

湖泊科学动态

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热点文章

➤ Local flow regulation and irrigation raise global human water consumption and footprint

Fernando Jaramillo, Georgia Destouni

Flow regulation and irrigation alter local freshwater conditions, but their global effects are highly uncertain. We investigated these global effects from 1901 to 2008, using hydroclimatic observations in 100 large hydrological basins. Globally, we find consistent and dominant effects of increasing relative evapotranspiration from both activities, and decreasing temporal runoff variability from flow regulation. The evapotranspiration effect increases the long-term average human consumption of fresh water by $3563 \pm 979 \text{ km}^3/\text{year}$ from 1901–1954 to 1955–2008. This increase raises a recent estimate of the current global water footprint of humanity by around 18%, to $10,688 \pm 979 \text{ km}^3/\text{year}$. The results highlight the global impact of local water-use activities and call for their relevant account in Earth system modeling.

(来源: Science, 2015, 350(6265): 1248-1251)

中文点评:

局部人类活动比过去认为的对总体水生态足迹的改变更大

在 Science 发表的一项新的研究提出, 在将局部水资源管理策略所致的蒸散和径流纳入考虑之后, 人类可能正在消耗比过去认为的要更多的淡水, 并会更大程度地改变水循环。如果这是正确的话, 该结果将人类总体全球淡水生态足迹提高了 18%。过去, 许多研究所关注的是水资源管理会如何影响诸如河流片段化和转向等因素, 但只是到了最近, 更不显眼因素(如蒸散作用)的重要性才变得明显。Fernando Jaramillo 和 Georgia Destouni 希望能确定水资源管理策略(如堤坝和灌溉)是否会影响蒸散作用和雨量比。他们对两段时期(1901-1954 年和 1955-2008 年)间 100 个流域的实体变化进行了分析。他们模型所得到的结果揭示, 在后一时期内, 蒸散作用明显增加, 而水的径流率也有所降低。与其它被测试的变量(诸如流域的地理位置或大气的气候变化)相比, 这一蒸散作用的变化更有可能受到人类局部水资源管理的影响。这些人类诱发的局部蒸散改变被发现具有全球层面的显著影响, 它令每年平均人耗淡水增加了 3563 km^3 , 或比最近对人类目前全球淡水生态足迹的估计高出了 18%。作者们提出, 这一新的估计达到了更大的不可持续性水平。

(来源: <http://www.eurekalert.org>)

➤ Continuous 1.3-million-year record of East African hydroclimate, and implications for patterns of evolution and biodiversity

Robert P. Lyonsa; Christopher A. Scholza; Andrew S. Cohen; et al.

The transport of moisture in the tropics is a critical process for the global energy budget and on geologic

timescales, has markedly influenced continental landscapes, migratory pathways, and biological evolution. Here we present a continuous, first-of-its-kind 1.3-My record of continental hydroclimate and lake-level variability derived from drill core data from Lake Malawi, East Africa (9–15° S). Over the Quaternary, we observe dramatic shifts in effective moisture, resulting in large-scale changes in one of the world's largest lakes and most diverse freshwater ecosystems. Results show evidence for 24 lake level drops of more than 200 m during the Late Quaternary, including 15 lowstands when water levels were more than 400 m lower than modern. A dramatic shift is observed at the Mid-Pleistocene Transition (MPT), consistent with far-field climate forcing, which separates vastly different hydroclimate regimes before and after ~800,000 years ago. Before 800 ka, lake levels were lower, indicating a climate drier than today, and water levels changed frequently. Following the MPT high-amplitude lake level variations dominate the record. From 800 to 100 ka, a deep, often overfilled lake occupied the basin, indicating a wetter climate, but these highstands were interrupted by prolonged intervals of extreme drought. Periods of high lake level are observed during times of high eccentricity. The extreme hydroclimate variability exerted a profound influence on the Lake Malawi endemic cichlid fish species flock; the geographically extensive habitat reconfiguration provided novel ecological opportunities, enabling new populations to differentiate rapidly to distinct species.

(来源: PNAS, 2015, 112(51): 15568–15573)

中文点评:

马拉维湖的慈鲷与湖面高度变化

东非的大尺度气候涨落可能解释为什么马拉维湖拥有丰富的慈鲷物种。马拉维湖是非洲大湖之中的第三大湖,它是超过 1000 个慈鲷物种以及大量的非慈鲷鱼、软体动物以及甲壳纲动物的家园。气候变化在马拉维湖生态系统进化中的作用几乎没有被探索过,这主要是由于缺乏陆地上的深度-时间气候记录。Christopher Scholz 及其同事分析了从马拉维湖钻探计划中获得的大约 1/4 英里长的沉积物岩心的连续序列,并且构建出了这个古代湖泊的过去 130 万年的气候历史。这组作者识别出了两打干旱期,当时的湖面高度下降了超过 650 英尺,还识别出了大约 80 万年前的一个关键的体制变化,从水面高度频繁涨落的干旱为主的气候走向了有严重而长期低水位期的湿润环境。这组作者说,这些发现可能解释被迫适应变化的栖息地、资源和生态系统动态的慈鲷物种如何迅速地多样化。

(来源: <http://www.eurekalert.org>)

➤ Global impacts of energy demand on the freshwater resources of nations

Robert Alan Holland; Kate A. Scott; Martina Flörke; et al.

Understanding the role of international trade in driving pressures on freshwater resources is key to meeting challenges at the water–energy nexus. A coupled trade and hydrological model is used to examine pressures on freshwater resources associated with energy production across the global economy. While the electric and gas sectors induce freshwater consumption predominantly within countries where demand originates (91% and 81%, respectively), the petroleum sector exhibits a high

international footprint (56%). Critical geographic areas and economic sectors are identified, providing focus for resource-management actions to ensure energy and freshwater security. Our analysis demonstrates the importance of broadening the discourse on energy policy to address issues including freshwater scarcity, the role of international trade, and wider environmental and societal considerations.

(来源: PNAS, 2015, 112(48): E6707–E6716)

中文点评:

能源与国际淡水使用

一项对能源生产有关的淡水消耗的研究发现, 尽管天然气和电力生产的水消耗很大程度上出现在有能源需求的一国内部, 石油生产可能驱动着对淡水资源的国际需求, 美国的国际淡水足迹是中国水足迹的大约 3 倍, 尽管两国的石油需求类似。

(来源: <http://www.eurekalert.org>)

摘要精选

Linkage between Three Gorges Dam impacts and the dramatic recessions in China's largest freshwater lake, Poyang Lake

Xuefei Mei, Zhijun Dai, Jinzhou Du; et al.

Despite comprising a small portion of the earth's surface, lakes are vitally important for global ecosystem cycling. However, lake systems worldwide are extremely fragile, and many are shrinking due to changing climate and anthropogenic activities. Here, we show that Poyang Lake, the largest freshwater lake in China, has experienced a dramatic and prolonged recession, which began in late September of 2003. We further demonstrate that abnormally low levels appear during October, 28 days ahead of the normal initiation of the dry season, which greatly imperiled the lake's wetland areas and function as an ecosystem for wintering waterbirds. An increase in the river-lake water level gradient induced by the Three Gorges Dam (TGD) altered the lake balance by inducing greater discharge into the Changjiang River, which is probably responsible for the current lake shrinkage. Occasional episodes of arid climate, as well as local sand mining, will aggravate the lake recession crisis. Although impacts of TGD on the Poyang Lake recession can be overruled by episodic extreme droughts, we argue that the average contributions of precipitation variation, human activities in the Poyang Lake catchment and TGD regulation to the Poyang Lake recession can be quantified as 39.1%, 4.6% and 56.3%, respectively.

(来源: Scientific Reports, 2015, doi:10.1038/srep18197)

中国潜在湿地分布的模拟

胡胜杰; 牛振国; 张海英; 等

潜在湿地分布的空间信息对于提高湿地制图精度、理解湿地空间分布的变化规

律以及制定湿地恢复政策等都具有重要意义地形特征对湿地的分布具有决定作用, 通过采用滤波方法识别真实洼地, 并结合气候降水和蒸发资料, 提高了地形特征(气候地形指数)的模拟精度; 基于气候地形指数的空间分布特征及其与潜在湿地分布的时空关系, 采用众数统计方法, 模拟中国潜在湿地分布。该方法不仅具有一定的物理基础, 而且避免了复杂分布式参数的获取和模型的数值求解, 更适用于大尺度湿地分布研究。基于多年的气象数据资料的模拟结果表明: 中国潜在湿地约为 $58.18 \times 10^4 \text{ km}^2$, 其中沼泽湿地面积约为 $32.50 \times 10^4 \text{ km}^2$, 水体面积约为 $25.68 \times 10^4 \text{ km}^2$, 主要分布在西北部的青藏、新疆地区, 东北部内蒙、黑龙江和吉林地区, 以及华北平原和长江流域。与已有湿地模拟结果对比表明: 模拟结果在空间分辨率(90m)和精度方面都有所提高; 与全国湿地调查结果在空间分布格局上具有较高的一致性。该结果为进一步提高湿地遥感制图精度、制定湿地恢复策略等提供了重要的支撑。

(来源: 科学通报, 2015, 60(33): 3251-3262)

Ancient lake system at Gale crater

Nicholas S. Wigginton

Since 2012, the Curiosity rover has been diligently studying rocky outcrops on Mars, looking for clues about past water, climate, and habitability. Grotzinger et al. describe the analysis of a huge section of sedimentary rocks near Gale crater, where Mount Sharp now stands (see the Perspective by Chan). The features within these sediments are reminiscent of delta, stream, and lake deposits on Earth. Although individual lakes were probably transient, it is likely that there was enough water to fill in low-lying depressions such as impact craters for up to 10,000 years. Wind-driven erosion removed many of these deposits, creating Mount Sharp.

(来源: Science, 2015, 350(6257):173-175)

Ecological consequences of long-term browning in lakes

Craig E. Williamson, Erin P. Overholt, Rachel M. Pilla; et al.

Increases in terrestrially-derived dissolved organic matter (DOM) have led to the browning of inland waters across regions of northeastern North America and Europe. Short-term experimental and comparative studies highlight the important ecological consequences of browning. These range from transparency-induced increases in thermal stratification and oxygen (O_2) depletion to changes in pelagic food web structure and alteration of the important role of inland waters in the global carbon cycle. However, multi-decadal studies that document the net ecological consequences of long-term browning are lacking. Here we show that browning over a 27 year period in two lakes of differing transparency resulted in fundamental changes in vertical habitat gradients and food web structure, and that these responses were stronger in the more transparent lake. Surface water temperatures increased by $2-3^\circ\text{C}$ in both lakes in the absence of any changes in air temperature. Water transparency to ultraviolet (UV) radiation showed a fivefold decrease in the more transparent lake. The primary zooplankton grazers decreased, and in the more transparent lake were largely replaced by a two trophic level zooplankton community. These findings provide new insights into the net effects of the complex and contrasting

mechanisms that underlie the ecosystem consequences of browning.

(来源: Scientific Reports, 2015, doi:10.1038/srep18666)

Sedimentary archaeal amoA gene abundance reflects historic nutrient level and salinity fluctuations in Qinghai Lake, Tibetan Plateau

Jian Yang, Hongchen Jiang, Hailiang Dong; et al.

Integration of DNA derived from ancient phototrophs with their characteristic lipid biomarkers has been successfully employed to reconstruct paleoenvironmental conditions. However, it is poorly known that whether the DNA and lipids of microbial functional aerobes (such as ammonia-oxidizing archaea: AOA) can be used for reconstructing past environmental conditions. Here we identify and quantify the AOA amoA genes (encoding the alpha subunit of ammonia monooxygenases) preserved in a 5.8-m sediment core (spanning the last 18,500 years) from Qinghai Lake. Parallel analyses revealed that low amoA gene abundance corresponded to high total organic carbon (TOC) and salinity, while high amoA gene abundance corresponded to low TOC and salinity. In the Qinghai Lake region, TOC can serve as an indicator of paleo-productivity and paleo-precipitation, which is related to historic nutrient input and salinity. So our data suggest that temporal variation of AOA amoA gene abundance preserved in Qinghai Lake sediment may reflect the variations of nutrient level and salinity throughout the late Pleistocene and Holocene in the Qinghai Lake region.

(来源: Scientific Reports, 2015, doi:10.1038/srep18071)

Large increases in carbon burial in northern lakes during the Anthropocene

Adam J. Heathcote, N. John Anderson, Yves T. Prairie; et al.

Northern forests are important ecosystems for carbon (C) cycling and lakes within them process and bury large amounts of organic-C. Current burial estimates are poorly constrained and may discount other shifts in organic-C burial driven by global change. Here we analyse a suite of northern lakes to determine trends in organic-C burial throughout the Anthropocene. We found burial rates increased significantly over the last century and are up to five times greater than previous estimates. Despite a correlation with temperature, warming alone did not explain the increase in burial, suggesting the importance of other drivers including atmospherically deposited reactive nitrogen. Upscaling mean lake burial rates for each time period to global northern forests yields up to 4.5 Pg C accumulated in the last 100 years—20% of the total burial over the Holocene. Our results indicate that lakes will become increasingly important for C burial under future global change scenarios.

(来源: Nature Communications, 2015, doi:10.1038/ncomms10016)

长白山-贝加尔湖断面水生植物正构烷烃及其氢同位素与环境水的分馏关系

李冬伟; 汉景泰; 孙会国; 等; 等

开展了自长白山至贝加尔湖空间跨度约 2000 km 断面上代表性地点的水生植物

正构烷烃及其单体氢同位素研究。结果表明, 该区域大型水生植物正构烷烃具有明显的奇偶优势, 以 C_{23} 或 C_{25} 为主峰, 这两个链长的正构烷烃可以作为研究区水生植物来源的普适性特征标志物。同一植物来源的不同链长正构烷烃的单体氢同位素值相近, 尤其是 $n-C_{21}$, $n-C_{23}$, $n-C_{25}$ 三者的氢同位素值相差很小。水生植物正构烷烃与环境水间的氢同位素分馏值稳定在-15‰左右, 与欧洲等地区获得的结果有很好的一致性, 表明正构烷烃单体氢同位素可以示踪水体的氢同位素组成。全球水生植物正构烷烃氢同位素数据综合分析显示, 正构烷烃 C_{23} 和 C_{25} 氢同位素平均值是反演环境水体氢同位素组成的优选代用指标。本研究不仅获得了这一区域水生植物的分子标志物数据, 同时对全面认识和理解正构烷烃氢同位素组成及其在古气候研究中的应用具有重要意义。

(来源: 科学通报, 2015, 60(28-29): 2774-2783)

Significant fraction of CO₂ emissions from boreal lakes derived from hydrologic inorganic carbon inputs

Gesa A. Weyhenmeyer, Sarian Kosten, Marcus B. Wallin; et al.

