



# Facing the Future and Sustainability Through Connecting the Coastal and Open Oceans: *Center for Mega-Science, Chinese Academy of Sciences (COMS, CAS)*



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YANTAI INSTITUTE OF COASTAL ZONE RESEARCH, CAS

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# Outline

01

**Background**

02

**COMS, CAS introduction**

03

**Long term observing  
networks and new findings**



# Increasingly heavy influence of human activities on coastal sea



## 内陆省份

Inland Provinces

VS

## 沿海11个省/市

Eleven Coastal Provinces & Cities

### 面积



### 人口



### 大城市



### GDP



### 外资



### 出口



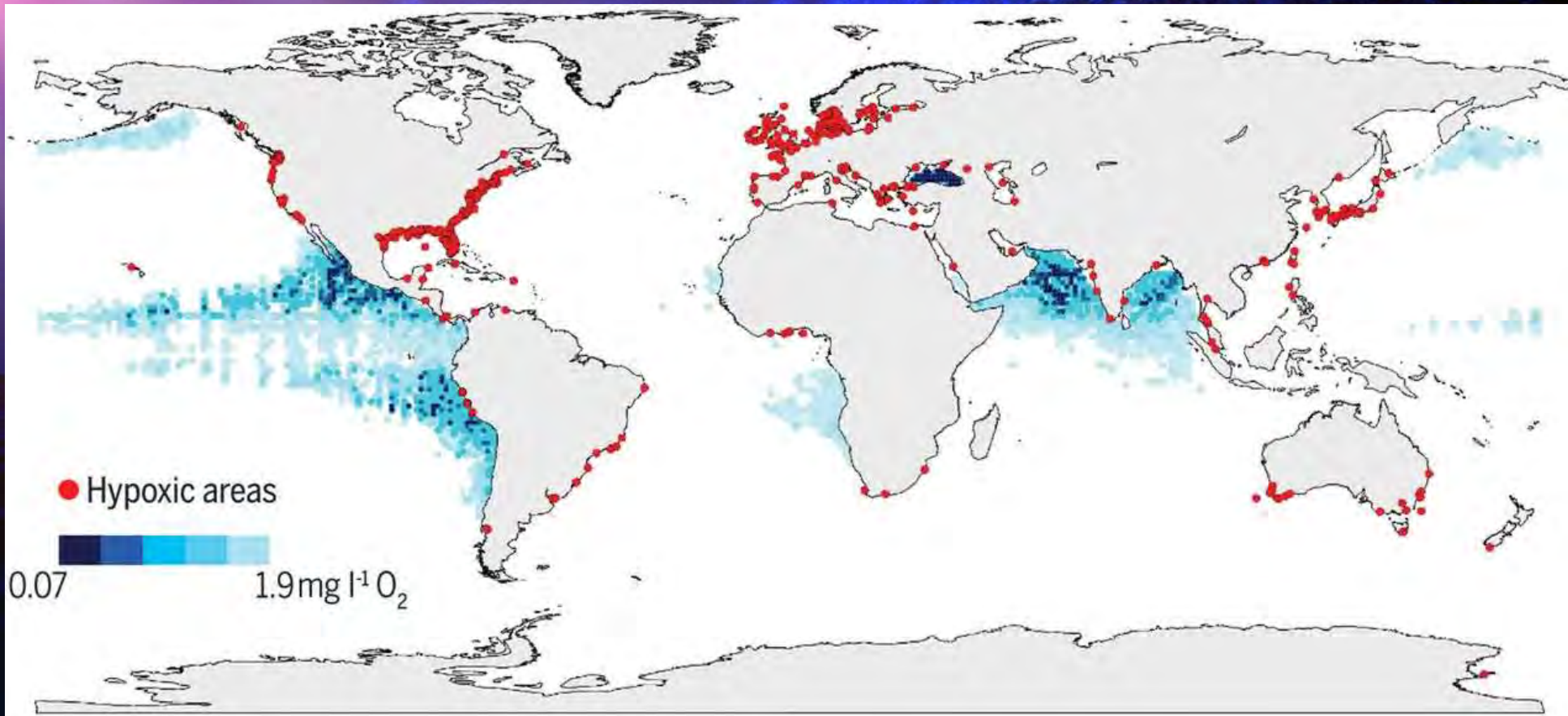


## ➤ Ports, bridges, sea reclamation, aquaculture, fishery, dams, industrialization, fertilization, urbanization

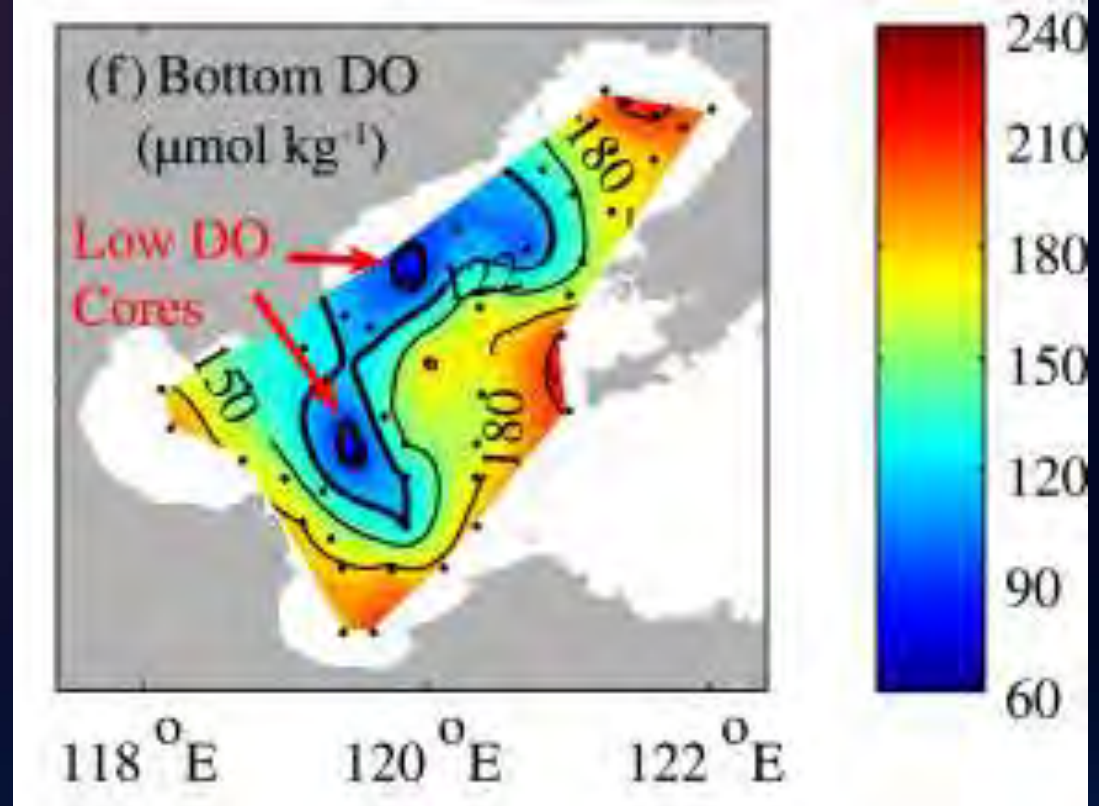
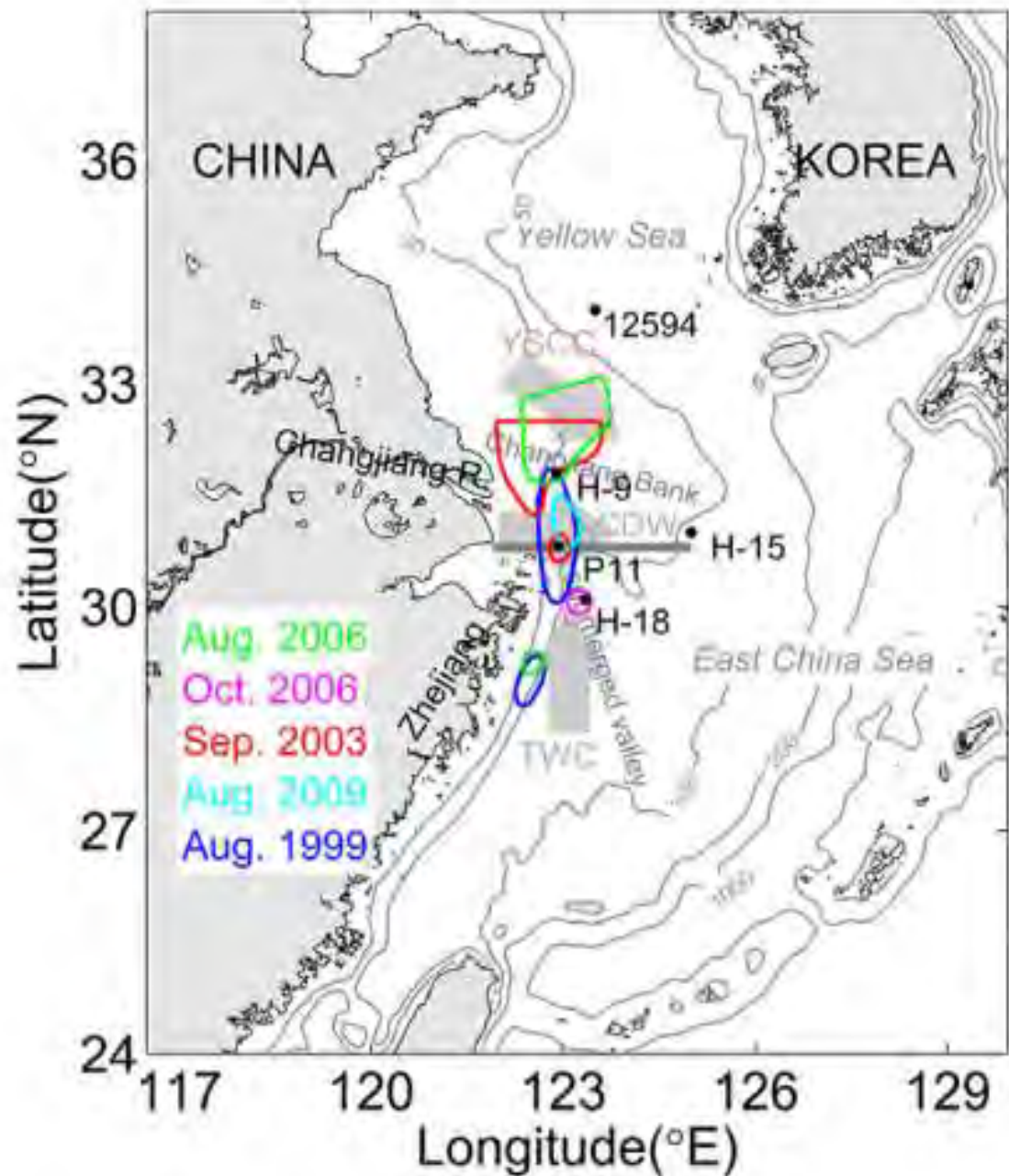


## ➤ Red, green, brown, ... tides caused by different algae blooms, jelly fish, hypoxia, ...





Low and declining oxygen levels in the open ocean and coastal waters affect processes ranging from biogeochemistry to food security. The global map indicates coastal sites where anthropogenic nutrients have exacerbated or caused O<sub>2</sub> declines to <math>< 2 \text{ mg liter}^{-1}</math> (<math>< 63 \text{ } \mu\text{mol liter}^{-1}</math>) (red dots), as well as ocean oxygen-minimum zones at 300 m of depth (blue shaded regions). Breitburg et al. 2018, Science

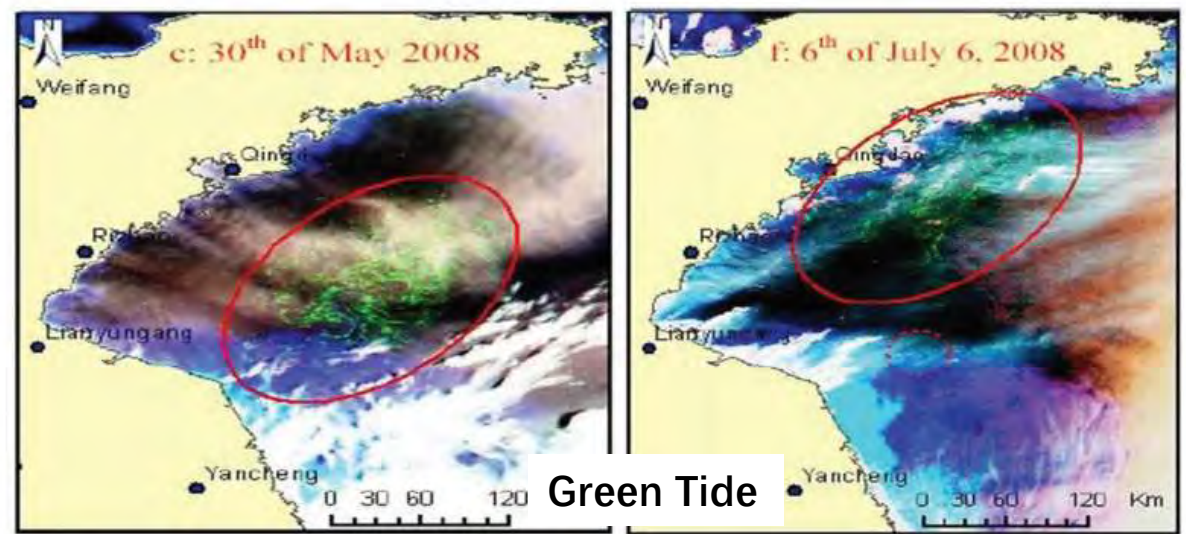
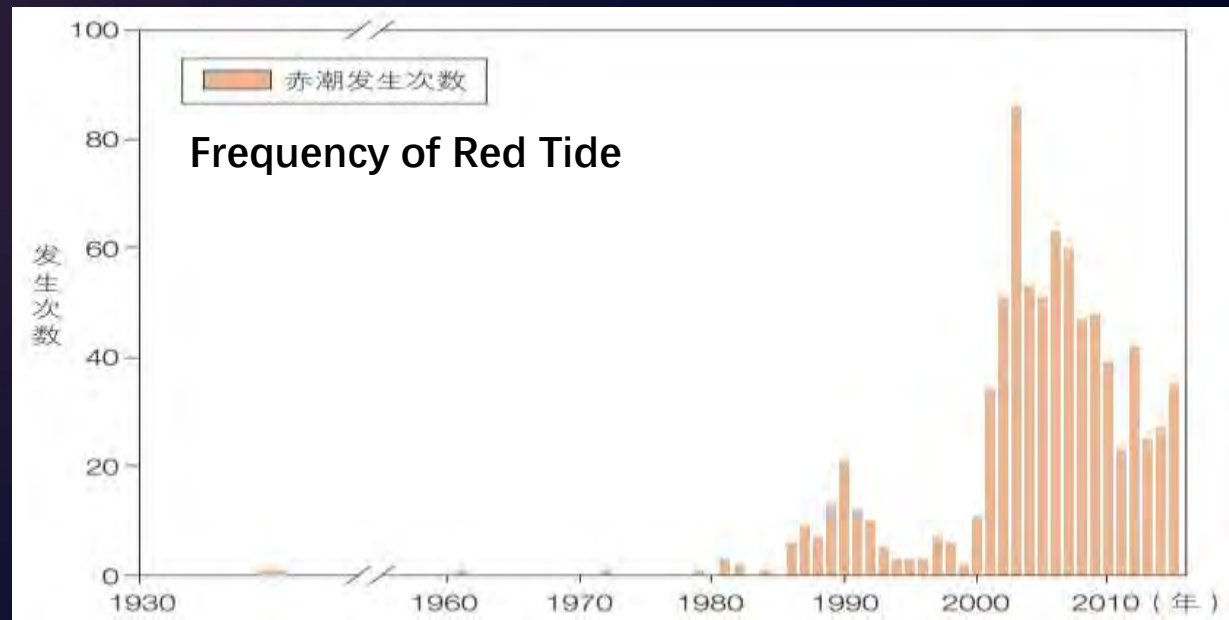


