

湖泊科学动态

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- ▶ **Nature** 文章: 新技术可能会彻底改变水净化行业
- ▶ 国际机构预测气候变化对亚洲五大河流流域的影响
- ▶ UN-Water 发布《水质监管框架纲要》报告
- ▶ 亚开行分析中国与水有关的灾害并提出灾害风险管理建议

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热点文章

► Intensification of phosphorus cycling in China since the 1600s

Xin Liu; Hu Sheng; Songyan Jiang; et al.

Phosphorus (P) is an essential nutrient for living systems with emerging sustainability challenges related to supply uncertainty and aquatic eutrophication. However, its long-term temporal dynamics and subsequent effects on freshwater ecosystems are still unclear. Here, we quantify the P pathways across China over the past four centuries with a life cycle process-balanced model and evaluate the concomitant potential for eutrophication with a spatial resolution of 5 arc-minutes in 2012. We find that P cycling in China has been artificially intensified during this period to sustain the increasing population and its demand for animal protein-based diets, with continuous accumulations in inland waters and lands. In the past decade, China's international trade of P involves net exports of P chemicals and net imports of downstream crops, specifically soybeans from the United States, Brazil, and Argentina. The contribution of crop products to per capita food P demand, namely, the P directly consumed by humans, declined from over 98% before the 1950s to 76% in 2012, even though there was little change in per capita food P demand. Anthropogenic P losses to freshwater and their eutrophication potential clustered in wealthy coastal regions with dense populations. We estimate that Chinese P reserve depletion could be postponed for over 20 y by more efficient life cycle P management. Our results highlight the importance of closing the P cycle to achieve the cobenefits of P resource conservation and eutrophication mitigation in the world's most rapidly developing economy.

(来源: PNAS, 2016, 113(10): 2609–2614)

中文点评:

中国的磷使用和生物地球化学循环

自从 17 世纪 00 年代以来, 中国对磷的开采、使用和出口已经强化, 正在耗尽这种关键的营养物质并且污染了淡水供应。磷是种植粮食的一个关键元素, 但是随着它流失到湖泊、河流和海洋中, 它逐渐变得不容易获得。同时, 大规模的磷流失导致了富营养化, 这可能导致藻华, 植物过度拥挤和氧耗尽。Zengwei Yuan 及其同事对自从 17 世纪 00 年代以来中国的磷循环进行了建模, 并且评估了富营养化的潜力。这组作者报告说, 中国强化了其磷循环从而养活不断增加的人口以及满足人们对于动物蛋白的需求, 特别是在过去大约 60 年间。此外, 磷在内陆水体和陆地上积累。根据对中国现有的磷酸盐矿石储量的粗略估计, 这组作者估计, 这个储量将会在大约 35 年内耗尽。然而, 这组作者发现, 有效使用可能把磷耗尽推迟超过 20 年。这组作者说, 这些发现为建立一个可持续的磷循环提供了数据, 从而可能带来有效率的粮食生产和健康的水供应。

(来源: <http://zh.eurekalert.org/>)

➤ Invasive species triggers a massive loss of ecosystem services through a trophic cascade

Jake R. Walsh; Stephen R. Carpenter; M. Jake Vander Zanden

Despite growing recognition of the importance of ecosystem services and the economic and ecological harm caused by invasive species, linkages between invasions, changes in ecosystem functioning, and in turn, provisioning of ecosystem services remain poorly documented and poorly understood. We evaluate the economic impacts of an invasion that cascaded through a food web to cause substantial declines in water clarity, a valued ecosystem service. The predatory zooplankton, the spiny water flea (*Bythotrephes longimanus*), invaded the Laurentian Great Lakes in the 1980s and has subsequently undergone secondary spread to inland lakes, including Lake Mendota (Wisconsin), in 2009. In Lake Mendota, *Bythotrephes* has reached unparalleled densities compared with in other lakes, decreasing biomass of the grazer *Daphnia pulicaria* and causing a decline in water clarity of nearly 1 m. Time series modeling revealed that the loss in water clarity, valued at US\$140 million (US\$640 per household), could be reversed by a 71% reduction in phosphorus loading. A phosphorus reduction of this magnitude is estimated to cost between US\$86.5 million and US\$163 million (US\$430–US\$810 per household). Estimates of the economic effects of Great Lakes invasive species may increase considerably if cases of secondary invasions into inland lakes, such as Lake Mendota, are included. Furthermore, such extreme cases of economic damages call for increased investment in the prevention and control of invasive species to better maximize the economic benefits of such programs. Our results highlight the need to more fully incorporate ecosystem services into our analysis of invasive species impacts, management, and public policy.

(来源: PNAS, 2016, doi: 10.1073/pnas.1600366113)

中文点评:

长柱尾突蚤与生态系统服务

美国威斯康星州的 Mendota 湖的一种入侵物种已经减少了水透明度大约 1 米, 其损失相当于所谓的“生态系统服务”损失 1.4 亿美元。生态系统服务包括人类从自然环境中得到的收益, 但是对这类服务的损失以具体财务术语的评估仍然具有挑战性。研究人员评估了 Mendota 湖由于长柱尾突蚤造成的水透明度下降的经济影响, 长柱尾突蚤是一种非原产的捕食性浮游动物物种, 在 20 世纪 80 年代入侵了美国的大湖地区。作者首先通过更新一个 2001 年的分析, 评估了目前水透明度的损失大约是 1.4 亿美元, 即每户 640 美元, 那个 2001 年的分析估计了当地居民为 1 米的水透明度付款的意愿。之后, 作者使用一个数学模型模拟了随着时间推移水清晰度的变化, 他们确定了减少来自农场径流的磷可能逆转这种破坏, 其成本是 8650 万到 1.63 亿美元。这组作者说, 这些发现证明了入侵物种造成的经济影响。

(来源: <http://zh.eurekalert.org/>)

摘要精选

Biogeochemical evidence for freshwater periods during the Last Glacial Maximum recorded in lake sediments from Nam Co, south-central Tibetan Plateau

Witt, Roman; Guenther, Franziska; Lauterbach, Stefan; et al.

Improved knowledge of deglaciation processes during the termination of the Last Glacial Maximum on the Tibetan Plateau can provide important information for understanding deglaciations in climate-sensitive high-altitude ecosystems. Little, however, is known about this time interval because most lacustrine sediment records from the Tibetan Plateau are younger than 19,000 years. This study focused on a lake sediment record from Nam Co, south-central Tibetan Plateau, covering the interval from similar to 23.7 to 20.9 cal ka BP. We analysed the distribution and compound-specific hydrogen isotope composition (δD) of sedimentary n-alkanes, as well as the bulk sediment TOC, TN, $\delta C-13(\text{org})$ and $\delta N-15$ composition, to infer lake system development. Pronounced changes in environmental conditions between similar to 21.6 and 21.1 cal ka BP, as well as between 23.1 and 22.5 cal ka BP (Greenland Interstadial 2), were inferred from increased aquatic n-alkane amounts and decreased δD (n-C23) values within these time intervals, respectively. Freshwater inputs, which most likely resulted from enhanced glacier melting, caused these changes. Our results suggest that mountain glacier retreat on the Tibetan Plateau started earlier than previously assumed. The required energy for thawing was probably provided by temperature changes caused by reorganization of atmospheric circulation, which has also been recorded in Greenland ice records.

(来源: JOURNAL OF PALEOLIMNOLOGY, 2016, 55(1):67-82)

Reconstruction of atmospheric soot history in inland regions from lake sediments over the past 150 years

Y. M. Han, C. Wei, R.-J. Huang; et al.

Historical reconstruction of atmospheric black carbon (BC, in the form of char and soot) is still constrained for inland areas. Here we determined and compared the past 150-yr records of BC and polycyclic aromatic compounds (PACs) in sediments from two representative lakes, Huguangyan (HGY) and Chaohu (CH), in eastern China. HGY only receives atmospheric deposition while CH is influenced by riverine input. BC, char, and soot have similar vertical concentration profiles as PACs in both lakes. Abrupt increases in concentrations and mass accumulation rates (MARs) of soot have mainly occurred since ~1950, the establishment of the People's Republic of China, when energy usage changed to more fossil fuel contributions reflected by the variations in the concentration ratios of char/soot and individual PACs. In HGY, soot MARs increased by ~7.7 times in the period 1980–2012 relative to the period 1850–1950. Similar increases (~6.7 times) were observed in CH. The increase in soot MARs is also in line with the emission inventory records in the literature and the fact that the submicrometer-sized soot particles can be dispersed regionally. The study provides an alternative method to reconstruct the atmospheric soot history in populated inland areas.

(来源: Scientific Reports, 2016, doi:10.1038/srep19151)

Historical Records of Mercury Stable Isotopes in Sediments of Tibetan Lakes

Runsheng Yin, Xinbin Feng, James P. Hurley; et al.

The Tibetan Plateau (TP), known as the “Third Pole”, is a critical zone for atmospheric mercury (Hg) deposition. Increasing anthropogenic activities in the globe leads to environmental changes, which may affect the loading, transport and deposition of Hg in the environment. However, the deposition history and geochemical cycling of Hg in the TP is still uncertain. Our records of Hg and Hg isotopes in sediment profiles of the two largest lakes in the TP, Lake Qinghai and Nam Co, show increased Hg influx since last century, with the maximum Hg influx enrichment ratios of 5.4 and 3.5 in Lake Qinghai and Nam Co, respectively. Shifts in negative $\delta^{202}\text{Hg}$ in Lake Qinghai (-4.55 to -3.15%) and Nam Co (-5.04 to -2.16%) indicate increased atmospheric Hg deposition through rainfall, vegetation and runoff of soils. Mass independent fractionation of both even-Hg ($\Delta^{200}\text{Hg}$: $+0.05$ to $+0.10\%$) and odd-Hg ($\Delta^{199}\text{Hg}$: $+0.12$ to $+0.31\%$) isotopes were observed. Positive $\Delta^{200}\text{Hg}$ suggest high proportion of precipitation-derived Hg in the TP, whereas the positive $\Delta^{199}\text{Hg}$ results from Hg(II) photo-reduction. Both lakes show increasing $\Delta^{199}\text{Hg}$ since the 1900s, and we conclude that with the decrease of ice duration, Hg(II) photo-reduction may have been accelerated in these TP lakes.

(来源: Scientific Reports, 2016, doi:10.1038/srep23332)

中国酸碱度不同湖泊四醚脂类分布影响因素及对湖泊古环境重建的启示

党心悦; 薛建涛; 杨欢; 等

湖泊沉积物中甘油二烷基甘油四醚化合物(GDGTs)在记录陆地古气候方面有着重要作用。然而, 这些化合物, 尤其是细菌支链 GDGTs(bGDGTs)异构体(5-, 6-甲基 bGDGTs)在中国不同酸碱度湖泊中的分布及其影响因素仍未可知。本文通过对碱度不同的湖泊进行对比, 并结合其他环境变量, 调查了 GDGTs 各类化合物在中国中东部湖泊系统和西南酸性青海中的分布特征及其影响因素。结果表明, 湖水含氧量能够影响湖泊古菌群落结构, 从而影响古菌 iGDGTs 的分布。GDGT-0/crenarchaeol 比值随着含氧量降低而增高, 表明厌氧的产甲烷古菌或混杂型泉古菌(MCG)与奇古菌相对含量受控于湖水含氧量。含氧量较低的湖泊奇古菌贡献 GDGTs 化合物比例较小, 四醚指数 TEX86 不能用来重建表层湖水温度。与土壤不同的是, 湖水 pH 并不会影响古菌 iGDGTs 和细菌 bGDGTs 的相对含量, 但在单一湖泊, 如腾冲青海中, 古菌与细菌的相对含量(Ri/b)与水深相关。虽然这些湖泊中细菌 bGDGTs 的甲基化指数(MBT')与年均大气温度(MAT)和 pH(或年均降雨量)相关, 环化指数(CBT)仅与 pH 相关, 但基于 5-甲基 bGDGTs 的 MBT'5ME 与 MAT 的关系并不明显, 反而是表征 6-甲基 bGDGTs 甲基化程度的 MBT'6ME 与 MAT 更相关。与全球土壤相似, 湖泊中 5-, 6-甲基 bGDGTs 的相对含量也主要受 pH 影响。因此, 6-甲基 bGDGTs 的相对含量(IR)或 CBT'可以作为潜在的湖泊 pH 计。但在较小 pH 梯度下, IR 和 CBT'两个指

标可能受其他环境因子, 如温度等的影响。

(来源: 中国科学 D 辑, 2016, 46(2): 141-155)

青藏高原湖泊表层沉积物 GDGTs 分布特征及其影响因素

王明达, 梁洁, 侯居峙; 等.

过去温度变化的定量记录对于深入探讨气候变化机制非常重要, 不仅有助于检验并改善气候模式模拟的准确性, 也可以为全球变化背景下的气候变化幅度提供参考。青藏高原由于其特殊的地理位置影响着大气环流格局, 研究青藏高原气候变化有助于理解高原对全球气候变化的响应及其与全球气候系统之间的关系。生物标志化合物代用指标在气候变化研究中的应用为定量重建高原过去温度变化提供了可能。湖泊沉积物中甘油二烷基甘油四醚类化合物(GDGTs)来源相对复杂, 其分布特征受多种气候与环境因素影响。本文对青藏高原 27 个湖泊表层沉积物及部分湖泊流域表土样品 GDGTs 进行分析, 探讨湖泊表层沉积物中 GDGTs 分布特征的影响因素, 并建立其与气候要素的定量关系。结果显示: (1) 绝大多数湖泊表层沉积物 GDGTs 以 bGDGTs 为主, crenarchaeol 和 GDGT-0 含量较低; (2) 高原多数湖泊表层沉积物与表土 GDGTs 分布没有显著差异, 表明 iGDGTs 可能同时来源于湖泊环境和陆源输入; (3) 湖泊表层沉积物 iGDGTs 分布主要受湖水水化学要素(pH 和盐度)及近地表大气年均温的影响, 对于青藏高原小型湖泊, TEX86 可能反映湖水 pH 的变化; (4) 湖泊表层沉积物 bGDGTs 分布主要受气候要素(温度和降水)控制; (5) 利用已发表的转换方程重建高原同一地区温度差异明显, 因此利用 GDGTs 定量重建青藏高原过去气候前必须开展 GDGTs 的现代过程调查。本研究基于湖泊表层沉积物 bGDGTs 分布, 分别利用代用指标(MBT, CBT)及不同 bGDGTs 化合物组分丰度(fabun)与湖泊所在地的年均气温(MAAT)建立了适用于青藏高原湖泊古气候研究的转换方程, 为高原古气候定量重建提供研究基础。

(来源: 中国科学 D 辑, 2016, 46(2): 167-183)

Organic matter transfer in Lake Superior's food web: Insights from bulk and molecular stable isotope and radiocarbon analyses

Kruger, B. R.; Werne, J. P.; Branstrator, D. K.; et al.