Annual CO₂ emissions from lakes and other inland waters into the atmosphere are estimated to almost entirely compensate the total annual carbon uptake by oceans^{1, 2, 3}. CO₂ supersaturation in lakes, which results in CO₂ emissions, is frequently attributed to CO₂ produced within the lake^{4, 5, 6, 7, 8}. However, lateral inorganic carbon flux through watersheds can also be sizeable^{9, 10, 11}. Here we calculated lake surface water CO₂ concentrations and emissions using lake pH, alkalinity and temperature from a compilation of data from 5,118 boreal lakes¹². Autumn surface water CO₂ concentrations and CO₂ emissions from the 5,118 lakes co-varied with lake internal autumn CO₂ production. However, using a mass balance approach we found that CO₂ emission in the majority of lakes was sustained by inorganic carbon loading from the catchment rather than by internal CO₂ production. Small lakes with high dissolved organic carbon and phosphorus concentrations, shorter retention times and longer ice-free seasons had the highest CO₂ concentrations. CO₂ emissions from these small lakes was twice that of comparable lakes in colder regions, and similar to emissions from subtropical and tropical lakes. We conclude that changes in land use and climate that increase dissolved inorganic carbon may cause emission levels from boreal lakes to approach those of lakes in warmer regions.

(来源: Nature Geoscience, 2015, 8: 933–936)

Industrial arsenic contamination causes catastrophic changes in freshwater ecosystems

Guangjie Chen, Haibin Shi, Jianshuang Tao; et al.

Heavy metal pollution is now widely recognized to pose severe health and environmental threats, yet much of what is known concerning its adverse impacts on ecosystem health is derived from short-term ecotoxicological studies. Due to the frequent absence of long-term monitoring data, little is known of the long-term ecological consequences of pollutants such as arsenic. Here, our dated sediment records from

two contaminated lakes in China faithfully document a 13.9 and 21.4-fold increase of total arsenic relative to pre-1950 background levels. Concurrently, coherent responses in keystone biota signal pronounced ecosystem changes, with a >10-fold loss in crustacean zooplankton (important herbivores in the food webs of these lake systems) and a >5-fold increase in a highly metal-tolerant alga. Such fundamental ecological changes will cascade through the ecosystem, causing potentially catastrophic consequences for ecosystem services in contaminated regions.

(来源: Scientific Reports, 2015, doi:10.1038/srep17419)

An inter-regional assessment of concentrations and delta C-13 values of methane and dissolved inorganic carbon in small European lakes

Rinta, Paeivi; Bastviken, David; van Hardenbroek, Maarten; et al.

Methane (CH₄) and carbon dioxide emissions from lakes are relevant for assessing the greenhouse gas output of wetlands. However, only few standardized datasets describe concentrations of these gases in lakes across different geographical regions. We studied concentrations and stable carbon isotopic composition (delta C-13) of CH₄ and dissolved inorganic carbon (DIC) in 32 small lakes from Finland, Sweden, Germany, the Netherlands, and Switzerland in late summer. Higher concentrations and delta C-13 values of DIC were observed in calcareous lakes than in lakes on non-calcareous areas. In stratified lakes, delta C-13 values of DIC were generally lower in the hypolimnion due to the degradation of organic matter (OM). Unexpectedly, increased delta C-13 values of DIC were registered above the sediment in several lakes. This may reflect carbonate dissolution in calcareous lakes or methanogenesis in deepwater layers or in the sediments. Surface water CH₄ concentrations were generally higher in western and central European lakes than in Fennoscandian lakes, possibly due to higher CH₄ production in the littoral sediments and lateral transport, whereas CH₄ concentrations in the hypolimnion did not differ significantly between the regions. The delta C-13 values of CH₄ in the sediment suggest that delta C-13 values of biogenic CH₄ are not necessarily linked to delta C-13 values of sedimentary OM but may be strongly influenced by OM quality and methanogenic pathway. Our study suggests that CH₄ and DIC cycling in small lakes differ between geographical regions and that this should be taken into account when regional studies on greenhouse gas emissions are upscaled to inter-regional scales.

(来源: AQUATIC SCIENCES, 2015, 77(4): 667-680)

Global Landscape of Total Organic Carbon, Nitrogen and Phosphorus in Lake Water

Ming Chen; Guangming Zeng; Jiachao Zhang; et al.

Human activities continue to increase the amount of carbon (C), nitrogen (N) and phosphorus (P) in lakes, which may cause serious environmental and human health problems. Global landscape of total organic C (TOC), N and P in lake water is still poorly known. Using a global data set that covers ~8300 lakes from 68 countries/regions spanning six continents, we estimate that global mean concentrations and storage in lake water are 5.578 mg L⁻¹ and 984.0 Tg for TOC, 0.526 mg L⁻¹ and 92.8 Tg for TN, and 0.014 mg L⁻¹ and 2.5 Tg for TP. These lake elements are significantly interrelated and in uneven distribution, being associated with morphological characteristics and climate conditions. We proposed that global C, N and P cycles should be considered as a whole in biogeochemical studies and policy-making related to

environmental protection.

(来源: Scientific Reports, 2015, doi:10.1038/srep15043)

Importance of diffusion and resuspension for phosphorus cycling during the growing season in large, shallow Lake Peipsi

Tammeorg, Olga; Horppila, Jukka; Laugaste, Reet; et al.

Our study aimed at elucidating the role of internal loading in the budget of phosphorus (P) and assessed the importance of resuspension and diffusive fluxes for P cycling in large, shallow Lake Peipsi. The internal loading of P was quantified by a mass balance approach that considered the gross sedimentation of P as a component. The gross sedimentation of P was measured with sediment traps during May-October 2011. Additionally, we followed the monthly dynamics of diffusive fluxes and resuspension of P within this time period. The gross sedimentation of P dominated the mass balance calculations in Lake Peipsi. The resuspension of P constituted 62-68% of the gross sedimentation of P, and thereby accounted for the bulk of the total internal P load. Until late July, the release of P by diffusion was similar in magnitude to that of resuspension. Since August, resuspension was of governing importance for P cycling: the release of P by resuspension at that time was about 40-fold higher than that of the diffusion. Therefore, diffusion and resuspension provided a continuous supply of P to the water column during the growing season.

(来源: HYDROBIOLOGIA, 2015, 760(1): 395-411)

Top consumer abundance influences lake methane efflux

Shawn P. Devlin; Jatta Saarenheimo; Jari Syväranta; et al.

Lakes are important habitats for biogeochemical cycling of carbon. The organization and structure of aquatic communities influences the biogeochemical interactions between lakes and the atmosphere. Understanding how trophic structure regulates ecosystem functions and influences greenhouse gas efflux from lakes is critical to understanding global carbon cycling and climate change. With a whole-lake experiment in which a previously fishless lake was divided into two treatment basins where fish abundance was manipulated, we show how a trophic cascade from fish to microbes affects methane efflux to the atmosphere. Here, fish exert high grazing pressure and remove nearly all zooplankton. This reduction in zooplankton density increases the abundance of methanotrophic bacteria, which in turn reduce CH₄ efflux rates by roughly 10 times. Given that globally there are millions of lakes emitting methane, an important greenhouse gas, our findings that aquatic trophic interactions significantly influence the biogeochemical cycle of methane has important implications.

(来源: Nature Communications, 2015, doi:10.1038/ncomms9787)

Phytoplankton lipid content influences freshwater lake methanogenesis

West, William E.; McCarthy, Shayna M.; Jones, Stuart E.

1. Rates of methanogenesis in freshwater sediments have been shown to increase with inputs of phytoplankton biomass. Although many studies have shown the importance of resource quality for

decomposition, little is known of the importance of substrate quality on rates of methanogenesis.

2. Here, we studied the effects of lipid content and taxonomic affiliation of phytoplankton biomass on rates of methanogenesis in lake sediment slurries from five lakes differing in trophic status.

3. Substrate quantity had a positive effect on methanogenesis despite differing trophic status. Furthermore, we observed that phytoplankton biomass quality, in terms of lipid content, enhanced methanogenesis rates. However, rates of methanogenesis between lake sediments treated with *Scenedemus obliquus* or *Microcystis aeruginosa* did not differ when lipid content was held constant.

4. Phytoplankton lipid content has been shown to increase when nutrients are limiting, which may result in an increase in substrate quality for methanogenesis with eutrophication. However, our study revealed that responses of substrate quantity to nutrient enrichment likely outpace the effects of resource quality and may result in a net increase in CH₄ emissions from eutrophied lakes. Interestingly, the resource quality feedback may at least partially reduce the potential effect of eutrophication on lake methanogenesis.

(来源: FRESHWATER BIOLOGY, 2015, 60(5): 2261-2269)

Selective consumption and metabolic allocation of terrestrial and algal carbon determine allochthony in lake bacteria

François Guillemette; S Leigh McCallister; Paul A del Giorgio.

Here we explore strategies of resource utilization and allocation of algal versus terrestrially derived carbon (C) by lake bacterioplankton. We quantified the consumption of terrestrial and algal dissolved organic carbon, and the subsequent allocation of these pools to bacterial growth and respiration, based on the $\delta^{13}\text{C}$ isotopic signatures of bacterial biomass and respiratory carbon dioxide (CO₂). Our results confirm that bacterial communities preferentially remove algal C from the terrestrially dominated organic C pool of lakes, but contrary to current assumptions, selectively allocate this autochthonous substrate to respiration, whereas terrestrial C was preferentially allocated to biosynthesis. The results provide further evidence of a mechanism whereby inputs of labile, algal-derived organic C may stimulate the incorporation of a more recalcitrant, terrestrial C pool. This mechanism resulted in a counterintuitive pattern of high and relatively constant levels of allochthony (~76%) in bacterial biomass across lakes that otherwise differ greatly in productivity and external inputs.

(来源: The ISME Journal, 2015, doi:10.1038/ismej.2015.215)

Ubiquitous anaerobic ammonium oxidation in inland waters of China: an overlooked nitrous oxide mitigation process

Guibing Zhu; Shanyun Wang; Leiliu Zhou; et al.

Denitrification has long been regarded as the only pathway for terrestrial nitrogen (N) loss to the atmosphere. Here we demonstrate that large-scale anaerobic ammonium oxidation (anammox), an overlooked N loss process alternative to denitrification which bypasses nitrous oxide (N₂O), is ubiquitous in inland waters of China and contributes significantly to N loss. Anammox rates in aquatic systems show different levels (1.0–975.9 $\mu\text{mol N m}^{-2} \text{ h}^{-1}$, $n = 256$) with hotspots occurring at oxic-anoxic interfaces

and harboring distinct biogeochemical and biogeographical features. Extrapolation of these results to the China-national level shows that anammox could contribute about 2.0 Tg N yr⁻¹, which equals averagely 11.4% of the total N loss from China's inland waters. Our results indicate that a significant amount of the nitrogen lost from inland waters bypasses denitrification, which is important for constructing more accurate climate models and may significantly reduce potential N₂O emission risk at a large scale.

(来源: Scientific Reports, 2015, doi:10.1038/srep17306)

Microbial communities reflect temporal changes in cyanobacterial composition in a shallow ephemeral freshwater lake

Jason Nicholas Woodhouse; Andrew Stephen Kinsela; Richard Nicholas Collins; et al.

The frequency of freshwater cyanobacterial blooms is at risk of increasing as a consequence of climate change and eutrophication of waterways. It is increasingly apparent that abiotic data are insufficient to explain variability within the cyanobacterial community, with biotic factors such as heterotrophic bacterioplankton, viruses and protists emerging as critical drivers. During the Australian summer of 2012–2013, a bloom that occurred in a shallow ephemeral lake over a 6-month period was comprised of 22 distinct cyanobacteria, including *Microcystis*, *Dolichospermum*, *Oscillatoria* and *Sphaerospermopsis*. Cyanobacterial cell densities, bacterial community composition and abiotic parameters were assessed over this period. Alpha-diversity indices and multivariate analysis were successful at differentiating three distinct bloom phases and the contribution of abiotic parameters to each. Network analysis, assessing correlations between biotic and abiotic variables, reproduced these phases and assessed the relative importance of both abiotic and biotic factors. Variables possessing elevated betweenness centrality included temperature, sodium and operational taxonomic units belonging to the phyla Verrucomicrobia, Planctomyces, Bacteroidetes and Actinobacteria. Species-specific associations between cyanobacteria and bacterioplankton, including the free-living Actinobacteria *acl*, Bacteroidetes, Betaproteobacteria and Verrucomicrobia, were also identified. We concluded that changes in the abundance and nature of freshwater cyanobacteria are associated with changes in the diversity and composition of lake bacterioplankton. Given this, an increase in the frequency of cyanobacteria blooms has the potential to alter nutrient cycling and contribute to long-term functional perturbation of freshwater systems.

(来源: The ISME Journal, 2015, doi:10.1038/ismej.2015.218)

A hydrodynamics-based approach to evaluating the risk of waterborne pathogens entering drinking water intakes in a large, stratified lake

Hoyer, Andrea B.; Schladow, S. Geoffrey; Rueda, Francisco J.