Polygons denote hypoxic extent in previous studies (Li et al., 2002; Wei et al., 2007; Zhou et al., 2010; Zhu et al., 2016a). Zhang et al. 2016





Major red tide events, China, last 20 years

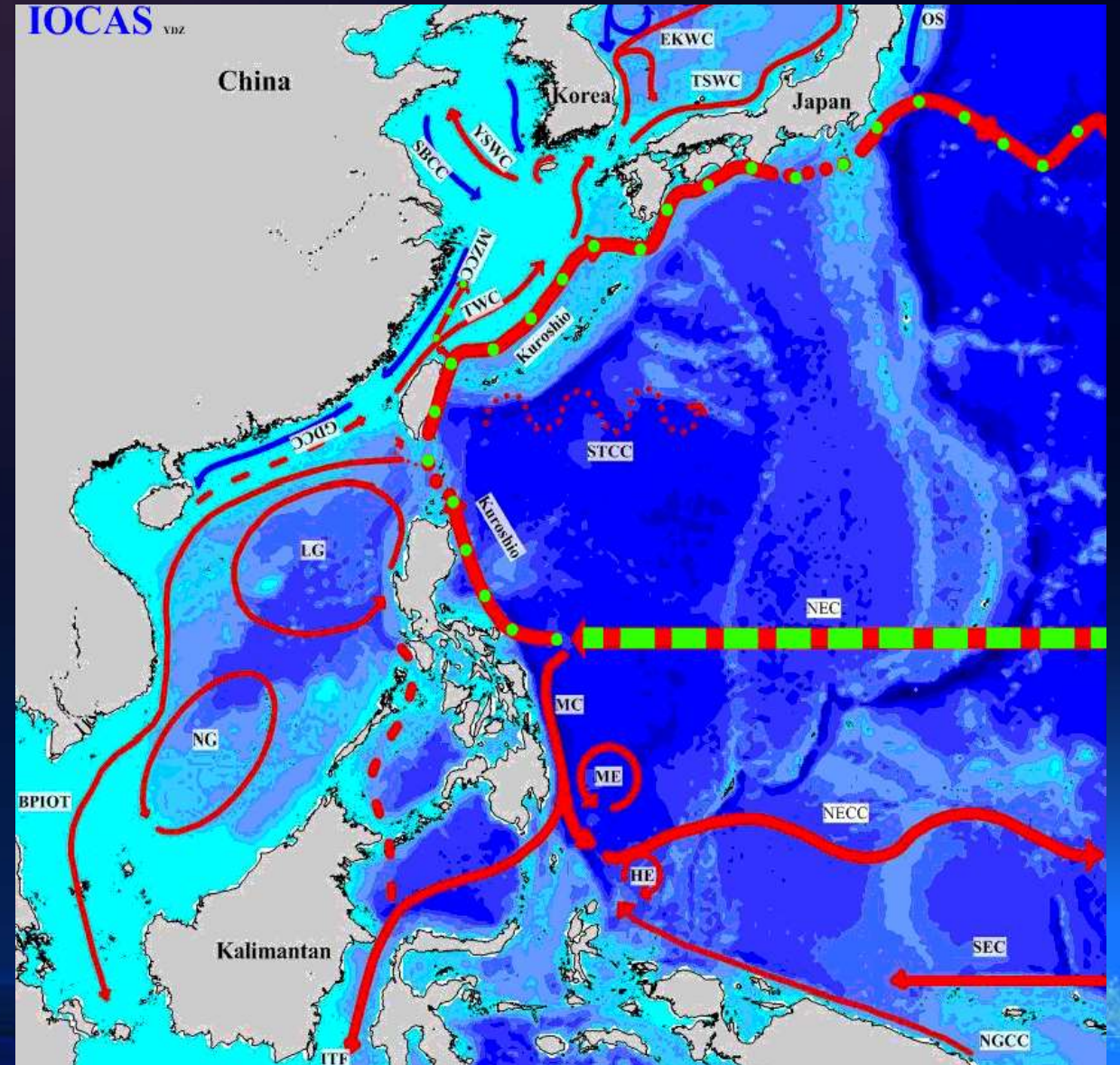


(Yu and Liu, 2016)

# Linkage with open ocean

## Coastal and Open Oceans Connecting

East China Sea is largest marginal sea in western Pacific with a broad continental shelf  
Complex interaction between open ocean and coastal waters





