SIGN

SINO GERMAN NETWORK

Assuring water quality
from the source to the tap

The joint project

SIno-German water supply Network

中德合作安全供水系统

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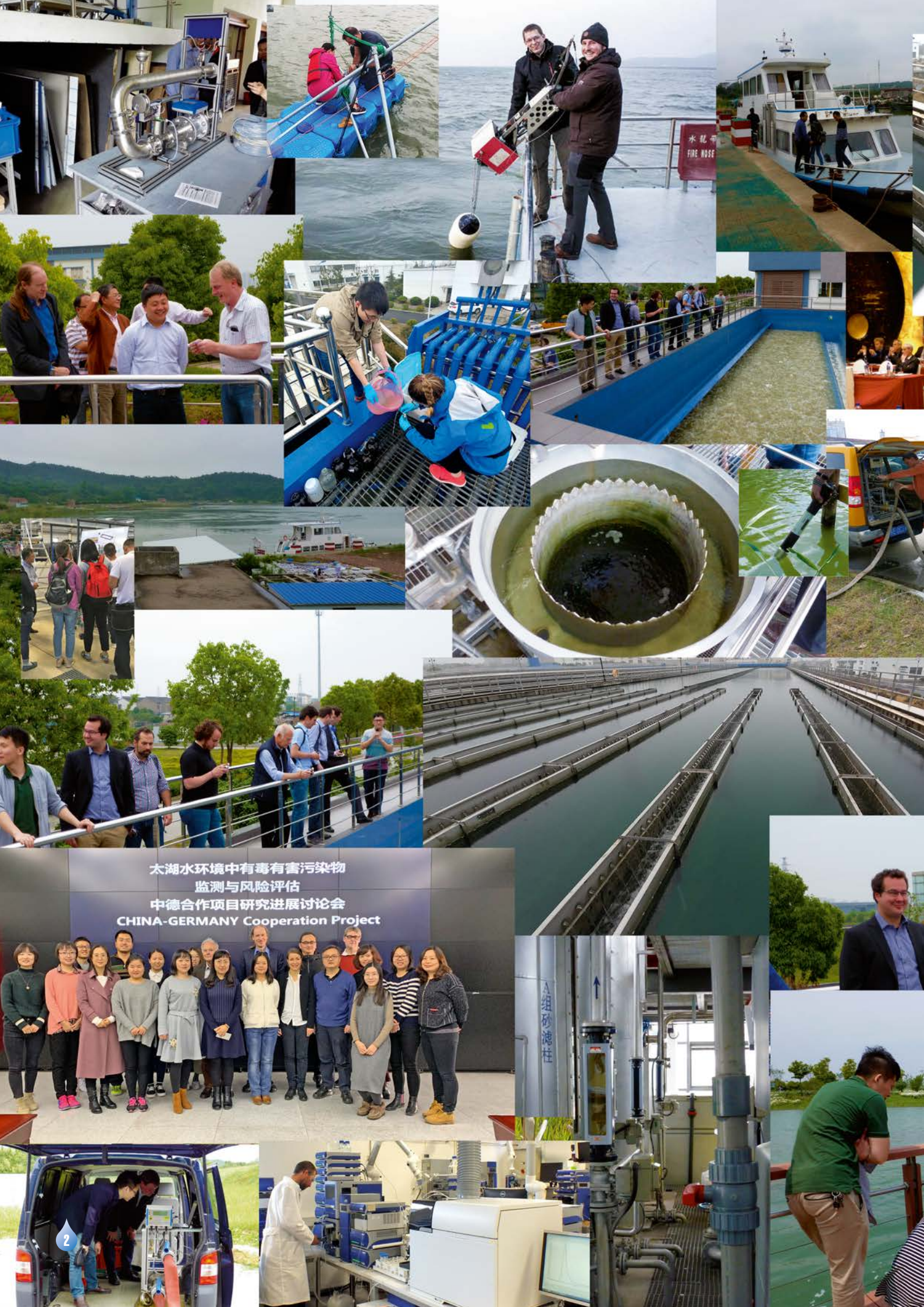
CLIENT II
Internationale Partnerschaften
für nachhaltige Innovationen

2nd phase


太湖水环境中有毒有害污染物
监测与风险评估
中德合作项目研究进展讨论会
CHINA-GERMANY Cooperation Project
A组砂滤柱
FIRE HOSE

SIGN at a glance

Water is essential for every kind of life, but its quality is threatened by a variety of contaminants. The Taihu (Tai Lake) in China represents a drastic example of water pollution from multiple sources. In the second phase of the project cooperation, a powerful consortium of German and Chinese research organisations, companies and concerned stakeholders will continue and extend its activities on different aspects of the water cycle. Great importance will be attached to the dynamic sediment/water phase at Taihu, the elimination of trace substances and the process optimisation at drinking water treatment, as well as the rehabilitation of the drinking water distribution network. The overall aim is to ensure good water quality from the source to the tap.

SIGN 项目概况

水是所有生物的必要组成部分，但水质正受到各种污染的威胁。中国的太湖就是受多种源头污染的典型湖泊。在SIGN项目二期合作过程中，中德双方的研究机构、企业和利益相关方将在一起形成强大的合力，继续推进项目，并拓展至水循环的各个环节中。工作重点将集中在太湖污染物在泥水相的动力解析、饮用水微量污染物质去除、及其水处理流程优化，以及饮用给水管网修复等方面。项目的总目标是确保从源头到水龙头的优良水质

SIGN
SINO GERMAN NETWORK

Assuring water quality
from the source to the tap

Content

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Foreword

China and Germany share a long history of cooperation in the water sector, spanning more than 35 years. This success has motivated MoST (Chinese Ministry of Science and Technology) and BMBF (German Federal Ministry of Education and Research) not only to fund cutting-edge research projects, as done before, but also to increasingly promote innovations.

