的观测和地球系统模型新体系，服务于亚洲水塔和丝路地区的水安全战略和水资源管理。

文章分析了气候变化对“第三极”固态水库的威胁及其对该区域河流、湖泊变化的影响，强调了在已建成的全球最大地表水气稳定同位素观测网的基础上，继续沿西风—季风传输路径拓展高精度三维（地表至高空）水气稳定同位素观测的重要性。为了清楚认识该区域水循环，服务于“一带一路”国家绿色发展，在“丝路环境”专项和STEP的支持下，TPE国际计划和青藏高原所致力于在泛第三极地区沿西风—季风传输断面建立气象和三维水体稳定同位素观测网络，并在3个热点地区：帕米尔山脉（西风主导）、喜马拉雅山脉（受印度季风影响）和横断山脉（东亚季风盛行）开展海拔、大气环流和水气相互作用的加强观测研究，同时，推动适用于全球和区域气候模型的数据共享，研发能够实现第三极多圈层相互作用的新一代地球系统模型，以评估人类活动和气候减缓策略的区域影响，从而帮助社会各群体制定相应的风险控制和适应策略。

文章呼吁全球从气候学到社会科学的多学科科学家必须通力合作，科学应对全球变暖在第三极的链式影响和响应。

（来源：中国科学报 2019-01-04）

近 5000 年来湖泊生态环境变化过程被“还原”

近日，从中科院南京地理与湖泊研究所获悉，该所与兰州大学合作，新近对过去5000年来湖泊生态环境的演化及原因进行了研究。研究发现，目前人类活动已经成为湖泊生态发生不可逆改变的主要原因。未来，这项研究还可能在更广阔的区域、以及更长的时间尺度上进一步展开。

此次，科研团队突破了以往研究主要集中在过去几十年的局限。他们选取历史

时期人类活动影响较早的黄土高原六盘山北联池为研究对象，利用湖泊沉积物岩芯分析古环境和古生态特征，结合碳14测年，较为准确地还原出过去5000年来，湖泊生态环境的演化过程及其驱动原因。

研究显示，公元前3050年至公元550年前后，六盘山一带没有明显的人类活动对湖泊生态造成影响的迹象，湖泊环境随自然气候变化而改变。到550年至1150年，人类活动对湖泊生态的影响开始增强，但此时湖泊生态系统具有较高的弹性，当人类活动减弱时，仍可恢复到自然背景状态。而在1150年至1950年，人类活动对湖泊生态的影响逐渐成为主要驱动因素。不断增强的人类活动，加剧了流域土壤侵蚀，严重改变了湖泊接受陆源及水生生物量的比例。到1650年时，陆源生物量占湖泊总生物含量已经达到80%左右，这表明，湖泊生态系统已经发生了根本性的状态转变。

“人类工业的发展是近现代以来对湖泊生态影响最大的因素。而一旦超过了临界点，人类活动就会对湖泊生态环境造成不可逆转的改变。”参与此项研究的中科院南京地湖所研究员赵成说。

相关研究成果已于近日发表在国际地学期刊《第四纪科学评论》上。

（来源：新华网 2019-03-06）

中国湖泊富营养化评估研究取得进展

湖泊富营养化是全球面临的最重要的生态环境问题之一，特别是在发展中国家，由于人类活动的影响，大部分湖泊都面临着水质恶化和生态失衡的问题。湖泊富营养化会引起水生态系统一系列异常的反应，其中藻华现象最为常见，严重影响湖泊的生态功能与水质安全。我国大多数湖泊面临着富营养化问题，开展湖泊营养化程度的监控研究刻不容缓。

现在普遍采用多参数相关加权的综合营养状态指数法（TSI）来评价湖泊营养化程度，但其使用过程中涉及多种水质参数的测量，测定方法及测量精度都会对最终的TSI计算结果产生影响，且难以实现大范围长时间序列的湖泊富营养化状态监测。水体吸收系数（aOACs）反映了水体中溶解态以及悬浮物质的含量，其与水体富营养化程度息息相关。中国科学院东北地理与农业生态研究所水环境遥感学科组的科研人员历经7年时间，对分布在全国的277个湖泊进行了野外调查采样，进行了全国范围内的湖泊富营养化程度和水体aOACs分析，系统阐明了湖泊水体aOACs与TSI的关系。结果表明：在所调查的湖泊中，69.5%的湖泊都处于富营养化状态，TSI与aOACs之间存在显著的对数相关性$TSI=13.64\times\ln(aOACs)+43.24$（$R^2=0.78$），从而通过对水体总吸收系数室内测定、在线监测和遥感反演就可以快速计算湖泊综合营养状态指数和划分湖泊营养类型。该研究提供了一种新的评价湖泊富营养化的方法，

