

Engagement in International Ocean Science Communities: From Existing Initiatives to SeaForAll



**IOC-UNESCO and the
Ocean Decade**



**CLIVAR's International
Scientific Collaboration**

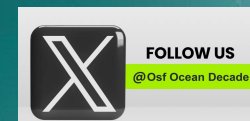


Co-creating SeaForAll



SeaForAll: Co-creating a Global Ocean-Climate Seamless Forecasting Community

Qian Zhao | 03 Sept. 2026 | Qingdao





Content

01 The Challenge

02 OSF Programme

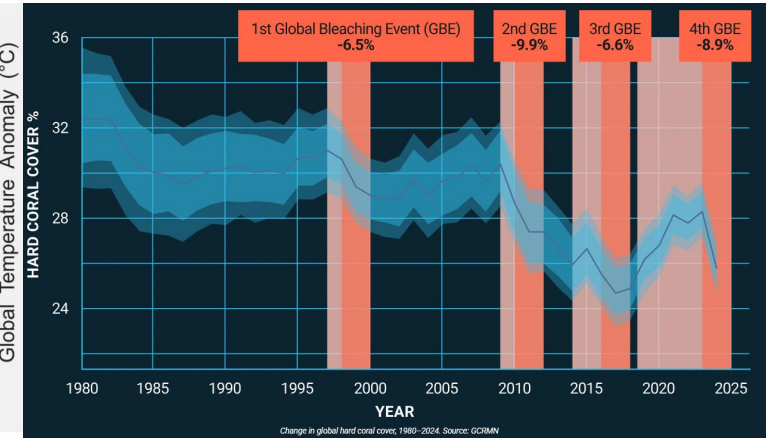
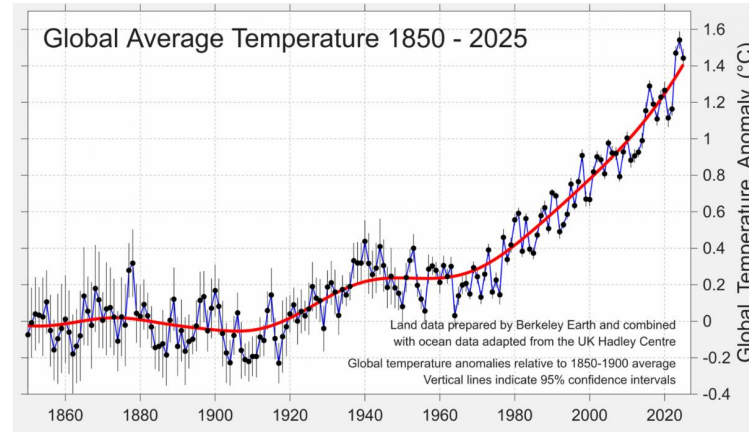
03 SeaForAll Initiative

The Challenge



Climate Change Crisis —The Clock Is Ticking

- 2025 Global Mean Surface Temperature **+1.44 °C** above pre-industrial, the past 11 years have been the 11 warmest on record (WMO).
- Largest single-year decline of coral reef by **8.9%** in 2023-2024. (GCRMN)
- Increased frequency and magnitude of **extreme weather events** (IPCC).



Notable Weather and Climate Events: Annual 2025

GLOBAL AVERAGE TEMPERATURE

The annual average global surface temperature was the third warmest on record since global records began in 1850.



ARCTIC SEA ICE EXTENT

The 2025 Arctic minimum sea ice extent tied as the 10th smallest on record, while the maximum was the lowest on record. The Arctic region had its second-warmest year on record.

NORTH AMERICA

North America experienced its fourth-warmest year on record.

TROPICAL STORM BARRY

Barry brought heavy rainfall and strong winds to parts of eastern Mexico. Remnants from Barry contributed to catastrophic flash flooding in central TX in early Jul.

HURRICANE ERICK

Erick was the earliest major hurricane on record to make landfall in Mexico.

HURRICANE MELISSA

Melissa tied with the 1935 Labor Day Hurricane as the strongest landfalling Atlantic hurricane on record due to wind speed and pressure.

SOUTH AMERICA

South America had its sixth-warmest year on record.

GLOBAL TROPICAL CYCLONES

Global tropical cyclone activity was above average with 101 named storms in 2025.