Pathogen contamination of drinking water lakes and reservoirs is a severe threat to human health worldwide. A major source of pathogens in surface sources of drinking waters is from body-contact recreation in the water body. However, dispersion pathways of human waterborne pathogens from recreational beaches, where body-contact recreation is known to occur to drinking water intakes, and the associated risk of pathogens entering the drinking water supply remain largely undocumented. A high spatial resolution, three-dimensional hydrodynamic and particle tracking modeling approach has been developed to analyze the risk and mechanisms presented by pathogen dispersion. The pathogen model represents the processes of particle release, transport and survival. Here survival is a function of both

water temperature and cumulative exposure to ultraviolet (UV) radiation. Pathogen transport is simulated using a novel and computationally efficient technique of tracking particle trajectories backwards, from a drinking water intake toward their source areas. The model has been applied to a large, alpine lake - Lake Tahoe, CA-NV (USA). The dispersion model results reveal that for this particular lake (1) the risk of human waterborne pathogens to enter drinking water intakes is low, but significant; (2) this risk is strongly related to the depth of the thermocline in relation to the depth of the intake; (3) the risk increases with the seasonal deepening of the surface mixed layer; and (4) the risk increases at night when the surface mixed layer deepens through convective mixing and inactivation by UV radiation is eliminated. While these risk factors will quantitatively vary in different lakes, these same mechanisms will govern the process of transport of pathogens.

(来源: WATER RESEARCH, 2015, 83: 227-236)

The genomics of ecological vicariance in threespine stickleback fish

Marius Roesti, Benjamin Kueng, Dario Moser; et al.

Populations occurring in similar habitats and displaying similar phenotypes are increasingly used to explore parallel evolution at the molecular level. This generally ignores the possibility that parallel evolution can be mimicked by the fragmentation of an ancestral population followed by genetic exchange with ecologically different populations. Here we demonstrate such an ecological vicariance scenario in multiple stream populations of threespine stickleback fish divergent from a single adjacent lake population. On the basis of demographic and population genomic analyses, we infer the initial spread of a stream-adapted ancestor followed by the emergence of a lake-adapted population, that selective sweeps have occurred mainly in the lake population, that adaptive lake-stream divergence is maintained in the face of gene flow from the lake into the streams, and that this divergence involves major inversion polymorphisms also important to marine-freshwater stickleback divergence. Overall, our study highlights the need for a robust understanding of the demographic and selective history in evolutionary investigations.

(来源: Nature Communications, 2015, doi:10.1038/ncomms9767)

Effects of trophic status on microcystin production and the dominance of cyanobacteria in the phytoplankton assemblage of Mediterranean reservoirs

Maria Antonietta Mariani; Bachisio Mario Padedda; Jan Kaštovský; et al.

The aim of our study was to evaluate the abundance of cyanobacteria and microcystins in four Sardinian reservoirs (Italy) characterised by different trophic status to define a reference picture for future changes. Increasing levels of eutrophication and the abundance of cyanobacteria are expected to occur due to climate change, especially in the southern Mediterranean. Consequently, an in-depth study of the occurrence of harmful cyanobacteria is important to develop appropriate management strategies for water resources at a local scale. Monthly samples were collected at one station in each reservoir over an 18-month period. The Analysis of similarity indicated that cyanobacterial abundance and species composition differed significantly among the reservoirs. The Redundancy analysis highlighted their relationship to trophic, hydrological and seasonal patterns. Spearman's analysis indicated that there

were significant correlations among the most important species (*Planktothrix agardhii*–*rubescens* group, *Aphanizomenon flos-aquae* and *Dolichospermum planctonicum*), nutrients and microcystins. We highlighted that the species composition during periods of maximum microcystin concentrations differed from those typically reported for other Mediterranean sites. We found new potential microcystin producers (*Aphanizomenon klebahnii*, *Dolichospermum macrosporum* and *Dolichospermum viguieri*), which emphasised the high diversity of cyanobacteria in the Mediterranean area and the need for detailed research at the local scale.

(来源: Scientific Reports, 2015, doi:10.1038/srep17964)

Microbial ecology of Antarctic aquatic systems

Ricardo Cavicchioli

The Earth's biosphere is dominated by cold environments, and the cold biosphere is dominated by microorganisms. Microorganisms in cold Southern Ocean waters are recognized for having crucial roles in global biogeochemical cycles, including carbon sequestration, whereas microorganisms in other Antarctic aquatic biomes are not as well understood. In this Review, I consider what has been learned about Antarctic aquatic microbial ecology from 'omic' studies. I assess the factors that shape the biogeography of Antarctic microorganisms, reflect on some of the unusual biogeochemical cycles that they are associated with and discuss the important roles that viruses have in controlling ecosystem function.

(来源: Nature Reviews Microbiology, 2015,13: 691-706)

The "Melosira years" of Lake Baikal: Winter environmental conditions at ice onset predict under-ice algal blooms in spring

Katz, Stephen L.; Izmet'eva, Lyubov R.; Hampton, Stephanie E.; et al.

Winter primary production in seasonally ice-covered lakes historically has not been well studied, but it is increasingly recognized as an important component of lake metabolism. Lake Baikal in Siberia is not only the World's oldest, deepest, and most biologically diverse lake, but also where large under-ice blooms of the diatom *Aulacoseira baicalensis* (formerly *Melosira*) occur in some years. The phenomenon of *Melosira* years is noteworthy both for the intensity of the diatom blooms, in which total under-ice production can be a majority of total annual production, and for the enigmatic regularity of their occurrence every 3-4 yr. The degree to which these episodic blooms might be controlled by external forcing and endogenous lake processes has been debated for decades. We used a 50-yr time series of phytoplankton observations to statistically model the occurrence of *Aulacoseira* blooms as a function of meteorological and climatological predictor variables. The results support the hypothesis that a confluence of meteorological conditions in the preceding fall season, which favor clear ice formation with minimal snow cover, also favor *Aulacoseira* blooms in the following spring. Further, we observe that this confluence of factors is related to relatively strong states of the Siberian High which, while not strictly periodic, do explain a significant fraction of the interannual bloom pattern. Finally, our analyses show that the timing of the peak abundance of *A. baicalensis* shifted 1.6 months later across the 50-yr time series, corresponding with the delay in ice-on timing that has been associated with climate change.

(来源: LIMNOLOGY AND OCEANOGRAPHY, 2015, 60(6): 1950-1964)

Habitat, not resource availability, limits consumer production in lake ecosystems

Craig, Nicola; Jones, Stuart E.; Weidel, Brian C.; et al.

Food web productivity in lakes can be limited by dissolved organic carbon (DOC), which reduces fish production by limiting the abundance of their zoobenthic prey. We demonstrate that in a set of 10 small, north temperate lakes spanning a wide DOC gradient, these negative effects of high DOC concentrations on zoobenthos production are driven primarily by availability of warm, well-oxygenated habitat, rather than by light limitation of benthic primary production as previously proposed. There was no significant effect of benthic primary production on zoobenthos production after controlling for oxygen, even though stable isotope analysis indicated that zoobenthos do use this resource. Mean whole-lake zoobenthos production was lower in high-DOC lakes with reduced availability of oxygenated habitat, as was fish biomass. These insights improve understanding of lake food webs and inform management in the face of spatial variability and ongoing temporal change in lake DOC concentrations.

(来源: LIMNOLOGY AND OCEANOGRAPHY, 2015, 60(6): 2079-2089)

Combined effects of temperature and food concentration on growth and reproduction of *Eodiaptomus japonicus* (Copepoda: Calanoida) from Lake Biwa (Japan)

Liu, Xin; Beyrend, Delphine; Dur, Gael; et al.

1. Life history traits of the freshwater calanoid copepod *Eodiaptomus japonicus* from Lake Biwa were examined in the laboratory. Four different food concentrations (FC, 10(3), 5x10(3), 10(4) and 5x10(4) cells mL⁻¹) and two temperature conditions (15 and 25 degrees C) were used to clarify the combined effects of those two factors on life history traits.

2. A survival rate of more than 70% was observed at the two medium FCs at 15 degrees C, although survival was <42% at all six of the other food-temperature combinations. Post-embryonic development times to adult stage in males and females were affected by both FC and temperature; median development times ranged from 28.7 to 37.3 and 31.4 to 35.0 days at 15 degrees C and 13.7 to 23.9 and 14.3 to 27.7 days at 25 degrees C, respectively, for males and females. An interaction between the two experimental factors was found only for females, with food shortage being most acute at 25 degrees C.

3. Clutch sizes also increased with FC at both temperatures and interaction occurred between those two factors. Egg production rates increased with increasing FC similarly at both temperatures without an interaction effect.

4. Adult body size increased with increasing FC at both temperatures: for example, average female prosome length increased from 0.865 mm to 0.922 mm at 15 degrees C and from 0.799 mm to 0.904 mm at 25 degrees C. Somatic and population growth rates calculated from the experimental data increased with FC, but the increase was more important at 25 degrees C. These responses to FC and temperature suggest that both growth and population dynamics of this copepod might be more influenced by food shortage at temperatures >15 degrees C.

5. Adult body sizes under food-limited conditions in this study are at the lower end of the range of those

observed insitu, while those predicted from insitu temperatures, assuming non-limiting food conditions, were always larger than those of natural populations. Therefore, food shortage appears to be the most important factor affecting both growth and reproduction of *E.japonicus* in Lake Biwa.

(来源: FRESHWATER BIOLOGY, 2015,60(10): 2003-2018)

Long-term stability of cladoceran assemblages in small, shallow, Canadian Shield lakes experiencing marked calcium declines

Moss crop, L. E.; Paterson, A. M.; DeSellas, A. M.; et al.

A greater appreciation of biotic responses to environmental changes is warranted in small, shallow lakes because of the high number of these habitats, and their unique contributions to regional biodiversity. Furthermore, recent water chemistry monitoring data show that shallow lakes in Ontario are sensitive and have responded significantly to environmental stressors such as acid deposition and lake water calcium decline. Here, we use paleoecological techniques to examine cladoceran assemblages in modern and pre-industrial sediments of 30 shallow lakes to determine the key environmental gradients that influence present-day assemblages, and to assess how assemblage structure has changed since pre-industrial times (pre-1850s). Redundancy analysis of present-day cladoceran assemblages and key environmental variables identified lake surface area and Secchi depth as significant predictors of assemblage composition. In our data set, Secchi depth was not correlated to water clarity but rather to macrophyte cover, suggesting that cladoceran assemblages were highly influenced by habitat structure. In contrast to nearby, deeper lakes, where pelagic cladoceran taxa have changed significantly in relative abundance over time, cladoceran assemblages in present-day and pre-industrial sediments of shallow lakes did not differ significantly in composition. While the specific reasons for this muted response are unknown, we hypothesize that: (1) littoral taxa may be less sensitive to low Ca concentrations, or ecological thresholds have not yet been crossed or are lower for littoral taxa; (2) calcium availability may vary spatially within shallow lakes, and this is not captured in a single measure of water chemistry from the centre of the lake; and/or (3) habitat structure is more important than water chemistry as a predictor of assemblage composition in these study lakes, and this has not changed significantly over time.

(来源: AQUATIC SCIENCES, 2015, 77(4): 547-561)

The role of ecophysiological and behavioral traits in structuring the zooplankton assemblage in a deep, oligotrophic, tropical lake

Ciros-Perez, Jorge; Ortega-Mayagoitia, Elizabeth; Alcocer, Javier.

Zooplankton inhabiting deep, oligotrophic, tropical lakes must cope with scenarios where the combination of resource limitation, high visual-predation risk, UV-induced damage and seasonal development of anoxic waters, entail particular challenges for organisms, uncommon in temperate environments. We assessed the diel vertical migration DVM (UV/predation-avoidance strategy), numerical response, and starvation resistance (physiological strategies to cope with food scarcity) of the copepod *Leptodiatomus garciai* and the rotifers *Hexarthra jenkiniae* and *Brachionus* sp. Mexico, which constitute the zooplankton assemblage of Alchichica, a high-altitude, deep, oligotrophic, hyposaline, warm-monomictic lake located in Mexico. *L. garciai* followed the normal pattern of DVM in all seasons; with organisms concentrated approximate to 20 m deeper than the depth of 1% photosynthetically active radiation at mid-day, with

evasion from the planktivore *Poblana alchichica* as the most probable driver. However, copepods could not evade the euphotic zone owing to the anoxic conditions of the hypolimnion during the well-established stratification period. Rotifers did not migrate vertically. The dominance of copepods throughout the year can be explained by their low food threshold, high proportion of usable reserves and the lowest rate of mass loss at food deprivation. Contrastingly, rotifers are scarce and intermittent due to frequent resource limitation and because they lose mass at higher rates. However, they are able to suddenly increase due to their high growth rates. We demonstrated that the interaction between environmental constraints and the specific combinations of traits can explain zooplankton structure in the lake. This study enlightens the necessity to improve current limnological models with data from tropical lakes.

(来源: LIMNOLOGY AND OCEANOGRAPHY, 2015, 60(6): 2158-2172)

Community structure of resting egg banks and concordance patterns between dormant and active zooplankters in tropical lakes

Santangelo, Jayme M.; Lopes, Paloma M.; Nascimento, Monalisa O.; et al.

Little effort has been devoted to characterizing the resting egg banks in tropical lakes. In this study, we evaluated the structure of egg banks across 26 Brazilian lakes located in four geographical regions. We also evaluated cross-taxon concordance in species richness and community similarity between dormant rotifers and dormant cladocerans, and searched for concordant patterns between dormant and active communities. We observed 88 taxa among all the hatchlings that belonged mainly to rotifers and cladocerans. Lakes located in the same geographical region displayed more similar dormant communities. Overall, no concordance was observed between dormant rotifers and dormant cladocerans. Concordance in community similarity was observed between dormant and active organisms but only for rotifers and the entire zooplankton community. Resting egg banks were not associated to a set of environmental variables. Our results demonstrate the occurrence of resting egg banks in several tropical lakes. Due to the weak concordant patterns, rotifers or cladocerans found in egg banks should be used cautiously as a surrogate of the other group in zooplankton surveys. Finally, the lack of strong concordance between the active and dormant stages of cladocerans suggests that some species may not receive appropriate cues to induce diapause.

(来源: HYDROBIOLOGIA, 2015, 758(1): 183-195)

Direct and indirect effects of additions of chromophoric dissolved organic matter on zooplankton during large-scale mesocosm experiments in an oligotrophic lake

Cooke, Sandra L.; Fischer, Janet M.; Kessler, Kirsten; et al.

1. The effects of changes in chromophoric dissolved organic matter (CDOM) on zooplankton grazers in pelagic food webs can be difficult to predict due to the potential for conflicting direct and indirect effects of CDOM on water column optics and food-web dynamics. We compared the responses of two dominant zooplankton groups, *Daphnia* spp. and calanoid copepods, to elevated CDOM in two mesocosm experiments conducted in a transparent, oligotrophic lake.

