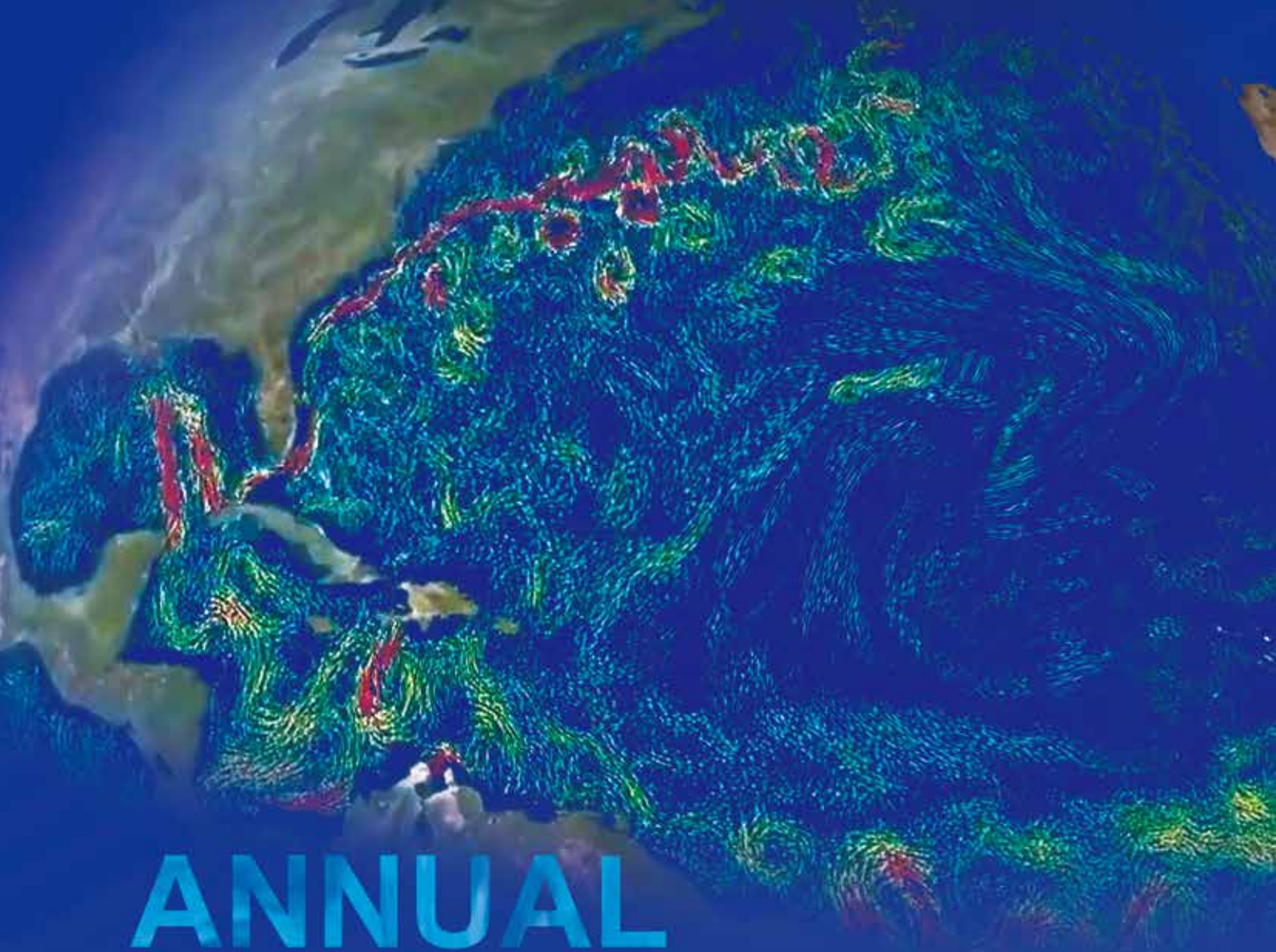

ANNUAL REPORT

近海海洋环境科学国家重点实验室（厦门大学）

State Key Laboratory of Marine Environmental Science
(Xiamen University)

2018年度报告
ANNUAL REPORT

MEL INTRODUCTION

近海海洋环境科学国家重点实验室（厦门大学）(英文缩写MEL）启动建设于2005年3月，2007年6月通过科技部验收，2010、2015年连续获评优秀国家重点实验室。实验室瞄准与全球变化有关的重大科学问题，直面国家对海洋环境保护和生态安全的重大需求，立足基础研究，以多学科交叉为基础、以技术创新为动力、主攻海洋生物地球化学过程及其与海洋生态系统相互作用，关注在自然变化和人类活动影响下的海洋生态系统对环境变化的响应和反馈。实验室坚持走国际化发展道路，科学研究力求具备国际视野，管理体系参比国际标准，文化建设崇尚自由宽松，努力建设成为具有重要国际影响力的海洋环境科学研究和创新性人才聚集的基地。

Founded in 1995, the Laboratory of Marine Environmental Science (MEL) was formally promoted to a state key laboratory in March, 2005. MEL consists of 62 scientists and 91 technicians. It is dedicated to cutting-edge and interdisciplinary research related to global and regional environmental changes. MEL's focus is on marine biogeochemistry and its interactions with the marine ecosystem.

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Associate Director: Congqiang Liu, Nianzhi Jiao
Members: Fei Chai, Bojie Fu, Zhengtang Guo, Zhimin Jian, Paul K.S. Lam, Weibo Song, Qisheng Tang, Fan Wang, Hui Wang, Ching-Ling Wei, Si Zhang, Meixun Zhao, Tong Zhu, Yongguan Zhu

实验室领导班子

名誉主任：洪华生
主　　任：戴民汉
副 主 任：焦念志、王海黎

MEL Leadership Team

Honorary Director: Huasheng Hong
Director: Minhan Dai
Associate Directors: Nianzhi Jiao, Haili Wang

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序 言
Message from the Director

2018年12月22日晚9点，曾引发史上最严重灾难的印尼巽他海峡喀拉喀托火山再次喷发，引发致命海啸，夺走了数百条生命，导致成千上万人颠沛流离。这是大自然母亲展现的威力，但我们人类却未抱有应当的敬畏之心。我们正以前所未有的“力量”继续快速改变地球。IPCC于10月发表的《全球1.5℃增暖特别报告》就是最好的警示：主要由化石燃料等人类活动导致的全球变暖快速地把地球系统推向其阈值，12年后，即2030年，我们的行为和生活方式就有可能将增温幅度推到1.5℃。这份报告提出，全球升温2℃的真实影响将比预测中的更为严重。极其不幸的是，美国的社会和群体的分裂趋势正在向全球漫延，使得国际社会应对全球气候变化的行动得到了最严峻的挑战，这一切从刚刚在波兰卡托维兹举行的《联合国气候变化框架公约（UNFCCC）》第24次缔约方会议（COP24）的谈判过程可见一斑。

这一年则是中国改革开放的第四十个年头，面临高质量发展的新挑战，中国的社会经济如此，科技亦然。这一年，MEL同仁也在“双一流”建设全面启动实施之际，探索着、前进着、思考着。

2018年，不忘初心的MEL人继续在追求科学和真理的道路上孜孜不倦，主动承担起率先探索、引领方向、独辟蹊径的职责重任，发挥“国家队”应有的担当。这一年来，MEL获批国家重点研发计划、国家自然科学基金重大项目及重点项目等纵向项目41项，合同经费1.25亿元。在SCI期刊发表学术论文272篇，58%发表在JCR一区（Q1）期刊， 17篇发表在Nature Index收录期刊，也不乏*Nature*及其子刊、*PNAS*等具重要影响力的期刊论文。中青年人才亦得到进一步的显露，多人获批“万人计划”、“中青年科技创新领军人才”、“青年千人计划”等人才计划，为实验室新一轮发展注入源头活水。“嘉庚”号科考船、东山临海观测与实验站完美启用后的首年里收获良多。颇具前瞻性的“大型仪器与技术服务中心（COMET）”已成功运行十年，是实验室科学研究当之无愧的“基石”。此外，新增的28项访问学者合作研究、举办的前沿学科发展论坛和国际讲习班等为深化学术交流与合作提供了广阔的舞台，杰出博士后基金、优秀博士生奖学金、本科暑期奖学金的进一步推广为实验室提供了人才储备。盘点其中，我们乐于见到成绩，为逐年有新的进展而欢欣。同时也反思如何能进一步激活MEL同仁的创新动能，更好地促进不同研究方向的协同发展。

2018年，MEL在坚持标杆引领、发挥“头雁”效应之余，积极摸索如何更好地将海洋科学知识普及给公众，提高全民海洋科学素养，因为海洋命运共同体的缔造需要大家的参与。我们携手第一次造访厦门的法国科考帆船塔拉号举办“知遇鹭岛，共话蓝海”的大型联合活动周，组织了海洋文化大讲堂、公众开放日、海洋科普展等活动，掀起了公众对海洋科考和海洋文化的关注潮，吸引了逾5000人次的参访。通过与新浪（厦门）和新浪微博平台，将活动覆盖面扩及到了百万网民。借此，MEL主动把握机遇，与厦门新浪战略性强强联合，打造海洋科普阵地的创新模式。一年一度的海洋开放日，也再次吸引了6000余名公众的热情参与。总结回望，我们深感欣喜，因为公众科普卓有成效。但也倍感责任重大，深入思考如何更好地为公众揭开海洋的奥秘，满足公众对科学知识的渴求。

回顾MEL十三年走过的路，喜见舞台已搭好、人员已到位。但如何进一步营造自由探索的学术环境，深化研究内容，让舞台上的演出更加精彩？这些都是我和同事们在新的一年里，乃至很长一段时间内需要共同思考、携手共进的问题。

落其实者思其树，饮其流者怀其源。站在辞旧迎新的界点，我内心感受至深的仍是一路关心、支持实验室成长的海内外同仁及朋友。谨借此文，以点滴感想向各位表示衷心的感谢，并致以最诚挚的新年祝福！

戴民汉 主任
于2018年12月31日

At 9:00 pm on December 22, 2018, Krakatoa, which had once caused one of the worst disasters in human history, erupted again. The subsequent tsunami took hundreds of lives and caused the displacement of thousands of people. This is the power of Mother Nature, yet we humans still seem to not have due respect for her. We are continuing to ruin her health with unprecedented severity. The IPCC Special Report on 1.5℃ Warming in the World released in October is a good wake-up call: This special report suggests that the real impact of a global temperature increase of 2 ℃ will be more serious than predicted. If we adjust the target to 1.5 ℃, we will be able to avoid many of the losses and risks caused by climate change. Unfortunately, the unilateralism that the new US government has adopted to pursue "the supremacy of US interests" has had a severe global impact and also challenges global climate change cooperative efforts. This is reflected in the negotiations of COP24 in Towitz, Poland.

Meanwhile, China has ushered in the fortieth year of reform and opening-up in 2018. In the new era, not only does China's social economy face new challenges from high-quality development, but the rapid development of science and technology also needs to be fully upgraded and further innovated. In 2018, taking the ride of fully realizing 'double-top' initiative, MEL has also started a new round of construction and development.

In 2018, MEL continued to work tirelessly on the road of pursuing science and truth and taking the initiative to take the lead in exploring, leading the way and creating new paths, and played the due role of "national team". Over the past year, MEL was approved with 41 research grants from the national key research and development program and National Natural Science Foundation of China (NSFC) major programs, with contract funds of 125 million Yuan. 272 papers were published in peer-reviewed journals, 58% of which were published in JCR Q-1 journals and 17 were in nature indexed high-profile journals such as *Nature*, *Nature Communications* and *PNAS*. Several of MEL colleagues were awarded the national talent programs. This injects fresh energy into the new round of development. R/V TKK and D-SMART have harvested a lot after the opening for the first year. COMET has been running successfully for ten years and now is the cornerstone of scientific research. In addition, 28 visiting scholarships and several symposia and workshops have provided a broad stage for deepening academic exchanges and cooperation. The further promotion of postdoctoral, PhD and undergraduate fellowships have created a potential talent pool. Taking stock of all this, we are happy to see fruitful results progressing every year. However, I also reflected on how to further activate the innovation momentum of MEL colleagues and better promote the collaborative development of different research scopes.

In 2018, in addition to taking the lead in ocean science research, MEL actively explored how to better popularize ocean science knowledge to the public so as to improve their understanding of ocean science. We clearly understand that the building of a community with a shared ocean requires everyone's participation. Together with the French research schooner TARA, which visited Xiamen for the first time, we held a large-scale event packed week. A series of events were organized, such as public lectures, vessel open days, exhibitions and other activities, which aroused the public's awareness in marine science and culture, and attracted more than 5,000 people with vessel visits. Through the cooperation with Sina (Xiamen) and Sina Weibo, the coverage of the event gathered to 3 million users. Therefore, MEL established a strategic collaboration with Sina (Xiamen) to innovate ocean science education. Ocean again, the annual open ocean science day has attracted the enthusiastic participation of more than 6000 people. Looking back, we are very pleased to see that the outreach has been very effective. Furthermore, we also feel a great responsibility to think deeply about how to better uncover the mysteries of the ocean for the public and satisfy the their thirst for scientific knowledge.

Looking back on the road MEL has traveled over the past 13 years, I am glad to see that the stage has been set up and the personnel are in place. But how can we further explore and deepen research? These are the issues that my colleagues and I need to think about and work together on in the New Year and for a long time to come.

"Every success should never forget where it comes from". Standing at the crossroads between old and the new, we are deeply moved by colleagues and friends from home and abroad who care about and support MEL all the way. I would like to take this opportunity to express my heartfelt thanks to you and best wishes for the New Year.

Minhan Dai
December 31, 2018

一月 / January

实验室年度学术研讨会首次在东山太古海洋观测与实验站举办。
MEL's Annual Academic Symposium was held at the Dongshan Swire Marine Station (D-SMART) for the first time.

二月 / February

董云伟团队研究成果在《美国科学院院报》发表，并于12月再次在该期刊发表论文，揭示海洋软体动物蛋白质温度适应性变化模式，开辟了利用计算生物学进行贝类进化研究的方向。
Yunwei Dong's research group published 2 research articles in Proceedings of *the National Academy of Sciences of the United States of America (PNAS)* in February and December, revealed the structural flexibility and protein adaptation to temperature of organisms by using molecular dynamics analysis of malate dehydrogenases in marine mollusks.

三月 / March

实验室第三届学术委员会第二次会议在厦门召开
MEL's Academic Committee Meeting was held in Xiamen.

完成“嘉庚”号痕量元素洁净采样系统的海上测试，获取高质量的痕量金属数据；5月举办2019年中国GEOTRACES航次的协调会以及海洋痕量元素与同位素生物地球化学国际讲习班，标志着MEL全方位进入海洋痕量元素及同位素的生物地球化学研究这一前沿领域。
The GEOTRACES test cruise was successfully conducted with the R/V TKK. In addition, a 2019 GEOTRACES-China Cruise Planning workshop and an international training workshop on "Metal Speciation and Isotopes in the Ocean for GEOTRACES and beyond" were organized in May, which indicates MEL's full efforts in GEOTRACES research frontier.

高树基研究团队在《自然·通讯》期刊发表研究论文，以现场原位速率观测与环境因子调查，证明环境硝酸盐浓度是调控海洋真光层不同氨氮消耗途径的关键因子。
Shuh-Ji Kao's group published an article in *Nature Communications* entitled "Ambient nitrate switches the ammonium consumption pathway in the euphotic ocean".

四月 / April

举办法国TARA科考帆船与厦门大学“嘉庚”号科考船联合活动周，开展了科考船入港直播与公众开放日、中法海洋科学研讨会、联合公众大讲堂、海洋科普展览及媒体发布会等活动。厦大1978级校友、著名媒体人杨锦麟先生受邀做有关海洋文明与民族复兴的演讲。活动期间，5200名公众登上两艘科考船参观，300多万人次通过新浪微博、人民日报客户端等新媒体渠道观看了科考船入港直播，实践了一场生动的海洋科普教育。

An eventful week was co-organized by the French research schooner TARA and Xiamen University's R/V Tan Kah Kee. Activities included a livestream of Tara's arrival, vessel open days, joint science symposium, public lectures, exhibition and media conference. Mr. Jinlin Yang, XMU alumni and well-known media person gave a public talk on ocean civilization. The events were highly popular, witnessed by 5,200 vessel visitors, and received 3 million online views through Sina Weibo and People's Daily livestream.

五月 / May

由Peter Liss、Curtis Suttle、Catherine Jeandel、Katja Fennel及刘祖乾教授等5名专家组成的国际评估委员会对实验室的发展进行现场评估并提出发展建议。
A group of 5 international scientists (the International Review Committee, including Drs. Peter Liss, Curtis Suttle, Catherine Jeandel, Fennel Katja and James Liu) met at MEL to review the Laboratory, with the overarching goal of identifying the strengths and weaknesses of MEL, and generated recommendations for further development.

东山太古海洋科学观测与实验站长时间序列共享航次项目正式启动。
The D-SMART long-term time-series shared cruises project was officially launched along the Dongshan coast.

六月 / June

焦念志当选美国微生物科学院院士
Nianzhi Jiao was named a Fellow of the American Academy of Microbiology.

七月 / July

厦门大学地球科学与技术学部与新浪（厦门）信息技术有限公司达成战略合作，通过新浪新闻与微博等新媒体，以全新方式推动海洋科学传播和科普教育。
A strategic agreement was signed with the Sina Corporation (Xiamen) to jointly promote the ocean education and outreach through Weibo and other new media.

八月 / August

商少凌担任首席科学家的项目“滨海核电站取水区典型致灾生物立体监控系统及应用示范”获国家重点研发计划“海洋环境安全保障”重点专项立项，获批经费1872万元。
The project on “Comprehensive system and application demonstration for monitoring typical disaster-causing organisms in coastal waters nearby power plants” led by Shaoling Shang was funded by the National Key Research and Development Program with the total funding of 18.72 million Yuan.

九月 / September

由国家自然科学基金委主办，我实验室与香港大学太古海洋科学研究所共同承办的“内地与香港前沿学科发展论坛”，汇聚了55名学者，共同探讨环境变化背景下近海可持续观测与实验面临的挑战，共谋海洋前沿学科发展。
A Mainland-Hong Kong Joint Workshop on Challenges in Sustainable Coastal Observation and Experiments in a Rapidly Changing Environment was organized by NSFC, and hosted by MEL and Swire Institute of Marine Sciences, the University of Hong Kong.

黄邦钦担任首席科学家的国家重点研发计划项目“海洋生态系统储碳过程的多尺度调控及其对全球变化的响应”中期评估优秀，获延续资助，总经费2500万元。
The National Key Research & Development Program on “Marine Carbon Sequestration: Multiscale Regulation and Response to the Global Change” led by Bangqin Huang was renewed for another 2 years owing to their excellent performance during the mid-term evaluation, with a total funding of 25 million Yuan.

李忠平入选美国光学学会会士
Zhongping Li was elected as a Fellow of the Optical Society of America.

十月 / October

成功回收2017年6月在南海中部海域布放的多学科多参数4000米深海潜标1套，该潜标已对观测站位的水文、水动力、海水化学、生物等要素进行了为期16个月的全水深连续观测。

A multi-disciplinary deep sea (4000m) sub-surface mooring system, which was deployed in June 2017 in the central South China Sea, was recovered successfully. The mooring system has collected all-depth profile data in hydrology, hydrodynamics, marine chemistry and biology for 16 months.

十一月 / November

厦门大学第七届海洋科学开放日暨海洋文化大讲堂在翔安校区举办，吸引约6300名公众前来参加。

The 7th Xiamen University Annual Ocean Sciences Day was held and attended by about 6300 visitors.

戴民汉担任首席科学家的项目“海洋荒漠生物泵固碳机理及增汇潜力”获国家自然科学基金重大项目立项，获批经费1984.9万元。

The project on “CARBON Fixation and Export in the oligotrophic ocean (Carbon-FE)” led by Minhan Dai was funded by the NSFC Major Program, with the total funding of 19.849 million Yuan.

十二月 / December

柯才焕担任首席科学家的项目“重要养殖贝类种质创制与规模化制种”获国家重点研发计划“蓝色粮仓科技创新”重点专项立项，获批经费3307万元。

The project on “Creation and large-scale seed production of important cultured shellfish” led by Caihuan Ke was funded by the National Key Research and Development Program with a total funding of 33.07 million Yuan.

东山站获福建省科技厅批准，成为福建省首批野外观测研究站。

The D-SMART was approved by the Fujian Provincial Science and Technology Department, to be one of the first field observation and research stations in Fujian Province.

与加拿大达尔豪西大学联合中国、加拿大、美国、法国、英国、德国等科研院校成立“海洋研究与教育国际联合实验室”

A joint laboratory for Ocean Research and Education (LORE) was co-convened and established with University of Dalhousie.

科研课题
RESEARCH PROJECTS

2018年度，实验室新增科研课题41项，合同经费约1.25亿元，其中包括国家重点研发计划专项项目2项，国家自然科学基金重大项目1项、重大研究计划重点项目4项、培育项目1项、国际(地区)合作与交流项目2项、联合基金项目3项，面上及青年基金项目课题14项，其他省部级项目15项。

In 2018, MEL faculties were awarded 125 million RMB for 41 projects in competitive research grants mainly from the National Natural Science Foundation (NSFC), Ministry of Science and Technology (MOST) and Ministry of Natural Resources (MNR).

部分新增课题
Selected New Projects Funded in 2018

课题名称 Project Title	课题负责人 PI	经费 Budget (10K RMB)
国家自然科学基金重大项目/重大研究计划重点支持项目/重点项目/培育项目 NSFC Key Program		
【项目】海洋荒漠生物泵固碳机理及增汇潜力 [Project] CARBON Fixation and Export in the oligotrophic ocean (Carbon-FE)	戴民汉 Minhan Dai	1984.9
【课题】海洋荒漠区生物固氮的时空格局、限制因子及对输出生产力的贡献 [Sub-project] Spatiotemporal distribution, nutrient limitation, and contribution to export production of biological nitrogen fixation in the oligotrophic ocean	史大林 Dalin Shi	229.4
【课题】海洋荒漠区真光层初级生产力和浮游生物群落的时空变化及控制机理 [Sub-project] Spatio-temporal variability of primary production and plankton and its driving mechanism in the euphotic zone of oligotrophic ocean	商少凌 Shaoling Shang	210
【课题】海洋荒漠区输出生产力的时空分布特征与主控机理 [Sub-project] Export production in the Oligotrophic Ocean: spatio-temporal variability and key controls	戴民汉 Minhan Dai	1010
陆海关键带（地上、地下河口）氮过程 Nitrogen processes in the critical zone at land-ocean boundary: The estuary and subterranean estuary	高树基 Shuh-Ji Kao	290
基于类群分辨的海洋浮游植物固碳遥感机理与方法研究 Development of phytoplankton-resolved remote sensing algorithm for estimation of primary production	李忠平 Zhongping Li	306
热带西太平洋地形、环流和涡旋共同调控下的暖池形态年代际演变过程 Decadal variation of tropical western Pacific warm pool modulated by topography, circulation and eddies	严晓海 Xiao-Hai Yan	253
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重点项目介绍
Project Highlight

海洋荒漠生物泵固碳机理及增汇潜力
CARBON Fixation and Export in the oligotrophic ocean (Carbon-FE)

国家自然科学基金重大项目，首席科学家：戴民汉
NSFC Major Program, Leading PI: Minhan Dai

全球表层海洋面积约 30% 为低生物量的寡营养海域，通常称为“海洋荒漠”。尽管单位面积的生产力很低，但海洋荒漠面积巨大，故而对全球海洋碳汇具有潜在的重要贡献，可能具有增汇潜力，是全球海洋碳循环的重要环节，但却是研究最为匮乏的海域。本项目聚焦最大的海洋荒漠区之一，北太平洋副热带流涡区（图 1），拟系统探究海洋荒漠区真光层的生物泵结构、过程和机理，评估其在全球变化背景下的发展趋势，进而构架寡营养系统生物泵新理论框架，并为海洋荒漠的增汇途径及其有效性提供科学论证。

项目的科学假设为：海洋荒漠区的真光层具有特征迥异的双层结构，由营养盐匮乏层（NDL）和营养盐充足层（NRL）构成，两者的营养盐来源与结构的不同，引起生物群落组成的差异，进而决定了真光层双层结构不同的输出生产力：NDL 的输出生产力主要由固氮作用等引入的外源营养盐驱动，而固氮又主要受微量营养盐铁的限制；NRL 的输出生产力则由深层输入的营养盐驱动。）（如图 2）

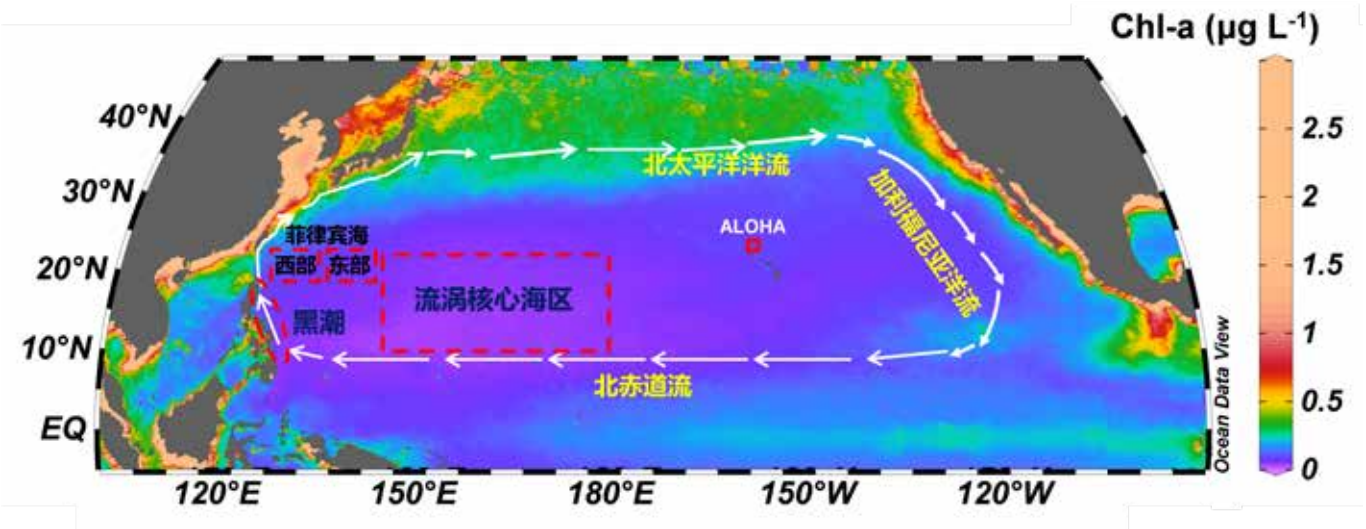


图 1. 北太平洋副热带流涡区图示。NPSG 西接黑潮、东邻加利福尼亚洋流，南北界分别为北赤道流和北太平洋洋流；颜色表示 1997–2010 年平均的表层叶绿素浓度（NASA/GSFC OBPG）；ALOHA 代表夏威夷时间序列站。

Figure 1. Schematic of the North Pacific Subtropical Gyre (NPSG). NPSG is formed by four prevailing ocean currents: the North Pacific Current to the north, the California Current to the east, the North Equatorial Current to the south, and the Kuroshio Current to the west. The background color indicates the long-term (1997-2010) climatology surface chlorophyll (NASA/GSFC OBPG). ALOHA represents the Hawaii Ocean Time-series station in the eastern NPSG.

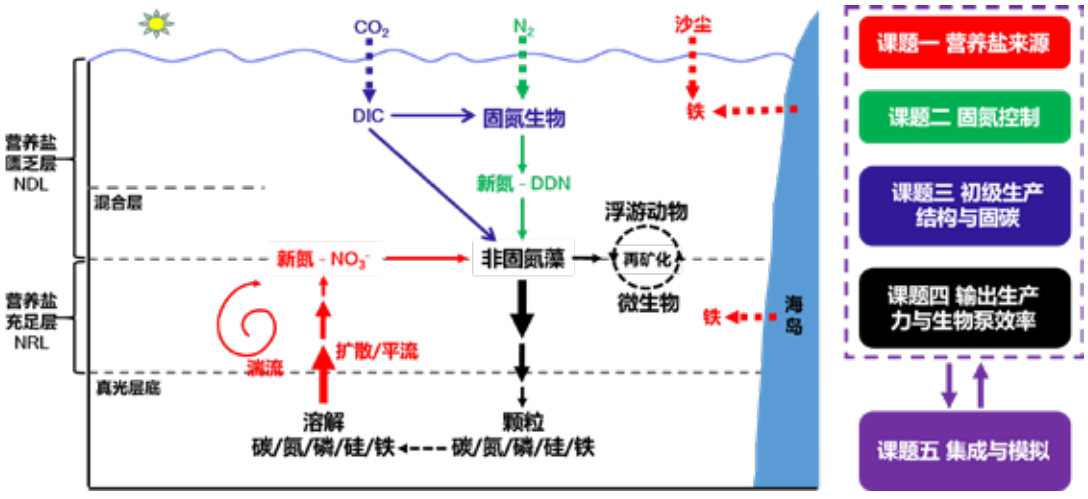


图 2. 寡营养海域真光层内的生物地球化学过程与机制示意图与本项目课题设置。
Figure 2. Schematic of major biogeochemical processes in the euphotic zone of the oligotrophic ocean (middle) and associated gradients in chemical and physical parameters (left; based on Du et al., 2017). The right panel indicates the five subprojects of this project. DDN denotes diazotrophic-derived nitrogen. Due to the strong thermal stratification, the surface mixed layer (SML) is typically shallower than the nutrient-depleted layer (NDL). The blue-green light that is more favorable to phytoplankton growth in the open ocean can penetrate deeper than the yellow-red light. The base of the "real euphotic zone" is thus usually deeper than that traditionally defined as the depth where photosynthetic available radiation (PAR) is 1% of its surface value. This implies that both light intensity and light quality should be taken into account when examining its effect on the biogeochemical processes in the oligotrophic ocean.