A suite of isotopic methods were combined to provide a comprehensive investigation of organic matter transfer and consumer-resource links in a large lake food web. We applied compound specific isotope analysis (CSIA) of nitrogen within amino acids of organisms, a relatively new method and one not yet widely applied to large lake systems, to determine the trophic positions of several dominant species. Comparison of this CSIA trophic designation to those calculated by traditional bulk stable carbon and nitrogen isotope ratios, as well as gut content analyses, revealed this CSIA method to be the most representative of known trophic links in Lake Superior. *Limnocalanus macrurus*, an omnivorous copepod,

was found to occupy a trophic position higher than would have been predicted based on gut analyses, and one full trophic position above primary consumer *Daphnia*. Radiocarbon analysis of bulk zooplankton and fish tissue was employed as a modern carbon tracer to elucidate the relative ages of carbon incorporated into, and propagated through, the food web. Comparison of animal tissue, non-living carbon pools (DOC, DIC), and POC radiocarbon content indicate the food web is supported predominately by newly synthesized autochthonous material. The uniquely depleted radiocarbon signature of the benthic amphipod *Diporeia*, attributed to consumption of aged sedimentary or allochthonous material, was not reflected in its known predators, indicating little overall incorporation of that aged carbon source into the pelagic food web. This multi-method isotopic investigation extends our understanding of food web structure and organic matter flow in this large lake.

(来源: LIMNOLOGY AND OCEANOGRAPHY, 2016, 61(1):149-164)

青海湖裸鲤耳石轮纹 O-Sr 同位素组成及其洄游行为的指示

周玲; 金章东; WILLIAMS Ian S; et al.

以溯河洄游为特征的青海湖裸鲤是青海湖鱼类的优势种,但其洄游行为还知之甚少。利用高分辨率 SHRIMP II 离子探针和激光剥蚀高分辨多接收电感耦合等离子体质谱仪(LA-MC-ICP-MS)分别测定了青海湖裸鲤微耳石轮纹中的氧和锶(O-Sr)同位素组成。结果表明,微耳石成长带中较低的 $\delta^{18}\text{O}$ 记录了青海湖裸鲤春夏时期所洄游的河水化学信息;将 $\delta^{18}\text{O}$ 与 $^{87}\text{Sr}/^{86}\text{Sr}$ 同位素组成相结合,微耳石轮纹的同位素组成明确指示了多数个体可能更倾向于固定的河流洄游产卵。这一结果对于认识青海湖裸鲤的洄游习性以及鱼类保护和管理有重要的意义。

(来源: 科学通报, 2016, 61(6): 668-675)

Temporal Succession of Ancient Phytoplankton Community in Qinghai Lake and Implication for Paleo-environmental Change

Li G, Dong H, Hou W; et al.

Tibetan lake sediments in NW China are sensitive recorders of climate change. However, many important plankton members do not leave any microscopic features in sedimentary records. Here we used ancient DNA preserved in Qinghai Lake sediments to reconstruct the temporal succession of plankton communities in the past 18,500 years. Our results showed that seven classes and sixteen genera of phytoplankton in the lake underwent major temporal changes, in correlation with known climatic events. Trebouxiophyceae and Eustigmatophyceae were predominant during the cold periods, whereas Chlorophyceae, Phaeophyceae, Xanthophyceae, Bacillariophyceae, and Cyanophyceae were abundant during the warm periods. The inferred changes in temperature, nutrients, precipitation, and salinity, as driven by the Westerlies and summer Monsoon strength, likely contributed to these observed temporal changes. Based on these correlations, we propose the phytoplankton index as a proxy to reconstruct the stadial versus interstadial climate change history in Qinghai Lake. This taxon-specific index is free of terrestrial contamination, sensitive to short-term climatic oscillations, and continuous in recording all climatic events in the lake. The validity of this index and its applicability to other lakes is

demonstrated by its good correlations with multiple climate records of Qinghai Lake and another lake on the Tibetan Plateau, Kusai Lake.

(来源: Scientific Reports, 2016, 19769)

Magnetic microparticles as a new tool for lake restoration: A microcosm experiment for evaluating the impact on phosphorus fluxes and sedimentary phosphorus pools

Funes, A.; de Vicente, J.; Cruz-Pizarro, L.; et al.

In the last decades, magnetic particles (MPs) as adsorbents have gained special attention due to their high adsorption capacity and the possibility of recovering them by applying a magnetic separation gradient. For the first time MPs have been tested as P adsorbents in a microcosm experiment in a context of lake restoration. MPs were added to sediment cores from a hypertrophic lake, at Fe:Pmobile molar ratio of 285:1 and 560:1 under both, oxic and anoxic conditions. We have found that, under anoxic conditions (anoxic), MPs are able to reduce P release rate from the sediment to the overlying water and to reduce sedimentary Pmobile concentration (a 22-25% reduction within 0-4 cm depth compared to controls). Under oxic conditions, the addition of MPs do not affect P fluxes across the sediment and water interface since the lake sediment is naturally rich in iron oxides. However a measured reduction in sedimentary Pmobile concentration (12-16% reduction in 0-10 cm depth) contributes to a potential reduction in longterm P efflux.

(来源: WATER RESEARCH, 2016, 89:366-374)

Alkalinity regulation in calcium carbonate-buffered lakes

Mueller, Beat; Meyer, Joseph S.; Gaechter, Rene

Biogenic calcite precipitation is the removal of calcite (CaCO_3) from the epilimnion to the sediments of hard-water lakes during summer stratification, caused by increased pH during algal blooms and by nucleation of calcite crystals on surfaces of micro-algae. Although this phenomenon has been studied for decades, details of the underlying mechanisms are still debated. Using results of approximately 70,000 alkalinity measurements from 13 hard-water Swiss lakes (each with approximately 30 yr to 50 yr of monitoring), we demonstrate that (i) calcium carbonate-buffered lakes act as alkalinity sinks during summer stratification but act as CO_2 sources during and immediately after spring overturn; (ii) as the alkalinity concentration ($[\text{Alk}(\text{mix})]$) and the total phosphorus concentration ($[\text{TPmix}]$) at spring overturn increase, increasingly more alkalinity is lost from the epilimnion during summer stratification; (iii) $[\text{Alk}(\text{mix})]$ is determined by the lake's discharge-weighted average inflow concentration ($[\text{Alk}(\text{in})]$), flushing rate, mean depth and $[\text{TPmix}]$; and (iv) $[\text{Alk}(\text{in})]$ depends on the mineralogy and the land use affecting in-soil nitrification of ammonia and subsequent calcite dissolution in the catchment.

(来源: LIMNOLOGY AND OCEANOGRAPHY, 2016, 61(1):341-352)

Agriculture causes nitrate fertilization of remote alpine lakes

Hundey EJ, Russell SD, Longstaffe FJ; et al.

Humans have altered Earth's nitrogen cycle so dramatically that reactive nitrogen (Nr) has doubled. This

has increased Nr in aquatic ecosystems, which can lead to reduced water quality and ecosystem health. Apportioning sources of Nr to specific ecosystems, however, continues to be challenging, despite this knowledge being critical for mitigation and protection of water resources. Here we use $\Delta(17)\text{O}$, $\delta(18)\text{O}$ and $\delta(15)\text{N}$ from Uinta Mountain (Utah, USA) snow, inflow and lake nitrate in combination with a Bayesian-based stable isotope mixing model, to show that at least 70% of nitrates in aquatic systems are anthropogenic and arrive via the atmosphere. Moreover, agricultural activities, specifically nitrate- and ammonium-based fertilizer use, are contributing most (~60%) Nr , and data from other North American alpine lakes suggest this is a widespread phenomenon. Our findings offer a pathway towards more effective mitigation, but point to challenges in balancing food production with protection of important water resources.

(来源: Nature Communications, 2016, 7:10571)

Uniform carbon fluxes in shallow lakes in alternative stable states

Zimmer, Kyle D.; Hobbs, William O.; Domine, Leah M.; et al.

Shallow lakes process large amounts of carbon (C) via gross primary production (GPP) and respiration (R), but C fluxes are highly variable among lakes. We used a two-prong approach to determine whether C fluxes differed between two alternative stable states observed in shallow lakes. First, we used a replicated whole-lake experiment where we manipulated fish densities in four experimental lakes to induce shifts from the phytoplankton-dominated state (turbid state) to a submersed macrophyte-dominated state (clear state), and determined whether whole-lake GPP, R, and net aquatic production (NAP) changed in response to the manipulation. We also compared lake metabolism in the four experimental lakes to four lakes in a turbid state and four lakes in a clear state. Second, we used sediment cores from 68 shallow lakes to test whether modern burial rates of organic C differed between lakes in clear and turbid states. Biomanipulation in the experimental lakes reduced abundance of fish and phytoplankton and increased abundance of aquatic invertebrates and submerged macrophytes. However, there was no significant change in GPP, R, or NAP. Similarly, GPP, R, and NAP did not differ among experimental lakes, turbid-state lakes, or clear-state lakes. Lastly, organic C burial in sediments did not differ between lakes in clear vs. turbid states, though variability among sites was high. High light and nutrient availability facilitate rapid transitions between two alternative groups of competing, rapidly growing primary producers in shallow lakes. These characteristics facilitate relatively uniform C fluxes at the ecosystem scale despite substantial differences in community structure.

(来源: LIMNOLOGY AND OCEANOGRAPHY, 2016, 61(1): 330-340)

Large contribution to inland water CO_2 and CH_4 emissions from very small ponds

MA Holgerson, PA Raymond

Inland waters are an important component of the global carbon cycle. Although they contribute to greenhouse gas emissions, estimates of carbon processing in these waters are uncertain. The global extent of very small ponds, with surface areas of less than 0.001 km^2 , is particularly difficult to map, resulting in their exclusion from greenhouse gas budget estimates. Here we combine estimates of the lake and pond global size distribution, gas exchange rates, and measurements of carbon dioxide and

methane concentrations from 427 lakes and ponds ranging in surface area from 2.5 m² to 674 km². We estimate that non-running inland waters release 0.583 Pg C yr⁻¹. Very small ponds comprise 8.6% of lakes and ponds by area globally, but account for 15.1% of CO₂ emissions and 40.6% of diffusive CH₄ emissions. In terms of CO₂ equivalence, the ratio of CO₂ to CH₄ flux increases with surface area, from about 1.5 in very small ponds to about 19 in large lakes. The high fluxes from very small ponds probably result from shallow waters, high sediment and edge to water volume ratios, and frequent mixing. These attributes increase CO₂ and CH₄ supersaturation in the water and limit efficient methane oxidation. We conclude that very small ponds represent an important inland water carbon flux.

(来源: Nature Geoscience, 2016, 9, 222-226)

Climate-sensitive northern lakes and ponds are critical components of methane release

M Wik, RK Varner, KW Anthony; et al.

Lakes and ponds represent one of the largest natural sources of the greenhouse gas methane. By surface area, almost half of these waters are located in the boreal region and northwards. A synthesis of measurements of methane emissions from 733 lakes and ponds north of ~50° N, combined with new inventories of inland waters, reveals that emissions from these high latitudes amount to around 16.5 Tg CH₄ yr⁻¹ (12.4 Tg CH₄-C yr⁻¹). This estimate from lakes and ponds alone is equivalent to roughly two-thirds of the inverse model calculation of all natural methane sources in the region. Thermokarst water bodies have received attention for their high emission rates, but we find that post-glacial lakes are a larger regional source due to their larger areal extent. Water body depth, sediment type and ecoclimatic region are also important in explaining variation in methane fluxes. Depending on whether warming and permafrost thaw cause expansion or contraction of lake and pond areal coverage, we estimate that annual water body emissions will increase by 20-54% before the end of the century if ice-free seasons are extended by 20 days. We conclude that lakes and ponds are a dominant methane source at high northern latitudes.

(来源: Nature Geoscience, 2016, 9, 99-105)

A novel ammonia-oxidizing archaeon from wastewater treatment plant: Its enrichment, physiological and genomic characteristics

Yuyang Li, Kun Ding, Xianghua Wen; et al.

Ammonia-oxidizing archaea (AOA) are recently found to participate in the ammonia removal processes in wastewater treatment plants (WWTPs), similar to their bacterial counterparts. However, due to lack of cultivated AOA strains from WWTPs, their functions and contributions in these systems remain unclear. Here we report a novel AOA strain SAT1 enriched from activated sludge, with its physiological and genomic characteristics investigated. The maximal 16S rRNA gene similarity between SAT1 and other reported AOA strain is 96% (with “*Ca. Nitrosotenuis chungbukensis*”), and it is affiliated with Wastewater Cluster B (WWC-B) based on *amoA* gene phylogeny, a cluster within group I.1a and specific for activated sludge. Our strain is autotrophic, mesophilic (25 °C–33 °C) and neutrophilic (pH 5.0–7.0). Its genome size is 1.62 Mb, with a large fragment inversion (accounted for 68% genomic size) inside. The strain could not utilize urea due to truncation of the urea transporter gene. The lack of the pathways to synthesize usual

compatible solutes makes it intolerant to high salinity (>0.03%), but could adapt to low salinity (0.005%) environments. This adaptation, together with possibly enhanced cell-biofilm attachment ability, makes it suitable for WWTPs environment. We propose the name “*Candidatus Nitrosotenuis cloacae*” for the strain SAT1.

(来源: Scientific Reports, 2016, doi:10.1038/srep23747)

Spatial distribution and source apportionment of PFASs in surface sediments from five lake regions, China

Yanjie Qi, Shouliang Huo, Beidou Xi; et al.

Perfluoroalkyl substances (PFASs) have been found in environment globally. However, studies on PFAS occurrence in sediments of lakes or reservoirs remain relatively scarce. In this study, two hundred and sixty-two surface sediment samples were collected from forty-eight lakes and two reservoirs all over China. Average PFAS concentrations in surface sediments from each lake or reservoir varied from 0.086 ng/g dw to 5.79 ng/g dw with an average of 1.15 ng/g dw. Among five lake regions, average PFAS concentrations for the lakes from Eastern Plain Region were the highest. Perfluorooctanoic acid, perfluoroundecanoic acid and perfluorooctane sulfonic acid (PFOS) were the predominant PFASs in surface sediments. The significant positive correlations between PFAS concentrations and total organic carbon, total nitrogen and total phosphorus contents in sediments revealed the influences of sedimentary characteristics on PFAS occurrence. A two-dimensional hierarchical cluster analysis heat map was depicted to analyze the possible origins of sediments and individual PFAS. The food-packaging, textile, electroplating, firefighting and semiconductor industry emission sources and the precious metals and coating industry emission sources were identified as the main sources by two receptor models, with contributions of 77.7 and 22.3% to the total concentrations of C4-C14- perfluoroalkyl carboxylic acids and PFOS, respectively.

(来源: Scientific Reports, 2016, doi:10.1038/srep22674)

Polycyclic aromatic hydrocarbons (PAHs) and organochlorine pesticides (OCPs) in sediments from lakes along the middle-lower reaches of the Yangtze River and the Huaihe River of China

Zhao Zhonghua; Zhang, Lu; Wu, Jinglu

Organochlorine pesticides (OCPs) and polycyclic aromatic hydrocarbons (PAHs) are among the most concerning environmental pollutants due to their highly toxic, persistent and bioaccumulative properties. A total of 111 sediment samples were collected from shallow lakes along the middle-lower reaches of the Yangtze River and the Huaihe River in China for the determination of OCPs and PAHs. OCPs were detected in all of the sediment samples, with residual values ranging from 8.1 ng g⁻¹ dw to 202.9 ng g⁻¹ dw, and the residual values of PAHs ranged from 11.8 ng g⁻¹ dw to 231.9 ng g⁻¹ dw. Hexachlorocyclohexanes (HCHs) and dichlorodiphenyltrichloroethanes (DDTs) were the major components, accounting for 29.1%±18.7% and 21.1%±14.3% of the total OCPs and mostly originating from historical use. Similar compositions of PAHs were observed with 3-, 4-, and 5-ringed congeners as the major contributors accounting for 86.0%±10.0% of the identified PAHs. Diagnostic ratios of typical PAHs demonstrated mixed sources from petroleum/petrogenic and combustion

processes, which were responsible for the PAHs observed in surface sediments from the studied lakes. A sediment risk assessment based on sediment quality guidelines (SQGs) suggested that heptachlor epoxide, p,p'-DDD and lindane could be potential contaminants of greater ecotoxicological concern.