In 2011, the BMBF started the CLIENT research program to strengthen the international cooperation with regard to applied research. In 2006, environmental protection has become an integral part of the Chinese "Five-Year Plan". In the same year, the Chinese government has started its Major Research Program, the largest national research program, and the Major Water Program, being one of the 13 areas of research. In 2015, MOST and BMBF signed a joint declaration on the cooperation in the frame of the Chinese Major Water Program. By this means, both ministries have provided a sound basis for accelerating the development and dissemination of innovative environmental technologies and water management tools. From 2015 to 2018, the BMBF has funded the first generation of German Major Water cooperation projects.

Due to the successful implementation of results and economic follow-up activities, MoST and BMBF have agreed upon five further Major Water projects, starting from 2018. This second generation of joint projects focuses on two regions of high political priority: the so-called "Jing-Jin-Ji" region (Beijing, Tianjin, Hebei Province) and the Lake Tai area west of Shanghai. The topics are wastewater treatment (PIRAT Systems, PEPcat), sewage sludge treatment (IntenKS), sponge city concepts (KEYS) and drinking water supply (SIGN2).

Federal Ministry
of Education
and Research

The SIGN project (Sino German Water Supply Network – Clean Water from the Source to the Tap) started in 2015 and focuses on Lake Tai region´s main challenges, which are pollutant input, assessment of lake processes, drinking water treatment and water distribution. The results of the first funding period contributed to a better water quality by mitigating taste and odour problems, the development of new sensors and more efficient treatment systems and the improved maintenance of the distribution network.

SIGN represents a successful example of multi-disciplinary technological and scientific bilateral cooperation. I am delighted to see the progress of the cooperation and the many contacts established so far. Therefore, I would like to express my sincerest wishes for the successful strengthening of this collaboration in the second phase of this project (SIGN2).

Dr. Christian Alecke
German Federal Ministry of Education and Research

德国联邦教育研究部
克里斯蒂安•阿勒克博士

前言

中德两国在水领域的合作已经成功走过了35个春秋。这也促使中国科技部和德国联邦教研部改变以往仅资助前沿高科技领域科研项目的惯例，越来越多地支持创新项目。

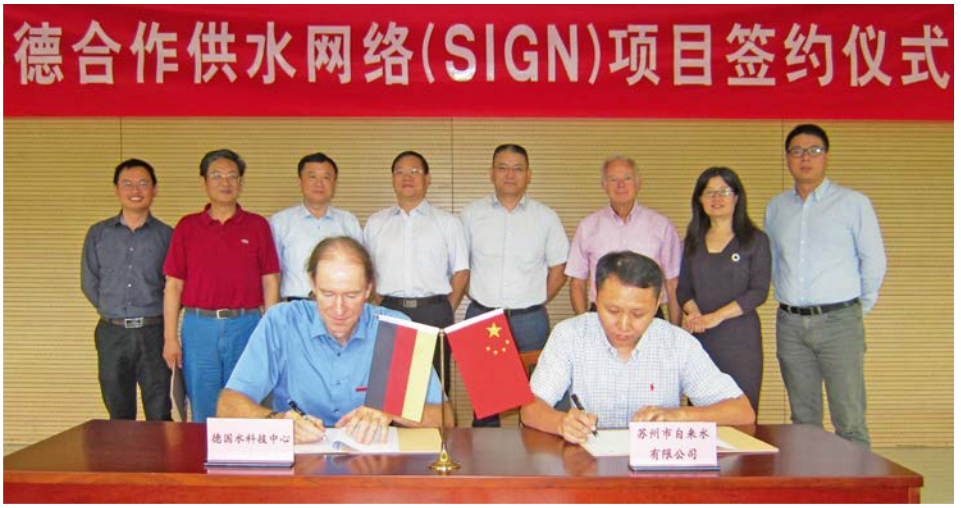
2011年，德国联邦教研部启动了CLIENT项目，以期加强应用科学领域的国际合作。自2006年以来，环境保护也被纳入中国的五年计划。同年，中国政府启动了重大科学研究计划，成为国家层面上最大的科研项目，重大水专项也位列13个研究领域之中。2015年，中国科技部和德国教研部签署了在中国重大水专项框架内进行合作的联合声明。借此，两部委为加速创新环境技术以及水管理工具的开发与传播打下了坚实的基础。2015年至2018年期间，德国联邦教研部为德方的重大水专项合作项目提供了资助。