为基于吸收系数进行水体富营养化遥感监测提供了相应算法。

研究论文“Quantifying the Trophic Status of Lakes Using Total Light Absorption of Optically Active Components”以东北地理所副研究员温志丹为第一作者，研究员宋开山为通讯作者，由助理研究员刘阁等共同完成，相关结果发表于国际期刊 Environmental Pollution。该研究得到中科院先导专项项目（XDA19070501）、国家自然科学基金项目（41730104，41501387）和中科院“人才计划”项目共同资助。

（来源：中国科学院网站 2019-01-30）

青藏高原湖泊水量变化的时空差异及原因获新进展

青藏高原湖泊众多且分布广泛，其水量变化对气候变化响应非常敏感，并深刻地影响着地表与大气的水分与能量交换。尽管对青藏高原湖泊水量变化研究已经取得一些认识，但由于受到数据源的限制，例如测深数据缺乏、卫星测高数据（例如，ICESat 和 Cryosat-1 等）覆盖不全等，对整个青藏高原长时间尺度且全覆盖的湖泊水量变化研究仍受到限制。近日，中国科学院青藏高原研究所、青藏高原地球科学卓越创新中心、中国科学院大学研究员朱立平课题组结合 Landsat 影像和 SRTM 估算了 1976-1990、1990-2000、2000-2005 和 2005-2013 四个时段内共 317 个湖泊的水量变化，结果表明青藏高原湖泊水量从 1976 年到 1990 年减少了 23.69 km^3，从 1990 年到 2013 年增加了 140.8 km^3。

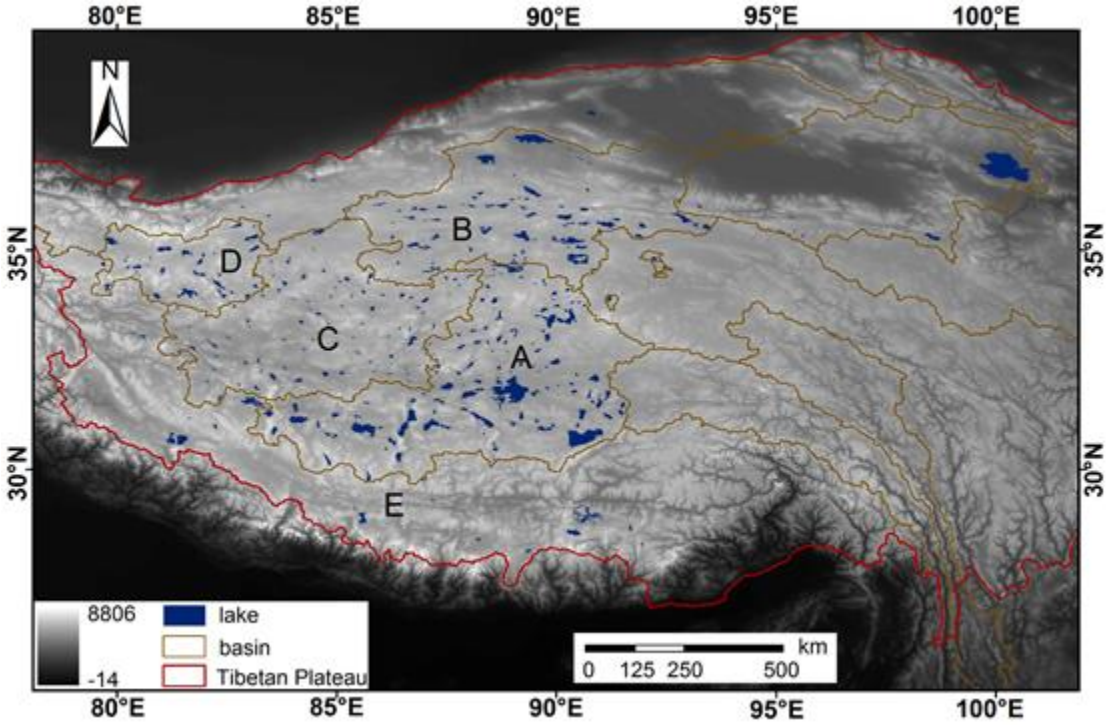

图 研究区域的位置、湖泊分部及区域划分情况

增加的湖泊水量主要集中在青藏高原的中部（A）和北部（B），且发现 2000-2013 年北部区域增加的湖泊面积（1981.6 km^2）比中部区域（1869.1 km^2）多，但增加的水量却只有后者的一半，表明由于湖泊周边地形的差异，湖泊的水量变化才能真实代表湖泊的变化情况。研究结果还发现，尽管湖泊水量变化（7.19 km^3/y）与陆表水储量变化量（7±7 Gt/y）一致，但是两者表现出明显的空间差异。