(来源: LIMNOLOGY AND OCEANOGRAPHY, 2016, 61(1):47-60)

Dynamic models of the complex microbial metapopulation of lake Mendota

Phuongan Dam, Luis L Fonseca, Konstantinos T Konstantinidis; et al.

Like many other environments, Lake Mendota, WI, USA, is populated by many thousand microbial species. Only about 1,000 of these constitute between 80 and 99% of the total microbial community, depending on the season, whereas the remaining species are rare. The functioning and resilience of the lake ecosystem depend on these microorganisms, and it is therefore important to understand their dynamics throughout the year. We propose a two-layered set of dynamic mathematical models that capture and interpret the yearly abundance patterns of the species within the metapopulation. The first layer analyzes the interactions between 14 subcommunities (SCs) that peak at different times of the year and together contain all species whereas the second layer focuses on interactions between individual species and SCs. Each SC contains species from numerous families, genera, and phyla in strikingly different abundances. The dynamic models quantify the importance of environmental factors in shaping the dynamics of the lake's metapopulation and reveal positive or negative interactions between species and SCs. Three environmental factors, namely temperature, ammonia/phosphorus, and nitrate+nitrite, positively affect almost all SCs, whereas by far the most interactions between SCs are inhibitory. As far as the interactions can be independently validated, they are supported by literature information. The models are quite robust and permit predictions of species abundances over many years both, under the assumption that conditions do not change drastically, or in response to environmental perturbations.

(来源: npj Systems Biology and Applications, 2016, doi:10.1038/npjsba.2016.7)

Shifts in diversity and function of lake bacterial communities upon glacier retreat

Peter H, Sommaruga R

Global climate change is causing a wastage of glaciers and threatening biodiversity in glacier-fed ecosystems. The high turbidity typically found in those ecosystems, which is caused by inorganic particles and result of the erosive activity of glaciers is a key environmental factor influencing temperature and light availability, as well as other factors in the water column. Once these lakes loose hydrological connectivity to glaciers and turn clear, the accompanying environmental changes could represent a potential bottleneck for the established local diversity with yet unknown functional consequences. Here, we study three lakes situated along a turbidity gradient as well as one clear unconnected lake and evaluate seasonal changes in their bacterial community composition and diversity. Further, we assess potential consequences for community functioning. Glacier runoff represented a diverse source community for the lakes and several taxa were able to colonize downstream turbid habitats, although they were not found in the clear lake. Operational taxonomic unit-based alpha diversity and phylogenetic diversity decreased along the turbidity gradient, but metabolic functional diversity was

negatively related to turbidity. No evidence for multifunctional redundancy, which may allow communities to maintain functioning upon alterations in diversity, was found. Our study gives a first view on how glacier-fed lake bacterial communities are affected by the melting of glaciers and indicates that diversity and community composition significantly change when hydrological connectivity to the glacier is lost and lakes turn clear.

(来源: The ISME Journal, 2016, doi:10.1038/ismej.2015.245)

Single-cell activity of freshwater aerobic anoxygenic phototrophic bacteria and their contribution to biomass production

MC Garcia-Chaves, MT Cottrell, DL Kirchman

Aerobic anoxygenic phototrophic (AAP) bacteria are photoheterotrophs that despite their low abundances have been hypothesized to play an ecologically and biogeochemically important role in aquatic systems. Characterizing this role requires a better understanding of the in situ dynamics and activity of AAP bacteria. Here we provide the first assessment of the single-cell activity of freshwater AAP bacteria and their contribution to total bacterial production across lakes spanning a wide trophic gradient, and explore the role of light in regulating AAP activity. The proportion of cells that were active in leucine incorporation and the level of activity per cell were consistently higher for AAP than for bulk bacteria across lakes. As a result, AAP bacteria contributed disproportionately more to total bacterial production than to total bacterial abundance. Interestingly, although environmentally driven patterns in activity did not seem to differ largely between AAP and bulk bacteria, their response to light did, and exposure to light resulted in increases in the proportion of active AAP bacteria with no clear effect on their cell-specific activity. This suggests that light may play a role in the activation of AAP bacteria, enabling these photoheterotrophs to contribute more to the carbon cycle than suggested by their abundance.

(来源: The ISME Journal, 2016, doi:10.1038/ismej.2015.242)

Extracellular microcystin prediction based on toxigenic *Microcystis* detection in a eutrophic lake

Xin Dong, Siyu Zeng, Fei Bai; et al.

Existing models for predicting microcystin concentration in water body generally use chlorophyll or cyanobacteria concentration as input variables, although microcystins only originate from toxigenic strains of a few species. Moreover, the nonconcurrency between harmful algal growth and toxin release has yet to be quantified. Therefore, this study explored a new prediction method that considers these toxin production mechanisms for the eutrophic Yangcheng Lake, a large-scale drinking water source in China. The Lake was monitored weekly at six sampling sites from July to October in 2012, including the detection of toxigenic *Microcystis* (expressed as *mcyA* copy number) by qPCR. Compared with chlorophyll a, cyanobacteria, and total *Microcystis* abundance, toxigenic *Microcystis* concentration was more significant in predicting extracellular microcystin. Site-specific nonlinear regression models that link *mcyA* to microcystins were established. Parameters for toxin release delay (i.e., one or two weeks) were embedded in these models. Further analysis ascribed the different release timescale to $\text{NH}_3\text{-N}:\text{TN}$ and $\text{TN}:\text{TP}$ ratios of approximately 0.015 and 9.2, respectively, which may decrease the delay in microcystin release. Model applications in determining *mcyA* monitoring frequency and its warning thresholds were

discussed.

(来源: Scientific Reports, 2016, doi:10.1038/srep20886)

Dominance of invasive mollusks in the benthos of Lake Marion, a large impoundment in South Carolina, USA

Taylor, Barbara E.; Bulak, James S.; Morrison, John

The benthos in the main basin of Lake Marion, a 330-km² impoundment on the Santee River in the Coastal Plain of South Carolina, was dominated by mollusks, including the Asiatic clam *Corbicula* sp. and the olive mystery snail *Viviparus subpurpureus*, and insects, including the burrowing mayfly *Hexagenia limbata* and dipterans. *Corbicula* sp. appeared in Lake Marion about forty years ago; *V. subpurpureus*, a native transplant from Gulf Coast drainages, about a dozen years ago. Benthic sediments were mainly silt; abundances of benthic invertebrates varied with water depth, but not with sediment attributes. Dry biomass, excluding shell, of benthic invertebrates ranged from 80-82 g m⁻² in the upper main basin to 37 g m⁻² in the middle main basin and 12 g m⁻² in the lower main basin. *Corbicula* sp. contributed 60-80 % of the total biomass; insects, <10 %. Mollusks do not appear to be heavily consumed by pelagic fish in Lake Marion. To the extent that the mollusks sequester resources that might otherwise support prey such as benthic insects or zooplankton, they may effectively reduce productivity of the fisheries. However, excess consumption of pelagic resources by the mollusks, particularly *Corbicula* sp., may subsidize other benthic consumers such as *H. limbata*, and nutrients released from digested pelagic material may promote benthic algal production.

(来源: FUNDAMENTAL AND APPLIED LIMNOLOGY, 2016, 187(3):247-261)

Invasive floating macrophytes reduce greenhouse gas emissions from a small tropical lake

K. Attermeyer, S. Flury, R. Jayakumar; et al.

Floating macrophytes, including water hyacinth (*Eichhornia crassipes*), are dominant invasive organisms in tropical aquatic systems, and they may play an important role in modifying the gas exchange between water and the atmosphere. However, these systems are underrepresented in global datasets of greenhouse gas (GHG) emissions. This study investigated the carbon (C) turnover and GHG emissions from a small (0.6 km²) water-harvesting lake in South India and analysed the effect of floating macrophytes on these emissions. We measured carbon dioxide (CO₂) and methane (CH₄) emissions with gas chambers in the field as well as water C mineralization rates and physicochemical variables in both the open water and in water within stands of water hyacinths. The CO₂ and CH₄ emissions from areas covered by water hyacinths were reduced by 57% compared with that of open water. However, the C mineralization rates were not significantly different in the water between the two areas. We conclude that the increased invasion of water hyacinths and other floating macrophytes has the potential to change GHG emissions, a process that might be relevant in regional C budgets.

(来源: Scientific Reports, 2016, doi:10.1038/srep20424)

Macrophyte landscape modulates lake ecosystem-level nitrogen losses through tightly coupled plant-microbe interactions

Vila-Costa, Maria; Pulido, Cristina; Chappuis, Eglantine; et al.

Root functional diversity of submerged vegetation exerts a major effect on nitrogen (N) cycling in lake sediments. This fact, however, is neglected in current N-balance models because the links between the engineering role of plants and in situ microbial N cycling are poorly understood. We hypothesized that macrophyte species with high root oxygen loss (ROL) capacity promote the highest denitrification because of a higher abundance of ammonia oxidizers and tighter coupling between nitrifiers and denitrifier communities. We sampled five small ultraoligotrophic shallow lakes with abundant macrophyte cover including sediments dominated either by *Isoetes* spp. (high ROL), mixed communities of natopotamids (low ROL), and unvegetated sandy sediments. At each site, we quantified denitrification (DNT) rates and proxies for the abundance of denitrifiers (*nirS* and *nirK* genes), and both ammonia oxidizing archaea (AOA) and ammonia oxidizing bacteria (AOB) and the diversity of *nirS*-harboring bacteria. Vegetated sediments showed significantly higher abundances of N-cycling genes than bare sediments. Plant communities dominated by *Isoetes* generated sediments with higher redox and NO₃-concentrations and significantly higher DNT rates than natopotamids-dominated landscapes. Accordingly, increasing DNT rates were observed along the gradient from low ROL plants-bare sediments-high ROL plants. Significantly higher abundance of the archaeal *amoA* gene was recorded in sediments colonized by high ROL plants unveiling a key biogeochemical role for AOA in coupling macrophyte landscape and ecosystem denitrification.

(来源: LIMNOLOGY AND OCEANOGRAPHY, 2016, 61(1): 78-88)

Photoadaptation to the polar night by phytoplankton in a permanently ice-covered Antarctic lake

Morgan-Kiss, R. M.; Lizotte, M. P.; Kong, W.; et al.

Photosynthetic microorganisms are a primary source of new organic carbon production in polar ecosystems. Despite their importance, relatively little is known about how they adapt to the bimodal solar cycles that exist at high latitudes. To understand how phytoplankton adapt to the extreme seasonal change in photoperiod, we transplanted cultures of a well-studied laboratory model for photosynthetic cold adaptation, *Chlamydomonas raudensis* UWO241, back to the water column of Lake Bonney (McMurdo Dry Valleys, Antarctica) at the depth from which it was originally cultured. The organism was suspended at this depth in dialysis tubing to allow the microalga to respond to the in situ light, temperature and dissolved ions. We then integrated in situ biological and chemical measurements with environmental molecular analyses and compared the responses of transplanted *C. raudensis* cultures with the natural phytoplankton community over the 6-week transition from Antarctic summer (24-h daylight) to polar night (24-h darkness). As solar radiation declined, natural communities exhibited a cessation of inorganic carbon fixation which was accompanied by a downregulation of expression of genes encoding for essential carbon fixation and photochemistry proteins. Transplanted *C. raudensis* cultures matched natural community trends in the regulation of photochemistry and carbon fixation gene expression, and shifted photochemical function to a shade adapted state in response to the polar night transition. We present a conceptual model for seasonal shifts in microbial community energy and carbon acquisition which integrates past cultivation-based studies in this model photopsychrophile with a body of

recent work on adaptation of natural populations to polar night.

(来源: LIMNOLOGY AND OCEANOGRAPHY, 2016, 61(1): 3-13)

Advancing two-component partitioning of light scattering in Cayuga Lake, New York

Peng, Feng; Effler, Steven W

The particulate scattering and backscattering coefficients ($b(p)$ and $b(bp)$) were partitioned into the additive contributions of minerogenic ($b(m)$ and $b(b,m)$) and organic ($b(o)$ and $b(b,o)$) components for nearshore and pelagic areas of Cayuga Lake, New York, over a 7 month period in 2013. The analysis was based on paired measurements of (1) bulk $b(p)$ and $b(bp)$, (2) light-scattering properties of mineral particles, with an individual particle analysis (IPA) technique, and (3) concentrations of chlorophyll *a* ([Chl]) and particulate organic carbon (POC), as two indices to quantify organic particle scattering. $b(m)$ and $b(b,m)$ were estimated through Mie theory calculations with IPA results as inputs. $b(o)$ and $b(b,o)$ were estimated with both system-specific and oceanic bio-optical models parameterized on [Chl] or POC. POC performed better than [Chl] as the index for both $b(o)$ and $b(b,o)$. The averages of the ratios $(b(m)+b(o)):b(p)$ and $(b(b,m)+b(b,o)):b(bp)$ at 660 nm, were 1.02 and 1.03, respectively; the average relative errors were 18.2% and 15.6%. Multiple empirical bio-optical models developed for Case 1 oceanic waters (for $b(o)$ and $b(b,o)$ estimates) approached the closure performance of the system-specific relationships. In addition to systematically accounting for more $b(bp)$ than $b(p)$, terrigenous minerogenic particles made greater contributions to both $b(p)$ and $b(bp)$ in the nearshore area proximate to tributary inputs than in pelagic waters. A strong positive dependency of the backscattering ratio ($b(bp) : b(p)$) on the $b(m) : b(p)$ ratio was observed for both nearshore and pelagic areas.

(来源: LIMNOLOGY AND OCEANOGRAPHY, 2016, 61(1): 298-315)

Iron and iron-binding ligands as cofactors that limit cyanobacterial biomass across a lake trophic gradient

Sorichetti, Ryan J.; Creed, Irena F.; Trick, Charles G

1. The frequency and intensity of cyanobacterial blooms (cyanoblooms) is increasing globally. While cyanoblooms in eutrophic (nutrient-rich) freshwater lakes are expected to persist and worsen with climate change projections, many of the 'new' cyanobloom reports pertain to oligotrophic (nutrient-poor) freshwater lakes with no prior history of cyanobloom occurrence.
2. Iron (Fe) is required in nearly all pathways of cyanobacterial macronutrient use, although its precise role in regulating cyanobacterial biomass across a lake trophic gradient is not fully understood.
3. In all lakes sampled representing a gradient in trophic status from oligotrophic to hypereutrophic (2.2-561.2 $\mu\text{g L}^{-1}$ total phosphorus), the relative cyanobacterial biomass was highest at low predicted Fe bioavailability in eutrophic Alberta lakes ($<1.0 \times 10^{-22} \text{ mol L}^{-1}$) and low Fe concentration in oligotrophic Ontario Lakes ($<3.2 \mu\text{g L}^{-1}$).
4. Fe-binding organic ligands were measured within this range of low bioavailable Fe. Concentrations of ligands with reactive hydroxamate moieties were positively correlated to cyanobacterial biomass in lakes

with low Fe bioavailability and supply, suggesting a possible cellular origin (i.e. siderophores) mediated by low Fe.

