湖泊科学动态

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热点文章

➢High-resolution mapping of global surface water and its long-term changes

Jean-François Pekel, Andrew Cottam, Noel Gorelick

The location and persistence of surface water (inland and coastal) is both affected by climate and human activity1 and affects climate2, 3, biological diversity4 and human wellbeing5, 6. Global data sets documenting surface water location and seasonality have been produced from inventories and national descriptions7, statistical extrapolation of regional data8 and satellite imagery9, 10, 11, 12, but measuring long-term changes at high resolution remains a challenge. Here, using three million Landsat satellite images13, we quantify changes in global surface water over the past 32 years at 30-metre resolution. We record the months and years when water was present, where occurrence changed and what form changes took in terms of seasonality and persistence. Between 1984 and 2015 permanent surface water has disappeared from an area of almost 90,000 square kilometres, roughly equivalent to that of Lake Superior, though new permanent bodies of surface water covering 184,000 square kilometres have formed elsewhere. All continental regions show a net increase in permanent water, except Oceania, which has a fractional (one per cent) net loss. Much of the increase is from reservoir filling, although climate change14 is also implicated. Loss is more geographically concentrated than gain. Over 70 per cent of global net permanent water loss occurred in the Middle East and Central Asia, linked to drought and human actions including river diversion or damming and unregulated withdrawal15, 16. Losses in Australia17 and the USA18 linked to long-term droughts are also evident. This globally consistent, validated data set shows that impacts of climate change and climate oscillations on surface water occurrence can be measured and that evidence can be gathered to show how surface water is altered by human activities. We anticipate that this freely available data will improve the modelling of surface forcing, provide evidence of state and change in wetland ecotones (the transition areas between biomes), and inform water-management decision-making.

（来源：Nature，2016，540：418-422 doi:10.1038/nature20584）

中文点评：

全球地表水的高分辨率制图及其长期变化

英国《自然》杂志 12 月 7 日在线发表的一篇环境学论文，以高分辨率绘制了过去 30 年全球地表水分布的变化情况，该研究认为导致变化的主要因素是干旱、水库修建（如筑坝）和水提取。

地表水是人类生活用水的最重要来源之一，更是各国水资源的主要组成部分。过去已有研究绘制全球地表水的分布情况，并且跟踪地表水随时间推移所发生的地方性和区域性变化。但是直到现在，一直没有出现全球性的、方法统一的有关地表水逐渐变化的定量研究。

此次，欧盟联合研究中心的研究人员让-弗朗科斯·佩凯尔及其同事，分析了拍摄于 1984 年至 2015 年之间的 300 多万张地球资源卫星图片，以 30 米×30 米的分辨率量化了地表水

的月度变化。研究团队使用一种算法将 30 米×30 米的区域划分为陆地或开放水域（包括淡水和咸水水域，但不包括海洋）。

团队成员表示，过去 32 年里，有将近 9 万平方公里的永久性地表水消失了，约相当于苏必利尔湖的面积，其中 70%发生在中东和中亚地区。但是，他们也指出，其他地方也会有新的永久性地表水形成，面积约是已消失地表水的两倍，约为 18.4 万平方公里；而且除大洋洲净减少 1%外，各大洲的永久性地表水均出现净增长。

论文作者最后总结称，此次最新数据为认识气候变化和气候振荡对地表水分布的影响，补充了进一步的信息，而且捕捉了人类对地表水资源分布的影响。

（来源：《科技日报》 2016-12-08）

➢Evaluating early-warning indicators of critical transitions in natural aquatic ecosystems

Alena Sonia Gsell; Ulrike Scharfenberger; Deniz Özkundakci; et al.

Ecosystems can show sudden and persistent changes in state despite only incremental changes in drivers. Such critical transitions are difficult to predict, because the state of the system often shows little change before the transition. Early-warning indicators (EWIs) are hypothesized to signal the loss of system resilience and have been shown to precede critical transitions in theoretical models, paleo-climate time series, and in laboratory as well as whole lake experiments. The generalizability of EWIs for detecting critical transitions in empirical time series of natural aquatic ecosystems remains largely untested, however. Here we assessed four commonly used EWIs on long-term datasets of five freshwater ecosystems that have experienced sudden, persistent transitions and for which the relevant ecological mechanisms and drivers are well understood. These case studies were categorized by three mechanisms that can generate critical transitions between alternative states: competition, trophic cascade, and intraguild predation. Although EWIs could be detected in most of the case studies, agreement among the four indicators was low. In some cases, EWIs were detected considerably ahead of the transition. Nonetheless, our results show that at present, EWIs do not provide reliable and consistent signals of impending critical transitions despite using some of the best routinely monitored freshwater ecosystems. Our analysis strongly suggests that a priori knowledge of the underlying mechanisms driving ecosystem transitions is necessary to identify relevant state variables for successfully monitoring EWIs.

（来源：PNAS, 2016, 113(50) : E8089-E8095）

中文点评:

评估自然水生生态系统关键转型的预警指标

水生生态系统状态在外界驱动下除了发生渐变，还会发生突发性持续性变化。然而，要预测这些关键状态的转化非常困难，因为系统状态在发生这些变化前往往只显示出细微的变化。早期预警指标（EWIs）被用于捕捉生态系统弹性丧失发出的信号，并且在理论模型中

可对生态系统的关键转型前进行预警，目前已经广泛运用到了古气候时间序列，实验室以及全湖试验的监测中。

目前 EWIs 监测自然水生生态系统的关键转型的研究还是普遍基于经验数据时间序列的，且大量研究结果尚未得到有效验证。本研究评估了 4 项常用的 EWI 指标，将它们运用到了 5 个淡水湖泊长期生态系统变化中，这 5 个湖泊的生态系统都经历了突发性持续性变化，通过该项研究可以更清晰地理解相关的生态机制及驱动力。这些案例研究按触发生态系统突变的 3 种机制——竞争、营养级联以及共位群内捕食被划分为 3 类。尽管在绝大多数的案例中都能监测到 EWIs，但这 4 项指标间的一致性很低。在一些案例中，生态系统关键转型发生前会大量采用 EWIs 进行监测。然而，该项研究结果显示，尽管目前采用了许多最好的 EWIs 进行淡水生态系统状态的常规监测，但仍然不能提供在即将发生的关键转型前可靠和一致的信号。最后研究结果强烈建议必需具有驱动生态系统关键转型潜在机制的先验知识，才能通过识别相关状态变量成功监控 EWIs。

（来源：http://www.pnas.org/content/early/2016/11/21/1608242113.full.pdf 根据相关资料编译）

摘要精选

Lanthanide-dependent cross-feeding of methane-derived carbon is linked by microbial community interactions

Sascha M. B. Krause; Timothy Johnson; Yasodara Samadhi Karunaratne; et al.

The utilization of methane, a potent greenhouse gas, is an important component of local and global carbon cycles that is characterized by tight linkages between methane-utilizing (methanotrophic) and nonmethanotrophic bacteria. It has been suggested that the methanotroph sustains these nonmethanotrophs by cross-feeding, because subsequent products of the methane oxidation pathway, such as methanol, represent alternative carbon sources. We established cocultures in a microcosm model system to determine the mechanism and substrate that underlay the observed cross-feeding in the environment. Lanthanum, a rare earth element, was applied because of its increasing importance in methylotrophy. We used co-occurring strains isolated from Lake Washington sediment that are involved in methane utilization: a methanotroph and two nonmethanotrophic methylotrophs. Gene-expression profiles and mutant analyses suggest that methanol is the dominant carbon and energy source the methanotroph provides to support growth of the nonmethanotrophs. However, in the presence of the nonmethanotroph, gene expression of the dominant methanol dehydrogenase (MDH) shifts from the lanthanide-dependent MDH (XoxF)-type, to the calcium-dependent MDH (MxaF)-type. Correspondingly, methanol is released into the medium only when the methanotroph expresses the MxaF-type MDH. These results suggest a cross-feeding mechanism in which the nonmethanotrophic partner induces a change in expression of methanotroph MDHs, resulting in release of methanol for its growth. This partner-induced change in gene expression that benefits the partner is a paradigm for microbial

interactions that cannot be observed in studies of pure cultures, underscoring the importance of synthetic microbial community approaches to understand environmental microbiomes.

（来源：PNAS, 2016, doi: 10.1073/pnas.1619871114）

Algal blooms increase heterotrophy at the base of boreal lake food webs-evidence from fatty acid biomarkers

Johansson, Karin S. L.; Trigal, Cristina; Vrede, Tobias; et al.

Physical defenses and grazer avoidance of the bloom-forming microalga Gonyostomum semen may reduce the direct coupling between phytoplankton and higher trophic levels and result in an increased importance of alternative basal food resources such as bacteria and heterotrophic protozoans. To assess the importance of algal and heterotrophic food resources for zooplankton during G. semen blooms and the effects of zooplankton diets on a higher consumer, we analyzed the fatty acid composition of zooplankton and the invertebrate predator Chaoborus flavicans from eight lakes along a gradient in the predominance of G. semen relative to other algae and the duration of G. semen blooms. The proportion of fatty acids of bacterial origin increased significantly along the G. semen gradient in all consumers studied. In addition, the proportion of polyunsaturated fatty acids (PUFA) decreased in cladocerans. These results suggest that heterotrophic pathways can compensate for a reduced trophic coupling between phytoplankton and filter-feeding zooplankton. The lower PUFA content in cladoceran prey from lakes at the higher end of the G. semen gradient did not affect the PUFA content of the predator C. flavicans, suggesting selective assimilation and retention of PUFA and/or feeding on other, more PUFA-rich prey.

（来源：LIMNOLOGY AND OCEANOGRAPHY, 2016, 61(5): 1563-1573）

Terrestrial prey fuels the fish population of a small, high-latitude lake

Milardi, Marco; Kakela, Reijo; Weckstrom, Jan ; et al.

The significance of terrestrial carbon subsidies in lake ecosystems has been under active research, but the contribution of terrestrial energy to the highest trophic levels has been explored less frequently. Here, we examined the terrestrial energy contribution to the ingested and assimilated diet of introduced brown trout (Salmo trutta) in a small, high-latitude lake using stomach content, stable isotope and fatty acid analyses. Stomach content analysis of brown trout indicated a terrestrial contribution of 29 % during the open-water season. Terrestrial prey was mainly composed of rodents (23 % in volume), but also amphibians and terrestrial insects. A longer term estimate, obtained with a mixing model (SIAR) for liver and dorsal muscle stable isotopes from 2010 and 2011, revealed a terrestrial contribution of 68.5 and 63.5 %, respectively. Through a similar model, fatty acid analysis on 2011 samples estimated a contribution of 71.5 %. Despite the relatively high proportion of rodents in the trout ingested diet, no correlation was evident between the long-term rodent cycles and terrestrial energy contribution estimated with stable isotopes of muscle. Terrestrial prey were an important long-term energy source for fish in small high-latitude lake, but its contribution was not directly dependent on the availability of pulsed resources such as small mammals.

（来源：AQUATIC SCIENCES, 2016, 78(4): 695-706）

Lake geochemistry reveals marked environmental change in Southwest China during the Mid Miocene Climatic Optimum

Julie Lebreton-Anberrée; Shihu Li Email author ; Shu-Feng Li; et al.

The Mid-Miocene Climatic Optimum (MMCO; ~15–17 Ma) was one of the short-term climatic warm events that punctuated the Cenozoic long-term cooling trend. Because there are very few terrestrial records of this event, most of our understanding comes from marine cores. In this report, we first present new palaeomagnetic data that revises the dating of our 400 m-thick lacustrine section in Wenshan (Yunnan), previously thought to be Late Miocene. These new data suggest an older age, ca. 15.2–16.5 Ma, coinciding with the MMCO. We measured δ13C on bulk organic matter (δ13Corg), total organic carbon (TOC), total nitrogen (TN) and C/N ratios at a high sample resolution to: (1) reconstruct the palaeoenvironmental changes in the lake catchment area, and (2) infer mechanisms responsible for these changes. Our results show that all four geochemical parameters demonstrate that a strong environmental change occurred around the middle of the section, shortly after the C5Cn/C5Br geomagnetic reversal and the Early/Middle Miocene boundary at 15.97 Ma. We propose that the environmental shift may be due to a combination of a change in climate, which became cooler, together with a change in organic matter cycling within the lake. This study provides a new insight into the MMCO and demonstrates that although the MMCO was generally a warm event, it was also a time of climatic instability and abrupt environmental changes.

（来源：Science Bulletin, 2016, 61(11): 897-910）

delta D values of n-alkanes in sediments from Gahai Lake, Gannan, China: implications for sources of organic matter

Duan, Yi; Zhao, Yang; Wu, Yingzhong; et al.

Gahai Lake in the Gannan region, located in the northeast of the Tibetan Plateau, is the largest pristine freshwater lake on the plateau. Surface sediments in the Gahai Lake were systematically sampled, and n-alkane distribution and hydrogen isotope were analyzed by a gas chromatograph-mass spectrometer and a gas chromatograph-interface-isotope ratio mass spectrometer. The delta D values of n-alkanes in the sediments ranged from -247 to -161 % and the mean values varied between -222 and -182 %. The studied sediments were divided into types I and II based on the average delta D values of n-alkanes. The average delta D values of n-alkanes in type I sediments were significantly higher than those in type II sediments and there were good correlations among the delta D values of the n-alkanes from the two sediment types. The delta D values of type I sediments indicated that the C-21-C-33 odd-numbered n-alkanes were derived mainly from aquatic plants in the Gahai Lake, while the delta D values of type II sediments showed that C-27-C-33 odd-number n-alkanes were derived from terrestrial herbaceous plants. This assessment of n-alkane sources was also confirmed by their distributions. It was inferred that the medium-chain length n-alkanes of relatively high abundance, low delta D values, and low carbon preference index values were derived principally from bacteria. The distribution patterns of the sedimentary n-alkane delta D values for the plateau humid-climate freshwater lake and dry-climate saline lake systems were compared. The results further confirmed that sedimentary n-alkanes record the hydrogen isotopic composition of source water used by organisms. Therefore, delta D values of sedimentary n-alkanes can be used as geochemical indicators for sources of sedimentary organic matter

and in paleoclimate studies. Our results also showed that the delta D values of n-alkanes from sediments within the lake can differ significantly for a given time period owing to their different biological sources. This should be taken into account when reconstructing paleoclimatic and hydrologic conditions using sedimentary n-alkane delta D values.

（来源：JOURNAL OF PALEOLIMNOLOGY, 2016, 56(2-3): 95-107）

Sedimentological and geochemical responses of Lake Zabinskie (north-eastern Poland) to erosion changes during the last millennium

Bonk, Alicja; Kinder, Malgorzata; Enters, Dirk; et al.

Increased erosion triggered by land-use changes is a major process that influences lake sedimentation. We explored the record of erosion intensity in annually laminated sediments of Lake Zabinskie, northeast Poland. A 1000-year-long, annually resolved suite of sedimentological (varve thickness, sediment accumulation rate) and geochemical data (scanning XRF, loss on ignition, biogenic silica) was analyzed with multivariate statistics. PCA indicated erosion was a major process responsible for changes in the chemical composition of the sediments. Analysis of sedimentary facies enabled identification of major phases of erosion that influenced lake sedimentation. These phases are consistent with the history of land use, inferred from pollen analysis. From AD 1000 to 1610, conditions around and in Lake Zabinskie were relatively stable, with low erosion intensity in the catchment and a dominance of carbonate sedimentation. Between AD 1610 and 1740, higher lake productivity and increased delivery of minerogenic material were caused by development of settlements in the region and widespread deforestation. The most prominent changes were observed between AD 1740 and 1880, when further land clearance and increased agricultural activity caused intensified soil erosion and higher lake productivity. Landscape clearance also created better conditions for water column mixing, which led to changes in redox conditions in the hypolimnion. The most recent period (AD 1880-2010) was characterized by partial reforestation and a gradual decrease in the intensity of erosional processes.

（来源：JOURNAL OF PALEOLIMNOLOGY, 2016, 56(2-3): 239-252）

Holocene carbonate record of Lake Kivu reflects the history of hydrothermal activity

Jillian E. Votava; Thomas C. Johnson; Robert E. Hecky.

The sediment record of Lake Kivu reveals a complex volcanogenic and climatic Holocene history. Investigation of the inorganic carbonate record dates the onset of carbonate deposition in the mid-Holocene in Kivu's deep northern and eastern basins and identifies conditions enabling deposition. The magnitude and timing of carbonate-rich sedimentation is not so much controlled by climate but, instead, linked strongly to hydrothermal activity in the basin. Sublacustrine springs supply the vast majority of the calcium and carbonate ions required for supersaturation with respect to aragonite. This major hydrothermal activity that permanently stratifies Lake Kivu today was initiated ~3,100 y before present (3.1 ka), when carbonate-rich sediments first appeared in the Holocene record. Aragonite is the dominant $CaCO_3$ mineral present in the lake deposits. Both $\delta^{13}C$ and $\delta^{18}O$ of the aragonite are enriched above the expected kinetic fractionation of meteoric waters, suggesting a volcanogenic influence on the

formation waters. Repeated major fluctuations in the carbonate record after 3.1 ka therefore most likely reflect the historical variation in hydrothermal inputs.

（来源：PNAS, 2016, doi: 10.1073/pnas.1609112113）

令戈错湖芯重建过去 17ka 青藏高原大气环流变化

贺跃，鲍征宇；侯居峙; et al.

亚洲季风和西风作为北半球重要的大气环流系统，对青藏高原冰川进退、水量平衡及生态环境变化具有重要意义。大量研究重建了两者的强弱变化，但是末次冰消期以来，西风与亚洲季风强度变化仍然存在争议。青藏高原中部令戈错湖泊岩芯样品重建的末次冰消期以来令戈错粒度与介形虫氧同位素记录表明，17~11.7ka，令戈错水位较浅且波动频繁，西风是气候变化的主要影响因素，研究区环境变化与北大西洋冷事件关系密切；11.7~10ka，对应于印度季风的增强，令戈错水位迅速升高，冬季风力变小，印度季风取代西风成为控制环境变化的主要因素；10~8ka 之后，令戈错水位略有降低，可能对应于印度季风的减弱或者冰川融水的减少；8ka 之后，响应于印度季风逐渐减小，令戈错逐渐萎缩，西风可能存在增强。末次冰消期以来西风与印度季风强弱演替历史可以归纳为: 16.5ka 之前，中纬度西风强盛，青藏高原大部分区域均由西风控制，与北大西洋气候变化表现出较好的耦合关系；16.5~11.5ka 气候格局与现今类似，西风控制着青藏高原中-北部地区，而青藏高原南部受印度季风影响更大。早中全新世，夏季太阳辐射增加，印度季风增强；晚全新世，印度季风减弱，西风可能对青藏高原西部以及北部存在影响。

（来源：科学通报, 2016, 61(33): 3583 - 3595）

Differential N_2O dynamics in two oxygen-deficient lake basins revealed by stable isotope and isotopomer distributions

Wenk, Christine B.; Frame, Caitlin H.; Koba, Keisuke; et al.