项目拟解决的核心科学问题是：在真光层双层结构框架下，海洋荒漠生物泵的物质基础、结构、时空格局、效率及其固碳和增汇潜力如何？据此，项目设置常量和微量营养盐的来源与通量、固氮作用的时空格局及调控因子、初级生产固碳及浮游生物群落结构、碳输出及其与氮、硅等生源要素的耦合、海洋荒漠区生物泵的模拟 5 个课题（图 2）。课题负责人分别为：厦门大学戴民汉、史大林、商少凌，中国海洋大学张劲，中科院南海海洋研究所修鹏。

The oligotrophic ocean occupies about 30% of the ocean surface and has been conventionally regarded as ocean deserts. It is characterized by nutrient depletion in the surface waters and extremely low net biological production and hence, per unit area, contributes little to carbon export from surface to deep waters. Emerging evidence, most notably based on ocean time-series studies such as those at the Hawaiian Ocean Time-series station, has shown a wider than previously assumed dynamic range of nutrient inputs and biological responses in this oceanic system. This project selects the North Pacific Subtropical Gyre (NPSG), one of the world's largest oligotrophic regimes, as the study site to examine carbon fixation and export, or the biological pump in general, regulated by differently sourced nutrients including macronutrients (i.e., N, P, Si) and micronutrients (e.g., Fe). The main hypothesis of this proposal is as follows. Due to strong surface stratification in the NPSG, the nutricline is shallow and structures the euphotic zone into two distinct vertical layers: the upper nutrient-depleted layer (NDL) lacking nutrient supply from below, and the lower nutrient-replete layer (NRL). Interestingly, the NDL often features high, sometimes even the majority of primary productivity in the euphotic zone along with frequently observable net community productivity and/or export production. Such paradox could partly result from new N introduced into the NDL from such as biological N_2 fixation and atmospheric deposition. As the N_2 fixation could be limited by Fe and/or P, their sources would possibly drive the carbon export from the NDL. In the NRL, in comparison, the driver of the carbon export would be the subsurface nutrient supplies.
The major objectives of this proposal are thus (1) to determine the distribution of macro- and micro-nutrients, fingerprint their sources and estimate their fluxes into the NPSG, (2) to constrain the spatial-temporal variability of biological N_2 fixation and its limiting factors in the NDL, (3) to quantify the carbon fixation and associated planktonic community structure, (4) to constrain the export production from both the NDL and NRL, and (5) to simulate the biological pump and carbon sinks in the NPSG. This project is aiming to substantially improve our understandings to fundamental biogeochemistry in these climatically and ecologically important oligotrophic ocean systems. The 5 sub-projects are chaired by Minhan Dai, Dalin Shi, Shaoling Shang from Xiamen University, Jing Zhang from Ocean University of China and Peng Xiu from CAS South China Sea Institute of Oceanology.

滨海核电站取水区典型致灾生物立体监控系统及应用示范

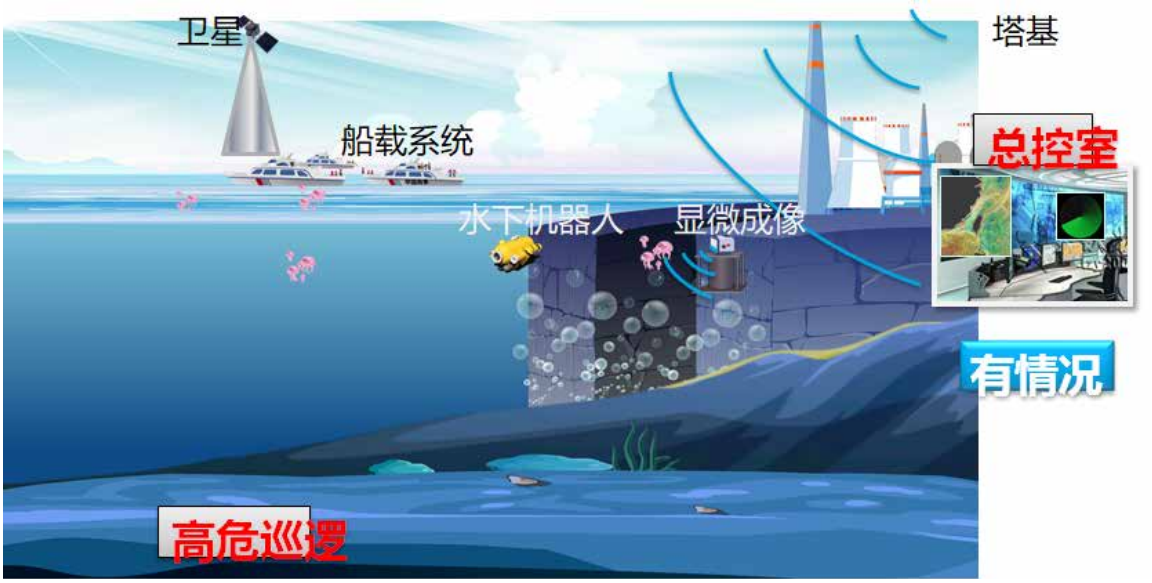
Comprehensive system and applied demonstration for monitoring typical disaster-causing organisms in coastal waters near nuclear power plants

国家重点研发计划 – 海洋环境安全保障专项项目，首席科学家：商少凌

National Key Research and Development Program, Leading PI: Shaoling Shang

滨海核电站海洋生物爆发堵塞取水口、影响核电安全运行的事件频频发生，而现有因应措施缺乏时效性与系统性，为此，本项目以研发建立先进的核电致灾生物立体动态监测与防控决策支持系统为目标。拟着重研究核电站海域致灾生物时空分布规律与聚集成因；研发致灾生物光 – 声立体探测技术，实现连续、大范围监测；发展水动力模型对致灾生物的运动轨迹进行准确预测，建立针对性的预警体系；研发新型致灾生物防控、处置技术；集成构建先进的核电致灾生物立体动态监测与防控决策支持平台，最终实现对致灾生物的多尺度全方位监测、预警、快速响应、控制与处置。该系统将在海南昌江核电站、福建福清核电站进行示范应用，最终与国家海洋环境安全保障平台对接，为核电冷源安全提供科技支撑。

There have been frequent water supply blockages for coastal nuclear power plants due to blooms of marine organisms. This severely undermines the safe running of the plants. However, existing systems cannot respond to such events in a timely and effective manner. This project aims to develop an advanced system to comprehensively monitor problematic organisms and support decision-making on the plant's safe operation. We will focus on studying the tempo-spatial distribution patterns and gathering mechanisms of these organisms in coastal waters near nuclear plants, develop comprehensive optical-sonic technologies that can continuously monitor the organisms, construct hydrodynamic models to precisely predict their trajectories and establish early-warning systems, research and develop novel prevention control and removal technologies, and eventually integrate a decision-making system to help the safe operation of such plants. The system will be demonstrated at Hainan Changjiang and Fujian Fuqing nuclear plants, and ultimately be connected to the National Safeguard Platform on Marine Environment to provide scientific and technological support for the supply of water for nuclear plants.



核电致灾生物立体动态监测与防控决策支持系统概念图

Conceptual diagram of a three-dimensional and dynamic monitoring system to support decision-making for nuclear power plants

热带西太平洋地形、环流和涡旋共同调控下的暖池形态年代际演变过程
Decadal variation of tropical Western Pacific Warm Pool modulated by topography, circulation and eddies

国家自然科学基金重大研究计划重点支持项目，首席科学家：严晓海
NSFC Major Program, Leading PI: Xiao-Hai Yan

西太平洋暖池对于全球热量、水汽和动量的再分配，特别是东亚气候变化，具有重要影响。本项目关注西太暖池近三十年来的年代际变化，拟结合遥感和历史现场观测资料，应用基于深度学习的中深层海洋遥感反演方法，得到自 1987 年以来的高精度次表层海温，准确刻画西太暖池的时空演变特征。在此基础上，采用高分辨率数值模式和动力诊断方法，研究在沟－弧－盆体系，特别是印度尼西亚海和菲律宾海群岛地形的调控下，热带西太平洋的环流调整和中尺度涡变化特征，阐明环流－涡旋－地形之间相互作用的动力过程。进而定量评估海气界面通量、海洋环流和涡致输运等过程对西太暖池年代际变化的各自贡献，并定性分析暖池变异与典型气候变率之间的动力关联。该研究有助于回答重大研究计划提出的关键科学问题（西太平洋复杂地形对海洋动力过程和气候系统的影响），更好地认识西太暖池的演变机理，为提高太平洋气候变率和东亚季风的预测能力提供有价值的动力学信息和理论支持。

Western Pacific warm pool (WPWP) exerts remarkable impacts on the global heat, moisture and momentum redistributions, especially the East Asian climate variability. This proposal focuses on the decadal variability of WPWP in the past 30 years. With the synergy of multi-sensor remote sensing data and in-situ observations, we will use deeper ocean remote sensing technology to reconstruct high-resolution subsurface and deeper ocean temperature since 1987, and thus illustrate the spatiotemporal variability of WPWP in detail. Then we will utilize a high-resolution numerical model and the dynamic diagnoses to investigate the circulation and eddy features with the modulation of the trench-arc-basin system, in particular the archipelagoes around the Indonesian Sea and Philippine Sea. An emphasis will be on the dynamics related to the interactions among circulation, eddy and topography. Furthermore, this study will try to quantify the respective contributions of air-sea flux, ocean circulation and eddy-induced transport to the decadal WPWP changes. The possible linkages between WPWP variability and some typical climate indices will also be assessed and dynamically explained. This application will be helpful to answer a key scientific question proposed in this major research plan (the impacts of complex topography on the ocean dynamics and climate system), better understand the mechanisms of WPWP changes and provide dynamic background and theoretical support for improving our ability on the Pacific climate prediction and East Asian monsoon forecasting.

基于类群分辨的海洋浮游植物固碳遥感机理与方法研究
Development of phytoplankton-resolved remote sensing algorithm for estimation of primary production

国家自然科学基金重点项目，首席科学家：李忠平
NSFC Major Program, Leading PI: Zhongping Li

浮游植物通过光合固碳（以初级生产力（PP）为指标）启动生物泵，而不同类群固碳速率及碳输出皆不同，故实现区分类群的海洋初级生产力遥感，关乎海洋碳收支与碳循环研究，意义重大。传统算法基于低反演准确度的叶绿素浓度，忽略浮游植物类群差异，导致遥感估算 PP 准确度低，难以反映实际的时空变化。浮游植物吸收系数遥感反演准确度高，且吸收与量子产率结合的固碳模型符合光合固碳机理，并可反映类群差异，故本项目提出吸收中心与分类群量子产率结合的固碳遥感新思路。首先基于浮游植物吸收光谱，研发可判别优势类群的半分析算法，并研究典型类群的量子产率特征，从而发展以吸收和分类群的量子产率为输入的 PP 模型。拟通过实验室培养与现场调查，覆盖近海至海盆不同生境，以硅藻、甲藻、绿藻、蓝藻为主要对象研究其光合作用机理；并选择陆架－海盆断面，应用遥感数据检验新算法对初级生产力与类群动态变化的反映。该研究将为碳循环与全球变化研究奠定核心技术基础。

Phytoplankton fix carbon via photosynthesis (measured as primary production, PP), and then initiate the biological pump. Different phytoplankton have varying photosynthesis and export rates, thus for the study of carbon budget and carbon cycle it is important to develop phytoplankton-resolved remote sensing algorithms. Traditional remote sensing models are centered on the concentration of chlorophyll and ignore differences in phytoplankton functional types, consequently the estimated PP from remote sensing data has a low accuracy which is inadequate to describe the temporal-spatial variations of PP. The remote sensing of phytoplankton absorption coefficient (aph) has a much higher accuracy than the remote sensing of chlorophyll concentration; also, a model through the combination of absorption and photosynthesis quantum yield is in accordance with photosynthesis. Therefore, this project proposes to develop phytoplankton-resolved-absorption-centered remote sensing model for PP. First, a semi-analytical algorithm will be developed to discriminate phytoplankton functional types (PFTs) based on aph spectrum; at the same time, the quantum yield of various typical PFTs will be characterized. Based on these, a PP model using aph and phytoplankton-resolved quantum yield as inputs will be developed. We will conduct both laboratory measurements and field surveys in China seas, covering both nearshore and offshore waters, focusing on diatom, dinoflagellates, green algae and cyanobacteria to study their photosynthesis mechanisms. Further, remote sensing data crossing coastal to oceanic waters will be selected to evaluate the developed algorithms on describing the dynamics of PFTs and PP in these environments. Outcomes of this project will not only greatly improve the accuracy of PP estimation, but also establish solid base in technology and data for studying carbon cycle and climate change.

西太平洋关键中小尺度过程能量串级与相互作用机理研究
An investigation of mesoscale and small-scale processes in the western Pacific Ocean: Energy cascades and multi-scale interactions

国家自然科学基金重大研究计划重点支持项目，首席科学家：刘志宇
NSFC Major Program, Leading PI: Zhiyu Liu

海洋是一个典型的多尺度强迫－耗散系统，为使不同尺度的运动达到准稳态，能量必须从强迫尺度传递到耗散尺度，这一跨越近十个数量级的能量传递过程称为能量串级。能量串级是物理海洋学研究的一个基本问题，而受观测、数值模拟水平以及理论建模难度等各方面的限制，这也是一个经典难题。西太平洋拥有强劲的西边界流、活跃的中尺度涡与内波等各种尺度的运动，是研究海洋能量串级与多尺度运动相互作用的绝佳实验场。本项目将综合利用现场与卫星遥感观测、理论分析与数值模拟等手段，探明控制内孤立波裂变及其生成高频内波的关键因子与作用机制，揭示参数次谐波不稳定在内波场非线性演化与能量串级中的核心作用，阐释流固相互作用所诱发的亚中尺度不稳定在中尺度平衡运动能量降尺度串级中的重要作用，阐明中尺度平衡运动与近惯性内波相互作用的主要过程与作用机理，从而显著提升对西太平洋关键中小尺度过程能量串级与非线性相互作用主要过程与控制机理的认识。

The ocean is a forced-dissipative system being operated at a wide range of spatiotemporal scales. In order to achieve quasi-equilibrium, the kinetic energy in the ocean transfers from scales of forcing at basins scale to viscous dissipation at the molecular scale. This energy transfer process, covering nearly ten orders of magnitude, is called energy cascade. Oceanic energy cascade is a fundamental issue of physical oceanography and also a classic puzzle due to challenges in observations as well as in numerical and theoretical modelling. Processes at all these scales occur in the western Pacific Ocean, for example from the strong western boundary currents, vigorous mesoscale eddies and internal waves down to small-scale overturns. Thus, it is an ideal experimental area for studies of oceanic energy cascade and multi-scale interactions. Based on a combination of in situ measurements, satellite observations, theoretical analyses and numerical modelling, this project aims to explore (i) the dynamics of the fission of internal solitary waves and key factors controlling the generation of high-frequency internal waves; (ii) the important roles played by Parametric Subharmonic Instability on the nonlinear evolution of internal waves and energy cascade; (iii) the submesoscale instabilities induced by flow-topography interactions and their roles on the forward energy cascade of mesoscale balanced motions; (iv) the processes and mechanisms of the interactions between mesoscale balanced motions and near-inertial waves. Better knowledge of the above processes will significantly improve our understandings of the characteristics, non-linear interactions, and fundamental dynamics of the oceanic energy cascade for the key mesoscale and small-scale processes in the western Pacific Ocean.

陆源有机碳在海洋中的归宿
The fates of terrestrial organic carbon in the ocean

国家自然科学基金委与联合国环境规划署合作研究项目，首席科学家：焦念志
NSFC International Cooperation and Exchange Program with the United Nations Environment Programme (UNEP), Leading PI: Nianzhi Jiao

海洋是地球上最大的碳汇。海洋中的有机碳绝大多数是以惰性有机物的形式存在的，是海洋碳汇的重要组分。河流每年输送的大量陆源有机物的消耗利用会引发众多的生态问题如酸化，缺氧和富营养化。然而，调控陆源有机碳 (DOC) “命运”的机制仍是未知的。微型生物碳泵（MCP）理论强调了微型生物过程对 DOC 库的贡献，提供了验证陆源 DOC “命运”和内在机制的框架。本项目旨在研究 MCP 的关键过程和机制以及在近海的生态环境和生物地球化学效应。主要研究内容：近海 MCP 对陆源 DOC 的转化利用；生物泵的垂向过程及 MCP 的效应；微生物活动及 MCP 在典型近海的季节性变化；营养盐对 MCP 的影响；MCP 的物理 – 生物耦合模型。通过结合现场时间序列调查、大尺度围隔培养实验和室内实验来探究 MCP 过程机制与海洋碳循环的生态和生物地球化学效应之间的联系，建立全球变化下海洋有机碳变化的情境模型，并且为未来海洋碳汇工程提供理论和技术性基础。

The ocean is the largest carbon sink on this planet. The majority of the organic carbon in the ocean is actually in the form of dissolved organic matter (DOM) which is recalcitrant, with an average age of ~5000 years, constituting a sequestration of carbon in the ocean. Rivers transport 400 Mt of organic carbon annually to estuary and coastal seas. Large amount of terrestrial organic matter consumption can lead to ecological problems such as acidification, hypoxia and eutrophication. However, the mechanisms controlling the fates of terrigenous DOC are largely unknown.

The microbial carbon pump (MCP) offers a formalized and mechanistic focus on the significance of microbial processes in carbon storage in the RDOM reservoir, and a framework for testing the fates of terrigenous DOC and the underlying mechanisms. Understanding of the functioning and efficiency of the MCP is an urgent need for our knowledge of marine carbon cycle. This project aims at the key processes and mechanisms of the MCP and the environmental and biogeochemical consequences of the MCP in the coastal seas. The major research contents include: terrestrial organic carbon transformation through the MCP in the coastal waters; Vertical process of the biological pump and the effects of the MCP; Seasonal dynamics of microbial activities and the MCP in typical coastal waters; Effects of nutrients on MCP; and Modeling the MCP based on physical-biological coupled model. This project combines the time series field investigation, large scale enclosures and laboratory research by using marine microbiology and chemistry to establish the linkages between the MCP process and the ecological and biogeochemical effect of the marine carbon cycle. Through interdisciplinary exchanges among biologists and chemists, and through comparative studies between macrocosm and field marine environments, the project targets on elucidating the MCP processes and mechanisms, establishing scenario models for marine DOC dynamics under global change, and providing theoretical and technical basis for future ocean carbon sink engineering.

交流与合作
EXCHANGES AND COOPERATION

组织或承办的会议
MEL ORGANIZED SYMPOSIA/CONFERENCES in 2018

内地与香港前沿学科发展论坛
The Mainland-Hong Kong Joint Workshop

“内地与香港前沿学科发展论坛：环境变化背景下近海可持续观测与实验面临的挑战”于 2018 年 9 月 27-29 日在厦门召开。论坛由国家自然科学基金委主办，近海海洋环境科学国家重点实验室、香港大学太古海洋研究所及厦门大学东山太古海洋观测与实验站共同承办，旨在探讨全球变化和人类活动加剧影响背景下的近海海洋观测和实验的研究现状、发展趋势和面临的挑战，共同研讨如何通过两地学者的通力协作，实现海洋科学相关领域的突破，提高海洋科学观测与研究水平。来自内地及香港的 12 个科研院所的物理海洋学、海洋生态学、化学海洋学、大气科学等领域共 55 名学者参加了该论坛。

The Mainland-Hong Kong Joint Workshop on Challenges in Sustainable Coastal Observation and Experiments in a Rapidly Changing Environment was held on September 27-29, 2018, organized by the NSFC and hosted by MEL, the Swire Institute of Marine Sciences and Dongshan Swire Marine Station. The workshop was composed of information and knowledge sharing via short talks and discussions. 55 researchers from mainland and Hong Kong institutions participated in the discussions on 3 topics: 1) Continuous observations of coastal Chinese waters: developing autonomous and interdisciplinary platforms; 2) Approaches to understanding the functioning of coastal ecosystems under the coupled impacts of intensive human activity and climate change; 3) The future of coastal ecosystems and human communities under 3°C warming: predictive modeling and empirical approaches to maximize adaptation. The goals were to frame large scale initiatives possible for funding support from mainland and/or Hong Kong agencies.

(Photo by Suwei Weng)

“海洋生源要素循环过程与效应”国际研讨会
International Workshop on Processes and Effects of Biogenic Element Cycling in the Ocean

11 月 8-9 日，由焦念志召集的“海洋生源要素循环过程与效应”国际研讨会在厦门召开，来自中国、加拿大、美国、法国、英国、德国等科研院校的研究人员 20 余人做了学术报告。会上成立了由厦门大学发起的“海洋研究与教育国际联合实验室”。联合实验室将通过项目申请、合作研究、大型实验、仪器共享、技术研发及研究生培养等方式，加强海洋科学前沿创新研究、支撑国家需求。

Convened by Nianzhi Jiao, the International Workshop on Processes and Effects of Biogenic Element Cycling in the Ocean took place in Xiamen on November 8-9, joined by over 20 speakers from China, Canada, USA, France, UK and Germany. An agreement to establish the Joint Laboratory for Ocean Research and Education (LORE) was signed by Xiamen University and the Dalhousie University, aiming to strengthen international collaboration on joint research proposals, experiments, facility sharing, and student exchanges.

协办的会议
MEL CO-SPONSORED SYMPOSIA/CONFERENCES

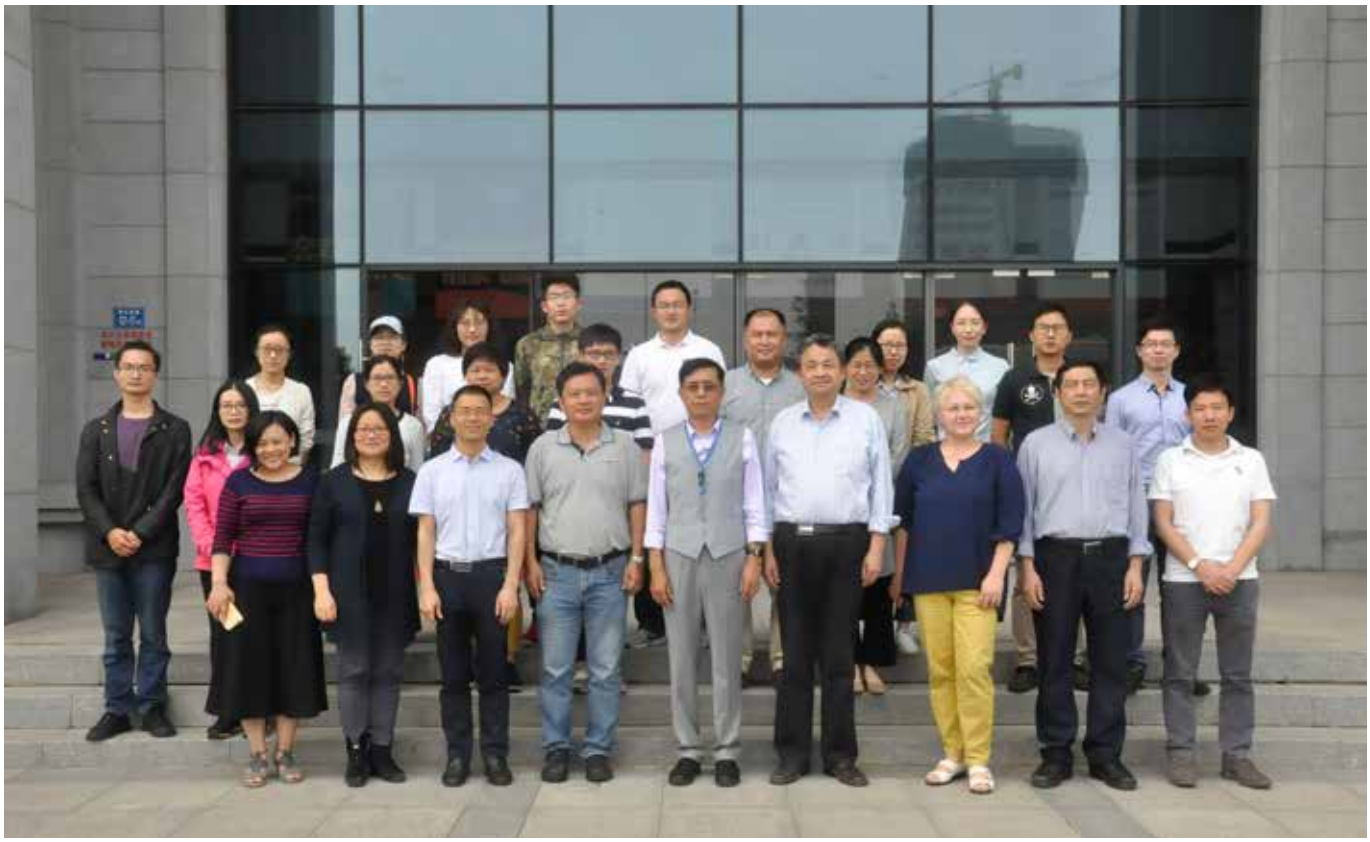
- Workshop on Tropical Inter-Basin Interactions, January 21-23, 2018, Xiamen
- 3rd Open Science Symposium on Western Pacific Ocean Circulation and Climate, May 8-10, 2018, Qingdao
- Symposium on Harmful Algal Blooms and Hypoxia in A Changing Ocean, May 25-26, 2018, Hangzhou
- Ocean Carbon from Space ($SatCO_2$): Joint Science Workshop and Training (III), November 23 -25, 2018, Hangzhou

凌峰论坛
LINGFENG FORUM

凌峰论坛自 2004 年开展以来，持续发挥“启迪新思想，促进学术融合”的重要作用，对实验室的研究方向与学术交流产生深远的影响。2018 年，实验室举办了 5 讲凌峰论坛。

Initiated in 2004, the Lingfeng Forum continues to play an important role as a platform to foster new ideas and promote academic fusion for MEL faculty and students. Five forums were organized in 2018.

No.	Theme	Conveners
#70	Emerging Topics --marine microplastics	Xinhong Wang and Minhan Dai
#69	Physical-biogeochemical coupling on mesoscale eddies -- progress and perspective	Kuanbo Zhou and Hongyang Lin
#68	Changing aquatic biological processes and ecological disasters under multiple anthropogenic drivers	Kunshan Gao and Yiyong Zhou
#67	Marine organisms and ecological processes under influences of ocean global changes	Yunwei Dong and Kunshan Gao
#66	Carbon cycle in mangrove wetland and global change	Bangqin Huang, Nengwang Chen, Xudong Zhu and Qian Liu



Group photo of the Lingfeng Forum #68 (Photo by Lei Chen)

午餐交流会
LUNCHEON SEMINARS

自 2014 年启动的“周一午餐交流会”，内容涵盖学术探讨、运行管理、平台建设等方面，2018 年共进行了 44 讲。
The MEL Weekly Luncheon Seminar Series was launched in 2014 to facilitate interactions among faculty, staff, students and visitors. A total of 44 luncheon seminars were held in 2018.

No.	Title	Speaker
#91	First results from Overturning in the Subpolar North Atlantic Program (OSNAP)	Feili Li Duke University, USA
#92	Accelerated deforestation in Maritime Continent contributes to weaken the Asian monsoon	Leo Oey National Central University (Taoyuan)
#93	Exploring the role of small-scale thermohaline structure on mixing and transport in the ocean	Yihua Li University of New South Wales, UK
#94	China’s anthropogenic nutrients fluxes in freshwater ecosystem and implications for coastal environment	Yan Lin Norwegian Institute for Water Research, Norway
#95	Adaptive Radiation of Marine Ammonia-oxidizing Archaea From Physiology, to Genome, to Ecology	Wei Qin University of Washington, USA
#96	The Driving Processes for the Subpolar North Atlantic Ocean Heat Content and implications on Global Climate Change	Weiwei Zhang Xiamen University
#97	Why We Need the Marine Iron Models and How They Work	Ying Ye Alfred Wegener Institute for Polar and Marine Research, Germany
#98	红海行动	Bai’an Lin Xiamen University
#99	Fine Systematics for the Vast Marine Invertebrates Incongruent Cladistics Indicate New Taxa	Xikun Song Xiamen University
#100	Response of C4 Photosynthesis to Environmental Changes in A Marine Dinoflagellate	Hao Xhang Xiamen University
#101	碳循环与气候变迁：冰与火	Weidong Sun Institute of Oceanology, CAS
#102	多重环境变化对颗石藻和南海浮游植物群落固碳速率的相互影响	Yong Zhang Xiamen University
#103	Shedding light on the dark depths inside coral	Chichi Liu Xiamen University
#104	Oceanic nutrient limitation Recent discoveries in the Atlantic	Thomas Browning GEOMAR Helmholtz Centre for Ocean Research Kiel, Germany

No.	Title	Speaker
#105	Evolutionary strategies in marine phytoplankton interrelated influence of nutrients, cell size, and grazing defense	William Sunda University of North Carolina, Chapel Hill, USA
#106	Marine iron at the edge Why ocean margins are our greatest source of uncertainty	Amber Annett National Oceanography Centre, University of Southampton, UK
#107	海兽搁浅救护与处置	Xinrong Xu Nanjing Normal University
#108	窥探中国的水下世界	Lixin Wu Freelance Photographer
#109	Microbially mediated phosphorus cycle in marine sponges	Fan Zhang Baylor College of Medicine, USA
#110	Chemistry and Biology of Nucleic Acid- and Nucleotide-Binding Proteins	Yinsheng Wang University of California Riverside, USA
#111	Paleo ocean circulation and nutrients distribution new insights from Si isotopes	Guillaume Fontorbe Lund University, Sweden
#112	和ROPOS去南海潜个水	Weidi Yang Xiamen University
#113	Food chains, food webs, and export production in the ocean	Edward Laws University of Hawaii, USA
#114	台湾浊水溪口工业开发环境影响评估个案：经济发展和海岸环境保育关系的视角	James T. Liu Department of Oceanography, National Sun Yat-sen University (Kaohsiung)
#115	Remote sensing of Chlorophyll a concentration and its applications in coastal waters in Gulf of Mexico	Chengfeng Le Zhejiang University
#116	Zooplankton, fisheries and the environment in a changing world	Chichi Liu Xiamen University
#117	'Missing Carbon' from Mangroves	Manab Kumar Dutta Xiamen University
#118	沿海地区波浪和风暴潮的多尺度数值模拟	Zhaoqing Yang Pacific Northwest National Laboratory, USA
#119	科学可以很浪漫：从一只鲍鱼的科普自媒体说起	Hongjie Lin Sina Xiamen
#120	Biogeochemical impacts of a western iron source in the Pacific Equatorial Undercurrent / Natural and Anthropogenic Ocean Acidification	James W. Murray University of Washington, USA

No.	Title	Speaker
#121	Mercury and Methylmercury in the Canadian Arctic, with an introduction to the Canadian Arctic GEOTRACES Program	Feiyue Wang University of Manitoba, Canada
#122	解剖海洋初级生产力	Yuyuan Xie Xiamen University
#123	Turbulent Processes in the Surface Ocean Impact on Air-Sea Exchange	Brian Ward National University of Ireland Galway, Ireland
#124	DNA-related enzymes from hyperthermophilic archaea are useful for developing new genetic engineering technologies	Yoshizumi Ishino Kyushu University, Japan
#125	Ocean acidification drives community shifts towards simplified non-calcified habitats in Asia	Jason Hall-Spencer University of Plymouth, UK
#126	Multi-Approaches to understand a macrotidal estuarine and coastal Environment	Robert Lafite University of Rouen- Normandy, France
#127	Some scientific questions, results and perspectives from the Land-to-Sea Continuum	Yoann Copard University of Rouen- Normandy, France
#128	Extratropical cyclone activity: historical and possible future changes/Part II: Historical and possible future changes of ocean surface waves in the East and South China Seas	Xiaolan Wang Environment and Climate Change Canada, Canada
#129	Studies of the emerging contaminants in estuarine sediments and ocean water	Xi Dai Xiamen University
#130	Controls on molybdenum and uranium isotopic signatures in marine sediments and pore waters on continental margin off Namibia	Zhiwei He University of Science and Technology of China & ETH Zürich
#131	The World's Last Unstudied Major River Delta System: Oceanographic and Tectonic Controls on Sediment Dispersal and Carbon Burial off the Ayeyarwady River	Steven Kuehl College of William and Mary, USA
#132	断层上的地震成核过程与前兆——现状与希望	Changrong He Institute of Geology, China Earthquake Administration
#133	Help, there's -omics in my comparative physiology! -How new tools direct and misdirect our research on insect thermal biology	Brent John Sinclair University of Western Ontario, Canada
#134	海洋微塑料研究：现状与挑战	Jingli Mu Minjiang College
#135	Explosive Volcanism in the Earth System: Experimental Insights	Donald Dingwell Ludwig Maximilian University, Germany

访问学者与开放课题基金
Visiting Fellowship Program

实验室访问学者基金（分为“郑重”杰出 / 杰出、高级和青年 3 类）支持国内外知名专家及青年学者到实验室开展 1 至 6 个月的学术交流与合作。2018 年度共有 28 名学者获批该项基金，包括杰出访问学者 7 名、高级访问学者 8 名、青年访问学者 13 名。其中，杰出访问学者蔡卫君教授为美国地球物理联合会会士，Cindy Lee 教授和 David Hutchins 教授为美国海洋与湖沼学会会士，而 James W Murray 教授是拥有美国古根海姆学者、英国爱丁堡皇家学会会士、英国伦敦皇家学会会士、英国生物学会会士等多个头衔的国际知名学者。

The MEL Visiting Fellowship Program was launched in 2009. The program has supported visiting fellows to conduct collaborative studies with MEL scientists for durations of 1 to 6 months, providing research funds, travel and living expenses. 28 fellows were sponsored in 2018. Among them, Prof. Wei-Jun Cai is an American Geophysical Union Fellow, Professors Cindy Lee and David Hutchins are ASLO Sustaining Fellows, and Professor James W Murray holds several honors, a selection of which are: Guggenheim Fellow 1968, Fellow of the Royal Society (Edinburgh) 1979, Fellow of the Royal Society (London) 1985, Fellow of the Institute of Biology (Great Britain) 1988.