2. In the first experiment, low, medium and high additions of CDOM [dissolved organic carbon (DOC)=2.7, 3.0 and 4.3mgL⁻¹], respectively] and non-manipulated controls (DOC=1.6mgL⁻¹) were used to test the hypothesis that food-web stimulation will increase with CDOM concentration. In the second experiment, we manipulated both CDOM (control and addition) and ultraviolet radiation (UV; ambient and shielded) to determine the importance of CDOM as a UV screen, as well as to examine the role of UV in food-web stimulation by CDOM. We also conducted short-term bioassays alongside this second experiment to assess the food resources for *Daphnia* and calanoids in treatments with UV-exposed and non-UV-exposed CDOM.

3. *Daphnia* abundance increased in the low and medium CDOM additions in the first experiment, and when food resources were simultaneously stimulated by CDOM and protected from the direct negative effects of UV in the second experiment.

4. In contrast, calanoid copepod abundance declined or remained unchanged when CDOM was added, and this response was not mediated by food resources.

5. Overall, our findings suggest that increased CDOM in clear lakes could alter the relative abundance of zooplankton groups through a combination of direct and indirect effects.

(来源: FRESHWATER BIOLOGY, 2015, 60(11): 2362-2378)

Wave forces limit the establishment of submerged macrophytes in large shallow lakes

Van Zuidam, Bastiaan G.; Peeters, Edwin T. H. M.

We studied the effect of waves on submerged macrophytes and hypothesized that exposure to large wave forces can hamper seedling establishment. In an indoor experiment in cylindrical mesocosms we tested whether large wave forces indeed inhibited the establishment of *Chara globularis* and *Potamogeton pusillus* from the propagule bank. We mimicked the effect of wave forces by generating a circular flow that caused resuspension of the sediment. Four treatments were applied, consisting of different repetition frequencies of resuspension events. Emergence and early growth of both species were monitored over 8 weeks. The resuspension treatments significantly reduced the emergence of both species, by 91% and 45% on average for *Chara* sp. and *P. pusillus*, respectively. We analysed field observations on the two species in the lakes of the IJsselmeer area in the Netherlands to evaluate whether wave forces may also inhibit establishment of macrophytes in the field. The field data seemed to support the hypothesis as both species hardly occurred in areas where a large bottom shear stress had occurred in spring, according to simulations with the SWAN wave model. The calculated maximum bottom shear stress correlated well with the occurrence of both *Chara* sp. and *P. pusillus* in the field. Regressions showed that this effect of wave forces was additional to the effect of light availability. Our study indicates that large wave forces may inhibit the establishment of macrophytes in large lakes. Reducing large wave forces can therefore potentially promote macrophyte development in these large lakes.

(来源: LIMNOLOGY AND OCEANOGRAPHY, 2015, 60(5): 1536-1549)

Long term water clarity changes in North America's Great Lakes from multi-sensor satellite observations

Binding, Caren E.; Greenberg, Tracie A.; Watson, Sue B.; et al.

Water clarity in North America's Laurentian Great Lakes has undergone considerable change over the last several decades as a consequence of invasive species, eutrophication, and implemented nutrient management practices. Satellite observations from the CZCS, SeaWiFS, and MODIS-Aqua sensors have been used in tandem with long term records of Secchi disk depth ($Z(SD)$) to provide a retrospective analysis of spatial and temporal variations in water clarity over the Great Lakes. A simple empirical algorithm is presented, relating $Z(SD)$ to remote-sensing reflectance at approximate to 550 nm (R_{rs} approximate to 550). Results suggest remarkable and complex changes in water clarity over the Great Lakes. Lakes Ontario, Huron, and Michigan have seen increases in average $Z(SD)$ over the three sensor periods of 58%, 49%, and 62%, respectively. Lake Erie shows highly variable $Z(SD)$ with no consistent long term trends, while Lake Superior has remained fairly consistent in its lake-wide water clarity conditions. Temporal trends document the decrease in whiting events on Lake Michigan while capturing the ongoing occurrence of these seasonal bright-water events on Lake Ontario. Results indicate a divergence in $Z(SD)$ trends between nearshore and offshore environments; with larger increases in offshore than nearshore $Z(SD)$ and some nearshore areas suggesting a decrease in $Z(SD)$. Offshore regions of Lakes Huron, Michigan, and Superior show diminished $Z(SD)$ seasonality in contrast to increasing seasonal variance in the nearshore. Spatial and temporal variations in $Z(SD)$ are in agreement with documented reductions in Great Lakes bioproductivity, degrading nearshore water quality, and changing biogeochemical processes influencing whiting events and sediment resuspension.

(来源: LIMNOLOGY AND OCEANOGRAPHY, 2015, 60(6): 1976-1995)

Wintertime weather-climate variability and its links to early spring ice-out in Maine lakes

Beyene, Mussie T.; Jain, Shaleen.

In recent decades, Maine lakes have recorded their earliest ice-out dates in over a century. In temperate regions, seasonal lake ice-cover is a critical phenomenon linking climate, aquatic ecosystem and society. And the lengthening of the ice-free period due to warmer climate has been linked to increased algal growth and declining lake water quality, warming of water temperatures leading to alterations in aquatic biodiversity, and the shortening of ice-fishing period and other traditional winter activities over lakes. In this study, historical record of eight lakes and six benchmarked meteorological stations in Maine for the period 1950-2010 were analyzed to (1) investigate the relationship between antecedent winter (January-February) temperatures, degree-day variables, and spring-time ice breakup dates, including the identification of thresholds and (2) determine the influence of the extreme phases of select atmospheric teleconnection patterns (Tropical Northern hemisphere- TNH and North Atlantic Oscillation- NAO) on the winter degree-day quantities and spring ice-out dates. The influence of antecedent winter degree-days on spring ice-out dates was characterized by determining the threshold winter accumulated freezing and melting degree-day (AFDD and AMDD), the exceedance (non-exceedance) of which engenders early (late) spring ice-out dates. Statistical analysis between teleconnection indices and winter AFDD and/or AMDD quantities for Maine revealed an asymmetric relationship. Strongly negative phases of TNH and, to a lesser extent, positive phases of NAO are linked with spatial and temporal pattern of early spring ice

breakup events in Maine lakes. These relationships taken together with observed warming trends have the potential to accelerate the decline in water quality in Maine lakes.

(来源: LIMNOLOGY AND OCEANOGRAPHY, 2015,60(6): 1890-1905)

Length-scale dependence of horizontal dispersion in the surface water of lakes

Peeters, Frank; Hofmann, Hilmar.

Horizontal dispersion in the surface waters of a medium-sized lake was investigated based on four experiments with ensembles of 14 to 17 drifters deployed in Lake Constance during the winter season. The experiments cover length scales between approximate to 30 and approximate to 3000 m which are typical for the grid length scales employed in 3-D models. Horizontal dispersion coefficients K_{disp} were estimated to range from approximate to 0.01 to approximate to 0.03 $\text{m}^2 \text{s}^{-1}$ at 100 m and from approximate to 0.1 to approximate to 0.7 $\text{m}^2 \text{s}^{-1}$ at 1000 m length scale L of the drifter distributions. In all experiments K_{disp} increased with L and in three of the four experiments this increase was about linear in L . However, although a linear increase of K_{disp} with L is consistent with dispersion by shear diffusion in flow fields with constant current shear, numerical modelling of the paths of the drifters, and the resulting spreading of the drifter ensembles indicates that horizontal shear diffusion is not sufficient to explain the increase of K_{disp} with L . The model results suggest that not shear diffusion due to large-scale shear across the entire drifter distribution, but scale-dependent turbulent diffusion is dominating the scale-dependence of K_{disp} at length scales between 100 and 1000 m. According to the model results, effects due to horizontal shear contribute less than 40% to the overall dispersion coefficient at length scales between 100 and 1000 m. However, horizontal shear is required to explain shape and orientation of the drifter distributions.

(来源: LIMNOLOGY AND OCEANOGRAPHY, 2015, 60(6): 1917-1934)

Shear dispersion from near-inertial internal Poincare waves in large lakes

Choi, Jun M.; Troy, Cary D.; Hawley, Nathan.

In this work, we study mixed layer lateral dispersion that is enhanced by near-inertial internal Poincare waves in the offshore region of a large stratified lake, Lake Michigan. We examine the hypothesis that the vertical shear created by near-inertial internal Poincare waves is not only an energy source for vertical mixing in the thermocline and mixed layer, but also enhances horizontal dispersion via an unsteady shear flow dispersion mechanism. Complex empirical orthogonal function analysis reveals that the dominant shear structure is observed to mirror the thermal structure, with the location of maximum shear gradually lowered as the mixed layer deepens. This changing structure of shear and vertical mixing produces different characteristics in shear flow dispersion between the early and later stratified periods. The estimated depth-averaged surface layer vertical turbulent diffusivity grows from $10\text{-}5 \text{m}^2 \text{s}^{-1}$ to $10\text{-}3 \text{m}^2 \text{s}^{-1}$ over the stratified period, and the associated lateral dispersion coefficients are estimated as $0.1\text{-}40 \text{m}^2 \text{s}^{-1}$. The Poincare waves are found to enhance greatly lateral dispersion for times less than the inertial period following release. In contrast, sub-inertial shear is the dominant mechanism responsible for shear dispersion for times greater than the inertial period. A simple approximation of the dispersion

coefficient for lateral dispersion is developed, which scales as the product of surface current velocity (or wind friction velocity) and mixed layer depth. The calculated dispersion coefficients agree well with Okubo's diffusion diagram for times up to a week, which suggests that unsteady shear dispersion is a plausible mechanism to explain observed dispersion rates in the mixed layer for early times after release.

(来源: LIMNOLOGY AND OCEANOGRAPHY, 2015, 60(6): 2222-2235)

Self-affinity and surface-area-dependent fluctuations of lake-level time series

Williams, Zachary C.; Pelletier, Jon D.

We performed power-spectral analyses on 133 globally distributed lake-level time series after removing annual variability. Lake-level power spectra are found to be power-law functions of frequency over the range of 20 d(-1) to 27 yr(-1), suggesting that lake levels are globally a f(-beta)-type noise. The spectral exponent (beta), i.e., the best-fit slope of the logarithm of the power spectrum to the logarithm of frequency, is a nonlinear function of lake surface area, indicating that lake size is an important control on the magnitude of water-level variability over the range of time scales we considered. A simple cellular model for lake-level fluctuations that reproduces the observed spectral-scaling properties is presented. The model (an adaptation of a surface-growth model with random deposition and relaxation) is based on the equations governing flow in an unconfined aquifer with stochastic inputs and outputs of water (e.g., random storms). The agreement between observation and simulation suggests that lake surface area, spatiotemporal stochastic forcing, and diffusion of the groundwater table are the primary factors controlling lake water-level variability in natural (unmanaged) lakes. Water-level variability is generally considered to be a manifestation of climate trends or climate change, yet our work shows that an input with short or no memory (i.e., weather) gives rise to a long-memory nonstationary output (lake water-level). This work forms the basis for a null hypothesis of lake water-level variability that should be disproven before water-level trends are to be attributed to climate.

(来源: WATER RESOURCES RESEARCH, 2015, 51(9): 7258-7269)

Tracking the hydro-climatic signal from lake to sediment: A field study from central Turkey

Dean, Jonathan R.; Eastwood, Warren J.; Roberts, Neil; et al.

Palaeo-hydrological interpretations of lake sediment proxies can benefit from a robust understanding of the modern lake environment. In this study, we use Nar Golu, a non-outlet, monomictic maar lake in central Turkey, as a field site for a natural experiment using observations and measurements over a 17-year monitoring period (1997-2014). We compare lake water and sediment trap data to isotopic, chemical and biotic proxies preserved in its varved sediments. Nar Golu underwent a 3 m lake-level fall between 2000 and 2010. $\delta^{18}\text{O}(\text{lakewater})$ is correlated with this lake-level fall, responding to the change in water balance. Endogenic carbonate is shown to precipitate in isotopic equilibrium with lake water and there is a strong relationship between $\delta^{18}\text{O}(\text{lakewater})$ and $\delta^{18}\text{O}(\text{carbonate})$, which suggests the water balance signal is accurately recorded in the sediment isotope record. Over the same period, sedimentary diatom assemblages also responded, and conductivity inferred from diatoms showed a rise. Shifts in carbonate mineralogy and elemental chemistry in the sediment record through

this decade were also recorded. Intra-annual changes in $\delta^{18}\text{O}$ (lake water) and lake water chemistry are used to demonstrate the seasonal variability of the system and the influence this may have on the interpretation of $\delta^{18}\text{O}$ (carbonate). We use these relationships to help interpret the sedimentary record of changing lake hydrology over the last 1725 years. Nar Golu has provided an opportunity to test critically the chain of connection from present to past, and its sedimentary record offers an archive of decadal- to centennial-scale hydro-climatic change.

(来源: JOURNAL OF HYDROLOGY, 2015, 529(SI): 608-621)

The hydrological and environmental evolution of shallow Lake Melincue, central Argentinean Pampas, during the last millennium

Guerra, Lucia; Piovano, Eduardo L.; Cordoba, Francisco E.; et al.

Lake Melincue, located in the central Pampean Plains of Argentina, is a shallow (similar to 4 m), subsaline lake (TDS >2000 ppm), highly sensitive to hydrological changes. The modern shallow lake system is composed of: (a) a supralittoral area, which includes a narrow mudflat, a vegetated mudflat and wetlands subenvironments; and (b) the main water body, comprising lacustrine marginal and inner areas. The development and extension of these subenvironments are strongly conditioned upon lake surface fluctuations. Past environmental changes were reconstructed through sedimentological, physical and geochemical proxy analyses of two short sedimentary cores (similar to 127 cm). Well-constrained Pb-210 ages profiles were modeled and radiocarbon chronologies were determined, covering a period from similar to AD 800 to the present. The analyzed sedimentary cores from Lake Melincue allowed for the reconstruction of past hydrological scenarios and associated environmental variability, ranging from extremely low lake levels during dry phases to pronounced highstands at wet periods. The paleohydrological reconstruction revealed very shallow conditions in the period between AD 806 and AD 1880, which was registered by massive deposits with low organic matter. Relatively wetter phases disrupting this dry period were represented by organic matter increases. A major wet phase was registered by AD 1454, after the end of the Medieval Climate Anomaly. A subsequent abrupt shift from this wet phase to drier conditions could be matching the transition between the end of the Medieval Climatic Anomaly and the beginning of the Little Ice Age. The occurrence of sedimentary hiatuses between AD 1492 and AD 1880 in Melincue sequence could correspond to intensive droughts during the Little Ice Age. After AD 1880, banded and laminated, autochthonous, organic matter-rich sediments registered an important lacustrine transgression and the onset of a permanent shallow lake, corresponding to the beginning of the current warm period. The uppermost recent fine-grained, low salinity, organic sediments represent a lake transgression occurred in the 1970s, coeval with a general increase in precipitation across southeastern South America. This transgression is registered regionally in other Pampean lakes and in the 20th century instrumental records of Lake Melincue. This paleoenvironmental reconstruction provides a new high-resolution record that registers striking hydroclimatic changes occurred at a regional scale across the Pampean Plains during the last millennium and it contributes to understand the past climatic history in southeastern South America.