5. These findings suggest that Fe serves as a possible cofactor that maintains cyanobacterial biomass across a lake trophic gradient and that cyanobacteria invoke a similar Fe-scavenging system to overcome Fe limitation in lakes of all trophic states.

(来源: FRESHWATER BIOLOGY, 2016, 61(1):146-157)

Interactions between hydrology and water chemistry shape bacterioplankton biogeography across boreal freshwater networks

JP Niño-García, C Ruiz-González, PA Del Giorgio

Disentangling the mechanisms shaping bacterioplankton communities across freshwater ecosystems requires considering a hydrologic dimension that can influence both dispersal and local sorting, but how the environment and hydrology interact to shape the biogeography of freshwater bacterioplankton over large spatial scales remains unexplored. Using Illumina sequencing of the 16S ribosomal RNA gene, we investigate the large-scale spatial patterns of bacterioplankton across 386 freshwater systems from seven distinct regions in boreal Québec. We show that both hydrology and local water chemistry (mostly pH) interact to shape a sequential structuring of communities from highly diverse assemblages in headwater streams toward larger rivers and lakes dominated by fewer taxa. Increases in water residence time along the hydrologic continuum were accompanied by major losses of bacterial richness and by an increased differentiation of communities driven by local conditions (pH and other related variables). This suggests that hydrology and network position modulate the relative role of environmental sorting and mass effects on community assembly by determining both the time frame for bacterial growth and the composition of the immigrant pool. The apparent low dispersal limitation (that is, the lack of influence of geographic distance on the spatial patterns observed at the taxonomic resolution used) suggests that these boreal bacterioplankton communities derive from a shared bacterial pool that enters the networks through the smallest streams, largely dominated by mass effects, and that is increasingly subjected to local sorting of species during transit along the hydrologic continuum.

(来源: The ISME Journal, 2016, doi:10.1038/ismej.2015.226)

Regular build-up of the spring phytoplankton maximum before ice-break in a boreal lake

Salmi, Pauliina; Salonen, Kalevi

The development of phytoplankton biomass and composition in a eutrophic boreal lake was studied during the evolution of under-ice convection in spring. The results from 8 yr showed that, within a few weeks before ice-break, phytoplankton biomass regularly increased by up to two or three orders of magnitude, reaching or exceeding the biomass in summer. Accordingly, this may be the most significant single annual phytoplankton episode in the lake. The development of phytoplankton was closely coupled with that of convection created by solar radiation at water temperatures <4 degrees C. In addition to vertical convection which keeps phytoplankton suspended, there was also horizontal convection which transported water with likely higher abundance of phytoplankton from the shallow lake margins. The

effect of mechanical mixing, which was meant to prevent anoxia in the deep water layers of the study basin, was overridden by natural convection. Stochastic variations in weather played a key role controlling light penetration into the lake and hence the abundance and composition of under-ice phytoplankton. After snow melt the proportion of motile algae was at first higher, sometimes with a maximum nearest to the ice, but later diatoms flourished throughout the convection layer. Only in the years of the shortest convection period did the proportion of motile algae remain high until the end of ice cover. More detailed information about the interaction between littoral and pelagial water masses under different mixing regimes is needed for a more profound understanding of the development of phytoplankton under-ice.

(来源: LIMNOLOGY AND OCEANOGRAPHY, 2016, 61(1): 240-253)

Accounting for littoral primary production by periphyton shifts a highly humic boreal lake towards net autotrophy

Vesterinen, Jussi; Devlin, Shawn P.; Syvaranta, Jari; et al.

The prevailing view that many humic lakes are net heterotrophic is commonly based on pelagic measurements alone. Poor light conditions in humic lakes are assumed to constrain littoral primary production (PP), such that the littoral zone has been considered an insignificant contributor to whole-lake PP. However, that assumption is based on models and inferences from pelagic processes which do not take littoral zone structure into account. Many lakes have an extensive ring of aquatic vegetation lying near the water surface, which provides substratum for epiphytic algae under well-illuminated conditions. We measured both pelagic and littoral PP and community respiration (CR) in Mekkojärvi, a small, highly humic headwater lake, in southern Finland throughout the open water season in 2012. We used a C-14 incorporation technique to measure pelagic PP, while littoral PP was determined using changes in dissolved inorganic carbon concentrations during insitu incubations. We then estimated whole-lake PP and CR for both the littoral and pelagic zones. We found that littoral PP usually dominated whole-lake PP, contributing >90% to total PP in summer. A mean pelagic production to respiration ratio (GPP:CR) of 0.4 clearly indicated strong net heterotrophy, but a value of 2.2 for the littoral zone indicated strong autotrophy. For both habitats combined, the mean whole lake GPP:CR was 1.6, indicating net autotrophy. We suggest that littoral PP can contribute significantly to whole-lake PP even in highly humic lakes, and that the littoral contribution can shift some lakes which have been considered net heterotrophic to metabolic balance or even net autotrophy during the ice-free period. Small humic lakes like Mekkojärvi with rings of littoral vegetation are widespread, especially in the boreal zone, and at least for similar lakes, evaluating lake metabolism from pelagic measurements alone is likely to be misleading.

(来源: FRESHWATER BIOLOGY, 2016, 61(3):265-276)

Water-level fluctuations affect sediment properties, carbon flux and growth of the isoetid *Littorella uniflora* in oligotrophic lakes

Baastrup-Spohr, Lars; Moller, Claus L.; Sand-Jensen, Kaj

Amphibious isoetids such as *Littorella uniflora* dominate the littoral zone in north-temperate oligotrophic, softwater lakes. Accumulation of labile organic matter in the sediments from eutrophication represents a threat to isoetids because of insufficient root oxygenation, reduced anchorage and enhanced growth of

taller competitors. These threats might be alleviated by fluctuating water levels potentially increasing sediment mineralisation and plant growth. We hypothesised that *L. uniflora* would produce higher areal biomass when sediments are drained because air exposure assists oxygenation, mineralisation and consolidation of sediments. If so, changing water level offers a possible restoration measure. We tested this hypothesis by measuring sediment metabolism and plant performance under drained, fluctuating and submerged conditions in the laboratory and along an elevation gradient in the field in natural and organically enriched sandy sediments. Laboratory and field experiments confirmed that *L. uniflora* grew in biomass under all conditions and maintained high leaf chlorophyll and photosynthesis. Increase in plant biomass was highest under drained conditions, particularly for roots probably in response to higher sediment oxygenation and leaf transpiration. The increase in biomass was lowest under fluctuating conditions as a logical consequence of higher costs of frequent shifts between aerial and aquatic growth forms. In the laboratory experiment, mineralisation of sediment organic matter was 5.5-fold higher under drained compared to submerged conditions in un-vegetated sediments measured as release of CO_2 . Fluctuating conditions led to an intermediary release of CO_2 . In vegetated sediments, part of the CO_2 released from mineralisation was incorporated into plant biomass, and taking this into account yielded twofold increase in mineralisation rate from submerged and fluctuating to drained conditions. During the field experiment, a substantial part of the added organic matter was mineralised particularly in the dry part of the gradient. The proportion of reduced Fe^{2+} to total Fe as a measure of oxygenation of sediments declined from submerged to fluctuating and permanently drained sediments. The proportion of reduced Fe^{2+} was lower in plant covered than bare sediments reflecting root release of O^{2-} . Drainage and air contact increased sediment density and thus potentially the root anchorage compared to submerged conditions. Periodic drainage and air exposure of isoetid beds is a natural phenomenon in oligotrophic lakes causing beneficial sediment conditions for isoetids and positively affect the growth of *L. uniflora*. Reinstating water-level fluctuations in regulated lakes or periodically lowering water levels could be used as a restoration measure.

(来源: FRESHWATER BIOLOGY, 2016, 61(3): 301-315)

太湖蓝藻水华“暴发”的动态特征及其机制

秦伯强; 杨桂军; 马健荣; 等

湖泊富营养化和有害藻类水华是目前全世界普遍面临的水域生态环境问题。太湖是典型的大型浅水富营养化湖泊, 其富营养化导致的蓝藻水华“暴发”常常呈现时间和空间上的高度变异与不稳定性。以往的研究, 无论是国际上流行的光合作用调节的藻类细胞上浮与下沉, 还是国内流行的蓝藻水华“暴发”四阶段理论, 都无法很好地解释太湖蓝藻水华“暴发”的时空动态变化特性。本文基于对太湖多次的野外观测与模拟实验, 提出了关于太湖蓝藻水华“暴发”的全新概念性解释。在蓝藻细胞生长阶段, 营养盐、温度、光照等环境因素影响较为显著, 决定了蓝藻生物量的多少, 为蓝藻水华“暴发”蓄积物质基础; 在蓝藻水华暴发阶段, 则主要受蓝藻细胞(团)浮力作用与水动力湍流作用的共同影响, 决定了蓝藻水华出现后的规模、范围及位置。野外调查显示, 在太湖这样的大型浅水湖泊, 风浪作用条件下蓝藻细胞(团)在水柱中呈均匀分布; 而当风浪消失后, 蓝藻细胞(团)即迅速上浮形成水体表面可

见的水华。蓝藻颗粒的上浮速度随着细胞团的增大而加快,适度的扰动促使蓝藻细胞团碰撞而形成更大的细胞团,更容易在水动力消失后快速上浮形成水华。湖流的辐合辐散是蓝藻水华上浮后形成可见的斑块形状、位置、漂移和聚集的决定因素。正是太湖地区风场高度多变与不稳定,才导致太湖蓝藻水华“暴发”的时空分布呈现多变的动态特征。上述研究结果澄清了长期以来一直困扰人们的太湖蓝藻水华难以监测、无法防控的问题,为蓝藻水华监测、预测预警、防控及应对措施的制定提供了科学的理论依据。

(来源: 科学通报, 2016, 61(7): 759-770)

Glacial lake drainage in Patagonia (13-8 kyr) and response of the adjacent Pacific Ocean

Neil F. Glasser, Krister N. Jansson, Geoffrey A. T. Duller, et al.

Large freshwater lakes formed in North America and Europe during deglaciation following the Last Glacial Maximum. Rapid drainage of these lakes into the Oceans resulted in abrupt perturbations in climate, including the Younger Dryas and 8.2 kyr cooling events. In the mid-latitudes of the Southern Hemisphere major glacial lakes also formed and drained during deglaciation but little is known about the magnitude, organization and timing of these drainage events and their effect on regional climate. We use 16 new single-grain optically stimulated luminescence (OSL) dates to define three stages of rapid glacial lake drainage in the Lago General Carrera/Lago Buenos Aires and Lago Cochrane/Pueyrredón basins of Patagonia and provide the first assessment of the effects of lake drainage on the Pacific Ocean. Lake drainage occurred between 13 and 8 kyr ago and was initially gradual eastward into the Atlantic, then subsequently reorganized westward into the Pacific as new drainage routes opened up during Patagonian Ice Sheet deglaciation. Coupled ocean-atmosphere model experiments using HadCM3 with an imposed freshwater surface “hosing” to simulate glacial lake drainage suggest that a negative salinity anomaly was advected south around Cape Horn, resulting in brief but significant impacts on coastal ocean vertical mixing and regional climate.

(来源: Scientific Reports, 2016, doi:10.1038/srep21064)

Water-level fluctuations regulate the structure and functioning of natural lakes

Evtimova, Vesela V.; Donohue, Ian

1. Despite becoming one of the main pressures on aquatic ecosystems globally, understanding of the ecological impacts of altered water-level regimes in lakes lags far behind that of other human disturbances (e.g. eutrophication, acidification).
2. We employed a multifaceted approach to explore the potential importance of water-level fluctuations (WLF) for the structure and functioning of littoral zones and multiple trait responses of primary producers and benthic consumers across a range of natural lakes.
3. We found that lakes with high WLF had significantly more coarse littoral substrata with less coverage

of macrophyte vegetation in the shallows than in lakes with low WLF. Lakes with high WLF also had greater proportions of motile diatom species and omnivorous benthic invertebrates in shallow waters, altered taxonomic and trophic structure of benthic consumers and more homogeneous algal and benthic invertebrate assemblages.

4. Variation along the littoral depth gradient needs to be examined when assessing the impacts of hydrological pressures in lakes. We found that depth interacted with WLF in its effects on habitat structure and mediated the response of both producer and consumer benthic assemblages to WLF.

5. Our results indicate that amplified WLF significantly affect both the structure and functioning of lake ecosystems. Given the growing importance of WLF as an increasingly pervasive pressure on lake ecosystems worldwide, our findings have important implications for the conservation and management of global aquatic biodiversity. Inclusion of both biological traits and sampling along a depth gradient in existing and in future monitoring programmes could improve significantly the ability to detect and predict effects of altered patterns of WLF on lake ecosystems.

(来源: FRESHWATER BIOLOGY, 2016, 61(2): 251-264)

Different roles of three emergent macrophytes in promoting sedimentation in Dongting Lake, China

Li, Feng; Pan, Ying; Xie, Yonghong; et al.

Aquatic macrophytes play an important role in promoting sediment deposition. However, compared to submerged macrophytes, the influence of emergent macrophytes on sedimentation dynamics have been studied less often. In this study, a field experiment was conducted to compare the influence of three typical emergent macrophytes (*Miscanthus sacchariflorus*, *Carex brevicuspis*, and *Phalaris arundinacea*) on sedimentation characteristics in Dongting Lake. In addition, the factors that determine sediment characteristics were also investigated. Both vegetation type and vegetation removal treatments had significant effects on sedimentation depth. Compared to the non-vegetated treatment, sedimentation depths were much greater in the vegetated treatments in all three communities. The order of sediment-trapping ability, from highest to lowest was *P. arundinacea* > *M. sacchariflorus* > *C. brevicuspis*; sedimentation rate was much higher in the *P. arundinacea* community than that in the other two communities, especially in the Tuanzhou and Chapanzhou lakeshores. In the vegetated treatment, clay and fine sand contents were significantly influenced by both vegetation type and vegetation removal treatment, whereas fine silt, coarse silt, and coarse sand contents were significantly affected only by vegetation type. Sand content was higher, but clay and silt contents were lower in the *M. sacchariflorus* community compared to the other two communities. Median particle size in the *M. sacchariflorus* community was much higher than that in the other two communities in both non-vegetated and vegetated treatments. Organic matter content, total N, and sediment pH were influenced by vegetation type alone. Sediment in the *M. sacchariflorus* community had a lower pH but higher organic matter and total N content compared to the other two communities. Multiple linear regression indicated that sediment characteristics were significantly correlated with vegetation characteristics (e.g. plant density, height, and biomass), elevation, and flooding time. The data indicate that the roles of these three emergent macrophytes in promoting sedimentation vary significantly, which is mainly due to their different structural properties and distribution patterns. Our results provide experimental information on the role of emergent

macrophytes in promoting sedimentation and may assist in the effective management of Dongting Lake.

(来源: AQUATIC SCIENCES, 2016, 78(1): 159-169)

Experimental assessment of a possible microbial priming effect in a humic boreal lake

Dorado-Garcia, Irene; Syvaranta, Jari; Devlin, Shawn P.; et al.