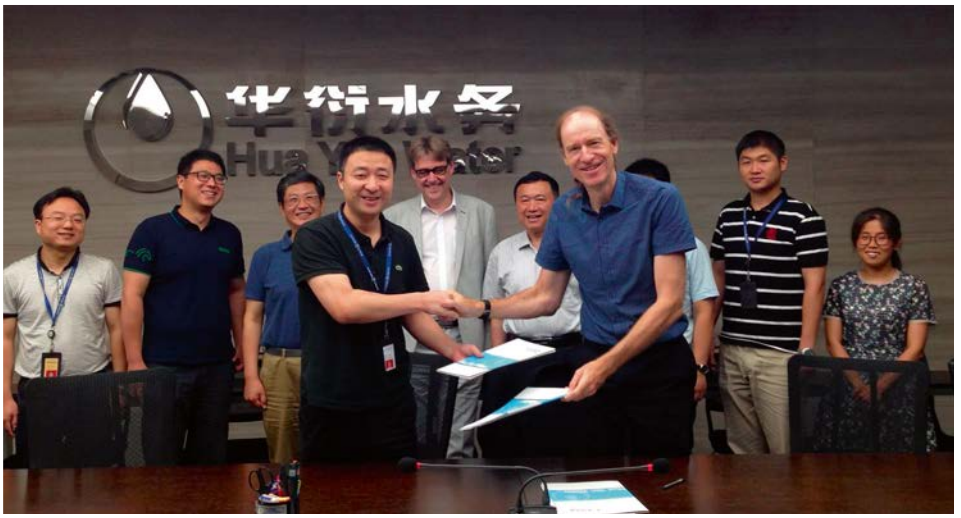
由于合作科研成果得以顺利实施并进入市场，中国科技部与德国教研部同意从2018年起继续资助五个重大水专项项目。这第二期合作项目聚焦中国两大具有重要意义的地区：京津冀地区和上海西侧的太湖地区。项目主题为废水处理（PIRAT系统，PEPcat），污水污泥处理（IntenKS），海绵城市理念（KEYS）以及饮用水供应（SIGN2）。

SIGN项目（中德水供应网络——从源头到水龙头的清洁水）始于2015年，聚焦太湖地区面对的多项重大挑战，如污染物输入、湖泊过程评估、饮用水处理以及配水。第一个资助期内取得了多项研究成果，通过缓解饮水异嗅异味问题、开发新型传感器以及更高效的水处理系统、改进水输配管网维护工作，带来了更好的水质。

SIGN项目是中德双边多领域科技合作的成功典范。我非常高兴地看到我们的合作取得进展，至此还建立了许多合作关系。因此，我为SIGN项目二期能成功加强我们的合作致以最好的祝福。

CLIENT II





CLIENT可持续创新国际伙伴关系合作计划项目二期

德意志联邦教研部（BMBF）已经启动了CLIENT项目二期的资助工作。受资助的项目目标为研发针对特定国家紧要问题的解决方案并在这些国家中产生杠杆效应。项目聚焦气候、能源与环境领域的技术、产品与服务开发。SIGN项目二期也被纳入德国联邦教研部的资助范围内(www.bmbf-client.de)。根据2015年5月作出的联合声明，SIGN项目二期(www.water-sign.de)将与中国关于水污染治理与管控的重大水专项项目紧密合作。

CLIENT II

The German Federal Ministry of Education and Research (BMBF) has launched the CLIENT II funding initiative. The aim of the funded projects is to develop solutions to urgent issues in selected countries and for these to have a leveraging effect. The focus is on the development of technologies, products and services in the fields of climate, energy and the environment. The SIGN2 project is funded by the BMBF within this initiative (www.bmbf-client.de). As stated in the joint declaration from May 2015, SIGN2 (www.water-sign.de) will cooperate closely with corresponding Chinese projects within the Chinese Major Program of Science and Technology for Water Pollution Control and Governance.

Scope of the SIGN2 project

SIGN项目二期概览

Assuring good water quality from the source to the tap

Water is essential for all life. However, in many parts of the world, water quality is threatened by multiple pollution sources. Access to clean and safe drinking water is crucial for human wellbeing and for the prevention of drinking water-borne diseases.

In the last few decades, China has undergone rapid industrial and economic growth. Especially in densely populated areas; the need for clean water is constantly increasing. At the same time, the quality of raw water is often impaired due to significant anthropogenic pollution. Furthermore, the available water resources in China are naturally low (only one quarter of the global average) and unevenly distributed, with high water scarcity in the dry, northern parts of the country.

The Sino-German research project SIGN2 will contribute towards improving the water quality in the Taihu region close to Shanghai, one of China´s most economically prospering areas. This region is one of the focus regions of the currently running Chinese Major Program of Science and Technology for Water Pollution Control and Governance, demonstrating its high political importance.

A powerful consortium of research facilities, companies and concerned stakeholders was set up to successfully manage the challenging tasks of the SIGN2 project. The project partners are working on the quality of the lake, which serves as a water resource, and on the quality of the drinking water for the adjacent megacities. Assuring the supply with good-quality water requires that the entire water cycle is taken into consideration, including the following:

- competent management of water resources,
- adapted and advanced monitoring strategies,
- capable water treatment processes,
- efficient distribution of drinking water.

Within the SIGN2 project, German water technologies and management concepts will specifically be developed and adapted to Chinese boundary conditions. Scientific progress and practical applicability will be ensured by the strong linkage between science and practice in Germany as well as in China.