(来源: JOURNAL OF HYDROLOGY, 2015, 529(SI): 570-583)

Reconstructing lake evaporation history and the isotopic composition of precipitation by a coupled delta O-18-delta H-2 biomarker approach

Hepp, Johannes; Tuthorn, Mario; Zech, Roland; et al.

Over the past decades, delta O-18 and delta H-2 analyses of lacustrine sediments became an invaluable tool in paleohydrology and paleolimnology for reconstructing the isotopic composition of past lake water and precipitation. However, based on delta O-18 or delta H-2 records alone, it can be challenging to distinguish between changes of the precipitation signal and changes caused by evaporation. Here we propose a coupled, delta O-18-delta H-2 biomarker approach that provides the possibility to disentangle between these two factors. The isotopic composition of long chain n-alkanes (n-C-33, n-C-27, n-C-31) were analyzed in order to establish a 16 ka Late Glacial and Holocene delta H-2 record for the sediment archive of Lake Panch Pokhari in High Himalaya, Nepal. The delta H-2(n-alkane) record generally corroborates a previously established delta O-18(sugar) record reporting on high values characterizing the deglaciation and the Older and the Younger Dryas, and low values characterizing the Bolling and the Allerod periods. Since the investigated n-alkane and sugar biomarkers are considered to be primarily of aquatic origin, they were used to reconstruct the isotopic composition of lake water. The reconstructed deuterium excess of lake water ranges from +57 parts per thousand to -85 parts per thousand and is shown to serve as proxy for the evaporation history of Lake Panch Pokhari. Lake desiccation during the deglaciation, the Older Dryas and the Younger Dryas is affirmed by a multi-proxy approach using the Hydrogen Index (HI) and the carbon to nitrogen ratio (C/N) as additional proxies for lake sediment organic matter mineralization. Furthermore, the coupled delta O-18 and delta H-2 approach allows disentangling the lake water isotopic enrichment from variations of the isotopic composition of precipitation. The reconstructed 16 delta O-18(precipitation) record of Lake Panch Pokhari is well in agreement with the delta O-18 records of Chinese speleothems and presumably reflects the Indian Summer Monsoon variability.

(来源: JOURNAL OF HYDROLOGY, 2015, 529(SI): 622-631)

Assessing intra-basin spatial variability in geochemical and isotopic signatures in the sediments of a small neotropical lake

Taylor, Zachary P.; Horn, Sally P.; Finkelstein, David B.

We examined intra-basin spatial variability of sedimentary geochemical and isotopic signals using a network of five sediment cores from a small lake in southern Costa Rica with a history of prehistoric maize agriculture in its watershed. All cores show a similar pattern of agricultural activity (2000-1000 cal yr BP), a transitional period of forest recovery (1000-675 cal yr BP), and a period after forest reestablishment (675-400 cal yr BP). During the agricultural period, bulk sediment stable carbon isotope ratios (delta C-13(TOC)) indicate significant forest clearance, percent total organic carbon (%TOC) is low due to accelerated erosion and dilution from mineral inputs to the lake, and carbon/nitrogen (C/N) ratios are consistent with increased productivity. At the conclusion of the agricultural period, delta C-13(TOC) and %TOC indicate rapid forest recovery and reduced mineral inputs and C/N ratios suggest lower lake productivity. There is little between-core variation in the magnitude of the agricultural signal for the four cores taken near the shore, but these cores indicate different timing for the end of widespread agriculture in the watershed. Three of these four cores indicate nearly all agriculture ended by 1000 cal yr BP, but in the fourth core agricultural indicators persist until 675 cal yr BP. The core from the center of the lake

shows a gradual decline in proxies indicating agriculture from 950 to 650 cal yr BP, which suggests sediment-reworking processes are integrating material from the entire basin as it is transported to the deeper portions of the lake. Differences between the records from the cores recovered near the shore illustrate the potential of multiple core studies to create spatially explicit paleoenvironmental reconstructions, while the delayed and less abrupt changes in the core from the center of the lake highlight the importance of sediment reworking of paleoenvironmental indicators.

(来源: JOURNAL OF PALEOLIMNOLOGY, 2015, 54(4): 395-411)

Eruptive and environmental processes recorded by diatoms in volcanically dispersed lake sediments from the Taupo Volcanic Zone, New Zealand

Harper, Margaret A.; Pledger, Shirley A.; Smith, Euan G. C.; et al.

Late Pleistocene diatomaceous sediment was widely dispersed along with volcanic ash (tephra) across and beyond New Zealand by the 25.4 ka Oruanui supereruption from Taupo volcano. We present a detailed analysis of the diatom populations in the Oruanui tephra and the newly discovered floras in two other eruptions from the same volcano: the 28.6 ka Okaia and 1.8 ka Taupo eruptions. For comparison, the diatoms were also examined in Late Pleistocene and Holocene lake sediments from the Taupo Volcanic Zone (TVZ). Our study demonstrates how these microfossils provide insights into the lake history of the TVZ since the Last Glacial Maximum. Morphometric analysis of *Aulacoseira* valve dimensions provides a useful quantitative tool to distinguish environmental and eruptive processes within and between individual tephras. The Oruanui and Okaia diatom species and valve dimensions are highly consistent with a shared volcanic source, paleolake and eruption style (involving large-scale magma-water interaction). They are distinct from lacustrine sediments sourced elsewhere in the TVZ. Correspondence analysis shows that small, intact samples of erupted lake sediment (i.e., lithic clasts in ignimbrite) contain heterogeneous diatom populations, reflecting local variability in species composition of the paleolake and its shallowly buried sediments. Our analysis also shows a dramatic post-Oruanui supereruption decline in *Cyclotella novaezelandiae*, which likely reflects a combination of (1) reorganisation of the watershed in the aftermath of the eruption, and (2) overall climate warming following the Last Glacial Maximum. This decline is reflected in substantially lower proportions of *C. novaezelandiae* in the 1.8 ka Taupo eruption deposits, and even fewer in post-1.8 ka sediments from modern (Holocene) Lake Taupo. Our analysis highlights how the excellent preservation of siliceous microfossils in volcanic tephra may fingerprint the volcanic source region and retain a valuable record of volcanically influenced environmental change.

(来源: JOURNAL OF PALEOLIMNOLOGY, 2015, 54(4): 263-277)

Depositional modes and lake-level variability at Lake Towuti, Indonesia, during the past similar to 29 kyr BP

Vogel, Hendrik; Russell, James M.; Cahyarini, Sri Yudawati; et al.

Lake Towuti (2.5°S, 121.5°E) is a long-lived, tectonic lake located on the Island of Sulawesi, Indonesia, and in the center of the Indo-Pacific warm pool (IPWP). Lake Towuti is connected with upstream lakes Matano and Mahalona through the Mahalona River, which constitutes the largest inlet to the lake. The

Mahalona River Delta is prograding into Lake Towuti's deep northern basin thus exerting significant control on depositional processes in the basin. We combine high-resolution seismic reflection and sedimentological datasets from a 19.8-m-long sediment piston core from the distal edge of this delta to characterize fluctuations in deltaic sedimentation during the past ~29 kyr BP and their relation to climatic change. Our datasets reveal that, in the present, sedimentation is strongly influenced by deposition of laterally transported sediments sourced from the Mahalona River Delta. Variations in the amount of laterally transported sediments, as expressed by coarse fraction amounts in pelagic muds and turbidite recurrence rates and cumulative thicknesses, are primarily a function of lake-level induced delta slope instability and delta progradation into the basin. We infer lowest lake-levels between ~29 and 16, a gradual lake level rise between ~16 and 11, and high lake-levels between ~11 and 0 kyr BP. Periods of highest turbidite deposition, ~26 to 24 and ~18 to 16 kyr BP coincide with Heinrich events 2 and 1, respectively. Our lake-level reconstruction therefore supports previous observations based on geochemical hydroclimate proxies of a very dry last glacial and a wet Holocene in the region, and provides new evidence of millennial-scale variations in moisture balance in the IPWP.

(来源: JOURNAL OF PALEOLIMNOLOGY, 2015, 54(4): 359-377)

重点关注

Nature News: 全球湖泊变暖快于大气变暖将对水生生态系统造成不利影响

对全球数百个湖泊进行的一项调查显示,世界各地的湖泊正在以比海洋和周围空气都要快的速度变暖。科学家表示,这种快速的温度上升将对湖泊生态系统造成普遍的影响。研究人员在日前于加利福尼亚州旧金山市举行的美国地球物理学会会议上报告了这一研究成果。

研究指出,由此产生的全球影响可能更为严重,因为更高的湖泊温度能够引发储存于湖泊沉积层中的碳转化为 CH_4 和 CO_2 ,进而在一个反馈效应中加速全球变暖。

大量研究已经表明,一些湖泊会在夏季变热。科学家很少在冬季跟踪湖泊的温度,因为冰层使得测量变得更具挑战性。这项新的研究包含了全世界的 235 个湖泊——研究人员将到达湖泊深处的手工测量结果与能够提供湖泊表面全球覆盖的卫星读数结合在一起。在该项研究的时间段——1985—2009 年间,一些湖泊冷却而另一些湖泊却急剧变暖,但每十年平均变暖了 0.34°C ,这一数字比海洋在相同时期每十年升温 0.12°C 的两倍还要多。

该项研究共有 64 位科学家在全球六大洲采集数据,其首席作者、美国伊利诺伊州立大学淡水生态学家 Catherine O'Reilly 表示,海洋升温滞后并不让人感到意外,因为它具有巨大的质量。但是许多湖泊正在以比表面气温更快的速度变暖,后者在 1979-2012 年之间每 10 年升高 0.25°C 。O'Reilly 说:“我曾预计,平均而言,湖泊会比空气更慢地变暖。”

一个由暖冬形成的更短冰季或许有助于解释其中的原因。并未参与该项研究的

加拿大里贾纳大学湖泊生物学家 Peter Leavitt 说：“通常情况下，冰层是一个很好的绝缘体，能够保护湖泊避免被大气加热。”然而随着冰融化得越来越早，湖水暴露在温暖的春季空气中的时间也越来越长。这可能解释了为什么通常在冬天结冰的湖泊每十年变暖 0.48°C ，大约比不结冰湖泊快了两倍。另一个可以加速湖泊变暖的因素是在一些温带地区云量的下降，这至少一部分是由气候变化引起的。更清晰的空气可以让更多的阳光洒在湖泊表面。随着湖泊从太阳和空气中吸收更多的热量，湖水就会变得更加分层，密度较轻的温水会漂浮在密度较重的冷水之上。这种分层化阻止了深处的低温湖水与表层湖水的混合，以及在夏季冷却湖水。

湖水快速的夏季变暖对湖中的物种可谓凶多吉少。喜欢寒冷的淡水鱼，如湖中的鳟鱼，可能会受到影响。而依赖于湖冰的物种同样面临威胁。华盛顿州立大学生物学家 Stephanie Hampton 指出，俄罗斯贝加尔湖中的贝加尔海豹通常在冰上产崽。O’ Reilly 补充说：“在我们的湖泊中发生的巨大变化不仅是无法避免的，而且可能已经发生了。”

与此同时，Leavitt 指出，在更温暖的地区，“强烈的分层和温暖的表层湖水是有毒和可能有毒的蓝藻水华的发源地，特别是在已经遭受农业和城市化影响的湖泊与河口水域尤为如此”。

作者表示，他们的研究结果表明需要更新全球气候模型，以便更好地预测湖泊变暖情况。研究人员也希望能够看到更好的遥感技术问世，从而可以测量目前卫星往往无法识别的较小湖泊的温度。

原文来源：<http://www.nature.com/news/lakes-warm-worldwide-1.19034#correction1>

（来源：中国科学报 2015-12-22）

Nature Geoscience：火山喷发影响全球主要河流的流量

2015 年 10 月 5 日，Nature Geoscience 在线发表了题为《火山喷发后全球径流模式的系统变迁》（Systematic change in global patterns of streamflow following volcanic eruptions）的文章，指出大爆炸式的火山喷发之后，全球多数地区的降水将减少，特别是气候湿润地区，这将直接影响全球主要河流的流量。平流层的火山气溶胶能够反射太阳光，从而减少蒸发，同时地表变冷可以稳定大气，降低其保水能力。环流的变化也将使得全球降水减少。但是，火山喷发是否会导致径流发生明显的变化尚不清楚。

爱丁堡大学的研究人员分析了 20 世纪和 19 世纪末期 2~6 次重要的火山喷发期间的全球 50 条大河的流速及流量的观测记录，其中包括从 1883 年喀拉喀托火山喷发到 1991 年的皮纳图博火山喷发。研究人员将河流按区域分组，采用计算机模型将降雨与火山喷发联系起来，预测火山对河流的影响。研究发现，火山喷发后 1~2 年，一些河流流量会减少，如亚马逊河、刚果河、尼罗河、橘河、鄂毕河、叶尼塞河和

科雷马河以及其它河流的流量在统计上均显著减少。结合另一些气候模型模拟火山喷发之后降水有所增加或减少的地区的河流数据, 研究人员发现, 南美北部、非洲中部和高纬度亚洲的河流、以及潮湿的热带和亚热带地区河流的平均流速及流量均显著下降 ($P < 0.1$), 而南美南部和北美西南部河流的流量却明显增加。