通过趋势分析表明 2000-2013 年减少的湖面蒸发对区域 A、区域 C 和区域 D 的湖泊水量变化的贡献量分别为 1.5%、2.5%和 1.7%。通过对青藏高原不同区域冰川物质平衡变化的资料收集，经过粗略的估算表明 2000-2013 年冰川融水对区域 A、区域 B、区域 C 和区域 D 的贡献分别为 22.2%、39.8%、50.6%和 100%。该研究结果表明青藏高原西北部由于处于极度干旱、寒冷且降水少的气候条件，冰川融水是湖泊水量变化的主要原因，而位于青藏高原中部和北部等区域，由于降水量多，降水是湖泊水量变化的主要原因，冰川融水的增多对湖泊的扩张起到一定的促进作用。

（来源：中科院青藏高原研究所网站 2019-03-11）

科学家在地下水来源中发现了微塑料污染

2019 年 1 月 23 日，《地下水》（Groundwater）期刊在线发表题为《岩溶地下水系统中的微塑性污染》文章指出，一项新的研究表明，科学家在一种占全球 25%饮用水供应的地下水来源，即裂缝性石灰岩含水层中，发现了微塑料污染。

研究人员指出，该研究发现微塑料存在于美国伊利诺伊州的两个含水层系统中。环境中的塑料分解成微观粒子这可能最终会出现在海洋生物的内脏和鳃中，从而让这些动物接触到塑料中的化学物质。伊利诺伊州可持续技术中心的研究员认为，当塑料分解时，它们就像海绵一样吸收污染物和微生物，最终会进入我们的食物供应。地下水通过石灰岩的裂缝和空洞流动，有时会从道路、输送污水和农业径流中带入污染物进入地下蓄水层。

研究人员从水井和泉水中收集了 17 个地下水样本，其中 11 个来自圣路易斯附近一个高度破裂的石灰岩含水层。其他的是从在伊利诺伊州西北部一个含水层裂缝中收集的。研究人员发现了各种家庭和个人健康污染物以及微塑料，这表明化学纤维可能来自家用化粪池系统。

研究人员认为该问题还需要大量的研究工作，并预计地表水和地下水在未来的几年里都会是个问题。他们指出，即使今天戒掉了塑料制品，也要花好几年来处理这个问题，因为塑料很难降解。

原文来源：https://onlinelibrary.wiley.com/doi/abs/10.1111/gwat.12862

（来源：科学研究动态监测快报 2019-02-15 第 4 期总第 345 期）

长江微塑料污染研究取得新进展:相当数量的微塑料可能滞留在流域内部

微塑料是一种新型环境污染物。它是指粒径小于5毫米的塑料颗粒。微塑料体积小，容易被水生生物摄食，同时也可能会成为其他污染物的载体。近年来微塑料污染在全球范围内受到广泛关注。在之前的研究中，对于微塑料污染的主要关注区域在海洋，但越来越多的研究发现，内陆水体也存在数量可观的微塑料，而江河被认为是海洋微塑料污染的重要来源。

在之前多个模型研究中，长江都被认为是全球微塑料输海通量最高的河流。但上述模型研究缺少实际数据的验证和支持。中科院水生所化学生态学学科组作为国内最早关注内陆水体微塑料污染的研究团队之一，日前与水生所鲸类保护生物学学科组合作，对长江中下游干流水体微塑料污染情况进行了系统调查。

研究团队采集从葛洲坝下（宜昌）到长江口前（南通）长达1700千米江段的15个样点的水体和沉积物微塑料样品，分析了水体和沉积物的微塑料浓度、微塑料形貌特征和微塑料种类组成，初步摸清长江中下游微塑料污染特征，并探讨了先前预测模型可能存在的问题。

调查结果发现，长江中下游江段微塑料的平均浓度，在全球采用类似方法采样调查的河流中，处于中等偏高水平。大城市和与长江连通的大型开放水域，可能会增加临近区域长江干流水体的微塑料浓度。研究还发现，长江中下游微塑料浓度总体并未呈现从上游至下游递增的趋势，长江的沉积物中也存在微塑料。这表明，相当数量的微塑料可能滞留在长江流域内部。

该研究结果表明，早先的模型研究由于未充分考虑微塑料的滞留以及选取的数据点位不合适，对长江微塑料输海通量的估算可能存在一定偏差。更重要的是，长江把数量可观的微塑料留在了流域内部，同时将微塑料对水生生态系统和对人类健康的风险留在了长江流域内。今后，需要对整个长江流域微塑料污染的来源、归趋和生态效应进行更为详细的调查研究，从而为长江流域微塑料污染的管理和长江生态环境保护提供更为可靠的科学支撑。该研究结果近日发表在环境科学领域国际重要期刊《Science of the Total Environment》上。