Global change models normally do not include interaction effects between different pools of recalcitrant humic organic carbon which can alter carbon cycling via their influence on biological activities. This issue is especially important in northern regions where lakes receive high inputs of allochthonous dissolved organic carbon (DOC) from the extensive surrounding peatlands. We investigated the threshold of added labile DOC necessary to promote a priming effect (PE); i.e. stimulation of bacterial metabolism with a subsequent increase in the mineralization of recalcitrant DOC and the accompanying changes in microbial community structure and function. Our study was carried out in a small highly humic lake (Mekkojarvi, southern Finland), physically divided by a plastic curtain into two experimental basins, one where fish were present (+FISH) and one that was fishless (-FISH). In each basin, we performed a factorial mesocosm experiment in which different amounts of labile DOC were supplied as cane sugar (control +6, +9, +12 mg C L⁻¹). Our results showed no priming effect in any carbon treatment, either in +FISH or in -FISH basins, despite a decreasing trend in total DOC concentration. Bacterial abundance and production did not increase as a response to carbon additions, while mixotrophic algae increased their abundance over time. In our experiments, the organisms that benefitted most after addition of labile DOC were mixotrophic algae, which can transform carbon into biomass by obtaining inorganic nutrients through phagotrophy. This appears most likely due to strong bacterial N limitation and dependence on resource availability and stoichiometry.

(来源: AQUATIC SCIENCES, 2016, 78(1):191-202)

Watershed-scale evaluation of the Water Erosion Prediction Project (WEPP) model in the Lake Tahoe basin

Brooks, Erin S.; Dobre, Mariana; Elliot, William J.; et al.

Forest managers need methods to evaluate the impacts of management at the watershed scale. The Water Erosion Prediction Project (WEPP) has the ability to model disturbed forested hillslopes, but has difficulty addressing some of the critical processes that are important at a watershed scale, including baseflow and water yield. In order to apply WEPP to forested watersheds, we developed and assessed new approaches for simulating streamflow and sediment transport from large watersheds using WEPP. We created specific algorithms to spatially distribute soil, climate, and management input files for all the subwatersheds within the basin. The model enhancements were tested on five geologically and climatically diverse watersheds in the Lake Tahoe basin, USA. The model was run with minimal calibration to assess WEPP's ability as a physically-based model to predict streamflow and sediment delivery. The performance of the model was examined against 17 years of observed snow water equivalent depth, stream flow, and sediment load data. Only region-wide baseflow recession parameters related to the geology of the basin were calibrated with observed streamflow data. Close agreement between simulated and observed snow water equivalent, streamflow, and the distribution of fine (<20 µm)

and coarse ($>20\ \mu\text{m}$) sediments was achieved at each of the major watersheds located in the high-precipitation regions of the basin. Sediment load was adequately simulated in the drier watersheds; however, annual streamflow was overestimated. With the exception of the drier eastern region, the model demonstrated no loss in accuracy when applied without calibration to multiple watersheds across Lake Tahoe basin demonstrating the utility of the model as a management tool in gauged and ungauged basins.

(来源: JOURNAL OF HYDROLOGY, 2016, 533: 389-402)

A hydroclimate-proxy model based on sedimentary facies in an annually laminated sequence from Lake Ohau, South Island, New Zealand

Roop, Heidi A.; Levy, Richard; Dunbar, Gavin B.; et al.

Annually laminated sediments collected from Lake Ohau, New Zealand offer an opportunity to generate a high-resolution paleoclimate record for the Southern Hemisphere mid-latitudes. Correlation between regional precipitation and synoptic climate indices like the Southern Annular Mode, paired with a correlation between Ohau catchment precipitation, lake inflow and suspended sediment yield suggest that the Lake Ohau varves are a potentially powerful tool for estimating the amplitude, timing and interdependence of different climate modes operating in the Southern Hemisphere mid-latitudes over time. A robust chronology and sound climate-proxy model are fundamental requirements for all high-resolution paleoenvironmental records. Here we present a chronology derived from layer counts, and Cs-137 and Pb-210 ages for the top 60 cm of sediments from the distal basin of Lake Ohau that confirm the varved nature of the sedimentary sequence. Sedimentary facies of different varve motifs are used to develop a hydroclimate-proxy model which links stratigraphy to seasonal hydrology. To establish this relationship we use a model accuracy statistic, which shows a quantitative difference between the annual hydrographs associated with each of three primary varve motifs. Distribution of above average inflow events points to summer and autumn hydrologic regimes as the primary control on the deposition of different motifs. This relationship between varve characteristics and hydrology will serve as a tool to reconstruct lake inflow, and by extension precipitation, on an annual basis throughout the late-Holocene for the South Island of New Zealand.

(来源: JOURNAL OF PALEOLIMNOLOGY, 2016, 55(1):1-16)

Spits formed in Glacial Lake Algonquin indicate strong easterly winds over the Laurentian Great Lakes during late Pleistocene

Schaetzl, Randall J.; Krist, Frank J., Jr.; Lewis, C. F. Michael; et al.

We report on a unique, new dataset: 49 spits that formed in the various phases of Glacial Lake Algonquin in the northern Great Lakes region, between approximately 13,200 and 11,500 years BP. The spits, which are now subaerially exposed well above the level of the current Great Lakes, trail off from former Lake Algonquin islands and headlands. Several exceed 10 km in length. Steep, eroded headlands coupled with their coarse-textured sediments, suggest that spit development was driven by large waves and strong longshore currents. The lake's islands and exposed headlands are usually strongly eroded on their eastern margins. Additionally, spits within a parts per thousand 150-200 km of the former ice margin,

and especially the very large spits in northern Michigan, trail to the west, particularly the WNW and SW. Some small spits that lie farther south trail to the east, and others, within confined bays, better reflect the localized littoral circulation systems. Together, these features provide on-the-ground evidence for persistent, easterly, summertime winds in the late Pleistocene in the northern Great Lakes region, supporting paleoclimate models that show southeasterly to easterly air flows, originating from a glacial anticyclone above the Laurentide Ice Sheet. Our research suggests that strong, anticyclonically driven, easterly winds were a key part of the regional circulation within a parts per thousand 150-200 km of the southern ice margin, while acknowledging that winds may have been more dominantly westerly at locations farther south. The latter conclusion reconciles with the record of loess transport and dune formation on westerly winds during this (and earlier) time periods in the south-central Great Lakes region and the Great Plains of North America.

(来源: JOURNAL OF PALEOLIMNOLOGY, 2016, 55(1):49-65)

Climate and human land-use as a driver of Lake Narlay (Eastern France, Jura Mountains) evolution over the last 1200 years: implication for methane cycle

Belle, Simon; Verneaux, Valerie; Millet, Laurent; et al.

This study aims at reconstructing the limnological conditions of Lake Narlay, a lake of which a previous study has shown major changes in the trophic reliance on methane of the benthic food web. The evolution of environmental and limnological conditions in and around Lake Narlay is reconstructed using combined analyses of subfossil chironomid remains, sedimentary pigments and organic carbon accumulation rates; whereas potential driving factors are reconstructed by pollen and coprophilous analyses and the use of climate paleo-records. The results suggest a complex combination of climate and anthropogenic pressure to explain the 1200 years of ecological trajectory of Lake Narlay. This ecological trajectory seems to be firstly control by climatic variability, because the colder event of the Little Ice Age induces a significant impact on chironomid assemblage, organic matter influx, and lake productivity. In a more recent time, the anthropogenic control seems to become predominant. The intensification of the agro-pastoral practices in the catchment area of Lake Narlay seems to induce the degradation of the oxygen conditions at the water/sediment interface. In addition, the present study gives also lines of evidence that the human intensification in the watershed of Lake Narlay seems to be the main cause of the major change in the contribution of biogenic methane to the benthic food web. However, the transition stage between the two trophic pathways (from absence to transfer of biogenic methane) involves a progressive change with intermediate limnological conditions, making the assessment of a tipping point in the temporal evolution difficult. Better knowledge of the relationships between the temporal evolution of limnological conditions and the activation of the trophic reliance on methane will require the study of other sites with different conditions.

(来源: JOURNAL OF PALEOLIMNOLOGY, 2016, 55(1):83-96)

Modelling daily water level fluctuations of Lake Van (Eastern Turkey) using Artificial Neural Networks

Dogan, Emrah; Kocamaz, Ugur Erkin; Utkucu, Murat; et al.

In this paper, two different Artificial Neural Network (ANN) techniques, namely the Feed-Forward Neural Networks (FFNNs) and the Radial Basis Function Neural Networks (RBFNNs), are used for the prediction of the daily water level of Lake Van. The water level fluctuations of Lake Van have been changing throughout history due to global warming processes. The estimated daily water levels using ANNs and the corresponding observed values correlate well. The results of the models are compared using Mean Squared Error (MSE) and Determination Coefficient (R-2) statistics. Comparison of the results has shown that the FFNN model performs better than the RBFNN model in the predictions. The forecasting results have indicated that the water level fluctuations of Lake Van have a long-term decreasing trend in the future with the water level reduced by as much as 15 cm compared with the lowest lake level of the 2011 water year.

(来源: FUNDAMENTAL AND APPLIED LIMNOLOGY, 2016, 187(3):177-189)

重点关注

Nature: 新技术可能会彻底改变水净化行业

全球范围内发生的比如来自农业、医药等的水资源有机微污染物, 已经给水生态系统和人类健康带来一定的负面效应, 对水质中有机微污染物质的净化也已经成为人们关注的问题。Nature 期刊于2015年12月21日在线发表题为《通过多孔环糊精聚合物快速去除水中有机微污染物质》(Rapid removal of organic micropollutants from water by a porous β -cyclodextrin polymer) 的文章。该文章称, 美国康奈尔大学的研究团队运用除味剂中的环糊精, 开发一种可以彻底改变水质净化的行业技术。该团队的负责人 Will Dichtel 为2015年麦克阿瑟基金会奖学金获得者, 报道指出该团队发明了一种多孔渗水形式的环糊精, 这种环糊精可以通过吸收的方式吸附水中污染物, 是一种可持续性、无毒高性能材料。

与传统的活性炭相比, 该净水物质具有以下优点: 更快速地净化水质, 在某些情况下其净水速率大概为传统活性炭吸附污染物的200倍。具有比活性炭更为强大的吸附捆绑污染物的优势, 其再生费用低, 可再生、可重复多次再循环使用, 且对水中微污染物质的净化效果不变。该环糊精聚合物只需要在室温下利用甲醇或乙醇进行清洗, 无须像活性炭那样需经过高热处理才可进行再次利用。

原文来源: <http://www.nature.com/nature/journal/vaop/ncurrent/full/nature16185.html>

(来源: 科学研究动态监测快报 2016-1-15, 第2期总第271期)

国际机构预测气候变化对亚洲五大河流流域的影响

近日, 国际山地综合发展中心 (ICIMOD)、联合国环境规划署 (UNEP) 下属合作中心 GRID-Arendal 以及挪威奥斯陆国际气候和环境研究中心 (CICERO) 联合

发布《喜马拉雅地区气候和水资源图集：气候变化对喜马拉雅地区五大河流域的影响》（The Himalayan Climate and Water Atlas: Impact of Climate Change on Water Resources in Five of Asia's Major River Basins），指出喜马拉雅地区印度河、雅鲁藏布江、恒河、怒江和湄公河流域的气候变化速度长期以来一直很快，这些地区未来的气候变化速度仍然会很快，将给当地和下游人口带来严重后果。主要结论包括：

（1）到2050年，整个兴都库什—喜马拉雅（HKH）山脉的温度将升高约1~2 °C（某些地区升高约4~5 °C）。HKH山脉地区的变暖速度快于全球平均变暖速度。到2050年，五大流域的温度将升高约1~2 °C，多数地方冬天的升温幅度比夏天要高，温度极端值出现得会更加频繁。

（2）季风季节时间可能变得更长且更加反复无常。季风季节开始时间更早，结束时间更晚，期间降雨量的变化幅度很大。总体而言，降雨量可能会出现小幅增加，给社区和灾害风险管理带来挑战。HKH山脉地区的平均降雨量会增加5%，有些地区的增加值会达到25%。恒河、怒江上游地区、湄公河上游地区的夏季降雨量可能会增加，雅鲁藏布江和印度河流域的趋势较为复杂。怒江上游和湄公河流域的冬季降雨量会增加，其他3个流域中，多数地区降雨量会减少。

（3）极端降雨事件会有所减少，但破坏力可能变得更大。喜马拉雅高山带的雨季降水量增加，特别是在东部地区，恒河和印度河流域南部地区的雨季降水量减少。极端降水事件的数量也呈现减少的趋势，但其强度正在增加。

（4）冰川可能会进一步遭遇更严重的融化，尤其是印度河盆地。未来10年，HKH大多数地区可能会发生大规模的冰川质量和面积的损失。湄公河流域冰川损失最为严重，为39%~68%，印度河流域损失最少，为20%~28%。温度升高可能也会导致更多的降水以降雨而不是降雪的形式出现，致使融化的冰川无法得到补充。

（5）位于冰川下游附近的居民社区对冰川变化最为脆弱。由于当地水资源稳定性降低，包括冰川湖溃决洪水在内的灾害发生频率增加，山区居民更容易受到冰川变化的影响。

（6）在2050年之前，年度径流总量不会出现减少。恒河上游、雅鲁藏布江和湄公河流域的径流会分别增加1%~27%、0~13%和2%~20%。出现这种变化的主要原因在于降水量增加以及冰川融化的增加。印度河上游和怒江上游的径流变化趋势不是很明显。预测结果说明，总体上，2050年之前径流不会出现明显的季节性变化。但是，径流变化的空间差异很明显，某些地区受到的影响可能会非常大。

（7）各种水源对河流径流的贡献可能会发生变化。受到降水量和温度模式变化的影响，冰雪融化、降雨和基本径流等不同水源对河流径流的相对贡献会发生变化，对水资源管理实践产生影响。

（8）尽管主要流域径流量整体会增加，但是河流径流量可能存在很大变动，而且雨季来临前的降水也可能增多。这将会导致难以预测的洪水和干旱事件发生的频

率,严重影响居民生计和生活安全,尤其是那些以河流灌溉为主的农业人口。

(9) 温度和降雨量的变化将会对一些受气候支配的领域(如农业、水资源和健康)产生严重及深远的影响。对农村地区人口来讲,农业尤其是最重要的生计来源,与水资源和温度的变化紧密相关。

报告最后针对气候变化影响带来的挑战提出如下建议:①针对解决气候变化影响的高度不确定性,制定和实施灵活、多样的解决方案;②采取结构性和非结构性措施,为防范和管理极端事件做好充分准备;③改进模拟方法,进一步减少不确定性,开展研究弥补重要空白;④加强区域合作和数据共享;⑤通过流域治理保护喜马拉雅山区生态系统,充分利用水资源的潜力;⑥把山地纳入全球气候变化重要议程之中。

原文来源: <http://www.icimod.org/wateratlas/index.html>

(来源: 科学研究动态监测快报 2016-1-1, 第1期总第187期)

多国科学家联合研究确定人类世开始的 7 大标志

2016 年 1 月 8 日, Science 发表由英国、美国、法国等 13 国科学家联合研究成果《人类世在功能与地层方面有别于全新世》(The Anthropocene is functionally and stratigraphically distinct from the Holocene), 指出众多证据表明, 人类对地球的影响已经形成了人类自身独特的地质时代——人类世, 文章确定了核武器、化石燃料、新材料、地层改变、肥料、全球变暖和生物灭绝等人类世开始的 7 个主要标志。

(1) 核武器。自 1952 年后, 越来越多的热核武器被引爆测试, 造成的核辐射在全球范围内留下印记, 例如 ^{14}C 和 ^{239}Pu 等, 在沉积物和冰中探测到的残留痕迹至少能保存 10 万年以上。