确保从源头到水龙头的优良水质

水是生命之源。然而，在世界上的许多地方，水质正受到各种污染源的侵害。获得清洁、安全的饮用水对人类健康生存、预防饮用水传播疾病至关重要。

在过去的数十年中，中国经历了迅速的工业与经济发展。特别是在人口稠密地区，对清洁水的需求在不断升高。与此同时，原水的水质经常受到严重的人为污染。此外，中国可用的水资源不足（仅占全球平均的四分之一）且分布不均，干燥的北方地区缺水严重。

中德联合研究项目SIGN二期将致力于提升太湖地区水质。而该地区紧邻中国经济最繁荣地区——上海，同时也是当前中国水专项重点治理的地区之一，可见其重大的政治意义。

科研机构、企业与利益相关方已经联手形成一个强大的实体，成功担起SIGN项目二期具有挑战性的任务。

项目各合作方正在致力于提升太湖水源水质，提高湖区周边特大型城市饮用水品质。为确保优质饮用水的供给，在治理时要将整个水循环都纳入考虑，包括：

- 有效的水源管理；
- 因地制宜、先进的水体监控策略；
- 有效的水处理工艺；
- 高效的饮用水输配。

SIGN项目二期将对来自德国的水科技与管理理念加以调整与改良，以适配中国当地的状况与条件。通过中德双方科学界与实施方之间紧密的联动，确保科技进程顺畅、应用实施顺利。

Some facts about the Taihu

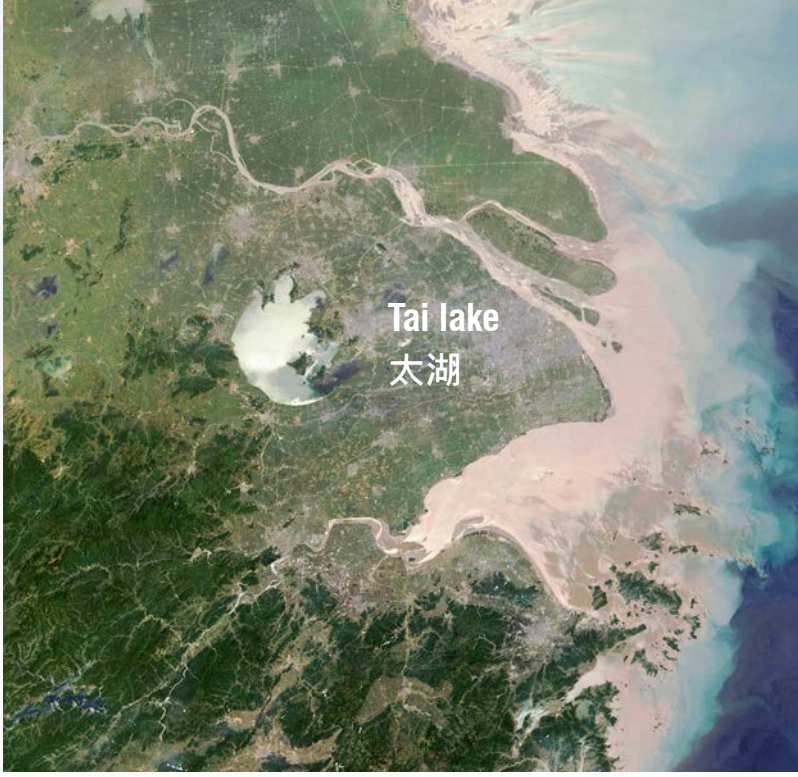
The Taihu (Tai Lake)

- is located in the Yangtze Delta (Jiangsu province) close to Shanghai,
- is the third-largest freshwater lake of China (2,200 km^2, 2 m average depth),
- represents a drastic example of water pollution with nutrients (nitrogen, phosphate), organic contaminants and heavy metals,
- has been suffering from eutrophication and algal blooms since the late 1980s,
- has insufficient raw water quality, which threatens the drinking water supply.

太湖现况

太湖

- 位于长江三角洲江苏省境内，毗邻上海；
- 是中国第三大淡水湖 (2200 平方公里，平均水深2米)；
- 富营养化（氮、磷酸盐）、有机污染物与重金属水污染的代表性案例；
- 从上世纪80年代后期起深受富营养化与蓝藻之危害；
- 原水水质不达标，危及饮用水的供给。



Lake processes
湖泊过程解析

Main aim: Securing the quality of the raw water resource by considering beneficial as well as detrimental ecosystem effects, especially the dynamic pollutant exchange between water, sediment and algae.

Partners: KIT, PAG, JÜLICH, BBE, RWTH Aachen, TZW-KA, HI, IWW, CRAES, Jiangnan University, NIGLAS

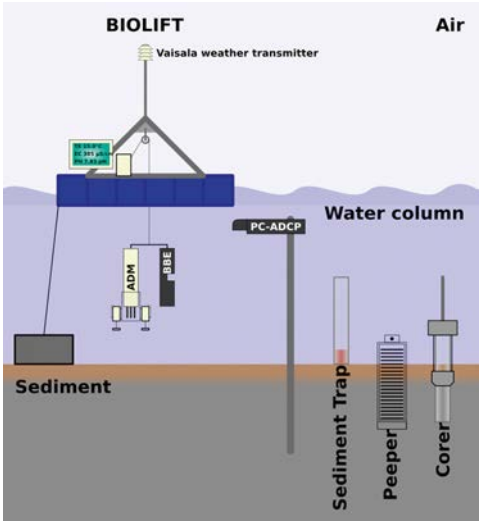
Due to the very low water depth of the Taihu, mixing processes between water and sediment have a major influence on the pollutant and nutrient distribution in the lake and thus on the quality of the raw water for drinking water production. To gain a deeper understanding of the dynamics of pollutants and nutrients in the Taihu, innovative monitoring methods and sensor technologies will be developed and tested. For the elucidation of these exchange dynamics, the availabilities of inorganic and organic pollutants and of biomass and their toxicity will be considered.

Innovative techniques, such as field flow fractionation (FFF), will be used to determine the influences of particle size and density on the dynamics of the suspended particles in the water phase. The development of an integrative system for lake monitoring is planned to assess eco-chemical risks of sediment resuspension events in this large and shallow eutrophic lake with a high resolution.