Lakes are a nitrous oxide (N_2O) source to the atmosphere, but the biogeochemical controls and microbial pathways of N_2O production are not well understood. To trace microbial N_2O production (denitrification, nitrifier denitrification, and nitrification) and consumption (denitrification) in two basins of Lake Lugano, we measured the concentrations and N and O isotope compositions of N_2O, as well as the intramolecular N-15 distribution, i.e., site preference (SP). Our results revealed differential N_2O dynamics in the two lake basins, with N_2O concentrations between 12 nmol L-1 and>900 nmol L-1 in the holomictic South Basin, and significantly lower concentrations in the meromictic North Basin (<13 nmol L-1). In the South Basin, the isotope signatures reflected a complex combination of N_2O production by nitrifying bacteria through hydroxylamine (NH_2OH) oxidation, N_2O production through incomplete denitrification, and N_2O reduction to N-2, all occurring in close vicinity within the redox transition zone (RTZ). In the North Basin, in contrast, the N_2O isotopomer signatures suggested that nitrifier denitrification was the main N_2O source. The pronounced decrease in N_2O concentrations to undetectable levels within the RTZ, in tandem with an

increase in N-15-N_2O, O-18-N_2O, and SP indicated quantitative N_2O consumption by microbial denitrification. In the northern basin this was primarily sulfide-dependent. The apparent N and O isotope enrichment factors associated with net N_2O consumption were (15)epsilon approximate to 3.2 parts per thousand and (18)epsilon approximate to 8.6 parts per thousand, respectively. The according O-18 to N-15 enrichment ratio ((18)epsilon: (15)epsilon approximate to 2.5) is consistent with previous reports for microbial N_2O reduction, underscoring its robust nature across environments.

（来源：LIMNOLOGY AND OCEANOGRAPHY, 2016, 61(5):1735-1749）

Occurrence investigation of perfluorinated compounds in surface water from East Lake (Wuhan, China) upon rapid and selective magnetic solid-phase extraction

Yusun Zhou; Yun Tao; Huarong Li; et al.

Using a novel magnetic nanocomposite as adsorbent, a convenient and effective magnetic solid-phase extraction (MSPE) procedure was established for selective separation and concentration of nine perfluorinated compounds (PFCs) in surface water sample. Then an ultra high-performance liquid chromatography-tandem mass spectrometry (UPLC-MS/MS) system was employed for detection of PFCs. Good linearity of the developed analytical method was in the range of 0.5–100 ng L−1 with R2 > 0.9917, and the limits of detection (LODs) ranged from 0.029 to 0.099 ng L−1. At three fortified concentrations of 0.5, 5 and 50 ng L−1, the spiked recoveries of PFCs were in the range of 90.05–106.67% with RSDs < 12.62% (n = 3). The proposed analytical method was applied for determination of PFCs in surface water from East Lake (Wuhan, China). The total concentrations of nine PFCs ranged from 30.12 to 125.35 ng L−1, with perfluorooctane sulfonate and perfluoroctanoic acid as the most prevalent PFCs, and the greatest concentrations of PFCs were observed in Niuchao lakelet. The concentrations of the PFCs (C ≥ 11) were mostly less than the limits of quantification (LOQs), attributed to the possibility that the more hydrophobic long-chain PFCs are potential to accumulate in sediment and aquatic biota.

（来源：SCIENTIFIC REPORTS, 2016, doi:10.1038/srep38633）

Aggregation kinetics of inorganic colloids in eutrophic shallow lakes: Influence of cyanobacterial extracellular polymeric substances and electrolyte cations

Xu, Huacheng; Yang, Changming; Jiang, Helong.

The stability/aggregation propensity of inorganic colloids in eutrophic shallow lakes is of great essence in governing the water transparency and contaminant behavior. In this study, time-resolved dynamic light scattering was employed to investigate the aggregation kinetics of Al_2O_3 inorganic Colloids over a wide range of cyanobacterial extracellular polymeric substance (EPS) concentrations in the absence and presence of electrolyte cations. The results showed that EPS adsorption alone greatly decreased the hydrodynamic diameters of colloidal particles, whose stability behavior followed closely the predictions of the classical DLVO theory. Electrolyte cations, however, can induce the aggregation of colloidal particles, and divalent Ca^{2+} were found to be more efficient in destabilizing the colloids than monovalent Na^{+}, as indicated by the considerably lower critical coagulation concentrations (2.5 mM for Ca^{2+} vs. 170 mM for

Na^{+}). Further addition of Ca^{2+}, i.e., >2.5 mM, caused an extremely high aggregation degree and rate. High resolution transmission electron microscopy revealed that this enhanced aggregation should be attributed to the gel-like bridging between colloidal particles, which were verified to be the amorphous EPS-Ca^{2+} complexes. Field-emission scanning electron microscopy coupled with elemental mapping provided additional evidence that the bridging interaction of EPS with Ca^{2+} was the predominant mechanism for the aggregation enhancement.

（来源：WATER RESEARCH, 2016, 106: 344-351）

Performance of novel media in stratified filters to remove organic carbon from lake water

Grace, Maebh A.; Clifford, Eoghan; Healy, Mark G.

Disinfection by-products (DBPs) are an ever-increasing occurrence in water networks, particularly those which abstract water from peatland areas. Although much research has been carried out to discover novel methods to remove specific DBPs, the removal of natural organic matter (NOM) from source water may provide a more sustainable solution in many areas. This study focuses on the removal of NOM by novel filters, which could be retrospectively fitted to any conventional water treatment facility. The filters comprised stratified layers of a variety of media, including sand, Bayer residue, granular activated carbon (GAC), and pyritic fill. The filters were operated under two loading regimes, continuous and intermittent, at loading rates similar to recognised design standards. The most successful filter design comprised stratified layers of sand, GAC, and pyritic fill. Over the duration of a 240 day study, these filters obtained average dissolved organic carbon removal rates of 40%, and achieved average specific ultra-violet absorbance reductions from 2.9 to 2.4 L mg(-1) m(-1). The study demonstrates that these novel filters may be used to reduce NOM levels, thus reducing the potential for DBP formation. Such designs can incorporate the use of waste media, making the overall design more sustainable and robust.

（来源：WATER RESEARCH, 2016, 104: 371-380）

Nutrient reduction magnifies the impact of extreme weather on cyanobacterial bloom formation in large shallow Lake Taihu (China)

Yang, Zhen; Zhang, Min; Shi, Xiaoli, et al.

Cyanobacterial bloom formation is dependent on nutrient levels and meteorological conditions. In this study, we elucidated the effects of extreme weather events (EWES, heavy rainfall and strong winds) on the cyanobacterial blooms in Lake Taihu in recent years based on an analysis of the meteorological, nutrient, and bloom area data from 2007 to 2015. The levels of total phosphorus (TP) and total nitrogen (TN) decreased by 42.5% and 31.2%, respectively, in the water of Lake Taihu over the past nine years. However, the frequency and intensity of cyanobacterial blooms did not significantly decrease. A total of 50.5% of the extended blooms (>300 km(2)) were associated with EWEs from 2007 to 2015, 36.2% of which were due to heavy rainfall and 38.3% of which were due to strong winds (25.5% were due to both). Interestingly, the frequency of the EWE-induced extended blooms significantly increased after 2012. Principal component analysis (PCA) showed that this frequency correlated positively with EWE-induced nutrient increases in the water, indicating that the complement from nutrient increases induced by EWE allow cyanobacterial cells to reach high biomass under relatively low nutrient condition. Our results

suggest that EWEs play a more important role in extended bloom formation after the nutrient levels in shallow lakes are reduced.

（来源：WATER RESEARCH, 2016, 103: 302-310）

Dissolved organic carbon and its potential predictors in eutrophic lakes

Toming, Kaire; Kutser, Tiit; Tuvikene, Lea; et al.

Understanding of the true role of lakes in the global carbon cycle requires reliable estimates of dissolved organic carbon (DOC) and there is a strong need to develop remote sensing methods for mapping lake carbon content at larger regional and global scales. Part of DOC is optically inactive. Therefore, lake DOC content cannot be mapped directly. The objectives of the current study were to estimate the relationships of DOC and other water and environmental variables in order to find the best proxy for remote sensing mapping of lake DOC. The Boosted Regression Trees approach was used to clarify in which relative proportions different water and environmental variables determine DOC. In a studied large and shallow eutrophic lake the concentrations of DOC and coloured dissolved organic matter (CDOM) were rather high while the seasonal and interannual variability of DOC concentrations was small. The relationships between DOC and other water and environmental variables varied seasonally and inter annually and it was challenging to find proxies for describing seasonal cycle of DOC. Chlorophyll a (Chl a), total suspended matter and Secchi depth were correlated with DOC and therefore are possible proxies for remote sensing of seasonal changes of DOC in ice free period, while for long term interannual changes transparency-related variables are relevant as DOC proxies. CDOM did not appear to be a good predictor of the seasonality of DOC concentration in Lake Vortsjarv since the CDOM DOC coupling varied seasonally. However, combining the data from Vortsjarv with the published data from six other eutrophic lakes in the world showed that CDOM was the most powerful predictor of DOC and can be used in remote sensing of DOC concentrations in eutrophic lakes.

（来源：WATER RESEARCH, 2016, 102: 32-40）

Occurrence and partitioning of bisphenol analogues in water and sediment from Liaohe River Basin and Taihu Lake, China

Jin, Hangbiao; Zhu, Lingyan.

Bisphenol analogues are widely used in the manufacture of polycarbonate plastics and epoxy resins, and the demand and production capacity of these compounds are growing rapidly in China. The occurrence and distribution of bisphenol analogues other than bisphenol A (BPA) in the aquatic environment is still poorly understood. In this study, nine bisphenol analogues were measured in water and sediment samples from Taihu Lake (TL), Liaohe River basin, including Liaohe River (LR) and Hunhe River (HR), China. Water samples from LR and HR contained much higher total bisphenols (Sigma BPs) concentrations. BPA and bisphenol S (BPS) were predominant with a summed contribution of 55, 75, and 75% to the Sigma BPs in TL, LR, and HR waters, respectively. This suggests that BPA and BPS were the most widely used and manufactured bisphenols in these regions. In sediment, BPA was always predominant, with the next abundant compound bisphenol F (BPF) in TL and HR sediment, but BPS in LR sediment. The average field sediment water partitioning coefficients (log K-oc) were calculated for the

first time for certain bisphenols and were determined to be 4.7, 4.6, 3.8, 3.7, and 3.5 mL/g for BPF, BPAP, BPA, BPAF, and BPS, respectively.

（来源：WATER RESEARCH, 2016, 103: 343-351）

The role of sediments in the carbon budget of a small boreal lake

Chmiel, Hannah E.; Kokic, Jovana; Denfeld, Blaize A.; et al

We investigated the role of lake sediments as carbon (C) source and sink in the annual C budget of a small (0.07 km(2)) and shallow (mean depth, 3.4 m), humic lake in boreal Sweden. Organic carbon (OC) burial and mineralization in the sediments were quantified from Pb-210-dated sediment and laboratory sediment incubation experiments, respectively. Burial and mineralization rates were then upscaled to the entire basin and to one whole year using sediment thickness derived from sub-bottom profiling, basin morphometry, and water column monitoring data of temperature and oxygen concentration. Furthermore, catchment C import, open water metabolism, photochemical mineralization as well as carbon dioxide (CO_2) and methane (CH_4) emissions to the atmosphere were quantified to relate sediment processes to other lake C fluxes. We found that on a whole-basin and annual scale, sediment OC mineralization was three times larger than OC burial, and contributed about 16% to the annual CO_2 emission. Other contributions to CO_2 emission were water column metabolism (31%), photochemical mineralization (6%), and catchment imports via inlet streams and inflow of shallow groundwater (22%). The remainder (25%) could not be explained by our flux calculations, but was most likely attributed to an underestimation in groundwater inflow. We conclude that on an annual and whole-basin scale (1) sediment OC mineralization dominated over OC burial, (2) water column OC mineralization contributed more to lake CO_2 emission than sediment OC mineralization, and (3) catchment import of C to the lake was greater than lake-internal C cycling.

（来源：LIMNOLOGY AND OCEANOGRAPHY, 2016, 61(5): 1814-1825）

Effects of silver nanoparticles on bacterioplankton in a boreal lake

Blakelock, Graham C.; Xenopoulos, Marguerite A.; Norman, Beth C.; et al.

Silver nanoparticles (AgNPs) are widely used antimicrobial agents and a growing body of evidence suggests that their release into aquatic environments threatens natural bacterial communities and whole ecosystems. However, a knowledge gap exists between the toxic effects of AgNPs found in laboratory studies and their potential impacts in natural environments. In an enclosure experiment conducted in a boreal lake, we exposed natural bacterial communities to AgNPs with two common types of coatings (polyvinylpyrrolidone(PVP) and citrate) under two different exposure regimes, a one-time (pulse) and a continuous (chronic) addition. AgNP additions increased Ag concentrations to nearly 50gL(-1) in the highest treatments. We examined bacterial responses (abundance, biomass, production, chlorophyll-a content and nutrient stoichiometry) over the course of 6weeks in the summer of 2012. Bacterioplankton exposed to AgNPs initially accumulated Ag over the experimental period regardless of AgNP concentration or coating. After the initial period of increase, Ag in the bacterial size fraction changed largely in concert with bacterial biomass. We found no toxic effects of AgNPs on bacterioplankton abundance, biomass, production or chlorophyll-a content throughout the experiment. Bacterial

production was greater after the pulse addition of PVP-coated AgNPs and in the chronic addition of PVP-coated AgNPs at the highest concentrations. Furthermore, AgNPs produced no significant changes in nutrient stoichiometry of the bacterioplankton size fraction. This lack of effects of AgNPs on lake bacterioplankton observed under the natural conditions studied here differs from results of short-term and laboratory studies of single-species bacterial cultures. Our results thus indicate AgNP effects in lakes may be less than expected based on standard laboratory experiments, and that additional studies are needed to understand AgNP toxicity under realistic natural conditions in lakes and other ecosystems.

（来源：FRESHWATER BIOLOGY, 2016, 61(12): 2211-2220）

The effect of increased nitrogen load on phytoplankton in a phosphorus-limited lake

Poxleitner, Monika; Trommer, Gabriele; Lorenz, Patrick; et al.

Widespread use of artificial fertilisers and the burning of fossil fuels and/or biomass release a large amount of reactive nitrogen into the atmosphere. So far, the effects of increasing nitrogen deposition from the atmosphere have mainly been studied in nitrogen-limited limnic and marine systems. Interestingly, in phosphorus-limited lakes, additional nitrogen input might not affect phytoplankton biomass, but rather increase mainly the degree of phosphorus limitation. The resulting effects on plankton communities are difficult to predict and quantify. To estimate the effects of increasing nitrogen load on a spring phytoplankton community in a primarily phosphorus-limited system, a mesocosm experiment was performed in an oligotrophic lake, in which a gradient of six increasing nitrogen enrichment levels was applied. During the initial phytoplankton growth phase (spring bloom), molar, seston nitrogen:phosphorus ratios increased from 43 to 72 and carbon:phosphorus ratios from 328 to 542 with increasing nitrogen enrichment, indicating increased phosphorus limitation. Three commonly used phytoplankton biomass proxies (phytoplankton biovolume, chlorophyll a and particulate organic carbon) showed only minor responses to nitrogen enrichment. Different groups and species of phytoplankton varied in their responses to the nitrogen enrichment in both the growth phase (spring bloom) and the descending phase (clear water phase). Overall, we detected an effect of nitrogen enrichment on phytoplankton stoichiometry and community composition. The observed changes in the phytoplankton community combined with changes in abundances of heterotrophic nanoflagellates and ciliates indicate bottom-up driven alterations of the basal food web due to increased nitrogen loads.

（来源：FRESHWATER BIOLOGY, 2016, 61(11): 1966-1980）

Comparing microscopic counts and pigment analyses in 46 phytoplankton communities from lakes of different trophic state

Schluter, Louise; Behl, Stephan; Striebel, Maren; et al.

1. Comparison between algal pigment analyses using HPLC and subsequent CHEMTAX analysis with microscopic counts from different lakes ranging from ultra-oligotrophic to eutrophic allowed testing of pigment: chlorophyll a ratios for lakes of different trophic conditions. Microscopic counts and pigment analyses were positively correlated for all groups except for the chrysophytes.

2. When examining the oligotrophic lakes only, microscopic analyses and pigment analyses of

chrysophytes were positively correlated, which showed that the oligotrophic pigment ratios were well suited for determining the abundance of the chrysophytes in oligotrophic lakes. In the eutrophic lakes, where chrysophytes constituted less than 10% of the biomass, the weak correlation was most likely related to counting inaccuracies.

3. Chrysophytes, generally indicative of oligotrophic conditions, were three times more abundant in the oligotrophic lakes. They constituted 28% of the total phytoplankton biomass as chlorophyll a measured by the pigment method and 26% of the total phytoplankton biomass measured as biovolume by microscopy. In mesotrophic/eutrophic lakes, chrysophytes constituted only 9% (pigment method) and 8% (microscopy).

4. Similarity analyses comparing the results of these two methods on functional group level documented the high accuracy of the pigment method in detecting all the functional groups present.

5. The results of the pigment analyses showed a more even composition of phytoplankton groups than found by microscopy, where often one or two of the less abundant groups were absent or only sporadically present. The Shannon's diversity index, H', for functional groups determined from results of the pigment method were higher than the H' values based on microscopic counts, confirming a more continuous composition of the phytoplankton groups when detected by the pigment method. The pigment method was found to be a useful alternative, which supplemented microscopic counts.

（来源：FRESHWATER BIOLOGY, 2016, 61(10): 1627-1639）

Ciliate community structure and interactions within the planktonic food web in two alpine lakes of contrasting transparency

Kammerlander, Barbara; Koinig, Karin A.; Rott, Eugen; et al.

Climate warming is accelerating the retreat of glaciers and recently, many new' glacial turbid lakes have been created. In the course of time, the loss of the hydrological connectivity to a glacier causes, however, changes in their water turbidity and turns these ecosystems into clear ones. To understand potential differences in the food-web structure between glacier-fed turbid and clear alpine lakes, we sampled ciliates, phyto-, bacterio- and zooplankton in one clear and one glacial turbid alpine lake, and measured key physicochemical parameters. In particular, we focused on the ciliate community and the potential drivers for their abundance distribution. In both lakes, the zooplankton community was similar and dominated by the copepod Cyclops abyssorum tatricus and rotifers including Polyarthra dolichoptera, Keratella hiemalis, Keratella cochlearis and Notholca squamula. The phytoplankton community structure differed and it was dominated by the planktonic diatom Fragilaria tenera and the cryptophyte alga Plagioselmis nannoplanctica in the glacial turbid lake, while chrysophytes and dinoflagellates were predominant in the clear one. Ciliate abundance and richness were higher in the glacial turbid lake (approximate to 4000-27800IndL(-1), up to 29 species) than in the clear lake (approximate to 570-7150IndL(-1), up to eight species). The dominant species were Balanion planctonicum, Askenasia cf. chlorelligera, Urotricha cf. furcata and Mesodinium cf. acarus. The same species dominated in both lakes, except for Mesodinium cf. acarus and some particle-associated ciliates, which occurred exclusively in the glacial turbid lake. The relative underwater solar irradiance (i.e. percentage of PAR and UVR at depth) significantly explained their abundance distribution pattern, especially in the clear water lake. In the glacial turbid lake, the abundance of the dominating ciliate taxa was mainly explained by the presence of

predatory zooplankton. Our results revealed an unexpected high abundance and richness of protists (algae, ciliates) in the glacial turbid lake. This type of lake likely offers more suitable environmental conditions and resource niches for protists than the clear and highly UV transparent lake.