水生所化学生态学学科组此前已对长江三峡水库的微塑料污染情况进行系统调查，发现水库是微塑料的热点区域，同时水库的水动力条件会影响微塑料在水库的环境归趋。团队还研究了地处偏远地区的藏北高原湖泊和青海湖的微塑料污染情况，梳理总结了中国内陆水体微塑料污染的相关研究，同时还与鲸类保护生物学学科组合作研究了江豚消化道微塑料的残留情况。

原文来源： http://hbrb.cnhubei.com/HTML/hbrb/20190125/hbrb3313957.html

（来源：湖北日报　2019-01-25）

南极冰封湖面下惊现微小动物尸体

据《自然》杂志日前报道，美国科学家在距离南极点600公里的一处冰封湖面下，发现了令人惊讶的古老生命迹象——一种甲壳类动物水熊虫的尸体。

此处水体几百年来未受任何干扰，此前人类只是通过穿透冰的雷达和其他遥感技术间接看到南极冰下湖泊。去年12月26日，美国国家科学基金会（NSF）资助的研究人员，成功融化了一个狭窄的通道，直达湖面。

内布拉斯加大学林肯分校微型古生物学家大卫·哈伍德说，在此处发现动物是“完全出乎意料的”。这种看起来像蠕虫的八条腿缓步动物，类似于已知栖息在潮湿土壤中的物种。

研究人员认为，这些生物曾经居住在距离该地约50公里处山脉的池塘和溪流中，时间大概是在1万年—12万年前，冰川消退的短暂温暖时期。随着气候变冷，冰块扼杀了生命绿洲。

加州大学圣克鲁兹分校冰川学家斯拉维克·图莱克亦克从上世纪90年代就开始研究冰下沉积物，曾在2013年率领探险队钻探南极冰下湖。虽未参加此次探索，但他认为，“这真的很酷！之前从未找到这样的东西，虽然湖水中充满微生物，但没有看到更高级生命的迹象”。

此类动物如何从远处到达这里，仍是一个未解之谜。未来，科学家还试图用碳定年法来确定水下物质的年龄，并尝试对这种水熊虫进行DNA测序，届时可能给出答案，并将这段历史拼图拼凑起来，与其他研究一起，揭示更多关于几千年前南极洲冰川退缩的情况。

（来源：科技日报 2019-01-23）

业界动态

环境部：2018 年我国地表水质有所好转

生态环境部近日通报了 2018 年 12 月和 1-12 月全国地表水环境质量状况。1-12 月，在国家地表水评价考核断面中，水质优良即Ⅰ—Ⅲ类水断面比例为 71%，同比提高 3.1 个百分点；劣Ⅴ类断面比例为 6.7%，同比降低 1.6 个百分点；而在 12 月，水质优良、劣Ⅴ类断面比例分别为 74.2%、7.1%。

据通报，1-12 月，西北诸河、西南诸河水质为优，长江、珠江流域和浙闽片河流水质良好，黄河、淮河和松花江流域为轻度污染，辽河、海河流域为中度污染。与去年同比，黄河、淮河和海河流域水质有所好转，辽河、松花江流域水质有所下降，其他流域水质均无明显变化。

而监测的 111 个重点湖（库）中，水质优良的湖库占 66.7%，同比提高 4.2 个百分点；劣Ⅴ类水质占 8.1%，同比降低 2.6 个百分点。其中，太湖和滇池为轻度污染、巢湖为中度污染，均为轻度富营养，与去年同比，滇池水质明显好转，太湖、巢湖无明显变化；洱海和丹江口水库水质为优、中营养，白洋淀为轻度污染、轻度富营养，三湖的水质和营养状态与去年同比，均无明显变化。

（来源：科技日报 2019-01-07）

《中国水治理研究》报告发布

2018年12月27日，世界银行（The World Bank）与中国国务院发展研究中心（The Development Research Center of the State Council of China）的联合研究项目成果《中国水治理研究》发布。该研究报告指出，有效管理稀缺的水资源，对于中国实现持续经济繁荣和生态文明建设的远景至关重要。中国在水资源管理和基础设施等方面已投入大量资金，进行了一系列体制机制改革创新，取得了系列重要进展。然而，与新时代的目标和要求相比，还需要创新性政策和激励机制，在国家和地区范围加强和更好地整合水资源管理，提供更多的环境用水，扩大使用市场机制促进用水效率提升，采取具有变革性影响的思路治理水污染。在面对这些挑战时，中国的经验也会对全球讨论做出重要贡献。