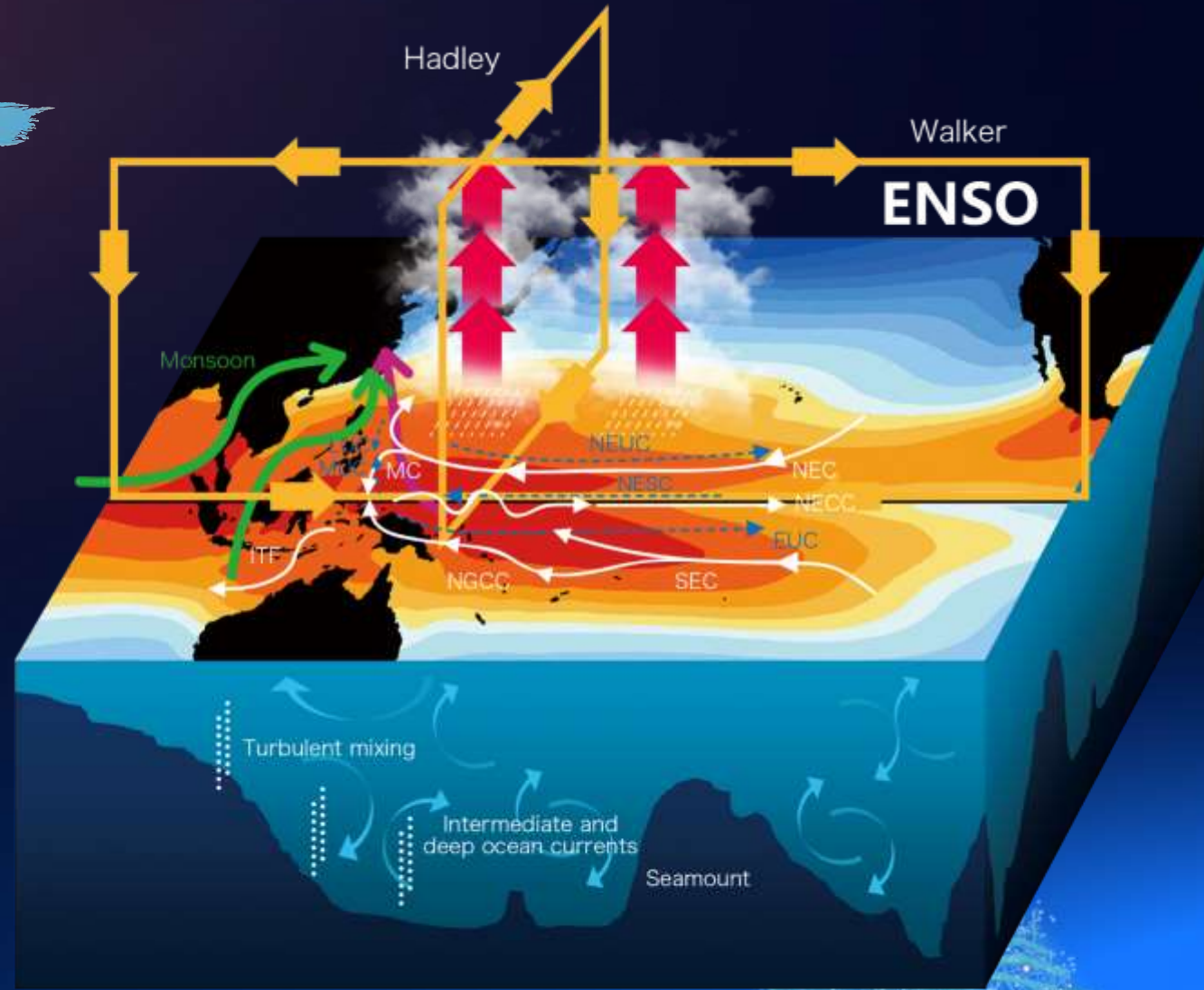
# Linkage with open ocean



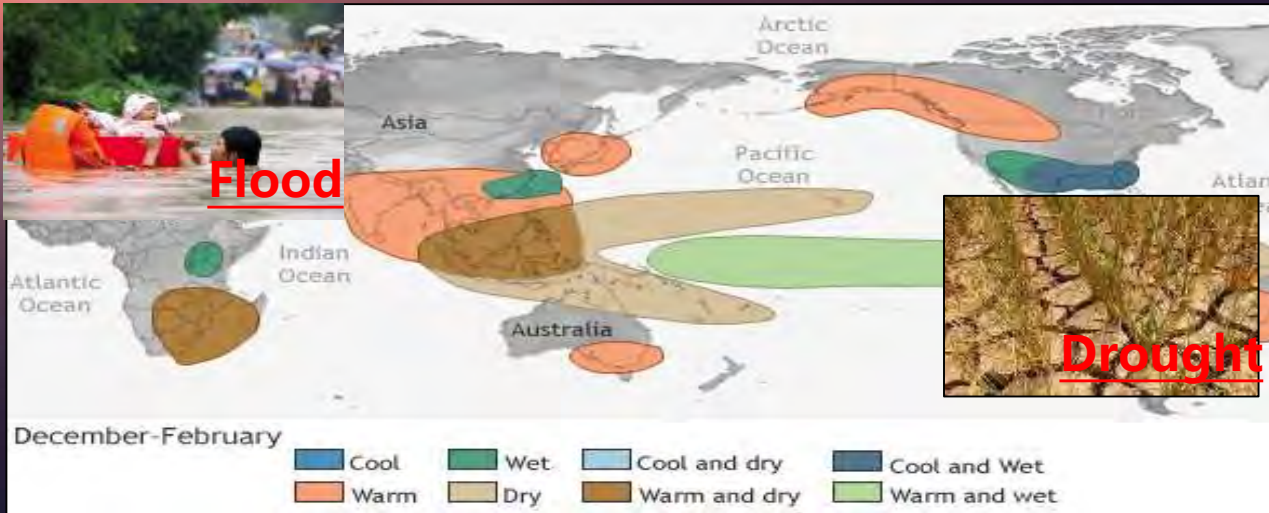
Western Pacific Warm Pool

**Center of action for interannual climate mode - El Nino Southern Oscillation**

**Impact on global through atmosphere “teleconnections”**

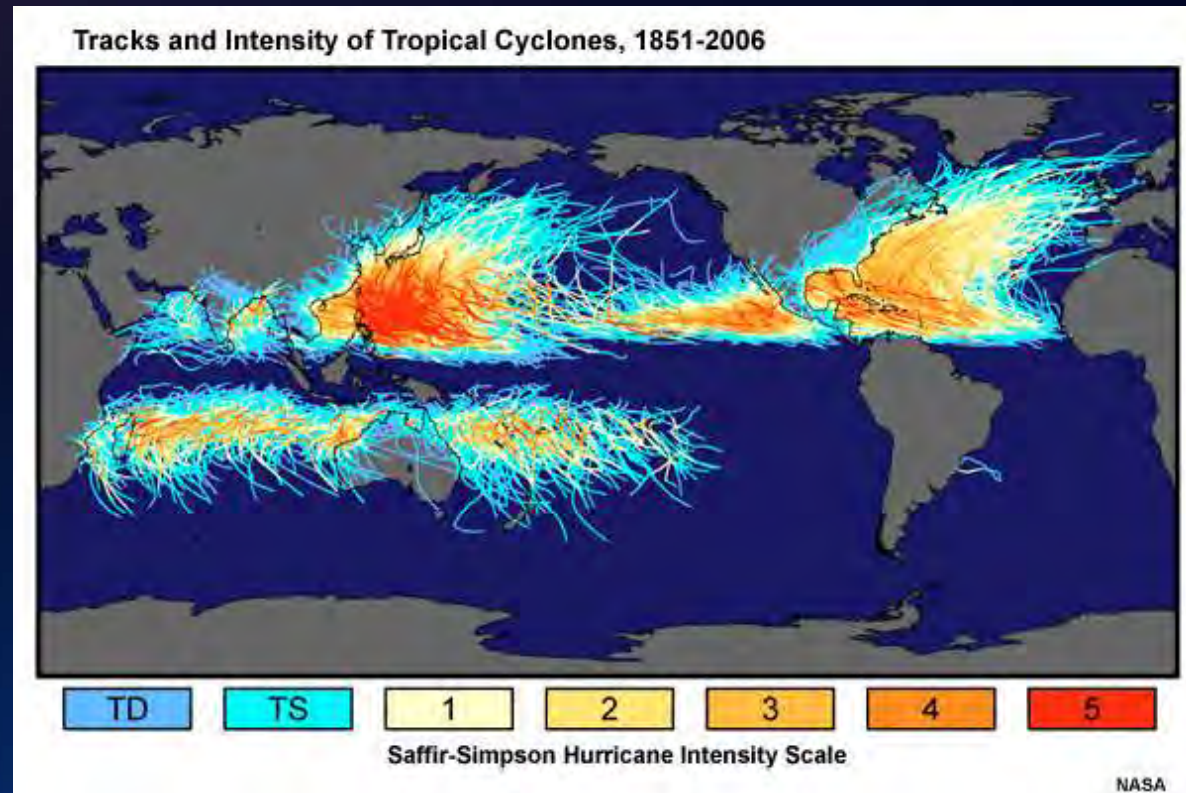


# Linkage with open ocean

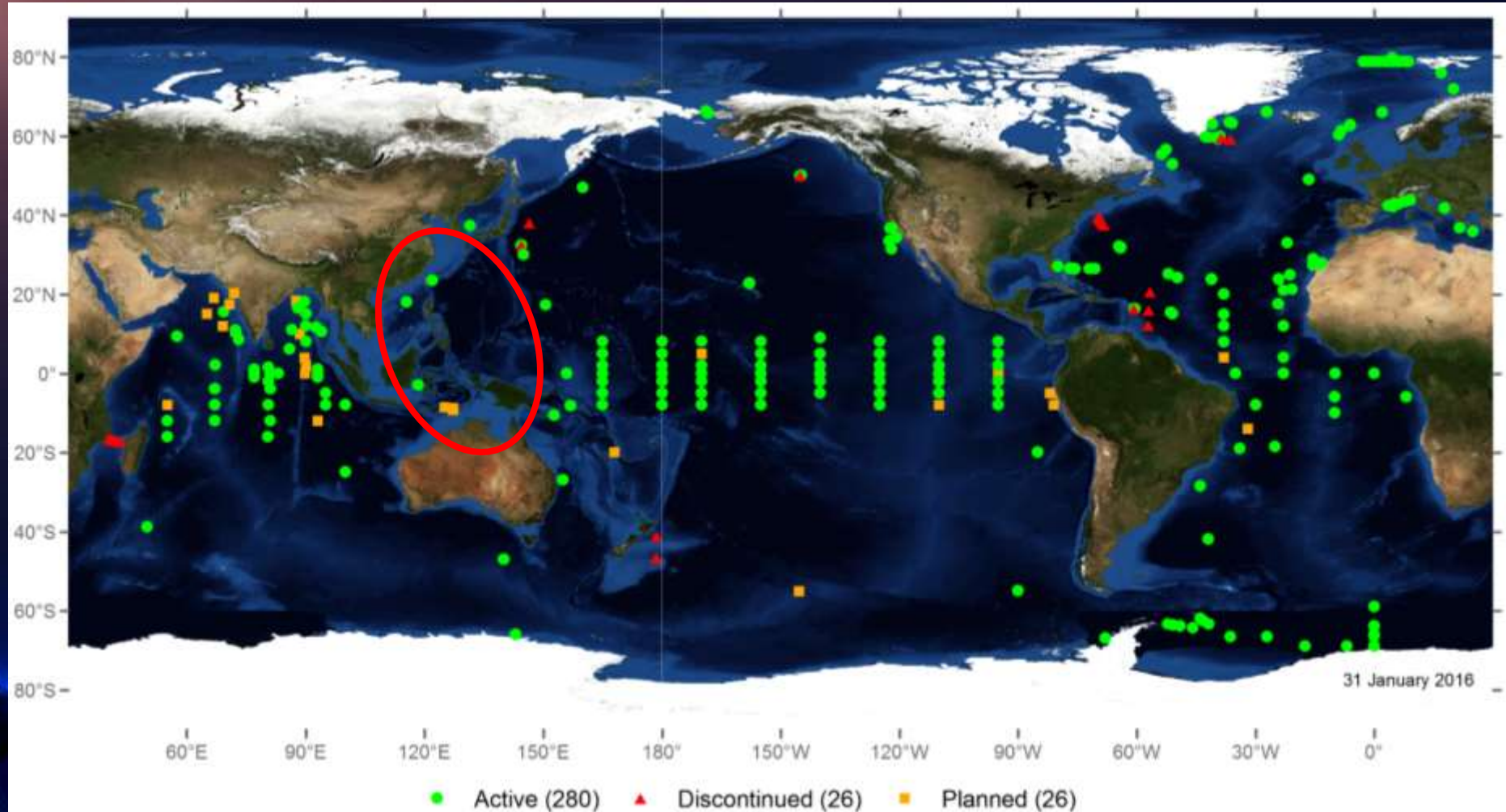


## ENSO Related Disasters

Western Pacific is the most active tropical cyclone basin on Earth



# Global Ocean Observation Network





# Outline

01

**Background**

02

**COMS/CAS introduction**

03

**Long term observing  
networks and new findings**



The Current Status  
of Ocean Science  
around the World

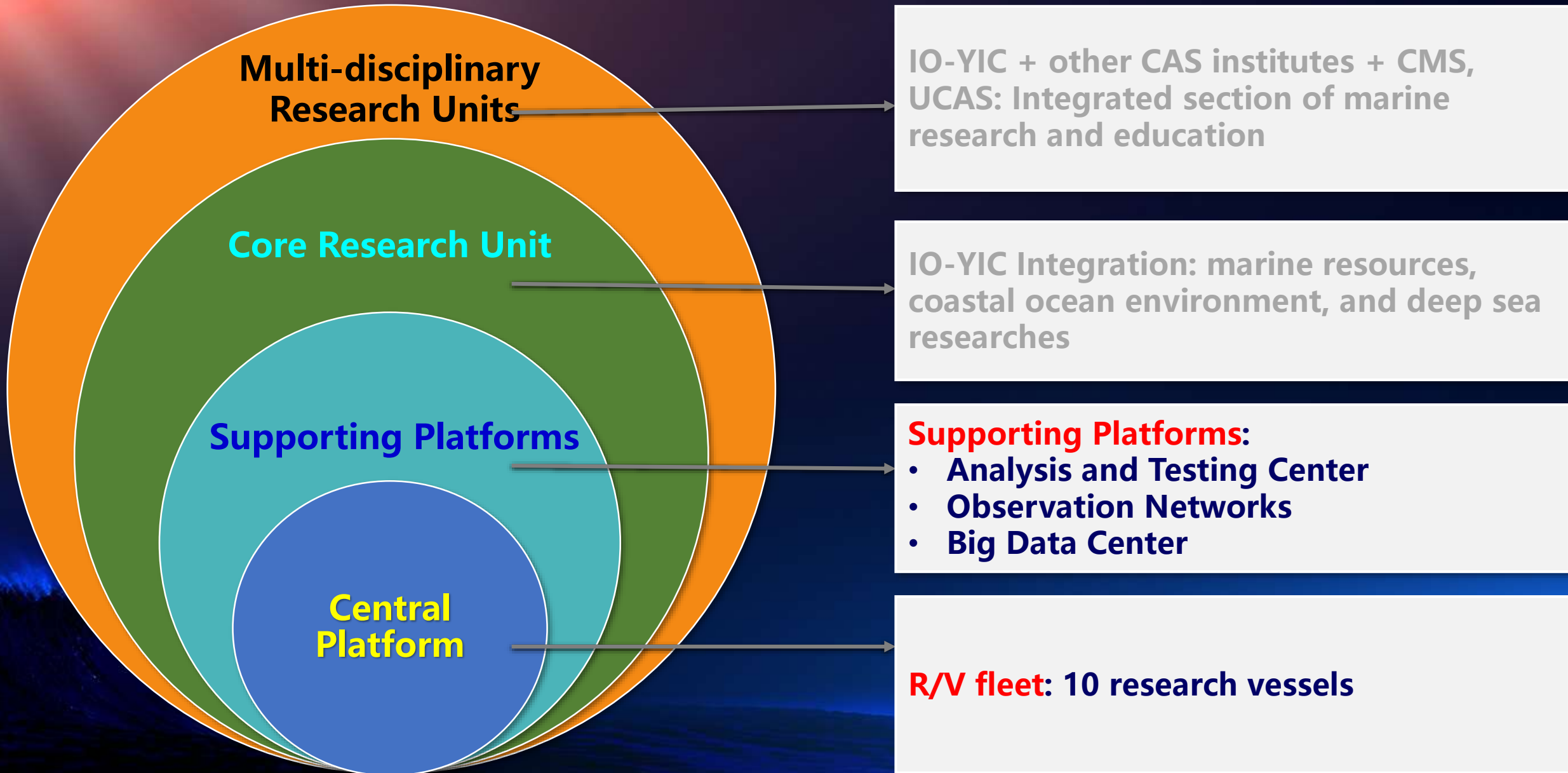


Figure ES1. Ocean science categories considered in the Global Ocean Science Report.

# Background of the COMS, CAS

- **Marine science is “Mega Science”**
  - National demands: **environment protection, ecological civilization, sustainability**
  - Multi-disciplinary study: **physical, chemical and biological process interactions**
  - Major facilities supporting observations and analyses: **money, money, money, ...**
- **New organization of CAS reformation, new engine for further development**
  - Coordination of RVs, observing networks, and instrumental analysis: **maximizing utilization and sharing of facility resources**
  - Integration of IOCAS and YICCAS: **crossing the border between coastal and open ocean researches**
  - Integration of 13 CAS institutes and College of Marine Science, UCAS: **connecting scientific research, technical development and application, and education**

# Structure of the COMS, CAS



# Central Platform: R/V Fleet

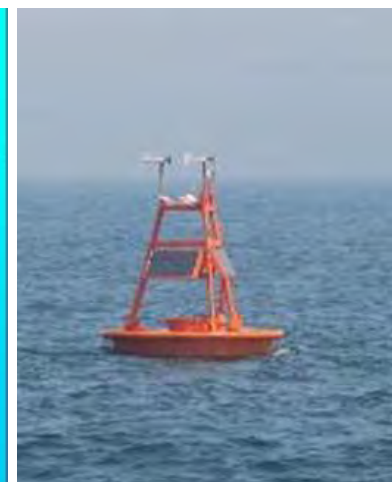
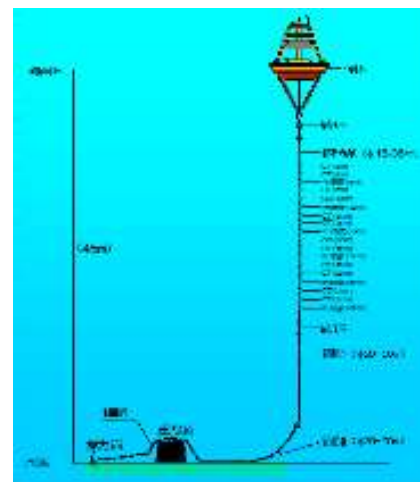
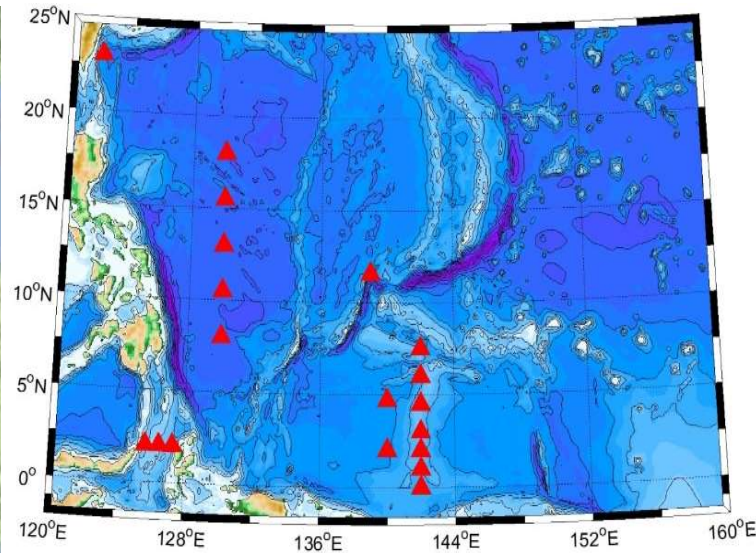


No.	Ship	Working area	Gross Tonnage	Management Institute	year
1	KEXUE	Global	4711	IOCAS	2012
2	Shiyan 1	Global	3071	SCSIOCAS	2009
3	KEXUE 1	Global	2748	IOCAS	1980
4	Shiyan 3	Global	2748	SCSIOCAS	1981
5	KEXUE 3	Regional	1106	IOCAS	2006
6	Shiyan 2	Regional	1153	SCSIOCAS	1979
7	Chuangxin	Local	44	IOCAS	2006
8	Explore1	Global	4968	IDSSECAS	1984
9	Chuangxin1	Local/Regional	500	YICCAS	2015
10	Chuangxin2	Local/Regional	300	IOCAS	2017