Biological tools are used to assess ecotoxicity as well as mutagenic and endocrine effects. Some microorganisms can be detrimental to water quality and human health, and therefore, powerful molecular biological methods are used to detect bacteria with antibiotic resistance genes as well as pathogenic viruses and bacteria. The biodegradation of organic pollutants and nitrogen-containing nutrients (nitrate, nitrite, ammonia) will be investigated in laboratory degradation studies with original material (water, sediment) from the Taihu basin.

The use of modern techniques and the measurement of the C-/N-isotope composition of the anthropogenic pollutants and biomass will allow evaluation of the bioactivity within the lake.

Another large and often clearly visible problem of Taihu is excessive algae growth, along with the production of toxins, compromising drinking water quality. The onset and duration of algal blooms are impacted by the nutrient content of the water as well as by mixing processes. A new method of a holographic system for the detection, counting and specification of algae cells will be developed.



中方研究团队：中国环境科学研究院, 江南大学, 中国科学院南京地理与湖泊研究所

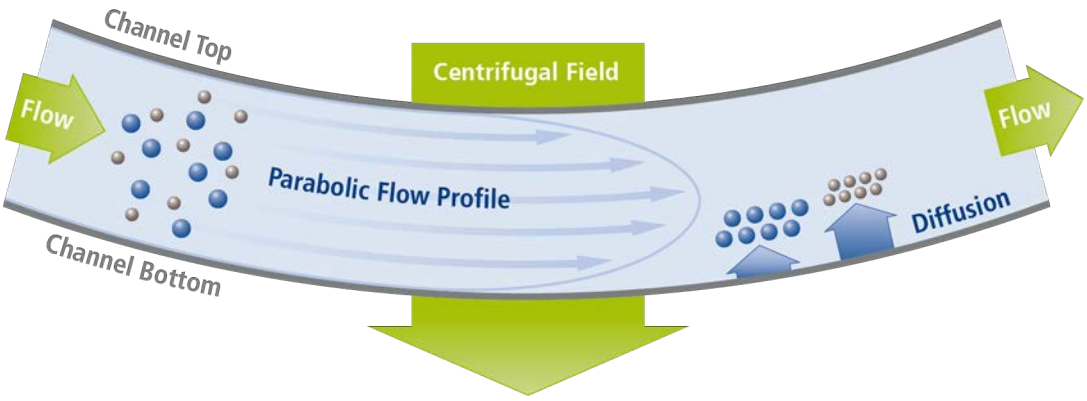
主要目标: 通过对比有利和有害的生态系统影响, 特别是水、沉积物与藻类的动态污染物交换，保障水资源水质。

德方研究团队：卡尔斯鲁厄尔理工学院, Postnova分析有限公司, 尤利希研究中心, BBE公司, 亚琛工业大学, 水科技中心, 水同位素公司, 水研究公司

由于太湖是浅水湖泊，水与沉淀物的混合过程对污染物和营养盐在水中的分布具有重要影响，从而影响其作为饮用水水源的原水质量。为更好地了解太湖中污染物与营养盐的动力过程，将应用创新的水体监控方法和传感技术做为研究方法。为了阐明这些动态交换过程，监测过程还将考虑无机和有机污染物以及生物质的生物量及其毒性。项目将使用场流分级测定技术(FFF)等多种创新技术来测定微粒大小与密度对水相中悬浮微粒动态的影响。计划开发一高精度的一体化湖水监测体系，评估大型浅水湖沉淀物再悬浮过程带来的生态与化学风险。

项目采用生物工具评估生态毒性以及致突变和内分泌效应。有些微生物会对水质和人体健康造成损害，因此采用强大的分子生物方法来检测携带抗生素抗性基因的细菌以及致病病毒与细菌。通过对太湖行程采集的样品（水和沉淀物）进行实验室降解研究，调查有机污染物与含氮富营养物（硝酸盐、亚硝酸盐、氨）的生物降解情况。采用现代技术测量人为污染物和生物质的碳氮同位素成分用于评估太湖的生物活性。

太湖另一个棘手的问题是藻类的过度生长，释放毒素并危及饮用水水质。藻华的发生和持续时间受到水体中营养物质及其混合过程的影响。项目将开发一全息影像系统作为藻类细胞检测、定量和定性分析的新方法。



Drinking Water Treatment
饮用水处理

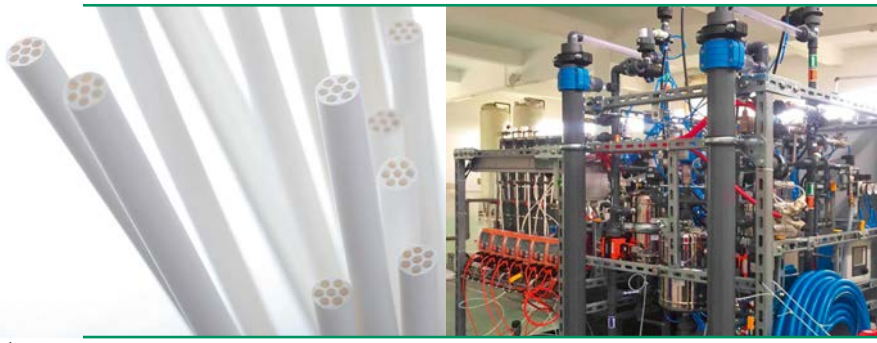
Main aim: Investigation of innovative processes for effective elimination of algae cells, organic pollutants and taste and odour substances

Partners: BBE, JÜLICH, INGE, IWW, SURF, TZW-KA, Suzhou Water, Tongji University, Hua Yan Water

Algal blooms are a large challenge for drinking water treatment. Thus, practicable, ecological and economical solutions for efficient drinking water treatment by ultrafiltration are needed. The further development of a spectrometer for algae detection with the use of special short-wave UV LEDs and their testing and application in the waterworks at Taihu will be conducted.