报告研究了在中国快速发展情况下水资源管理的关键问题，提出水治理的新思路方法，可以更好实现生态文明建设目标，以及在水短缺情况下实现经济增长与用水需求增加之间的平衡的宗旨。

中国是世界第二大经济体，占全球人口的21%，却只有世界淡水资源的6%。在过去50年里，中国在水资源管理和基础设施建设中进行了大量投资，在供水、灌溉、

防洪和水电方面取得了重要成就。但是，中国仍然面临水量和水质的严峻挑战。快速城镇化使得各行业的用水需求不断增长；水污染对人民健康构成严重威胁；城镇化和日益增长的用水需求给生态系统服务造成巨大压力；水资源分布不均和降雨量变化大，使中国大部分地区遭受干旱和局部地区缺水的困扰；中小城市和农村地区的供水、卫生和防洪基础设施服务水平偏低。

近年来，中国实施了一系列改革和试点，旨在应对诸多与水相关的挑战，包括水资源短缺、水污染、水生态退化以及洪涝和干旱风险及其影响加剧等。中国制定的“最严格水资源管理制度”确立了三个主要控制目标，即“三条红线”（水资源开发利用控制，用水效率控制和水功能区限制纳污）。“三条红线”和生态文明建设已成为中国政府的首要政策重点。建设美丽中国以满足公众对改善环境质量日益增长需求的目标。

鉴于中国实行新的增长模式推动生态文明建设，报告建议采取新的水治理战略，包括水治理改革的五个重点：

（1）强化水治理的法律基础。须对2002年最后一次修订的《水法》进行修订，以反映中国水治理中新出现的原则和挑战。中国已经建立了很多水质标准，但须加强现有水质标准的执行，并解决跨行政区的问题，市场可以发挥重要作用。中国作为世界上最重要、最活跃的水市场之一，进一步加强和规范政府与社会资本合作（PPP）的现有规定会很有裨益。

（2）加强国家和流域的水治理。考虑到水资源的跨部门特性，中国可以考虑建立一个高层次、跨部门的协调机制，由与水治理相关的主要部委代表组成，这样有助于协调政策努力，推动形成共识，确定国家战略重点并指导流域管理机构。流域管理机构将是一个水资源、水环境、水生态和集水区的独立管理机构。在规划、协调、实施、执法和融资等关键领域，应赋予流域管理机构更大的权力并给予明确界定。将省级河（湖）长制与流域管理机构正式关联起来，可有助于河（湖）长制的制度化。

（3）完善和优化经济政策工具。进一步开发和实施水价和水权交易等经济政策工具，可以促进更可持续和高效率的用水。还需要收集更多的实证数据来评估这些经济政策工具的效果并进行调整。增强中国“最严格的水资源管理制度”的有效性，创新性融资机制可以更好地配合协作省和行政区达到国家目标。

（4）加强对气候变化和环境变化的适应能力。在业已面临水资源短缺的情况下，全球气候变化的前景更增加了实施中的紧迫性。中国须更多地采用绿色基础设施的方式管理洪水，并试用水污染物排放许可交易。加强对面源污染的政策关注和探索替代性金融机制的必要性，探索针对生态用水制定“三条红线”目标。

（5）加强涉水数据收集和信息共享。建立国家水资源，水环境和水生态信息共享平台，有助于加强各机构之间的协调与协作，支持水资源，水环境和水生态行业

的创业、创新和科学发现。提高公众意识和加强公众参与，减轻水质监测的工作压力，推动建设“节水型社会”。

原文来源： http://www.worldbank.org/en/country/china/publication/watershed-a-new-era-of-water-governance-in-china

（来源：科学研究动态监测快报 2019-01-15 第2期总第343期）

我国已全面建立湖长制

1 月 24 日，在水利部举行的新闻发布会上，水利部副部长魏山忠介绍，目前，全国已全面建立湖长制，在 1.4 万个湖泊（含人工湖泊）设立省、市、县、乡四级湖长 2.4 万名，其中，85 名省级领导担任最高层级湖长，此外，还设立村级湖长 3.3 万名。

“在全面推行河长制的基础上，根据湖泊管理的特殊重要性，在湖泊实施湖长制，对湖泊进行更为严格、更有针对性的管理保护，取得初步成效。”魏山忠表示。他举例道，有的地方实施生态补水，改变湖泊常年干涸状况；有的地方实施退圩还湖，有效增加湖泊水面面积；有的地方实施水岸同治，湖泊水域岸线恢复自然形态，水质恶化趋势有效遏制，生物生态环境明显改善。