## Observation Networks



## Analysis and Testing Center



中国科学院  
海洋科学大型仪器区域中心  
REGIONAL CENTER OF FUNDAMENTAL INSTRUMENT IN MARINE SCIENCE

科技条件信息平台 | 仪器共享管理平台 | 中国科学院

开放共享 协作创新

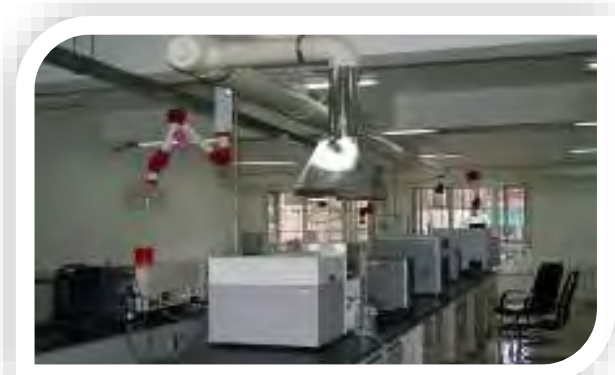
首页 关于我们 专家团队 仪器共享 工作动态 联系我们

**工作动态** [更多](#)

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- ▶ 海洋研究所海洋科普项目—“龙... (2017-06-01)
- ▶ 烟台海岸带研究所举行“健康海... (2017-06-02)
- ▶ 张涛副院长调研南海海洋所 (2017-05-16)
- ▶ 烟台海岸带所召开“现代海洋牧... (2017-05-12)

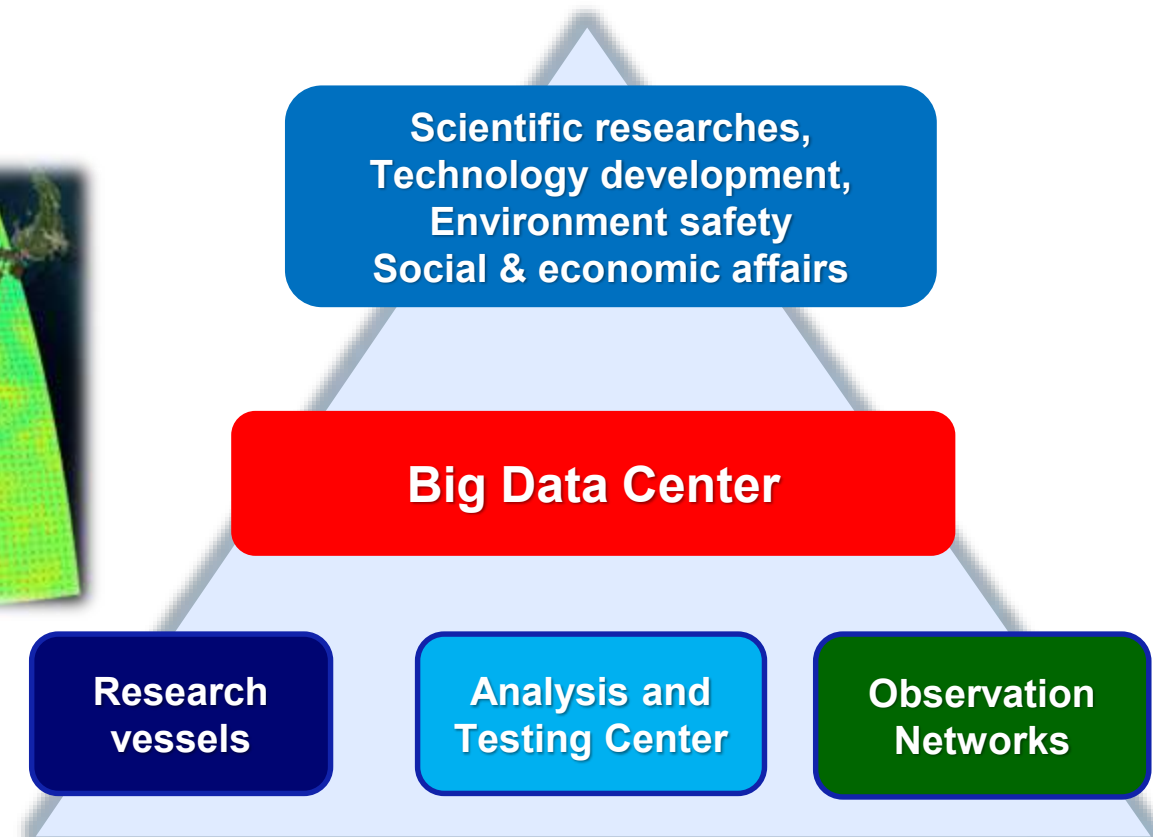
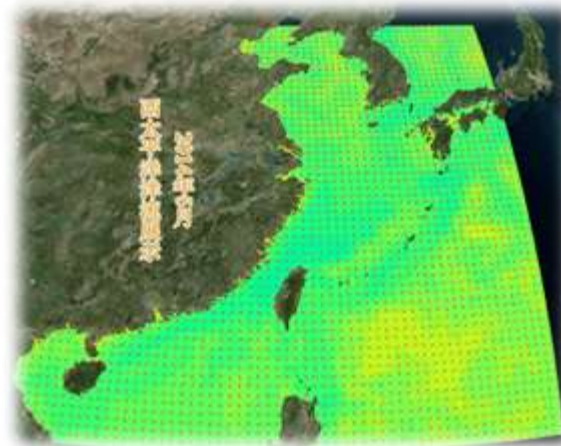
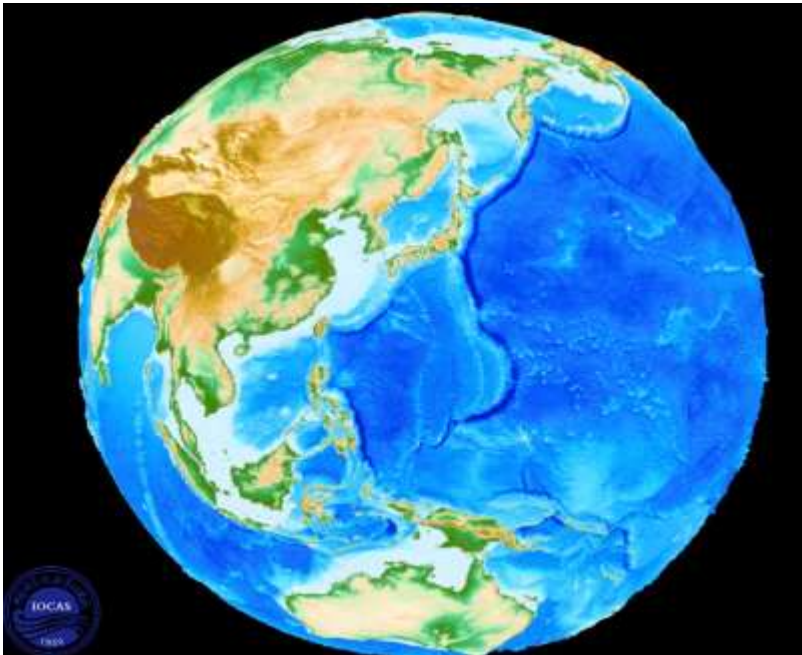
**通知** ▶ 海洋区域中心2017技术交流会议通知

**公告** ▶ 关于公布2015年技术能手和优秀报...

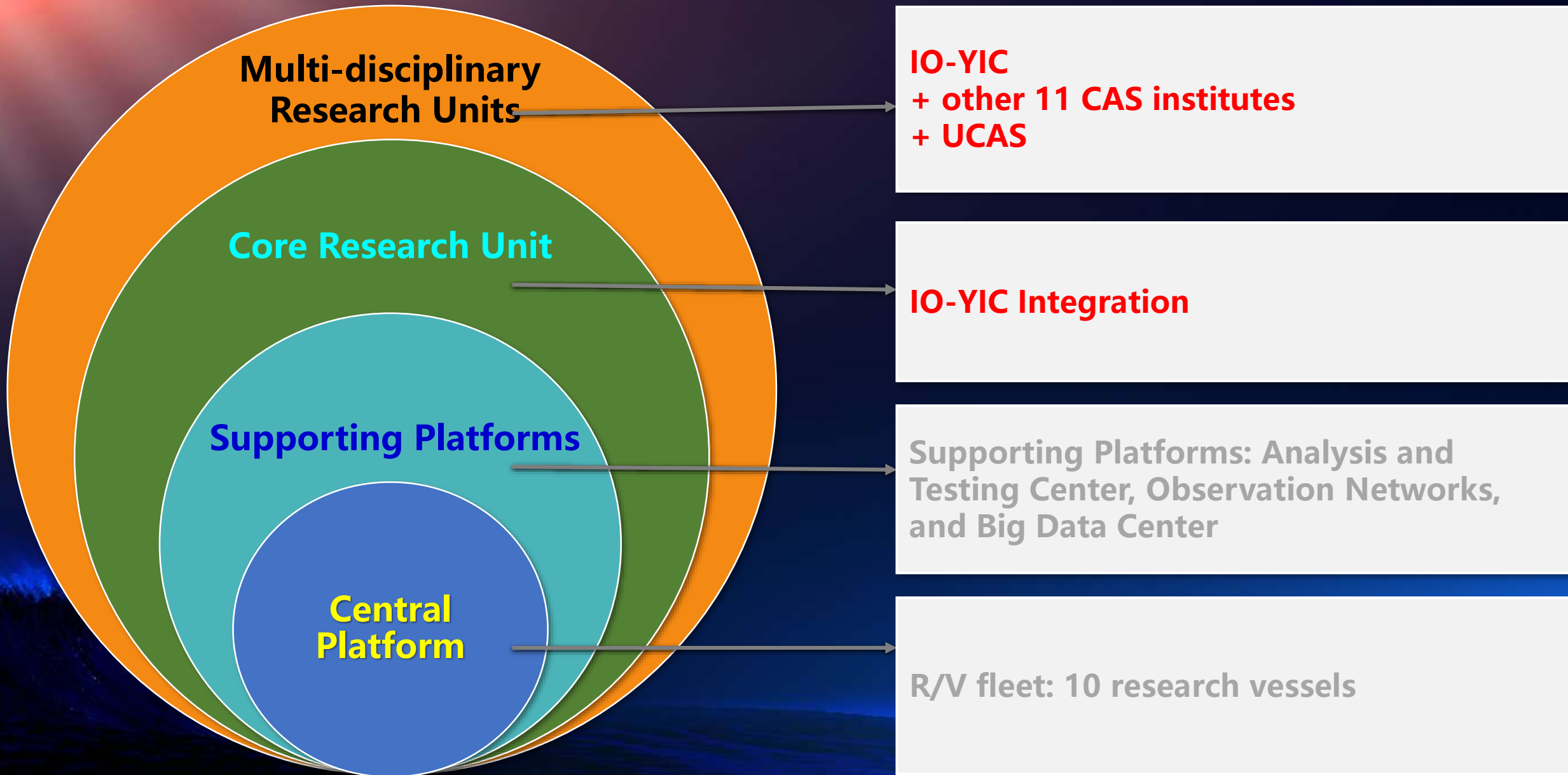


## Big Data Center

- Data collection (combination of data obtained from RV Fleet, Observation Networks and, Analytical and Testing Center)
- Data products and visualization: Supporting policy-making and social development



# Structure of the COMS, CAS



# Institutes in Marine Science in CAS



**Yantai Institute of Coastal Zone Research (2006)**

**Institute of Oceanology (1950)**

Integrated development of  
IOCAS and YICCAS since  
March 2017

**South China Sea Institute of Oceanology (1959)**

**Sanya Institute of Deep-sea Science and Engineering (2011)**

## Three Tasks

- Ocean health: Mechanisms, Strategies and Solutions
- Multi-spherical Interactions in Indo-Pacific Convergence Zone
- Marine Life Process and Green Development of Bio-resources

## Ecosystem Observation and Simulation

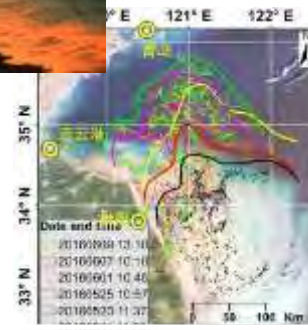
- Automated acquisition of integrated observation data
- Simulation of coastal ocean dynamics



Environmental degradation

## Ecosystem Health Assessment

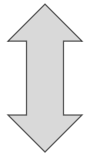
- Development of carrying capacity assessment method



## Ecological Disaster Prevention and Mitigation

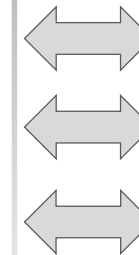
- Developing prevention and control technology of ecological disasters.
- Developing capabilities in predicting and early warning of ecological disasters

Central and Regional Govt Strategies and Planning



Management Solutions

Land use options  
Marine use option



## Integrated Observation and Exploration

- Full-depth ocean observation and Real-time data transmission technology

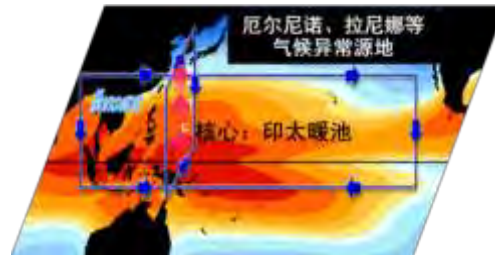


Autonomous environmental surveillance



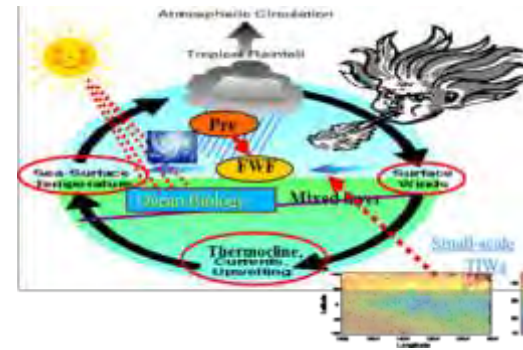
## Multi-spherical interaction Study

- Key process and mechanism of multilayered mass and energy exchange in Ocean-Atmosphere-Geosphere-Biosphere