（来源：FRESHWATER BIOLOGY, 2016, 61(11): 1950-1965）

Effect of submerged, freshwater aquatic macrophytes and littoral sediments on pan evaporation in the Lake Balaton region, Hungary

Anda, A.; Simon, B.; Soos, G.; et al.

The evaporation (Er) of a US Class A pan (C) with submerged, freshwater aquatic macrophytes (Potamogeton perfoliatus, Myriophyllum spicatum and Najas marina), hereafter macrophytes (P-s) and a sediment-covered bottom (S) was measured in Hungary during 2014-2015 using reference E of Shuttleworth (E-o) and Penman-Monteith crop reference evapotranspiration (crop ETo). There were two main climatic controls affecting variation in E: direct (air and water temperature) and indirect (wind mediated change affecting the penetration of sunlight; precipitation inflow, impacting plant emergence). Lower seasonal mean E-p rates of 2.75 +/- 0.89, 2.83 +/- 0.91 and 3.06 +/- 1.14 mm day(-1) were observed in C, S and P-s, respectively, during the wet 2014. In the 2015 season, higher overall daily mean E-p rates for C, S and P-s were 3.76 +/- 1.3, 4.19 +/- 1.34 and 4.65 +/- 1.52 mm day(-1), respectively. A comparison of US Class A pan E containing macrophytes/sediments with that of a standard US Class A pan showed that pan coefficients (K-ap and K-as) might allow for more accurate on-site lake E estimates. In 2014, seasonal mean Km and K-ap were 1.04 +/- 0.14 and 1.09 +/- 0.18, respectively. Slightly higher K-a values were observed during the warm and dry 2015 (K-as: 1.15 +/- 0.22; K-ap: 1.26 +/- 0.23). A K-a value greater than 1 indicates that the E of a US Class A pan containing macrophytes and sediment is always higher than that of C. The calculated E-o overestimated measured E-p of P-s during the course of this study. During the warm-dry growing season, crop ETo was closest to E-p of P-s. Empirical coefficients can be useful for estimating E of lakes with submerged macrophytes more precisely. The accuracy of the estimate of Keszthely Bay's E improved by 9.85% when K-a was determined on site.

（来源：JOURNAL OF HYDROLOGY, 2016, 542: 615-626）

Nutrient enrichment modifies temperature-biodiversity relationships in large-scale field experiments

Jianjun Wang; Feiyan Pan; Janne Soininen; et al

Climate effects and human impacts, that is, nutrient enrichment, simultaneously drive spatial biodiversity patterns. However, there is little consensus about their independent effects on biodiversity. Here we manipulate nutrient enrichment in aquatic microcosms in subtropical and subarctic regions (China and Norway, respectively) to show clear segregation of bacterial species along temperature gradients, and decreasing alpha and gamma diversity toward higher nutrients. The temperature dependence of species richness is greatest at extreme nutrient levels, whereas the nutrient dependence of species richness is strongest at intermediate temperatures. For species turnover rates, temperature effects are strongest at intermediate and two extreme ends of nutrient gradients in subtropical and subarctic regions,

respectively. Species turnover rates caused by nutrients do not increase toward higher temperatures. These findings illustrate direct effects of temperature and nutrients on biodiversity, and indirect effects via primary productivity, thus providing insights into how nutrient enrichment could alter biodiversity under future climate scenarios.

（来源：Nature Communications, 2016, doi:10.1038/ncomms13960）

Effect of DOC on evaporation from small Wisconsin lakes

Watras, C. J.; Morrison, K. A.; Rubsam, J. L.

Evaporation (E) dominates the loss of water from many small lakes, and the balance between precipitation and evaporation (P-E) often governs water levels. In this study, evaporation rates were estimated for three small Wisconsin lakes over several years using 30-min data from floating evaporation pans (E-pans). Measured E was then compared to the output of mass transfer models driven by local conditions over daily time scales. The three lakes were chosen to span a range of dissolved organic carbon (DOC) concentrations (3-20 mg L-1), a solute that imparts a dark, tea-stain color which absorbs solar energy and limits light penetration. Since the lakes were otherwise similar, we hypothesized that a DOC-mediated increase in surface water temperature would translate directly to higher rates of evaporation thereby informing climate response models. Our results confirmed a DOC effect on surface water temperature, but that effect did not translate to enhanced evaporation. Instead the opposite was observed: evaporation rates decreased as DOC increased. Ancillary data and prior studies suggest two explanatory mechanisms: (1) disproportionately greater radiant energy outflux from high DOC lakes, and (2) the combined effect of wind speed (W) and the vapor pressure gradient (e(s)- e(z)), whose product [W(e(s) - e(z))] was lowest on the high DOC lake, despite very low wind speeds (<1.5 m s(-1)) and steep forested uplands surrounding all three lakes. Agreement between measured (E-pan) and modeled evaporation rates was reasonably good, based on linear regression results (r(2): 0.6-0.7; slope: 0.5-0.7, for the best model). Rankings based on E were similar whether determined by measured or modeled criteria (high DOC < low DOC). Across the 3 lakes and 4 years, E averaged similar to 3 mm d(-1) (C.V. 9%), but statistically significant differences between lakes resulted in substantial differences in cumulative E that were consistent from year to year. Daily water budgets for these lakes show that inputs were dominated by P and outputs by E; and our findings indicate that subtle changes in the variables that drive E can have measurable effects on water levels by shifting the balance between P and E.

（来源：JOURNAL OF HYDROLOGY, 2016, 540: 162-175）

Consequences for pelagic energy mobilisation of a sudden browning episode without a clear increase in DOC concentration: a case of a boreal pristine lake

Peltomaa, Elina; Ojala, Anne

In the boreal zone, episodes of heavy rains are among the most conspicuous events disturbing aquatic ecosystems. Due to climate change they are predicted to become more frequent and intense, leading on browning of lakes. We assessed the possible effects of heavy rains to DOC concentration and water colour and resulting impacts on functioning of a headwater lake with naturally high water colour and

concentration of allochthonous DOC. The weekly measurements were carried out in summers 2002-2004; the first 2 years had normal and the last year very high summer precipitation. The rains resulted in rapid increase in water colour, but not in DOC. We hypothesised that due to browning, irrespective of whether it stems from an increase in brownish DOC or other coloured substances, photosynthesis decreases, bacterial activity increases, and the lake becomes more heterotrophic. We also anticipated that due to strengthened heterotrophy, the period with apparent net autotrophy and CO_2 flux onto the lake would disappear. To test our hypothesis, we measured autotrophic inorganic carbon uptake of photosynthetic organisms as well as dark fixation of inorganic carbon, community respiration and leucine uptake. Finally, we compared the results to CO_2 flux measurements with an eddy covariance technique. Our hypotheses were only partly supported since there were no drastic changes in any of the metabolic processes measured. Although the lake ecosystem became slightly more heterotrophic, primary production was still occasionally higher than community respiration and the lake could act as a sink of CO_2. Thus regarding metabolic processes, the ecosystem of this pristine lake was not strongly disturbed by the sudden browning episode.

（来源：AQUATIC SCIENCES, 2016, 78(4): 627-639）

Urban point sources of nutrients were the leading cause for the historical spread of hypoxia across European lakes

Jean-Philippe Jenny; Alexandre Normandeau; Pierre Francus; et al.

Enhanced phosphorus (P) export from land into streams and lakes is a primary factor driving the expansion of deep-water hypoxia in lakes during the Anthropocene. However, the interplay of regional scale environmental stressors and the lack of long-term instrumental data often impede analyses attempting to associate changes in land cover with downstream aquatic responses. Herein, we performed a synthesis of data that link paleolimnological reconstructions of lake bottom-water oxygenation to changes in land cover/use and climate over the past 300 years to evaluate whether the spread of hypoxia in European lakes was primarily associated with enhanced P exports from growing urbanization, intensified agriculture, or climatic change. We showed that hypoxia started spreading in European lakes around CE 1850 and was greatly accelerated after CE 1900. Socioeconomic changes in Europe beginning in CE 1850 resulted in widespread urbanization, as well as a larger and more intensively cultivated surface area. However, our analysis of temporal trends demonstrated that the onset and intensification of lacustrine hypoxia were more strongly related to the growth of urban areas than to changes in agricultural areas and the application of fertilizers. These results suggest that anthropogenically triggered hypoxia in European lakes was primarily caused by enhanced P discharges from urban point sources. To date, there have been no signs of sustained recovery of bottom-water oxygenation in lakes following the enactment of European water legislation in the 1970s to 1980s, and the subsequent decrease in domestic P consumption.

（来源：PNAS, 2016, 113(45): 12655-12660）

Spatial and environmental analysis of an ostracod metacommunity from endorheic lakes

Castillo-Escriva, Andreu; Valls, Luis; Rochera, Carlos; et al.

The metacommunity concept has promoted a new theoretical view of communities that emphasizes their inter-dependence in a multi-scale nature. However, empirical studies testing the proposed mechanisms structuring communities are still scarce. Here we present a multi-scale spatial analysis on the ostracod metacommunity from endorheic lakes in the Central Iberian Peninsula. For this purpose, multivariate ordination, scalograms and variation partitioning analysis were used to identify environmental (i.e. species sorting) and spatial control (i.e. dispersal limitation, mass effects), and their effects on the metacommunity. The results indicate that both species sorting and dispersal processes structure the metacommunity. The main environmental factors contributing to species sorting were salinity and ephemerality. In addition, significant broad-scale spatial components also structure the species assemblages, suggesting ostracod dispersal limitation within the spatial extent considered. Our study confirms the importance of species sorting, but also reveals how dispersal processes play a role in the structure of ostracod metacommunities.

（来源：AQUATIC SCIENCES, 2016, 78(4): 707-716）

Environmental change explains cichlid adaptive radiation at Lake Malawi over the past 1.2 million years

Sarah J. Ivory; Margaret W. Blome; John W. King; et al.

Long paleoecological records are critical for understanding evolutionary responses to environmental forcing and unparalleled tools for elucidating the mechanisms that lead to the development of regions of high biodiversity. We use a 1.2-My record from Lake Malawi, a textbook example of biological diversification, to document how climate and tectonics have driven ecosystem and evolutionary dynamics. Before ~800 ka, Lake Malawi was much shallower than today, with higher frequency but much lower amplitude water-level and oxygenation changes. Since ~800 ka, the lake has experienced much larger environmental fluctuations, best explained by a punctuated, tectonically driven rise in its outlet location and level. Following the reorganization of the basin, a change in the pacing of hydroclimate variability associated with the Mid-Pleistocene Transition resulted in hydrologic change dominated by precession rather than the high-latitude teleconnections recorded elsewhere. During this time, extended, deep lake phases have abruptly alternated with times of extreme aridity and ecosystem variability. Repeated crossings of hydroclimatic thresholds within the lake system were critical for establishing the rhythm of diversification, hybridization, and extinction that dominate the modern system. The chronology of these changes closely matches both the timing and pattern of phylogenetic history inferred independently for the lake's extraordinary array of cichlid fish species, suggesting a direct link between environmental and evolutionary dynamics.

（来源：PNAS, 2016, 113(42): 11895-11900）

Do warming and humic river runoff alter the metabolic balance of lake ecosystems?

Rodriguez, Patricia; Bystrom, Par; Geibrink, Erik; et al.

Global warming is expected to influence lake gross primary production (GPP) and ecosystem respiration (R) by increasing water temperature and terrestrial export of organic material and inorganic nutrients from the catchment. We experimentally tested the effects of warming (3 A degrees C) and natural humic

river runoff, separately and in combination, on habitat-specific and whole ecosystem net ecosystem production (NEP = GPP - R) in replicated large scale (136 m(3)) experimental pond ecosystems over one open water season. Pelagic NEP was reduced by warming and increased with humic river water addition. Littoral NEP (benthos, macrophytes, periphyton) showed an opposite pattern with increasing NEP following warming and decreasing NEP following humic river water addition. These changes were a result of changes in GPP with warming (negative in pelagic, positive in littoral) and with humic water addition (positive in pelagic, negative in littoral), while no effects were observed on pelagic respiration. As a result of the counteracting effects on NEP in pelagic and littoral habitats, whole ecosystem NEP was not affected by the treatments. The study suggests that climate mediated changes in temperature and river runoff have relatively small effects on the overall metabolic balance of shallow aquatic ecosystems but there may be large habitat-specific effects.

（来源：AQUATIC SCIENCES, 2016, 78(4): 717-725）

Diatom assemblages reveal regional-scale differences in lake responses to recent climate change at the boreal-tundra ecotone, Manitoba, Canada

Shinneman, Avery L. C.; Umbanhowar, Charles E., Jr.; Edlund, Mark B.; et al.

The direction of pan-Arctic ecosystem shifts in response to climate warming is relatively well understood; however, landscape-level linkages among terrestrial, wetland, and lake ecosystems significantly influence the dynamics of each, making it difficult to generalize about lake responses to warming across the Arctic, and at times difficult to interpret paleoclimate records from lake sediments. To investigate differences in lake responses to recent climate change at the boreal-tundra ecotone, we conducted a 2-year survey of diatom assemblages from lakes with varying catchment characteristics in northern Manitoba, Canada. We investigated whether catchment geomorphology and landscape, including slope and vegetative cover, result in characteristic water chemistries and hence diatom assemblage signatures, which could then be used in paleolimnological studies to infer past changes in the catchment. Forty-four lakes were sampled for water chemistry and catchment vegetation was characterized using Landsat Imagery. Lake catchments were generally small (median 702 ha) and dominated by peat (Sphagnum) with or without lowland forest (Picea-Larix), or open tundra, with different amounts of exposed rock/till, upland forest/woodlands, and burn recovery area. Lakes were generally nutrient-poor, with lower nutrient and DOC concentrations in tundra-dominated catchments, and higher nutrients and DOC in catchments with greater forest cover. A diatom-based transfer function for pH (R-2 = 0.72, = 0.54) was developed and compared with diatom assemblage turnover and sediment geochemistry in cores from eight lakes to reconstruct limnologic conditions over the past similar to 200 years. Most cores showed similar increases in biogenic silica and carbon burial, beginning around AD 1880 in the tundra lakes and about 1920 in the more forested catchments, likely in response to regional warming. In contrast to lakes in other Arctic regions, our lakes showed only minor pH changes in recent decades. The shift, however, was more pronounced in higher-latitude lakes with less forest cover, suggesting small-scale watershed influence on lake response to climate, even on short time scales. Diatom assemblages did not follow previously published models of climate-linked community change seen in circum-Arctic and sub-Arctic lakes. Translating local changes detected in the paleolimnological record to the regional level requires an understanding of how different catchment properties mediate the response of lakes, and their diatom

assemblages, to climate change.

（来源：JOURNAL OF PALEOLIMNOLOGY, 2016, 56(4): 275-298）

Tracking the long-term responses of diatoms and cladocerans to climate warming and human influences across lakes of the Ring of Fire in the Far North of Ontario, Canada

Hargan, Kathryn E.; Nelligan, Clare; Jeziorski, Adam; et al.

The extensive peatlands and lakes of the Far North of Ontario warrant committed scientific attention given their status as a significant carbon sink. Economic interest in this region has recently increased due to the discovery of vast mineral deposits (mainly chromite and nickel) known as the "Ring of Fire". Mineral exploration and infrastructure planning are underway, but environmental monitoring is only beginning. Detailed baseline ecological information is required to assess the impacts of future resource extraction within the context of multiple environmental stressors (including recent regional climate warming). Here we use sediment cores from two relatively deep lakes (Z(max) similar to 10 m) and two shallow lakes (Z(max) similar to 2 m), all located in the vicinity of the Ring of Fire, to examine biotic responses to warming prior to the commencement of mining activities. Our data show that, over the past similar to 150 years, diatom and cladoceran sedimentary assemblages have transitioned from dominance by littoral/benthic forms to greater abundances of planktonic cladoceran (an increase of similar to 3 to 34 %) and diatom taxa (an increase of similar to 3 to 22 %). Increased relative abundances of planktonic taxa are consistent with warming-induced changes in lake properties including longer ice-free periods and increased production by planktonic algae. The response of diatom assemblages in shallow lakes to warming preceded the deeper lakes by similar to 45 to 60 years, and substantial increases in aquatic production (similar to 4 to 15 times higher than in sediments deposited prior to 1900) were observed in the shallow lakes, in agreement with previous analyses demonstrating the heightened sensitivity of shallow systems to climate warming. These data provide important information necessary to distinguish potential ecological impacts related to resource extraction from natural variation and the ongoing responses to regional climate warming.

（来源：JOURNAL OF PALEOLIMNOLOGY, 2016, 56(2-3):153-172）

Reversal of a cyanobacterial bloom in response to early warnings

Michael L. Pace; Ryan D. Batt, Cal D. Buelo; et al

Directional change in environmental drivers sometimes triggers regime shifts in ecosystems. Theory and experiments suggest that regime shifts can be detected in advance, and perhaps averted, by monitoring resilience indicators such as variance and autocorrelation of key ecosystem variables. However, it is uncertain whether management action prompted by a change in resilience indicators can prevent an impending regime shift. We caused a cyanobacterial bloom by gradually enriching an experimental lake while monitoring an unenriched reference lake and a continuously enriched reference lake. When resilience indicators exceeded preset boundaries, nutrient enrichment was stopped in the experimental lake. Concentrations of algal pigments, dissolved oxygen saturation, and pH rapidly declined following cessation of nutrient enrichment and became similar to the unenriched lake, whereas a large bloom

occurred in the continuously enriched lake. This outcome suggests that resilience indicators may be useful in management to prevent unwanted regime shifts, at least in some situations. Nonetheless, a safer approach to ecosystem management would build and maintain the resilience of desirable ecosystem conditions, for example, by preventing excessive nutrient input to lakes and reservoirs.

（来源：PNAS, 2016, doi: 10.1073/pnas.1612424114）

Do invasive quagga mussels alter CO_2 dynamics in the Laurentian Great Lakes?

Peng Lin; Laodong Guo.