（来源：科技日报 2019-01-25）

处理有害藻类的最新方法

2018 年 12 月 14 日在华盛顿举行的美国地球物理联合会（AGU）上，来自俄亥俄州立大学（Ohio State University）的一个科学家团队分享了其研究的初步成果，研究用相关模型来模拟农业实践，以降低农场流失氮和磷的风险，从而降低水道中有毒藻类的生长。

研究采用的模型精准的预测了各种肥料使用后带来的结果，对肥料的使用配方和用量具有科学性和重要的意义，得到了农民和环保组织的认可。初步的研究重点在于了解施肥的时机与暴雨的交点是如何促使养分流失。俄亥俄州立大学的科学家正在与俄亥俄州施肥预测公司（Ohio Applicator Forecast）合作，该公司利用美国国家气象局（National Weather Service）的数据，对不同时期施用化肥的风险进行评估，重点在于了解不同定量模型在不同环境下产生的结果。根据初步的实践观测，当前的模型在单个农场的效果颇佳，但是在大的流域环境中，还未得到有效的验证证据。

原文来源： https://www.nsf.gov/news/news_summ.jsp?cntn_id=297535&org=NSF&from=news

（来源：科学研究动态监测快报 2019-01-01 第 1 期总第 342 期）

从地下水中去除有毒砷的技术的综合分析

全球有数亿人饮用了受砷污染的地下水，导致严重的健康并发症以及社会和经济损失。目前，去除地下水中砷的技术较多。然而，尽管正在对这对些技术机械牛研究，但其广泛应用仍然有限。2019 年 1 月 31 日，联合国大学加拿人水、环境与健康研究所（UNU's Canadian-based Institute for Water, Environment and Health）发布《去除地下水中砷的成本和效率》(*Cost and Efficiency of Arsenic Removal from Groundwater: A Review*)报告，首次比较了旨在去除地下水中砷的许多不同技术的有效性和成本。

报告分析了 1996-2018 年发表的 31 篇相关文章。这些文章都描述了在实验室或实地研究中测试的新技术，分析研究发现：

(1) 在实验室环境中测试的 23 项技术的砷去除效率在 50%-100%之间，多数去除效率相对较高（>90%），大约一半的技术使水中砷含量达到了世界卫生组织（WHO）的标准（10μg/L）。实验室研究使用的地下水样本来自阿根廷、孟加拉国、柬埔寨、中国、危地马拉、印度、泰国、美国和越南 9 个国家。

(2) 在实地测试的 14 种技术实现了 60%-99%的去除效率水平，其中 10 种去除率达到 90%以上。只有 5 个技术使水中砷含量达到了 WHO 标准。在阿根廷、孟加拉国、智利、中国、印度和尼加拉瓜的家庭或社区层面进行了实地测试。

(3) 一些技术在处理中度砷污染的水时具有高的去除效率，但在处理重度砷污染的水时可能效率不高。此外，去除剂的寿命是决定去除效率的重要因素。

(4) 对于实验室测试的技术，每立方米水的处理成本在 0-93 美元之间，但有一种技术的成本为每立方米 299 美元。对于实地测试的技术，每立方米水的处理成本在 0-70 美元之间。

(5) 影响去除效率及其成本的关键因素包括：进水中的砷浓度、进水的 pH 值、使用的材料、所需的能量、吸收能力、使用的劳动力、再生期和地理位置。

对于实验室环境中表现出砷去除效率高的修复技术，考虑到其高昂的生产和运营成本，建议进一步评估这些技术是否适合大规模应用。展望未来，该研究确定了可能有助于商业化大规模实施砷去除技术的 4 个优先领域：①重点确定技术的市场可行性；②克服技术的实际局限性；③确定技术背景的适宜性；④共同努力增加区域内和区域之间的知识共享，以加速实地研究的实施。

（来源：科学研究动态监测快报 2019-03-1 第 5 期总第 346 期）

NOC 研发“早期预警”系统监测有害藻华

2019年1月14日，国家海洋学中心（NOC）官方网站发布《NOC科学家正在开

发用于检测有害藻类繁殖的“早期预警”系统》（NOC scientists to develop ‘early warning’ system for detecting harmful algal blooms）简讯称，NOC的科学家正在开发一种新型传感器和相关的分析技术，用于监测和分类可能导致有害藻华（HABs）的浮游植物。项目为期两年，由英国研究与创新中心（UKRI，主要专注于英国水产养殖研究）资助。

HABs通过吸收光、水的脱氧作用和生物毒素的生产等过程影响水产养殖场，其中以含有毒素的藻类为食的贝类会对人类健康产生严重的不利影响，而现有的监测技术却需要花费相当多的时间和资源，造成决策制定相对缓慢的现状，以及增加了健康和经济影响的风险。尤其在水产养殖部门，由于存在HABs而导致的库存损失或场地关闭等现象可能引起重大的财政损失。因此，掌握水产养殖场HABs形成的详细和最新的知识将有助于水产养殖部门快速和明智地采取措施，从而带来直接的经济效益。