## Modelling and Simulation

- Develop simulation and prediction methods on the effects of climate change



Multi-spherical interaction theory



- *Exploration & observation facilities*
- *Earth system model*





## Marine life in Deep Sea

- Marine biodiversity and marine life in deep sea
- Exploitation of biological resources from the deep ocean



## New varieties & Species

- New varieties of economic important species
- Core technologies on genome sequencing



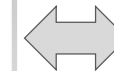
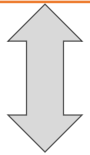
## Green Mariculture Modes

- Monitoring & observation techniques
- Stands and facilities for marine ranching
- Remediation of degraded habitat



## Theory on Life in the Deep Sea Sustainable Mariculture Industry

- new understandings on marine life in deep sea
- New varieties or species
- environment-friendly mariculture modes





College of Marine  
Science, UCAS

# Multi- disciplinary Units

The Institute of Acoustics, CAS  
The Institute of Atmospheric Physics, CAS  
Shenyang Institute of Automation, CAS  
Institute of Geology and Geophysics, CAS  
Institute of Microbiology, CAS  
Dalian Institute of Chemical Physics, CAS



## Institutes

**IOCAS**

YIC, CAS  
Qingdao Institute of Bioenergy and  
Bioprocess Technology, CAS

Shanghai Institute of Materia Medica, CAS

South China Sea Institute of Oceanology, CAS  
Guangzhou Institute of Geochemistry, CAS

Institute of Deep-sea Science and Engineering, CAS



# Multi-disciplinary research Units

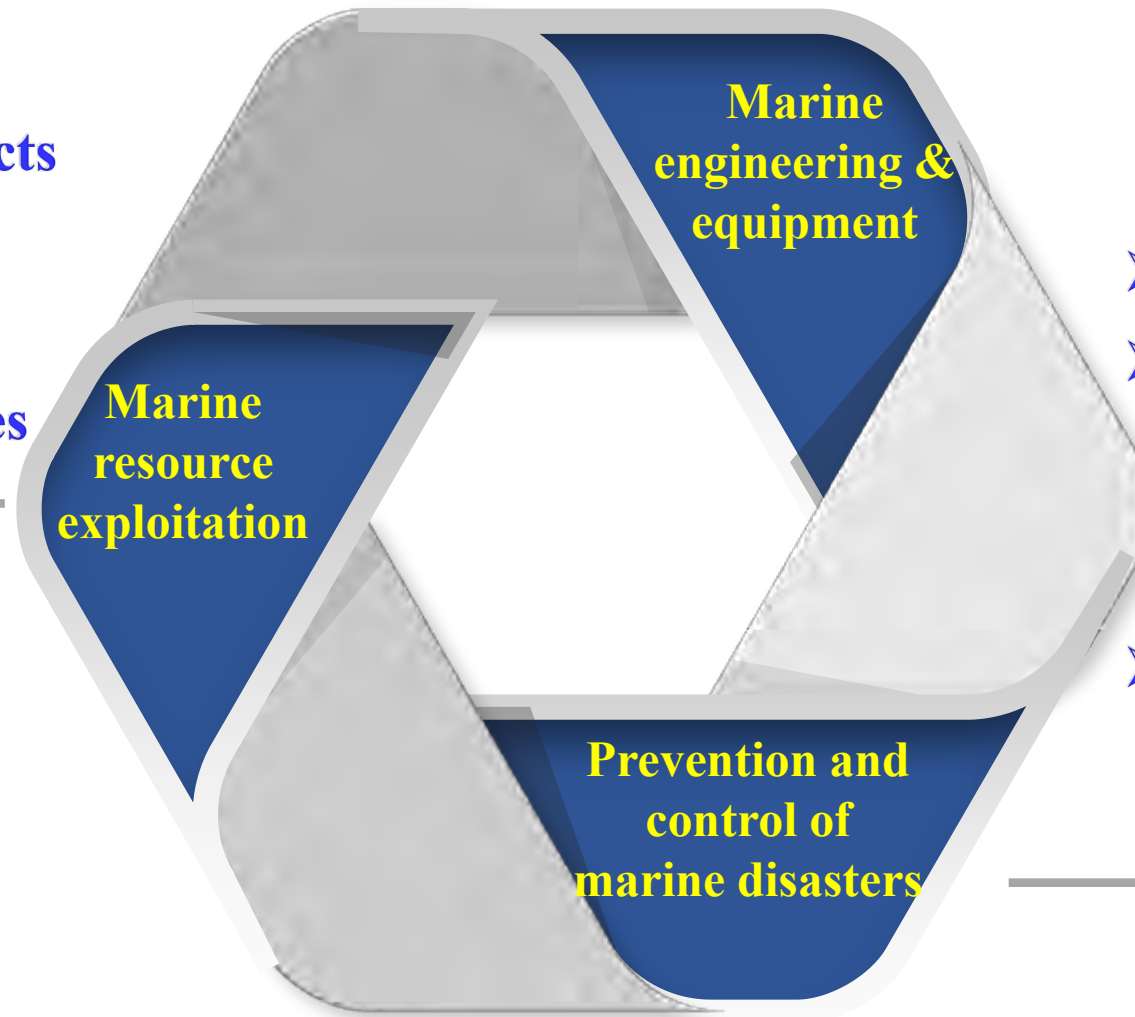


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INSTITUTE OF OCEANOLOGY, CHINESE ACADEMY OF SCIENCES

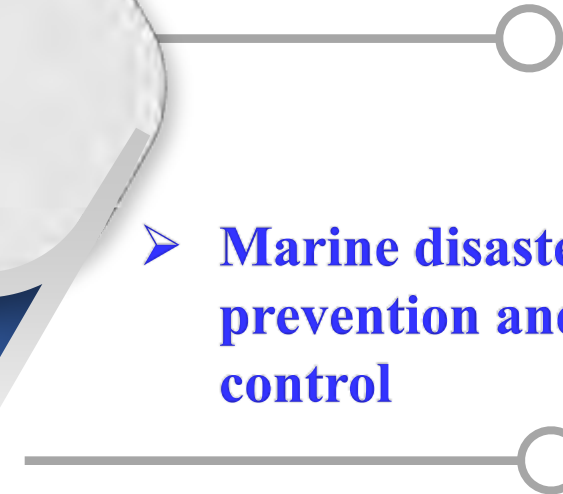
3 directions, 7 R&D centers

- Marine medicines and Marine biological products
- New marine energy
- Seawater desalination
- Marine mineral resources



- marine equipment
- marine engineering

- Marine disaster prevention and control





# Outline

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**Long term observing  
networks and new findings**

# Observation Networks of COMS, CAS



## Four Stations:

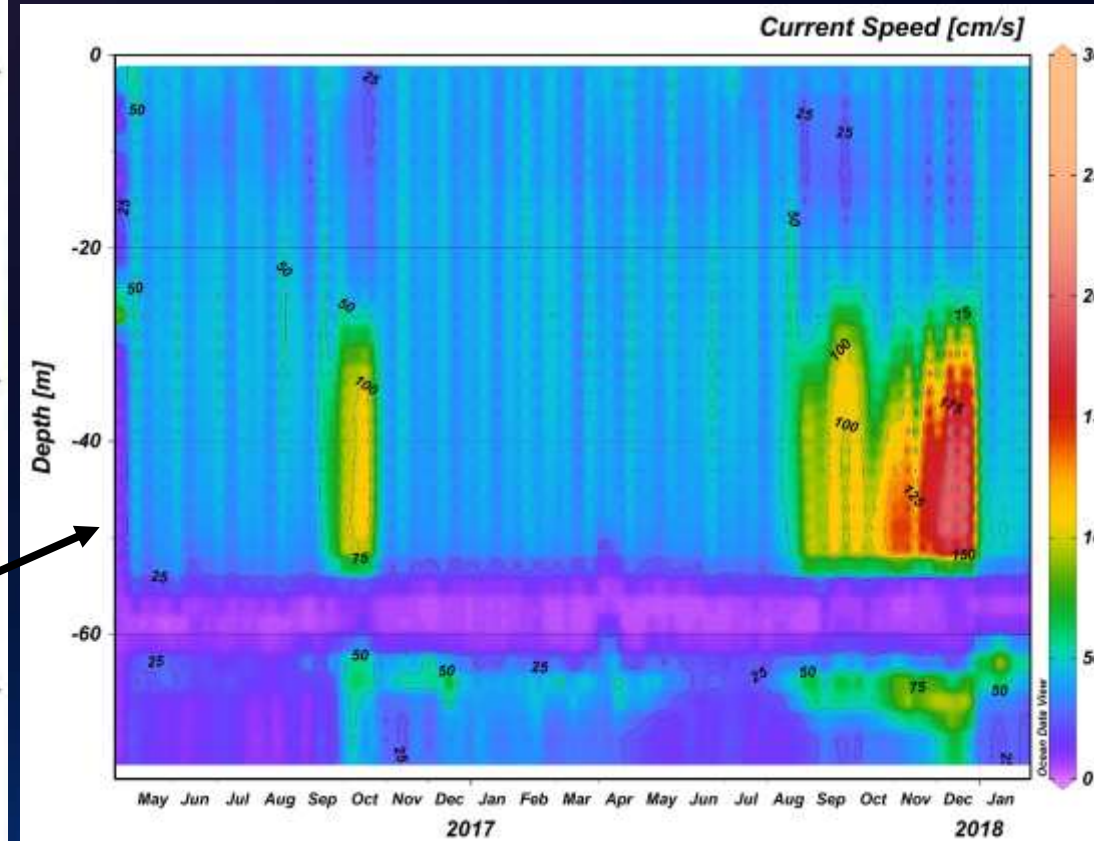
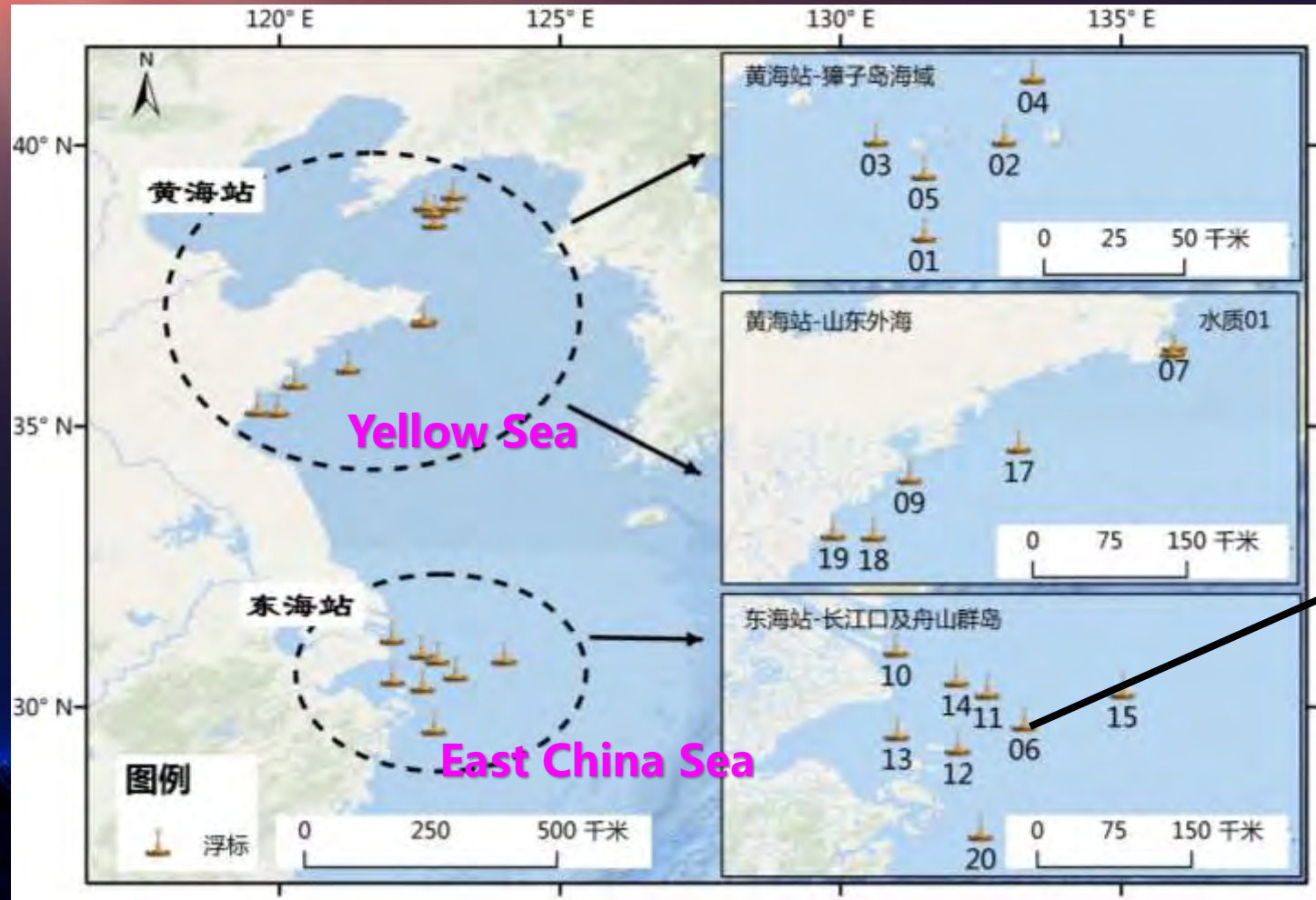
- Jiaozhou Bay Station (1981, State station)
- Muping Station (2011)
- Yellow River Estuary Station (2011)
- Changjiang River Estuary Station (2014)