The Laurentian Great Lakes have experienced unprecedented ecological and environmental changes, especially after the introduction of invasive quagga mussel (Dreissena rostriformis bugensis). While impacts on ecological functions have been widely recognized, the response of carbon dynamics to invasive species remains largely unknown. We report new CO_2 data showing significant increases in pCO_2 (up to 800 μatm in Lake Michigan) and CO_2 emission fluxes in most of the Great Lakes compared to those prior to or during the early stage of the colonization of invasive quagga mussels. The increased CO_2 supersaturation is most prominent in Lakes Huron and Michigan, followed by Lakes Ontario and Erie, but no evident change was observed in Lake Superior. This trend mirrors the infestation extent of invasive quagga mussels in the Great Lakes and is consistent with the decline in primary production and increase in water clarity observed pre- and post-Dreissena introduction, revealing a close linkage between invasive species and carbon dynamics. The Great Lakes have become a significant CO_2 source to the atmosphere, emitting >7.7 ± 1.0 Tg-C annually, which is higher than the organic carbon burial rate in global inland-seas and attesting to the significant role of the Laurentian Great Lakes in regional/global CO_2 budget and cycling.

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Applicability of drinking water treatment residue for lake restoration in relation to metal/metalloid risk assessment

Nannan Yuan; Changhui Wang; Yuansheng Pei; et al.

Drinking water treatment residue (DWTR), a byproduct generated during potable water production, exhibits a high potential for recycling to control eutrophication. However, this beneficial recycling is hampered by unclear metal/metalloid pollution risks related to DWTR. In this study, the pollution risks of Al, As, Ba, Be, Cd, Co, Cr, Cu, Fe, Mn, Mo, Ni, Pb, and Zn due to DWTR application were first evaluated for lake water based on human health risk assessment models and comparison of regulatory standards. The risks of DWTR were also evaluated for sediments on the basis of toxicity characteristics leaching procedure and fractionation in relation to risk assessment code. Variations in the biological behaviors of metal/metalloid in sediments caused by DWTR were assessed using Chironomus plumosus larvae and Hydrilla verticillata. Kinetic luminescent bacteria test (using Aliivibrio fischeri) was conducted to analyze the possibility of acute and chronic detrimental effects of sediment with DWTR application. According to the obtained results, we identify a potential undesirable effect of DWTR related to Fe and Mn (typically under anaerobic conditions); roughly present a dosage threshold calculation model; and recommend a procedure for DWTR prescreening to ensure safe application. Overall, managed DWTR application is

necessary for successful eutrophication control.

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Apparent quantum yield of photochemical dissolved organic carbon mineralization in lakes

Koehler, Birgit; Broman, Elias; Tranvik, Lars J.

Up to one tenth of the carbon dioxide (CO_2) emissions from inland waters worldwide are directly induced by the photochemical mineralization of dissolved organic matter (DOM). The photochemical production of dissolved inorganic carbon (DIC) per photon absorbed by chromophoric DOM (CDOM) decreases exponentially with increasing irradiance wavelength, and is commonly described by an apparent quantum yield (AQY) spectrum. Although an essential model parameter to simulate photochemical mineralization the AQY remains poorly constrained. Here, the AQY of photochemical DIC production for 25 lakes located in boreal, polar, temperate, and tropical areas, including four saline lagoons, was measured. The wavelength-integrated AQY (300-500 nm; mol DIC mol CDOM-absorbed photons(-1)) ranged from 0.05 in an Antarctic lake to 0.61 in a humic boreal lake, averaging 0.24 +/- 0.03 SE. AQY was positively linearly correlated with the absorption coefficient at 420 nm (a(420)) as a proxy for CDOM content (R-2 of 0.64 at 300 nm and 0.26 at 400 nm), with specific UV absorption coefficients as a proxy for DOM aromaticity (R-2 of 0.56 at 300 nm and 0.38 at 400 nm), and with the humification index (R-2 of 0.41 at 300 nm and 0.42 at 400 nm). Hence, a considerable fraction of the AQY variability was explained by water optical properties in inland waters. The correlation of AQY with a(420) opens up the possibility to improve large-scale model estimates of sunlight-induced CO_2 emissions from inland waters based on water color information derived by satellite remote sensing.

（来源：LIMNOLOGY AND OCEANOGRAPHY, 2016, 61(6): 2207-2221）

Wind-driven thermocline movements affect the colonisation and growth of Achnanthidium minutissimum, a ubiquitous benthic diatom in lakes

Cyr, Helene

1. Benthic algae form a major component of primary production in shallow waters and are an important component of lake food webs. I tested the effects of thermocline movements and bathymetric slope on the colonisation and population development of a ubiquitous and often dominant benthic diatom, Achnanthidium minutissimum.

2. Sampling sites were positioned along the upwind and downwind shorelines of an elongated 22 km 2 lake basin, on a range of bathymetric slopes (1-16%). A first set of substrates was deployed at eight sites during early stratification (June 19, 2004) and were sampled after 4, 11 and 20 days and 5.5 and 11 weeks to compare colonisation, establishment, early growth rate and density of mature populations. The second set of substrates was deployed at 16 sites in mid-summer (July 26) and was sampled after 5.5 weeks. The density of A. minutissimum and their average cell length were measured in all samples. Thermocline movements were calculated using a 3D hydrodynamic model, which was calibrated offshore in the lake basin and validated at each sampling site.

3. Achnanthidium colonised the open substrates very rapidly. Initial cell densities increased with increasing thermocline movement, especially along shallow bathymetric slopes. These results suggest an inverse relationship between thermocline-induced nearshore turbulence and bathymetric slope.

4. The density of early colonisers was reduced by 30-95% during the establishment period (411 days after substrate deployment), suggesting that Achnanthidium needs time to attach firmly to the substrate and is vulnerable to disturbances during that period. Achnanthidium established most efficiently at upwind nearshore sites exposed to more thermocline movement.

5. The early growth rate of Achnanthidium in nearshore areas was negatively related to mean water temperature, a likely surrogate for nutrient availability at the sediment-water interface.

6. The density of Achnanthidium in mature populations was positively related to thermocline movements and showed a negative interaction with bathymetric slope early in the stratification period, but not later in summer. These results suggest that physical forces associated with thermocline movements interact differently with the bottom in nearshore areas as the season progresses and as the water-column stabilises.

7. The size of Achnanthidium cells increased during settlement and early population growth, peaked in early July at most sites and decreased over the rest of the summer. This common pattern of seasonal change in Achnanthidium cell sizes suggests a strong factor synchronising its life cycle across the whole lake basin.

8. Thermocline movements over nearshore substrates clearly affect the colonisation and population development of A. minutissimum. These results support the idea that wind-driven physical forces are a major factor structuring nearshore habitats in lakes, even in the lower littoral zone, and that benthic organisms should distribute themselves in a predictable way around lake basins.

（来源：FRESHWATER BIOLOGY, 2016, 61(10): 1655-1670）

Cyanobacteria in lakes on Yungui Plateau, China are assembled via niche processes driven by water physicochemical property, lake morphology and watershed land-use

Jingqiu Liao; Lei Zhao; Xiaofeng Cao; et al.

Plateau lakes are important ecosystems with diverse ecological functions. Cyanobacteria play a key role in plateau lakes as primary producers. However, they are threatening when dense blooms occur. Identifying cyanobacteiral biogeography and the mechanism of assembly processes shaping the distribution of cyanobacteria in plateau lakes is critical for understanding cyanobacterial ecology and applying it to lake management. In the present study, the biogeographic pattern and importance of neutral and niche processes in assembly of cyanobacteria in 21 lakes on Yungui Plateau, China were examined. Results showed that cyanobacteria exhibit unique biogeographic pattern, and most of them have a narrow habitat preference in plateau lakes. They were assembled via niche processes driven by water physicochemical property, lake morphology and watershed land-use, which explained 62.4% of the biological variation. Neutral processes were not at play. Water physicochemical property (key variables - dissolved oxygen, salinity, trophic status and pH) was the most dominant driver shaping its unique

biogeographic pattern. Watershed land-use especially urban land, water body and agricultural land also exhibited a strong impact on cyanobacterial distribution, followed by lake morphology. As most of the cyanobacteiral genus detected in these plateau lakes were potential toxin-producers, this study indicated that in order to protect waters from toxic-bloom in the future, reducing nutrient loading and land-use practices are two practical approaches in plateau lake management.

（来源：SCIENTIFIC REPORTS, 2016, doi:10.1038/srep36357）

Increased variability and sudden ecosystem state change in Lake Winnipeg, Canada, caused by 20(th) century agriculture

Bunting, L.; Leavitt, P. R.; Simpson, G. L.; et al.

Eutrophication can initiate sudden ecosystem state change either by slowly pushing lakes toward a catastrophic tipping point beyond which self-reinforcing mechanisms establish an alternate stable state, or through rapid but persistent changes in external forcing mechanisms. In principle, these processes can be distinguished by determining whether historical changes in focal parameters (phytoplankton) exhibit transient (rising then declining) or continuously-elevated variability characteristic of alternate stable states or a paradox of enrichment, respectively. We tested this hypothesis in the south basin of Lake Winnipeg, Canada, a site with intense blooms of N-2-fixing cyanobacteria since 1990, but for which little is known of earlier limnological conditions, causes of eutrophication, or whether modern conditions represent a alternate stable state. Paleolimnological analysis revealed that the basin was naturally mesotrophic (approximate to 15-20 g P L-1) with diazotrophic cyanobacteria, productive diatoms, and phosphorus-rich sediments. Eutrophication accelerated during ca.1900-ca.1990, when sedimentary nitrogen, phosphorus and carbon contents increased 10-50%, N-15 enriched 3-4 parts per thousand, and concentrations of many fossil pigments increased 300-500%. Nearly 75% of 20(th) century variability was explained by concomitant increases in production of livestock and crops, but not by climate. After ca.1990, the basin exhibited a rapid threefold increase in akinetes from Aphanizomenon and Anabaena spp. and 50% declines in pigments from chlorophytes and cyanobacteria because of sudden socio-economic reorganization of agriculture. Phytoplankton variability quantified using Gaussian generalized additive models increased continuously since the onset of agriculture for bloom-forming taxa, did not decline after state change, and suggested that recovery should not be affected by stable-state hysteresis.

（来源：LIMNOLOGY AND OCEANOGRAPHY, 2016, 61(6): 2090-2107）

Molecular characterization of lake sediment WEON by Fourier transform ion cyclotron resonance mass spectrometry and its environmental implications

Zhang, Li; Wang, Shengrui; Xu, Yisheng; et al

The compositional properties of water-extractable organic nitrogen (WEON) affect its behavior in lake ecosystems. This work is the first comprehensive study using Fourier transform ion cyclotron resonance mass spectrometry (FT-ICR MS) for the characterization of the molecular composition of WEON in lake sediment. In sediments of Erhai Lake in China, this study found complex WEON species, with

N-containing compounds in the northern, central, and southern regions contributing 34.47%, 42.44%, and 40.6%, respectively, of total compounds. Additionally, a van Krevelen diagram revealed that lignin components were dominant in sediment WEON structures (68% of the total), suggesting terrestrial sources. Furthermore, this study applied ESI-FT-ICR-MS to the examination of the environmental processes of lake sediment WEON on a molecular level. The results indicated that sediment depth impacted WEON composition and geochemical processes. Compared with other ecosystems, the double bond equivalent (DBE) value was apparently lower in Erhai sediment, indicating the presence of relatively fewer and smaller aromatic compounds. In addition, the presence of a large number of N-containing species and abundant oxidized nitrogen functional compounds that were likely to biodegrade may have further increased the potential releasing risk of WEON from Erhai sediment under certain environmental conditions.

（来源：WATER RESEARCH, 2016, 106:196-203）

Recent accelerated warming of the Laurentian Great Lakes: Physical drivers

Zhong, Yafang; Notaro, Michael; Vavrus, Stephen J.; et al.

The primary drivers of the recent accelerated warming of the Laurentian Great Lakes from 1982 to 2012 are explored through observations, remote sensing, and regional climate model experiments. The study focuses on the abrupt warming from 1997 to 1998 as a proxy for the long-term warming trend. The lake surface warming has been heterogeneous in both space and time, ranging from moderate warming in late spring over the southern lakes and shallow areas of the northern lakes to strong warming in mid-summer over the northern, deep lake areas. The greatest lake warming between 1997 and 1998 occurs over the deepest areas of Lake Superior during mid-summer, primarily arising from enhanced heat accumulation during the mild winter of 1997/1998 and amplified by greater incoming surface solar radiation and air temperature during the spring of 1998, according to model experiments. The mild winter condition, together with the increased solar radiation and air temperature during spring, causes an earlier onset of springtime stratification, resulting in enhanced heat absorption by surface water and thereby contributing to lake surface warming during the subsequent summer in 1998 compared with 1997. In contrast, the modest peak warming over southern lakes and shallow areas of northern lakes from 1997 to 1998 is a rapid response to synchronous increases in solar radiation and air temperature during May between the 2 yr. Changes in antecedent wintertime lake ice cover are found to have played only a minor role in the accelerated warming trend of the Laurentian Great Lakes.

（来源：LIMNOLOGY AND OCEANOGRAPHY, 2016, 61(5): 1762-1786）

Excess warming of a Central European lake driven by solar brightening

Schmid, M.; Koster, O.

Recent trends in summer surface temperatures of many lakes exceed the corresponding air temperature trends. This disagrees with expectations from lake surface heat budgets, which predict that lake surface temperatures should increase by 75-90% of the increase in air temperatures. Here we investigate the causes for this excess warming for Lower Lake Zurich, a representative deep and stratified Central

European lake, by a combined data analysis and modeling approach. Lake temperatures are simulated using a one-dimensional vertical model driven by 33 years of homogenized meteorological data. The model is calibrated and validated using an equally long time series of monthly water temperature profiles. The effects of individual forcing parameters are investigated by scenarios where the trends of single variables are retained while those of all other forcing variables are removed. The results show that approximate to 60% of the observed warming of spring and summer lake surface temperatures were caused by increased air temperature and approximate to 40% by increased solar radiation. The effects of the trends of all other forcing variables were small. Following projections of climate models, the increasing trends in solar radiation, and consequently the excess warming of lake surface temperatures, are not likely to continue in the future.

（来源：WATER RESOURCES RESEARCH, 2016, 52(10): 8103-8116）

Effects of re-oligotrophication and climate change on lake thermal structure

Flaim, Giovanna; Eccel, Emanuele; Zeileis, Achim; et al.

1. During recent decades, climate change and re-oligotrophication have been affecting many lakes. Most long-term research focuses on large North American and northern European lakes, but climate forcing south of the Alps seems to be different. Furthermore, lake restoration frequently involves smaller lakes (<10 km(2)) that are often overlooked in long-term limnological studies despite their importance for local stakeholders. We investigated the effects of climate change and re-oligotrophication on the thermal structure of Lake Caldonazzo (Italy - southern Alps; area = 5.6 km(2); maximum depth = 49 m) for the years 1973-2014. The lake received untreated wastewaters from its catchment until the mid-1970s, leading to algal blooms, severe hypolimnetic anoxia and fish kills. Afterwards, local government initiated sewage removal that was completed in 1989.

2. We used transparency, phosphorus and chlorophyll concentrations as trophic indicators, air temperature and global circulation indices as climatic indicators and epilimnion depth and temperature, hypolimnion temperature, thermocline depth and Schmidt stability as indicators of thermal structure. For these time series, we determined trend patterns and timing of change points.

3. Epilimnetic temperatures showed an upward shift in 1985. Here, we present an alternative explanation for this observed change that generally has been attributed to global circulation indices. Epilimnetic depth continually increased until 1989, but less markedly afterwards. We suggest that until restoration continued, the increasingly deeper epilimnion absorbed the incoming heat of climate change without increasing epilimnetic temperature. After sewage removal, however, the epilimnion did not deepen enough to prevent an upward shift in epilimnetic temperature. We linked the deepening of the epilimnion to increased water transparency.

4. Hypolimnetic temperatures showed a downward shift in 1998. Hypolimnetic cooling has been seldom observed and was in our case related to specific interactions between re-oligotrophication, climate and lake depth. Penetration of incident solar radiation was insufficient to heat the hypolimnion (>50% of lake volume), while deeper mixing released accumulated heat from the previous season and earlier stratification trapped colder water in the hypolimnion. We suggest that these combined effects resulted in a decrease in hypolimnetic temperature.

5. Our study indicated that re-oligotrophication mitigated the effects of climate change, but when re-oligotrophication was no longer progressing, the effects of climate on thermal structure were perceivable. These changes were site specific and not tied to atmospheric circulation indices. Epilimnetic warming in particular will have repercussions on plankton dynamics. Management of non-point sources of nutrients will become increasingly important to limit the eutrophication-like effects of climate change, especially in the case of a warming epilimnion.

（来源：FRESHWATER BIOLOGY, 2016, 61(10): 1802-1814）

Changes in lakes water volume and runoff over ungauged Sahelian watersheds

Gal, L.; Grippa, M.; Hiernaux, P.; et al

A large part of the Sahel consists of endorheic hydrological systems, where reservoirs and lakes capture surface runoff during the rainy season, making water available during the dry season. Monitoring and understanding the dynamics of these lakes and their relationships to the ecohydrological evolution of the region is important to assess past, present and future changes of water resources in the Sahel.

Yet, most of Sahelian watersheds are still ungauged or poorly gauged, which hinders the assessment of the water flows feeding the lakes and the overall runoff over their watershed.

In this paper, a methodology is developed to estimate water inflow to lakes for ungauged watersheds. It is tested for the Agoufou lake in the Gourma region in Mali, for which in situ water height measurements and surface areas estimations by remote sensing are simultaneously available. A Height-Volume-Area (HVA) model is developed to relate water volume to water height and lake surface area. This model is combined to daily evaporation and precipitation to estimate water inflow to the lake, which approximates runoff over the whole watershed. The ratio between annual water inflow and precipitation increases over the last sixty years as a result of a significant increase in runoff coefficient over the Agoufou watershed.

The method is then extended to derive water inflow to three other Sahelian lakes in Mauritania and Niger. No in situ measurements are available and lake surface areas estimation by remote sensing is the only source of information. Dry season surface area changes and estimated evaporation are used to select a suited VA relationship for each case.

It is found that the ratio between annual water inflow and precipitation has also increased in the last 60 years over these watersheds, although trends at the Mauritanian site are not statistically significant.

The remote sensing approach developed in this study can be easily applied to recent sensors such as Sentinel-2 or Landsat-8, to quantify the evolution of hydrological systems in ungauged Sahelian regions.

（来源：JOURNAL OF HYDROLOGY, 2016, 540: 1176-1188）

Flood frequency matters: Why climate change degrades deep-water quality of peri-alpine lakes

Fink, Gabriel; Wessels, Martin; Wuest, Alfred; et al.

Sediment-laden riverine floods transport large quantities of dissolved oxygen into the receiving deep

layers of lakes. Hence, the water quality of deep lakes is strongly influenced by the frequency of riverine floods. Although flood frequency reflects climate conditions, the effects of climate variability on the water quality of deep lakes is largely unknown. We quantified the effects of climate variability on the potential shifts in the flood regime of the Alpine Rhine, the main catchment of Lake Constance, and determined the intrusion depths of riverine density-driven underflows and the subsequent effects on water exchange rates in the lake. A simplified hydrodynamic underflow model was developed and validated with observed river inflow and underflow events. The model was implemented to estimate underflow statistics for different river inflow scenarios. Using this approach, we integrated present and possible future flood frequencies to underflow occurrences and intrusion depths in Lake Constance. The results indicate that more floods will increase the number of underflows and the intensity of deep-water renewal and consequently will cause higher deep-water dissolved oxygen concentrations. Vice versa, fewer floods weaken deep-water renewal and lead to lower deep-water dissolved oxygen concentrations. Meanwhile, a change from glacial nival regime (present) to a nival pluvial regime (future) is expected to decrease deep-water renewal. While flood frequencies are not expected to change noticeably for the next decades, it is most likely that increased winter discharge and decreased summer discharge will reduce the number of deep density-driven underflows by 10% and favour shallower riverine interflows in the upper hypolimnion. The renewal in the deepest layers is expected to be reduced by nearly 27%. This study underlines potential consequences of climate change on the occurrence of deep river under flows and water residence times in deep lakes.