浮游植物形态和光学特性传感器（PhytoMOPS）装置将通过检测HABs的存在来监测藻类浮游植物物种的动态变化过程，以帮助提高原料的生产率和可用性。该装置通过提供低成本和高分辨率的独立数据来解决现有监测技术的不足，并作为一个“早期预警”系统，使监管机构和法定机构能够迅速做出明智的决策并更有效地利用其资源。PhytoMOPS将会对水产养殖业的财政和消费者的信任产生积极的作用，也将持续推动经济的发展。

NOC将通过提供PhytoMOPS与相关组织机构合作。如苏格兰海洋科学协会（SAMS）将就选择适当的水产养殖HABs形成试验品种，为试验样品进行长期培养以及为田间试验提供技术援助；农业食品和生物科学研究所（AFBI）目前在北爱尔兰提供法定的有毒浮游植物监测方案，将提供比较数据、模型访问、数据记录和分析设施等；切尔西科技集团将提供基于荧光的藻类监测系统和专业知识，以实现并行测试。

原文来源： http://noc.ac.uk/news/noc-scientists-develop-early-warning-system-detecting- harmful-algal-blooms

（来源：科学研究动态监测快报 2019-02-01 第3期总第344期）

NERC 资助东南亚干旱和洪水灾害影响研究

2019年1月19日，英国自然研究理事会（NERC）宣布其将在牛顿基金的支持下与英国经济及社会研究理事会（ESRC）联合印度尼西亚、马来西亚、菲律宾、泰国和越南五个东南亚国家建立合作，共资助717万英镑支持18个项目对该区域灾害的影响进行研究。新的国际研究将增强东南亚国家抵御洪水、干旱、风暴潮和山体滑坡

等灾害的能力，这些项目将改善东南亚国家的风险评估并实现更好的基础设施规划。

水文气象灾害对东南亚人民的人身安全以及房屋、商业、运输联系、电力供应和农业用地等生计构成直接威胁。气候变化和人口增长正在增加面临危险的人数，土地使用的变化和城市地区的扩张导致洪水和干旱对社区的影响发生了变化。NERC负责人指出，为了提高容易遭受水文气象灾害的国家的恢复能力，需要更好地了解可能的环境和社会影响。本研究方案将能够制定和实施有效的适应和减轻措施。表1是东南亚水文气象灾害的影响研究获资助的研究项目。

表1 东南亚水文气象灾害的影响研究获资助的研究项目

序号	资助项目	项目负责机构	项目期限	金额（万英镑）
1	越南过去、现在和未来洪水风险的跨学科方法研究	布里斯托大学	2019.1.1—2021.12.31	38.08
2	印度尼西亚爪哇岛洪水1号研究项目	英国杜伦大学、NERC生态和水文中心	2018.10.1—2021.9.30	46.44
3	菲律宾：在不断变化的土地使用和气候情况下，定量的拉哈尔（Lahar）影响和损失评估	布里斯托大学	2018.11.15—2021.11.14	38.05
4	菲律宾地下水展望（PhiGO）	NERC英国地质调查局	2019.1.1—2021.12.31	46.06
5	菲律宾暴雨滑坡灾害模拟（SCaRP）	东英吉利亚大学	2019.1.15—2022.1.14	38.09
6	强化泰国农业抗旱能力技术研发	NERC生态和水文中心	2018.10.1—2021.9.31	43.51
7	越南：大三角洲地区干旱和洪水极端情况增多的相关作用研究	南安普敦大学	2019.1.1—2021.6.30	38.01
8	印尼：极端降雨及其对印尼洪灾风险的影响	纽卡斯尔大学	2018.10.1—2021.9.30	37.22
9	印尼：在西里黄河流域通过跨界河流管理减轻水文气象灾害的影响	哈德斯菲尔德大学	2018.10.1—2021.9.30	45.36
10	马来西亚：洪水跨尺度影响-通过综合多尺度方法提供洪水暴露和脆弱性的信息模型	NERC生态和水文中心	2019.1.1—2021.12.30	47.53
11	马来西亚极端风暴降水影响（IMPRESS - Malaysia）	埃克塞特大学	2019.1.1—2021.12.31	31.09
12	马来西亚半岛兰加特盆地水文气象影响滑坡综合建模（iModelLandslides）	英国杜伦大学	2019.1.1—2021.12.31	38.08
13	马来西亚极端水文气象条件下与水有关疾病的风险管理研究	帝国理工学院	2019.1.1—2021.12.31	38.10
14	菲律宾：流域对水文气象事件（沉积物通量和地貌变化）的敏感性驱动因素研究	格拉斯哥大学	2018.10.1—2021.9.30	38.07
15	增强对泰国东北部流域未来极端水文气象的应变能力	埃克塞特大学	2018.10.1—2021.5.30	37.31
16	泰国海岸的脆弱性、恢复力和适应能力研究	边山大学	2018.10.1—2021.9.30	38.1
17	越南沿海复合洪水研究	南安普敦大学、英国海洋学中心	2019.1.1—2021.12.31	38.85