## Three Arrays:

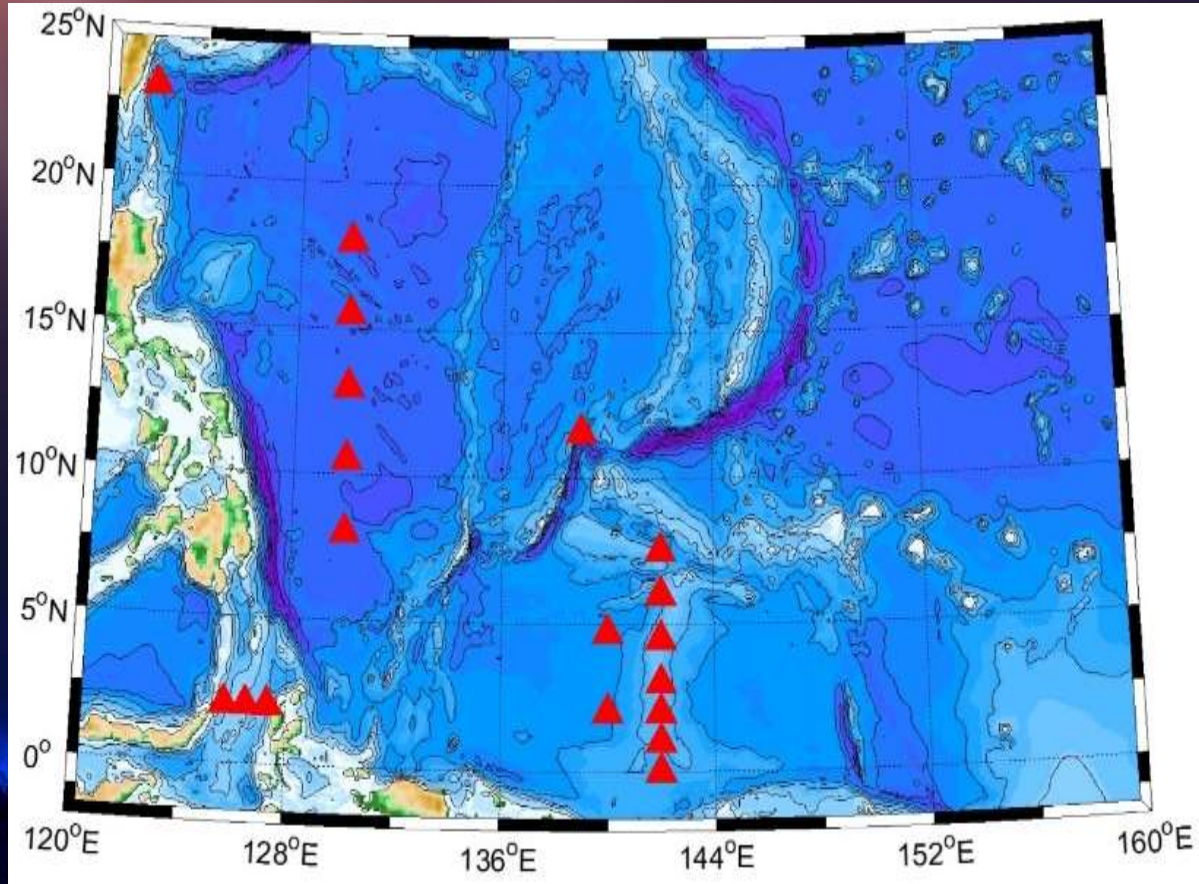
- Yellow Sea Buoy Array (2007)
- East China Sea Buoy Array (2007)
- Western Pacific Subsurface Mooring Array (2014)

**Goals: To provide high-resolution, long-term, and multi-variable observational datasets**

# Yellow Sea and East China Sea Buoy Networks



# CAS Scientific Observing Network (CASSON) in the Western Pacific Ocean



30

Sets

Deep-Sea  
Subsurface Moorings

121

sets

Succeeded in releasing and  
retrieving subsurface moorings

1000

Sets

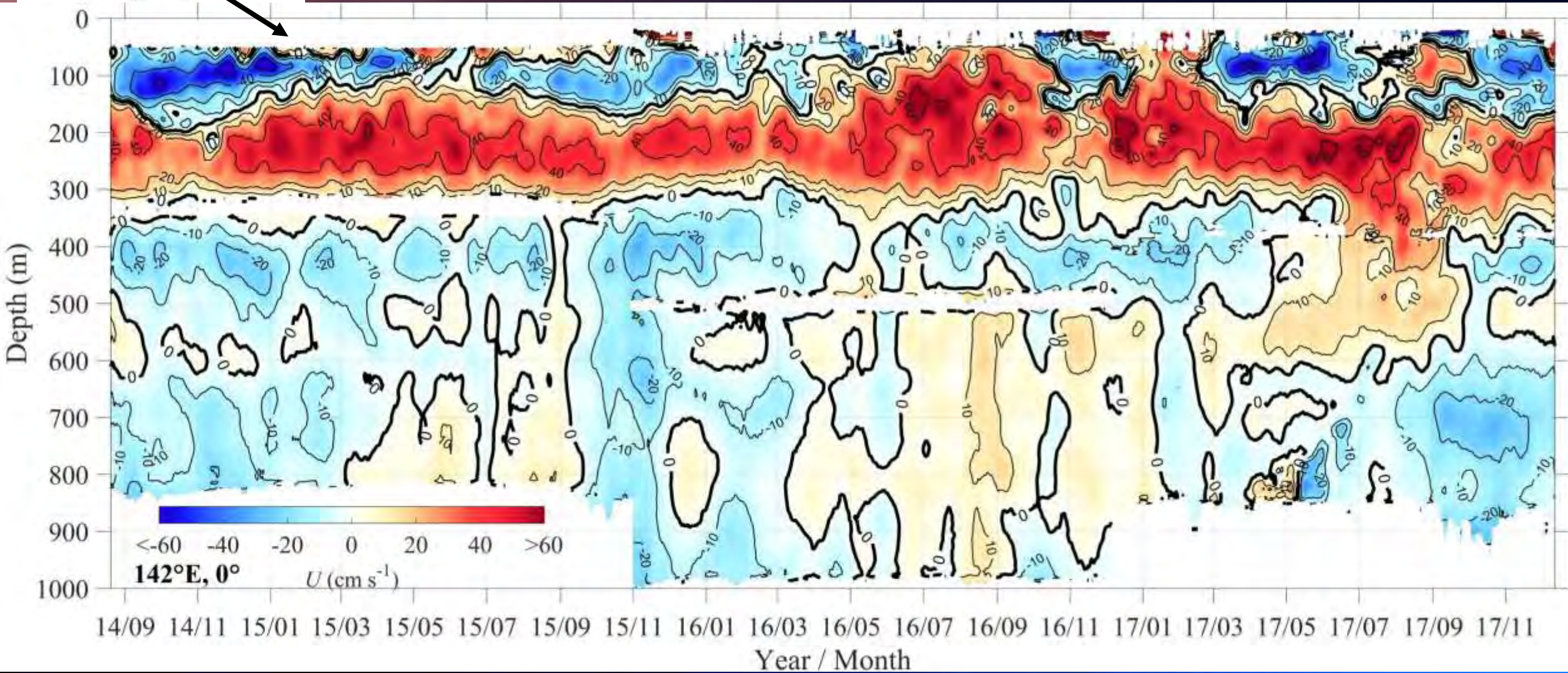
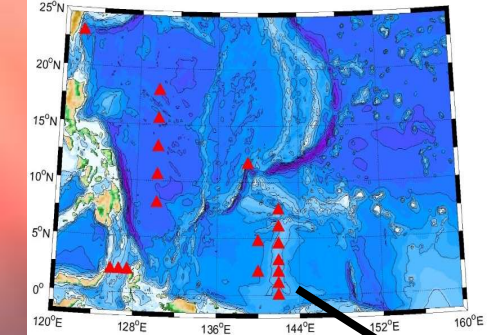
T, S, Current Instruments