（来源：JOURNAL OF HYDROLOGY, 2016, 540: 457-468）

Effects of heated effluent on Midwestern US lakes: implications for future climate change

Mulhollem, Joshua J.; Colombo, Robert E.; Wahl, David H.

Numerous simulation studies have considered the effects of impending climate change on lakes. Predictive models exist for the responses of a multitude of variables to a warmer climate, and potential effects on food webs and ecosystem functions. Although these predictions are numerous, there is a need for manipulative experiments testing for the effects of warming on actual lake systems. We used power plant lakes across the central Midwestern US as a substitute for future climate change effects. These treatment lakes receive heated effluent and are typically 2-6 A degrees C warmer than other regional lakes. We collected data from 1997 to 2010 on a number of abiotic and biotic variables from three of these treatment lakes and six control lakes that were of similar size and location but did not have an artificial thermal regime. Phosphorus and phytoplankton concentrations were similar between treatment groups, although treatment lakes had greater phosphorus and less phytoplankton in September. No differences existed in turbidity (measured as Secchi depth transparency). Zooplankton were less abundant in treatment lakes than in control lakes throughout our sampling period (May-October), with differences in cladocerans driving this disparity. There was evidence of earlier spawning of gizzard shad (Dorosoma cepedianum) due to the warmer temperature regime, but not for bluegill (Lepomis macrochirus). Average sizes of juvenile bluegill were larger in warmed systems in July and August. Juvenile largemouth bass (Micropterus salmoides) were larger in heated systems in June, but no differences existed in July or August. Growth of adult largemouth bass was greater in systems with a warmer thermal regime. Our results provide insights into patterns that can be expected in the future, and

may be used to further understand the wide-reaching implications of climate change.

（来源：AQUATIC SCIENCES, 2016, 78(4):743-753）

Effects of sedimentation on soil physical and chemical properties and vegetation characteristics in sand dunes at the Southern Dongting Lake region, China

Ying Pan; Hao Zhang; Xu Li; et al

Sedimentation is recognized as a major factor determining the ecosystem processes of lake beaches; however, the underlying mechanisms, especially in freshwater sand dunes, have been insufficiently studied. To this end, nine belt transects from nine freshwater sand dunes, classified into low (<23.7 m), medium (25.4–26.0 m), and high-elevation groups (>28.1 m) based on their elevations in 1972, were sampled to investigate differences in sedimentation rate and soil and vegetation characteristics in Southern Dongting Lake, China. Sedimentation rate, soil sand content, and soil pH increased, whereas soil clay, fine silt, moisture (MC), organic matter (OM), total N, and total K content, in addition to the growth and biodiversity of sand dune plants generally decreased with decreasing belt transect elevation. Regression analyses revealed that the negative effects of sedimentation on the ecosystem functions of sand dunes could be attributed to higher fine sand content in deposited sediments and stronger inhibition of plant growth. These results are consistent with previous studies performed in coastal sand dunes, which highlights the importance of sedimentation in determining ecological processes.

（来源：SCIENTIFIC REPORTS, 2016, doi:10.1038/srep36300）

Estimating the volume and age of water stored in global lakes using a geo-statistical approach

Mathis Loïc Messager; Bernhard Lehner; Günther Grill; et al

Lakes are key components of biogeochemical and ecological processes, thus knowledge about their distribution, volume and residence time is crucial in understanding their properties and interactions within the Earth system. However, global information is scarce and inconsistent across spatial scales and regions. Here we develop a geo-statistical model to estimate the volume of global lakes with a surface area of at least 10 ha based on the surrounding terrain information. Our spatially resolved database shows 1.42 million individual polygons of natural lakes with a total surface area of 2.67×10^6 km^2 (1.8% of global land area), a total shoreline length of 7.2×10^6 km (about four times longer than the world's ocean coastline) and a total volume of 181.9×10^3 km^3 (0.8% of total global non-frozen terrestrial water stocks). We also compute mean and median hydraulic residence times for all lakes to be 1,834 days and 456 days, respectively.

（来源：Nature Communications, 2016, doi:10.1038/ncomms13603）

Remote Sensing of the Water Storage Dynamics of Large Lakes and Reservoirs in the Yangtze River Basin from 2000 to 2014

Xiaobin Cai; Lian Fen; Xuejiao Hou; et al.

Basin-scale water volumes of lakes and reservoirs are difficult to obtain due to a number of challenges. In this study, area-based water storage estimation models are proposed for large lakes and reservoirs in the Yangtze River Basin (YRB). The models are subsequently applied to Moderate Resolution Imaging Spectroradiometer (MODIS) observations of 128 large lakes and 108 reservoirs between 2000 and 2014, and the first comprehensive map of the temporal and spatial dynamics of water storage in large water bodies in the YRB is provided. The results show that 53.91% of the lakes experienced significant decreasing trends in water storage during this period, and the total water storage in lakes showed a decreasing trend of 14 million m3 month−1. By contrast, a monthly mean increase of 177 million m3 was observed for water storage in reservoirs. Our analysis revealed that the pronounced increase in reservoirs was primarily due to the rapid water level increase in the Three Gorges Reservoir in recent years, while understanding the water loss in lakes requires additional studies. The long-term data presented in this study provide critical baseline information for future water resource monitoring and regulation in the YRB and China.

（来源：SCIENTIFIC REPORTS, 2016, doi:10.1038/srep36405）

Impacts of Three Gorges Reservoir on the sedimentation regimes in the downstream-linked two largest Chinese freshwater lakes

Yongqiang Zhou; Erik Jeppesen; Jingbao Li; et al.

We studied the impacts of Three Gorges Reservoir (TGR) on the sedimentation regimes in the downstream-linked two largest Chinese freshwater lakes, Lake Dongting and Lake Poyang. Our results indicate that up to 1.73×10^9 t sediment was retained in TGR from June 2003 to December 2014. This resulted in a 145.9×10^6 t yr−1 decline in the suspended sediment load at Zhicheng and a 16.8×10^6 t yr−1 lower sediment flow from Yangtze River to Lake Dongting, which partially explains the 13.4×10^6 t yr−1 lower sedimentation in Lake Dongting during the post-TGR period. Furthermore, TGR resulted in a 0.5 ± 0.3 m reduction of the multi-year mean water level at the Lake Poyang outlet Hukou, accelerating the suspended sediment export discharge from the lake. The reduced sedimentation in Lake Poyang during the post-TGR period was estimated to 6.3×10^6 t yr−1. We estimate that a monthly mean concentration of sediment flow from TGR below 0.60 kg m−3 will lead to erosion in Lake Dongting and Lake Poyang. Better regulation of TGR may extend the life expectancy of the two vanishing large lakes.

（来源：SCIENTIFIC REPORTS, 2016, doi:10.1038/srep35396）

Is water age a reliable indicator for evaluating water quality effectiveness of water diversion projects in eutrophic lakes?

Zhang, Xiaoling; Zou, Rui; Wang, Yilin; et al.

Water diversion has been applied increasingly to promote the exchange of lake water and to control eutrophication of lakes. The accelerated water exchange and mass transport by water diversion can usually be represented by water age. But the responses of water quality after water diversion is still disputed. The reliability of using water age for evaluating the effectiveness of water diversion projects in eutrophic lakes should be thereby explored further. Lake Dianchi, a semi-closed plateau lake in China, has suffered severe eutrophication since the 1980s, and it is one of the three most eutrophic lakes in

China. There was no significant improvement in water quality after an investment of approximately 7.7 billion USD and numerous project efforts from 1996 to 2015. After the approval of the Chinese State Council, water has been transferred to Lake Dianchi to alleviate eutrophication since December 2013. A three-dimensional hydrodynamic and water quality model and eight scenarios were developed in this study to quantity the influence of this water diversion project on water quality in Lake Dianchi. The model results showed that (a) Water quality (TP, TN, and Chla) could be improved by 13.5-32.2%, much lower than the approximate 50% reduction in water age; (b) Water exchange had a strong positive relationship with mean TP, and mean Chla had exactly the same response to water diversion as mean TN; (c) Water level was more beneficial for improving hydrodynamic and nutrient concentrations than variation in the diverted inflowing water volume; (d) The water diversion scenario of doubling the diverted inflow rate in the wet season with the water level of 1886.5 m and 1887 m in the remaining months was the best water diversion mode for mean hydrodynamics and TP, but the scenario of doubling the diverted inflow rate in the wet season with 1887 m throughout the year was optimum for mean TN and Chla; (e) Water age influenced the effectiveness of water diversion on the improvement in TP, but not in TN and Chla. Therefore, water age solely could not be used to evaluate the restoration of water quality in a eutrophic lake, because geobiochemical processes played a more important role in the growth of algae than did water exchange in Lake Dianchi.

（来源：JOURNAL OF HYDROLOGY, 2016, 542: 281-291）

Linking freshwater fishery management to global food security and biodiversity conservation

Peter B. McIntyre; Catherine A. Reidy Liermann; Carmen Revenga.

Fisheries are an essential ecosystem service, but catches from freshwaters are often overlooked. Hundreds of millions of people around the world benefit from low-cost protein, recreation, and commerce provided by freshwater fisheries, particularly in regions where alternative sources of nutrition and employment are scarce. Here, we derive a gridded global map of riverine fisheries and assess its implications for biodiversity conservation, fishery sustainability, and food security. Catches increase with river discharge and human population density, and 90% of global catch comes from river basins with above-average stress levels. Fish richness and catches are positively but not causally correlated, revealing that fishing pressure is most intense in rivers where potential impacts on biodiversity are highest. Merging our catch analysis with nutritional and socioeconomic data, we find that freshwater fisheries provide the equivalent of all dietary animal protein for 158 million people. Poor and undernourished populations are particularly reliant on inland fisheries compared with marine or aquaculture sources. The spatial coincidence of productive freshwater fisheries and low food security highlights the critical role of rivers and lakes in providing locally sourced, low-cost protein. At the same time, intensive fishing in regions where rivers are already degraded by other stressors may undermine efforts to conserve biodiversity. This syndrome of poverty, nutritional deficiency, fishery dependence, and extrinsic threats to biodiverse river ecosystems underscores the high stakes for improving fishery management. Our enhanced spatial data on estimated catches can facilitate the inclusion of inland fisheries in environmental planning to protect both food security and species diversity.

（来源：PNAS, 2016, 113(45):12880-12885）

Bayesian Monte Carlo and maximum likelihood approach for uncertainty estimation and risk management: Application to lake oxygen recovery model

Chaudhary, Abhishek; Hantush, Mohamed M

Model uncertainty estimation and risk assessment is essential to environmental management and informed decision making on pollution mitigation strategies. In this study, we apply a probabilistic methodology, which combines Bayesian Monte Carlo simulation and Maximum Likelihood estimation (BMCML) to calibrate a lake oxygen recovery model. We first derive an analytical solution of the differential equation governing lake-averaged oxygen dynamics as a function of time-variable wind speed. Statistical inferences on model parameters and predictive uncertainty are then drawn by Bayesian conditioning of the analytical solution on observed daily wind speed and oxygen concentration data obtained from an earlier study during two recovery periods on a eutrophic lake in upper state New York. The model is calibrated using oxygen recovery data for one year and statistical inferences were validated using recovery data for another year. Compared with essentially two-step, regression and optimization approach, the BMCML results are more comprehensive and performed relatively better in predicting the observed temporal dissolved oxygen levels (DO) in the lake. BMCML also produced comparable calibration and validation results with those obtained using popular Markov Chain Monte Carlo technique (MCMC) and is computationally simpler and easier to implement than the MCMC. Next, using the calibrated model, we derive an optimal relationship between liquid film-transfer coefficient for oxygen and wind speed and associated 95% confidence band, which are shown to be consistent with reported measured values at five different lakes. Finally, we illustrate the robustness of the BMCML to solve risk-based water quality management problems, showing that neglecting cross-correlations between parameters could lead to improper required BOD load reduction to achieve the compliance criteria of 5mg/L.

（来源：WATER RESEARCH, 2017, 108: 301-311）

Reconstructing fish movements between coastal wetland and nearshore habitats of the Great Lakes

Schoen, Lee S.; Student, James J.; Hoffman, Joel C.; et al.

The use of resources from multiple habitats has been shown to be important to the production of aquatic consumers. To quantify the support of Great Lakes coastal wetland (WL) and nearshore (NS) habitats to yellow perch, we used otolith microchemistry to trace movements between the habitats. WL and NS water and fish samples were collected from lakes Huron and Michigan for water and otolith trace element analysis. Recently deposited otolith-edge Sr : Ca and Ba : Ca from otoliths were strongly correlated with the chemistry of the water in which fish were caught. In general, Sr : Ca and Ba : Ca in otoliths were significantly greater for individuals collected from WL areas. Because of these observed chemical differences between WL and NS habitats, quadratic discriminant function analysis (QDFA) was used to classify individuals with high accuracy to the habitat from which they were collected. We then combined the predictive abilities of QDFA with the otolith chemistry transect data that represents an individuals' entire life, to classify habitat use through each fish's life. Our results suggest larval use of WL habitats as well as three life histories for adult yellow perch. These strategies include (1) fish utilizing WL once

annually (2) WL residents (3) WL residence as juveniles followed by movement to nearshore as adults. This application represents a novel use of transect otolith microchemistry to reconstruct fish movements between freshwater environments across entire life spans at fine scales. These results suggest that regular movements of fish may facilitate the production of coastal fishes in the Great Lakes.

（来源：LIMNOLOGY AND OCEANOGRAPHY, 2016, 61(5): 1800-1813）

重点关注

Science：必须以战略规划指导水坝建设

2016 年 9 月 9 日，Science 发表《大坝如何能顺其自然》（How dams can go with the flow）的文章，通过分析水坝的建造和运行对生态系统功能和服务造成的损害，提出水坝战略运营的新见解，以恢复部分损失的生态系统功能和服务。

世界各地的水坝为不断增长的社区提供着重要的供水和水力发电，同时发展中国家还有数百个新的水坝建设已提上日程。尽管水电被视为潜在的绿色能源来源，但水坝建设也带来了重大环境成本的上升。

该研究以美国科罗拉多河葛兰峡谷大坝为研究对象，提出了减缓大坝对生态环境不利影响的见解，其中包括一份管理技术建议，重点提及以减缓由“水文峰（hydropeaking）”现象造成的影响。“水文峰”能够制造一种水流的日常波动模式，该模式通过反复浸润和干燥沿岸栖息地的方式严重破坏其生产能力。文章指出，目前并不能做到对“水文峰”的完全消除，但即使是对河流流动规律做很小的调整，也将有助于恢复河流生态系统。

该研究提出，目前对水坝的修复工作只能做这么多，建议在东南亚、南美和非洲的有关水坝的建设应在数量上做谨慎的战略规划，包括水坝的选址、设计以及运行等。此外，在水和能源需求不断增长的今天，我们面临着一个日益不确定的水文情况，因此必须权衡环境恶化的经济利益。

原文来源：http://science.sciencemag.org/content/sci/353/6304/1099.full.pdf

（来源：科学研究动态监测快报 2016-10-1，第 19 期总第 288 期）

Science：湖泊细菌从 P 中产生甲烷

淡水湖泊是排放到大气中的甲烷的主要贡献者-比全球的海洋提供的还要多。一些厌氧微生物产生的甲烷蕴藏在沉积物或缺氧的深水水域，然而含氧的表层水体也能通过生物过程产生甲烷。 在印度尼西亚的马塔诺湖（ Lake Matano, Indonesia）

的上层湖水中甲烷含量处于饱和状态，研究人员发现甲烷细菌的生产力与湖泊水体中可利用的P含量密切相关。异养菌分解甲基膦酸酯作为P的来源，并在此过程中释放甲烷。在培养试验中也可以看到，当P含量增加时甲烷产量下降。因此，湖泊的甲烷释放模型应当耦合不同含氧的水层可用营养盐含量，以帮助准确预测全球甲烷排量预测。

该文章在Appl. Environ. Microbiol. 10.1128/AEM.02399-16 (2016)上发表。

原文来源：http://science.sciencemag.org/content/354/6313/717.5

（来源：Science, 2016, 354(6313):717-718 根据相关资料编译）

Nature：监测、保护世界上最深的淡水湖-贝加尔湖

贝加尔湖位于西伯利亚东部，因其独一无二的生物多样性而被联合国列为世界遗产保护名录。然而，由于近年来政府削减了该湖近30%的长期监测项目经费，其生态及环境健康目前正面临极大威胁。

伊尔库茨克国立大学的生态学家早自1945年起，就开始每隔一周收集该湖水样的温度、透明度、浮游植物丰度及物种结构组成等指标数据。在20世纪初贝加尔湖绝大多数还出于天然状态，然而随着近年来随着表层水体的变暖以及冬季冰盖量的减少，其生态系统发生快速变化。比如，在湖滨带来自于工业区及居民区过量营养盐的排放导致水绵等绿藻泛滥以及近岸地区特有海绵动物种属的减少。

对贝加尔湖这个世界上最深的湖泊健康状态的长期观测至关重要。维持这项观测（一年不到7万欧元）相对于这个世界级湖泊的生态和经济价值而言其实是微乎其微的。

原文来源：http://www.nature.com/nature/journal/v538/n7623/full/538041a.html

（来源：Nature, 538(41): doi:10.1038/538041a 根据相关资料编译）

NCAR 高分辨率模型预测大气河流的未来变化

2016年9月26日，来自美国国家大气研究中心（NCAR）的研究人员发表《大气河流的登陆纬度在未来气候模拟中的变化》（Atmospheric River Landfall-latitude Changes in Future Climate Simulations）的文章，指出NCAR高分辨率的气候模型精确捕捉到了大气河流（Atmospheric River，AR）及其影响，并对未来北太平洋和北大西洋两大地区大气河流的变化趋势进行了预测。该研究成果被Geophysical Research Letters选为当期亮点文章。

大气河流是携带有大量水汽由热带地区向热带外地区延伸的狭长湿度带，当其

登陆陆地时会释放产生大量降水，可能造成灾害性洪水。研究人员主要关注大气河流的频率、强度和路径变化，但以往标准分辨率的气候模型很难真实地模拟到大气河流及其影响。因此，研究人员利用共同体气候系统模式（Community Climate System Model，CCSM4）以常规分辨率的2倍进行模拟，并确定大气河流登陆纬度的变化趋势。该研究分析了两大地区的大气河流：美国西岸的北太平洋大气河流和英国的北大西洋大气河流。