18	重视蓝色/绿色基础设施对越南抗洪能力、自然资本和城市发展的益处	圣安德鲁斯大学、拉夫堡大学	2019.1.1—2021.6.30	39.28

（来源：科学研究动态监测快报 2019-02-01 第3期总第344期）

长江经济带水环境保护道阻且长

长江经济带是我国水环境问题最为突出的流域之一，生态环境部、发展改革委印发了《长江保护修复攻坚战行动计划》，该如何保护与修复长江经济带？中国环境科学研究院研究员许秋瑾表示，坚持全流域“一盘棋”的思路，根据上中下游不同生态功能，统筹开展水生态功能分区；关注流域风险物质，制定有效土地管理措施，促进相关科技成果应用和转化，支持长江经济带水环境管理及整治等。

土地利用方式不合理是造成污染恶化的关键

多年监测数据显示，长江经济带面积虽然仅为全国的21%，但废水排放总量占全国的40%以上，单位面积的化学需氧量、氨氮、二氧化硫、氮氧化物、挥发性有机物排放强度是全国平均水平的1.5-2倍。

许秋瑾说，水污染的根本来源不仅是水体本身，更重要的是流域内与土地利用息息相关的人类生活和生产活动。其中，工业用地产生工业点源污染、城市生活带来生活污水，还有水土流失、城市不透水面积增加、农药化肥过量使用等可形成非点源污染，而土地利用方式不合理是造成流域污染恶化的关键。

研究表明，城市、农业用地类型与水体污染物浓度呈显著正相关，林地、草地等土地利用类型与污染物浓度呈负相关，而流域土地利用类型改变10%即可引起水质显著变化。因此，许秋瑾表示，要深入研究长江流域土地利用与水质关系，通过调整土地利用方式来减少和控制污染，制定有效的土地管理措施，改善长江水质状况，促进流域经济、社会、环境协调可持续发展。

关注风险物质、强化微量毒害污染物管制

长江是许多沿江省市饮用水源，其饮用水安全关系到5亿多人的健康，水体中的微量毒害污染物可通过食物链危害人体健康及水生态环境。为加强其环境管理，美国环保署专门设立环境激素、药物与个人护理用品等研究专项，进行流域水体环境风险物质研究。我国“十一五”水专项东江项目曾对东江流域38个采样点的地表水、沉积物样品采集并分析结果显示：东江流域可广泛检测到多种环境风险物质。

许秋瑾说，我国目前水体污染物控制指标仍主要以溶解氧、化学需氧量、氨氮、总磷、总氮等常规项目为主，饮用水源地环境风险物质底数仍然不是很清晰。东江项目研究也显示，东江是我国水质相对较好的河流，其新型污染物情况尚且不容乐观，因此，长江流域饮用水源地保护需进一步关注高风险物质，强化微量毒害化学物质的管制，严控环境激素类化学物质污染，加强源头管理，严格环境准入等。

统筹考虑水资源、水环境和水生态

长江中上游地区的闸坝建设对防洪、灌溉和发电等发挥着巨大作用。许秋瑾说，但闸坝会让水流变缓，大坝回水区富营养化，下游湖泊湿地水量持续减少；由于中下游灌区土地得不到江水泛滥的营养补充，造成这些区域可耕地土质肥力持续下降。如通过综合运用多种统计学方法，对洞庭湖监测资料进行研究分析显示，洞庭湖氮、磷的营养盐趋势变化与流量和水位变化密切相关。“因此，呼吁统筹考虑水资源、水环境和水生态，建议实施有效闸坝调控，确保长江生态流量，保护长江中下游湖泊湿地的自然生态，遏制藻类暴发。”

当前，通过重大科技专项研究，已产生了一批阶段性的科研成果，中国环境科学研究院开展了水专项科技资源数据整理、标准化建库工作，汇编了成果库，从2018年10月，通过互联网面向公众提供共享服务。“为充分发挥水污染治理与管理科技成果的价值，建议在沿江城市水环境整治、长江经济带生态大保护等工作中推广使用，服务长江生态环境保护修复驻点跟踪研究工作。”许秋瑾说。

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