Recipients of the 2018 MEL Visiting Fellowship Program

Distinguished Visiting Fellow		
Edward Allen Laws	Professor	University of Hawaii, USA
Stephen John Hawkins	Professor Emeritus	University of Southampton, UK
Weijun Cai	Mary A. S. Lighthipe Chair Professor	University of Delaware, USA
James W Murray	Professor Emeritus	University of Washington, USA
Guoping Jiang	Professor	National Taiwan Ocean University (Keelung)
David Hutchins	Professor	University of Southern California, USA
Cindy Lee	Distinguished Professor Emeritus	Stony Brook University, USA
Senior Visiting Fellow		
Weiqiang Wang	Research Scientist	South China See Institute of Oceanology, CAS
Nobuyoshi Yamashita	Chief Senior Research Scientist	National Institute of Advanced Industrial Science and Technology, Japan
Lim Po Teen	Associate Professor	University of Malaya, USA
Kang Xu	Associate Research Scientist	South China See Institute of Oceanology, CAS
Zhi Huang	Research Scientist	Geoscience Australia, Australia
Arnaud Huguet	Research Associate	METIS - CNRS/Sorbonne Université, France
Feixue Fu	Associate Professor	University of Southern California, USA
Qiang Xie	Research Scientist	Institute of Deep-sea Science and Engineering, CAS

Young Scientist Visiting Fellow		
Yongle Xu	Postdoctoral Researcher	Shandong University
Ruilong Li	Assistant Professor	Guangxi University
Xiaolong Li	Associate Researcher	Institute of Oceanology, CAS
Yilong Chen	Postdoctoral Researcher	Biodiversity Research Center, Academia Sinica (Taipei)
Wenhui Qiu	Assistant Professor	Southern University of Science and Technology
Guillaume Fontorbe	Doctor	Unaffiliated (previously Lund University), France
Lucia Porzio	Research fellowship	Stazione Zoologica Anton Dohrn, Italy
Bingyi Liu	Associate Professor	Ocean University of China
Jianping Li	Associate Research Scientist	Shenzhen Institutes of Advanced Technology, CAS
Xiaomin Xia	Research Scientist	South China See Institute of Oceanology, CAS
Fei Chen	Assistant Research Scientist	Fuzhou University
Aziz Ullah	Assistant Professor	Kohat University of Science and Technology, Pakistan
Xiangyuan Deng	Associate Professor	Jiangsu University of Science and Technology

#113 Luncheon Seminar by Dr. Edward Laws

#124 Luncheon Seminar by Dr. Yoshizumi Ishino

#125 Luncheon Seminar by Dr.Jason Hall-Spencer

(http//mel.xmu.edu.cn/Visiting_Fellowships.asp?id=1)

其它交流与合作

Other Exchange Highlights

实验室通过访问学者基金与开放课题、“111”引智计划、“凌峰论坛”、“周一午餐交流会”等形式为实验室成员提供与海内外学者交流的平台。2018 年度，共有 120 余名国内外学者通过学术报告、讲授课程、合作研究等多种形式来实验室开展合作交流。此外，科研、技术人员和研究生共计 250 余人次出访，参加国内外学术研讨会、合作研究、联合航次或技术培训等。

International exchanges and collaborations are supported by several programs, for example, the MEL Visiting Fellowship Program, Lingfeng Forum, and the “111” Collaborative Program. In 2018, more than 120 visitors came to MEL and more than 250 MEL members and students went overseas for conferences, academic exchanges, joint research and cruise surveys.

Newly Selected: Service in International Journals in 2018

- Zhimian Cao, Associate Editor, Marine Chemistry
- Xi Chen, Member of Corresponding Editor, Chinese Chemical Letters
- Xi Chen, Member of International Editorial Board, SN Applied Sciences
- Kunshan Gao, Member of Editorial Board, Marine Ecology
- Kunshan Gao, Member of Editorial Advisory Board, Global Change Biology
- Haipeng Liu, Member of Editorial Board, Fish and Shellfish Immunology
- Haipeng Liu, Member of Editorial Board, World Journal of Aquaculture Research & Development
- Zhiyu Liu, Associate Editor, Frontiers in Marine Science
- Dalin Shi, Special Issue Organizer, Journal of Geophysical Research – Oceans

Selected invited talks in national/international conferences

Pinghe Cai, Biogeochemical fluxes between bottom water and sediment based on a novel $^{224}Ra/^{228}Th$ disequilibrium approach. 2018 Gordon Research Conference on Ocean Biogeochemistry, July 8-13, 2018, Hong Kong, China. (Invited talk)

Xi Chen, CsPbBr3 perovskite nanocrystal films as an ECL emitter. 69th Annual Meeting of the International Society of Electrochemistry, August 30-September 1, 2018, Bologna, Italy. (Invited talk)

Minhan Dai, Ocean biogeochemistry in the ocean desert, 3rd Open Science Symposium on Western Pacific Ocean Circulation and Climate, May 8-10, 2018, Qingdao, China (Invited talk)

Nianzhi Jiao, Tackling the enigma of refractory carbon in the ocean. 2018 Gordon Research Conference on Ocean Biogeochemistry, July 8-13, 2018, Hong Kong, China. (Invited talk)

Nianzi Jiao, Microbial carbon sequestration and climate change. 2018 Sino-Micro Annual Meeting -- Microbiome and Organisms: A New Era in Medicine, Food & Agriculture, and the Environment, June 6-11, 2018, Atlanta, USA (Invited talk)

Jian Ma, Development of an integrated Syringe-pump-based Environmental-water Analyzer (iSEA). The 14th International Conference on Flow Analysis, December 2-7, 2018, Bangkok, Thailand. (Invited lecture)

Shuh-Ji Kao, The nitrogen process in key belt of the land-sea interface (surface and underground estuary). The Annual Conference of Chinese Society for Microbiology, October 19-22, 2018, Nanchang, China (Plenary talk, in Chinese)

Shuh-Ji Kao, Marine nitrogen cycle process indicated by the isotope. The fifth China National Conference on Stable Isotope Ecology (2018), September 16-19, 2018, Shenyang, China (Plenary talk, in Chinese)

Minhan Dai was invited to attend the Macao International Conference on Marine Administration, Utilization and Development on August 3-4, and gave a talk on "The present situation of marine ecoenvironment and its sustainable development in the greater Bay Area of the Pearl River delta the Macao Ocean Strategic Planning.

Dalin Shi at the Biogeoscapes Working Group meeting with another 27 scientists from 9 nations in Woods Hole, USA, November 7-10, 2018.

Jian Ma, giving an invited lecture at the 14th International Conference on Flow Analysis, December 2-7, 2018, Bangkok, Thailand.

Bangqin Huang giving an oral presentation on Marine Carbon Sequestration in Marginal Sea Ecosystems: Multiscale Regulation and Response to Global Changes at the 15th AOGS Annual Meeting, June 3-8, 2018 in Hawaii, USA.

Several faculty member and graduate students participated the Gordon Research Conference on Ocean Biogeochemistry in Hong Kong, July 8-13, 2018. Pinghe Cai and Nianzhi Jiao were invited to give talks at the conference.

Minhan Dai and Kejian Wang visited Xiamen University Malaysia to promote the cooperation with local government and the development of China-ASEAN College of Marine Sciences, and attended the International Conference and Exhibition on Cities and Digital Transformation during August 26-28, 2018.

（Photo by meeting organizers）

奖学金与学生教育
FELLOWSHIPS & EDUCATIONAL PROGRAMS

2018年，实验室继续开展多样化人才培养计划，如实施优秀博士生奖学金、本科生奖学金，举办首届海洋动力学春季讲习班、海洋痕量元素与同位素生物地球化学国际讲习班，与台湾海洋大学、香港城市大学及北京大学联合举办“全球变化下的海洋环境和渔业资源保育”暑期学校。鼓励学生继续组织第三届研究生学术论坛，而由厦门大学与香港大学学生自行发起的“水环境科学高校联盟”研讨会已举办至第十年，已成为海洋学科人才培养与交流的重要平台。

MEL continues to sponsor and organize multi-tiered programs to inspire students to pursue excellence in science, such as the MEL PhD Fellowship and Undergraduate Research Fellowship. MEL also hosts and supports diverse exchange programs to foster capacity building, students' leadership and academic development. The programs include the International Training workshop on metal speciation and isotopes in the ocean for GEOTRACES and beyond, the First Spring School on Ocean Dynamics, the Summer School on Marine Environmental and Fishery Resources under Global Change, and the 3rd Graduate Student Forum. We also celebrated the 10th anniversary of the University Consortium on Aquatic Sciences (UCAS) Graduate Symposium!

海洋痕量元素与同位素生物地球化学国际讲习班
A training workshop on metal speciation and isotopes in the ocean for GEOTRACES and beyond

海洋痕量元素与同位素生物地球化学国际讲习班于2018年5月12-17日在厦门举办，美国特拉华大学George Luther III、美国麻省理工学院Edward Boyle、厦门大学王德利、蔡毅华、戴民汉等教授共同组成组委会，并邀请18名国内外专家讲学，来自14个国家的30名学员参加。讲习班包括痕量元素与同位素生物地球化学、电化学两部分的基础理论教学及实操训练。

Co-organized by Drs. George Luther, Edward Boyle, Deli Wang, Yihua Cai and Minhan Dai, the Training Workshop was held on May 12-17, 2018 in Xiamen. 30 students and early career scientists from 14 countries participated in the training. The workshop was composed by both lectures and hand-on experiments.

(Photo by Vera Shi)

首届海洋动力学春季讲习班
The First Xiamen Spring School on Ocean Dynamics (Xmod)

实验室首届海洋动力学春季讲习班于 2018 年 3 月 12-17 日在厦门举办，由厦门大学刘志宇、林宏阳、戴民汉，美国伍兹霍尔海洋研究所黄瑞新、香港科技大学甘剑平发起，主题为“中尺度 – 次中尺度海洋动力过程”，由夏威夷大学 Qiu Bo 教授、法国国家科学研究中心及加州理工 Patrice Klein 教授为主讲专家，为研究生及青年科学家讲解海洋动力学基础知识及最新研究进展，并邀请相关专家共同研讨。共 10 名青年学者入选讲习班“荣誉学员”，约 120 名研究生及青年学者旁听课程。

Convened by Drs. Ruixin Huang (Woods Hole Oceanographic Institution), Jianping Gan (Hong Kong University of Science and Technology), Zhiyu Liu, Hongyang Lin and Minhan Dai (MEL), the First Xiamen Spring School on Ocean Dynamics (Xmod) was held on March 12-17, 2018 in Xiamen. It aimed at introducing fundamental ocean dynamics, from the basics to the research frontiers, to graduate students and early-career scientists. The topics cover a wide range of oceanic phenomena and processes. The theme of the first Xmod was ***Ocean Dynamics at Meso- and Submeso- Scales***. Dr. Bo Qiu (University of Hawaii at Manoa), Patrice Klein (LOPS-CNRS, Ifremer, France / California Institute of Technology, USA) and Ruixin Huang (Woods Hole Oceanographic Institution) were invited to deliver the core lectures for 10 Xmod fellows and other 120 guest participants.

Prof. Ruixin Huang giving lecture.

Prof. Bo Qiu giving lectures.

(Photo by Lei Chen)

(Photo provided by NTOU)

The 2018 Summer School on Marine Environment and Fishery Resources under Global Change was held in Keelung Taiwan on July 5-14, jointly organized by National Taiwan Ocean University, Xiamen University, City University of Hong Kong and Peking University. 16 scientists from NTOU, XMU, PKU, XMU and University of Saskatchewan were invited to give lecturers for 23 participants. It was the 7th iteration since MEL and the State Key Laboratory in Marine Pollution co-convened the first event in 2008.

The 3rd MEL Graduate Forum – One Step Forward Science, organized by the Marine Environmental Science Student Association (MESSA), took place on May 29-31 and was attended by 35 graduates with 25 oral presentations and 10 posters. Special workshops on scientific writing and data analysis, student night, and outreach beyond science were organized. Participants also delivered an outreach class in the Liu Wu Dian Middle School and visited the Chinese White Dolphin Conservation Base.

(Photo provided by MESSA)

（Photo by UCAS Committee）

The UCAS Postgraduate Symposium celebrated its 10th anniversary at D-SMART, Dongshan on March 18 – 23, 2018. The theme of this symposium was "The blue planet——What are we doing & What is to be done?". Together with more than 10 mentor scientists, there were 50 postgraduate students from Xiamen University, University of Hong Kong, National Taiwan Ocean University, National Kaohsiung University of Science and Technology, Ocean University of China and Hohai University, who joined the celebration to share oral presentations, invited talks, interactive workshops, social activities, and field trips to abalone aquaculture farms.

MEL 杰出博士后基金
MEL Outstanding Postdoctoral Fellowship

实验室于2014年设立“杰出博士后基金”，吸引国内外优秀的博士毕业生开展博士后研究，一次促进学科交叉，提高人才培养能力。

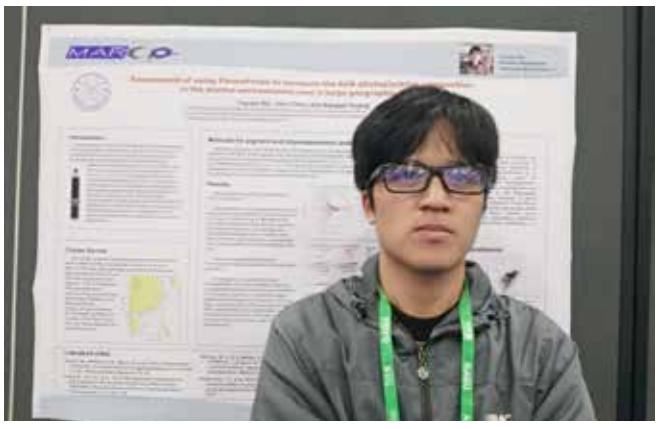
2018年共资助2人，分别是中国地质科学院地质研究所张衍博士、中国科学院海洋研究所高霄龙博士。

2018年，博士后积极申报国家自然科学基金及中国博士后科学基金资助，科研能力不断提升。张勇博士获国家自然科学基金青年科学基金项目，宋希坤博士先后获国家自然科学基金面上项目、中国博士后科学基金第11批特别资助以及中国博士后科学基金第63批面上项目二等资助。

Aiming to foster innovative research and interdisciplinary collaborations, MEL initiated the Outstanding Postdoctoral Fellowship Program in 2014. The Fellowship funds innovative, ground-breaking projects that have the potential to advance knowledge in marine environmental sciences and other interdisciplinary research that fits into MEL's research scopes.

Two applicants were funded in 2018. They are Dr. Kan Zhang from the Chinese Academy of Geological Sciences Institute of Geology, and Dr. Xiaolong Gao from CAS Institute of Oceanology. Among all postdocs, Xikun Song was granted an NSFC General, supported from China Postdoctoral Science Foundation for a Special Project, and received the support from the China Postdoctoral Science Foundation for a General Project. Yong Zhang was granted an NSFC Young Scientists Fund.

Dr. Xikun Song participated in the third SAT of science mission (KK1802 Cruise) (Photo by Dongwei Lin)



Dr. Yuyuan Xie at the 2018 Ocean Sciences Meeting

Dr. Manab Kumar Dutta and other postdocs participate the XMAS-IV

博士生奖学金
MEL PhD Fellowship

为吸引国内外优秀生源，培养杰出的博士研究生，实验室于 2016 年设立“博士生奖学金”，面向国内外高校招收直博生及所有读博申请者开放，资助海洋环境科学相关领域及与实验室主攻方向相关的其他学科领域。2018 年共有 4 名学生入选，并已于 2018 年 9 月入学。

Aiming to attract and encourage academically outstanding PhD students, MEL initiated the MEL PhD Fellowship since 2016. The Fellowship is offered in marine environmental sciences and other interdisciplinary research that fits into MEL's research scopes. Applicants must have already obtained or been currently working towards a master degree and are seeking admission as new full time PhD students. The first 4 awardees joined MEL in September 2018.

马瑞洁 Ruijie Ma
海洋细菌前噬菌体的多样性、生理生态特性及其与宿主的相互作用
Prophages in marine bacteria: diversity, activity and interaction with hosts

陈晓炜 Xiaowei Chen
海洋微型生物生态学（病毒和细菌）
Marine microbial ecology (virus and bacteria)

吴泽轮 Zelun Wu
南大洋涡动能变化及机制
Eddy Kinetic Energy Variability and Mechanism in the Southern Ocean

吴思琪 Siqi Wu
上层海洋氮循环与深层海洋黑暗固氮作用 Nitrogen cycling in the upper ocean and deep ocean dark nitrogen fixation

海洋环境科学本科生暑期科研奖学金项目
MEL Summer Undergraduate Research Fellowship

为鼓励本科生尽早开展科研训练，更好地培养本科生的创新能力和学术精神，激发优秀学生的科学兴趣，并为其提供继续深造的平台和机会，实验室自 2014 年起启动“MEL 海洋环境科学本科生暑期科研奖学金”。2018 年录取了来自美国普林斯顿大学、美国特拉华大学、美国加州大学欧文分校、美国印第安纳大学伯明顿分校、浙江大学、南京大学、中国海洋大学、兰州大学、河海大学、汕头大学、广西大学、天津科技大学、海南大学、广东海洋大学及厦门大学马来西亚分校等 16 所高校的 22 名本科学生。项目以科研课题为导向，本科生在导师的指导下进行学习，开展实验研究。组委会还为本科生组织了系列学术讲座、技术安全讲座和出海实习，并定期开展学术沙龙，以期全方位培养学生的学术能力、科学表达与交流能力，助其拓展国际化的视野。

Initiated in 2014, the MEL Summer Undergraduate Research Fellowship in Marine Environmental Science (URF) encourages undergraduates to pursue science and technology careers by providing research experiences at MEL. 22 undergraduate students from 16 universities (including Princeton University, University of Delaware, University of California Irvin, Indiana University Bloomington, Zhejiang University, Nanjing University, etc.) joined the program in 2018, working on mini research projects with individual supervisors. They also received training on lab safety and facility operations. Several interactive seminars and research cruise were also organized for participants.

Yuting Gu from Tianjin University of Science and Technology was extracting RNA from the N-fixing microorganism cyanobacteria in the South China Sea.

© Lei Chen

公众教育
OUTREACH

2018 年，气候变化对全球影响愈发剧烈，以科学为基础的大众环境教育更加显示出其必要与重要性。我们力求让更多公众受到良好的环境保护教育，才能遏制破坏的趋势。为此，实验室以中国海洋科学卓越教育伙伴计划（COSEE China）为依托，继续开展公众教育与宣传。

2018 has served, if nothing else, to highlight the absolute necessity of environmental education, grounded in sound science, for the masses. Climate change impacts and repercussions from global consumption at levels beyond what the planet can sustain have hit an all-time high. It is only with an educated public, making environmentally conscious choices, that we can stem the tide of devastation. To that end, COSEE China has continued to serve in this capacity, as providers of marine environmental education and awareness programs for the greater Xiamen community.

7 月，水生科学暑期生态营继续面向 30 名中学生开放；8 月，与太古飞机工程有限公司共同举办第三届厦大 – 太古红树林夏令营。与此同时，COSEE China 的影响力也日益扩大，1–2 月，为北京教育研究院附中等多所中学的 75 名中学生组织海洋科学实践，了解潮间带生态与沿海地质科学；9 月，日本“和平号”邮轮海上大学带着 6 个国家的 17 名青年来到东山太古海洋观测与实验站，了解科学家在可持续发展养殖与渔业等方面所做的努力；12 月，澳大利亚墨尔本 Genazzano 女子中学的 6 名高中生到访实验室，动手实验，学习海洋的物理特性、海洋酸化及全球变暖等知识；此外，还组织师生走进中小学校开设科普讲座与调研。
此外，COSEE China 参加了在美国波特兰举办的 2018 年海洋科学会议，参与全球海洋教育的讨论。

The summer camp and Ocean Science Day events continue to be popular highlights in the local calendar for participants both near and far and we are constantly striving to improve the quality of both events. New lessons in fish anatomy and overfishing were introduced to summer campers this year and we are working on further developing lessons with our faculty and staff. On November 4, 6300 visitors joined the 7th Ocean Sciences Open Day. Besides the lab visits, interactive experiments, art exhibits, videos and outreach talks, we introduced a “Panel discussion with ocean scientists – about global warming of 1.5°C” (convened by Dr. Minhan Dai) and “Public Lectures on Ocean Culture” (co-organized with MNR Ocean Publicity and Education Center and Xiamen Ocean & Fishery Bureau) and broadened the impact by working with Sina interview and Tencent Science live broadcast (with 155,000 online participants). Based off of survey results from this year’s Ocean Science Day, we are looking to revamp this program to include more interactive experiences for the life-long learner as well as our younger visitors.

(Photo from Peace Boat)

In September, 13 participants of 6 nationalities came to Xiamen with the Japanese Peace Boat Global University and join COSEE in the Dongshan Swire Marine Station, learning about abalone aquaculture and researchers’ engagement with the issue of sustainability.

Emily King explaining projected sea level rise impacts to FCJ students

We have also been able to broaden our reach beyond Xiamen by working with student groups from as far afield as Beijing, Japan and Melbourne, Australia! At the start of the year 75 students from the Beijing Academy of Educational Sciences Affiliated School and other middle schools came and spent a day with us as part of a much larger program designed to introduce students to other provinces and regions in China. During their short stay, we were able to introduce them to intertidal ecology as well as some coastal geology, culminating in a laboratory experience which allowed the students to really examine what makes up those beautiful sandy beaches we all love. At the end of this year, we received a group of 6 students from Genazzano FCJ College, a private all-girls school based in Melbourne, Australia. Over an afternoon, the high school students did experiments which highlighted the basic, but crucial, physical properties of the ocean and left with a better understanding of what the impacts of ocean acidification, global warming, and climate change are on the Earth's life support system.

Lastly, COSEE China remains committed to working at the international level with educators around the world to further develop best practices in marine education, both formal and informal. We were fortunate enough to participate in the 2018 Ocean Sciences Meeting in Portland, Oregon as part of a panel discussing opportunities in Global Ocean Education. We hope to continue collaborating with our international counterparts in 2019 on this crucial theme.

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11 月 4 日，以“我们的神秘海洋”为主题，第七届厦门大学海洋科学开放日继续成为本地及周边公众最期待的活动之一，迎来了 6300 名公众。活动形式不断创新，在实验室开放、科普展览、趣味互动、科普讲座、视频展播的基础上，戴民汉发起的“我与海洋科学家面对面——对话全球升温 1.5℃”、自然资源部海洋宣教中心、厦门大学及厦门市海洋与渔业局共同主办的“海洋文化大讲堂”等新创意为开放日带来了更多活力，并通过新浪专访、腾讯科学直播等新媒体，为更多公众提供了学习和讨论平台，约 15.5 万公众在线参加活动。

From left: Profs. Dalin Shi, Shaoling Shang, Minhan Dai, Wenqing Cao Luzhen, Jianzhong Wang (Captain of icebreaking R/V Xulong) and Luzhen Che at the discussion panel on global warming.

Captain Jianzhong Wang (left) giving a public lecture on Chinese polar research with R/V Xuelong, and Prof. Wenjing Su (right) from Fuzhou University shared her thoughts on ocean exploration, Chinese silk road and human civilization.

Vistors getting involved in the experements and demenstrations.

(Photo by Xin Zhang, Zhihua Zhang, Yiting Hong)

知遇鹭岛，共话蓝海——“嘉庚”号科考船与法国塔拉号科考帆船联合活动周
French Schooner TARA's visit and the joint open house

塔拉号是一艘以保护地球和海洋为使命的双桅纵帆船，是法国的公益科学组织。2016-2018 年，TARA 启动“环太平洋之旅（TARA Pacific）”，研究气候变化和生态危机对海洋造成的影响，并停靠不同城市，开展科学研究与公众教育。

4 月 2 日至 10 日，在结束对香港及基隆的访问后，塔拉号首次访问中国大陆，停靠东渡国际邮轮码头，与“嘉庚”号科考船共同举办“科考船联合活动周”系列海洋科普和公众教育活动。

2018 saw perhaps the most exciting public outreach event occur in Xiamen in the last decade. TARA, a research schooner from France, set sail on the TARA Pacific expedition from 2016 to 2018, aiming to understand the evolution of coral reefs under the threats of environmental changes.

TARA called at Xiamen on its first-ever Mainland China tour on April 2-10, 2018 after visiting Hong Kong and Keelung. During the stopover, TARA was docked at Dongdu International Ferry port alongside R/V Tan Kah Kee (TKK) and jointly hosted a series of events to promote the awareness and outreach on scientific research and protection of the oceans. Although her stopover in Xiamen was quite short, the impact of her visit will be felt for years to come.

科普展览与儿童主题绘画
Exhibitions and Drawing Event

自 3 月起，在厦门市科技馆、市青少年宫、厦门大学海洋科技博物馆开展了为期 3 周的“塔拉号 – 嘉庚号”联合科普展览，受到市民的欢迎。一场“迎接嘉庚号的新朋友 TARA”主题绘画活动吸引了厦大幼儿园小朋友的热情参与，孩子们的绘画作品也登上两艘科考船，面向市民展出，并有部分跟随塔拉号开启了全球航行。

From March to April, exhibitions of TARA and TKK's research story were displayed in Xiamen Science Museum, Xiamen Youth & Children's Center and XMU Marine Science and Technology Museum. Children from XMU Kindergarten participated in a drawing event named “Welcome TKK's new friend” and their works were exhibited onboard during the ship open days. 2 of the drawings were collected by TARA crews and started their global journey with TARA.

TARA Captain Johann Mucherie and the child whose works was collected by TARA

迎接塔拉号入港
Salute TARA's arrival

4 月 2 日上午，“嘉庚”号科考船率厦门帆船队出海，迎接塔拉号科考帆船，在新浪微博平台全程直播“塔拉入港”，同时在厦门日报与人民日报客户端直播。直播中，受邀嘉宾从两艘科考（帆）船的历史、舱内空间、合作计划、停靠期间的活动安排等方面进行介绍。直播得到网友积极参与，共 313 万人次观看，微博主题“嘉庚号的法国朋友”及“跟着嘉庚号科考去”更是获得 3800 万次阅读量，这是开展海洋科普、传播海洋文化的有益尝试。

R/V TKK warmly welcomed TARA by sailing out of Xiamen port to meet her new friend on April 2. Sina Weibo (China's twitter) did a live broadcast online. Invited guests from XMU introduced the two vessels to the public, allowing people to see two very different aspects of at ocean research. The entire arrival was livestreamed by Sina and was viewed by 3.13 million people. Subsequent viewings of the Weibo subject “R/V TKK’s French Friend” and “Go research with R/V TKK” has received 38 million views. It was also livestreamed by Xiamen Daily and People’s Daily.

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公众大讲堂
Public lectures

4 月 5 日下午，《海洋探索与海洋文明》公众大讲堂开讲，吸引大中学生、社会公众近 500 人到场。法国巴黎高等师范学院教授、法国国家科学院银质奖章得主 Chris Bowler，厦门大学 1978 级校友、知名媒体人杨锦麟，厦门大学科考船运行管理中心主任王海黎三位主讲嘉宾为听众奉上一场精彩纷呈的海洋文化盛宴。

Xavier Bougeard interviewed by student journalists from Binglang School (Photo by Emily King)

除此之外，塔拉基金会海外教育项目主任 Xavier Bougeard 博士还受邀前往厦门槟榔中学，为 120 名学生讲授题为“塔拉—海洋之舟”的科普讲座，并接受了少年记者的采访，让青少年更了解海洋的富饶与脆弱，及保护海洋生态环境的紧迫性。

On April 5th, public lectures about Ocean Exploration and Civilization were given by Chris Bowler (professor of Ecole Normale Supérieure, Paris; winner of the CNRS Silver Medal), Jinlin Yang (alumni of XMU, renown media person) and Haili Wang (director of Marine Operations, Xiamen University) followed by exciting panel discussions. Nearly 500 people attended.