3-4

years

Temperature, Salinity, and  
Ocean Current Data

# Time-Depth Variation of Zonal Currents at 142°E, 0° During Aug 2014 – Nov 2017

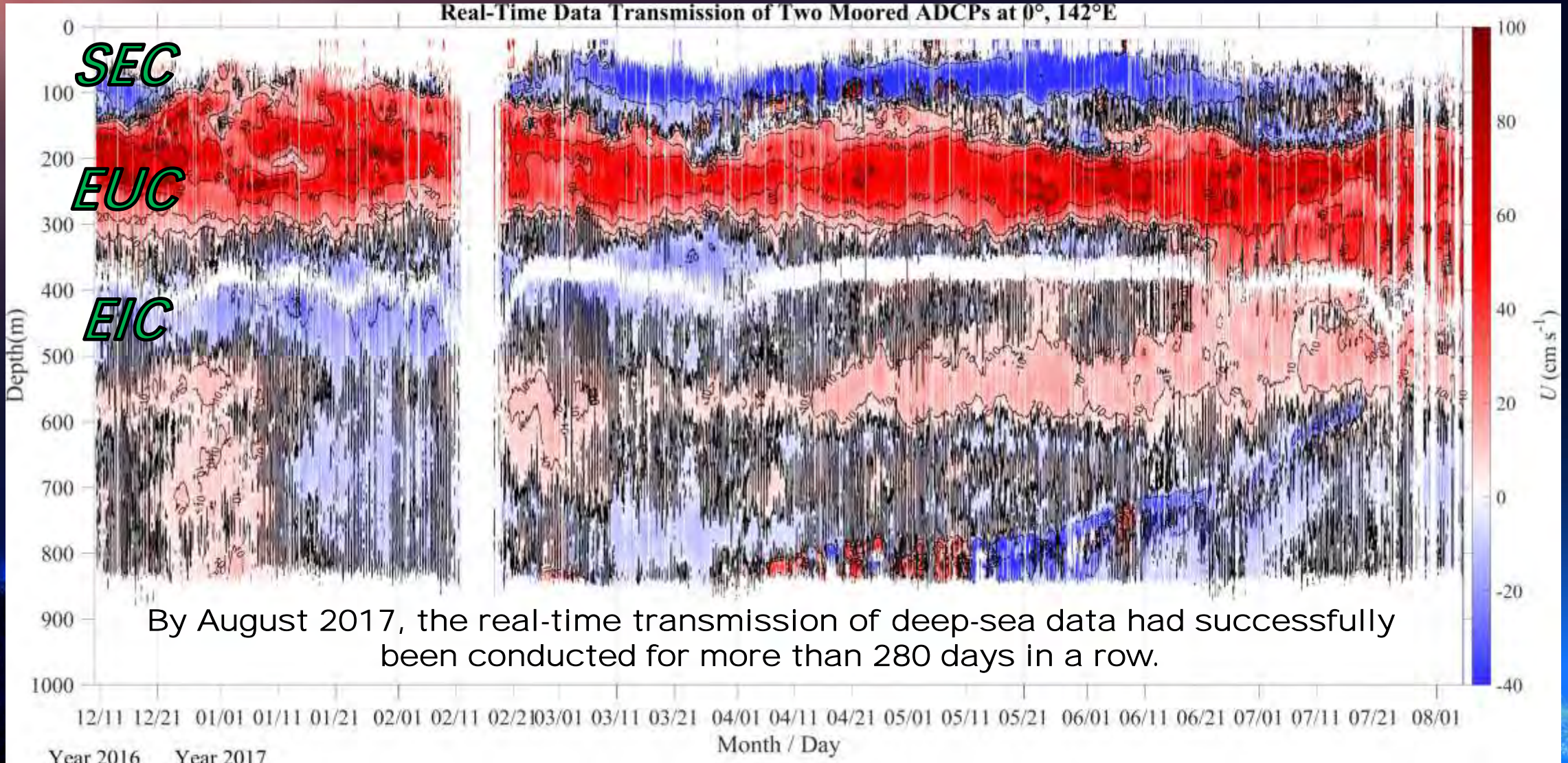




# Real-Time Observation of CASSON

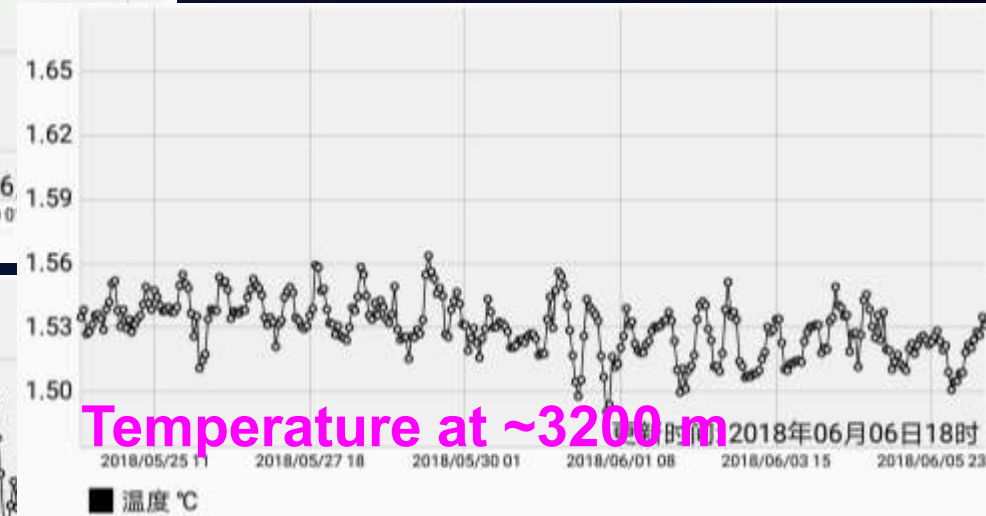
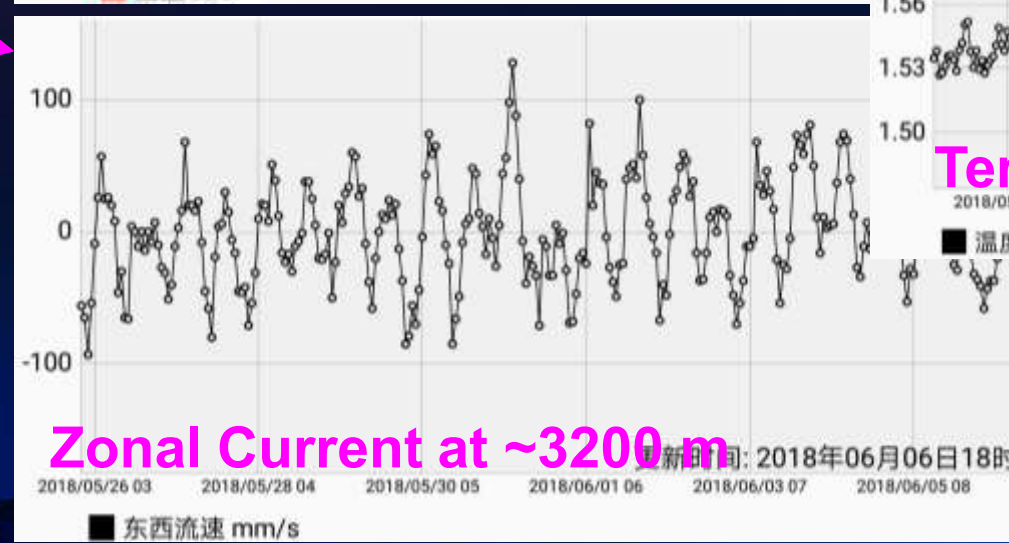
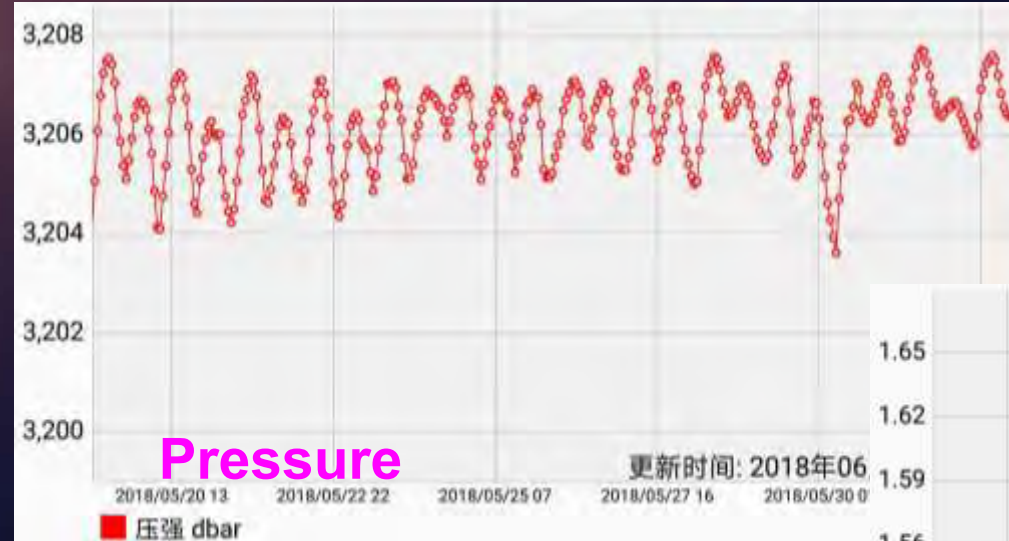
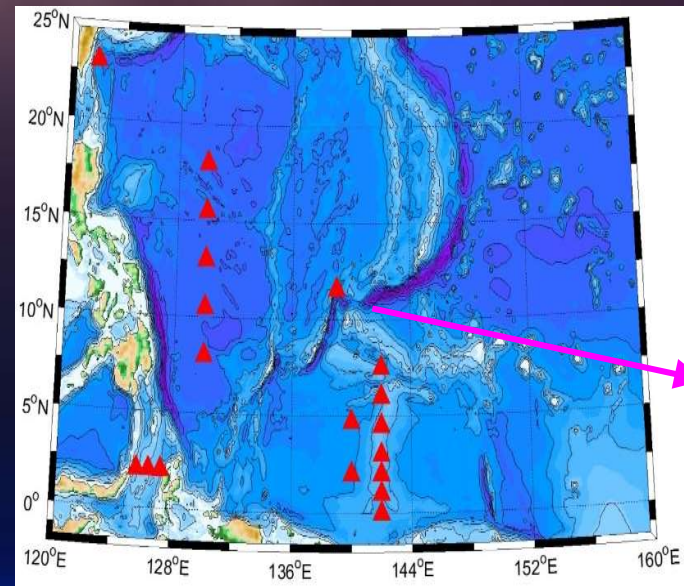
Year 2016

Zonal Current



# Two Functional Developments in 2017: Real-time Network and 3000 m depth transmission

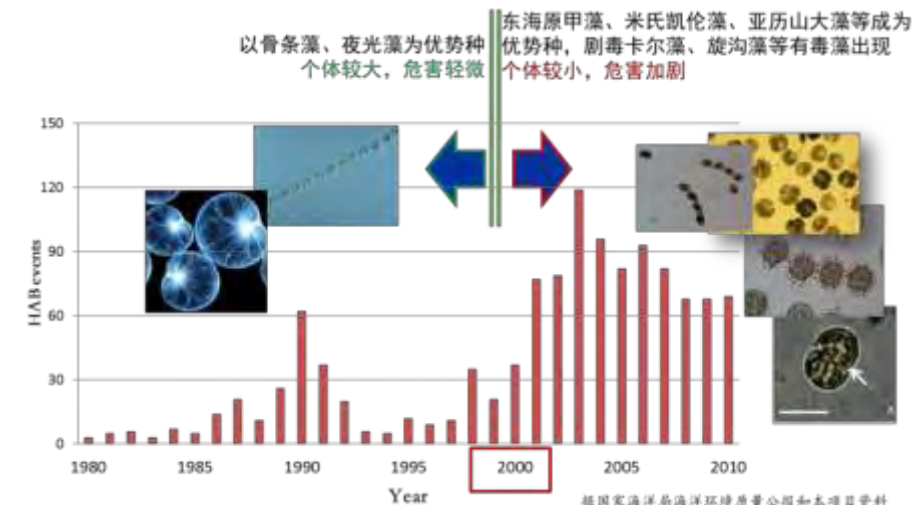
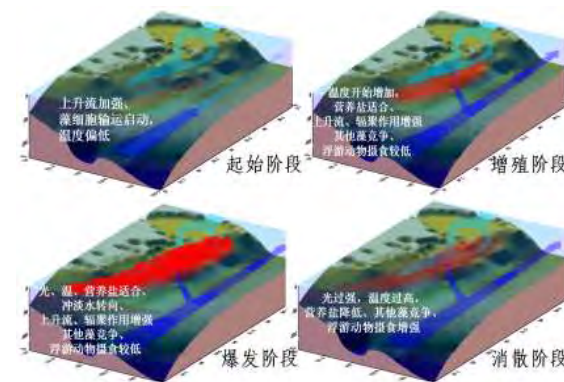
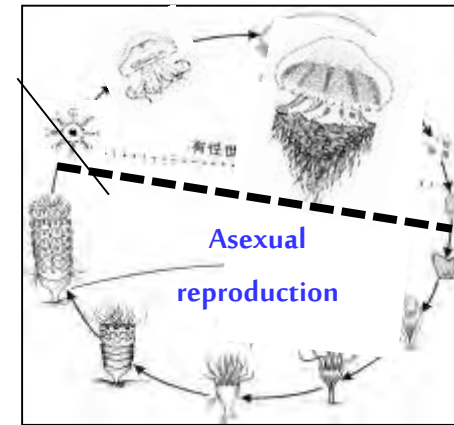
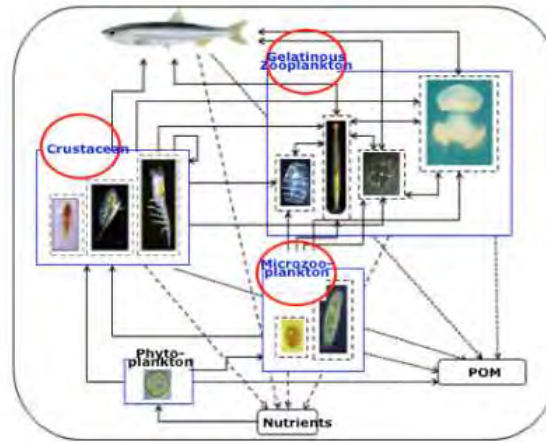
Year 2017



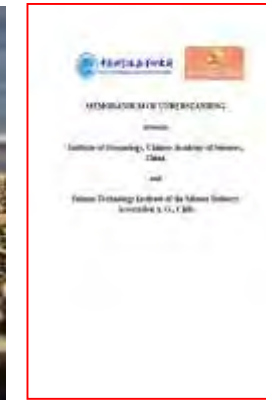
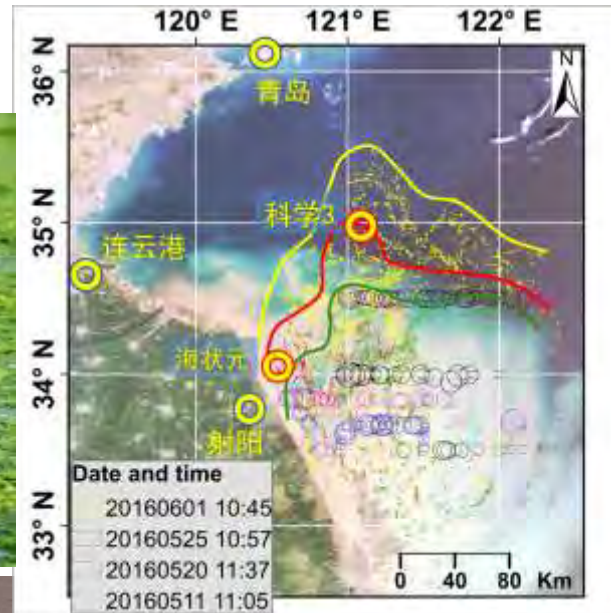
## The Concept of Marine Ranching



## Biodiversity and marine ecosystem studies



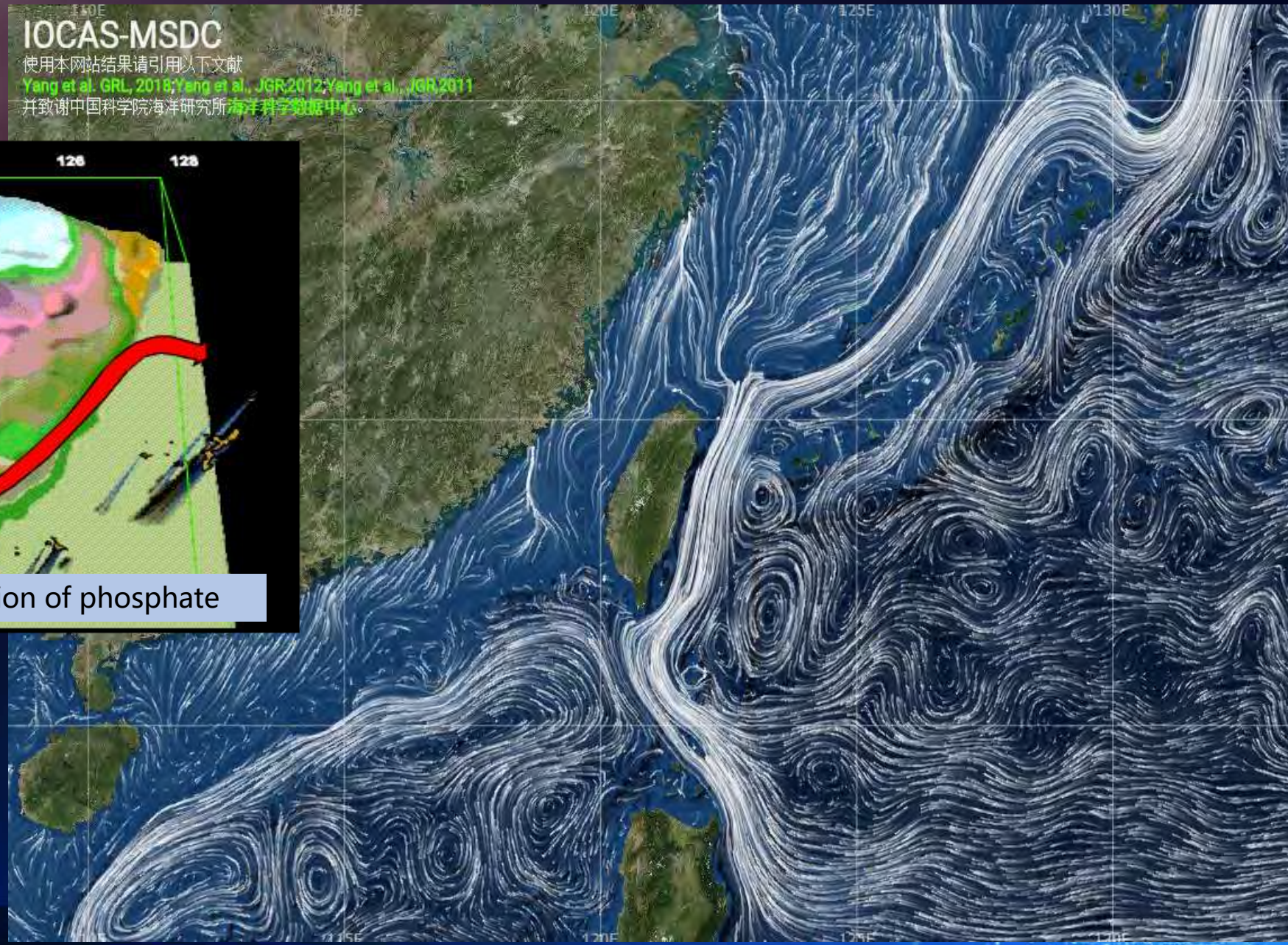
## Systematic solutions on marine ecological and environmental problems