研究人员表示, 预测河流流量的变化对人类的影响并不简单。亚马逊人烟稀少, 因此流量的减少造成的影响可能不大。然而, 对于人类需求较高的河流, 如尼罗河, 流量的损失可能会产生较大的影响。因此, 未来的火山喷发可能会大幅度地影响全球可用水资源。

原文来源: <http://www.nature.com/ngeo/journal/vaop/ncurrent/pdf/ngeo2545.pdf>

(来源: 科学研究动态监测快报 2015-10-15, 第20期总第218期)

浮游植物可能适应全球升温

英国埃克塞特大学新发布的一项研究显示, 浮游植物或许能适应未来全球气温升高后的环境。研究人员认为, 鉴于这类生物具有很强的固碳能力, 未来对气候变化影响的相关评估不应忽视它们的作用。

浮游植物指水中以浮游方式生存的植物, 包括多种浮游藻类。这类植物尽管微小, 但能高效吸收大气中的二氧化碳, 因此探讨它们能否适应全球升温非常重要。

据埃克塞特大学研究人员介绍, 他们在实验室中将一种名为“小球藻”的藻类置于温度变化的环境中, 一开始它们在环境温度达到30摄氏度时生长就放缓了, 但这种寿命短暂的生物经过100代的繁衍后(大约45天), 进化出能适应更高温度的能力, 逐步恢复生长速度, 且其固碳效率还有所提升。

研究人员说, 此前有预测说全球温度上升到一定程度后, 水生态系统的固碳能力或被削弱, 但从新的研究结果看, 浮游植物对温度上升具有很强的适应能力, 未来建立模型评估气候变化对水生态系统影响的时候也需要把这一因素考虑进去。

(来源:《科技日报》2015-12-04)

我国湖泊碳积累速率加快

国际上近年来愈来愈多的研究表明, 湖泊生态系统是不容忽视的碳汇。探索湖泊碳积累规律对过去气候变化和人类活动的响应, 不仅能为更好地评估和预测未来气候和人类活动变化下湖泊的固碳能力提供理论基础, 而且对区域或全球碳循环规律的研究也具有重要意义。中科院成都生物所与国外学者合作, 日前在中国湖泊的碳积累动态及其影响方面取得进展, 相关成果发表于《全球变化生物学》。

科研人员对过去 1.2 万年来中国湖泊沉积物的碳积累动态变化及其影响因素进行了整合分析, 估算了中国湖泊的碳埋藏总量。结果表明, 在过去 1.2 万年中, 中

国湖泊碳积累速率总体呈增加趋势，其积累高峰发生在近 1000~2000 年，主要与近期人类活动加强所引起的陆源有机物增加有关。

科研人员还发现，中国湖泊沉积速率存在空间差异——东部平原地区的湖泊沉积速率显著高于青藏高原湖区、蒙新高原湖区、云贵高原湖区、东北湖区等其他 4 个湖区的积累速率。湖泊碳沉积速率随着年均温、年降雨量及湖泊流域面积与湖泊面积比值的增大而增大。中国湖泊全新世碳埋藏总量大概是泥炭地的 4 倍。而气候和人类活动的变化历史是导致中国湖泊碳积累速率的时空动态变化的重要因素。

原文来源: <http://news.sciencenet.cn/sbhtmlnews/2015/11/305854.shtm>

(来源: 光明网 2015-11-13)

Science: 证据显示火星上有持久存在的湖泊

来自好奇号火星探测车的新的数据揭示了一个三角洲和湖泊的瞬态水系统，它们曾经主导了火星盖尔陨石坑的景观。尽管过去有关这一区域历史的理论一直基于来自远处的观察，而来自好奇号的实地数据则能让研究人员直接测试大型撞击陨石坑能够在相当长的时期内积累和储存水的假说。在该陨石坑内，探测车发现了在轨道上无法观察到的陆坡地形（盆地表面）。John Grotzinger 等人分析了沿着这些陆坡地形的沉积物，并注意到该盆地表面会随着时间而上升。这些观察与该陨石坑边缘侵蚀计算的结合表明，加积（因沉积物的堆积而引起的地面上升增加）发生了。盖尔北部陨石坑壁和边缘的侵蚀所产生的砾石和沙子在浅流中被向南输送。随着时间的推移，这些浅流沉积向陨石坑内部推进，并演变成为颗粒更细的下游。这些三角洲标志着一个古老湖泊的边界，在那里，最细的（泥土颗粒大小的）沉积物得以累积。由 Grotzinger 和同事的分析提示，尽管水的存在可能短暂，但这个区域中的远古个体湖泊一度稳定的时间在 100 年至 1 万年——这一时间长度可能足以支持生命。由好奇号迄今穿过的区域需要 1 万至 1 千万年的累积，表明这些瞬态湖在整个时间中可能源自一个共同的地下水床。此外，证据表明，随着时间的推移，由风驱动的侵蚀移动了陨石坑内的沉积物而创建了夏普山。这些新的数据对火星过去的水格局、气候和可居住性提出了空前未有的见解。由 Marjorie Chan 撰写的一篇《视角》对这一论文进行了解读。

原文来源: <http://www.sciencemag.org/content/350/6257/aac7575.abstract>

(来源: <http://www.aaas.org/> 2015-10-09)

英报告评估气候变化对水资源和自然资产的影响

根据英国《2008 年气候变化法案》（Climate Change Act 2008）的要求，英国政府将于 2017 年发布第二次《气候变化风险评估报告》（Climate Change Risk

Assessment, CCRA)。2015年9月,英国气候变化委员会(Committee on Climate Change)适应小组(Adaptation Sub-Committee)委托相关机构发布了其中两份CCRA研究依据报告,分别评估了气候变化对水资源和自然资产的影响。

第一份报告《英国水资源可利用性的预测更新》(Updated Projections for Water Availability for the UK)由英国水力研究院(HR Wallingford)于9月11日提交,对当前水资源利用规划风险的影响因素进行了评估,预测到2100年在不同的人口、气候变化条件和适应措施下的结果。报告指出,英国当前已有27个区域出现了水资源供求平衡赤字;在高人口增长率和高气候变化情景下,若不采取适应措施,赤字区域将持续扩张,到2080年将覆盖英国全部组成地区。报告还指出,英国的水资源总需求到2080年将增加4%~18%;但同时,可利用的水资源将明显减少8%~15%。

第二份报告《气候变化对英国自然资产的影响的评估》(Assessment of Climate Change Impacts on UK Natural Assets)由AECOM公司联合英国艾克斯特大学(University of Exeter)、约克大学(University of York)等机构于9月16日发布,评估了气候变化在清洁水资源、稳定气候和野生生物三方面产生的影响,并对未来优先研究领域进行了介绍。

(1) 清洁水资源。气候变化对清洁水资源带来以下五个方面的风险:①加剧现有的水体富营养化。②影响合流污水溢流(Combined Sewer Overflows)事件发生的频率和持续时间。③影响土壤向水体释放出溶解有机碳。④影响化学污染物的挥发与输送。⑤地下水过度抽取和海水入侵。

(2) 稳定气候。在三种不同的社会—经济发展方向下,气候变化对土壤和植物碳储量产生不同的影响。在“本地管理”(Local stewardship)和“绿色乐土”(Green and pleasant land)的发展条件下,土壤碳储量增加约11%,植物碳储量增加约28%,经济增加740亿和100亿英镑。而在“世界市场”(World markets)发展条件下,最大将造成13%的土壤碳储量和8%的植物碳储量的损失,经济损失则分别达8800万和30亿英镑。

(3) 野生生物。考虑气候变化对英国17个类群超过4000个物种的野生生物多样性的可能影响,结果表明特定物种对气候变化敏感性更高,不同类群之间存在系统性差异。例如苔藓植物是最可能受气候变化影响的群。

(来源:科学研究动态监测快报 2015-10-15,第20期总第182期)

欧研究指出 2080 年欧洲洪水损失将高达 1000 亿欧元

2015年9月24日,《全球环境变化》(Global Environmental Change)杂志发表题为《综合评估高端气候情景下欧洲洪水风险》(Ensemble Flood Risk Assessment in Europe under High End Climate Scenarios)的文章指出,在高水平的全球变暖情景下,21世纪末欧洲河流洪水造成的社会经济影响平均会增加220%。

来自欧洲委员会联合研究中心(JRC)的科研人员,预测“典型浓度路径”(RCP 8.5)情景下21世纪极端河川径流情况,结合欧洲洪水风险图编制的最新进展,研究了气候变化对欧洲未来洪水风险的影响。结果表明,仅仅考虑气候变化,21世纪末欧洲河流洪水造成的社会经济影响平均会增加220%。如果同时考虑社会经济发展路径的影响,至2050年,欧洲每年受洪水影响的人口数量达到50~64万,到2080年这一数量达到54~95万,而当前每年受洪水影响的人口数量为21.6万。至2050年洪水造成的经济损失每年会增加至200~400亿欧元,至2080年这一值达到300~1000亿欧元,当前这一值为53亿欧元。

原文来源: <http://www.sciencedirect.com/science/article/pii/S0959378015300406>

(来源: 科学研究动态监测快报 2015-10-15, 第20期总第182期)

Water International 文章指出远距离输水缓解大城市用水需求

2015年12月3日, Water International 期刊发表了题为《城市水系统中的远程耦合: 评价北京的输入水资源供应》(Telecoupling in urban water systems: an examination of Beijing's imported water supply) 的文章, 以中国的南水北调工程为例运用耦合新方法阐述了现代国际大都市从远距离水源地调水供给城市的影响。

当前城市用水问题突出, 主要体现在大城市百万居民生活用水缺乏, 城市附近水源紧张, 开始从含水层、水库和更远的农田取水, 当前复杂的缺水情况所带来的影响还是未知数。密歇根州立大学(MSU)的科学家提出了一种新的方式研究北京、洛杉矶、圣保罗等全球大城市从远处调取所需水之后全球将会发生什么变化。这种新的耦合框架可让更多学科的科学家的研究环境和社会经济行动将带来哪些波及全球的反应和影响。

大城市目前仅占据世界陆地面积的1%, 但却从全球41%的陆地面积取水。这就意味着水的长距离输送以及世界水格局的改变。本文指出水的来源可以有很多途径。研究人员关注北京应用耦合的新途径获得超量级的水源。大多数城市用水研究者主要侧重于城市本身, 耦合的方法重点思考城市水源区域周边的正面和负面的影响, 它需要一幅完整的输送图, 以便充分评估现代城市水供应的可持续性。密歇根州立大学团队应用耦合框架, 基于以下解决北京供水需求的三种方式, 多角度严密探究了人类和自然系统耦合所发生的变化。

(1) 调水。中国的南水北调工程从中国南方向北方输水, 是至今为止全球最大的跨流域调水工程。全部工程包括三条调水线路, 从长江流域向北方水短缺地区输送11.8万亿加仑的水, 该工程耗资4860亿人民币(800亿美元), 预计到2020年将为北京增加43%的水供应。

(2) 虚拟水。这些水是农作物生长和生产工业产品所用的水。虚拟水供应了北京超过一半的水足迹, 而且还会继续增加。

(3) 生态系统服务补偿, 这是对人们改变生产和生活习惯的一种补偿, 从而改善水量和水质。例如, 北京附近的农田区域在从水田转变为旱田的过程中, 需要支付农民从需水量大的水稻田转变为谷物田所损失的收入。研究表明, 这种服务性价比高, 可以改善可用水的质量, 但是水量却不能增加很多。

远距离的调水为北京提供了急需的水资源。这种耦合型的水源减少了北京本地水供应的不稳定性, 削弱了水资源短缺的弱势。另一方面, 这些水的输送对广泛区域具有复杂的影响, 耦合方式也全面考虑整个系统, 填补了之前被忽略的研究空白。

原文来源: [Water International, DOI: 10.1080/02508060.2015.1113485](https://doi.org/10.1080/02508060.2015.1113485)

(来源: 科学研究动态监测快报 2015-12-15, 第 24 期总第 269 期)

欧洲培育出治理水污染的超级细菌

西班牙巴塞罗那自治大学 (UAB) 研究人员近日就在水污染治理方面实现了这一想法。他们培育出一种能将有毒有机氯化物转变成无害可降解物质的超级细菌, 在利用生物技术解决水污染问题上跨出了一大步。

这种超级细菌名为绿弯菌门细菌 (Dehalogenimonas), 之前已在北冰洋、波罗的海、加拿大、中国、德国、西班牙和美国等地被发现, 但直到人们在美国路易斯安那州的氯代烷污染含水层发现该菌种的细菌时, 才第一次发现该菌种的高效降解氯化物特性。有机氯化物引起的水污染一直是世界上最严重的污染之一, 一旦有机氯化物进入深水层, 超低的生物降解性会导致其毒性污染长久存在于水源中。该细菌的特性使其成为解决氯化物水污染的有力武器。

据物理学家组织网报道, 这些细菌在呼吸过程中只能将有机化合物作为能量来源, 并通过活跃的新陈代谢将它们转化为可生物降解的、不含氯的、对环境无害的物质。例如将 1,2-二氯丙烷、1,2-二氯乙烷等污染氯化物分别转化成丙烯与乙烯这种无害物质, 成功去除氯元素, 净化水质。

为更高效地消除污染物, 研究人员对该细菌进行了基因改造, 添加了具有特殊分解代谢特性的基因片段。而为了测定超级细菌消除水污染的效率, 他们还通过高科技分析技术准确标记出污染物的稳定同位素, 排除自然界其他减少水源污染物含量的外界影响, 例如大量降雨对污染物的稀释、污染源的挥发等情况。结果证明, 利用该菌种消除氯化物污染源十分有效。

UAB 的欧内斯特·马可表示, 生物污染治理技术是一个低成本、高收益, 并与其他环保技术相兼容的技术模式, 通过培养超级细菌处理污染将大大降低污染治理成本, 未来超级细菌甚至能够在工厂厂房将污染源直接消除。

(来源: 《科技日报》2015-10-28)