In addition, Mr. Xavier Bougeard, Head of Overseas Educational Program of TARA Foundation was invited to Xiamen Binglang Middle School and shared his story with 120 students about TARA and its global exploration on phytoplankton and climate change. He was also interviewed by a few student journalists during the day.

Chris Bowler sharing his story about Tara Oceans and ocean exploration in the 21st century

Jinlin Yang giving a speech on ocean civilization and ocean culture

Haili Wang introducing R/V TKK

(Photo by Hua Zhuang, Yumeng Wei)

公众开放日
Side-by-side open house

4 月 4 日至 9 日，塔拉号与“嘉庚”号联合对公众开放，约 5200 人登船参观。通过海报、视频、志愿者讲解等多种形式，登船公众更直观了解海洋科考船及海洋科考知识。

A joint open house was organized onboard TARA and R/V TKK, over 5,200 local residents (a mix of school groups and general public) visited these two ships from April 4 to 9.

Mr. Nicolas GHERARDI, the Science and Technology Program Officer from French Consulate General in Guangzhou get on board TARA with 30 students and 2 teachers from Xiamen Foreign Language School who study French as a foreign language. (Photo by Vera Shi)

TARA Crew and XMU volunteers giving a tour to student visitors

合作新篇章
New cooperation

4 月 3-4 日，“中法海洋科学研讨会——变化中的海洋生态系统”在厦门大学科学艺术中心举办，曾参加过塔拉号科考船考察的 5 名法国、意大利科学家与 10 余名中国学者一同分享科考成果，探讨联合双方优势进一步加深合作。6 日，TARA 探险基金会执行秘书长 Romain Troublé 先生，海洋科学家 Chris Bowler 先生与戴民汉教授在 TARA 科考帆船内举行媒体见面会，表示了双方希望密切合作的愿望，包括共同组织海洋科学考察、共同进行海洋科学教育、共同培养海洋科学人才等方面。

During a fruitful two-day TARA-TKK scientific symposium on April 3-4 between scientists from the TARA Oceans expedition, representatives from the TARA Foundation and Chinese scientists discussed possible future collaborations. The discussions highlighted a common will to develop an exciting long-term collaboration both in research, education and outreach activities.

On April 6th, Romain Troublé (executive director of TARA Expeditions Foundation), Chris Bowler and Minhan Dai participated in a media conference held onboard TARA, announcing the initialization of cooperation, including organizing scientific expeditions, joint research studies and promoting ocean science education and outreach.

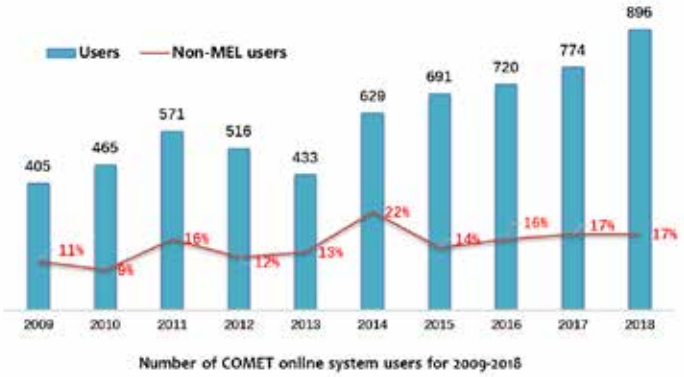
Minhan Dai, Chris Bowler and Romain Trouble announce intention of collaboration to the media (Photo by Suwei Weng)

科研设施与实验观测
FACILITIES AND FIELD OBSERVATION

大型仪器与技术服务中心
Center of Major Equipment and Technology (COMET)

“大型仪器与技术服务中心”（简称 COMET）于2008 年成立，以“推动大型科研仪器的资源共享、提高仪器使用效率”为宗旨，为培养高层次人才，开展高水平科研项目提供高效率、高水准服务。COMET 致力于全面规范化管理实验室安全、仪器设备以及技术人员培训和考核，成功建立了大型仪器网上预约共享系统，真正实行仪器公开透明化管理。至2018年底，COMET已成功运行10年有余，共有200余台大型预约共享设备面向校内外科研人员开放共享，注册会员2100余人，平均每年预约数达1.8万余次。近几年来使用COMET预约系统人数均稳定在700余人/年。

The Center of Major Equipment and Technology (COMET) was established in 2008 to better maintain MEL's scientific instruments with higher efficiency and lower operating costs. COMET continues to strive for excellence as an infrastructure for research and teaching and to inspire innovative research discoveries. COMET has been successfully run for the last 10 years. Over 200 facilities are available online, and 2100 users are registered in the system.



Number of COMET online system users for 2009-2018

2017-2018年，COMET获得中央修购专项实验仪器设备开放共享信息系统建设经费，对预约系统进行了升级改造，将于2019年1月正式运行。新系统预约方式将更加便捷、灵活，实现网上预约和移动APP预约，实现对仪器设备远程监管的智能化管理，以及对资深用户24小时开放和多方位实时数据统计等功能。

Special funding from the central government was granted for COMET system improvement in 2017-2018. With the funding, COMET was able to upgrade its online booking system. Technicians will be able to monitor and manage the instruments remotely using their computer or mobile phone and keep the system open to users 24 hours a day. Real-time data updates and analysis will also be realized. The new system will be online beginning January 2019, and will be more flexible and convenient for technicians and users.

2017-2018 年，实验室获批了国家财政部仪器专项9153万元，主要用于购置海洋现场观测和实验室公共平台设备，目前大部分已到货并试运行。

In 2017-2018, MEL has received a special funding of 91.53 million RMB from the Ministry of Finance for equipment and infrastructure construction. Most of the facilities are in place and commissioned in 2018.

超速流式细胞分析分选平台
The BD Influx™ high-speed cell sorter

A flexible flow cytometry platform with modular architecture, powerful detection capabilities, and high-speed cell sorting allow researchers to configure the BD Influx system to their site and application needs.

海洋小分子溶解有机物质谱表征系统
The UPLC-Q-TOF

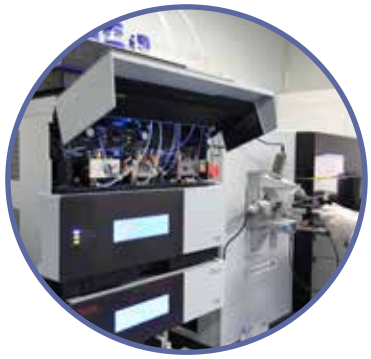
This device is used for the mass spectrometric characterization of small molecule dissolved organic matter in the ocean, as well as the exploration of some small molecule peptides, unknown compound, and degradation mechanism of organic matter.

温湿度可控纳米级化学成像平台
The chemical imaging system with temperature and humidity control

It is used for physical and chemical characterization of various samples under different temperatures, humidity, vacuum conditions and for in-situ observation of dynamic processes.

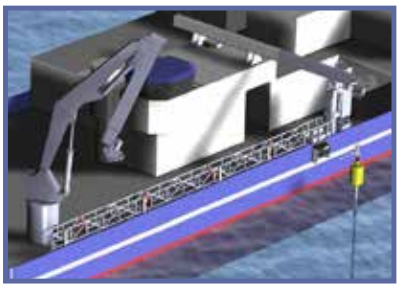
高分辨电感耦合等离子质谱仪
The high resolution inductively coupled plasma mass spectrometer (Element XR, Thermo Fisher Scientific)

It enables multi-element analysis covering a mg/L to sub pg/L concentration range and offers fully automated tuning and analysis in conjunction with a comprehensive, customizable quality control system. The instrument will be used for determining the concentration of various trace metal elements in the open ocean water and sediment pore water.



超高分辨率液相色谱—三合一质谱联用仪
Ultra high resolution liquid chromatography - tribrid mass spectrometer (Thermo Fisher UltiMate™ 3000 RSLCnano - Orbitrap Fusion™ Lumos™)

It can be widely applied in the proteomic and metabolomic studies, such as the detection, identification and quantification of peptides, proteins, carbohydrates, lipids and metabolites in the natural complex seawater samples.



长岩芯重力活塞取样系统
Piston Corer

The coring system is able to collect continuous and undisturbed sediment cores up to 20m.

(Photo by Weidi Yang, Yaojin Chen)

技术人员开放基金
MEL Technology and Innovation Fund

为继续鼓励技术人员的技术创新，实验室 2018 年资助三项技术开放基金，分别为废液及废气中微量汞脱汞初试、大体积海水现场过滤泵系统升级、“嘉庚”号科考船运行大数据可视化分析系统原型开发。

Three projects were supported by Technology and Innovation Funds in 2018 for 2 years for technical staffs. They were: 1) Removal of trace mercury from seawater sample waste and lab atmosphere; 2) The upgrading of in situ pumps; 3) R/V big data visualization development.

仪器研制与改造
Instrumentation

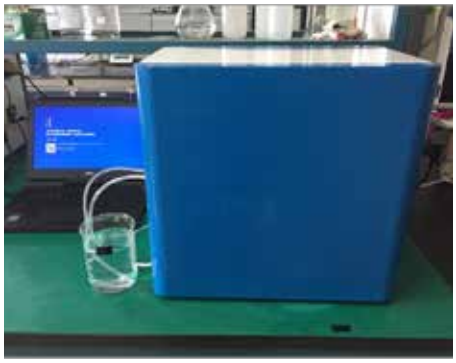
至2018年底，实验室海洋环境监测仪器研发团队基本完成中央财政仪器研发专项“船基深远海高通量海水化学实验室装备”所研制仪器的装配工作，进入仪器调试阶段。2019年将完成方法互校、仪器海试等任务。已经装配完成的仪器包括：走航式痕量营养盐分析仪、走航式痕量金属分析仪、走航式总碱度分析仪。

The research progress of the project of "Ship-basde high-throughput equipment for seawater chemical parameters" was funded by a Ministry of Finance grant for Equipment and Infrastructure Construction. In the las two years, the team of marine environmental monitoring instrumentation continued their efforts to overcome multiple challenges in many aspects. By the end of 2018, the assemblage of developed instruments has been completed and laboratory-testing of the instruments has begun. In 2019, the method laboratory-comparison, instrument sea-testing and other tasks will be carried out. The assembled instruments include: underway trace nutrient analyzer, underway trace metal analyzer, and underway total alkalinity analyzer.

(Photo by Weidi Yang)

走航式痕量营养盐分析仪
Underway Trace Nutrient Analyzer

走航式痕量金属分析仪
Underway Trace Metal Analyzer

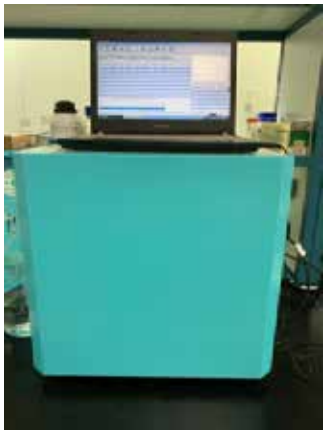


走航式总碱度自动测定仪
Underway Total Alkalinity Analyzer

海洋仪器研发 Marine Instrumentation

完成总碱度（Total alkalinity, TA）走航测定仪的研制，并在实验室和嘉庚号上进行了测试，结果表明仪器的精密度和准确度可达到 ±2 μmol/kg，且有极好的稳定性 (10 天内漂移小于 0.1%)；完成原位 TA 测定仪的研制，正进行实验室测试。这些仪器将成为获取高时空分辨率的海水总碱度数据的有力工具。

An underway analyzer for the measurement of seawater total alkalinity (TA) has been developed and tested in laboratory and on board. The analyzer has precision and accuracy as high as ±2 μmol/kg, and excellent stability (less than 0.1% over 10 days). The in situ analyzer for the measurement of seawater total alkalinity has been developed and is still under test in laboratory. These instruments could be the powerful tools to obtain seawater TA data of high spatio-temporal solution.



总碱度走航测定仪
Underway TA analyzer

总碱度原位测定仪
In situ TA analyzer

pCO_2 走航测定仪
Underway pCO_2 analyzer

完成海水二氧化碳分压（pCO_2）走航测定仪器的研制，并进行了多次的海试。该仪器采用基于射流器（Venturi pipe）的水气平衡器，具有水气平衡速度快，样气水分去除效率高，无需频繁更换干燥剂，体积小重量轻，易于安装和搬运等特点。该仪器可使科学家更容易获得海水pCO_2的走航监测数据。

An underway analyzer for the measurement of seawater pCO_2 has been developed and tested in field several times. This analyzer uses an equilibrator based on Venturi pipe. It features faster water-gas equilibrium, higher humidity-removing rate, no need for frequent desiccant replacement, low weight and small size. It provides scientist with convenience to obtain pCO_2 data.

海洋现场观测
MEL at Sea

2018年实验室组织33个航次，搭载21个科考航次，481人次在南海、东海、黄海、台湾海峡、西北太平洋、长江口、珠江口等海域、河口开展了共计518天的海上调查。

In 2018, MEL organized 33 cruises and participated in 21 cruises. A total of 481 scientists, technicians and/or students were involved. The investigation areas included Northwest Pacific Ocean, South/East China Sea, Taiwan Strait, Yellow Sea, and major Chinese estuaries.

海洋痕量元素与同位素洁净采样预研航次
GEOTRACES Test Cruises and Planning Workshop

近年来，国内数家单位正在或计划筹建痕量元素洁净采样系统。其中厦门大学“嘉庚”号已配备我国首套符合国际标准的超洁净痕量金属采水系统。该系统包括痕量金属洁净CTD、两套痕量金属采水器、高强度Kevlar缆绳、痕量金属现场分样洁净集装箱及现场分析洁净集装箱，并成功于2017年8月和2018年3月进行两个预研航次测试。结果表明这一系统可胜任采集未受沾污、具有极地铁含量（<0.1 nmol L-1）的海洋上层水样，与国际主流实验室的数据比对也表明实验室有能力产生高质量的痕量金属浓度数据。

在此基础上，该系统于2018年正式入列，并计划于2019年4-5月执行中国GEOTRACES西北太平洋GP09断面航次，调查西北太平洋痕量元素及同位素生物地球化学行为与过程。GEOTRACES计划发起人之一、首任共同主席Robert Anderson教授、美国GEOTRACES航次首席科学家Greg Cutter教授及伍兹霍尔海洋研究所著名海洋学家Ken Buesseler教授于2018年5月5-6日受邀参加航次规划会。该系统为实验室全方位进入海洋痕量元素及同位素的生物地球化学研究这一前沿领域提供了保障。

Several Chinese institutes are currently building or planning to build clean sampling systems for studying trace elements in the ocean. R/V TKK is the first R/V in China equipped with a trace metal collection system meeting the international GEOTRACES requirements. The system includes a trace metal clean CTD, 2 sets of trace elements sampling bottles, an 8000 meter long high-strength Kevlar cable, and 2 trace metal clean vans. Two test cruises were conducted in August 2017 and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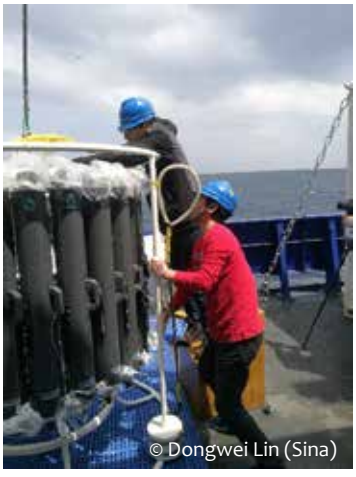
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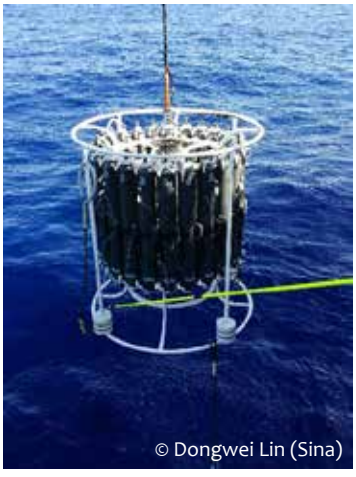
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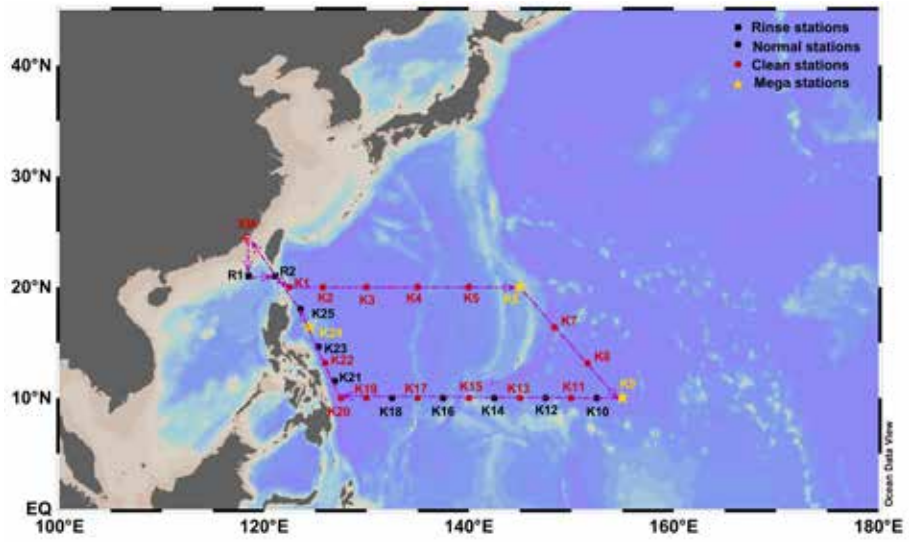
March 2018 with the deployment of the trace metal clean sampling system. The test results suggest that the system is capable of collecting uncontaminated surface seawater samples with ultra-low iron concentrations (<0.1 nmol L-1). Data comparisons with international labs also show our ability to produce high-quality trace metal concentration data in the open ocean.

Based on the successful tests and R/V facilities, MEL is planning the Chinese GEOTRACES GP09 cruise in 2019, to investigate the marine biogeochemical cycles of trace elements and their isotopes in the largely unexplored western North Pacific. A planning workshop was held on May 5-6, 2018, in which Drs. Robert Anderson (co-founding chair of GEOTRACES program), Greg Cutter (US GEOTRACES Cruise Chief Scientist) and Ken Buesseler (Woods Hole Oceanographic Institute) were invited along with Chinese scientists to share valuable experience of their on-going projects, to discuss potential key processes that regulate and control the biogeochemical cycles of trace elements and to develop a detailed cruise plan. This indicates MEL's full efforts and involvement in the GEOTRACES research frontier.



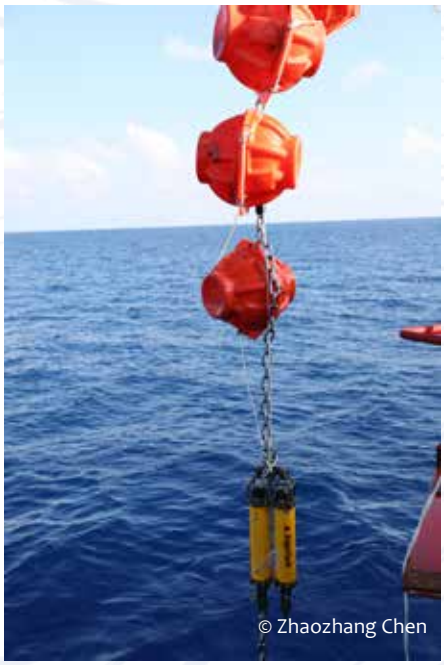
Sampling stations of the 2019 GEOTRACES-China cruise (planned) to the western North Pacific.

The GEOTRACES-China Cruise Planning Workshop, May 5-6, 2018.

深海潜标回收
Recovery of a sub-surface mooring system

2018年10月，在南海中部海域成功回收一套多学科多参数4000米深海潜标，该潜标于2017年6月搭载“嘉庚”号科考船布放于南海中部海域，对观测站位的水文、水动力、海水化学等要素进行了连续观测，获取了长达16个月的海洋全水深剖面数据。该潜标是我校首次在4000米海盆深度成功布放和回收潜标系统，也是我国南海海区少数成功完成的多学科多参数深海观测潜标之一。

A multi-disciplinary deep sea (4000m) sub-surface mooring system, which was deployed in June 2017 in the central South China Sea, was successfully recovered in October 2018. The mooring system has collected all-depth profile data in hydrology, hydrodynamics, marine chemistry and biology for 16 months. This is the first 4000m basin depth mooring system that our university has deployed and recovered, and is also one of the few multi-disciplinary and multi-parameter mooring system successfully applied in SCS area.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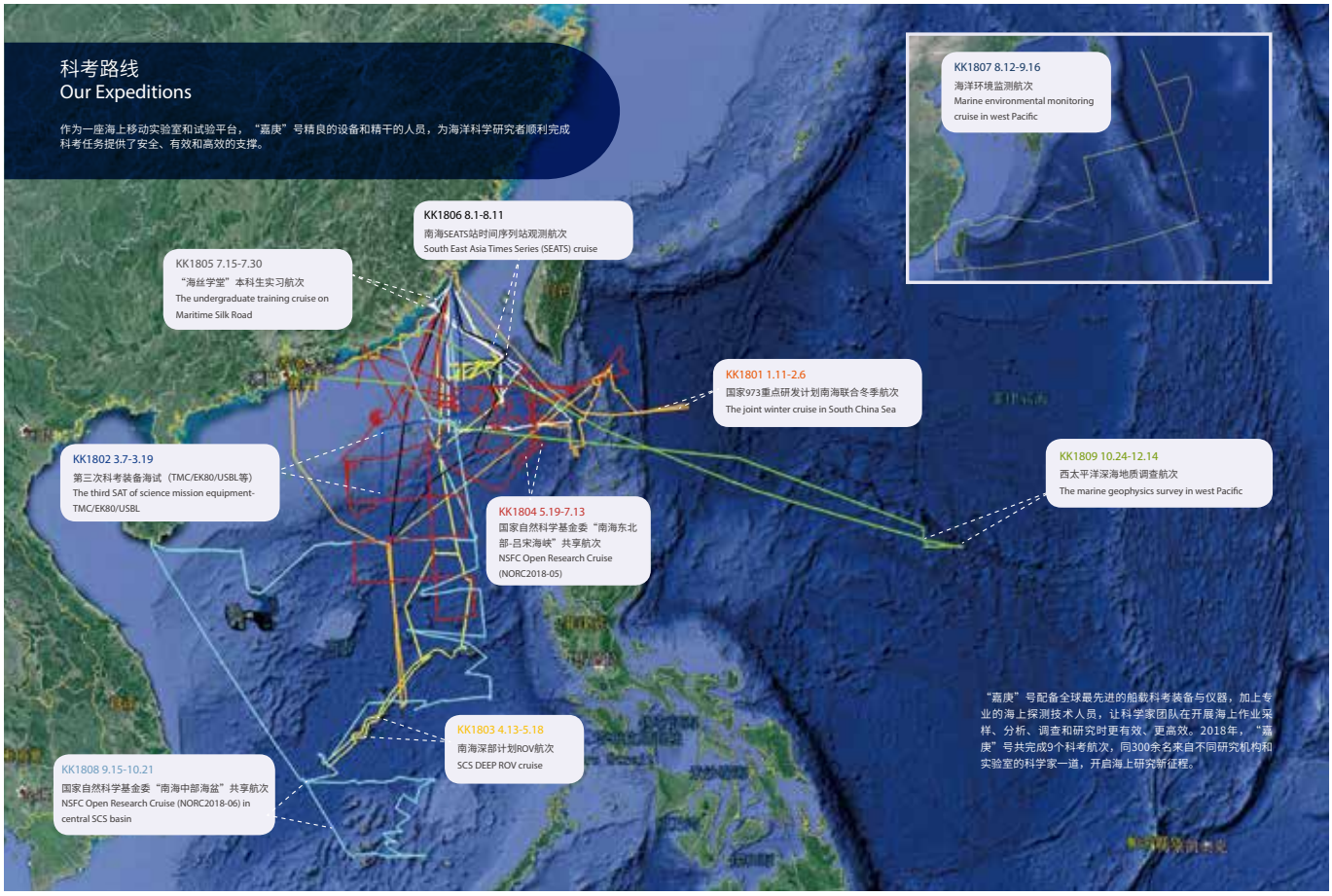
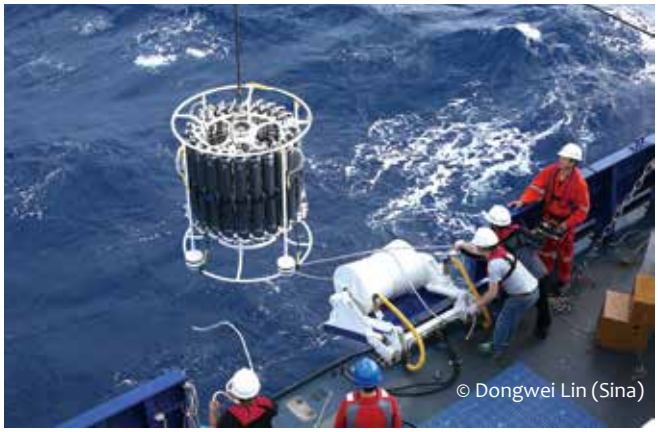
“嘉庚”号海洋科学考察船
Research Vessel Tan Kah Kee

2018年，“嘉庚”号海洋科学综合考察船在南海和太平洋海域，完成了9个航次的科学考察任务，累计在航241天，总航程约26523海里。约有300名来自研究机构、大学和企事业单位的科研人员和学生搭乘“嘉庚”号科考船，进行海洋科学研究。

In 2018, 9 research cruises were conducted by R/V TKK, with a total of 241 days working at sea, and sailing more than 26523 nautical miles. Throughout the year, about 300 researchers and students from various Chinese institutions and universities went aboard the TKK for marine scientific research.





“海丝学堂”本科生教学实习航次（KK1805）
Students' training Cruise – Silk Road @ Sea

依托“嘉庚”号科考船平台，厦门大学海洋学专业的本科教学实习首次由近海拓展到深远海。7月15日~30日，厦门大学地学部师生66人从厦门起航，搭乘“嘉庚”号，赴南海北部海域执行多学科综合考察暨教学实习航次。本航次极大增强了学生海上科考实践能力、动手能力和科研思维能力。

Silk Road @ Sea 2018 is the first training cruise for Xiamen University undergraduate students, the internship areas range from offshore to deep sea for the first time in Xiamen University (XMU). It aims to strengthen students' practical abilities in marine scientific research. During the cruise, 66 undergraduate students and teachers from XMU conducted hands-on research. The cruise provides a valuable platform for students to apply what they have learned in the classroom.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南海东南亚时间序列站观测航次
South East Asia Times Series (SEATS) Cruise

起始于联合全球海洋通量研究（Joint Global Ocean Flux Study, JGOFS）之际，台湾同仁于1998年发起建立位于南海北部海盆的东南亚时间序列海洋观测站（the South East Asian Time-series Station, SEATS，116°E，18°N），并于1999年9月开展了首个现场观测航次。 2008年至今，实验室与台湾同行开展了多次航次协作。至今厦门大学方面已实施了十余次SEATS站现场观测，聚焦生物地球化学尤其是碳氮循环相关研究。8月2-11日， “嘉庚号”顺利完成2018年SEATS观测。航次以上层海洋生物地球化学为核心，主要利用CTD观测及垂直高分率水样采集、多同位素示踪培养，漂浮式沉积物捕获器的布放和回收、湍流剖面观测、单层生物拖网、后甲板拖曳、大体积泵等多种手段进行综合观测，并随航采集有SBE21、多波束和浅剖数据，同时提供气象站和ADCP流速等配套参数。

Initialized during the Joint Global Ocean Flux Study (JGOFS) era, Taiwan scientists started the South East Asian Time-series Station (SEATS, 116°E, 18°N) Project in 1998 in the northern basin of South China Sea and launched the first cruise in September 1999. Since 2005, MEL has joined the SEATS investigation and conducted over 10 cruises, focusing on biogeochemistry, with a special interest in carbon cycle related study.

The 2018 SEATs summer cruise was conducted on Aug. 2-11. Multi-disciplinary approaches including CTD (Conductivity-Temperature-Depth profiler), high-resolution sampling, multi-isotope labelling incubations, floating trap, turbulence observation, towed underwater observation, biological trawl and in situ pump were used to conduct a comprehensive investigation in the biogeochemistry in the upper ocean. In addition, SBE21/ Multibeam echo sounder/ Sub-bottom profiler data are collected underway, and meteorological and ADCP data are also provided.

东山太古海洋观测与实验站
Dongshan Swire Marine Research Station

作为国内首个获跨国企业（太古集团慈善信托基金）捐资的海洋科研设施，厦门大学东山太古海洋观测与实验站（以下简称“东山站”）位于福建省东山县西埔镇苏峰山，距厦门市约173公里，占地87.59亩，面向台湾海峡开阔水域，位于省级珊瑚自然保护区的南缘。

东山站自2017年启用，目前已完成道路工程、绿化改造等基础设施，以及地下河口监测平台的保护及无扰动、底流速采样测试及样品分析；水文浮标观测系统相关设备交付并完成海试；与浙江大学流体动力与机电系统国家重点实验室、中天海洋系统有限公司的合作，完成海底观测网珊瑚礁观测节点相关设备的调试和验收。

同时，围绕东山站的多学科研究工作已陆续开展：5月27日，东山站长时间序列共享航次项目正式启动，在东山湾及周边海域开展大面调查，对东山近海海域珊瑚生态群落分布开展3次潜水调查，定期开展不同微环境潮间带大型底栖动物生态调查和栖息地温度监测，同时也完成了拥剑梭子蟹渔业改进一期项目。

2018年，东山站还迎来许多学者及单位的参观访问，并举办多个学术交流与科普活动，如实验室2107年会、第十届“水环境科学高校联盟”研究生研讨会、本科生实习、东山站国际咨询委员会第三届会议等。

As the first marine scientific research facility in China that has been funded by multinational corporations (Swire Group), the Dongshan Swire Marine Station of Xiamen University (D-SMART) is located at Sufeng Mountain, Xipu Town, Dongshan County, about 173 km away from Xiamen. It covers an area of 14.43 acres and faces the open waters of the Taiwan Strait. It is located on the southern margin of the provincial coral nature reserve.