Taste and odour problems as well as micropollutants, which will not be removed by conventional water treatment steps, are major challenges for drinking water production on the basis of water from Taihu. On top, antibiotic resistance genes are increasingly attracting interest, and the Tai Hu region is no exception. Regarding taste and odour (T&O), it is not fully understood which compounds are responsible for those effects and whether they originate from algae-related compounds, from disinfection by-products or from undefined sources. In this context, emphasis will be placed on mechanism elucidation. Furthermore, the measurement and assessment of organic pollutants within the various purification steps in Taihu waterworks, including the analysis of the elimination efficiency, will be part of the investigations. Elimination of antibiotic resistance genes will be tracked across the drinking water process, starting with Taihu raw water.

As an alternative, filtration with tight membranes, such as nanofiltration or reverse osmosis, is a promising solution to retain target compounds in a low-molecular-weight range by means of physical separation. In this project, a membrane with separation abilities that can retain identified low-molecular substances, such as taste and odour compounds, micropollutants and antibiotic resistance genes, will be developed. Using the technology of membrane surface alteration, the so-called "layer-by-layer technology", different separation layers sum up to produce tight ultrafiltration membranes in such a way that certain target compounds can be retained. Laboratory experiments will be performed to investigate the elimination efficiency by membrane filtration in detail.



主要目标: 探索有效消除藻类细胞、有机污染物和异味物质的创新工艺

德方团队：BBE公司, JÜLICH公司, 滢格公司, 水研究所, SURF公司, 水科技中心
中方团队：苏州水务集团, 同济大学, 华衍水务

藻类水华是饮用水处理的一大挑战。因此需要寻找切实可行、生态且经济的饮用水超滤处理方法。项目将深入研制特殊短波紫外发光二极管的藻类检测光谱仪，并在太湖水厂进行测试和应用。

传统的水处理步骤无法去除的异味问题以及微粒污染物是在使用太湖原水制备饮用水过程中面临的主要挑战。最重要的是，抗生素耐药基因越来越引起人们的关注，太湖地区也不例外。至于异味问题，目前还不完全清楚这是由哪些化合物造成的，它们是否源于藻类，还是来自消毒副产物或者其他不明来源。在这方面，研究重点将放在弄清污染物产生的机制上。此外，对太湖水厂各净化步骤中有机污染物的测量和评价，包括对去除效率的分析，也将是调查的一部分。从获取太湖原水开始就要追踪并消除抗生素抗药性基因。

作为一种替代，紧密膜过滤，如纳滤或反渗透，是通过物理分离将目标化合物保留在低分子量范围内的一种有希望的解决方案。在这个项目中，将开发出一种能够过滤拦截已知的低分子物质的膜，如异味化合物、微污染物和抗生素抗药性基因。利用膜表面改性技术，即所谓的"逐层技术"，将不同的分离层叠加起来形成致密的超滤膜，使特定的目标化合物得以截留。对膜过滤的去除效果将进行详细的实验研究。

饮用水输配
Drinking Water Distribution

Main aim: Higher water quality and quantity in the drinking water network by advanced flushing, valve testing and leakage detection methods

Partners: FAST, TZW-DD, 3A, 3SC, Suzhou Water, Tongji University, Hua Yan Water

Drinking water as a product from the waterworks in Suzhou has a good and stable quality. However, water discoloration and problems with T&O compounds reoccur during transport along the drinking water pipes. For efficient flushing of large scaled pipes, new algorithms for the extrapolation of calculated flushing intervals from pilot zones to large network areas must be developed. For better software-based maintenance of the network infrastructure, new features will extend the parameter spectrum for the rehabilitation modelling of networks.

Because of technical, hygienic and economic reasons, water suppliers are urged to reduce the water losses from their water distribution networks to a minimum. A monitoring system, installed during the first phase of the SIGN project, will be used to deploy and use newly developed hydrophone loggers in the distribution network on large to very large pipelines.

Furthermore, with the additional acquisition of network parameters, such as the status analysis of valves through a valve-turning machine, together with already acquired data from network flushing and leakage incidence, a deduction of rehabilitation strategies shall be developed through a special software tool. KANEW 3S is a software tool for condition and risk assessment as well as the simulation of asset management strategies of pipe networks. This tool shall be extended by several new components on the strategic and operational/tactical planning levels in the field of water supply. Thus, the spatial and chronological planning of rehabilitation activities will be optimised.