研究人员发现高分辨率的气候模式的效果很好，能够捕捉到大气河流过去一个世纪来的登陆频率、位置及相关的风暴。该研究发现，未来大气河流发生的变化大体上依赖于急流的变化。袭击美国西岸的大气河流受副热带急流变化的影响，研究预计未来北太平洋大气河流将向东移动。而袭击英国的大气河流受极锋急流的影响，并呈现季节性变化。另外，研究预计，与大气河流相关的降水强度将增强。

原文来源：http://onlinelibrary.wiley.com/doi/10.1002/2016GL070470/abstract

（来源：科学研究动态监测快报 2016-10-15，第20期总第242期）

青藏高原所揭示亚洲高原湖泊变化模式及驱动因素

高山湖泊的动态变化，如它们的出现/消失、扩张/收缩，是环境变化的重要指标，这些变化整合了气候和人类活动的影响。区域尺度的对比研究对了解不同区域对气候变化的响应非常重要。对于不同区域的高山湖泊系统，它们对气候变化的响应可能完全不同，这主要依赖于其受大尺度大气环流、区域气候及冰冻圈过程的影响。

除地球南北极外，青藏高原和蒙古高原也是气候变化最敏感的地区。与临近的蒙古高原不同，青藏高原有广泛分布的冰川和冻土。过去几十年来，这两个高原经历了相似的快速变暖，升温率高出世界其他地区的3倍。考虑到更为强烈的环境变化及西风、季风系统和其他气候现象的影响，两个高原的能水循环可能发生显著的变化。青藏高原和蒙古高原分布有大量的湖泊，这是地表水循环的重要组成部分。在快速变暖的情景下，这两个高原湖泊的状态可能朝不同的方向变化。目前这两个高原湖泊变化已有一些碎片化的研究，但并不系统。

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副研究员张国庆联合国内外科学家对过去40多年来两个高原湖泊变化模式及演化规律进行了系统的定量研究。研究主要围绕着“在气候变暖背景下，过去40多年来，水和冰冻圈如何在世界上相邻、最大的高原——青藏高原和蒙古高原上循环？”这一科学问题开展。利用遥感数据对1970s-2013年间两个高原的湖泊变化进行了监测，研究表明：青藏高原湖泊主要分布在内流区（即羌塘盆地），青藏高原湖泊变化特征体现为湖泊的扩张和新湖泊的出现；长期连续时间序列湖泊（内流区）的快速扩张，主要发生在1997/1998年后；在空间上，青藏高原南部（雅江流域）湖泊出现萎缩，但其变化幅

度较小，其他流域湖泊无明显的变化趋势。蒙古高原湖泊出现消失和萎缩，连续时间序列变化显示其萎缩主要发生在1997/1998年后。湖泊水量平衡变化分析显示，青藏高原湖泊的扩张主要归因于降水的增加和冰冻圈的贡献，在内流区尤为突出。蒙古高原湖泊的萎缩主要归因于降水的减少，同时伴随有人类活动的影响，内蒙古相比于外蒙古更为明显。两个高原湖泊变化相反的模式及水循环的变化，特别是时间序列拐点发生在1997/1998年，被认为是大尺度及区域大气环流变化对气候变暖的响应。

该研究结论主要概括为三个方面：1）青藏高原和蒙古高原湖泊变化呈现相反的模式；2）两个高原湖泊变化明显的时间拐点发生在1997/1998年；3）青藏高原暖-湿的气候和蒙古高原暖-干的气候，是导致过去40多年来两个高原湖泊变化呈现完全不同模式的主要原因。此研究为区域水资源和生态系统管理提供了重要信息，为在区域尺度上制定适当的适应和管理战略提供决策支持。

该研究得到了国家自然科学基金（41571068，41190081，41301063，31228021，41374020）等项目的支持，研究成果近期发表于《地球物理研究快报》期刊。

（来源：《中国科学院报》 http://www.cas.cn 2016-12-30）

气候、人类活动影响共同导致乌尔米湖的退化

曾经是世界上第二大的咸水湖的伊朗乌尔米湖，近年来由于受到人类活动和气候变化的影响出现急剧退化，文章发表在Journal of Great Lakes Research杂志上，该项研究首次比较了气候变化和水资源管理对该湖入湖流量的影响。

国际应用系统研究所（IIASA）及荷兰瓦赫宁根大学的首席研究员Somayeh Shadkam认为保护乌尔米湖需要从国家层面加强水资源管理，同时还需要国际科研力量合作应对气候变化的难题。

乌尔米湖曾经是世界第二大咸水湖，但在近几十年间湖泊面积缩减了80%。早前Shadkam及其同事的研究表明气候变化威胁到了该湖的生存，并采用未来气候情景分析模拟展示了入湖流量的相应变化。该团队的最新研究旨在更深入了解该湖退化的原因，采用1960-2010年间共计50年的数据测算不同的影响因素，如人类用水量和气候变化等变量的相对贡献。

在研究期内，乌尔米湖的年均入湖流量已经下降了48%。通过模型计算入湖流量，研究人员发现60%的变化是由于气候变化所致，如降水和温度的变化，此外剩下的40%可能是由于水资源开发引起的，如将水用于灌溉等。

之前绝大多数的研究显示水资源开发的变化是引起该湖衰退的主导因素。而这项新研究表明气候变化才是导致该湖干涸的主因。这也就进一步说明仅仅靠减少用水量而不采取其它应对气候变化的措施无法挽救该湖干涸的命运。

“水资源管理和气候变化是有着千丝万缕的联系”，国际应用系统研究所（IIASA）的首席研究员Pavel Kabat博士认为，“这是一个从综合系统的视角为政策制定者提供优化建议的区域案例，将对解决诸多诸如此类的紧迫问题提供参考”。

原文来源：https://www.eurekalert.org/pub_releases/2016-11/iifa-chi111016.php

（来源：http://pure.iiasa.ac.at/13926/ 2016-11-10 根据相关资料编译）

火星上冰盖储水量比苏必利尔湖还要多

北京时间11月28日消息，研究人员利用美国宇航局“火星勘测轨道器”(MRO)的观测数据近日得到结论，认为在火星上一处遍布裂隙和撞击坑的平原地下存在大量水冰，其含水量甚至可能与北美五大湖中最大的苏必利尔湖的水量相当，苏必利尔湖同时也是世界上面积最大的淡水湖。

这就是火星北半球中高纬度地区的乌托邦平原(Utopia Planitia)，科学家们利用MRO飞船搭载的“浅地表雷达”(SHARAD)对该平原部分区域进行了研究，该设备能够穿透地表，看到浅层地下情况。通过对该区域超过600次的飞越过程中采集的资料，科学家们的分析结果显示这里的地下存在一个巨大的水冰储存区，其面积甚至比整个新墨西哥州还要大。该区域的冰层厚度在80米至170米之间，其成分大约是80%~85%的水冰，再加上其他一些尘埃物质和较大的岩石颗粒物。

在该水冰储存区域所在的纬度(北半球中高纬度)，水冰是无法稳定存在于火星表面的。在火星今天如此稀薄的大气环境下，暴露于地表的水冰很快就会升华为水汽并消散殆尽。而乌托邦平原地下的水冰则被上覆的土层保护了起来，该土层厚度达到1~10米。

德克萨斯大学奥斯汀分校地球物理学院的卡西·斯图尔曼(Cassie Stuurman)是发表在《地球物理学研究通报》杂志上有关研究论文的第一作者。她说：“该水冰储库可能是在地质历史上某个时期形成的，当时火星的黄赤交角比现在更大，当大量降雪逐渐累积时，逐渐挤压成为水冰，并混入了大量沙尘物质。”

今天的火星黄赤交角大约25度，在其两极地区储存了大量的水冰物质。在大约12万年的周期内，这一角度的变化量将达到两倍之多，导致两极地区升温，冰雪物质将向中纬度迁移。火星气候模型和此前在中纬度地区大量水冰物质的发现表明在黄赤交角变化的某些时期，大量冰雪物质会在远离火星极地的区域累积。

美国宇航局喷气推进实验室(JPL)的“火星勘测轨道器”(MRO)执行项目科学家莱斯利·坦帕里(Leslie Tamppari)表示：“拓展我们对于火星上水体分布与数量的认识是非常重要的。”他说：“我们知道早期火星表面存在足够水体，使得河流和湖泊能够存在。但后来这些水体都去了哪里?它们中的大部分都已经经由大气层散失掉了，其他探测器目前正在对这一过程进行考察。但与此同时还有很大一部分的水体

至今仍然以地下水冰的形式留在火星上，而我们需要对此有更深的了解。”

德克萨斯大学的乔·列维(Joe Levy)也是这项最新研究的论文合著者。他说：“乌托邦平原此次发现的水冰储库并不仅仅是能够满足未来探测所需，它也是最方便获取到的火星古代气候记录之一。目前我们还并未完全理解为何水冰会在火星上的某些区域，而不是在另外一些区域累积。这些水冰对于未来登陆火星的宇航员们来说意义重大，对它们开展的取样研究同时也将帮助我们揭开这些水冰的埋藏年代之谜。”

SHARAD是MRO飞船携带的六台科学载荷之一，MRO飞船本月刚刚迎来其在火星轨道工作的第十个年头。该任务的长期和持续性使其能够帮助科学家们观察火星上的一些长期过程以及多年变化，从浅地表一直到大气层。SHARAD设备是由意大利空间局研制的，该设备的日常科学运行由意大利罗马大学负责管理。总部位于美国亚利桑那州图森的行星科学研究所参与了该设备的部分研制工作。加州理工学院下属的喷气推进实验室(JPL)为美国宇航局科学任务委员会代为管理MRO飞船，而位于丹佛的洛克希德·马丁空间系统公司则是MRO飞船的建造承包商并对该飞船的在轨运行提供长期技术支持。

原文来源：

http://www.sciencemag.org/news/sifter/hidden-ice-sheet-mars-contains-more-water-lake-superior

（来源：Science官网 2016-11-28 根据相关资料编译）

痛心!印度最大淡水湖干涸变沼泽

因政府推行柳树种植计划，印度乌勒尔湖在五年间经历了绿洲变沼泽的悲惨命运，其近期干涸荒芜的图片更是引发热议。

据悉，乌勒尔湖位于印控克什米尔北部，是印度最大的淡水湖。在水资源越来越缺乏的南亚占据重要地位。 但在 20 世纪 50 年代，印度政府雇用村民在乌勒尔湖沿线大规模种植柳树用作木材、建材与板球拍。而柳树耗水性极强，不仅加重了乌勒尔湖的干涸，其缠结的根部也对土壤造成了破坏。

1911 年，乌勒尔湖及附近沼泽面积达 83 平方英里（约 215 平方千米），到 2008 年锐减至 40 平方英里（约 104 平方千米）。

2008 年，国际湿地组织拿出 8200 万美元（约合人民币 4.8 亿元）用以修复乌勒尔湖生态，印度国会在 2011 年也作出了行动。

科学家警示，乌勒尔湖的生态修复应该引起政府足够的重视，气候变暖这一因素也应纳入考虑中。

（来源：光明网 http://www.gmw.cn/ 2016-11-14）

加州最大湖泊生态环境恶化

图 美国加利福尼亚州索尔顿湖南岸大片裸露的干涸河床

美国加利福尼亚州东南部该州最大的湖泊——索尔顿湖是二十世纪初人为因素形成的，曾经是繁荣的度假区，高峰期每年吸引150万游客。然而，由于自然蒸发量大及周边城市和农业大量用水等因素，这座巨大的湖泊已经严重萎缩，生态环境恶化。如今，大片干涸裸露的湖床成为沙尘暴的策源地，湖泊水量减少致使湖水盐度增加，鱼类大量死亡，散发出刺鼻的咸腥气味，曾经繁华的旅游区已经人迹罕至。

（来源：《科技日报》 2016-10-14）

RAND：使用集成化模拟技术支持水资源规划

2016年12月兰德公司（RAND）在线发布题为《利用高性能计算支持水资源规划》（Using High-Performance Computing to Support Water Resource Planning）的报告，指出，近年来决策支持模型主要集中在决策—分析迭代这一领域的研究，这种仿真模拟的方法在决策的整个过程中，因为存在时间差的问题，会有很多不确定的因素未被考虑进去，造成整个决策过程中决策者和分析者的相互关系存在不确定性。

如何使用集成化的模拟技术和近乎实时的分析是当前决策者亟需解决的问题。兰德公司与劳伦斯利弗莫尔国家实验室（LLNL）的相关专家提出使用改进的决策—分析迭代模型—强健决策模型（Robust Decision Making，RDM）可以很好地解决这一问题，尤其在资源管理领域效果明显。已经将强健决策模型（RDM）应用于路易斯安那州海岸可持续发展总体规划与美国垦务局的科罗拉多河流水域供需研究中。

原文来源：http://www.rand.org/pubs/conf_proceedings/CF339.html

（来源：科学研究动态监测快报 2016-12-15，第24期总第293期）

WRI：美国保护饮用水源流域投资计划的经验教训

2016年10月27日，世界资源研究所（WRI）发布《保护饮用水源地》（Protecting Drinking Water at the Source）报告。本报告确定了美国建立和发展13个流域投资计划的共同方法和基本条件。在2013~2016年期间，来自世界资源研究所和科罗拉多州立大学的研究人员分别分析了美国各地13个流域投资计划的经验和教训，提出投资一个流域计划所需要的途径。报告最后，基于3年的比较案例研究分析，得出一个保护珍贵水源路线图指导公用事业和社区。表1为美国13个流域投资计划的分布区域、资助年份、资助金额及区域环境和所在区域土地类型情况。

流域投资计划的目的在于通过保护资助土地保存和修复来保护水量和水质。这些计划将下游用水户（如水务公司、市政府、企业和公众）连接到上游土地所有者（如美国林务局管理的私人森林所有者和公共土地）。他们联合饮用水公用事业、农村土地所有者、政府机构、保护组织和其他人等围绕提供安全饮用水这个目标达到可持续流域管理。借鉴这些流域投资计划的经验，可以相互学习，克服共同挑战，评估他们自己的方案发展方法，并通过学习他人经验受益节省时间和金钱。水管理者还可以使用这项研究来教育培训利益相关者关于流域投资计划的目的和结构。表2 为报告中给出流域投资计划每个阶段发展的经验描述及实施路线框架。

表1 美国13个流域投资计划基本情况序号

序号	州	流域投资计划	资助年份	资助金额（$）	区域环境	土地类型
1	科罗拉多州	丹佛水-美国 森林服务水域保护伙伴关系	2010	1,300,000	野火洪水风险；生态威胁；水质恶化	公共/私人
2		奥罗拉-美国森林水域保护伙伴关系	2011	325,000	野火洪水风险；生态威胁；水质恶化	公共
3		科罗拉多-大汤普森上游水伙伴关系	2012	860,000	野火洪水风险；生态威胁；水质恶化	公共/私人
4		科罗拉多斯普林斯公用事业-美国森林服务水域保护伙伴关系	2013	480,000	野火洪水风险；生态威胁；水质恶化	公共
5		普韦布洛水务局-美国美国森林服务水域保护伙伴关系	2013	109,000	野火洪水风险；生态威胁；水质恶化	公共
6	加利福尼亚州	旧金山公用事业委员会流域和环境改善计划	2005	2,600,000	发展威胁:野火和洪水风险:干旱和供水下降:生态威胁	公 共 / 私人
7	亚利桑那州	弗拉格斯塔夫流域保护项目	2012	66,000	野火洪水风险	公共
8	新墨西哥州	南里约德兰的水资金	2013	1,000,000	生态威胁	公共/私人
9		圣达菲市流域投资计划	2008	78,000	野火洪水风险	公共
10	俄罗冈州	波特兰水区	2013	200,000	发展威胁；水质恶化；正在试区环境保护局过滤豁免威胁	私人
11	特拉华州	特拉华河普通水基金	2010	15,000,000	发展威胁；森林覆盖损失；水质恶化；用水需求增加	私人
12	北卡罗来纳州	纽斯河上游清洁水倡议	2005	500,000	水需求增加；发展威胁；水质恶化	私人
13	北卡罗来纳州	中央阿肯色水	2007	400,000	发展威胁；水质恶化；法治威胁	私人

表 2 流域投资计划各阶段的实施框架

阶段	描述	教训
建设初期	明确流域投资计划的需求和的；确保主要利益相关者的承诺。	1.识别灾害（野火、干旱等）并抓住机遇团结支持者；2.建立伙伴关系填充重要角色和责任；3.阐明一个清新明确的未来愿景；4.从水公共事业、地方政府、非政府组织及土地所有者等培养支持者和倡导者。
项目设计	评估方案的科学和经济基础；制定实现计划目标的战略。	5.制定科学的流域计划；6.评估投资的商业案例；7.确保水公共事业、公司、基金会等投资者以及初始和长期工资的融资机制。
行动计划实施	积极并适应性的进行投资，跟踪投资的结果。	8.让土地所有者和公共管理者保护、恢复和可持续的管理自然基础设施；9.明确方案管理的作用及计划；10.监测和评估绩效。

原文来源：http://www.wri.org/publication/protecting-drinking-water-source

（来源：科学研究动态监测快报 2016-12-15，第24期总第293期）

英国政府制定提高洪水适应力的计划与战略

2016年9月7日，英国政府发布题为《国家洪水适应力评估》（National Flood Resilience Review）的报告，审查了英国对洪水的适应力现状，分6个领域提出减轻洪水风险的计划，最后制定了2021年后的长期战略。

1. 提高地方基础设施的适应力

过去的6个月中，政府已经和基础设施行业合作，确定了面临洪水风险的设施以及遭受洪灾后会使大批人无法获得服务的设施。一些行业已经具备了明显的适应力，但整个基础设施行业的进展不一致。处于风险中的所有基础设施行业已经同意，制定或扩展现有的中期计划，通过充分保护资产或其他手段，比如互联或备用供应，来增加极端洪水中为重要人群提供服务的弹性。主要行动与计划包括：

（1）电力行业将在2015-2021年投资2.5亿英镑，增加电力网络对洪水的适应力。电力行业已经调查了解到所有服务对象超过1万个人且不具备极端洪水应对能力的电力网点，如果需要或可行的话，针对这些网点会制定计划构建临时屏障。

（2）水利和通信行业已经同意，为了在短期内提高基础设施的适应力，需要采取基于现有的管理资产洪水风险的行动，详细评估所有无法弹性应对极端洪水事件的关键基础设施。这两个行业已经承诺到2016年圣诞节之前，实现适应力的短期提高。

（3）政府已经与公用事业达成一致，合作提高政府和弹性基础设施运营商之间的合作和信息共享的机制。政府正在主动与公用事业合作，建立一个国家基础设施适应力委员会或论坛，旨在：①赞助跨行业的合作和信息共享；②制定关于适应力的合适建议；③仔细检查并记录不同行业之间的相关性；④在紧急情况下，加强不同行业部门、相关地方适应力论坛（Local Resilience Forum，LRFs）和政府内阁紧急应变小组（Cabinet Office Briefing Rooms，COBR）机制之间的联系。