Phase I of D-SMART was completed in 2017 and the infrastructure have been improved since then, such as the road construction and landscape engineering. Facilities are put in place or improved in this year: The 4 monitoring wells were put in use; as part of the Cabled Ocean Observatory for the coral reef ecosystem at D-SMART, the

Full view of D-SMART

Subterranean Estuary Monitoring Wells

Hydrological Observation Buoy

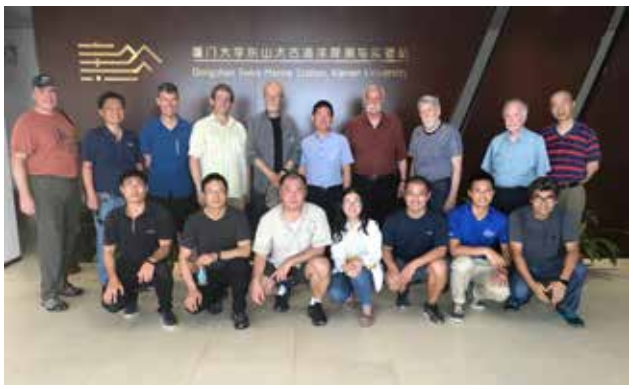
http://mel.xmu.edu.cn/dsmart/

(Photo by Jixin Chen, Shengyao Sun and Qisi Cai)

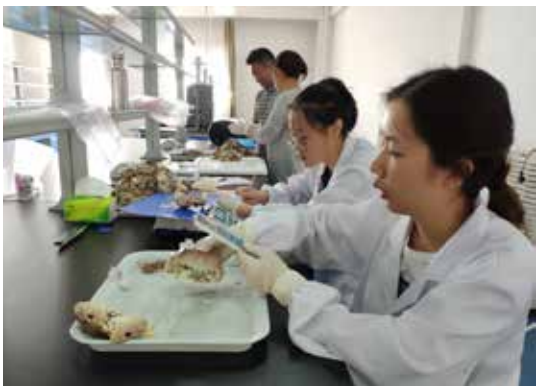
Hydrological Observation System was deployed in June near the Xiongdi Island, 30 km south off D-SMART in the upwelling and coral community areas, and was recovered in October. In collaborating with the State Key Lab of Fluid Power & Mechatronic Systems (Zhejiang University) and Zhongtian Technology Marine System Co. Ltd, the instruments for Coral Reef Node in the Cabled Ocean Observatory have been delivered to D-SMART and tested.

At the same time, researches based on D-SMART are being carried out as follows:
The First D-SMART long-term time-series shared cruises project was launched on May 27-29 with R/V Ocean II in Dongshan Bay and the surrounding sea, to obtain a comprehensive set of data on physical hydrology, biogenic elements, water chemistry, biology, and marine geology. 3 diving surveys were conducted in Dongshan waters and around Xiongdi Islet, to investigate the distribution of the coral community, and provide data for cabled seabed observation nodes deployment; ecological surveys were carried out in different microhabitats every two months near D-SMART to investigate the temporal and spatial variation of intertidal zones; The fisheries improvement project on red swimming crab (Portunus haanii) were also conducted in D-SMART.

In addition, D-SMART has welcomed a host of visits and academic activities in 2018, including MEL Annual Symposium, the 10th UCAS (University Consortium on Aquatic Sciences) Postgraduate Symposium, Third International Advisory Committee Meeting of D-SMART and undergraduate student field practical.



IAC members visiting D-SMART during The Third IAC Meeting



The project conducted in D-SMART from Liu Min Fish Biology Lab to develop a sustainable improvement model for the red swimming crab fisheries, processing industries and export business.

Group photo of The First D-SMART long-term time-series cruise (DSC2018S)

(Photo by Xinya Xu and Shengyao Sun)

科研进展
RESEARCH HIGHLIGHTS

海洋生物地球化学
Marine Biogeochemistry

Ambient nitrate switches the ammonium consumption pathway in the euphotic ocean

Wan, XS; Sheng, HX; Dai, MH; Zhang, Y; Shi, D; Trull, TW; Zhu, YF; Lomas, MW; Kao,* SJ. ***NATURE COMMUNICATIONS,*** 2018. 9, 915, DOI:10.1038/s41467-018-03363-0.

Abstract: Phytoplankton assimilation and microbial oxidation of ammonium are two critical conversion pathways in the marine nitrogen cycle. The underlying regulatory mechanisms of these two competing processes remain unclear. Here we show that ambient nitrate acts as a key variable to bifurcate ammonium flow through assimilation or oxidation, and the depth of the nitracline represents a robust spatial boundary between ammonium assimilators and oxidizers in the stratified ocean. Profiles of ammonium utilization show that phytoplankton assemblages in nitrate-depleted regimes have higher ammonium affinity than nitrifiers. In nitrate replete conditions, by contrast, phytoplankton reduce their ammonium reliance and thus enhance the success of nitrifiers. This finding helps to explain existing discrepancies in the understanding of light inhibition of surface nitrification in the global ocean, and provides further insights into the spatial linkages between oceanic nitrification and new production.

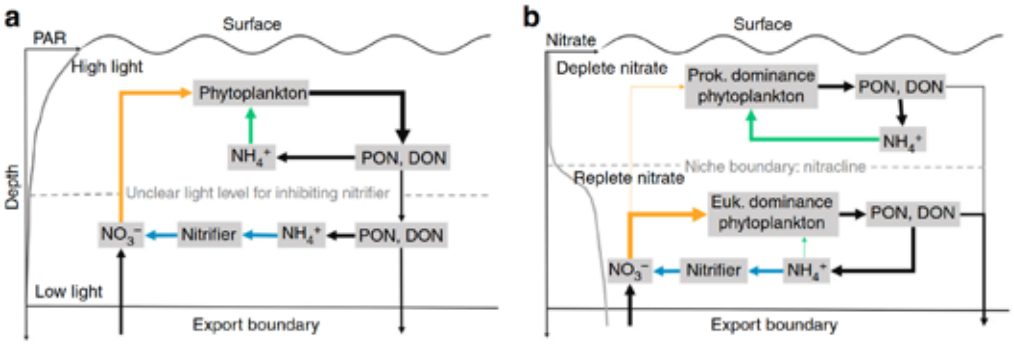
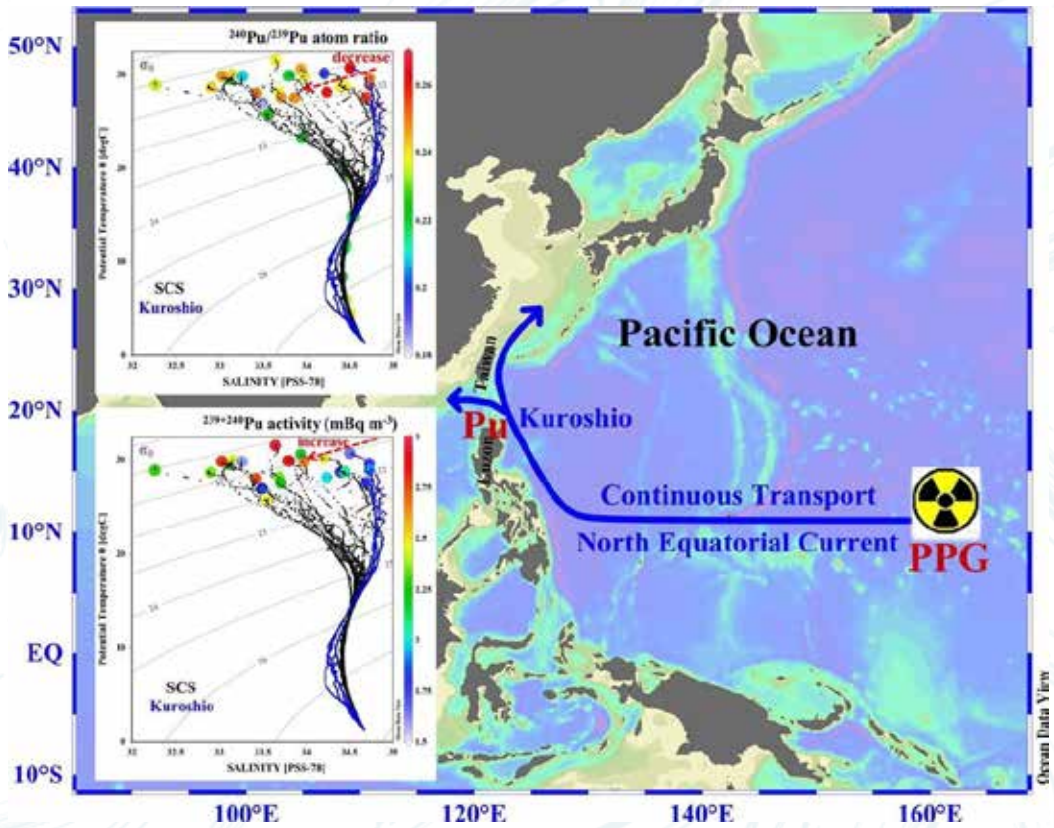


Fig. 1. Conceptual diagrams for the regulation of ammonium transformation pathways. a Conventional view: the control of the vertical distribution of NH_4^+ assimilation and nitrification in the euphotic ocean is separation by light: phytoplankton dominate NH4+ consumption at high-light intensity, and reduced light inhibition enables nitrifiers to dominate NH_4^+ consumption at greater depth. However, the light level for inhibition shows large temporal-spatial variations and thus the niche boundary for nitrifiers is unclear. b Amended view: ambient NO_3^- exerts important influence on the competition for NH4+ by nitrifiers versus phytoplankton via determining phytoplankton community structure, and thus, the affinity of phytoplankton for $NH4^+$. Above the nitracline, prokaryotes dominate, yielding higher affinity for NH_4^+; while below the nitracline eukaryotes dominate and use the abundant NO_3^- as the main nitrogen source, reducing phytoplankton affinity for NH_4^+ and enabling nitrifiers to dominate ammonium recycling. Thus, the depth of the nitracline represents a predictable boundary for the bifurcation of the fate of ammonium. Blue arrows indicate nitrification; green and orange arrows indicate NH_4^+ uptake (regenerated production) and NO_3^- uptake (new production), respectively.



Sources and accumulation of plutonium in a large Western Pacific marginal sea: The South China Sea.

Wu, JW; Dai*, MH; Xu, YP; Zheng, J. ***Science of the Total Environment,*** 2018. 610-611, 200-211.

In order to examine the sources of plutonium (Pu) and elaborate its scavenging and accumulation processes, $^{240}Pu/^{239}Pu$ atom ratios and $^{239+240}Pu$ activities in the water column of the South China Sea (SCS) were determined and compared with our previously reported data for the sediments. Consistently high $^{240}Pu/^{239}Pu$ atom ratios that ranged from 0.184–0.250 (average = 0.228 ± 0.015), indicative of non-global fallout Pu sources were observed both in the surface water and at depth during 2012–2014. The spatial distribution of the $^{240}Pu/^{239}Pu$ atom ratio in the SCS showed a decreasing trend away from the Luzon Strait, which was very consistent with the introduction pathway of the Kuroshio Current. The Kuroshio had an even heavier Pu isotopic ratio ranging from 0.250–0.263 (average = 0.255 ± 0.006), traceable to the non-global fallout Pu signature from the Pacific Proving Grounds (PPG). Using a simple two end-member mixing model, we further revealed that this PPG source contributed 41 ± 17% of the Pu in the SCS water column. The $^{239+240}Pu$ activities in the SCS surface sea-water varied from 1.59 to 2.94 mBq m^{-3}, with an average of 2.34 ± 0.38 mBq m^{-3}. Such an activity level was ~40% higher than that in the Kuroshio. The distribution of $^{239+240}Pu$ in the surface seawater further showed a general trend of increase from the Kuroshio to the SCS basin, suggesting significant accumulation of Pu within the SCS. The $^{239+240}Pu$ inventory of the water column in the SCS basin at the SEATS station with a total depth of ~3840 m was estimated to be ~29 Bq m^{-2}, which was substantially higher than the sediment core estimates made for the SCS basin (3.75 Bq m^{-2}) but much lower than the sediment core estimates made for the shelf of the northern SCS (365.6 Bq m^{-2}). Such differences were determined by the lower scavenging efficiency of Pu in the SCS basin compared to the northern SCS shelf.

Benthic fluxes of metals into the Pearl River Estuary based on $^{224}Ra/^{228}Th$ disequilibrium: From alkaline earth (Ba) to redox sensitive elements (U, Mn, Fe)

Hong, QQ; Cai*, PH; Geibert, W; Cao, ZM; Stimac, I; Liu, LF; Li, Q. ***GEOCHIMICA ET COSMOCHIMICA ACTA,*** 2018. 237: 223-239.

Abstract: We extended the 224Ra/228Th disequilibrium approach to examine benthic fluxes of a variety of metals, ranging from alkaline earth (Ba) to redox sensitive elements (U, Mn, and Fe), into the Pearl River Estuary (PRE), China. Depth profiles of ^{224}Ra and 228Th in bulk sediment, as well as dissolved ^{224}Ra and trace metals in porewater were measured along a transect within the estuary in July 2015. Significant deficit of ^{224}Ra relative to ^{228}Th was commonly observed in the upper 0-15 cm sediment. We took advantage of the $^{224}Ra/^{228}Th$ disequilibrium in the bottom sediments to construct a full mass balance of ^{224}Ra in the overlying water column. We demonstrated that porewater exchange (PEX) processes with scale lengths of several centimeters are the predominant mechanism for solute transport between sediments and overlying waters in the PRE. In contrast, deep porewater flow or submarine groundwater discharge (SGD) with scale lengths of "meters to kilometers" are a negligible component in the water column budget of ^{224}Ra. Strong correlations between dissolved 224Ra and trace metals (Ba, U, Mn, and Fe) in porewater were frequently observed in the study region. This likely reflects a fact that geochemical cycling of alkaline earth elements (e.g., Ra and Ba) and redox sensitive elements (like U) in sediments was closely linked to diagenetic reactions of manganese and iron oxides. This linkage makes it possible to quantify benthic fluxes of alkaline earth and redox sensitive metals using $^{224}Ra/^{228}Th$ disequilibrium in sediments. Benthic Ba fluxes based on $^{224}Ra/^{228}T$ disequilibrium were found to vary from virtually nil to 320 µmol m-2d-1 within the PRE. The highest flux was identified at salinity = 3.0-7.8 and could lead to an elevation of 54 nmol Ba l^{-1} in the water column, which well reproduced the Ba excess frequently observed in the low salinity domain of the estuary. Benthic fluxes of redox sensitive U ranged from -0.42 ("-" denotes flux into sediment) to 1.3 µmol $m^{-2}d^{-1}$. This could only cause a change of -0.1 to 0.3 nmol U 1^{-1} in the water column, which is very small when compared to the U concentration of 13-14 nmol 1^{-1} in the northern South China Sea. We therefore predicted that water column U in the PRE must behave conservatively during mixing. This prediction is consistent with historical measurements of water column U concentration within the PRE. Large benthic fluxes of Mn and Fe were generally acquired with the $^{224}Ra/^{228}T$ disequilibrium method. They varied from virtually nil up to 97 mmol $m^{-2}d^{-1}$, and from zero to 27 mmol $m^{-2}d^{-1}$, respectively. These estimates are 1-2 orders of magnitude higher than historical measurements based on the traditional incubation method in other coastal settings. Nonetheless, they are in agreement with a simple consideration of Mn and Fe mass balances in the sediment. An important implication of this study is that the role of coastal sediments in estuarine geochemistry of trace metals may need to be re-evaluated.

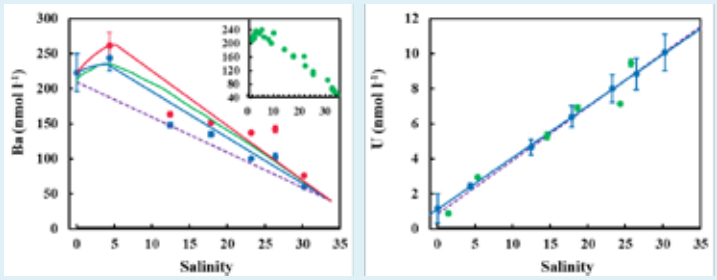


Fig. 2. Comparison of dissolved Ba and U concentrations in the water column predicted from a multitude-box model with previous field measurements within the Pearl River Estuary. The gray dash line denotes the theoretical dilution line of the riverine and coastal end-members. The end-members of Ba were taken from Cao et al. (2016), and the end-members of U were adopted from Sun et al. (1987). Field measurements of Ba in July 2012 are indicated in the box within the left graph and are shown as the green solid line. The blue line with filled triangles denotes the predicted concentrations affected only by benthic input. The red line with open circles denotes the upper limit of the predicted concentrations affected by both the benthic input and the release from suspended particles (i.e., all the exchangeable fraction and all the organic fraction of Ba in suspended particles were released during estuarine mixing.).

Production and transformation of dissolved and particulate organic matter as indicated by amino acids in the Pearl River estuary, China

Li*, XL; Liu, ZF; Chen, W; Wang, L; He, BY; Wu, K; Gu, S; Jiang, P; Huang, BQ; Dai, MH. ***JOURNAL OF GEOPHYSICAL RESEARCH-BIOGEOSCIENCES***, 2018. 123, DOI:10.1029/2018JG004690.

Abstract: Production and transformation of dissolved and particulate organic matter (DOM, POM) in estuaries regulate the carbon export from land to ocean, yet tracing their source and diagenetic status is challenging in these dynamic environments. Here we study the production, transport, and diagenetic status of DOM in the Pearl River Estuary (PRE), China, based on total dissolved amino acids, their enantiomers (D/L ratios), and other ancillary biogeochemical parameters with a complete coverage of upper, middle, and lower estuary. Inferred from amino acid composition and D/L ratios, DOM in the upper PRE was highly altered by bacteria, while the carbon yields of total dissolved amino acids were relatively high showing a conflicting pattern likely contributed by multiple sources including planktonic production, soil leachates, and sewage discharge. Conservative mixing between freshwater and seawater predominantly controlled DOM dynamics in the middle PRE. In contrast, the lower PRE was characterized by high planktonic production, leading to the accumulation of labile DOC in the surface water. The compositional pattern of amino acids differed significantly between dissolved and particulate phases, yet the diagenetic indices of POM and DOM were both relatively lower in the upper and middle PRE compared to the lower PRE, suggesting that primary production is a major driving factor in the lower PRE. Overall, our study emphasizes the highly dynamic and spatially heterogeneous nature of the PRE, and the results from molecular level characterization provide new insights into the complex sources, diagenesis, and transformation processes of DOM in different regions of the estuary, as well as its connection with POM.

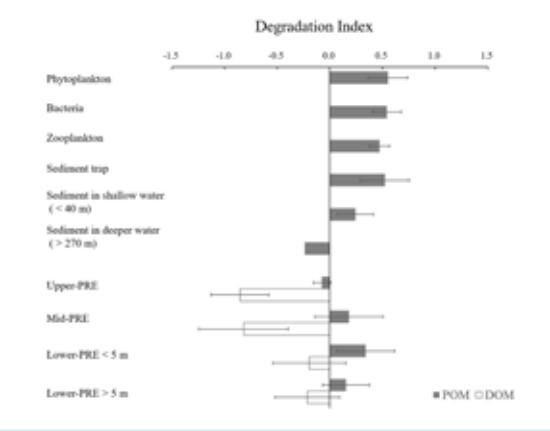


Fig. 3. Average diagenetic indexes of phytoplankton (n = 10), bacteria (n = 3), zooplankton (n = 4), and sediment trap POM (n = 27) to sedimentary POM in shallow water (<40-m water depth, n = 5) and the average values of DOM and POM samples collected in the upper, middle, and lower PRE surface and deeper samples. Standard deviations are shown as error bars. Plankton and sediment end-members were adopted from Dauwe et al. (1999), and references therein.

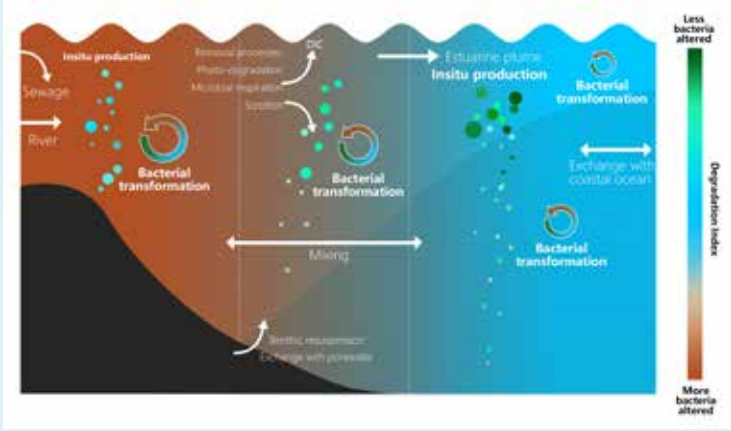


Fig. 4. A conceptual diagram showing the diagenetic status of DOM and POM in different regions of PRE during the wet season. The color range of the diagenetic status is referenced from the DI values estimated in this work, and the sources, transport, and transformation processes are shown as arrows in the diagram.

Molecular composition and origin of water-soluble organic matter in marine aerosols in the Pacific off China

Bao*, HY; Niggemann, J; Luo, L; Dittmar, T; Kao, SJ. ***ATMOSPHERIC ENVIRONMENT***, 2018. 191: 27-35.

Abstract: The atmospheric deposition of water-soluble organic carbon (WSOC) contributes to the open ocean dissolved organic carbon (DOC) reservoir similarly to riverine discharge. However, information on the sources and composition of water-soluble organic matter (WSOM) in marine aerosols remains scarce, particularly at the molecular level. By using ultra-high resolution Fourier transform ion cyclotron resonance mass spectrometry (FT-ICR-MS), we identified approximately ten thousand molecular formulas in marine aerosols collected over the China coastal seas and the northwestern Pacific Ocean (NWPO). Even though their molecular compositions were highly variable (Bray-Curtis distance: 0.12-0.74), four distinctive origins, namely, marine biogenic sources, secondary organic aerosols (including CHO, CHON formulas derived from biogenic volatile organic compounds (VOCs) and organosulfate derived from both biogenic and anthropogenic VOCs), soil-derived organic matter (OM) and biomass and fossil fuel burning-derived polycyclic aromatics (including highly condensed organosulfur compounds) and unsaturated compounds, were discovered. Moreover, the different types of aerosols, including aerosols from the NWPO (marine-influenced), NWPO (dust) and China coastal seas, contained various proportions of organics from different sources. The NWPO (marine-influenced) aerosols were enriched with sea spray-derived OM, which was widely distributed and was likely related to marine biological activity. The NWPO (dust) aerosols exhibited a higher fraction of soil-derived OM, while the China coastal sea aerosols exhibited a much higher fraction of organosulfate than the other aerosols. Our investigation provided detailed molecular compositional and source information for marine aerosols over the northwestern Pacific Ocean, which can be utilized to understand the composition of WSOM deposited on the sea surface.

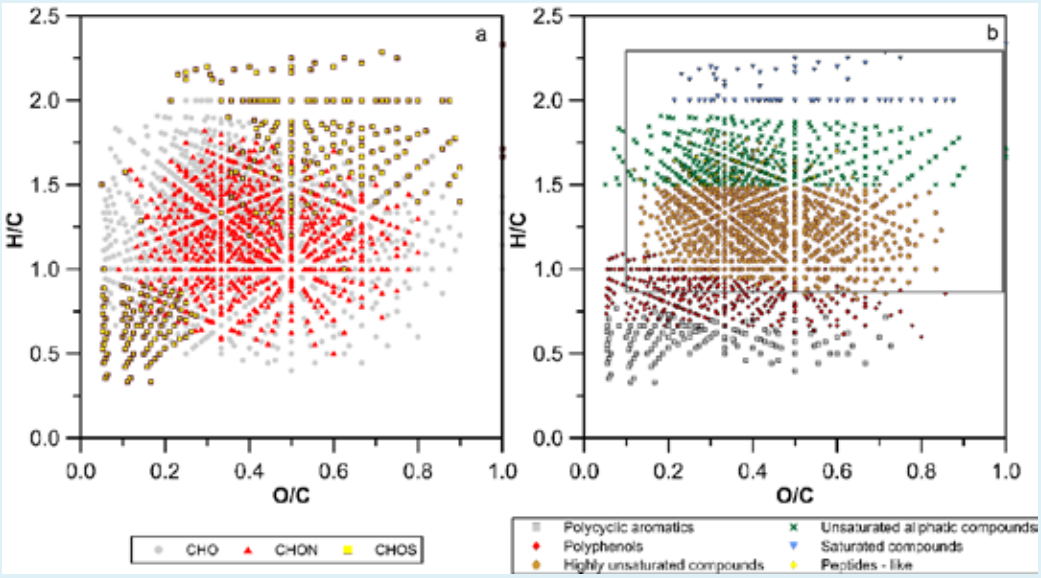


Fig. 5. Van Krevelen plot of common formulas (observed in at least 38 of 46 samples) (a), and the main molecular groups assigned (b). Both CHO and CHON formulas are spread throughout the van Krevelen diagram (a). These compounds are unsaturated aliphatic compounds, highly unsaturated compounds, peptide-like formulas, polyphenols and polycyclic aromatics, which likely originated from soil, sea spray, SOAs and biomass and fossil fuel burning (b). CHOS formulas were mainly organosulfates and organo-sulfur, including highly condensed aromatic organosulfate derived from fossil fuel combustion.

海洋微型生物与浮游生物生态
Marine Microbial and Phytoplanktonic Ecology

Contribution of structural recalcitrance to the formation of the deep oceanic dissolved organic carbon reservoir

Wang, NN; Luo, YW; Polimene, L; Zhang, R; Zheng, Q; Cai, RH; Jiao*, NZ. ***ENVIRONMENTAL MICROBIOLOGY REPORTS***, 2018. 10: 711-717.

Abstract: The origin of the recalcitrant dissolved organic carbon (RDOC) reservoir in the deep ocean remains enigmatic. The structural recalcitrance hypothesis suggests that RDOC is formed by molecules that are chemically resistant to bacterial degradation. The dilution hypothesis claims that RDOC is formed from a large diversity of labile molecules that escape bacterial utilization due to their low concentrations, termed as RDOCc. To evaluate the relative contributions of these two mechanisms in determining the long-term persistence of RDOC, we model the dynamics of both structurally recalcitrant DOC and RDOCc based on previously published data that describes deep oceanic DOC degradation experiments. Our results demonstrate that the majority of DOC (84.5 ± 2.2%) in the deep ocean is structurally recalcitrant. The intrinsically labile DOC (i.e., labile DOC that rapidly consumed and RDOCc) accounts for a relatively small proportion and is consumed rapidly in the incubation experiments, in which 47.8 ± 3.2% of labile DOC and 21.9 ± 4.6% of RDOCc are consumed in 40 days. Our results suggest that the recalcitrance of RDOC is largely related to its chemical properties, whereas dilution plays a minor role in determining the persistence of deep-ocean DOC.

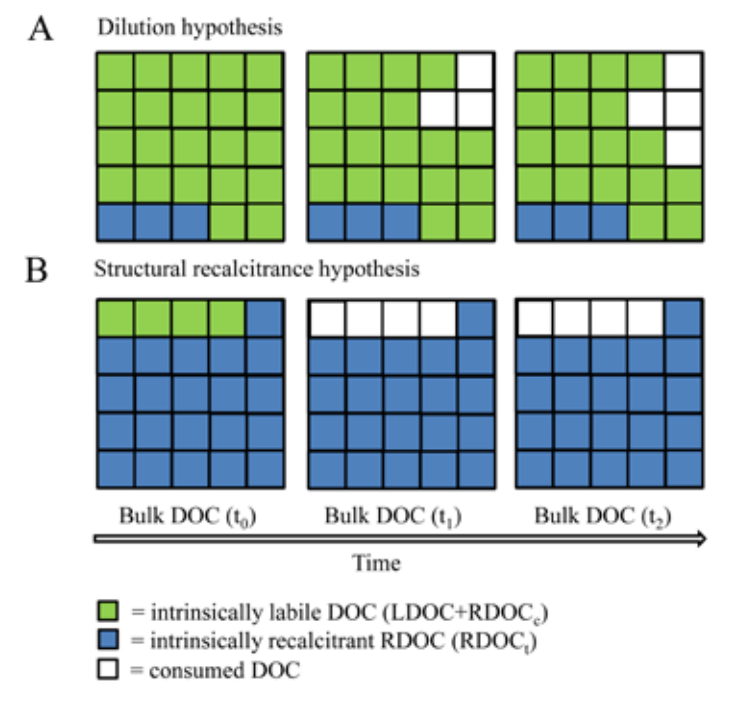


Fig. 6. Two possible interpretations for the small proportion of SPE DOC consumption in a 40-day incubation. A. A large fraction of the SPE DOC is intrinsically labile and complete consumption of it would take a long time. This is what has been proposed in Arrieta and colleagues (2015b). B. According to our estimates, there is a small amount of intrinsically labile DOC in the SPE DOC and it is rapidly utilized.

Anticyclonic eddy edge effects on phytoplankton communities and particle export in the northern South China Sea

Wang, L; Huang*, BQ; Laws, EA; Zhou, KB; Liu, X; Xie, YY; Dai, MH. ***JOURNAL OF GEOPHYSICAL RESEARCH-OCEANS***, 2018. 123, DOI: 10.1029/2017JC013623.

Abstract: We examined response of phytoplankton total chlorophyll α (TChl α) and community composition to three coherent anticyclonic eddies (ACEs) observed during a cruise to the northern South China Sea on 28 July to 7 August 2007. Photosynthetic pigments were measured to estimate the contribution of nine phytoplankton groups to TChl α. Although the water column-integrated TChl α inventory in the upper 100 m was very similar among the three ACEs (17.6–18.9 mg/m^2) we observed during the cruise, there were remarkable enhancements in biomasses at the eddy edges. TChl α inventory was 20.8 ± 3.0 mg/m^2 at the edge, which was 33% or 60% higher than at the center and reference. The greatest enhancement of the TChl α at edge was attributed to haptophyte-8, which was 1.6 and 2.2 times the analogous concentrations at the center and reference sites. The Prochlorococcus Chl α was ~50% greater at the edge relative to the reference and was intermediate at the center. Diatom Chl α at the edge was ~2.5 times the concentrations at the center and reference sites. The positive correlation between particulate organic carbon flux and haptophyte-8 Chl α at the edge implied an important role of haptophyte-8 in particle export productivity. It is interesting to note that there occurred higher fluxes of biogenic Si at the center of the ACEs due likely to lateral transport of diatoms from the edge. The phenomenon of higher TChl α at the edge but higher export at the center may have been the combined result of vertical convection and lateral transport within the eddies.