(2) 化石燃料。当前的碳排放率已达到 6500 万年以来的最高记录。自 1850 年来, 大气中二氧化碳浓度急剧上升, 现已超过 400ppm。化石燃料燃烧也导致 $^{12}\text{C}/^{13}\text{C}$ 比值的升高, 这将在树轮、石灰岩、化石骨骼和壳体组成中得以验证。

(3) 新材料。水泥、塑料和铝 3 种材料的出现是人类所主宰的时代的显著标志。在 19 世纪以前, 人们很少能在自然界中发现铝, 而现在人类已生产了约 5 亿吨的铝。从 20 世纪起水泥已成为使用最广泛的建筑材料, 现在人类已经生产了约 500 亿吨的水泥, 并且超过一半是在过去 20 年间生产的。塑料最早于 19 世纪初开始出现, 而现在人类每年将生产 5 亿吨塑料。塑料、铝和水泥的降解过程极其缓慢, 而且会留下可辨识的地质记录。

(4) 地层改变。到目前为止, 为了达自身的目的, 人类已经改变了面积超过 50% 的地球土地。砍伐森林、农业、钻井、采矿、垃圾填埋、建坝和围海等都对沉积过程有着广泛的影响, 其对岩层结构的破坏在未来数千年都将能够被探测到。

(5) 肥料。化肥在农作物种植中的应用令土壤中的氮、磷含量翻了一番。目前全球每年生产 2350 万吨的磷, 是全新世的两倍。人类活动可能已经对 25 亿年的氮循环造成了最大影响, 活性氮的总量比全新世增加了 120%。

(6) 全球变暖。人为造成的气候变化在未来将很容易被区分。20 世纪地球温度上升了 $0.6 \sim 0.9^{\circ}\text{C}$, 已经超出了全新世的自然变化范围。全球平均海平面也是过去 11.5 万年来最高的, 并且还在迅速上升。

(7) 生物灭绝。全球规模的生物大灭绝可以被用作地球地质时期的开始与结束的判别标志。一些分析预测认为当前正处于地球历史上的第 6 次大规模物种灭绝期, 75% 的物种将在未来数个世纪中消失。

原文来源: <http://science.sciencemag.org/content/351/6269/aad2622.full>

(来源: 科学研究动态监测快报 2016-2-1, 第 3 期总第 225 期)

气候变化造成的全球降水量增加被高估

近日, Nature 杂志发表题为《辐射观测值制约水文循环的增强程度》(An Observational Radiative Constraint on Hydrologic Cycle Intensification) 的文章指出, 原先的气候模型高估了气候变化造成的全球降水量增加。

评估全球降水变化的模型预测值与实际观测值之间的差异存在很多困难, 包括空间和历史数据覆盖不足在内的许多因素都会带来不确定性。水文循环增强程度通常以地球表面温度每升高 1°C , 全球平均降雨量的增加来表示, 不同气候模型得到的水文循环强度预测存在巨大差异。来自美国加州大学洛杉矶分校 (UCLA) 和劳伦斯利莫国家实验室 (LLNL) 的科研人员, 评估了 25 个气候模型模拟的全球降水变化与观测值之间的差异。

研究表明, 气候模型通常会低估太阳能吸收对大气水汽变化的敏感性, 从而低估短波吸收的增加和高估降水量的增加。由于不同模型的辐射传输参数存在差异, 导致不同模型的上述敏感性也存在着很大的差别。通过改进辐射传输参数将得到准确的短波吸收响应, 研究发现至 21 世纪末, 地球表面温度每升高 1°C 造成的降水增加量比原先模型预测的平均值要低 40%。研究人员指出, 全球变暖会导致水蒸汽吸收更多阳光, 这会抑制降水量的增加。大多数模型低估了在大气更加潮湿的情况下水蒸汽吸收阳光的能力, 最终高估了全球降水的增加量。

原文来源: <http://www.nature.com/nature/journal/v528/n7581/full/nature15770.html>

(来源: 科学研究动态监测快报 2016-1-15, 第 2 期总第 188 期)

气候变化并非未来全球洪水风险上升的主要诱因

近日,《自然气候变化》(Nature Climate Change)发表题为《未来全球河流洪水风险的驱动因素》(Global Drivers of Future River Flood Risk)的文章指出,若不采取进一步的行动,至21世纪末全球洪水的绝对损失可能会比当前增加20倍,而且社会经济增长对河流洪水风险增加的贡献大于气候变化。

理解未来全球河流洪水风险是量化气候变化影响和规划有效的适应策略的先决条件。来自荷兰的科研团队,首次通过分别预测气候变化和社会经济发展的影响,预测全球未来河流洪水风险。基于气候模型模拟、社会经济情景以及最先进的水文流域洪水模型,并结合社会经济影响模型对洪水风险的预测进行了研究。

研究结果表明,在全球范围内,若不采取行动,至21世纪末全球洪水的绝对损失可能会比当前增加20倍,洪水多发地区的经济增长对损失增加的贡献率占70%。早期的研究已经显示,气候变化将会使东南亚面临的洪水风险大幅上升。本研究发现,东南亚气候变化对风险大幅上升的贡献较大,但与社会经济增长的影响相比仍然相形见绌。非洲国家面临的风险主要是源于社会经济的强劲增长。

原文来源: <http://www.nature.com/nclimate/journal/vaop/ncurrent/full/nclimate2893.html>

(来源: 科学研究动态监测快报 2016-1-15, 第2期总第188期)

Nature Climate Change 文章评估人为气候强迫作用

近日, Nature Climate Change期刊在线发表题为《评估观察到的人为气候变化的影响》(Assessing the Observed Impact of Anthropogenic Climate Change)的文章,系统评估人为气候变化对区域气候变化趋势影响范围的作用。

近期区域气候变化对自然与人类系统的影响在全球范围内都有所记录,但是鲜有研究将这些观察现象与人为气候强迫联系起来。来自德国波茨坦气候影响研究所和美国劳伦斯伯克利国家实验室的研究人员利用一种新算法系统评估了IPCC第五次评估报告中提及的人为气候变化在区域气候趋势影响范围的作用。新算法评估了观测数据与气候模型数据产品的适用性,探讨了人为排放作为气候模型模拟必要条件的程度,以重现观察到的气候趋势。研究发现,接近2/3的与大气和海洋温度有关的影响可以确定地归因于人为强迫。相比之下,涉及降水变化及其对人类影响的证据仍显薄弱。此外,人为气候变化已经成为陆地尺度上观测到的3/4影响的主要影响。因此,不仅在全球尺度上观察到人为排放的影响,而且更多地是在区域和局地尺度上的自然和人类系统中观测到人为排放的影响。

原文来源: <http://www.nature.com/nclimate/journal/vaop/ncurrent/full/nclimate2896.html>

(来源: 科学研究动态监测快报 2016-2-1, 第3期总第189期)

人类活动将影响冰河期轮回

德国波茨坦气候研究所的研究人员发表在最近一期《自然》杂志上的研究表明,日照和二氧化碳浓度的关系是地球历史上 8 个冰河期轮回的关键标准,人类已经变成抑制下一个冰河期到来的地质力量。研究还表明,人类对地球天然碳平衡的干扰可能将下一个冰河期推迟 10 万年。

论文第一作者安德鲁·甘诺珀尔斯基认为,即使没有人为影响的气候变化,下一个冰河期的到来也不会早于 5 万年后。然而,研究显示,从人为燃烧石油、煤和天然气中排放的相对温和增加的二氧化碳,足以将下一个冰河期再推迟 5 万年。

这是第一次通过量化关键因素来研究过去的 8 个冰河期轮回。甘诺珀尔斯基说,结果显示,夏日光照和大气二氧化碳之间的独特关系,不仅解释了其与大规模冰川增长之间的关系,还让研究人员能预料未来冰河期到来的可能性。

利用模拟大气、海洋、冰盖和全球碳循环的地球系统模型,研究人员分析了人类进一步排放二氧化碳对于北半球冰量的影响。对冰河期轮回的动力源研究是最令人兴奋的古气候学话题之一,通常,一个新冰河期开始的标志,是夏季超低的辐射量。但目前并没有证据证明新的冰河期已开始。

“冰河期塑造了全球环境,进而决定了人类文明的发展。比如说,上个冰河期雕琢了今日的风景,留下了峡湾和湖泊河流。”论文合作者汉斯·乔奇姆·斯琪尔胡伯说,“然而,今天人类的化石燃料排放决定了这颗星球的未来。这非常清楚地说明了人类本身已经成为一种地质作用力。”

(来源:《科技日报》 2016-1-18)

科罗拉多河的威胁更多地来自于气候变化

近日,Water Resources Research期刊在线发表题为《Hydrologic implications of GRACE satellite data in the Colorado River Basin》(基于GRACE卫星数据的科罗拉多河流域水文影响研究)的文章指出,科罗拉多流域总储水量的消耗主要来自于地表修建的水库和储存于科罗拉多盆地上游的土壤水分,以及下游地区地下水储量的锐减。而这种储水量的变化主要受制于输入的水量对于该区域的气候干湿循环的响应,并不完全归因于用水量的增加。

近10年来,流域地区持续干旱少雨,使该河面临的缺水威胁不断加剧。从支流集水区流入科罗拉多河上游的水量变小,导致干流径流量逐年减少,水坝形成的鲍威尔湖和米德湖水位持续下降。水资源的供求不平衡已导致这条河经常出现在注入太平洋之前就发生断流的现象,对流域内的野生动植物、生态系统和民众生活造成了重大影响。

该项研究的数据来自于重力恢复与气候实验 (GRACE) 卫星, GRACE 是 NASA 联合德国航空航天中心、德国地球科学研究中心以及得克萨斯大学奥斯汀分校共同开展的重力卫星合作项目, 用于观测地球重力场变化。通过重力场的变化来推测出地下水的变化情况。

研究小组发现, 该地区的大旱平均每十年爆发一次, 而流域的储水量下降约 50~100 km³。近几年频发的干旱与以前的相比, 最大的区别在于, 自 2000 年以来几乎没有湿润年份对流域进行水分补给。最后, 研究人员认为, 长达十几年的连年干旱少雨使科罗拉多河面临百年来最严重的天然水资源不足的压力。所以, 建议管理者需要改变目前的水资源供应管理方式, 比如改进通过水库来存储地表水等造成水资源的无效浪费等。

原文来源: <http://onlinelibrary.wiley.com/doi/10.1002/2015WR018090/full>

(来源: 科学研究动态监测快报 2016-1-1, 第1期总第270期)

Biological Conservation: 美拆除水坝后生态恢复速度惊人

近日, Biological Conservation 杂志刊载了一篇题为《水坝拆除后淡水食物网得到了来自海洋营养成分的快速补给》(The Rapid Return of Marine-derived Nutrients to a Freshwater Food Web following Dam Removal) 的文章称美国水坝拆除后, 重要营养物质通过跨陆地—水域边界补给返回到食物链的速度快于预期。

拆坝是一个可行的河流生态修复行动。拆坝后生态恢复的主要受益者除了洄游鱼类种群外, 还包括陆地淡水食物网的其他部分。研究者通过测定淡水食物网中占有关键生态位的鲑鱼、淡水无脊椎动物和河鸟等动物体内的稳定同位素, 发现美国国内最大的水坝——Elwha 河坝拆除后不到一年, 生态系统中鲑鱼体内检测到了来自海洋的营养物质 (MDN)。随后, 食物网中稳定的氮、碳同位素比例逐渐增加。这些研究结果表明, MDN 作为生态系统恢复的一个重要组成部分, 在水坝拆除后, 能够通过跨陆地—水域边界补给迅速地返回到食物链中。

原文来源: <http://www.sciencedirect.com/science/article/pii/S0006320715301002>

(来源: 科学研究动态监测快报 2016-1-15, 第2期总第271期)

南极科考钻取出长 3.55 米深冰芯

从国家海洋局获悉, 2016 年 1 月 5 日, 第 32 次南极考察昆仑队在昆仑站成功钻取出一支长 3.55 米的深冰芯, 这是本次考察钻取出的第一支深冰芯。

此次钻探, 昆仑队 9 位队员连续 5 天加班加点, 在零下四五十摄氏度的极端寒冷天气下, 调试深冰芯钻探系统获得成功。

深冰芯记录的古气候环境信息是研究地球系统气候变化机制的基础, 而地球气

候系统自然变化规律的探寻是评估人类活动对地球气候系统影响程度的基本前提。通过冰芯钻探,可探究全球气候的演变过程并推断未来变化趋势。截至目前,我国已在昆仑站取得 300 多米深冰芯,这些深冰芯将被接续起来,用于 100 万年时间尺度全球气候变化研究,有望为科学家揭开地球古气候之谜、重建中新世气候档案提供一把“金钥匙”。

位于南极内陆冰盖最高点冰穹 A 地区的昆仑站海拔 4000 多米,冰厚 3000 多米,是国际公认的南极冰盖最理想的深冰芯钻取地点,在此处钻探也是世界上技术难度最大的冰芯钻探科学工程。经过我国南极考察队的不懈努力,昆仑站目前已开辟出长 40 米、地下深 3 米、宽 5 米的深冰芯钻探场地,并开挖一条长 10 米的钻探槽,完成了深冰芯处理和储存的工作场地、导向钻孔及安装、钻机循环系统、通风系统等建设工作。

(来源:《科技日报》 2016-1-8)

业界动态

UN-Water 发布《水质监管框架纲要》报告

联合国水机制(UN-Water)于 2015 年 12 月 11 日正式发布了《水质监管框架纲要:水分类使用》(Compendium of Water Quality Regulatory Frameworks: Which Water for Which Use)报告,指出全球水质问题复杂多变,采取有效的监管工具可以使水质管理适应多方的需要。联合国水机制(UN-Water)是由联合国方案问题高级别委员会于 2003 年正式建立的机构间机制,旨在加强联合国负责淡水和卫生方面问题的实体之间的统一与协调。《水质监管框架纲要》是在联合国倡议下,由国际水协会(IWA)和联合国环境规划署(UNEP)合作完成的。该报告的主要目的是通过支持政府和其他利益相关方来解决水质方面的诸多挑战,实现联合国水质专项优先发展领域的相关目标。

1 根据水的用途制定相应的水质标准

《水质监管框架纲要》总结和分析了世界各地一系列的水质指导准则、标准和监管框架,其主要目标是获取不同用户对多元化水质的需求信息,提高各地的用水效率,并且最终减少用水冲突。为了提高用水效率,就需要有更好地反映用户对水质不同需求的监管框架,例如将工业废水回收用到农业中。因此,有效的监管工具可以使水质管理适应多方的需要,而目前很多现有的标准和准则都对起草全面的监管工具有指导意义。

该纲要对水质方面的法律和政策进行了综合详实的分析，并且同时考虑到了其他补充性工具、管理方法及应用过程中的经验教训，为评估相关法律和监管工具的效力提供了基础。纲要回顾了世界不同国家和地区 46 个法律和政策工具，进行深度的分析解读，并且涵盖了不同的用水领域，包括饮用水、生活用水、农业用水、生态系统用水和水力发电等。

2 水质评估标准

评估标准是《水质监管框架纲要》的核心组成部分，同时也是纲要在未来不断更新完善的重要参考依据。确定评估标准的目的是更好地反映出优质水质监管工具的特征。以下的问题清单可以帮助决策者判断水质监管工具是否有效。