（4）2016年下半年，政府会和水利部门合作扩展审查分析，覆盖服务对象超过1万人的水利资产。

（5）政府将继续扩充和提高基础设施适应力的相关知识。政府已经委任交通部（Department for Transport），在2016年冬季风暴和洪水到来之前，研究确定由于严重洪水事件面临孤立风险的群体，交通部也会和当地公路部门分享研究成果，以确保在洪水适应力措施中，优先考虑被确定的脆弱群体。

（6）为解决评估不同行业之间相关性面临的挑战，交通部将和公用事业合作，确定那些对于基础设施供应商而言为单点故障的桥梁，或是在严重洪水灾害中会处于危险的桥梁，确保行业可以通过开展应对行动来保护服务正常进行。

2. 提高应急响应能力

提高应急响应能力方面的行动与计划包括：

（1）环境署（Environment Agency）计划投资1250万英镑，用于临时洪水屏障、移动水泵、事故指挥车辆，最终显著提升其应对洪水突发事件的能力。

（2）政府计划投资75万英镑的维护款，确保全国部署的洪水救援队伍可以维护其设备，保证救援用途的国家资产达到最大容量，能及时应对2016年冬天的洪灾。

（3）政府部门间应该密切合作，登记国家所有的洪水应急资产清单，相关信息应该易于更新，并通过适应力指挥部向外界开放。此外，政府会建立一个行动中心，把相关机构集合在一起来提高情境意识，促进及时部署国家资产，包括武装力量。

（4）持续采取行动，提高政府对于地方应急人员准备状态的了解，同时识别地方洪水适应力和应急规划中的良好实践。环境、食品和农村事务部（Defra）将与政府其他部门合作，为地方应急人员制定一个标准的行动模式，环境署会和地方适应论坛合作，寻找机会把良好的实践嵌入地方的洪水响应规划中。政府将促进地方应急人员对《适应力指导》（Resilience Direct）的使用，进一步改善使《适应力指导》对用户尽可能友好，同时发展符合应急人员需求的新能力。总体目标是，开发一种工具，使参与应急的所有人员都能了解别人正在做什么。

（5）2016年秋天，环境署计划举行一次适应力演练，测试部署新的应急设备所做的准备。环境部（Department for Environment）、Defra以及国民紧急事务秘书处（Cabinet Office Civil Contingencies Secretariat）将与环境署一起参加演练。很多地方应急人员也有相似的计划来为即将到来的冬天检测作准备工作。

3. 在核心城市开展创新洪水防御和城市发展的试点

评估报告的目的是战略性地考虑如何规划城市以抵御河流和沿海洪水。考虑到所面临的挑战的程度，以及严重洪水灾害发生带来的显著的经济影响，必须在不给纳税人增加大幅额外负担的条件下，寻找更加创新的解决办法去构建新的洪水防御。政府将以英国的核心城市（Core Cities in England）之一谢菲尔德（Sheffield）作为开展创新洪水防御和城市发展的试点，确定一种城市发展类型，可以使城市在开启重建机会的同时符合当地发展优先事项。

为了支持这项挑战，政府集合了很多来自多部门和多学科的高级商业领导和专家组成的小组，重点关注如何去设计能够为地方提供经济价值的新防御，并考虑那些由于洪水防御模式带来显著经济效益的国际例子。

如果这种试点方法能成功推行，下一步目标就是在那些洪水保护级别不如伦敦的其他核心城市推广这种方法，并为其他城市区域提供参考，在设计城市发展和重建规划时采取建筑弹性准则，从洪水防御中创造出额外的社会和经济价值。更长远来说，未来会让社区把这种方法应用到更大的城市区域中，并扩展到那些大城市所属的小城镇里去。

4. 长期建模改进的滚动计划

现有的建模方法已经足够，但仍然可以在以下地方加以改进。包括：①开发更

完善的洪水风险建模方法，使之能同时开展全国范围的气象、水文和洪水模拟，使得未来评估特定级别的洪水发生概率、确定影响以及评测一系列洪水管理方法变得更简单和快捷；②进一步使用历史资源的信息去扩展洪水记录，便于改善评估英国特定地方过去不同时期发生极端洪水事件的可能性；③进一步发展统计方法来减少洪水评估中的不确定性，包括考虑长期的变化和趋势；④定期评估洪水风险和相关影响，旨在考虑最新的研究成果，以反映基本假设下的任何变动。

环境署正在推进工作以提高完善所有来源的洪水建模，将其作为现存计划的一部分去更新《国家洪水风险评估》（National Flood Risk Assessment）报告。环境署还购买了一个升级后的洪水预测系统，这个系统可以利用与气象局（Met Office）一起开发的概率天气预测产品，更加密切地结合气象和洪水预测。气象局将和环境署合作，审视调查更进一步整合气象学和洪水风险建模能产生的收益。

要实现这种长期的方法以及其他被推荐的行动，需要新的科学和分析技术。政府会鼓励英国研究团体与气象局、环境署接洽，建立友好的合作关系，开发下一代综合洪水风险评估模型。

5. 环境署洪水风险沟通

在之前科技智慧（Sciencewise）项目提高公众洪水风险参与度的基础上，环境署会与其他机构合作，开发不同的方法去传达严重洪灾的程度和可能性。

环境署会使用新方法，开展一个秋季提高意识活动，重点针对面临洪水风险的社区，尤其是那些洪水风险很高但是从未经历过洪水的社区，旨在鼓励这些城市或社区为其城市和社区制定洪水风险防御计划并采取行动。

Defra应通过其科学咨询委员会（Science Advisory Council），与环境署和气象局合作，针对如何与不同受众沟通洪水风险制定建议。

6. 地表水泛滥

评估报告主要关注了国家所面临的来自河海水泛滥的洪水风险，但地表水泛滥也是洪水的重要来源之一，应该采取行动去重视这种类型的洪水。

2014年《国家风险评估》（National Risk Assessment）报告考虑了沿海洪水和内陆洪水两种洪水风险，内陆洪水风险几乎只关注了河流泛滥的风险，以及一些潜在的来自地表水泛滥的额外影响。2016年《国家风险评估》报告将分开讨论河流和地表水泛滥的风险，识别出地表水泛滥和河流泛滥的不同特性，从而允许在国家和地区层面上，用更有针对性的方法规划管理地表水泛滥的风险。

社区及地方政府事务部（Department for Communities and Local Government）将与Defra、环境部、关键利益相关者合作，评估英国的规划立法、政府规划政策和地方规划政策等内容，重点关注与英国土地发展相关的可持续排水。

7. 长期战略（2021年后）

在本届议会内，英国政府将维护和改善防洪设施投资列为重点事项。本届议会

有一个记录，6年内承诺推出1500种计划，在2021年之前将洪水总风险降低5%，更好地保护30万个家庭。2016年预算提供了额外的刺激，即在2021年前为洪水防御和适应力投资超过7亿英镑。评估报告最后提出了2021年后英国减轻洪水风险的长期战略，包括：

（1）基于本次评估掌握的证据，Defra今后会把注意力转移到2021年后的投资，以及政府在支持社区和整个经济范围内的适应力中发挥的作用上来。在提高地方基础设施的适应力方面取得进步之后，Defra将和环境署、财政部（HM Treasury）以及国家基础设施委员会（National Infrastructure Commission）合作，考虑长期投资需求和融资选择，考虑核心城市的适应力，包括从谢菲尔德试点学到的开发自负盈亏的新模型的经验教训。Defra的工作会考虑保护和适应力之间的平衡，密切关注英国城市的洪水风险，也会在减少洪水风险中考虑政府和社会的作用。

（2）Defra将和环境署合作，加强长期投资方案的分析，确保政府资金在支持风险最高的社区和最大化经济利益中达到平衡。Defra将评估政府投资如何最有效地实现这些目标，同时提供最佳可能信息允许其他机构来管理风险。

（3）政府的6年资金承诺与合作融资方法在资金方面已经提供了更大的确定性，允许风险管理机构去制定规划、提高效率和做出更多的贡献。未来政府将考虑2021年后，如何利用政府减少洪水风险和提高防御能力的滚动计划做出进一步改善。

（4）设计坚固的洪水防御只是解决方案的一部分。自然洪水管理可以带来很多好处，政府的未来25年保护环境计划会着重加强地方合作伙伴的作用，把它们集中起来，整合流域层面的水资源规划与洪水管理。

（5）流域领导者将协调规划，使用综合的方法和评估干涉措施。政府将会继续将资金用于减少洪水风险管理，确保新方法（比如减缓河水流动的土地管理措施）可以与传统工程防御具有类似的经济竞争力。

原文来源：https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/551137/national-flood-r

（来源：科学研究动态监测快报 2016-10-01，第19期总第288期）

兰德公司创建全球粮食、能源与水安全评价工具

2016年10月13日，兰德公司（RAND）发布文章《世界热点》（The Hot Spots of the World）称，粮食、能源和水的缺乏危机上百万人的生命，为此兰德公司创建了“帕蒂兰德粮食-能源-水指数”（Pardee RAND Food-Energy-Water Index）工具，以更有效的促进援助计划和举措。人类生存的三大基石（粮食、能源和水）在全世界范围内是紧密相连的，某一方面的薄弱会降低其他两个方面的供给。为更好地理解粮食、能源和水之间的联系可以增强国际援助计划实施的有效性，同时也能够更好

的应对全球面临的挑战，如气候变化等。兰德公司研究人员及帕蒂兰德研究生院（PRGS）的学生们已经花了数年在各国追踪粮食、能源和水这三大基石之间的节点和联系。研究人员收集了各国国内粮食价格、可饮用水量、现代烹饪和加热燃料的使用情况等数据。最后他们合并了十几个数据集以显示粮食、水和能源之间的关系。在此基础上，他们创建了“帕蒂兰德粮食-能源-水指数”，该工具是一副可以互动的、共享的免费地图，其展示了当前全世界粮食、能源和水的安全状态，并可以在未来情景下分析这三大主题，同时用户能够详细获得的每个国家粮食、水和能源的供应数据及分布。

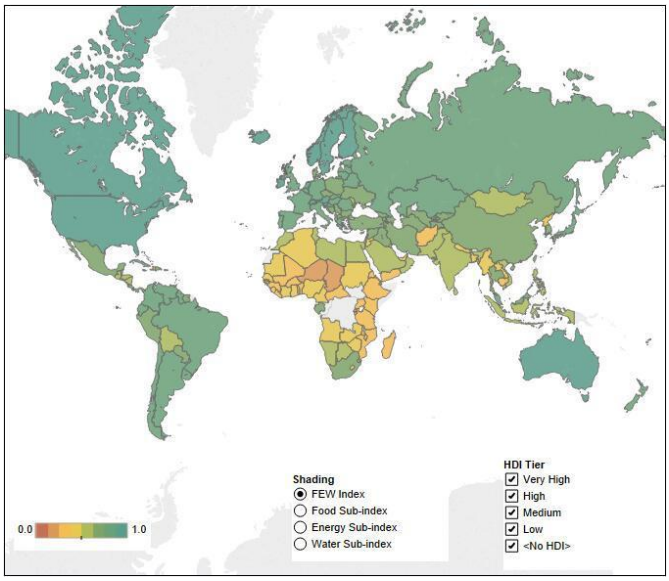

图 1　“帕蒂兰德粮食-能源-水指数”地图

未来15年全世界人口数量预计将从现在的73亿增加到90亿，按此估算，在未来需要至少增加40%的食物、水和能源。兰德公司通过该工具指出问题的严重性，需要全球制定有效控制粮食、水和能源的政策和援助计划，进一步研究粮食、能源与水耦合的重大课题和气候变化与资源的相互作用等。

原文来源：http://www.rand.org/blog/rand-review/2016/10/the-hot-spots-of-the-world.html

（来源：科学研究动态监测快报 2016-12-1，第 23 期总第 292 期）

基于水足迹评估的撒哈拉以南非洲可持续发展的途径

2016年11月7日，水足迹网络（Water Footprint Network）在线发布撒哈拉以南的非洲地区七个国家（贝宁、埃塞俄比亚、加纳、肯尼亚、马里、莫桑比克和卢旺达）水足迹概况（*Water Footprint: Key to Sustainable Development in Sub-Saharan Africa*）报告，这是首次对该区域开展这类系列评估，其目的是使用水足迹建立一个对撒哈拉以南非洲每个国家用水情况的了解，以通过制定政策和指导投资促进该区

域可持续发展，最终实现公平和合理利用该地区的淡水。该项目由荷兰外交部资助，目的是支持其提出的提高水生产率的25%的目标。

世界银行统计显示，世界上75%的缺水国家位于撒哈拉以南的非洲，该区域的人类主要依靠农业为生。增加农业绩效被认为是撒哈拉以南的非洲国家的社会和经济发展的核心，也是联合国实现可持续发展的目标。撒哈拉以南非洲的农业生产是水资源消耗的主要源头，伴随人口剧增更加加剧了该区对粮食的需求及水资源的匮乏。在该区，提高作物水分和土地生产力的做法和政策将直接有助于改善人类生计，有助于在增加粮食安全的同时减少贫困。同时，这样做可以使可持续河流盆地获得清洁的水，并有助于维持该地区的生态系统。水足迹概述主要包括以下几个方面：①从该国生产的商品的角度来看每个国家的水的使用；②利用全球水足迹基准对比主要作物的生产，以评估作物生产及增加水和土地生产力的潜力情况下如何有效地用水；③每个国家的作物生产用水的可持续性相比水的可用性；④该国公民对货物（特别是作物）的消费，以及这些商品是否在国内生产，或从其他国家进口。

水足迹为撒哈拉以南非洲地区可持续发展的社会经济发展提供了科学依据。揭示了该区域如何发展都取决于和支持一个可持续的、可靠的水供给的质量和数量。进一步深入评价这些分析提供的有价值的见解和他们提出的问题可以支持一个国家和地区层面包容性的绿色增长。撒哈拉以南非洲走向可持续发展的四条途径：①更有效地利用绿色水资源（降雨）是加强撒哈拉以南非洲地区粮食安全和气候恢复能力的关键一步。②扩大灌溉，确保环境的水流动和调节地下水资源的使用，将有助于避免过度使用水资源产生的负面后果。③从全面发展的角度出发，整合各部门政策将有助于避免部门间的目标相互矛盾所导致的可持续发展减缓。④生产作物和使用农业生产系统提高水的生产率，将有助于提高生计并降低水资源的压力。

原文来源：

http://waterfootprint.org/media/downloads/WFN_press_release_Africa_WF_Profiles_2.pdf

（来源：科学研究动态监测快报 2016-12-1，第 23 期总第 292 期）

太湖水草锐减带来严重生态隐忧，专家疾呼——太湖，不能没有水草！

经多地长达三年的集中清除和常态化打捞，太湖水草锐减。水草大量减少，导致今年太湖虾产量只有往年的十分之一。更为严峻的是，少了水草这个“天敌”，太湖蓝藻控制将更加不容乐观。中科院多位湖泊生态专家表示，水草大量减少将引发生态危机，如再不采取果断措施，明后年太湖蓝藻大爆发将是大概率事件。专家们呼吁：立即叫停打捞，让太湖水草休养生息！

据本地渔民介绍东太湖水草以前长势旺盛，但目前已基本绝迹。在水草里寻食吃的鱼、虾、蟹也少了，影响最大的是湖虾，产量只有往年的十分之一；青、草、

鲢、鳙四大家鱼明显生长缓慢，个子比往年小，只有白鲢多到卖不掉，一公斤只卖到1元。太湖渔业管理办公室副主任吴林坤介绍，每年太湖水产产量约5万吨，今年依傍水草生存的鱼虾螺蛳减少了，青虾减产幅度最大，螃蟹也减产了。

记者了解到，太湖上的水草打捞船几百、几十吨位的都有，船上的全自动装置对水草分离切割，将水下1.5米深水草全部清除。打捞船由水利、环保等部门向社会招标，划定清理水域网格化管理。部分招标公告要求，打捞必须先割掉水面上的水草，再将割下漂浮的捞上船只，保护水草根部不受破坏；而更多的水草打捞，则根本没有设定限制，这直接导致了水草被斩草除根。

太湖曾遭受蓝藻爆发之痛，当年曾准备花数千万元聘请中国水草专家、国家重点野外实验室于丹教授团队种水草，如今相关各地却大规模清除水草，这是为何？苏州吴中区水利部门表示，清除水草是保证湖面清洁，航道通畅。相城区农业局相关人员则反问道：夏天水草烂在太湖里，不捞水源不就被污染了吗？

湖泊生态专家可不这么看。他们认为，太湖水草目前的生存状况非常令人担心，大规模的人工清除，导致水草大量减少，损害了湖泊自净功能，将引发一系列连锁反应，导致生态恶化。多位专家表示，大规模打捞水草是错误的决策，太湖应立即停止打捞水草。中科院南京地理与湖泊研究所湖泊生态专家刘正文表示，如果水草没有了或大面积死亡，以后几年，太湖富营养化将更加严重，蓝藻大爆发是可以预见的大概率事件，政府必将为此花费巨大处置成本。

太湖总面积2300平方公里，平均水深2米。国土资源部生态专项调查显示，太湖有很强的自净功能，水草对湖水、水质生态平衡系统有重要保护功能。太湖湖泊生态系统研究站站长秦伯强接受记者采访时说，太湖需要水草，水草对湖泊健康的生态系统，保护生物多样性，尤其是堤岸边净化水质作用无可替代。而在刘正文看来，近年太湖水草不是多了，而是少了，从上世纪50年代到现在，太湖水草越来越少。最可惜的是，水草优质种群苦草、黑藻、马来眼子菜、微齿眼子菜也被捞光了，这让刘正文很痛心。他说，太湖长蓝藻的原因就是富营养化，水草与蓝藻是竞争关系，它们在生长期相互竞争，都要吸收水中氮磷营养，水草少了，蓝藻就多了。

中科院南京地理与湖泊研究所湖泊环境与工程室研究人员表示，东太湖胥口湾水草原来覆盖达70%，渔民捞水草养螃蟹，就能平衡生态。太湖浅水区湿地发育较好，有大量挺水植物，净化水质功能强，即使腐烂死亡，分泌的物质也是遏制蓝藻生长的；沉水植物分布面积大，对水的净化功能和水体自净能力保持贡献最大，水草腐烂后，短期水质差一点，也不会对水体造成大的影响。在大量水草沼泽化情况下，水草才需要打捞 ，而太湖不存在沼泽化现象。

多位湖泊生态专家表示，针对太湖作出的决策，不应也不能只考虑某些地区或部门利益。即便打捞，也应是严格限定打捞范围、草种、季节、方法的局部打捞，而不是大规模的“清剿”。比如，为了确保通航航道局部打捞，漂浮水面的水草影

响美观可稍作打捞，但必须严禁用打捞船深度绞割。

有关太湖治理恢复水生植被规划，都是增加水草种植。无锡太湖水域曾大量种水草，但在目前也仅能在岸边做一点恢复，代价很大。湖泊生态，破坏容易恢复难。专家介绍，如果割掉一亩水草要花1万元，种一亩水草则要花10万元甚至更多。无锡太湖的贡湖湾就是个典型例子。贡湖湾100多平方公里，2002年前水草覆盖率达到40%，因望虞河调水等因素，水草被大量淹没，2007年出现蓝藻危机，由于水生植物被严重破坏，经多年修复改善，效果仍不明显。