主要目标: 使用先进的冲洗、阀门测试和泄漏检测方法提高饮用水网络的水质和流量

德方团队：FAST公司, 水科技中心, 3A公司, 3SC公司
中方团队：苏州水务集团, 同济大学, 华衍水务

苏州水厂提供的饮用水质量优良、稳定。然而在管道输送过程中，水的变色和异味化合物的问题再次出现。为了有效地冲洗大型管道，必须开发新的算法推算冲洗间隔并从试点区域扩大到全网络。为了更好地对供水网络基础设施进行基于软件的维护，新功能将扩展网络恢复建模的参数谱。

由于技术、卫生和经济方面的原因，供水商须将其供水网络的水损失降到最低。在SIGN项目一期安装的监测系统将继续发挥作用，并使用最新开发的水声监听记录仪搭载在输配管网的大型及超大型管道上。

此外，随着更多网络参数的获取（如通过阀门转辙机对阀门所作的运行状态分析），结合已经从网络冲洗和泄漏事件中获得的数据，通过一个专用的软件工具来推导出管网修复策略。Kanew 3S是一种用于管网设备管理策略仿真和状态评估的软件工具。

这一工具将获得供水领域战略和运行/战术规划的几个新组件的拓展，用于优化管网修复的空间和时间规划。

Training, dissemination and market implementation

Main aim: Implementation of the results among the different Chinese stakeholders

Partners: TZW-KA, CRAES, Tongji University

The research and development activities will lead to the adaptation of the products of the German industrial partners for the Chinese market as well as to practicable action recommendations and management concepts for a sustainable water management. Demonstrations, trainings and workshops at different institutions and companies will be performed to involve collaboration partners in China.

The focus will be on the cities of Wuxi and Suzhou.
All results obtained will be actively shared with the scientific community as well as with concerned Chinese stakeholders. Based on the existing Chinese standards and guidelines as well as on the raw water situation of Taihu, the most important parameters for drinking water quality will be selected to facilitate future monitoring and control.

培训与推广

主要目标：将研究成果在中国进行推广与应用

德方团队：TZW-KA
中方团队：同济大学、中国环科院

研发活动将有助于帮助德国参与企业的产品的推广应用，服务于可持续水资源的管理与保护。研讨会、培训和推广将在中方合作单位开展，重点在苏州市和无锡市。

中德合作所有研究成果在中德双方共享。根据现有的中国标准、指南和太湖原水特征，筛选最重要的饮用水质量指标开展进一步的测定和控制。

Partners - Tasks and contact details
合作伙伴-任务和联系方式

Coordination, Biodegradation, Water quality, Flushing
协调、生物降解、水质、冲洗

TZW: DVGW-Technologiezentrum Wasser
TZW: 德国燃气与水工业协会 水科技中心

www.tzw.de

TZW-KA: Department of Microbiology and Molecular Biology
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TZW-DD: Distribution Networks
Dr. Andreas Korth | andreas.korth@tzw.de

TZW is an independent research institute working on all aspects of the water cycle – from the source to the tap.

TZW 是一家独立的研究机构，致力于水循环的各个方面-从源头到水龙头。

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藻类传感器，生物学早期水预警系统

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Christian Moldaenke | CMoldaenke@bbe-moldaenke.de

BBE develops and produces measuring instruments and software for the monitoring of water quality.

BBE 开发并生产用于水质监测的测量仪器和软件。

Leak detection
渗漏检测

F.A.S.T. GmbH
F.A.S.T. 公司

www.fastgmbh.de

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Hans-Peter Karle | karle@fastgmbh.de

FAST GmbH is an expert for leakage detection and for the developing and manufacturing of all kinds of equipment for water supply networks.

FAST公司是一所检测泄漏的专业公司，并且为供水管网研发和制造各种设备

T&O compounds, Suspended particles in lake water

嗅味物质

FZJ: Forschungszentrum Jülich GmbH
FZJ: Jülich 研究中心公司

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FZJ works on key technologies for energy and environmental research.

FZJ 致力于能源和环境研究的关键技术

Lake water processes, Isotope monitoring

湖泊过程，同位素监测

Hydroisotop GmbH
Hydroisotop 公司

www.hydroisotop.de

Dr. Florian Eichinger | FE@Hydroisotop.de
Dr. Siegmund Ertl | SE@Hydroisotop.de

Hydroisotop GmbH investigates isotopes in the environment and the hydrological cycle to secure water quality within the water cycle.

Hydroisotop 公司从事环境与水文的同位素调查，以保证水循环各环节的水质

Membrane filtration

膜过滤

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Organic and inorganic analytics, Drinking water supply

有机、无机分析，饮用水供应

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Department Water Resources Management
IWW: 水研究公司
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IWW is one of Europe's leading institutes for interdisciplinary and applied research, training, and consulting for the water sector.

IWW是欧洲水界在跨学科应用研究、培训和咨询领域的龙头机构之一。

Multi-sensor monitoring, Inorganic pollution, Early warning

多传感监测、无机污染、提前预警

KIT: Karlsruhe Institute of Technology
Institute of Applied Geosciences (AGW)
Working Group Environmental Mineralogy & Environmental System Analysis (ENMINSA)
KIT: 卡尔斯鲁厄理工学院
应用地球科学研究所 (AGW)
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KIT works on environmental process understanding, substance fluxes and interrelationships in environmental systems.

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Field-Flow Fractionation (FFF), Size distribution and chemical identity of particulate matter in environmental samples

场流分离技术(FFF), 环境样本颗粒物质的粒度分布与化学特性分析

PAG: Postnova Analytics GmbH
PAG: Postnova分析有限公司

www.postnova.com

Dr. Florian Meier | florian.meier@postnova.com

PAG is the leading manufacturer of analytical instrumentation based on the principles of Field-Flow Fractionation (FFF).

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Ecotoxicology

生态毒理学

RWTH Aachen: Research Institute for Ecosystem Analysis and Assessment at RWTH Aachen University
亚琛工业大学: 生态系统分析与评估研究所

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RWTH develops solutions for a sustainable environmental management and is an expert in applied research and risk assessment in ecotoxicology and ecology.