(1) 监管工具的目标是否足够的清晰明确，并且能够通过一系列的指标体系进行监督？

(2) 是否有监督和评估制度，如定期的取样和监测？

(3) 是否有经过认证的实验机构来进行相关分析工作，确保足够的实验分析能力和质量控制能力？

(4) 是否设定了用于评估未来发展情况的参照标准？

(5) 是否能够获取有关排污许可设施的信息和数据库？

(6) 是否有根据地区差异和不同需求建立和改善用于确保公众对不同水质要求接收度的监管框架？

报告最后指出，总结和应用其他相似国家和地区的经验教训，参考不同地区的决策管理经验可以实现最佳实践的本土化，促进不同组织机构之间的合作和能力完善。该纲要为这一类型合作的开展提供了出发点。

原文来源：

http://www.unwater.org/fileadmin/user_upload/unwater_new/docs/Compendium%20of%20Water%20Quality%20-%20Main%20Report_4.pdf

(来源：科学研究动态监测快报 2016-1-1，第 1 期总第 270 期)

WRI 报告研究水与能源的关系链

英 2016 年 1 月 15 日，世界资源研究所（WRI）发布报告《水与能源的关联关系：商业风险和回报》（Water-Energy Nexus: Business Risks and Rewards）建议更有效地解决水和能源之间的关系链及相互制约关系。该报告重点对中东和北非、中国和美国三个区域开展分析。这三个区域的产业面临着与水和能源供给相关的风险，并且正在寻找新的解决方案解决其对稀缺资源的依赖。

全球趋势表明，未来 25 年对水和能源资源的需求和竞争将会增加。到 2040 年，世界人口将从今天的 70 亿增长到 90 亿。这些增长同时也伴随着城市化趋势、人口流动、经济增长、国际贸易、文化和技术的变革、环境的变化，同时会驱动在水、能

源、农业和其他领域之间的竞争。对水和能源日益增长的需求将迫使干旱或缺水地区在发展中作出权衡。这些资源的相互联系也被称为“水、能源关系链”，大量的淡水资源被用来冷却发电厂、驱动可以发电的涡轮、提取和加工石油、天然气、煤炭、金属和化学物质。同样，重要的能源还需要被用来加热、淡化、运输水。

水资源缺乏给全球的工业都带来挑战，全球人口的增长和经济的发展意味着将来对本来就有限的淡水资源的需求、竞争、成本都会增加。水资源缺乏，反过来，会对能源供应形成新的挑战，因为煤炭、石油、天然气和电力生产都需要大量的淡水资源。然而，许多国家将需要更多能源来满足其能源密集型水处理技术，如海水淡化，来满足其对水资源日益增长的需求。

这种相互依赖被称作“水-能源的关联关系”，现在这个概念已经被固定下来，但与其相关的商业风险和机遇的关系仍然需要被人们所理解，从事水资源和能源密集型行业的公司，对评估和处理新风险的兴趣与日俱增。特别是，当淡水和能源的供应变得更加不稳定（通过供应中断和价格波动）和昂贵（因为新规定、竞争和基础设施和运营成本）的时候这些行业将会面临物资和金融方面的风险。重要的是，这里同时存在社会风险和需要注意的事项，尤其是数以百万人口的国家仍然缺乏能力去改善水资源和电力资源。现在由于自身所处的区域或价值链遇到的挑战一些本可以期待的行业和地区，在“水-能源的关系链上”也面临着风险。这份报告重点分析了以下三个区域：

（1）中东和北非：该地区的国家面临极高的水资源压力，并且使用石油和天然气为盐场提供能源，以此来解决日益扩大的淡水供应缺口。就某一个国家而言，预计到2035年，其将使用该国当前所有的能源生产来进行海水淡化。

（2）中国：随着经济的增长对电力的需求也在不断增加，近60%的火电厂面临高或非常高的水资源缺乏的压力。

（3）美国：到2020年，60%的页岩气体将面临干旱的气候条件，将面临高或极高的水资源缺乏压力。

这些地区的风险和机遇给其他地区和那些依赖其产品的地区敲响了警钟。他们认为企业在管理水和能量关系上应该检查以下事项：①水和能源供应上出现的风险已被公认，但是也不能忽视应对需求的解决方案；②充分考虑水和能源的回收利用；③将需求转向水资源的替代性资源和清洁能源；④创建新的伙伴关系和业务模型。

完成以上事项需要克服一些商业方面的障碍。想要积极应对风险的企业仍需要看到他们在新技术和服务投资上的回报。同样，企业关于这些创新的发展方案和销售方案仍需要盈利。但水和能源价格、基础设施和合作都对这些企业形成挑战。克服目前的障碍需要新的理念、方法和协作。在水和能源的关系链上如何满足他们的行业客户对水和能源的需求主要涉及到以下不同的方面，具体地说，不是试图扩大供应有限的淡水和化石燃料资源，而是企业可以找到机会来减少需求和扩展选择。

该报告提供了几种思路,包括:①制定包容性的方法,这种方法需要认识到在水和能源资源的决策中,性别主流化和地方利益相关者的参与所带来的益处的包容性方法。②在能源终端利用效率、水资源的重复利用、分散的清洁能源和智能化的基础设施方面,制定雄心勃勃的跨部门目标。③对创新的、有远见的碳定价和水评价方法开展财务方面的调查。

通过合作来测试这些想法可以帮助它们变成现实,企业可以分担成本和风险同时也可以学习一些新的技术。企业可以签订数据共享和报告的协议,在公共领域和政府部门合作,分享实践经验。需要携手努力探寻解决方案,以此来确保在接下来的25年对企业和世界将近90亿的人口水和能源资源的供应。

原文来源:

http://www.wri.org/sites/default/files/Water-Energy_Nexus_Business_Risks_and_Rewards.pdf

(来源:科学研究动态监测快报 2016-2-1,第3期总第272期)

亚开行分析中国与水有关的灾害并提出灾害风险管理建议

2015年12月15日,亚洲开发银行(ADB)发布题为《中国与水有关的灾害及灾害风险管理》(Water-Related Disasters and Disaster Risk Management in the People's Republic of China)的报告,指出近年来中国与水有关的自然灾害发生频率出现增加的趋势,并为加强综合灾害风险管理提出建议。

报告指出,中国的自然灾害,尤其是与水有关的灾害的发生率在增加,导致人口对灾害的暴露性和脆弱性也随之上升。中国发生的与水有关的灾害主要有三种,分别为洪涝、干旱和极端风暴。洪涝灾害每年影响人数最多,大约为7700万人。洪涝灾害每年造成的经济损失也最高,约为92.5亿美元。与水有关的次生灾害主要包括滑坡、塌陷、野火和海水入侵。

与水有关的灾害与气候变化和环境恶化密切相关。预计未来温度将继续升高,导致一些地区水资源压力和干旱灾害风险增加。洪水也预计增加,尤其是在城市沿海地区。这将严重影响人体健康(水源性疾病增加)、渔业、农业生产以及食品。

在实施《2005—2015年兵庫行动框架》的过程中,中国在识别长期战略目标方面取得了重大进展。中国正在努力识别当前和未来的风险,减少和管理这些风险,并努力更好地适应变化和提高灾后恢复能力。报告认为,风险管理是一种积极的灾害管理方法,重点是与水有关的灾害发生之前,设计措施帮助预防或减轻风险和脆弱性。鉴于多部门性质的工作,与水有关的灾害风险管理给中国各机构带来了挑战。

报告建议,中国应利用准备制定第十三个五年规划的机会来解决政策空白,加强机构协调和实施新的行动,以防止与水有关的灾害和通过灾害风险管理减少其影响。具体建议如下:①巩固灾害管理立法,使之与自然资源规划和管理立法整合;

②促进协调和合作, 澄清各个部门、机构、政府部门和及其所属部门之间的角色和职责, 指定一个单一的职能领导机构; ③弥补存在的知识空白, 厘清洪水管理、流域管理、海岸带管理和与水有关的灾害 (包括气候变化影响) 之间的联系; ④扩大流域生态补偿项目, 促进商业实体和社区的参与; ⑤改善对水资源的可用性和需求的计算, 明确规定水资源使用权、水资源共享法规以及交易和定价; ⑥采用风险管理方法进行灾害管理; ⑦改善灾害损失预测评估; ⑧加强灾害保险, 为购买保险提供激励, 扩大民众使用保险的机会。

原文来源:

<http://www.adb.org/publications/water-related-disasters-and-disaster-risk-management-prc>

(来源: 科学研究动态监测快报 2016-1-15, 第 2 期总第 271 期)

UNEP: 废水的经济价值需要在决策层面引起重视

近日, 联合国环境规划署 (UNEP) 发布题为《废水的经济价值-行动的成本和非行动的成本》(Economic Valuation of Wastewater--the cost of action and the cost of no action) 的报告。报告提出了对废水经济价值分析研究的结果, 并对有效废水管理的成本和不采取行动的成本进行了比较。

伴随城市化的快速扩张和工业化进程加快, 废水产生量迅速增高。据估计, 全球 80% 的废水未经处理直接排入水道, 严重影响了水生态系统和影响生物多样性的保护, 并且影响到人类的食物安全。低收入国家废水的利用率尤其低, 严重影响了渔业和海洋食物链, 并引发相关传染病蔓延。如果废水处理得当, 可以变废为宝。

该报告研究了废水的经济价值, 并且比较分析了废水管理的成本问题。联合国千年发展目标 (MDGs) 指出, 到 2015 年末要达到全球一半以上的人口获得安全饮水和健康的饮用水环境的目标。2012 年里约+20 峰会重申, 要求各个国家采取行动, 减少水污染, 提高水质, 改善污水处理设施, 实现水的可持续发展。为实现这些目标, 很多发展中国家采取了相关措施, 取得了一定的效果。

但是对于废水处理的經濟价值, 废水处理的管理问题, 在决策领域仍重视不足, 普遍认为废水处理的經濟价值不足, 带来的效益较少, 致使废水处理的經濟价值被低估。对废水处理的成本和废水处理带来的价值研究较少。该报告利用行动的成本对非行动的成本 (CNA-CA) 模型对部分国家的废水处理成本和废水处理带来的经济效益进行评估, 研究结果表明: 从经济学的角度分析, 实施污水项目在发展中国家带来的效益是多方面的, 尤其在环境和健康领域带来的益处, 其价值不容忽视。

原文来源:

http://apps.unep.org/publications/index.php?option=com_pub&task=download&file=011889_en

(来源: 科学研究动态监测快报 2016-1-1, 第 1 期总第 270 期)

中日水环境国际合作形成“湖南经验”

科技日报记者从1月28日—29日在长沙举行的中日政府间基层友好技术合作项目-“城市污水处理厂运行管理技术和居民环境意识的提高”成果发布会上获悉,经3年实施,项目在对我国污水处理厂运营管理和环境教育方面,获得了可推广的“湖南经验”。这是湖南省和日本滋贺县开展水环境领域科技合作的典范之一。

中日政府间基层友好技术合作项目即日本国际协力机构(JICA)基层友好技术合作项目,是一种基层市民、地方政府层级的合作,项目最终拟促进以技术合作为基础的经济合作。湖南省水资源研究与利用合作中心主任张灿明介绍,2008年湖南启动城镇污水处理设施建设,截至去年8月,全省累计建成城市污水处理厂141座,污水处理能力585.5万吨/日。2013年,湖南省水资源研究和利用合作中心与滋贺县琵琶湖环境部共同向JICA申报基层友好技术合作项目“城市污水处理厂运营及居民环境意识提高”,同年,湖南省人民政府和日本滋贺县签署了“湖南省和滋贺县环保领域合作协议书”。

据悉,以此项目为基础,中日双方自去年起,开始实施“洞庭湖区生态村镇与环保农业关键技术集成及应用示范”国际科技合作专项项目,拟将琵琶湖保护的经验和技術带到湖南,助力洞庭湖区较突出的水环境退化、土壤潜育化等问题解决。通过借鉴日本滋贺县村镇生态规划、绿色生态技术、城镇污水处理与雨水综合利用、环保与精准农业等技术,在湖南三个试点村镇展开,与琵琶湖环境科学研究中心进行环境综合治理。

(来源:《科技日报》 2016-2-3)

三峡水库泥沙调控通过验收

新华社记者2月4日从中国长江三峡集团公司获悉,作为“十二五”国家科技支撑计划项目之一的《三峡水库泥沙调控与多目标优化调度》已顺利通过验收。

据三峡集团介绍,这个项目的研究成果对于提高三峡水库水沙资源的调控能力、减轻下游防洪压力、保障下游用水安全和航运安全具有重要作用。部分研究成果已在近几年的调度实践中成功应用示范。

这一项目由三峡集团牵头,一些长期参加三峡工程科研、设计和运行管理的优势单位共同实施。项目于2012年1月启动,2015年12月完成,2700万元经费全部由国家拨款资助,属重大公益性研究项目。

三峡工程是世界上综合规模最大的水利水电工程之一,三峡库区的泥沙淤积一直是舆论关注的焦点之一。《三峡水库泥沙调控与多目标优化调度》项目组研究提出了新水沙形势下三峡水库泥沙调控与多目标优化调度综合方案,并向长江防汛抗

旱总指挥部办公室提交了《关于三峡水库泥沙调控重大建议的报告》，为充分发挥三峡工程的综合效益提供了技术支撑。

据介绍，水利部国际合作与科技司1日在北京主持召开“三峡水库和下游河道泥沙模拟与调控技术”验收会，《三峡水库泥沙调控与多目标优化调度》顺利通过验收。

（来源：《科技日报》 2016-2-5）

湖泊污染治理“懒人”技术助洱海去污还清

近20年来，排入洱海的氮、磷及有机污染负荷急剧上升，洱海水质日益恶化。控制面源污染已成为洱海保护治理的关键。

为保护洱海，国家水体污染控制与治理科技重大专项将洱海水质改善和技术推广应用作为重点研究工作，将“十一五”和“十二五”取得的成套整装技术在洱海流域推广应用，并与地方保护治理和流域生态文明建设工程紧密结合，使得洱海总体水质保持在地表水Ⅲ类水质标准，成为我国城市近郊保护得最好的湖泊之一。



大理喜洲镇上关村污水处理项目

江西金达莱环保股份有限公司（以下简称“金达莱”）承担的水专项项目“湖泊富营养化控制与治理技术及工程示范”下设的“流域面源污染处理设备研发及产业化基地建设”课题，研发出了农村生活污水脱氮除磷深度处理技术-FMBR兼氧膜生物反应器技术和设备，同时探索出了一种适合分散式污水处理设施的管理模式-“远程监控+4S流动站”，实现了分散式污水处理设施真正落地的问题。这项技术不仅为洱海流域分散式污水治理提供科技支撑，也为类似湖泊和广大农村分散式污水治理提供了示范。

大理洱海湖泊研究中心卫志宏告诉记者，为保护洱海水质，当地政府没少投入。先后尝试了各种国内外污水处理工艺，但大多难以稳定达标，集成化程度低，管理

维护难,无法有效发挥作用。而水专项研发的农村生活污水脱氮除磷深度处理FMBR技术和设备,在大理百村项目的应用效果,得到了当地政府的高度认可。

洱海流域共有774个自然村,每年大约产生污水1036万吨,成为洱海最主要的污染源之一。洱海周边才村、上关村是水专项的两个示范点。这两个示范点是普通生活污水、洱海流域养殖生活混排水等两类村落污水的典型代表。课题研发的FMBR处理技术和设备将两种污水的处理成本分别控制在0.57元/吨、0.78元/吨,且出水水质都能达到《城镇污水处理厂污染物排放标准》一级A标准,实现了高效、低耗、低成本。