青藏高原所揭示色林错湖泊蓄水量变化及其影响因素

湖泊蓄水量作为水文循环中的重要组分，其变化强烈影响着青藏高原湖泊及其周边流域的水量平衡。近年来，在气候变化的影响下，高原中部湖泊扩张迅速，湖泊扩张及其影响因素受到广泛探讨。入湖径流、冰川融水、湖面降雨及蒸发已被认为是高原湖泊变化的主要影响因素，但关于湖泊扩张主导因子的解释一直存在争议。限于高原湖泊普遍缺乏长期的实地观测资料（入湖径流、湖面蒸发），目前相关研究仍然缺少以模型为主要手段的定量分析。色林错已扩张成为高原第一大内陆湖，定量分析色林错湖泊蓄水量变化及其影响因素对于深入认识其扩张过程和机制有着重要意义。

近期，中国科学院青藏高原地球科学卓越创新中心研究员王磊课题组和张寅生课题组，以色林错湖泊流域内入湖径流和湖面蒸发的定位观测数据为基础，利用分布式陆面水文模型web-dhm结合湖面在结冰期和非结冰期的不同蒸发算法，通过对模型进行点（入湖径流、短期湖面蒸发）、面（modis地表温度、全流域平均蒸发）多尺度的校准和验证后，分析了色林错在2003-2012年间的湖泊蓄水量变化及其影响因素的贡献。研究结果表明，在色林错湖泊流域内，入湖径流和湖面降雨在暖季（5月—10月）和全年（月尺度）对湖泊蓄水量变化均有较大影响，而湖面蒸发则在冷季（11月—次年4月）与湖泊蓄水量变化密切相关。入湖径流是影响色林错湖泊蓄水量变化的主导因素，其次为湖面降雨和蒸发，三者对湖泊蓄水量变化的贡献达到90%。此外，研究以扎加藏布（最大入湖支流）为例发现，相比于积雪和冰川融水，降雨径流仍是入湖径流的主要成分（70%以上）。这一研究成果为认识色林错湖泊变化提供了定量方法，还可为高原其他湖泊研究提供借鉴。

该研究得到了中国科学院战略性先导b专项和国家自然科学基金的支持，张寅生和博士生郭燕红提供了实地观测资料。以上研究成果近期发表于 *Water Resources Research*，周璟为第一作者，王磊为通讯作者。

（来源：中国科学院网 2015-10-28）

俄专家称俄远东最大湖泊因中国河流改道而泛滥

俄罗斯科学院远东分院生物土壤研究所所长、俄科学院院士尤里·茹拉夫廖夫在“自然无国界”国际生态论坛上向记者表示，俄远东最大的湖泊兴凯湖因中方改变河流流向而使湖水泛滥。

据俄罗斯“卫星”新闻通讯社网站10月29日报道，学者表示：“兴凯湖淹没了周围的低地，冲毁了道路、房屋，中断了交通。出现了一个跨境问题：兴凯湖可能是由于中方改变了松阿察河的流向而使湖水泛滥。如果松阿察河河水此前流向列索

扎沃茨克以北，那么现在大量河水流入兴凯湖沿岸谷地，再从那里注入兴凯湖。准确的水量目前不得而知。”



报道称，滨海边疆区行政长官弗拉基米尔·米克卢舍夫斯基表示，学者们的研究已有初步结果，可做初步论断。他称：“兴凯湖是跨境湖泊，其一部分属于中国，因此应该进行联合工作，签署解决水位升高问题的政府间协议。”

兴凯湖是俄远东联邦区最大的淡水水体，面积为4070平方公里，位于俄滨海边疆区与中国黑龙江省的交界处。

（来源：参考消息网 2015-10-30）

全球变暖将给中国北方带来更多雨水

中国科学家 12 日发表的一项新研究显示，全球变暖将导致东亚夏季风雨带北移，从而给中国北方带来丰富的降水，逆转当地自上世纪 70 年代以来的干旱局面。

论文通讯作者、中科院地质与地球物理研究所研究员杨石岭告诉新华社记者：“简单地说，就是过去几十年北方的干旱化是短暂的。从地质记录看，全球变暖一定会使东亚夏季风雨带向西北推进，从而极大地改善我国北方的生态环境，惠泽数亿人。”

这项成果发表在新一期美国《国家科学院学报》上，并被该期刊评为亮点文章。

20 世纪 70 年代以来，东亚夏季风强度持续减弱、季风雨带逐渐南移，从而导致中国北方干旱、南方洪涝。对于这一现象，学术界多归因于全球变暖。由于人类活动排放的温室气体还将不断增加，从而进一步加剧了人们对中国北方干旱化的担忧。

杨石岭与同事丁仲礼院士等人对黄土高原末次冰盛期（距今 2 万年前，是最近

的极寒冷时期)以来 20 多个地点的土壤变化进行了系统研究,以通过对降水敏感的古植被来重建古季风,从而了解古夏季风雨带对全球温度变化的影响。

通过分析沉积物有机质中的碳稳定性同位素组成,他们发现,从末次冰盛期至全新世暖期(距今 1 万至 4000 年前),黄土高原 C4 植被(光合作用初级产物为四碳化合物的草本植物)显著增加,而且 C4 植被生物量等值线呈东北—西南向分布,跟现代降水量等值线非常一致。因此,C4 植被生物量等值线的移动可以有效指示古季风雨带的位置变化。

杨石岭说,末次冰盛期时,黄土高原东南部的 C4 植被生物量为 10%至 20%,而在全新世温暖期,该等值线(10%至 20%)出现在黄土高原西北部,空间移动幅度达 300 公里以上。这一结果表明,全球变暖导致东亚夏季风雨带向西北方向推进。

他进一步表示,东亚属于亚洲季风气候区,降水主要由东亚夏季风带来,夏季风所到之处通常会带来降水,从现代降水的雨量等值线来看,主要呈现出东北—西南带状分布的降水等值线,尤其是中国北方。季风向北方推进,北方干旱—半干旱区降水就会增加;季风向南方撤退,北方地区就会大旱,南方就会出现洪涝灾害。

他说据此可以推断,“如果全球增温持续下去,季风雨带目前南撤的趋势会逆转,长时间尺度上一定会向北推进,我国北方的降水将显著增加。这为评估全球变暖对我国北方气候和生态脆弱带的影响提供了科学依据”。

(来源:《科技日报》 2015-10-14)

业界动态

亚行：与中国合作治理湖泊的经验可供国际社会借鉴

亚洲开发银行(亚行)23日在总部马尼拉发布新书说,得益于创新的改革措施,亚行在中国的一项治理大型湖泊项目进展顺利,其经验可供中国乃至国际社会所借鉴,以促进湖泊生态的恢复。

该书所提的大型湖泊项目主要落脚在中国安徽巢湖。长期以来,巢湖一直饱受污染问题困扰,包括来自农药化肥和牲畜养殖的污染,导致环境恶化,鱼类资源锐减。2012年11月,亚行批准安徽省申请,贷款2.5亿美元(约合16亿元人民币)用于巢湖治理项目。

新书介绍了当地政府治理湖泊的三大举措:制定协调一致的全面总体规划;调整行政结构,将大部分巢湖上游集水区划归单一行政机构管辖;建立巢湖管理局,使其成为负责管理巢湖的综合部门,从而实现改善巢湖水质的长期目标。

亚行新书还分析了巢湖治理中采取的初步改革措施,并将中国的经验与来自澳大利亚、日本、英国和美国的4个案例进行了比较。据亚行介绍,此前许多类似的湖

泊治理项目未能取得预期的治理成果。

亚行副行长史蒂芬·格罗夫在新书发布会上说：“希望亚行新书中阐释的巢湖治理战略能够为中国乃至国际上的湖泊生态恢复提供新的蓝图。”

此次发行的新书为《湖泊和湿地生态恢复》的第二卷，除记录了亚行和中国政府针对巢湖污染问题所采取的治理措施外，还讨论了巢湖长期污染带来的挑战及相关补救措施。

该书第一卷已于2008年12月底出版，内容涵盖了中国湖泊和湿地生态恢复工作获得成功的四大关键因素：坚定和持续一贯的政治领导力、统筹规划与分析、有效的管理结构和金融工程。

(来源：新华网 2015-10-24)

我国重要江河湖泊水功能区达标率达到 67.5%

近年来，我国加大大江大河流域环境治理力度。2014 年，重要江河湖泊水功能区达标率达到 67.5%，黄河干流已实现连续 16 年不断流，河湖生态和大江大河环境得到改善。

这是记者从水利部 5 日召开的“大江大河流域环境治理措施成效”新闻通气会上获悉的。

水利部水资源司副司长石秋池表示，近年来，水利部门着力通过控制经济社会用水总量，把水资源水环境的承载能力作为区域发展的刚性约束，为生态留下更多的水资源；把强化节水作为缓解水资源短缺的根本性措施；提出限制纳污总量要求；更加注重保护河道自然生态；加大水土流失综合治理，涵养水源。

据了解，“十二五”期间，全国用于大江大河流域综合治理的中央水利投资达 2800 多亿元，全国新治理河长 1.1 万公里、新建堤防 5120 公里、加固堤防 7710 公里、新增供水能力 380 亿立方米，172 项节水供水重大水利工程进展顺利。全国完成水土流失综合治理面积 26.15 万平方公里。

水利部全面落实最严格水资源管理制度，实施水生态治理和修复，有序开展水资源调度和生态补水。核定完成 4493 个全国重要水功能区的纳污能力，提出限制排污总量意见，并送环保部作为入河排污总量控制的依据。对供水人口 50 万以上的 175 个重要饮用水水源地开展达标建设，已连续四年实现水质达标率 95% 以上。

同时，对黑河、塔里木河、太湖、滇池等水系实施生态脆弱河湖治理修复或水环境综合治理；选择东江、滦河流域，启动了国土江河综合整治试点；大力实施退田还湖、退渔还湖；加大华北平原区等严重超采区治理修复力度。指导开展黄河、黑河、塔里木河等流域水资源统一调度，黑河下游东居延海实现连续 11 年不干涸。从 2003 年开始先后组织开展了 38 次引江济太水量调度，2005 年以来实施了 11 次珠江枯水期水量调度，牛栏江—滇池补水工程运行以来已累计向滇池补水 9.1 亿立

方米, 保障了太湖周边、澳门和珠海等地供水安全, 显著改善了太湖、滇池等重点河湖水生态环境状况。

“虽然大江大河综合整治方面取得了一定的成绩, 但是全国尚有 11.7% 的河段水质劣于 V 类, 丧失基本使用功能, 流域环境治理依然任重道远。”石秋池说, 必须继续做好水生态文明建设, 提高全民环境意识, 积极参与水环境整治和监督管理。

(来源: 中国新闻网 2015-11-05)

今年重大水利工程项目已累计新开工 27 项

从 11 月 4 日水利部召开的重大水利工程建设进展情况新闻通气会上获悉, 截至 10 月 31 日, 今年重大水利工程项目已累计新开工 27 项, 新增投资规模 1147 亿元, 提前 2 个月完成《政府工作报告》明确的年度目标任务。

水利部规划计划司常务副司长汪安南介绍, 这 27 项工程建成后可新增防洪库容 9.3 亿立方米, 年供水量 72 亿立方米, 发电装机 32 万千瓦, 新增或改善灌溉面积 845 万亩。新开工的 27 项工程中有 21 项位于中西部地区, 占 78%, 对促进中西部地区经济增长、保障和改善民生、促进地区间协调发展等发挥重要作用。

据初步统计, 今年 1—10 月, 在建水利工程完成中央水利建设投资计划 2666.2 亿元, 较上年同期增加 1071.9 亿元, 增幅 67.2%。其中, 重大水利工程完成投资 660.3 亿元, 是去年同期完成投资的 2.6 倍。

(来源: 《科技日报》2015-11-08)

第五届中国湖泊论坛举行

日前, 以“湖泊湿地与绿色发展”为主题的第五届中国湖泊论坛在吉林省长春市举行。

论坛主题报告会上, 有关专家学者就《中国水生态现状与未来挑战》《浅水湖泊的保护和治理》《太湖流域环境问题与防治策略》等题进行了演讲。

与会专家们还围绕“湖泊与湿地流域生态环境管理”“湖泊与湿地水污染防治理论与技术”“湖泊与湿地生态环境恢复与保护”“河湖水系连通与流域水资源优化配置理论与技术”4 个专题进行了交流研讨。论坛还邀请部分专家针对吉林省西部河湖连通工程进行了座谈交流。

(来源: 《科技日报》2015-10-12)

欧盟 BIOFRESH 项目推出在线淡水信息平台

淡水动植物栖息地与生物多样性面临巨大威胁, 其物种消亡速度远远高于海洋和陆地物种。从 2009 年 11 月开始, 由欧盟 10 个成员国及马来西亚和菲律宾的 18 家主

要水产和渔业环境科研机构跨学科研究者组成的BIOFRECH研发团队，致力于淡水生物多样性的世界普查，加大研究力度和扩散相关知识，促使世界各国重视淡水生物多样性保护，总研发投入810万欧元。

目前，研发团队在广泛收集、整理和分析大量早期有关江河、湖泊和沼泽淡水生物多样性数据的基础上，建立起世界首个淡水生物多样性研究平台及数据库。搜索的数据记录超过900万，从中筛选出的淡水物种超过4.7万种，包括覆盖地球陆地表面积819条主要江河流域的1.3万多种物种。研发团队的负责人称，为了更好地理解淡水生物多样性保护的意义与作用，邀请来自世界各地的科学家、学生和其他感兴趣的研究人员为平台添加数据、地图或其他信息，预计该平台于2018年全面完成。具体的网址信息请参见<http://www.freshwaterplatform.eu>。

淡水信息平台涵盖的研究范围包括淡水生态学、淡水资源管理与研究等主题，现已成为欧盟重要的淡水生物多样性科研基础设施之一，正在开展着多项淡水栖息地保护和修复方法研究。例如，研发团队专门针对大坝开发的生态多功能综合评估工具，可量化评估相关的生态、环境、经济和社会综合指标，已应用于欧盟已建和计划在建大坝。主要从淡水生物多样性保护和经济社会效益的综合角度，确定大坝的选址和运作。

原文来源：<http://phys.org/news/2015-09-comprehensive-online-resource-freshwater.html>

（来源：科学研究动态监测快报 2015-10-15，第20期总第265期）

世界首份海洋分析报告出炉

澳大利亚阿德莱德大学对已发表的 632 个实验数据进行了统合，发表了世界首份全球性分析，勾勒出渔业和海洋生态系统一个严峻的未来：海洋酸化和变暖可能造成生物多样性下降和大量关键物种数量的减少，甚至海洋食物链物种崩溃。