太湖水草虽然在大量减少，但幸运的是湖底还留有水草苗种种源。专家呼吁，加大水草保护力度，让水草休养生息。除了叫停太湖水草打捞外，因太湖常年调控在高水位运行，光照少不利水草生长，明年春季应将湖水调控到较低水位，以保证春季水草嫩芽发育，多长水草。

有数据表明，为治理太湖，江苏省8年投资了1600亿元。一方面是重金治太，另一方面却是一些部门管理粗放、急功近利，花钱清除水草，带来生态隐患。专家们表示，这种好心办坏事、花钱损害太湖生态的做法可以休矣！

（来源：《新华日报》 2016-12-09）

黄河小浪底水库防洪减淤怎么解

近日，由黄河水利委员会黄河水利科学研究院、武汉大学、黄河勘测规划设计有限公司完成的“小浪底水库淤积形态优选与调控的理论及关键技术”项目荣获了中国水利学会大禹一等奖。

该项目主要由张俊华、夏军强、马怀宝、窦身堂、李书霞、李涛、蒋思奇、王婷、李昆鹏、万占伟、张翠萍、张防修、李元亚、余欣、郜国明等完成。项目研究期间出版专著 3 部，发表论文 98 篇，其中 SCI、EI 31 篇，计算机软件著作权 2 项，发明专利 2 项，获黄委科技进步奖 2 项。成果通过河南省科技厅组织的鉴定，整体达到国际领先水平。

黄河水利科学研究院副总工程师张俊华说，项目团队在诸多前沿科学问题研究取得突破性进展，完整构建了水库调度与下游河道数学模型体系，在水库调控技术取得创新与突破，量化了优化调度效果。基础研究成果已应用于国务院、国家防总批复的黄河水库调度方案中，并已作为学科前沿问题收录于国家自然基金委 2016 年出版的《中国学科发展战略》；水库调度相关成果已应用于水利部批复并发布的小浪底水库拦沙后期（第一阶段）调度规程；构建的数学模型在黄河治理开发规划设计研究中得到广泛应用；成果在高校教学与科研中得到应用。

项目研究人员首次从水库淤积形态调整的视角及其与水沙输移和水库调度之间的影响反馈机制为主线，从优化水沙组合、支流库容充分利用、减缓水库淤积等全

方位优选水库淤积形态，并提出可长期保持优选形态的水库调控技术，且量化了调控效果；首次针对极细颗粒泥沙形成的浑水水库淤积问题，研究减缓水库无效拦沙的高效输沙关键技术。

项目研究团队提出了可精确描述高含沙异重流产生与演化、干支流倒回灌、水库溯源冲刷等复杂边界条件下水沙运动控制方程；揭示了水沙过程对河道滩岸崩退的影响机制；首次开展高含沙异重流产生至浑水水库演变及其与后续水沙响应等全过程的试验研究与原型跟踪观测，定义了“侵入型”与“界面型”两类异重流及其界定判数。

该项目建立了具有模拟水库复杂边界水沙输移及水库调度等功能的模型；构建适用于黄河下游复杂断面形态的洪水传播与河床调整的水沙耦合应用级模型。创新与突破了水库调控技术。首次以保持水库优选淤积形态为切入点研究水库水沙调控，优选了水库拦沙后期淤积形态，并将黄河上、中游水沙过程、水库调控与下游输沙一体化考虑确定调控指标与方式；基于对浑水水库演变及其与水沙响应机制的研究提出高效输沙技术。

项目科研人员利用数学模型与物理模型平行预测水库优化效果表明，本次提出的优化方案 20a 系列水库减少淤积量 10.2 亿 m^3 至 12.7 亿 m^3，入海沙量增加 6.7 亿吨，优化方案有效延长水库拦沙期年限并增大入海沙量。

（来源：《科学日报》 2016-12-09）

业界动态

鄱阳湖水利工程争议再起 建与不建都为生态

争议了十余年的“鄱阳湖水利枢纽工程”（以下简称“鄱阳湖工程”），在方案几经修改之后，终于正式转入可行性研究阶段。11月23日，江西省水利厅官网发布鄱阳湖水利枢纽环境影响评价公众参与第一次信息公示。27日，官网又发布了更为详尽的说明性文章《为了“一湖清水”——鄱阳湖水利枢纽工程介绍》，阐释建设该工程的必要性和整体思路。

和之前一样，环保组织集体出声反对。一直主张暂缓该工程上马的WWF（世界自然基金），以“也为‘一湖清水’”为题，发文呼吁采取无坝无闸的替代方案。

湖口建闸，是否唯一方案？

鄱阳湖确实遇到了问题。

江西省水利厅指出，近十年来，受长江上游干支流水库群汛后蓄水引起的长江中下游径流减少、清水下泄冲刷引起的河道下切等因素影响，鄱阳湖连续出现枯水

时间提前、枯水期延长、水位超低等情况。

鄱阳湖枯水常态化和趋势化的新变化，造成枯水期水资源、水生态、水环境承载力严重不足，对湖区民生、生态、经济等多方面造成严重影响。

对这一现状，WWF也表示“充分理解”。“鄱阳湖出现了极端的水位和局部水环境问题，成为了制约区域经济发展的一个重要问题，需要通过各种途径和方式来应对这些内外部压力。”

但是建闸，一直被质疑为“用工程的方式对抗工程”。12月2日，九三学社中央人口资源环境专门委员会发表了《我们对鄱阳湖口建闸工程的看法和建议》，提出“使用地下水”和“改造提灌站、增加饮水设施”来解决湖区灌溉和居民饮水困难等民生问题的替代性方案。

“我们不是没有想过其他方案，我们至少论证过三种。” 江西省生态文明研究与促进会会长、南昌大学教授胡振鹏告诉科技日报记者。

方案一，如九三学社所建议，用地下水来保障居民用水。胡振鹏说，2002年，为了解决农村安全用水的问题，江西省政府批准在环鄱阳湖的99个行政村统一进行“改水改厕”。改水的方案，就是使用地下水。“江西省处于红壤地区，土壤成分以三氧化二铁为主。鄱阳湖周边的地下水，铁和锰都超标。”他透露，也曾咨询专家，没有经济实用的净化方法去除铁离子和锰离子，水质达不到饮用要求。地下水方案夭折。

方案二，就是增加饮水设施。目前鄱阳湖周围有100多个提灌站，都建在高程大概12到14米处。一到枯水季节，取不到水。而如果要到深水区去引水，必然要在鄱阳湖底开挖引水沟。“这要挖多少沟，挖掉多少泥？挖出来的泥，堆放到两边，又要埋掉多少湿地？这笔账一算，鄱阳湖损失的湿地，比因为水位上涨而淹掉的湿地可能还要多，恐怕国际湿地公约组织也难通过。”性价比太低，放弃。

方案三，对鄱阳湖流域的水库进行联合调度。鄱阳湖流域的大型水库一共23座。在满足水库基本功能的前提下，在枯水季节放水为鄱阳湖补水，能否缓解鄱阳湖枯水之困？研究人员计算，大费周章联合调度，可以抬升鄱阳湖9cm到15cm的水位。但胡振鹏认为，“流水的抬升作用非常有限”。

三种办法，有的试过，有的想过，有的算过，综合效益都比不上建闸。当年的“反对派”胡振鹏，也转成了支持者。

建也为生态，不建也为生态

“生态”，是反对和支持建闸者共同的“武器”。

鄱阳湖是东亚迁徙候鸟在南方的主要越冬栖息地和停歇地。世界上98%以上的白鹤和75%以上的东方白鹳在此越冬。

沈阳理工大学生态环境研究室主任周海翔指出，水利枢纽工程建设，会给鸟类栖息地带来不可逆的破坏。枯水季节水位上升，将淹没鸟类的越冬地。“这是要改

变自然。”周海翔强调。

江西省科学院生物资源所副所长戴年华研究员和鄱阳湖打了三十几年的交道。他表示，枯水期提前，枯水期延长且水位急剧降低，对湿地植物生长的时空产生一定影响。为何候鸟近几年依然留守鄱阳湖？戴年华说，这是因为鄱阳湖比较特殊，它是一个盆，但盆里还有许多小碗，也就是碟型湖。盆里水位明显降低的时候，这些湖中湖因渔民传统的堑秋湖生产方式还保留有水。碟型湖,也是鄱阳湖越冬候鸟最集中的觅食地。

胡振鹏研究过，如果鄱阳湖汛期遭遇大洪水或者高水位持续时间长，沉水植物群落无法正常生长，白鹤11月来到鄱阳湖觅食困难，将影响白鹤越冬。鄱阳湖水位也影响到碟型湖水位能否缓慢下降，湖水位太高，碟型湖不能全部外露或水位不能缓慢下降，也不利于白鹤越冬。但湖水位太低，使浅碟型内湖干涸，更不利于白鹤越冬。

“鄱阳湖水量增多，对水生动植物的分布和生长肯定是有利的。而修闸对候鸟觅食的影响，关键要看它的水位调度，确保有一定的浅水滩地。”戴年华说。

对此，胡振鹏表示，湖区约80%的越冬候鸟在两个国家级自然保护区越冬。根据现有方案，闸前蓄水10米，不会影响碟形湖水位自由涨落，不影响候鸟觅食的可及性。

不过，湖区人类活动确实影响了湖区脆弱的生态系统。戴年华说，过去，渔民靠鄱阳湖解决温饱问题，现在，要靠鄱阳湖有限的资源奔小康，攫取的资源更多，给湖区生态环境造成的压力更大。

戴年华也希望“自然的归自然”。但换位思考，站在湖区百姓的立场上，他们的出路在哪里？“记得老师讲过，生态学不要简单说个‘不’字，要拿出方案来解决问题。”

如果有了水资源，一切会好办。有水，可以“转捕为养”，可以依托水发展其他产业。戴年华坦言，评价水利工程的好坏，是看如何平衡利弊。“该不该建？怎么建？建了怎么管？这是三个关键问题。”他认为，水工程，一定会对利益相关方造成一定影响，影响能否被接受，这个可以开诚布公深入讨论。政府、当地百姓、专家和社会组织，这三方面的意见，都得听。

做好环评报告被翻“底朝天”的准备

为了鄱阳湖水利枢纽工程，江西一度“屡战屡败”“屡败屡战”。从11月27日发布的工程介绍来看，此版方案跟江西最开始提出的工程方案已有较大差别。

“对那么多不赞成的声音，包括当年院士联名给总理写信表示反对，我们江西从来没有抱怨过。”胡振鹏说，工程能走到今天，其实要感谢这些反对之声。“没有他们的‘逼迫’，我们不会有这么一个方案出台。”

调度水位调低，水位消落要符合鄱阳湖自然水文节律，为江豚设置了4孔60米宽

的大闸……这些改变，其实都是江西省在质疑之下，研究之后做出的回应性调整。

对新一轮质疑之声，胡振鹏很淡定：“任何工程大家都会有不同意见，有分歧是正常的。”他研读了这些质疑，评价其“质量没有达到给我太多启发的水平”，还没有出现让他“睡不着觉要深入研究”的意见。

胡振鹏认为，信息公示只是个开头，工程完整方案并没有公布，只讲了规划思想。相关工作才刚刚起步，之后还有一系列程序要走。

“环评报告出来后，大家会看到，我们的调度方案到底会淹没多少湿地，哪个地方淹没多深，会不会改变植被性质，会不会影响鸟类……这些大家有疑问的地方，我们都做了细致的研究。”胡振鹏说，按照要求，明年环评报告就会在网上公示。他建议，大家可以下载下来，慢慢研究，看他们的算法对不对、结论可不可靠，提出意见的针对性会更强。

“我们都做好了环评报告被翻个‘底朝天’的准备，我们也期待更尖锐、更有价值的意见。”胡振鹏说。

（来源：《科技日报》 2016-12-07）

2016 中国水博览会在北京举行

11月15日至17日，2016中国水博览会在北京中国国际展览中心（新馆）举行。展览汇集了12个国家和地区的150多家知名企业，集中展示了节水灌溉、水利自动化和信息化等水行业的最新技术和成果。图为北京恒通国盛环境公司展示的自主研发、全球首创的清淤机器人模型。

（来源：《科技日报》 2016-11-16）

亚欧 18 国专家长沙共商“水安全”

10 月 20 日，由中国外交部、湖南省人民政府和亚欧基金举办的 “亚欧城市水管理研讨会”在长沙闭幕。澳大利亚、中国、法国等 18 个亚欧会议成员国专家共商“水安全”合作。会上，亚欧水资源研究和利用中心、常德市人民政府联合发起“水环境保护与海绵城市建设亚欧科技合作倡议”。

此次研讨会是亚欧各方推进城市水管理领域国际合作的里程碑。来自国际组织和亚欧会议成员的 30 名官员、专家就应对气候变化的城市水资源一体化管理，城市水安全、区域及国家层面的城市水资源开发利用经验等 6 大主题展开探讨，分享亚欧会议成员在城市水管理方面的经验和成功做法及领域内科研动态、新技术、新理念。

亚欧水资源研究和利用中心和常德市人民政府还联合发起“水环境保护与海绵城市建设亚欧科技合作倡议”，坚持低影响开发理念，不断加大协同创新力度，提升科技内涵来保护环境、防控污染。以常德为示范，率先搭建科技研发、转化、产业化共享平台。

（来源：《科技日报》 2016-10-21）

印度与英国联合共建水资源安全中心

2016年9月27日英国全国环境研究委员会（NERC）在线发布了题为《印度与英国联合共建水资源安全中心》（India-UK Joint Centre on Water Security officially launched）的声明。该虚拟研究中心将促进两国在水资源安全利用与水资源可持续发展领域达成合作。世界经济论坛认为水危机在2016年全球重大风险排名中位居第三，在2015年，经济合作与发展组织（OECD）发布报告称，印度是面临水资源危机最严重的国家。

由英国全国环境研究委员会（NERC）与印度地球科学部（MOES）共建的水安全中心预计将用三年时间建成，近期将共同合作开展一些项目研究，包括：水资源循环、南亚季风变化的驱动力、维持水资源的食品、能源和生态系统服务等方面的研究。该研究中心将在英国全国环境研究委员会（NERC）建立实体的生态与水文子中心（CEH），将在印度地球科学部（MOES）建立实体的热带气象研究所（IITM），两家实体单位将进一步加强学习与合作。

原文来源：http://www.nerc.ac.uk/press/releases/2016/40-india/

（来源：科学研究动态监测快报 2016-11-1， 第 21 期总第 290 期）

脏水里放张“神奇网” 半月水质变了样

12月17日，由国内重点企业与科研单位联合承担的国家级石墨烯光催化治理黑臭污染水体项目，通过了中国环境科学学会组织的由中国工程院院士任阵海、蔡道基等组成的专家组的鉴定。专家组一致认为：该研究技术成果整体上达到国内领先水平，其中石墨烯光催化网的制备与应用达到国际先进水平。

该项目由江阴嘉润石墨烯光催化技术有限公司与中国科技开发院江苏分院、中国环境科学研究院环境技术工程有限公司共同承担完成。其核心技术具有可见光响应的异质间高效量子转移技术，今年5月17日通过了江苏省经信委新产品新技术鉴定。在此基础上，他们与港股上市公司允升国际合作，加入高品质、“零缺陷”的石墨烯进行应用试验，仅半年的时间就研发出石墨烯可见光催化网、可见光催化石子、可见光催化人工水草等系列产品，并选择在江阴瑰宝小区河道、利港南段河两个黑臭污染水体放入石墨烯可见光催化网，进行示范应用。

负责这个项目的中国科技开发院江苏分院副院长冯冠华介绍，石墨烯可见光催化网以聚丙烯纤维为基材，通过独特涂覆工艺负载多层石墨烯光催化材料而成，可用于水体净化、空气净化等，尤其适用于城市黑臭水体的治理，可对水体中有毒有机物进行分解、除臭、增加水体含氧量，与其他治理技术兼容性强，材料绿色环保，并且可以循环使用。示范应用证明，放入这张“神奇”网后，在正常运行条件下能在半个月内消除黑臭。其中，高锰酸指数降低59.4%，5日生化需氧量降低56.9%，总氮降低51.6%，总磷降低80.8%，浊度降低83.98%，悬浮物降低67.9%。

（来源：《科技日报》 2016-12-19）

利益共享，才能破解红碱淖干涸困局

位于陕西神木县和内蒙古交界地带的中国最大沙漠淡水湖红碱淖，因为上游截水而面积缩小近半造成生态危机，沙漠明珠可能逐渐演变成第二个罗布泊，然后两省互相指责，打口水仗。

在极度缺水的地方，水意味着收成和财富，而没有水有时就无法生存。这时，一味要求上游不要引水并不现实，上游地区的人也难免要嘀咕：凭什么你下游坐享江湖之利，而我们不能靠水吃水？所以这里面有个利益共享的问题，即下游受益地区如何补贴回馈上游地区的生态补偿问题。

红碱淖从原先的沼泽发展成为最大沙漠湖泊只有一百年不到的历史。20世纪50年代，当地发动以疏通排水渠为主的改造湿滩地工程，两省7条季节性内陆小河水流入红碱淖，其中较大的3条河流有2条就在内蒙古境内。红碱淖水面当时达到10万亩之广，就是说它是后天生成的湖泊，这当中内蒙古贡献甚大。矛盾的激化是在发现

煤矿资源后，因为红碱淖周边埋藏着储量丰富的优质煤炭，无论储量还是质量，都远超周边矿区。所以，当陕西方面指责内蒙古只顾自家利益在上游修建水库的时候，内蒙古方面也指责陕西独霸红碱淖的煤炭和旅游资源，红碱淖干涸主因并非河流补给水遭截用所致。

所以红碱“闹”，其实缘于利益纷争，如何解决这个利益纠纷，首先国家层面的统筹规划不可缺少。如何破解矿产开发与保护自然生态的矛盾？或者在湖底防渗技术成熟可行的若干年后再开发？水量的分配使用如何决定？这一切都需要国家层面的介入。

而更重要的是利益分享方面。早在1992年，红碱淖建起了旅游区，一年门票收入不菲，如今门票更是涨到49元一张。由于红碱淖在区域上属于陕西，内蒙古方面眼看着陕西人挣钱，心中自然失落，凭什么我们不但没有旅游收益而且上游不能建工矿企业甚至不能引水灌溉？只有上下游共享红碱淖的收益而不是一方独占，矛盾才可能在协调中解决，而不是像现在这样在情绪化中对峙僵持。

而事实上早先类似红碱淖这种因上下游利益纠纷导致的生态毁灭现象并不少见。针对于此，早在上个世纪八九十年代，有关方面就已提出下游地区应当对上游地区做出生态补偿，而上游城市水污染要给下游城市补偿，都收到了很好的社会效果。但仅限于补偿还不够，更要利益共享，红碱淖是比较容易实施利益共享的地方。我想，一旦双方都能理性地坐下来协商，实现利益共享，共同的利益追求将会使许多问题迎刃而解。

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