卫志宏说,高浓度畜禽养殖废水是农村污水处理的难点,而之前采用的土壤净化槽、人工湿地处理系统等污水处理设施,对氮磷的处理效果不稳定,且效率不高。示范点采用的兼氧FMBR技术的核心是将传统污水处理生化—沉淀分离—过滤—消毒—污泥脱水干化—污泥处置等多个环节合并为一、高度集成,不排有机剩余污泥,基本无二次污染问题,出水可直接回用。

验收专家组组长杨朝飞告诉记者,湖泊污染治理最大的难点在于治理量大面广的面源污染。治理面源污染的关键是做好大量分散的治理设施的维护和管理。过去开发的一些治理技术和设施往往因无法解决设备维护和管理问题,结果“人走茶凉”,验收之后就成了摆设,无法发挥作用。这次洱海治理项目之所以能够取得成效,其亮点就在于较好地解决了这个难题。

课题负责人、金达莱董事长廖志民告诉记者,适合分而治之的产品,一定要能实现无人值守。如果能让污水处理设施成为自动运行的产品,现场就不需要传统意义上的监管。要无人值守,必须实现污水处理过程中不排放有机污泥,这就是技术的核心要求,也是传统工艺根本无法实现的。

分散式处理设施监管难不难?金达莱总工居德金接受采访时说:“如果用常规技术治理肯定不现实,因为常规技术需要做工程,需要专人看守,一个人不行,还得倒班,最起码需要两个人,但是技术人员谁愿意长期待在农村?水专项研发的产品安装之后不需专人值守。这种污水处理设施好像空调一样,只要设定好功能参数,便可自动运行,出来的水就是处理之后的可再生利用的中水。只需借助视频监视,几个人就可监控成百上千套设备的运行情况。”

“现场维护也很简单,兼氧FMBR设备只需每3个月维护30分钟。5万~10万人的片区,布置30~50台设备,设一个维护站,配备两名专职人员即可。这很像汽车4S店模式,所不同的是汽车4S店是固定的,而这种设备的维护人员是流动的。”居德金说,“水专项将适用于不同环境、不同类型、小型分散的污水处理设备变成标准化、系列化的产品,形成了日处理量15m³/d、50m³/d、100m³/d、200m³/d、300m³/d、500m³/d的标准化产品,并开发了远程监视系统和故障报警系统,实现对FMBR设备集中远程监管和实时报警,这是对产业的突破。”

产业化推广成效显著，设备已扎根全国近千个乡镇村。据了解，目前，我国农村生活污水年排放量为80亿~90亿吨，96%的村庄没有排水渠道和污水处理系统。农村生活污水具有量大面广、有机物浓度偏高、日变化系数大、间歇排放、控制困难等特点，未经处理的生活污水肆意排放，严重污染农村生态环境，直接威胁广大农民群众的身体健康，阻碍农村经济发展。农村生活污水到底怎样才能治好，这个问题考验着管理层和整个业界。目前，FMBR兼氧膜生物反应器设备已在大理百村项目中推广，在洱海流域11个乡镇60个村落污水处理点得到应用，大大助力了洱海保护，也为国内同类湖泊和农村分散式污水治理提供了装备和管理支撑。

课题承担单位金达莱获得国际水协IWA2014年度东亚地区项目创新的研究应用奖，FMBR设备也在国内28个省市近千个乡镇村污水治理项目得到应用，并成功出口500余套设备至13个国家。截至目前，累计实现处理水量近40万吨/天，实现总产值预计达11亿元。

（来源：《中国环境报》 2016-3-18）

美国国家科学院报告指出雨水和灰水必须有安全使用准则

近日，美国国家科学院（NAS）工程和医学院发表题为《利用灰水和雨水来提高当地的水供应：风险、成本和效益评估》（Using Graywater and Stormwater to Enhance Local Water Supplies: An Assessment of Risks, Costs, and Benefits）报告指出，地表干旱和水源短缺使得美国越来越多地转向雨水和灰水等替代水源，但这些水对公众健康和环境的风险必须有指导方针和安全使用准则，以支持其被安全使用的决策。利用现有技术获取和处理灰水和雨水可以显著补充传统饮用水供给，但是当前在项目成本、收益、风险和监管等方面还存在很多不足。

灰水的来源包括水槽、淋浴、浴缸、洗衣机和洗衣水槽等未经处理的废水，雨水是屋顶、停车场和地表的降水径流或雪融水。这类的水可以收集和处理成非常规用水，如灌溉、冲厕、洗衣及室外清洁等。委员会推动研究并撰写报告，全面分析了灰水和雨水各种用途的风险、成本和效益及其在家庭、社区和区域范围内进行的实践和应用。

报告指出，雨水和灰水质量的研究和数据风险评估至关重要，特别是可能出现的病原体的类型和浓度。雨水和不同用途灰水的化学成分信息也必须明确。报告提出了雨水和灰水获取和利用的最佳实践方法和体系。从邻近或更大的区域获取雨水，并将其存储在含水层以供干旱季节使用，能够显著缓解城市供水压力。雨水下渗—地下水补给是常规的模式，但是这个设计和规定可能不能保证水的质量，尤其是城市雨水。灰水可用于保证像冲厕和干旱地区灌溉等非饮用水方面，例如洛杉矶在夏季几乎没有降水的情况下成为稳定的水源保证。然而，巨大的灌溉系统和室内再利

用需要更复杂的管道设施和处理系统,因此其更适合于新的多住户小区的建设和发展,也将适用于未来城市计划。

报告指出较小规模的灌溉需要简单的系统、能量和维护可以实现,但是灰水和雨水都不应该被用于干旱地区环境美化工程,从长远考虑将是不可持续的。如果节水是主要目标,应该研究减少或者无灌溉的节水型景观策略,并在干旱区域大量减少需水量。

报告指出,确保关乎公共健康的水质问题最大的一个障碍是缺乏基于风险的准则。基于风险的准则可以提高用水安全性,减少不必要的危害健康的医疗支出,协助社区弥补当前水供应监管的缺失。委员会建议美国环境保护署(EPA)与美国水组织合作制定这些准则。当前,国家和地方层面的灰水和雨水准则发生着巨大的变化,法规落后于技术的发展与应用,妨碍着灰水和雨水再利用以及有效扩大国家淡水供应的能力。

原文来源: http://download.nap.edu/cart/download.cgi?&record_id=21866

(来源:科学研究动态监测快报 2016-1-1,第1期总第270期)

首次全国地理国情普查数据采集完成

从1月11日召开全国测绘地理信息工作会议上了解到,第一次全国地理国情普查历时三年,建成了国家级地理国情数据库,数据总量相当7亿册50万字的图书。目前,普查已进入统计分析阶段,有望在今年形成成果并向社会发布。

本次普查内容包括一级分类12个、二级分类58个、三级分类135个。顾及不同要素重要性、影像分辨率、行业需求等,科学设定采集指标,其中耕、林、园、草、水库(坑塘)、独立房屋建筑等重要要素采集指标最小面积400平方米;城镇区域绿化林地、绿化草地、独立房屋等重要要素采集最小面积为200平方米。通过本次普查,全面摸清了我国地理国情家底。一是查清了我国“山水林田湖”等地表自然资源要素基本情况,具体包括耕地、园地、林地、草地、湖泊、河流、水库(坑塘)、荒漠和裸露地表、冰川和常年积雪等的类别、位置、范围、面积等信息。二是查清了与人类活动相关的交通网络、居民地与设施、地理单元等人文地理要素基本情况,掌握其类别、位置、范围、长度、面积及空间分布情况。

2016年,普查重心已转入统计分析和深化应用阶段,主要包括:基于全国普查数据库,开展国家级基本统计,形成全国地理国情普查基本统计成果;编制完成普查公报、专报、皮书和图件成果;实现普查成果全面网络化共享;积极推进成果在国土空间布局、农业现代化建设、自然资源资产管理和保护、生态文明绩效评价考核、服务保障民生等方面的应用。

(来源:《科技日报》2016-1-12)

南水北调东线实现全线供水目标

3月1日10时,南水北调东线2015-2016年度第二次通水正式开闸,向威海市首次供水,这标志着南水北调东线工程规划供水目标全部实现。

按照计划,今年南水北调东线工程将向山东调水4.42亿立方米,为历年最多。威海市作为山东南水北调工程的最东端,这在历史上是首次调入长江水,届时可实现长江水、黄河水和当地水多水源联合调度。

据悉,南水北调东线一期工程从江苏省扬州市附近的长江干流引水,通过13级泵站逐级提水,利用京杭运河及其平行的河道输水,经洪泽湖、骆马湖、南四湖后到达山东。南水北调东线工程自通水以来,已累计向山东调水6.7亿立方米,已向8个地市供水,惠及人口4000余万人。

(来源:《科技日报》 2016-3-2)

60 年黄河输沙量减少 90%

中科院院士、自然地理学家傅伯杰的研究团队在《自然·地球科学》杂志2016年第1期刊文称,60年来黄河输沙量减少90%,已经回落到了人类活动影响之前的数值。

傅伯杰指出:“根据我们的研究,坝库、梯田等工程建设是1970年代至1990年代黄土高原产沙减少的主要原因;2000年以来,以‘退耕还林’为代表的坡面林草植被恢复措施则成为了土壤保持的主要贡献者。”

随着近年来黄土高原坝库等工程建设规模减小和拦截能力下降,黄河输沙量很可能出现反弹迹象。因此,具有固碳、降温等诸多生态服务功能的林草植被恢复措施显得尤为重要。“但是,林草植被也有其负面生态影响,那就是耗水”。傅伯杰称,黄土高原本就多处于干旱半干旱地区,如果再种植高耗水植被,更容易形成土壤干层,出现总也长不大的“小老头树”等现象,导致生态系统不稳定。

傅伯杰建议,黄土高原林草植被建设需要根据当地植被承载能力,因地因水确定适宜的植被类型、密度进行科学种植恢复。“如年降水低于400毫米地区,应该以自然恢复或者退耕还草为主,谨慎退耕还林”。

傅伯杰认为,未来,协调好黄河水沙关系是流域有效治理的关键。水多沙少会侵蚀,水少沙多会淤积。他建议,黄河水沙管理需要变传统的小流域综合治理为上、中、下游全流域的整体协调。

(来源:《科技日报》 2016-1-30)

青海湖最大鱼类承载力为 42 万吨

青海省农牧厅经过十年调查研究, 评估出青海湖最大鱼类承载力为42万吨。

自2006年开始, 青海湖裸鲤救护中心同新南大学生命科学院共同开展研究青海湖水域水生生物资源状况, 依照国家内陆水域渔业自然资源调查与评价的技术规范, 经过十年调查研究, 通过对青海湖水域内饵料生物的数量分析, 评估出鱼类最大承载力。结论为属贫营养型湖泊, 水体饵料生物资源的最大生产力能支撑42万吨的鱼类肉类蛋白资源。

青海湖, 作为维系青藏高原东北部生态安全的重要水体, 不仅是控制西部荒漠化向东蔓延的天然屏障, 也是区域内最重要的水汽源和气候调节器。生存在青海湖保护区内的鱼类有8种, 鱼类资源主要为青海湖裸鲤, 处于青海湖整个生态系统的核心地位。青海湖裸鲤对维系青海湖流域“水-鱼-鸟”生态链安全和生物多样性有着举足轻重的作用。

2003年青海湖裸鲤被列入“青海省重点保护水生野生动物第一批名录”中。2001年来, 我省每年坚持向青海湖放流裸鲤原种鱼种, 由此使青海湖裸鲤资源呈现缓慢恢复趋势。为了保护湟鱼, 保护周边的鸟类以及其他野生动植物, 修复青海湖复合生态功能, 从上世纪80年代开始, 我省先后5次对青海湖实施了封湖育鱼。二十年来, 在省委、省政府的领导下, 在青海湖封湖育鱼工作领导小组精心组织和周密部署下, 青海湖封湖育鱼工作取得显著成效, 裸鲤资源量增长明显, 青海湖复合生态功能得到初步恢复。

在封湖育鱼的同时, 我省还不断加大执法力度, 严厉打击非法捕捞、运输、贩运、销售、加工等破坏裸鲤资源的行为。到2015年底, 我省青海湖裸鲤资源量由保护初期的2592吨, 预计恢复到60000吨, 是保护初期资源量的23倍。

(来源:《西海都市报》 2016-1-10)

再生水成北京第二水源

再生水年利用量达到9.5亿立方米, 其中有6亿立方米左右用于市政和园林绿化。记者从26日北京市人大第十四届四次会议召开的新闻发布会上获悉, 再生水已成为北京“第二水源”, 利用率在全国遥遥领先。

近些年来, 北京以年均不足21亿立方米的水资源, 维持着36亿立方米的用水需求, 每年水资源缺口达15亿立方米, 由此带来地下水严重超采等环境问题。北京市水务局局长金树东说:“到去年底, 北京再生水利用量达到9.5亿立方米, 与南水北调进京水量大体相当, 成为中心城区水源可靠、供应量集中的两大主力水源, 对缓解“水荒”、保障城市用水起到了积极作用。”

目前,北京已经在国内率先形成了基于地表四类水标准的再生水标准体系。这个标准远远高于国内绝大部分污水处理厂的执行标准。

为推广和鼓励使用再生水,多年来北京维持再生水价格1元/立方米不变,同时对再生水的用户免缴水资源费和污水处理费。

去年底,北京市水资源调度中心成立,逐步建立北京市水资源统一调度平台,开展全市水资源配置与调度工作,努力实现本市地表水、地下水、再生水及外调水的联合调度、总量控制和统一调配,确保全市供水安全稳定。

(来源:《科技日报》 2016-1-27)

神秘嗜盐微生物导致澳大利亚一湖泊呈粉红色

澳大利亚西部洛切切群岛最大岛屿有一个美丽而神秘的湖泊——希利尔湖,它具有粉色湖水,多年以来,旅游者和科学家对于希利尔湖明亮粉色湖水是如何形成感到迷惑不解。目前,研究人员最新研究表明,该湖水存在一些嗜盐极端微生物,从而导致湖水产生粉红色。



研究人员指出,这种极端微生物是地球生态系统中最怪异、最奇特的生物,它们可以生活在极端环境,其中包括像澳大利亚希利尔湖这样的高盐湖泊。他们采集该湖泊中的沉积物和水,探测生活在湖泊中的藻类、古生菌和一些细菌。

基于这些样本,研究人员进行一项宏基因组分析,使用基因信息识别物种中的DNA成分。在收藏的细菌样本中,他们发现盐生杜氏藻,科学家认为这种藻类是导致水质变成粉色的主要原因。此外,盐生杜氏藻还存在于另一个粉色湖泊——塞内加尔玫瑰湖。

盐生杜氏藻制造一种叫做类胡萝卜素的色素化合物, 研究人员汉克·格林(Hank Green)解释称, 类胡萝卜素将有助于吸收太阳光线, 这些化合物使藻类呈现粉红色。但是研究人员发现盐生杜氏藻并不是希利尔湖出现粉红色的唯一原因, 研究人员在希利尔湖中还发现其它“红色细菌”, 其中包括一些古生菌。

希利尔湖的细菌种群还有助于洞悉这个湖泊的历史, 其历史可追溯至20世纪初。格林解释称, 研究小组意外地发现一种细菌, 它擅长分解苯和甲苯, 这些化合物通常存在于化学溶剂。基于以上信息, 研究人员对希利尔湖进行深入分析, 发现20世纪初这个湖泊曾是一个皮革制造点。

(来源: 《科技日报》 2016-3-24)