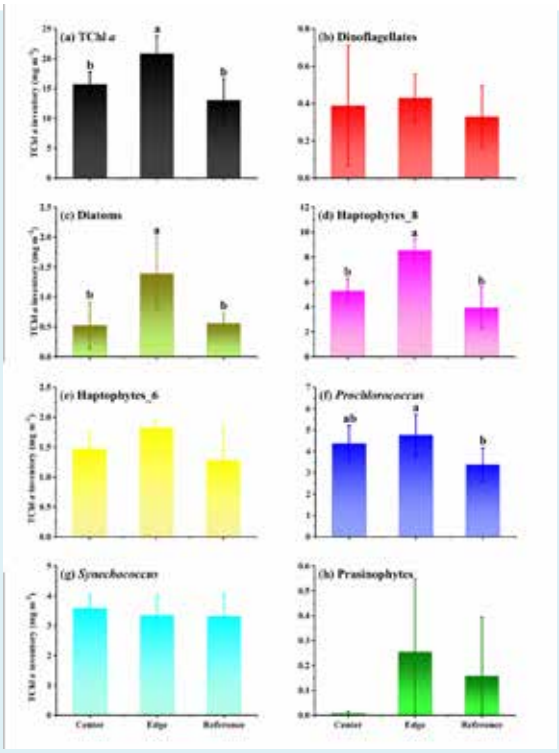


Fig.7. Post hoc multiple comparisons of (a) TChl α, (b) dinoflagellates, (c) diatoms, (d) haptophyte-8, (e) haptophyte-6, (f) *Prochlorococcus*, (g) *Synechococcus*, and (h) prasinophytes TChl α inventory (mg/m^2) in the upper 100-m water column between the ACEs' center, edge, and reference stations during the August 2007 cruise. The superscript labels ^{a}, ^{b}, and ^{ab} represent significant difference at the level of $p < 0.05$. ACES = anticyclonic eddies.

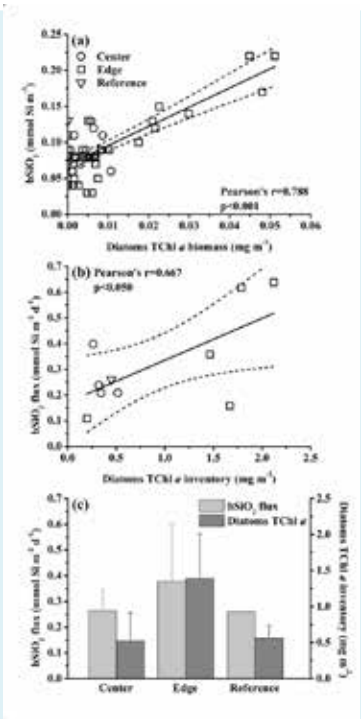


Fig. 8. The correlation analysis between (a) $bSiO_2$ concentration (mmol Si/m^3) and diatom TChl α concentration (mg/m^3), (b) $bSiO_2$ flux (mmol Si·m^{-2}·d^{-1}) and diatom TChl a concentration inventory (mg/m^2), and (c) the histogram of $bSiO_2$ flux and diatom TChl α concentration at the ACEs' center, edge, and referencestations. The dots, squares, and inverted triangles represent the center, edge, and reference stations. The linear regression is in the solid line with two dashed lines showing the confidence limits. ACES = anticyclonic eddies.

Metaproteomics of marine viral concentrates reveals key viral populations and abundant periplasmic proteins in the oligotrophic deep chlorophyll maximum of the South China Sea

Xie, ZX; Chen, F; Zhang, SF; Wang, MH; Zhang, H; Kong, LF; Dai, MH; Hong, HS; Lin, L; Wang*, DZ. ***ENVIRONMENTAL MICROBIOLOGY***, 2018. 20: 477-491.

Abstract: Viral concentrates (VCs), containing bioinformative DNA and proteins, have been used to study viral diversity, viral metagenomics and virus-host interactions in natural ecosystems. Besides viruses, VCs also contain many noncellular biological components including diverse functional proteins. Here, we used a shotgun proteomic approach to characterize the proteins of VCs collected from the oligotrophic deep chlorophyll maximum (DCM) of the South China Sea. Proteins of viruses infecting picophytoplankton, that is, cyanobacteria and prasinophytes, and heterotrophic bacterioplankton, such as SAR11 and SAR116, dominated the viral proteome. Almost no proteins from RNA viruses or known gene transfer agents were detected, suggesting that they were not abundant at the sampling site. Remarkably, nonviral proteins made up about two thirds of VC proteins, including overwhelmingly abundant periplasmic transporters for nutrient acquisition and proteins for diverse cellular processes, that is, translation, energy metabolism and one carbon metabolism. Interestingly, three 56 kDa selenium-binding proteins putatively involved in peroxide reduction from gammaproteobacteria were abundant in the VCs, suggesting active removal of peroxide compounds at DCM. Our study demonstrated that metaproteomics provides a valuable avenue to explore the diversity and structure of the viral community and also the pivotal biological functions affiliated with microbes in the natural environment.

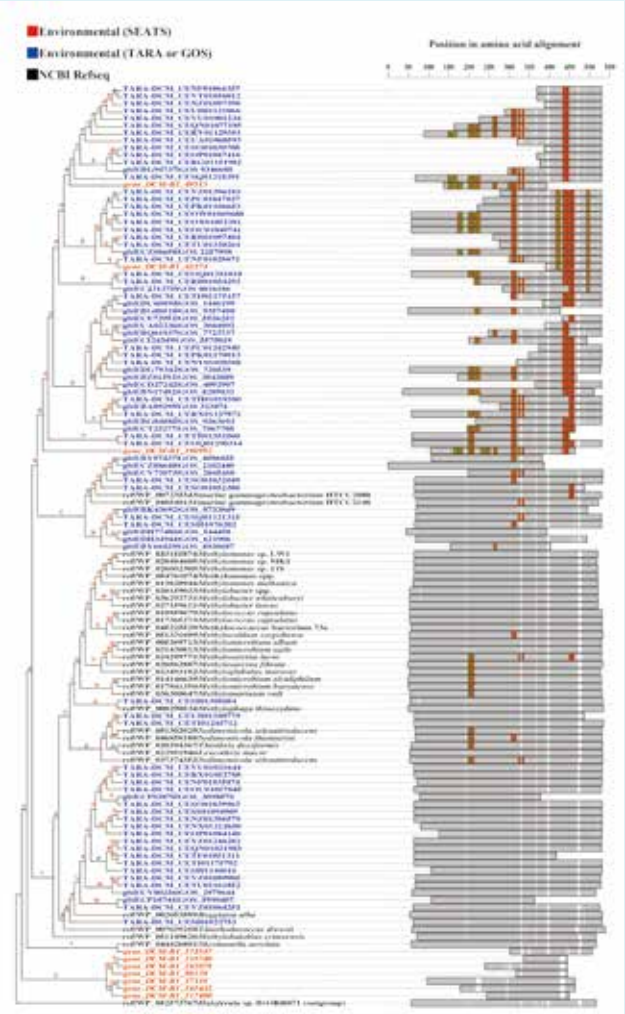


Fig. 9. Phylogenetic analysis and peptide coverage of environmental and reference SBP56-like proteins. The prevalence of a given amino acid residue at that position in the consensus sequence is heat mapped, with red as the most frequent and green as the least frequent residue. Grey means the undetected residues.

Coupled carbon, sulfur, and nitrogen cycles mediated by microorganisms in the water column of a shallow-water hydrothermal ecosystem

Li, YF; Tang, K; Zhang, LB; Zhao, ZH; Xie, XB; Chen, CTA; Wang, DL; Jiao, NZ; Zhang*, Y. ***FRONTIERS IN MICROBIOLOGY,*** 2018. 9, DOI:10.3389/fmicb.2018.02718.

Abstract: Shallow-water hydrothermal vent ecosystems are distinctly different from deep-sea vents, as other than geothermal, sunlight is one of their primary sources of energy, so their resulting microbial communities differ to some extent. Yet compared with deepsea systems, less is known about the active microbial community in shallow-water ecosystems. Thus, we studied the community compositions, their metabolic pathways, and possible coupling of microbially driven biogeochemical cycles in a shallow-water hydrothermal vent system off Kueishantao Islet, Taiwan, using high-throughput 16S rRNA sequences and metatranscriptome analyses. Gammaproteobacteria and Epsilonbacteraeota were the major active bacterial groups in the 16S rRNA libraries and the metatranscriptomes, and involved in the carbon, sulfur, and nitrogen metabolic pathways. As core players, *Thiomicrospira*, *Thiomicrorhabdus*, *Thiothrty*, *Suffurovum*, and *Arcobacter* derived energy from the oxidation of reduced sulfur compounds and fixed dissolved inorganic carbon (DIC) by the Calvin-Benson-Bassham (CBB) or reverse tricarboxylic acid cycles. Sox-dependent and reverse sulfate reduction were the main pathways of energy generation, and probably coupled to denitrification by providing electrons to nitrate and nitrite. Sulfur-reducing Nautiliaceae members, accounting for a small proportion in the community, obtained energy by the oxidation of hydrogen, which also supplies metabolic energy for some sulfur-oxidizing bacteria. In addition, ammonia and nitrite oxidation is another type of energy generation in this hydrothermal system, with marker gene sequences belonging to *Thaumarchaeota/Crenarchaeota* and *Nitrospina*, respectively, and ammonia and nitrite oxidation was likely coupled to denitrification by providing substrate for nitrate and nitrite reduction to nitric oxide. Moreover, unlike the deep-sea systems, cyanobacteria may also actively participate in major metabolic pathways. This study helps us to better understand biogeochemical processes mediated by microorganisms and possible coupling of the carbon, sulfur, and nitrogen cycles in these unique ecosystems.

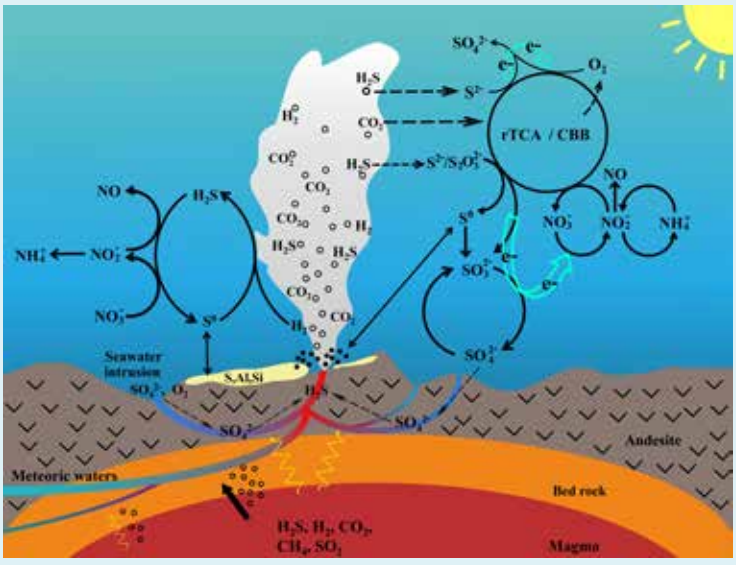


Fig. 10. Schematic diagram illustrating the coupling of the carbon, sulfur, and nitrogen cycles mediated by microorganisms in the shallow-water hydrothermal ecosystem. SO_4^{2-}, sulfate; SO_3^{2-}, sulfite; S/S^0, sulfur; $S_2O_3^{2-}$, thiosulfate; S_2^-, sulfide; H_2S, hydrogen sulfide; SO_2, sulfur dioxide; NO_3^-, nitrate; NO_2^-, nitrite; NH_4^+, ammonium; NO, nitric oxide; H_2, hydrogen; CH_4, methane; CO_2, carbon dioxide; O_2, oxygen.

Metatranscriptome analysis reveals environmental and diel regulation of a *Heterosigma akashiwo* (raphidophyceae) bloom

Ji, NJ; Lin, LX; Li, L; Yu, LY; Zhang, YQ; Luo, H; Li, MZ; Shi, XG; Wang, DZ; Lin*, SJ. ***ENVIRONMENTAL MICROBIOLOGY***, 2018. 20: 1078-1094.

Abstract: Despite numerous laboratory studies on physiologies of harmful algal bloom (HAB) species, physiologies of these algae during a natural bloom are understudied. Here, we investigated a bloom of the raphidophyte Heterosigma akashiwo in the East China Sea in 2014 using metabarcode (18S rDNA) and metatranscriptome sequencing. Based on 18S rDNA analyses, the phytoplankton community shifted from high diversity in the pre-bloom stage to *H. akashiwo* predominance during the bloom. A sharp decrease in ambient dissolved inorganic phosphate and strong up-regulation of phosphate and dissolved organic phosphorus (DOP) uptake genes, including the rarely documented (ppGpp)ase, in *H. akashiwo* from pre-bloom to bloom was indicative of rapid phosphorus uptake and efficient utilization of DOP that might be a driver of the *H. akashiwo* bloom. Furthermore, observed up-regulated expression of mixotrophy-related genes suggests potential contribution of mixotrophy to the bloom. Accelerating photosynthetic carbon fixation was also implied by the up-regulation of carbonic anhydrase genes during the bloom. Notably, we also observed a strong morning-to-afternoon shift in the expression of many genes. Our findings provide insights into metabolic processes likely important for *H. akashiwo* bloom formation, and suggest the need to consider timing of sampling in field studies on this alga.

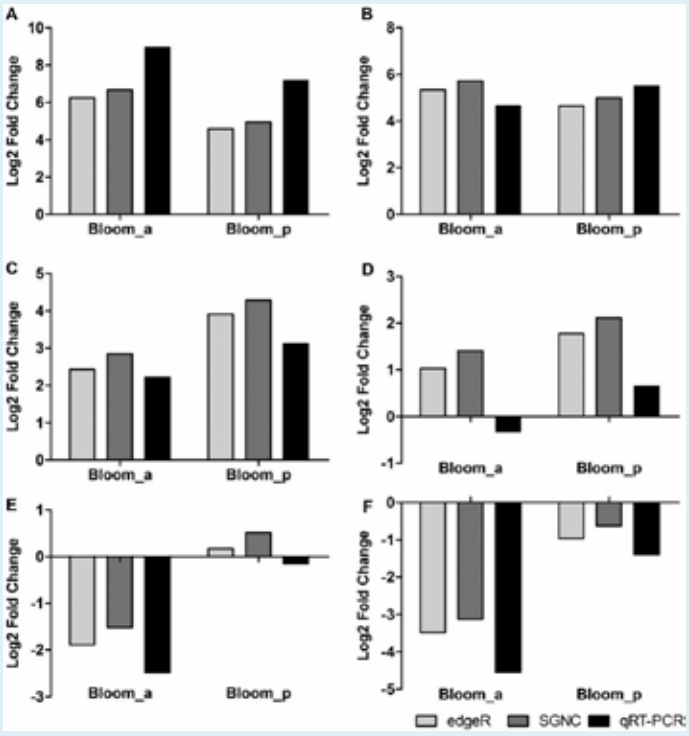


Fig. 11. Validation of differential gene expression patterns by comparing results from three different analysis methods. (A) Phosphate-repressible phosphate permease Pho4; (B) Alkaline phosphatase; (C) Nitrate reductase [NAD(P)H]; (D) Nitrite reductase (Ferredoxin); (E) ABC transporter F family member 1; (F) ABC transporter E family member 2. edgeR, the result of metatranscriptome based on number of reads mapped to the gene calculated by edgeR; SGNC, the result of metatranscriptome based on the relative expression levels of genes calculated by stable gene-normalized counts, the detailed calculation process of which is shown in Supporting Information Table S3; qRT-PCR, the results of quantitative reverse transcription PCR, expression levels of target genes were normalized to *rpL17-2*, *rpL23* and *tub*. The Log2 fold change represents the transcript abundance of a target gene in a bloom

全球变化及海洋生物响应
Marine Ecosystem Responses to Global Change

Interactive network configuration maintains bacterioplankton community structure under elevated CO_2 in a eutrophic coastal mesocosm experiment

Lin*, X; Huang, RP; Li, Y; Li, FT; Wu, YP; Hutchins, DA; Dai, MH; Gao, KS. ***BIOGEOSCIENCES***, 2018. 15: 551-565.

Abstract: There is increasing concern about the effects of ocean acidification on marine biogeochemical and ecological processes and the organisms that drive them, including marine bacteria. Here, we examine the effects of elevated CO_2 on the bacterioplankton community during a mesocosm experiment using an artificial phytoplankton community in subtropical, eutrophic coastal waters of Xiamen, southern China. Through sequencing the bacterial 16S rRNA gene V3-V4 region, we found that the bacterioplankton community in this high-nutrient coastal environment was relatively resilient to changes in seawater carbonate chemistry. Based on comparative ecological network analysis, we found that elevated CO_2 hardly altered the network structure of high-abundance bacterioplankton taxa but appeared to reassemble the community network of low abundance taxa. This led to relatively high resilience of the whole bacterioplankton community to the elevated CO_2 level and associated chemical changes. We also observed that the Flavobacteria group, which plays an important role in the microbial carbon pump, showed higher relative abundance under the elevated CO_2 condition during the early stage of the phytoplankton bloom in the mesocosms. Our results provide new insights into how elevated CO_2 may influence bacterioplankton community structure.

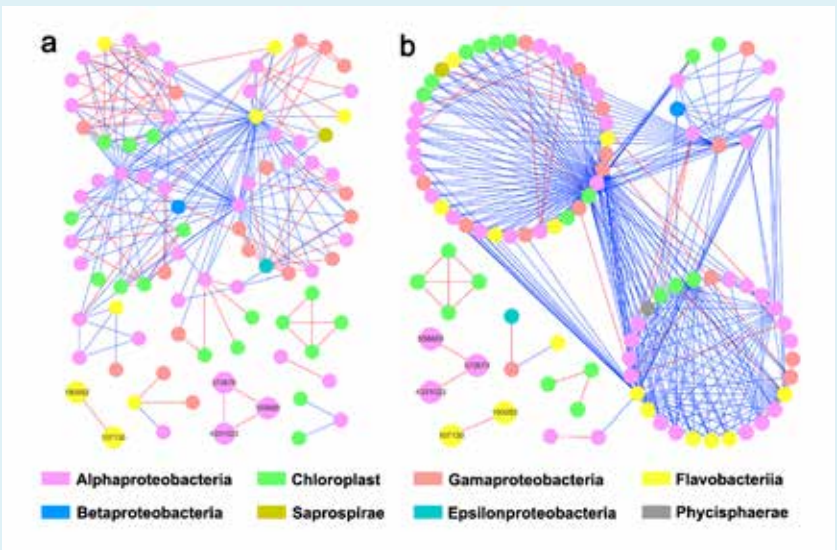


Fig. 12. Bacterioplankton network interactions under LC (a) and HC (b) conditions. Each node represents an OTU. Node colors denote different taxa. Each line connects two OTUs. A blue line indicates a negative interaction between nodes, suggesting predation or competition, while a red line indicates a positive interaction suggesting mutualism or cooperation. Important OTUs are marked with OTU identification numbers.

Adaptive evolution in the coccolithophore *Gephyrocapsa oceanica* following 1,000 generations of selection under elevated CO_2

Tong, SY; Gao*, KS; Hutchins, DA. ***GLOBAL CHANGE BIOLOGY***, 2018. 24: 3055-3064.

Abstract: Coccolithophores are important oceanic primary producers not only in terms of photosynthesis but also because they produce calcite plates called coccoliths. Ongoing ocean acidification associated with changing seawater carbonate chemistry may impair calcification and other metabolic functions in coccolithophores. While short-term ocean acidification effects on calcification and other properties have been examined in a variety of coccolithophore species, long-term adaptive responses have scarcely been documented, other than for the single species *Emiliania huxleyi*. Here, we investigated the effects of ocean acidification on another ecologically important coccolithophore species, *Gephyrocapsa oceanica,* following 1,000 generations of growth under elevated CO_2 conditions (1,000 µatm). High CO_2-selected populations exhibited reduced growth rates and enhanced particulate organic carbon (POC) and nitrogen (PON) production, relative to populations selected under ambient CO_2 (400 µatm). Particulate inorganic carbon (PIC) and PIC/POC ratios decreased progressively throughout the selection period in high CO_2-selected cell lines. All of these trait changes persisted when high CO_2-grown populations were moved back to ambient CO_2 conditions for about 10 generations. The results suggest that the calcification of some coccolithophores may be more heavily impaired by ocean acidification than previously predicted based on short-term studies, with potentially large implications for the ocean's carbon cycle under accelerating anthropogenic influences.

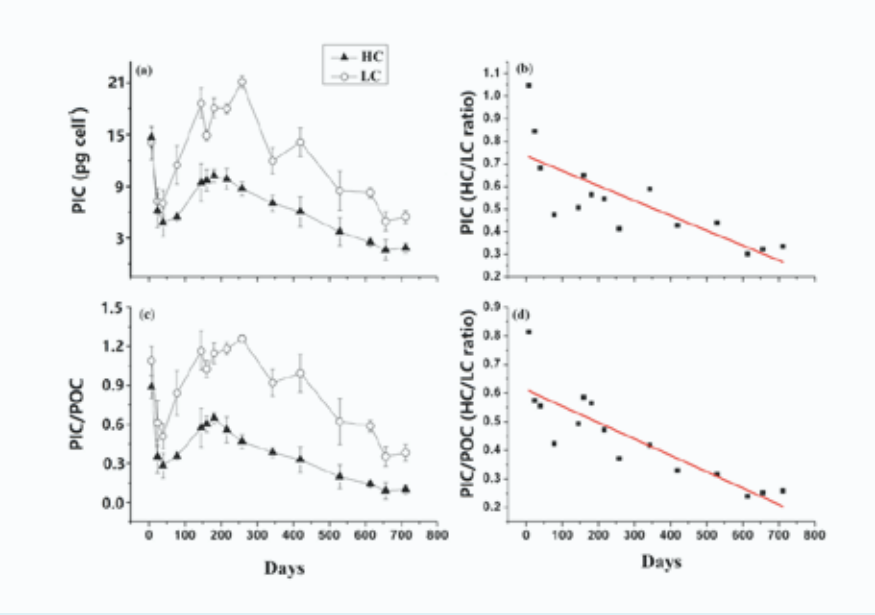


Fig. 13 Decreased production of particulate inorganic carbon (PIC) and its ratio to production of particulate organic carbon (POC) in the coccolithophore *Gephyrocapsa oceanica* grown under elevated (HC, 1000 µatm) and ambient (LC, 400 µatm) CO_2 concentrations during adaptation to 1000 generations

Calcification moderates the increased susceptibility to UV radiation of the coccolithophorid *Gephryocapsa oceanica* grown under elevated CO_2 concentration: Evidence based on calcified and non-calcified Cells

Miao, HB; Beardall, J; Gao*, KS. ***PHOTOCHEMISTRY AND PHOTOBIOLOGY***, 2018. 94: 994-1002.

Abstract: The physiological performance of calcified and non-calcified cells of *Gephyrocapsa oceanica* (NIES-1318) and their short-term responses to UV radiation were compared for cultures grown under present-day (LC, 400 µatm) and high pCO_2 (HC, 1000 µatm) conditions. Similar growth rates and Fv/Fm values were observed in both types of cell under LC conditions, indicating that the loss of calcification in the non-calcified cells did not lead to a competitive disadvantage under such conditions. Detrimental effects of elevated pCO_2 were observed in both cell types, with the growth rate of non-calcified cells decreasing more markedly, which might reflect a negative impact of higher cytoplasmic H^+. When exposed to short-term UV radiation, similar trends in effective quantum yield were observed in both cell types acclimated to LC conditions. Elevated pCO_2 and associated seawater chemical changes strongly reduced effective quantum yield in non-calcified cells but no significant influence was observed in calcified cells. Based on these findings and comparisons with previous studies, we suggest that the negative impact of elevated cytoplasmic H^+ would exacerbate the detrimental effects of UV radiation while the possession of calcification attenuated this influence.

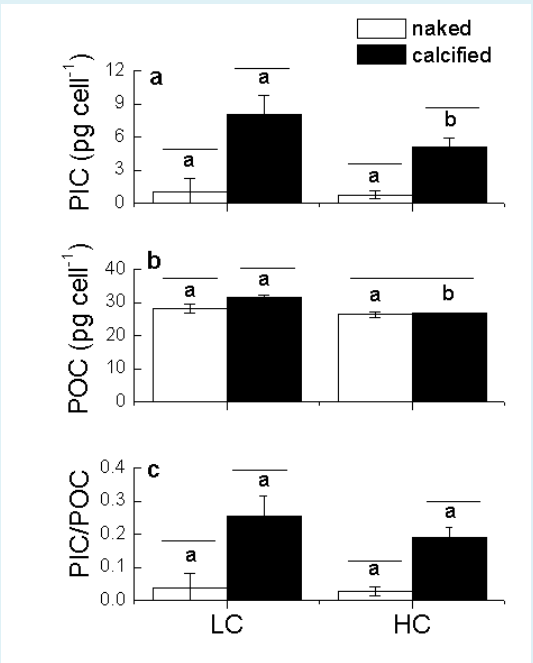


Fig. 14. PIC content (a) and particulate inorganic carbon (PIC) to particulate organic carbon (POC) ratio (b) of high (calcified) and less-calcifying (naked) Coccolithophorid *Gephryocapsa oceanica* cells grown under LC (400 µatm CO2) and HC (1000 µatm CO_2) conditions. Continuous lines above histogram bars indicate a lack of significant differences between naked and calcified cells, and different letters indicate significant differences between LC and HC conditions. The vertical lines indicate SD (n=3).

Variation in cell size of the diatom *Coscinodiscus granii* influences photosynthetic performance and growth

Yan, D; Beardall, J; Gao*, KS. ***PHOTOSYNTHESIS RESEARCH***, 2018. 137: 41-52.

Abstract: Cell size has implications for the package effect in photon absorption as well as for metabolic scaling of metabolism. In this study, we have avoided species-related differences by using isolates of the marine planktonic diatom Coscinodiscus granii with cells of different sizes and grown at different light intensities to investigate their energy allocation strategies. To make full use of incident light, several fold variations in cellular chlorophyll a content were employed across cell size. This modulation of pigment-related light absorbance was deemed effective as similar light absorbing capacities were found in all treatments. Unexpected low values of O_2 evolution rate at the highest irradiance level of 450 µmol photons $m^{-2}s^{-1}$ were found in medium and large cells, regardless of more photons being absorbed under these conditions, suggesting the operation of alternative electron flows acting as electron sinks. The growth rate was generally larger at higher irradiance levels except for the large cells, in which growth slowed at 450 µmol photons $m^{-2}s^{-1}$, suggesting that larger cells achieved a balance between growth and photoprotection by sacrificing growth rate when exposed to high light. Although the ratio of carbon demand to rates of uncatalysed CO_2 diffusion to the cell surface reached around 20 in large cells grown under higher irradiance, the carbon fixation rate was not lowered, due to the presence of a highly effective carbon dioxide concentrating mechanism.

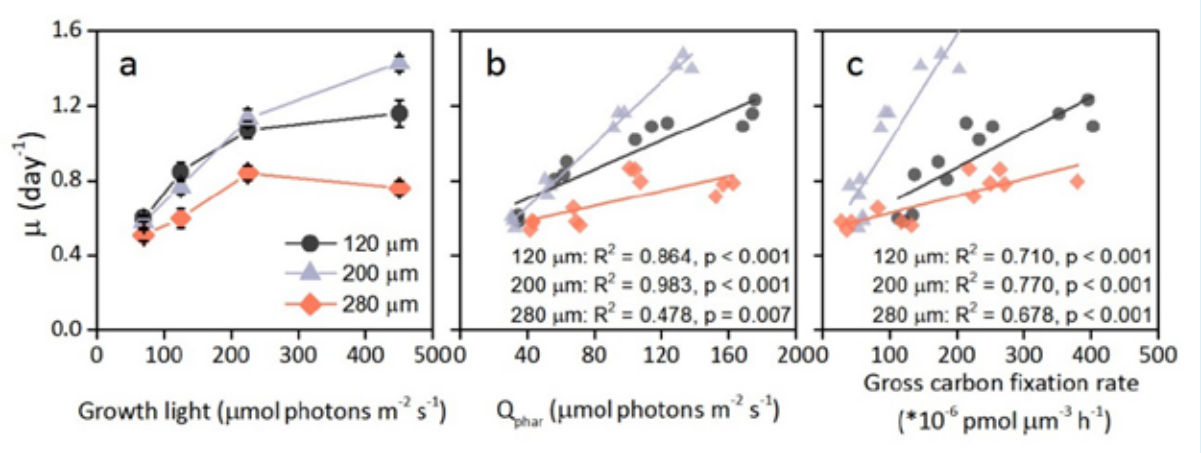


Fig. 15. Averaged specific growth rates of the diatom *Coscinodiscus granii* plotted against (a), growth light; (b), absorbed light and (c), gross carbon fixation rate normalized to cell volume (10^{-6} pmol C $\mu m^{-3} h^{-1}$). The solid lines in (b) and (c) are the linear fitted values of growth rate as a function of different independent variables.

Structural flexibility and protein adaptation to temperature: Molecular dynamics analysis of malate dehydrogenases of marine molluscs

Dong*, YW; Liao, ML; Meng, XL; Somero, GN. ***Proceedings of the National Academy of Sciences of the United States of America.*** 2018, 115: 1274-1279.

Abstract: Orthologous proteins of species adapted to different temperatures exhibit differences in stability and function that are interpreted to reflect adaptive variation in structural "flexibility." However, quantifying flexibility and comparing flexibility across proteins has remained a challenge. To address this issue, we examined temperature effects on cytosolic malate dehydrogenase (cMDH) orthologs from differently thermally adapted congeners of five genera of marine molluscs whose field body temperatures span a range of 60 °C. We describe consistent patterns of convergent evolution in adaptation of function [temperature effects on KM of cofactor (NADH)] and structural stability (rate of heat denaturation of activity). To determine how these differences depend on flexibilities of overall structure and of regions known to be important in binding and catalysis, we performed molecular dynamics simulation (MDS) analyses. MDS analyses revealed a significant negative correlation between adaptation temperature and heat-induced increase of backbone atom movements [root mean square deviation (rmsd) of main-chain atoms]. Root mean square fluctuations (RMSFs) of movement by individual amino acid residues varied across the sequence in a qualitatively similar pattern among orthologs. Regions of sequence involved in ligand binding and catalysis—termed mobile regions 1 and 2 (MR1 and MR2), respectively—showed the largest values for RMSF. Heat-induced changes in RMSF values across the sequence and, importantly, in MR1 and MR2 were greatest in cold-adapted species. MDS methods are shown to provide powerful tools for examining adaptation of enzymes by providing a quantitative index of protein flexibility and identifying sequence regions where adaptive change in flexibility occurs.