亚琛工业大学开发可持续环境管理解决方案，专业从事生态毒理学和生态学应用型研究和风险评估。

Goethe University: Faculty of Biosciences, Ecology, Evolution and Diversity, Goethe University, Frankfurt am Main
法兰克福大学: 生物科学、生态学、进化与物种多样性学院

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逐层涂层

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www.surflay.com

Dr. Lars Dähne | L.daehne@surflay.com

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3S 驱动设备有限公司

www.3s-antriebe.de

Axel Sacharowitz | a.sacharowitz@3s-antriebe.de

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Asset management simulations and rehabilitation planning

设备管理模拟与修复规划

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Ingo Kropp | kropp@3sconsult.de

3S Consult GmbH is a leading engineering and software company for hydraulic simulations and asset management.

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National governmental rules

国家政策

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住房与城乡建设部标准定额司科研处
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Jiangsu Provincial Center for Protectionand Security of Urban-Rural Water Supply,
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同济大学 TONGJI UNIVERSITY

Coordination
Drinking water treatment, Drinking water distribution

协调单位
饮用水处理，饮用水配水

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College of Environmental Science and Engineering
同济大学 环境科学与工程学院

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CRAES 中国环境科学研究院

Coordination
Lake monitoring, Lake processes

协调单位
湖泊监测，湖泊过程

CRAES: Chinese Research Academy of Environmental Sciences
CRAES: 中国环境科学研究院

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Drinking water treatment

饮用水处理

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Water quality monitoring

水质监测

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Prof. Hua ZOU | 邹华 教授 | zouhua@jiangnan.edu.cn

Algae growth

藻类生长

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Prof. Boqiang QIN | 秦伯强 教授 | qinbq@niglas.ac.cn

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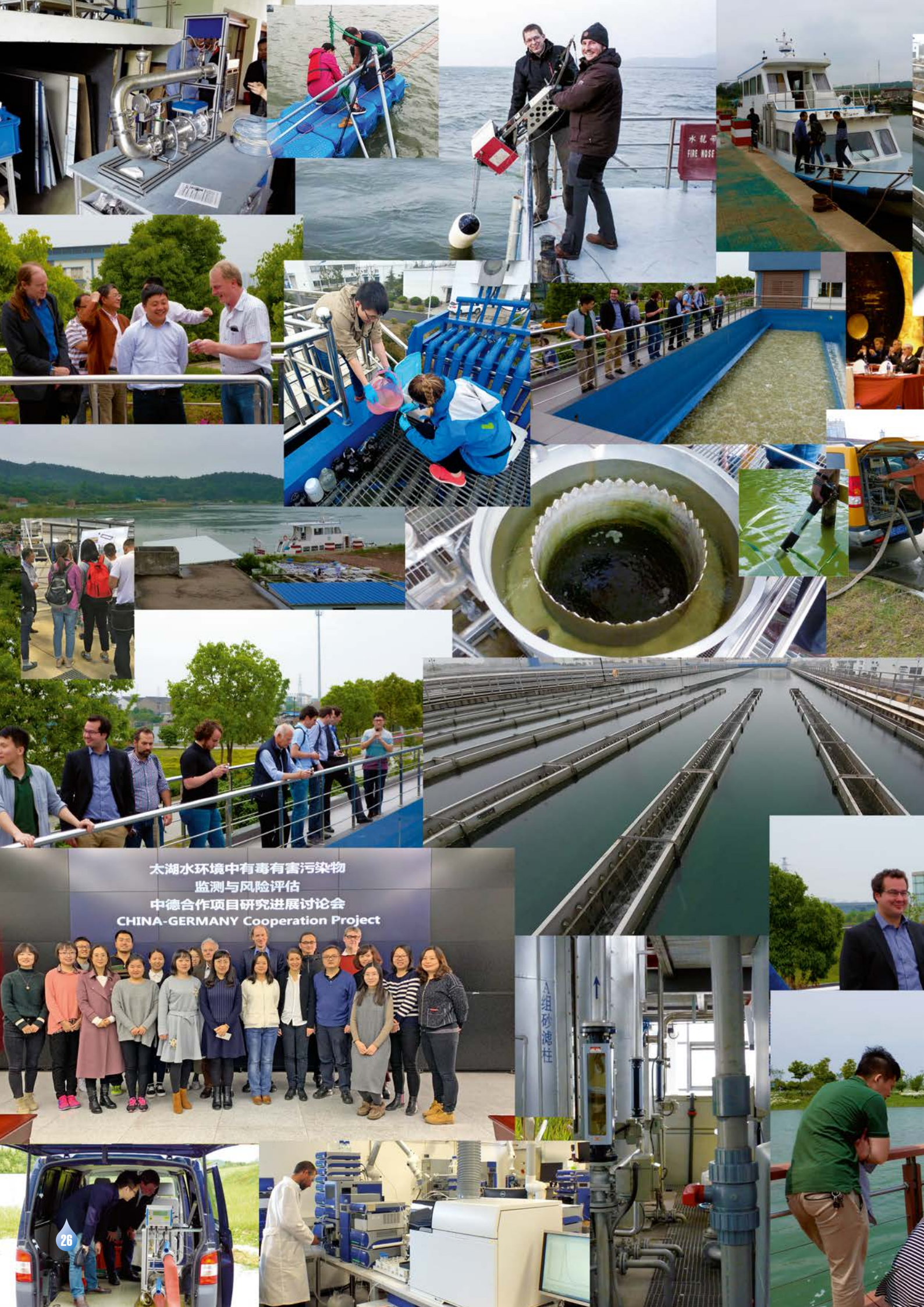
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