Strategies to prevent green tides in the Yellow Sea

Mitigation of Harmful algal blooms with modified clay

# Research Findings

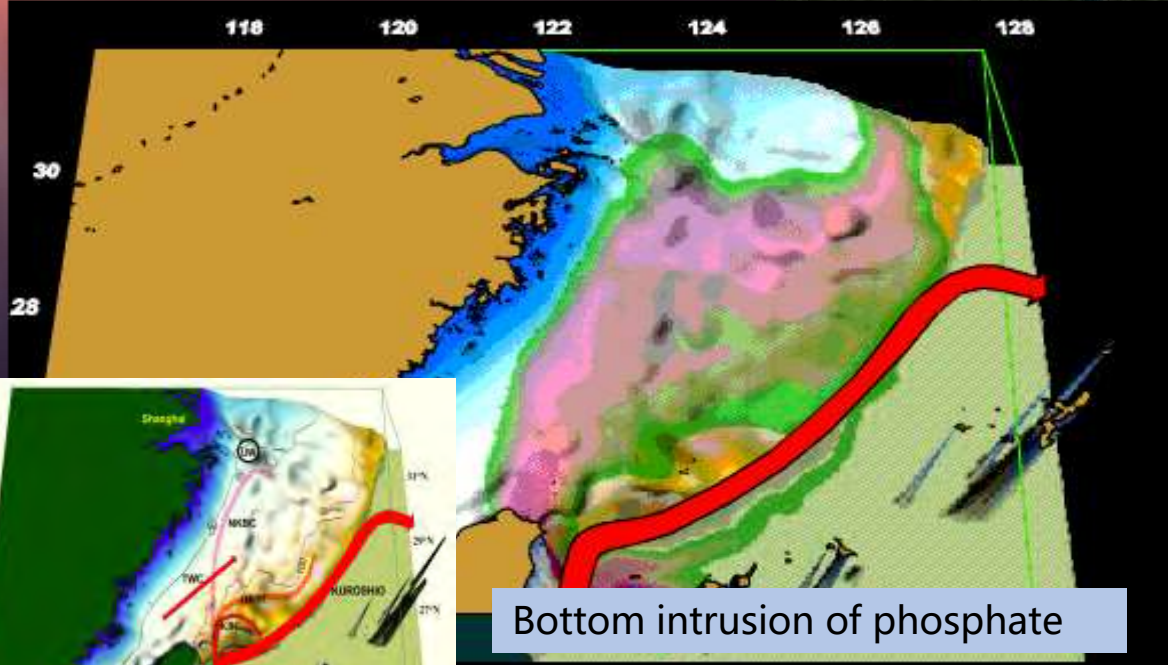


IOCAS-MSDC

使用本网站结果请引用以下文献

Yang et al. GRL, 2018; Yang et al., JGR, 2012; Yang et al., JGR, 2011

并致谢中国科学院海洋研究所 海洋科学数据中心。



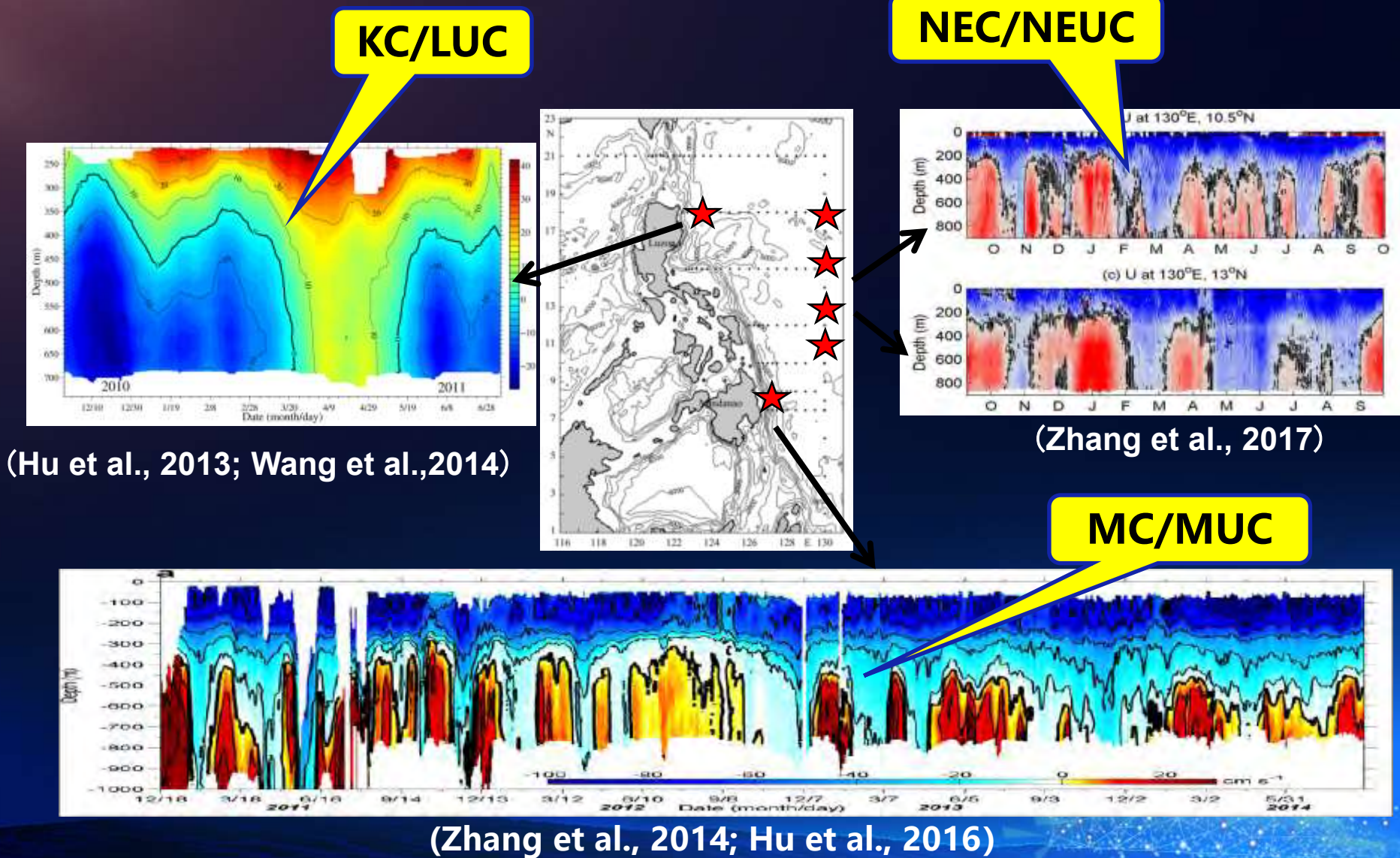
Bottom intrusion of phosphate

The coastal Algal blooms are closely influenced by the timing and location of the phosphate-rich, cold Kuroshio branch current (NKBC).

[Yang, et al., JGR, 2011, 2012, GRL, 2018]

# Research Findings

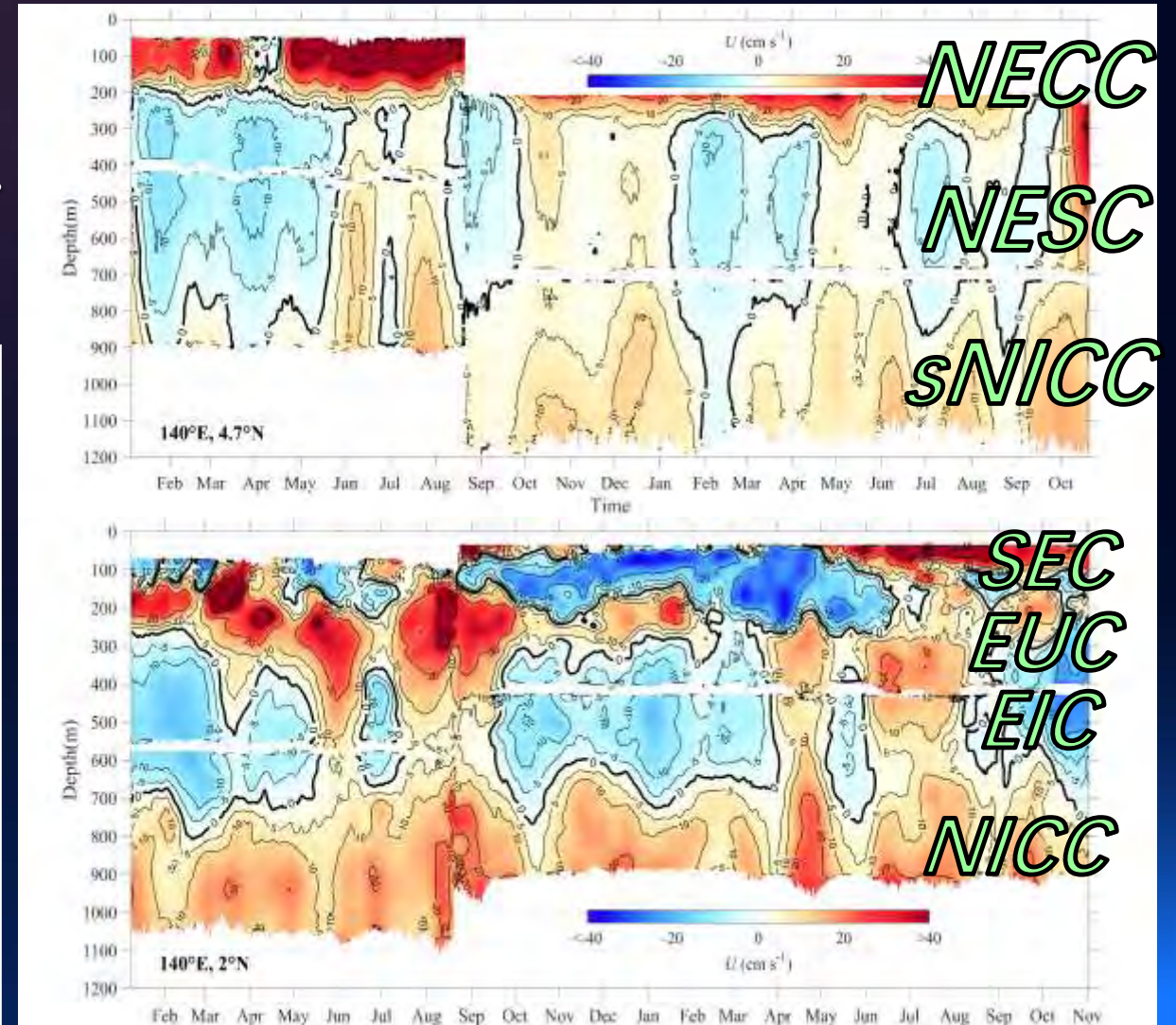
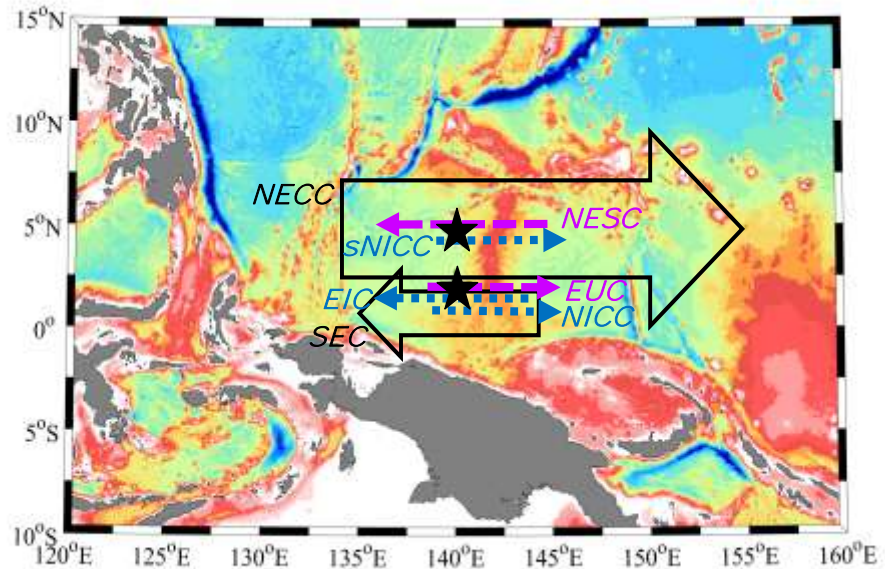
Structure and Variability of WBCs, WBUCs, NEC/UC from Mooring Measurements at 8N, 18N, 130E



# Research Findings

Structure and Variability of North Equatorial Countercurrent, Equatorial Undercurrent, etc. in upper 1000 m at 140E

(Wang et al., 2016, JGR)





- A comprehensive research center with global influence and contribution
- An opening and sharing facility cluster of S&T innovation
- An elite talent cultivation base
- A platform for collaborations with domestic and international institutions

**The COMS, CAS will act as the bridges connecting the coastal and open ocean study, science and technology, and academic and social/industrial requests, based on integrating, coordinating and sharing the advanced platforms and task teams of the CAS.**

The background is a dark blue gradient. At the top, a satellite with solar panels is in orbit above a view of Earth. In the center, the word "THANKS" is written in large white letters. Below it, the name "Fan Wang" and email "fwang@qdio.ac.cn" are displayed in white. The bottom half of the image shows a glowing blue wave on the left, a yellow buoy with a white float, and a wireframe ship on the right.

# THANKS

Fan Wang

[fwang@qdio.ac.cn](mailto:fwang@qdio.ac.cn)