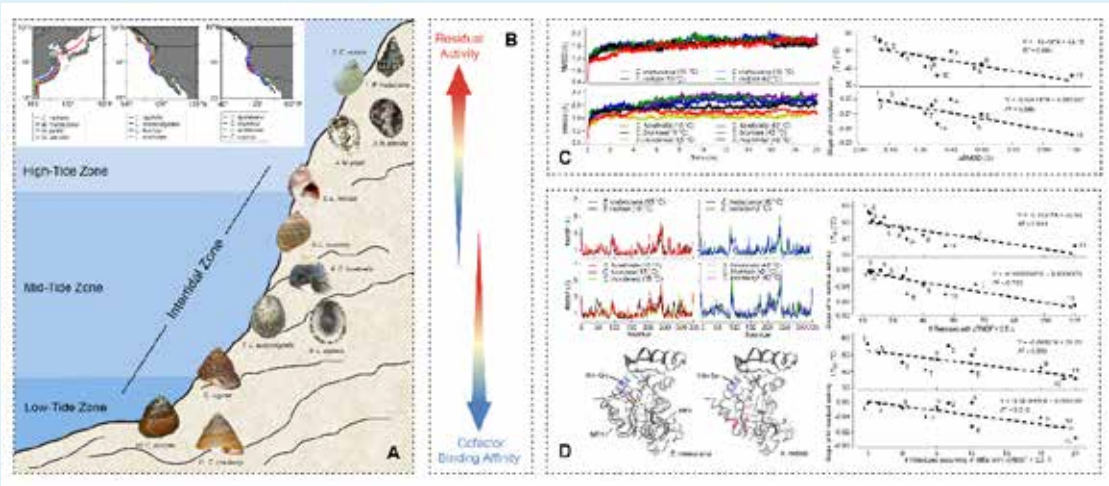


Fig. 16. MDS analysis of backbone atom movements in cMDHs. (A and B) The rmsd of backbone atom positions for cMDHs from *Echinolittorina malaccana, E. radiata*, *C. funebralis*, *C. brunnea*, and *C. montereyi* at simulation temperatures of 15 and 42 °C (n =3). (C) The ΔRMSD (the difference of rmsd value between 42 and 15 °C) over the equilibration state (10–20 ns) vs. lethal temperature (LT50) for cMDH orthologs of 11 species of molluscs. (D) The ΔRMSD vs. the rate of thermal denaturation for 11 cMDH orthologs. Species are numbered as follows: 1, *E. malaccana*; 2, *E. radiata*; 3, N. *albicilla*; 4, *N. yoldii*; 5, *L. keenae*; 6, *L. scutulata*; 7, *L. austrodigitalis*; 8, *L. digitalis*; 9, *C. funebralis*; 10, *C. brunnea*; and 11, *C. montereyi*. The relationship between ΔRMSD and LT50 or rate of thermal denaturation was analyzed by a least-squares linear regression analysis model.

Comparing mutagenesis and simulations as tools for identifying functionally important sequence changes for protein thermal adaptation

Liao, ML; Somero, GN; Dong*, YW. ***Proceedings of the National Academy of Sciences of the United States of America***, 2018. DOI: 10.1073/pnas.1817455116.

Abstract: Comparative studies of orthologous proteins of species evolved at different temperatures have revealed consistent patterns of temperature-related variation in thermal stabilities of structure and function. However, the precise mechanisms by which interspecific variations in sequence foster these adaptive changes remain largely unknown. Here, we compare orthologs of cytosolic malate dehydrogenase (cMDH) from marine molluscs adapted to temperatures ranging from −1.9 °C (Antarctica) to 55 °C (South China coast) and show how amino acid usage in different regions of the enzyme (surface, intermediate depth, and protein core) varies with adaptation temperature. This eukaryotic enzyme follows some but not all of the rules established in comparisons of archaeal and bacterial proteins. To link the effects of specific amino acid substitutions with adaptive variations in enzyme thermal stability, we combined site-directed mutagenesis (SDM) and in vitro protein experimentation with in silico mutagenesis using molecular dynamics simulation (MDS) techniques. SDM and MDS methods generally but not invariably yielded common effects on protein stability. MDS analysis is shown to provide insights into how specific amino acid substitutions affect the conformational flexibilities of mobile regions (MRs) of the enzyme that are essential for binding and catalysis. Whereas these substitutions invariably lie outside of the MRs, they effectively transmit their flexibility-modulating effects to the MRs through linked interactions among surface residues. This discovery illustrates that regions of the protein surface lying outside of the site of catalysis can help establish an enzyme's thermal responses and foster evolutionary adaptation of function.

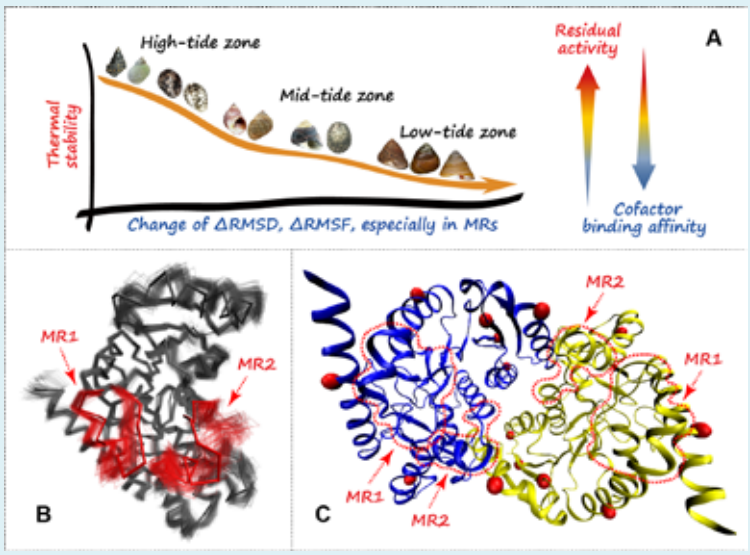


Fig. 17. (A) The cytosolic malate dehydrogenase (cMDH) orthologs of marine molluscs adapted to different temperatures exhibit differences in stability and function that are interpreted to reflect adaptive variation in structural rigidity and flexibility. (B) High variation in rigidity and flexibility mainly occurred at the mobile regions (MRs) during the thermal denaturation process of molecular dynamics simulations. The initial 3-d structure of Echinolittorina radiata cMDH is shown by a heavy solid line, the structure trajectories of the first 2 ns at 57 °C are shown by dashed lines, and the locations of the two MRs are highlighted in red. (C) Dimeric assembly of *E. malaccana* cMDH. There are only seven nonconservative amino acid substitutions among the *E. malaccana*, *E. radiata*, *Littorina keenae*, and *L. scutulata* cMDH orthologs (be shown in red spheres) whose thermal sensitivities varied dramatically. The substitutions mainly occur near (but not within) the MR sites in the individual subunit or in regions of the subunit that, in the dimer, lied near the other subunit's MRs. The locations of the two MRs are shown by red dashed lines.

海洋污染与生态毒理
Marine Ecotoxicology

Multigenerational effects of 4-methylbenzylidene camphor (4-MBC) on the survival, development and reproduction of the marine copepod *Tigriopus japonicus*

Chen, LY; Li, XL; Hong*, HZ; Shi, DL. ***AQUATIC TOXICOLOGY***, 2018. 194: 94-102.

Abstract: One of the most widely used organic UV filters, 4-methylbenzylidene camphor (4-MBC), is present at high concentrations in offshore waters. The marine copepod Tigriopus japonicus was exposed to different concentrations of 4-MBC (i.e., 0, 0.5, 1, 5 and 10 μg L^{-1}) for 4 consecutive generations (F0-F3) to evaluate the impact of 4-MBC on marine ecosystems. The results showed that in the FO generation, 4-MBC caused significant lethal toxicity in *T. japonicas* at concentrations of 5 and 10 μg L^{-1} and the nauplii were more sensitive to 4-MBC toxicity than the adults. However in the F1-F3 generations, 4-MBC exposure did not affect the survival rate. The hatching rate and the developmental duration from the nauplii to the copepodite (N-C) and from the nauplii to adult (N-A) decreased significantly in the F1-F2 generations and in the F2-F3 generations, respectively, even at the lowest exposure concentration (0.5 μg L^{-1}). In the subsequent two generations (i.e., the F4-F5 generations) of recovery exposure in clean seawater, the growth rates of the original 4-MBC exposure groups were still faster than the control in both the N-C and N-A stages, suggesting possible transgenerational genetic and/or epigenetic changes upon chronic 4-MBC exposure. The expression of the ecdysone receptor gene was up-regulated by 4-MBC, which was consistent with the decrease of the N-C/N-A duration. In addition, 4-MBC may induce oxidative stress and trigger apoptosis in *T. japonicas*, resulting in developmental, reproductive and even lethal toxicity. A preliminary risk assessment suggested that under environmentally realistic concentrations, 4-MBC had significant potential to pose a threat to marine crustaceans and marine ecosystems.

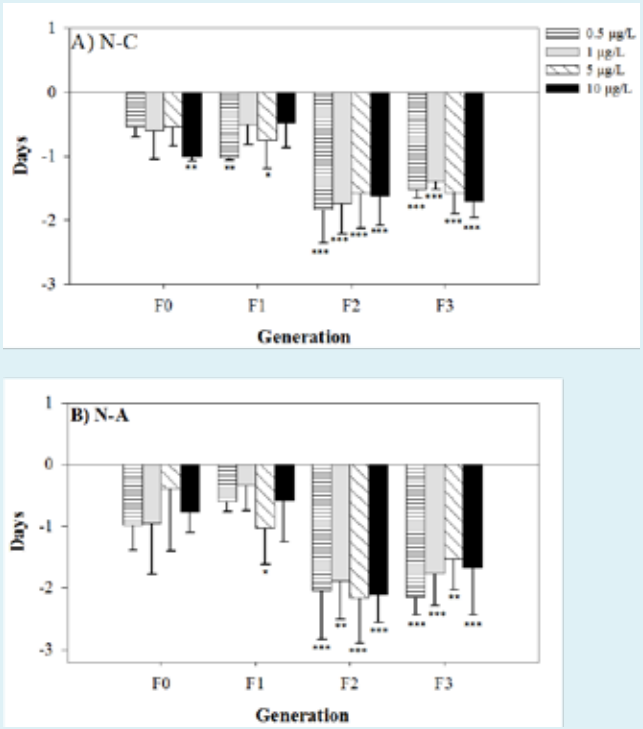
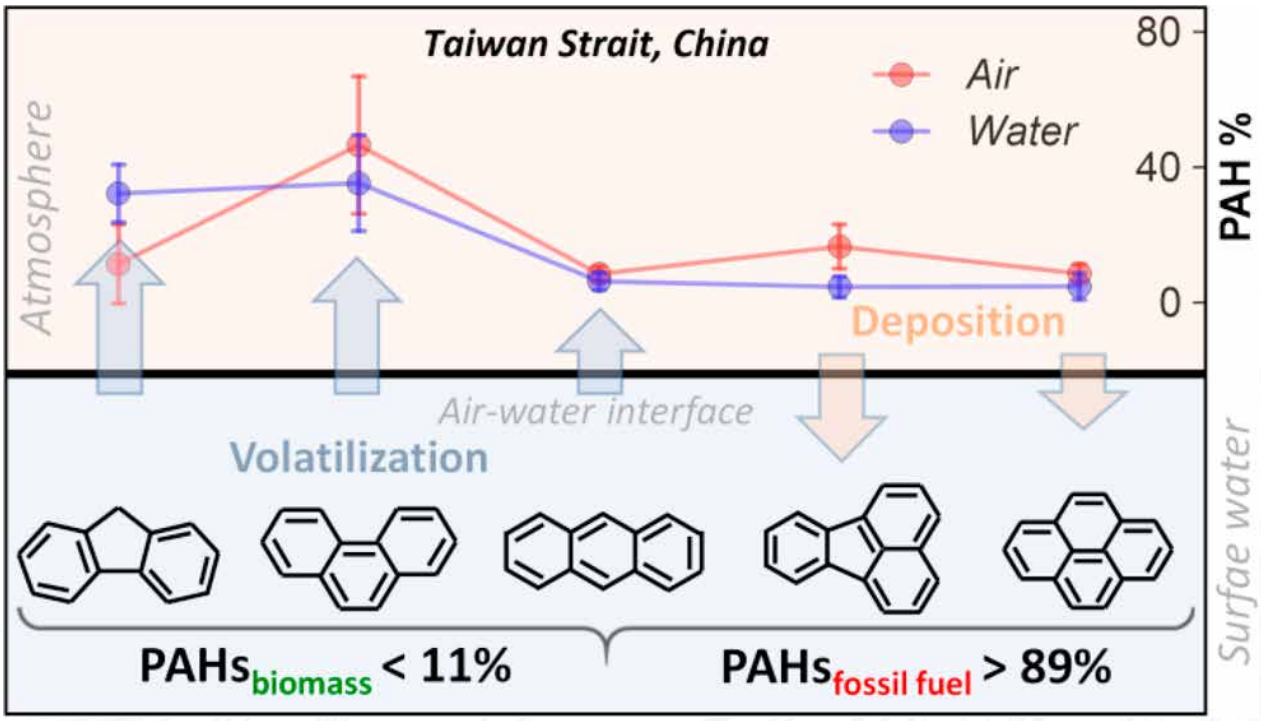


Fig. 18. Effects of 4-MBC exposure on the developmental duration of the nauplius phase (A) (from newly hatched nauplii to the copepodite, N-C) and maturation period (B) (from newly hatched nauplii to adults bearing egg sacs, N-A) in *T. japonicas* in the F0-F3 generations. *T. japonicus* was exposed to different 4-MBC concentrations (0.5, 1, 5 and 10 μg L-1). The reduced developmental time compared to the control are shown and the data are expressed as the means ± SD (n = 5). Values that are significantly different from the control are indicated by asterisks (*p < 0.05, **p < 0.01, ***p < 0.001).

Fossil fuel-derived polycyclic aromatic hydrocarbons in the Taiwan Strait, China, and fluxes across the air-water interface

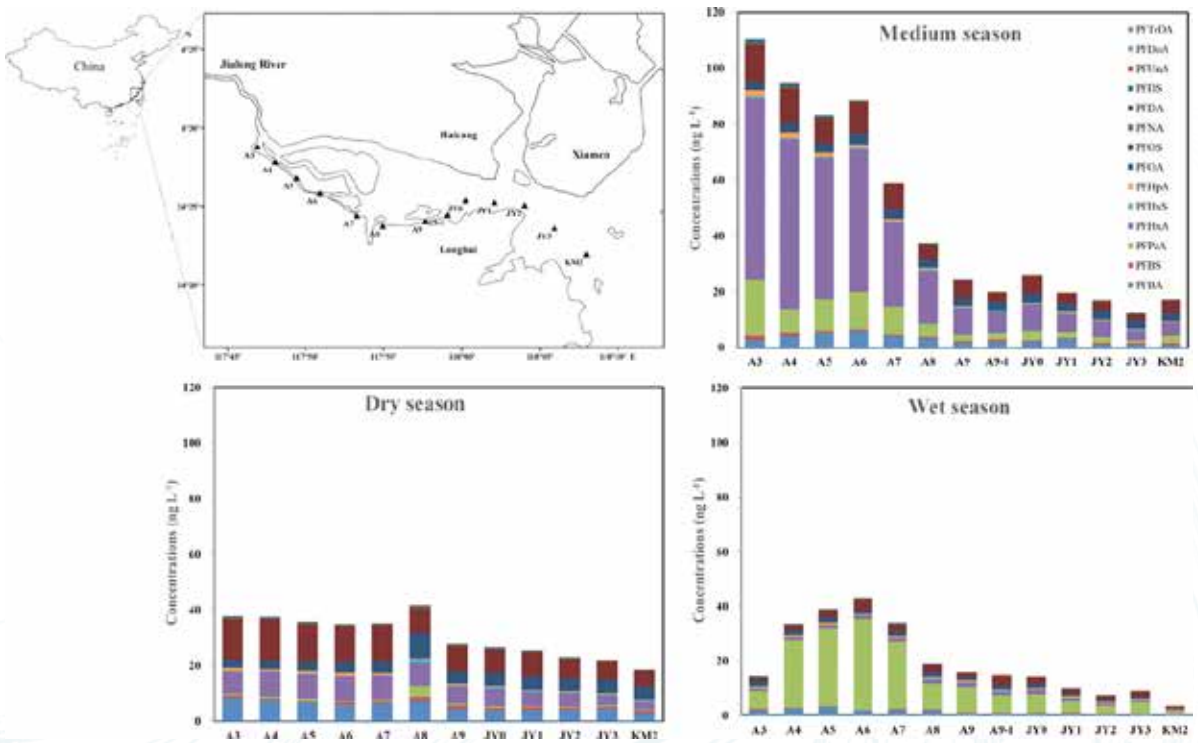
Ya, ML; Xu, L; Wu, YL; Li, YY; Zhao, SH; Wang*, XH. ***ENVIRONMENTAL SCIENCE & TECHNOLOGY***, 2018. 52: 7307-7316.



Abstract: On the basis of the application of compound specific radiocarbon analysis (CSRA) and air-water exchange models, the contributions of fossil fuel and biomass burning derived polycyclic aromatic hydrocarbons (PAHs) as well as their air-water transport were elucidated. The results showed that fossil fuel-derived PAHs (an average contribution of 89%) presented the net volatilization process at the air-water interface of the Taiwan Strait in summer. Net volatile fluxes of the dominant fluorene and phenanthrene (>58% of the total PAHs) were 27 ± 2.8 μg m^{-2} day^{-1}, significantly higher than the dry deposition fluxes (average 0.43 μg m^{-2} day^{-1}). The Δ14C contents of selected PAHs (fluorene, phenanthrene plus anthracene, fluoranthene, and pyrene) determined by CSRA in the dissolved seawater ranged from -997 ± 4 parts per thousand to -873 ± 6 parts per thousand, indicating that 89-100% (95 ± 4%) of PAHs were supplied by fossil fuels. The South China Sea warm current originating from the southwest China in summer (98%) and the Min-Zhe coastal current originating from the north China in winter (97%) input more fossil fuel PAHs than the Jiulong River estuary (90%) and Xiamen harbor water (93%). The more radioactive decayed 14C of fluoranthene (a 4-ring PAH) than that of phenanthrene and anthracene (3-ring PAHs) represented a greater fossil fuel contribution to the former in dissolved seawater.

Temporal trends and transport of perfluoroalkyl substances (PFASs) in a subtropical estuary: Jiulong River Estuary, Fujian, China

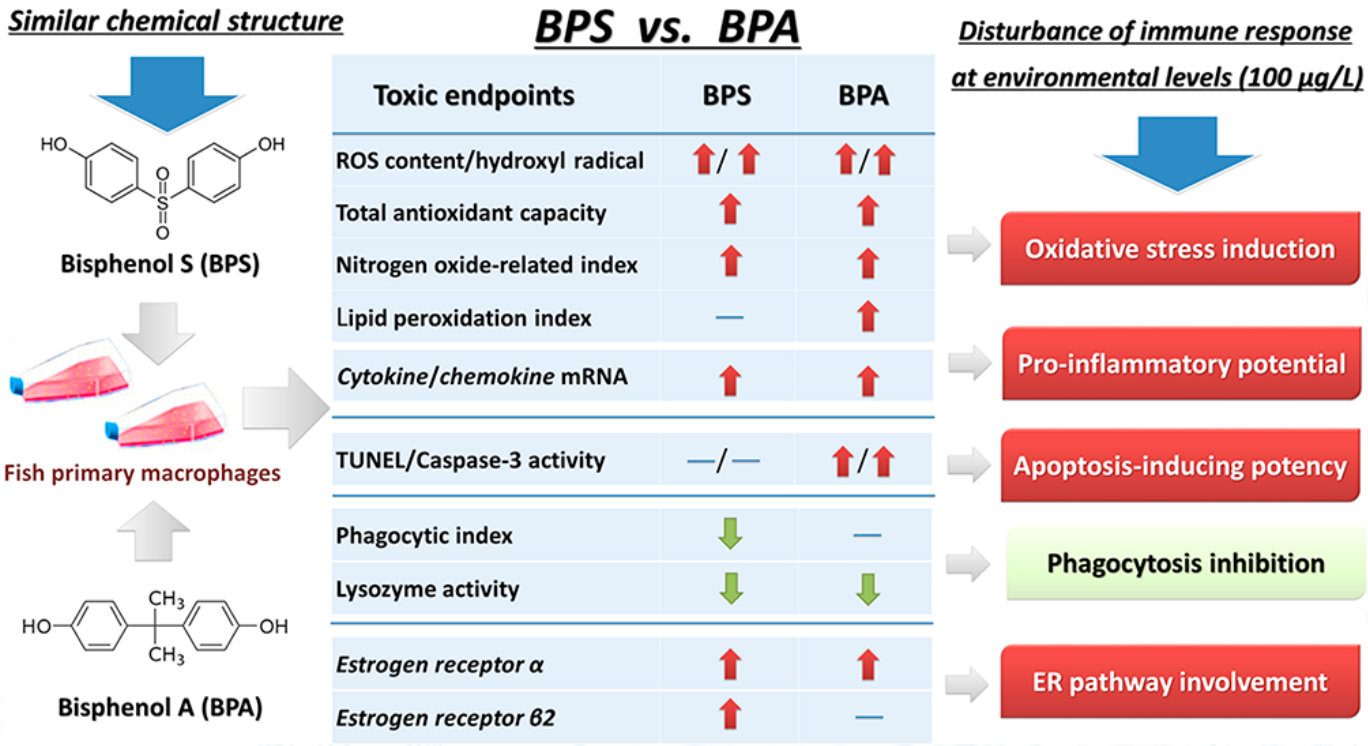
Cai, YZ; Wang*, XH; Wu, YL; Zhao, SH; Li, YY; Ma, LY; Chen, C; Huang, J; Yu, G. ***SCIENCE OF THE TOTAL ENVIRONMENT***, 2018. 639: 263-270.



Abstract: The seasonal variations and spatial distributions of fifteen perfluoroalkyl substances (PFASs) were investigated in thewater of the subtropical Jiulong River Estuary (JRE) in Fujian, China. The concentrations and composition profiles of PFASs showed significant seasonal variations. ΣPFASs concentrations ranged from 4.8 to 37.6 ng L^{-1}, 12.2 to 110 ng L^{-1} and 3.3 to 43.0 ng L^{-1} in the dry, medium and wet seasons, respectively. Perfluorooctane sulfonate (PFOS) was found to be the most abundant PFAS in the dry season, with a composition of 33% ± 5%, Perfluorohexanoic acid PFHxA (47% ± 13%) and perfluoropentanoic acid (PFPeA) (52% ± 15%) were the dominant compounds in the medium and wet seasons, respectively. Seasonal and spatial distributions of ΣSPFASs were different in the upstream and downstream sections. High concentration of PFHxA occurred in the medium season, and showed a linear decreasing trend from upstream to downstream. The majority of other PFASs did not show clear seasonal variation. Composition profiles indicated that the JRE was mainly contaminated by shortchain perfluoroalkyl carboxylic acids (PFCAs), shipbuilding industry, multiple wastewater and river runoff were identified as major potential sources.

Toxic effects of Bisphenol S showing immunomodulation in fish macrophages

Qiu, WH; Yang*, M; Liu, S; Lei, PH; Hu, L; Chen, B; Wu, MH; Wang*, KJ. ***ENVIRONMENTAL SCIENCE & TECHNOLOGY***, 2018. 52: 831-838.



Abstract: Bisphenol S (BES), a structural analogue of bisphenol A (BPA), has been increasingly used as a common replacement of BPA due to health concerns regarding the former. However, mounting evidence suggests, that BPS has similar endocrine-disrupting effects as BPA, and likewise, its presence in the environment may :pose considerable risks to ecosystems and human health. Using fish primary macro-phageS (fpMQs), we here evaluated the immunothodulatory effects of BPS and its mechanisms, of action associated with estrogen receptors (ERs). Following BPS exposure at environmentally relevant concentrations from 0.1 to 1000 μg /l. we observed approximate concentration-dependent increases in nitric oxide and reactive oxygen species generation and total antioxidant capacity as well as the gene expression of inflammatory cytokines in fpMQs. BPS impaired phagocytic capability but enhanced fpMQ activation levels in response to lipopolysaccharide stimulation and promoted apoptosis, indicating an impact on cell functions. At a concentration of 100 μg/L, BPS and BPA showed comparable pro-inflammatory. potential with both up-regulating the production of free radicals and cytokine expression; however, BPS had no significant potency with regard's to inducing lipid peroxidation and apoptosis, different from BPA's effects. Moreover, BPS induced both erα and erβ2 expression in fpMQs, whereas BPA induced only era expression. This study demonstrates that, similarly to BPA, exposure to low doses of BPS significantly disturbs the immune response of fpMQs in vitro and first reveals overlapping but different roles of ERs in response to BPS and BPA.

物理海洋学、海洋遥感与气候变化
Physical Oceanography, Remote Sensing & Climate Changes

The deflection of the China coastal current over the Taiwan Bank in winter

Liao, EH; Oey, LY; Yan, XH; Li, L; Jiang*, YW. ***JOURNAL OF PHYSICAL OCEANOGRAPHY***, 2018. 48: 1433-1450.

Abstract: In winter, an offshore flow of the coastal current can be inferred from satellite and in situ data over the western Taiwan Bank. The dynamics related to this offshore flow are examined here using observations as well as analytical and numerical models. The currents can be classified into three regimes. The downwind (i.e., southward) cold coastal current remains attached to the coast when the northeasterly wind stress is stronger than a critical value depending on the upwind (i.e., northward) large-scale pressure gradient force. By contrast, an upwind warm current appears over the Taiwan Bank when the wind stress is less than the critical pressure gradient force. The downwind coastal current and upwind current converge and the coastal current deflects offshore onto the bank during a moderate wind. Analysis of the vorticity balance shows that the offshore transport is a result of negative bottom stress curl that is triggered by the positive vorticity of the two opposite flows. The negative bottom stress curl is reinforced by the gentle slope over the bank, which enhances the offshore current. Composite analyses using satellite observations show cool waters with high chlorophyll in the offshore current under moderate wind. The results of composite analyses support the model findings and may explain the high productivity over the western bank in winter.

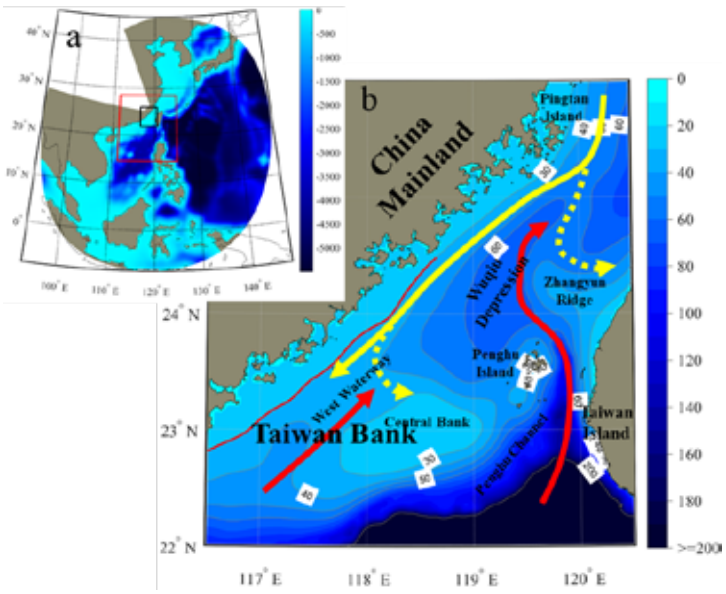


Fig. 19. (a) The model domain and (b) the topography around the Taiwan Bank. (a) The color shading region is the domain of the coarse grid, the red box is the fine grid, and the black box is the focus region that is zoomed in on in b). (b) The Taiwan Bank as a focus region is divided into three parts: West Waterway, Central Bank (30-m isobaths in the center), and Penghu Channel. The gray lines are the isobaths. The thin red line is the 30-m isobath used for transect analysis. The yellow arrow represents the southward (downwind) coastal current, and the dashed yellow arrows are the offshore flows in the northern and southern strait. The red arrow in the West Waterway is the SCSWC's extension, and the other red arrow in the Penghu Channel represents the SCSWC's extension and Kuroshio Extension. The schematic coordinate (alongshore and cross-shore) is plotted as the white line.

New findings on the route of heat transport between the Indo-Pacific and Southern Ocean

Liao, EH; Yan*, XH; Jiang*, YW; Kidwell, AN. ***CLIMATE DYNAMICS***, 2018. DOI:10.1007/s00382-018-4436-4.

Abstract: Since the end of the twentieth century, the global mean surface temperature (GMST) exhibited a shift from a rapid warming to an unexpected deceleration. An anomalous heat was transported from the Pacific Ocean into the Indian Ocean through a strengthened Indonesian Throughflow during the same period. Within this background, it is essential to continue tracking the fate of the anomalous heat arriving in the Indian Ocean to form a comprehensive picture of the global ocean energy redistribution. The anomalous heat may continue flowing westward into the Atlantic Ocean along the main pathway of the regional ocean currents via the South Equatorial Current (SEC) and Agulhas Current. However, here we examine an alternate pathway: a southward heat transport in conjunction with a weakened SEC, diverting the canonical westward transport. This additional transport pathway causes an increase in heat content in the South Indian Ocean mid-latitudes (15–30°S, 95–110°E), may contribute to the Southern Ocean warming, and intensifies hemispheric asymmetry of oceanic heat content. The heat increase has important climate impacts such as changes to rainfall and increased coral bleaching over the western coast of Australia. The new path discovered here may be an essential route of heat transport linking the tropical Indo-Pacific Ocean and the Southern Ocean in 2003–2012.

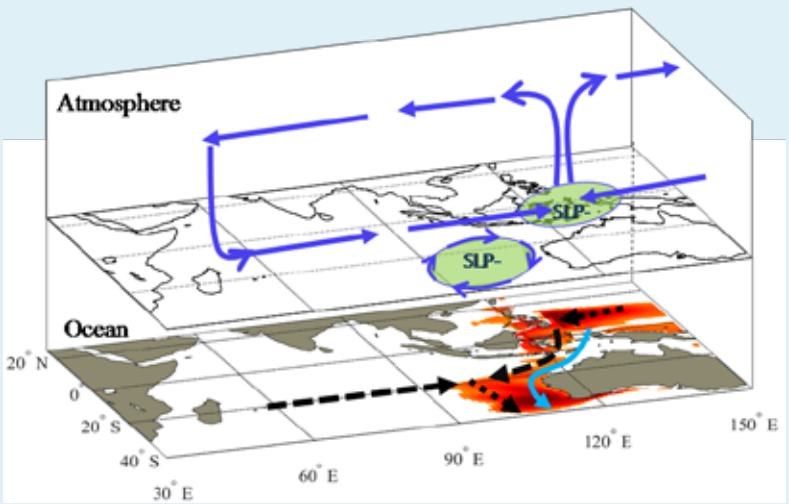


Fig. 20. The schematic graph of the trends in OHC700 and ocean-atmosphere circulation in the Indo-Pacific over 2003-2012. The color shading represents the OHC700 trend (red represents warming). In the atmosphere part, the blue solid vector is the wind anomaly under the influence of La Niña-like state in the Pacific Ocean. The "SLP-" means the negative sea level pressure trend. In the ocean part, the dashed black vectors are the flow trend and the green solid vector is the transmission of high sea level from the Pacific to the Indian Ocean.