（来源：《科技日报》 2015-10-19）

治理畜牧污染从微藻开始

目前，我国畜牧业已发展成为相对独立的产业，但由于资金、技术、管理等方面的缺乏，尤其是对环境保护意识的淡薄，畜牧养殖而造成的环境污染现象已经越来越严重。据全国污染源普查数据表明，畜禽养殖业 COD、总氮、总磷的排放量分别为 1268 万吨、106 万吨和 16 万吨，分别占全国总排放量的 41.9%、21.7%、37.7%。因畜牧业造成的环境污染，也已成为国际关注热点问题。

畜禽养殖业：环境治理刻不容缓

“畜牧业的环境污染，主要表现在水源污染、点源污染、土地污染、排放污染等几大方面。这些污染如不能得到及时治理，不仅会制约畜牧业的发展，还将造成

环境污染的加剧。”在 9 月 29 日绿倍生态科技有限公司成立仪式上，大成食品集团董事会主席韩家寰表示，养殖业的发展离不开种植业，种植业为养殖业提供饲料，养殖业为种植业提供充足的有机肥。而由于我国大部分地区农牧分离、种养脱节，无法实现发达国家土地与养殖场结合的大农场粪污还田模式，导致加剧了畜禽粪便对环境的污染。

据统计数据显示：我国水污染中化学需排放总量（COD）中 48%来自于农业，而其中畜牧业占据了很重要的一部分。为改善这一状况，国家先后出台了各项法规政策：2001 年颁布《畜禽养殖污染防治管理办法》，2014 年颁布《畜禽规模养殖污染防治条例》，以及 2015 年《环境保护法》的施行，希望能在法律、政策层面对这一环境污染问题进行大力整治。

强企联合：共创绿倍养殖新生态

业内专家表示，畜牧业不仅涉及三农，更关系到人们的日常生活。对于畜牧业污染的治理，一方面需要国家意志的顶层设计，另一方面也需要利用经济手段，动员社会企业的力量共同治理。在达到抑制畜牧业污染目的的同时，还能推动我国畜牧业的发展。

为响应国家对畜牧业污染的整治号召，由大成食品集团、万科集团、华大基因及凯达环保 4 家企业联手打造了绿倍生态科技有限公司，旨在以微藻科技为核心优势，站在微藻技术的世界制高点上，解决畜牧业污染的问题，做到生态的可持续发展和资源的可循环利用，形成以微藻运用为基础的人类社会生态、畜牧养殖生态、食品加工生态的发展闭环。

据了解，主持创建绿倍的 4 家企业均在各自专业领域拥有雄厚实力。大成食品集团集动物营养与家禽养殖于一体，并专注于食品加工安全；华大基因是全球最大的基因组学研发机构，致力于用基因科技造福人类，推动资源保存及生态可持续发展，在基因领域有着权威信服力；中国领先的房地产公司万科，在环保社区生态方面有着得天独厚的卓越实力。而凯达环保则拥有 15 年农牧业废水治理稳定达标经验，已建成遍布全国十几个省市 200 余座废水处理工程，在废水处理方面优势显著。

绿倍微藻：营建环保生态圈

依靠 4 家企业，绿倍微藻一开始就站在了尖端技术制高点。在践行国家节能减排战略的同时，也为养殖、食品及其他相关产业，提供完善的动物营养及生态环境两方面的解决方案。

“在此过程中，绿倍通过独有的微藻技术、强大的基础研发落地能力以及专业的运营团队，协助养殖、食品等相关企业设计及运营微藻废水处理系统。该系统能够克服传统污水处理方法引起的二次污染，同时还能够对污水进行深度处理，有效去除 COD、氨氮等有机物质”，华大基因研究院执行院长徐迅表示。

据介绍,这套解决方案的核心便是微藻,微藻作为有机污染的逆行者,具有让氨氮转化为蛋白的能力,30 亿年来,一直是大自然自我修护过程中的重要环节,对地球生态的延续和发展起到至关重要的作用。在自养和异养两种生长模式中,微藻生成了丰富的油脂、多糖、蛋白质、维生素与螯合矿物质等等,能在食品、医药、荧光材料、能源、环保等领域具备广阔的开发与应用价值。

据介绍,绿倍生态科技公司将以尖端生物科技微藻处理系统,解决养殖相关企业的废水问题。通过食物链的循环利用系统,以沼气、有机肥和微藻系统为纽带的生态链,将畜牧养殖生态、人类社区生态以及食品加工生态联系在一起,优化农业整体资源,做到资源再循环利用,达到减排、绿色及高效的目的,进而完善了可持续发展的生物工程及微藻系统的环保高新技术。

华大基因董事长汪健表示,“我们找到更高效转化氮、硫、甲氨的绿藻种,不光要减少排放,而且要把排放的废物转为宝物,转化为人类生存发展,财富积累的必须物质。为人类社会的发展做出我们的一份贡献。”

“绿倍以微藻技术作为企业核心,基于微藻在生态保护以及开发应用等方面的强大优势和潜力,依托大成自身及合作伙伴万科、华大基因、凯达的坚实支撑,将在积极响应国家节能减排的战略指引前提下,实现农畜牧产业及环境科技的可持续发展。”韩家寰说。

目前,国家也在积极推进各种资源再循环利用技术,“十二五”期间,国家将农业源减排纳入总量减排管理体系,将化学需氧量和氨氮排放量纳入问题减排约束性考核指标。目前,集约化、规模化养殖排放导致了水污染,已经成为主要污染源之一,据悉,日本和西方国家排放标准是 600,我国环保部提出要达到 150 的目标。这需要使大量的有机物质在排放前就要分解掉,变成无害的、无污染的无机物。

此次绿倍通过独有的微藻技术,不仅有望解决畜牧业的环境污染问题,还为创建绿色中国提供了一个全新的样板。相信在不久的将来,绿倍微藻会为畜牧业的发展带来全新动力,为绿色中国尽一份绵薄之力。

(来源:《科技日报》 2015-10-15)

从“死亡之河”到“活力之江”：韩国“工业之都”蔚山的河流治污

蔚山位于韩国东海岸,1962 年被指定为韩国第一个工业区,现在仍是工业重镇,它的历史是韩国实现飞跃式发展的缩影。据蔚山市环境局局长李镇壁向新华社记者介绍,蔚山既有“近代化的制造者”“工业之都”的荣誉,也曾有过“公害城市”的污名。穿城而过的太和江,是蔚山的母亲河,它既见证了蔚山的崛起和繁荣,也曾饱受污染之痛。在工业化和城市化过程中,工业污水和生活废水大量流入,各种垃圾大量堆积,河水浑浊,恶臭熏天;河鱼死亡,候鸟离去,太和江不再健康,沦为“死亡之河”。上世纪 90 年代,太和江下游的水质极差,生化需氧量达到 11.3PPM

(百万分比浓度), 根本无法用作农业用水, 人们望而却步。



在这一惨淡的现实面前, 没有人再以蔚山是“工业之都”为荣。为治理太和江, 市政府收集市民和专家的意见, 于 2004 年发表生态城市宣言, 开启了打造“生命之江”重建生态环境城市的序幕。

截流污水和废水是治理的第一步。当地建设了下水处理厂, 把流入太和江的污水和废水逐一截流, 同时疏浚 8.8 公里的污泥带, 清理河道, 并确保每天有 4 万吨河流生态用水来净化水质。在太和江的治理中, 环境团体、广大市民和众多企业齐心协力、积极参与。环境团体和市民积极开展水中、水边清洁运动, 清除过去 40 年腐烂于河底、恶化水质的水中垃圾, 拆除违规设置的铁桩渔网。企业则积极参与“一公司一河流”活动, 营造清洁河流。经过水质改善, 太和江水 2007 年的生化需氧量降至 2.0PPM (百万分比浓度) 以下, 至今一直保持着一级水资源水平。

此外, 蔚山还在韩国全国率先拆除混凝土河堤, 改为植物湿地河堤, 并改善全流域水质, 将太和江建设成自然型河流, 并指定河口地区为生态景观保护区, 为河流的系统保护和管理奠定了基础。经过征收私有土地、拆除近 400 座塑料大棚、清除 3500 吨垃圾等大量工程后, 一座面积达 53 万平方米的太和江大公园竣工。

蔚山市主管经济的副市长李泰成告诉记者, 整个河流治理历时 12 年, 总投入高达 1 万亿韩元 (1 元人民币约合 165 韩元)。无论是太和江的治理还是其他产业污染的治理, 依靠的是有民意支持的政策法规、奖罚分明的操作办法和不折不扣的切实执行。他认为, 蔚山成功治理环境问题的经验对其他城市的开发建设具有借鉴意义。

登上太和江观景台, 迎面吹来的是清新湿润的空气。河水清澈, 河岸整洁, 不时有游鱼跃出水面, 掀起串串涟漪。环境局政策课课长尹永赞告诉记者, 目前太和江沿岸生活着 900 多种动植物, 每年有 8000 多只白鹭夏天来此筑巢、约 53000 只渡鸦来此过冬。在河边, 记者看到工作人员正在拦网前统计回游鲑鱼的雌雄和数量。

尹永赞说, 鲑鱼、鲟鱼、水獭等也回到太和江繁衍栖息。鲑鱼对水质要求很高, 它选择在这里产卵, 就是对太和江最高的认可。

(来源:《科技日报》 2015-11-10)

新疆投 3.57 亿专项资金护三大湖泊生态环境

日前从新疆维吾尔自治区环保厅了解到, 2015年中央和新疆维吾尔自治区将投入3.57亿元专项资金, 用于赛里木湖、博斯腾湖和乌伦古湖生态环境保护。

据了解, 赛里木湖将获中央和自治区专项资金2.97亿元, 主要支持赛里木湖生态恢复与保护、污染源治理、环境监管能力建设三大类17个项目;博斯腾湖将获中央专项资金5000万元, 用于博斯腾湖生态安全综合评估、污染源治理、生态恢复与治理三大类11个项目;乌伦古湖将获自治区专项资金820万元, 主要支持饮用水水源地保护、污染源治理、生态恢复与保护三大类5个项目。

此外, 还安排自治区环境保护科学研究院自治区湖泊专项资金180万元, 用于编制《新疆水污染防治方案》和《新疆III类以下地表水体达标整治实施方案》。

(来源:《中国环境报》2015-09-22)

江西：书记省长挂帅“河长” 量化河湖生态保护责任

在11月2日召开的全省生态文明先行示范区推进大会上, 江西省公布了省级“总河长”及省级负责河流“河长”名单。江西省委书记强卫担任省级“总河长”, 省长鹿心社担任省级“副总河长”, 江西省委、省人大常委会、省政府、省政协相应领导担任“五河一湖”及长江江西段省级“河长”, 同时开启省、市、县、乡、村五级“河长”管理体系建设。

“河长制”是从河流水质改善领导督办制、环保问责制所衍生出来的水污染治理制度, 目的是为了保证河流在较长的时期内保持河清水洁、岸绿鱼游的良好生态环境。作为江西深入推进绿色崛起战略的重要举措, 全面实施“河长制”将成为该省生态文明建设的有力抓手, 通过推动各级党委、政府以及村级组织全面履行河湖保护责任, 创新河湖保护管理体制, 建立水陆共治、部门联治、全民群治的河湖保护管理长效机制, 加强水管理, 保护水资源, 防治水污染, 维护水生态, 保障河湖健康。

强卫强调, 要牢固树立绿色发展理念, 以质量和效益为中心, 以创新驱动为引擎, 以转型升级为路径, 以生态增值为导向, 实现生态效益、经济效益、社会效益的共同提升。一方面, 要把生态优势转化为发展优势, 在各领域唱响“江西风景独好”, 借助绿色生态的品牌影响力, 吸引高附加值项目落地, 吸引优秀人才集聚, 打造全国知名的绿色产业基地。另一方面, 要把增长效益转化为生态效益, 始终坚

持保护优先,运用新理念谋划绿色产业,运用新技术提升生产方式,建立体现生态文明要求的目标考核体系,用经济增长收益反哺大自然。

根据“河长制”推进的目标量化要求,江西省将在 2015 年建立县(市、区)级以上三级“河长制”组织体系,2016 年完成县以上试点,2017 年全境河流实施“河长制”。

(来源:《科技日报》 2015-11-04)

贵州最大天然湖泊保护规划获国务院批复

贵州草海高原喀斯特湖泊生态保护与综合治理规划》(以下简称《规划》)于日前获国家发改委批复同意。规划主要包括城镇污水和垃圾处理、面源污染控制等8方面内容,总投资约百亿元人民币。

草海位于贵州省威宁彝族回族苗族自治县南侧,与洱海、滇池同为我国三大高原淡水湖,也是贵州最大的天然湖泊,被列为全球十大最佳湿地观鸟区。

据了解,草海现已查明的生物物种有1914种,还有包括国家一级保护物种黑颈鹤在内的228种、10万余只鸟类在此过冬,候鸟总数占全国六分之一以上,黑颈鹤占全国五分之一以上,有“物种基因库”和“露天博物馆”之称。同时,草海水系还是长江上游重要的水源补充,有13条支流,在黔流域总面积2897平方公里,为长江年均提供约10.67亿立方米稳定水量。目前草海水系生态系统正面临严重威胁,植被退化及水土流失严重,如不及时治理,37年后草海或完全退化为沼泽。

《规划》的出炉将更好地引导草海的保护和治理。批复同意的规划综合治理区总面积230平方公里,主要建设内容包括城镇污水和垃圾处理、面源污染控制等8个方面,总投资约为100亿元人民币。

国家发改委指出,草海生态保护与综合治理是一项系统工程,贵州省应按照生态文明建设的总要求,统筹处理环境保护和区域经济发展、扶贫开发的关系,坚持以转变发展方式为主线,以保护鸟类生存环境与和谐的人居环境为核心,系统推进生态保护和工程治理、产业结构调整 and 城乡布局优化、强化管理监督和体制机制创新等措施,促进《规划》总体目标实现。同时,要大力探索市场化运作机制,采取有效措施,积极吸引社会资本投入,推动《规划》实施。

(来源:中国新闻网 2015-11-28)