On estimating turbulent Reynolds stress in wavy aquatic environment

Bian, CW; Liu*, ZY; Huang, YX; Zhao, L; Jiang, WS. ***JOURNAL OF GEOPHYSICAL RESEARCH-OCEANS***, 2018. 123: 3060-3071.

Abstract: Several methods have been developed for the estimation of the turbulent Reynolds stress in wavy aquatic environment. They are based on different physical assumptions and often give discrepant results. It is practically difficult to quantify the uncertainties in these estimations. Using high-resolution velocity measurements of acoustic Doppler velocimeter (ADV) from a coastal benthic layer subject to moderate wave influence (the ratio of rms wave orbital velocity to current magnitude was 0.23-0.92), this study tests a Synchrosqueezed Wavelet Transform (SWT)-based method and three existing methods (i.e., the Coherence, Cospectra, and Ensemble Empirical Mode Decomposition [EEMD] methods) for wave-turbulence decomposition. In particular, we evaluate the performance of different methods for objective estimation of the turbulent Reynolds stress. Power spectra and cospectra analysis is conducted to quantify the uncertainties in the estimations. The results suggest that the Coherence method tends to overestimate the Reynolds stress due to incomplete removal of wave motions from the observed velocity records; the Cospectra method performs poorly because the empirical model does not fit the observed cospectra well; both the EEMD and SWT methods underestimate the Reynolds stress, as they tend to attribute turbulent fluctuations at frequencies in the vicinity of the wave frequencies to wave motions. In general, the SWT method performs best inducing lowest uncertainty in the Reynolds stress estimation. For the data set analyzed in this study, the estimations with the Coherence, Cospectra, EEMD, and SWT methods account for 70%, 50%, 51%, and 60% of the total covariance of horizontal and vertical velocities, respectively.

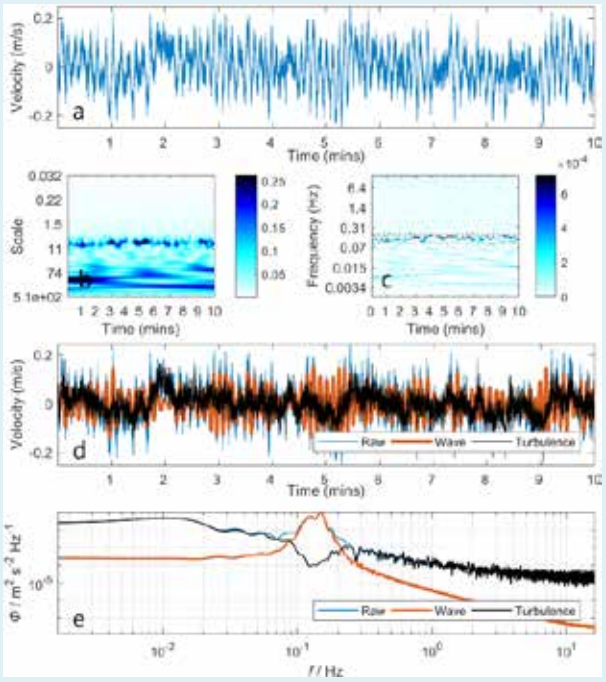


Fig. 21. (a) The raw velocity fluctuation u' of Segment-009. (b) Discrete Wavelet Transform (DWT) of u' in the time scale plane, with the colors indicating energy density. (c) SWT of u' in the time-frequency plane with the red dashed lines indicating the frequency band of the waves. (d) Raw u' (blue), wave motions (orange) reconstructed from components at the frequency band indicated by red dashed lines in Figure 4c, and turbulence (black) calculated by subtracting wave motions from the raw velocity. (e) Power spectra of the raw u' (blue), as well as the decomposed wave motions (orange) and turbulence (black).

新技术与分析方法
New Technologies and Analytical Methods

Simultaneous determination of total dissolved nitrogen and total dissolved phosphorus in natural waters with an on-line UV and thermal digestion

Lin, KN; Pei, JX; Li, PC; Ma, J; Li, QL; Yuan*, DX. ***TALANTA***, 2018. 185: 419-426.

Abstract: A flow injection method combined with an on-line UV and thermal digestion for simultaneous determination of total dissolved nitrogen (TDN) and total dissolved phosphorus (TDP) in natural waters was established in this study. A novel flow manifold made the proposed system compact and automatic. The conversion rates of various nitrogen and phosphorus compounds to their nitrate and phosphate forms with different digestion models and different concentrations were well investigated using the flow injection technique. The reagent concentrations for colorimetric analysis were optimized based on a univariate experimental design. The detection limits were 0.8 μmol L^{-1} and 0.2 μmol L^{-1}, and linear analytical ranges were up to 300 μmol L-1 and 25 μmol L^{-1} for TDN and TDP, respectively. The sample throughput was similar to 5 h^{-1}. The recovery of spiked natural water samples varied from 86.8% to 102.6% for TDN and 88.0% to 102.0% for TDP. The present approach was successfully applied for the determination of TDN and TDP in natural water samples and was found to have good agreement with reference methods. The outcomes of present study indicated that the proposed method is suitable for routine analysis as well as for potential on-line monitoring.

Highlights

▶ TDN and TDP were oxidized simultaneously with an alkaline persulfate reagent;

▶ Simultaneous determination of TDN and TDP with two flow cells aligned in the same cell support;

▶ No significant difference between the results obtained using the proposed method and the reference method;

▶ Suitable for routine analysis as well as for potential on-line monitoring.

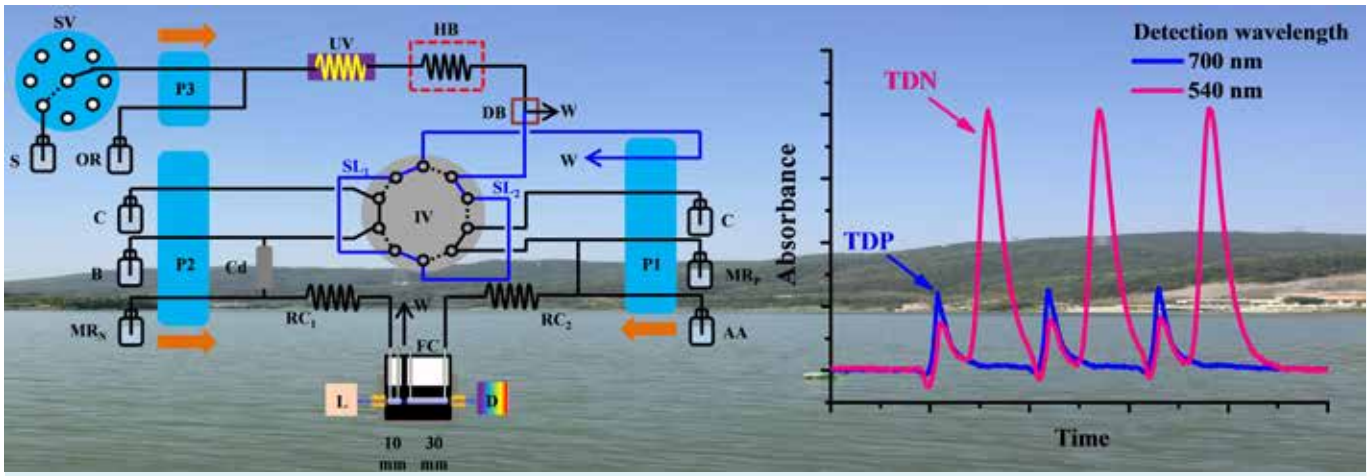
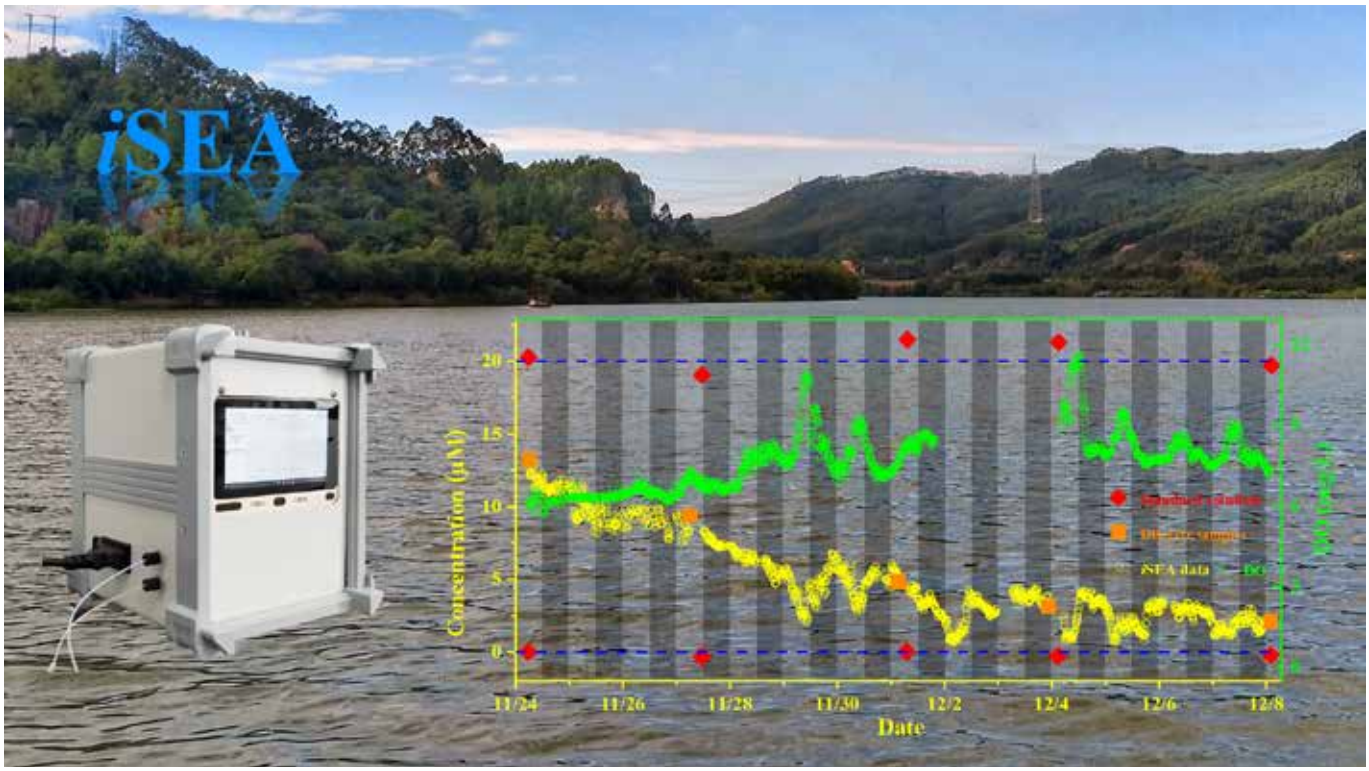


Fig. 23. (left) Manifold of FIA used for simultaneous determination of TDN and TDP with on-line UV & thermal digestion. (S, samples or standards; C, ultrapure water carrier stream; B, ammonium chloride buffer; OR, oxidation reagent; MRN, mixing reagent for nitrogen determination; MR_p, mixing reagent for phosphorus determination; AA, ascorbic acid; Cd, cadmium column; P1, P2 and P3, peristaltic pumps; IV, 10-port injection valve; SV, 8-position selector valve; DB, debubbler; L, light source; D, detector; FC, "U" shape flow cell; UV, UV-digester; HB, heated bath; RC, reaction coil; SL, sample loop; W, waste; The dashed line in IV represents the valve in position A, and the solid line represents the valve in position B); (right) Output signals of the TND and TNP.

Development of an Integrated syringe-pump-based environmental-water analyzer (*i*SEA) and application of it for fully automated real-time determination of ammonium in fresh water

Ma*, J; Li, PC; Chen, ZY; Lin, KN; Chen, NW; Jiang, YY; Chen, JX; Huang, BQ; Yuan, DX. ***ANALYTICAL CHEMISTRY***, 2018. 90: 6431-6435.



Abstract: The development of a multipurpose integrated syringe-pump-based environmental-water analyzer (*i*SEA) and its application for spectrophotometric determination of ammonium is presented. The *i*SEA consists of a mini-syringe pump equipped with a selection valve and laboratory-programmed software written by LabVIEW. The chemistry is based on a modified indophenol method using o-phenylphenol. The effect of reagent concentrations and sample temperatures was evaluated. This fully automated analyzer had a detection limit of 0.12 μM with sample throughput of 12 h^{-1}. Relative standard deviations at different concentrations (0-20 μM) were 0.23-3.36% (n = 3-11) and 1.0% (n = 144, in 24 h of continuous measurement, similar to 5 μM). Calibration curves were linear (R^2 = 0.9998) over the range of 0-20 and 0-70 μM for the detection at 700 and 600 nm, respectively. The *i*SEA was applied in continuous real-time monitoring of ammonium variations in a river for 24 h and 14 days. A total of 1802 samples were measured, and only 0.4% was outlier data (≥3 sigma residuals). Measurements of reference materials and different aqueous samples (n = 26) showed no significant difference between results obtained by reference and present methods. The system is compact (18 cm x 22 cm x 24 cm), portable (4.8 kg), and robust (high-resolution real-time monitoring in harsh environments) and consumes a small amount of chemicals (20-30 μL/run) and sample/standards (2.9 mL/run).

On the fluorometric measurement of ammonium in oligotrophic seawater: Assessment of reagent blanks and interferences

Zhu, YF; Liu, J; Huang, T; Wang, LF; Trull TW, Dai*, MH. ***LIMNOLOGY AND OCENAOGRAPHY: METHODS***, 2018. 16: 516-52.

Abstract: Dynamically distributed at trace levels in the open ocean, ammonium is one of the most important and reactive nitrogen compounds in the marine environment. Obtaining reliable measurements of ammonium concentrations is thus a prerequisite to fully understand its role in marine biogeochemical processes, but remains challenging. Among others, quantification and identification of different sources of blanks is an outstanding issue, due partly to the fact that ammonium-free water is very difficult to prepare and/or preserve. Building on a recently developed method using solid phase extraction combined with fluoescence detection (SPE-Flu), we examined the kinetics of the ortho-phthaldialdehyde-sulfite-ammonium reaction and introduce a new approach to quantifying reagent blanks via a "reagents addition" method. The reagent blank of the method, equivalent to 6.7±61.5 nmol L^{-1} of ammonium under our experimental settings, accounted for up to 27% of the ammonium background in seawater samples collected from the oligotrophic ocean. We also showed that the SPE-Flu method is highly specific, with negligible interference from three types of amines and 15 types of amino acids at nanomolar concentrations, which are typical of open ocean regimes. The determination of the reagent blank allowed for optimized data reduction, which was applied to a study in the oligotrophic South China Sea. Water column profiles showed a very well-defined structure and smooth distribution of ammonium concentrations, consistent with the distribution of other parameters. We thus contend that our proposed approach provides a way to further optimize the quantification of ammonium concentrations in natural seawater via the SPE-Flu method.

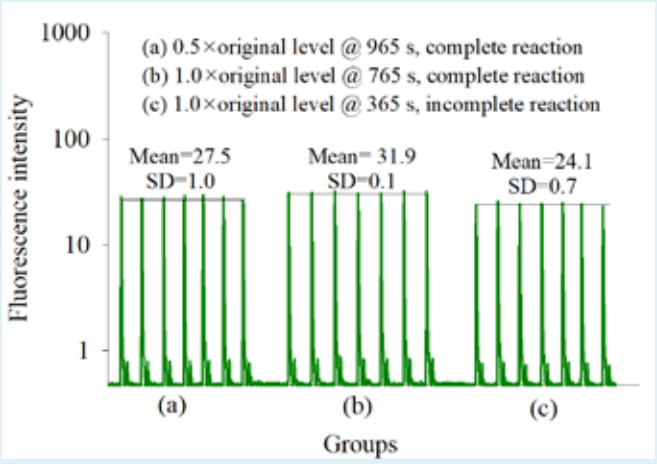


Fig. 22. Successive measurements of the background fluorescence of Milli-Q water under (a) 0.53× reagent levels at a reaction time of 965 s, (b) original (1.0×) reagent levels at a reaction time of 765 s, and (c) 1.0× reagent levels at a reaction time of 365 s. The small peaks following each of the main peaks were prerinsed peaks using ethanol.

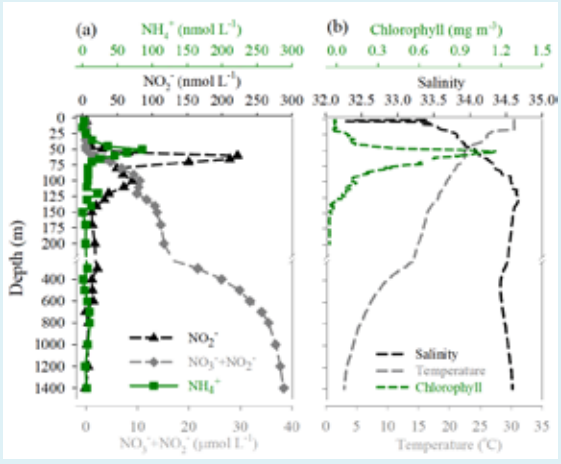


Fig. 24. Vertical profiles of nitrite, nitrate 1nitrite, and ammonium concentrations (a) and chlorophyll, salinity, and temperature (b) at Sta. X5, located at 111°E, 18°N in the oligotrophic SCS. The sampling resolution was 10 m in the upper 200 m. The reagent blank was used as the "true" blank during data reduction to calculate ammonium concentrations.

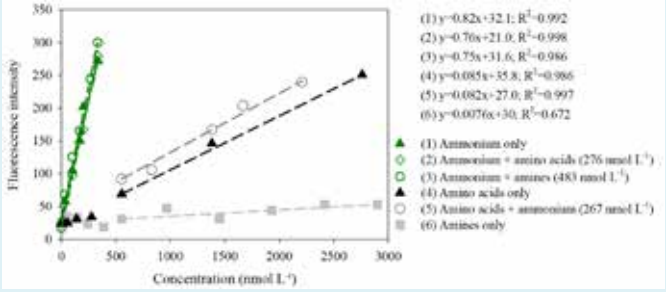


Fig. 23. Response of the ammonium analyzer to amino acid and amine additions. Ammonium only samples were not measured at micromolar levels since the SPE-Flu method is linear only at nanomolar levels. The average slope of the two regression lines of amino acids (alone and with 267 nmol L^{-1} of ammonium) was 0.088 and the RSD was 0.6%. The average slope of three regression lines of ammonium (alone, with 276 nmol L^{-1} of amino acids and with 483 nmol L^{-1} of amines) was 0.77 and the RSD was 6.3%. No significant response to amines was detected.

Developing on-site paper colorimetric monitoring technique for quick evaluating copper ion concentration in mineral wastewater

Liu*, GK; Peng, JJ; Zheng, H; Yuan, DX. ***SPECTROCHIMICA ACTA PART A-MOLECULAR AND BIOMOLECULAR SPECTROSCOPY***, 2018. 196: 392-397.

Abstract: With the reinforce of the copper mining, the on-site monitoring of the accompanied effluent discharge is highly demanded for the emergency response to minimize the negative effect of the effluent on the surrounding ecosystem. On the basis of the specific interaction between Cu^{2+} and L-Cysteine (L-Cys), which was modified on gold nanoparticles (Au NPs), and the aggregation dependent surface plasmon resonance (SPR) of Au NPs, we developed an easy-on-going paper colorimetric method for the quick evaluating the copper ion concentration in the waste water excreted from the copper mine. The color change of L-Cys modified Au NPs (L-Cys-Au NPs) immobilized on a filter paper was very sensitive to the Cu^{2+} concentration and free of interference from other metal ions typically in waste water. The proposed paper colorimetry has the LOD of 0.09 mg/L and the linear range of 0.1-10 mg/L, respectively, with the RSD (n = 5) was 6.6% for 1 mg/L Cu^{2+} and 3.5% for 5 mg/L Cu^{2+}. The quantitative analysis results for the mineral wastewater is in good agreement the China National Environmental Protection Standards HJ485-2009, which indicates the current method could be developed to the on-site detection technique for the emergency response in monitoring Cu^{2+} in industrial wastewater or polluted water.

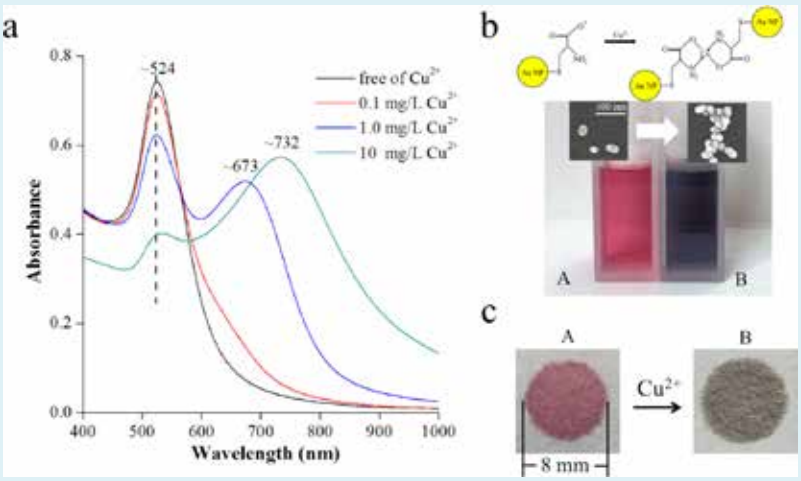


Fig. 25. Cu^{2+} concentration dependences of the UV–vis absorption spectra of L-Cys-Au NPs solution (a), the color change of the solution (b) and the color change of the colorimetric paper (c), due to the complexation between L-Cys-Au NPs and Cu^{2+} and the neighbor L-Cys-Au NPs, whose schematic diagram and the related SEM images before and after the complexation is inthe insert of (b). (A and B stand for the case free of (Blank) and containing 1 mg/L Cu^{2+}).

论文专著
LIST OF PEER-REVIEWED PUBLICATIONS

论文专著
LIST OF PEER-REVIEWED PUBLICATIONS

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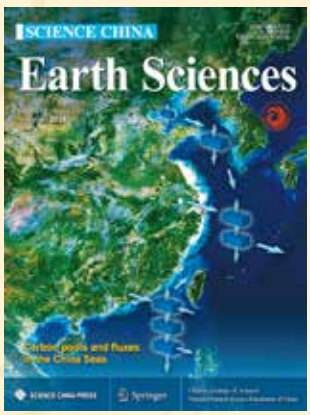

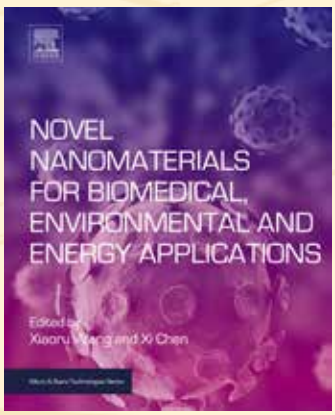

人员情况
PERSONNEL

人才计划、晋升及奖项
Recognition, Promotion and Awards

▶ 焦念志当选美国微生物科学院院士
Nianzhi Jiao was elected as the Fellow of the American Academy of Microbiology

▶ **戴民汉、张瑶入选国家"万人计划"科技创新领军人才**
Minhan Dai, Yao Zhang received support from the "National High-Level Talents Plan"

▶ 刘海鹏入选科技部"2017 年中青年科技创新领军人才"
Haipeng Liu received support from the MOST Science and Technology Innovation Program

▶ 史大林入选福建省高校领军人才资助计划"青年拔尖人才"项目
Dalin Shi received the Young Talent Program for leading talents in Universities Supporting Program of Fujian Province

▶ 史大林获第五届中国生态学学会青年科技奖
Dalin Shi received the 5th Young Scientist Award of the Ecological Society of China

▶ 史大林团队研究成果"海洋酸化对束毛藻的影响及其机理"获 2017 年度中国海洋与湖沼十大科技进展
Research achievements related to ""The effects of ocean acidification on the cyanobacterium *Trichodesmium* and its mechanism" led by Dalinshi was listed as the "Top 10 Science and Technology Advances of China in Oceanology and Limnology in 2017" by the Chinese Society for Oceanology and Limnology

▶ 王杉霖新聘为厦门大学教授
Shanlin Wang was newly recruited as XMU Professor

▶ 林宏阳、林昕新聘为厦门大学副教授
Hongyang Lin and Xin Lin was newly recruited as XMU Associate Professor

(Photo from ASM)

2018 年 6 月 10 日，焦念志在美国亚特兰大参加美国微生物科学院院士 (AAM Fellow) 就任仪式。美国微生物科学院是由美国微生物学会 (ASM) 中备受尊重和具有引领能力的科学家组成，其使命在于选拔在微生物学领域做出杰出贡献的科学家，并为科学界及社会公众提供微生物学方面的专业知识。
On June 10, Nianzhi Jiao was elected as a fellow of the American Academy of Microbiology, AAM, the honorific leadership group within the American Society for Microbiology. Fellows, all eminent leaders in the field of microbiology, are elected annually through a highly selective, peer-review process, based on their records of scientific achievement and exceptional contributions to the advancement of microbiology.

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Postdoctoral Researcher, Los Alamos National Laboratory, USA (2014-2015)
Scientist, Los Alamos National Laboratory, USA (2015-2018)
Professor, Xiamen University (2018-)

研究方向：
海洋生态系统与生物地球化学循环的模式与模拟，地球系统模型中不同模块间生物地球化学循环的耦合及其影响，海洋生态系统对气候变化的响应及反馈
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Marine ecosystems and biogeochemical cycle modeling; the coupling of biogeochemical cycles among various components in Earth system models and its impacts; response and feedback of marine ecosystems to climate change

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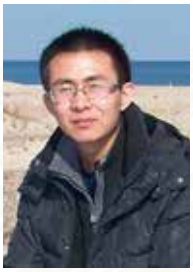

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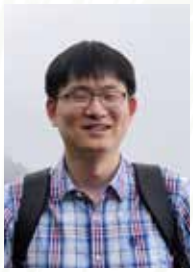

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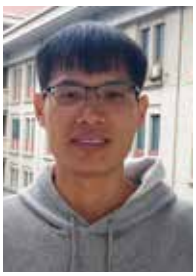

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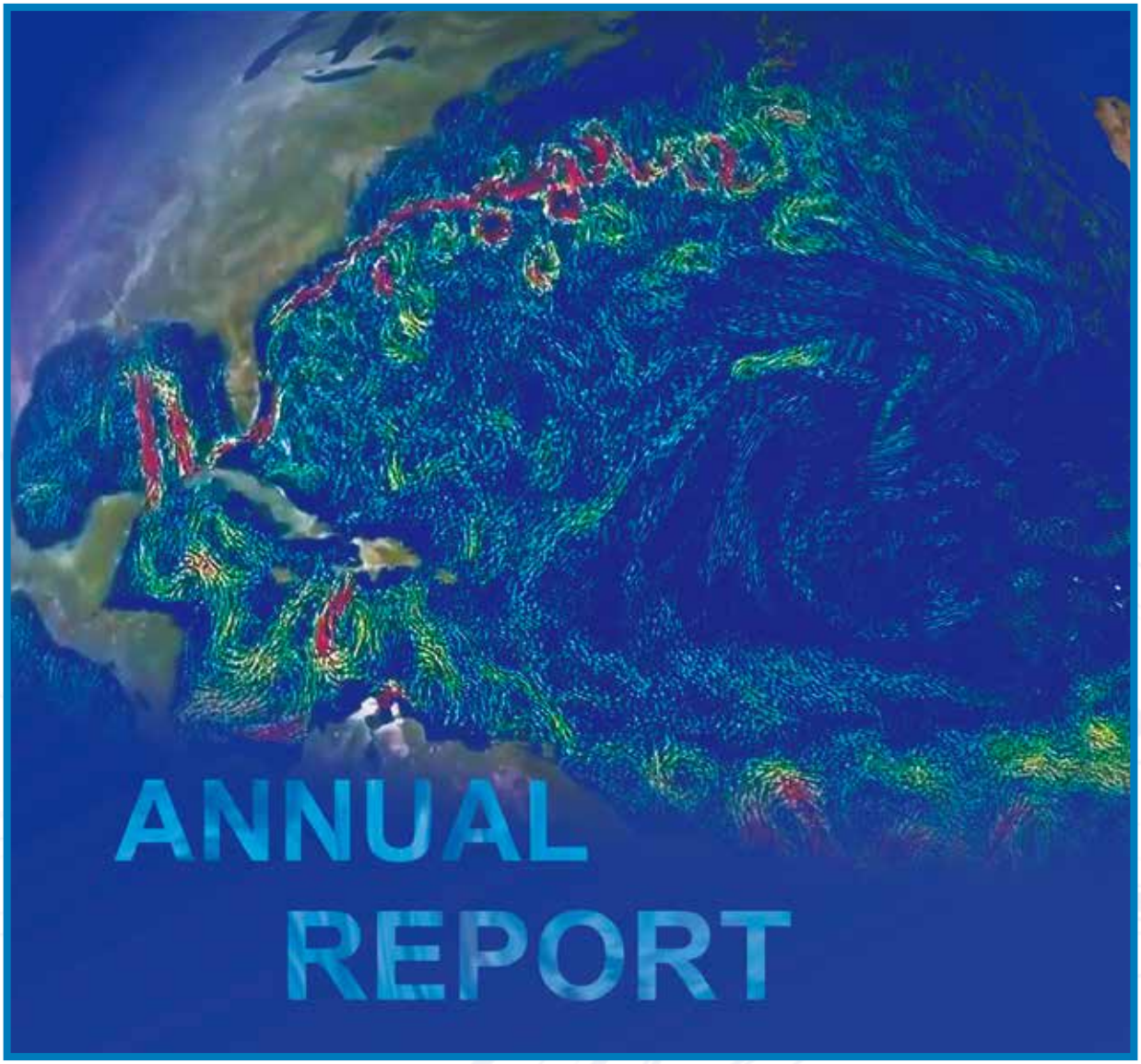

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