UNITED KINGDOM

Storm Eowyn, the strongest UK storm in 10 years, brought destructive winds and heavy rain to parts of the UK.

EUROPE

2025 was Europe's second-warmest year on record, behind 2024.

SOUTHEAST EUROPE

In Jul, persistent heat and drought conditions contributed to the development of dangerous wildfires across the region.

CONGO

Heavy rain in Apr triggered severe floods and landslides in Congo's capital, causing widespread damage and loss of life.

AFRICA

Africa saw its seventh-warmest year on record.

THAILAND

Southern Thailand experienced catastrophic flooding in mid- to late Nov after record-breaking rainfall overwhelmed rivers and drainage systems.

CYCLONE SENYAR

Senyar was an extremely rare tropical storm in Nov. It was the first storm to form directly over the Strait of Malacca, and only the second named storm on record there.

PHILIPPINES

In Nov, the Philippines was affected by three consecutive storms—Typhoon Kalmaegi, Typhoon Fung-Wong and Typhoon Koto—that together caused significant loss of life and major infrastructure damage.

OCEANIA

Oceania had its second-warmest year on record.

ANTARCTIC SEA ICE EXTENT

The 2025 Antarctic maximum sea ice extent was the third lowest on record, while the minimum tied as the second lowest on record. The Antarctic region recorded its fourth-warmest year on record.

Please note: Material provided in this map was compiled from NOAA's State of the Climate Reports. For more information please visit: <https://www.ncei.noaa.gov/access/monitoring/monthly-report/global/>

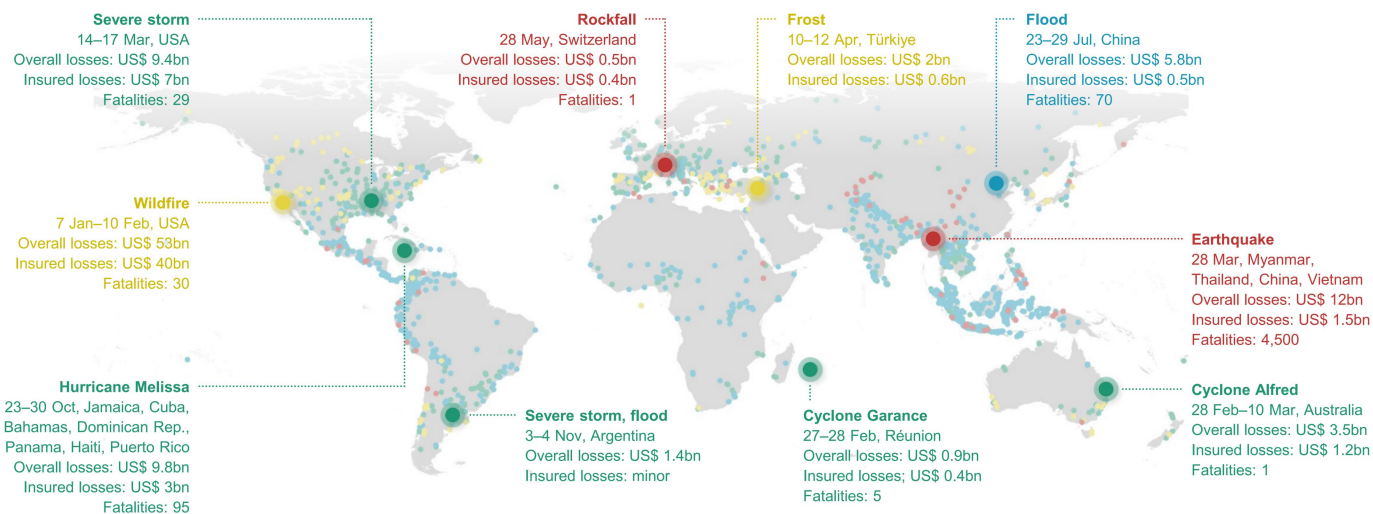


NatCatSERVICE

US events dominated natural disaster losses in 2025

Selected natural catastrophe loss events worldwide

Munich RE 



Geophysical events
Earthquake, tsunami, volcanic activity, rockfall



Meteorological events
Tropical storm, extratropical storm, convective storm, local storm



Hydrological events
Flood, mass movement



Climatological events
Extreme cold temperature, wildfire



Selected significant catastrophes

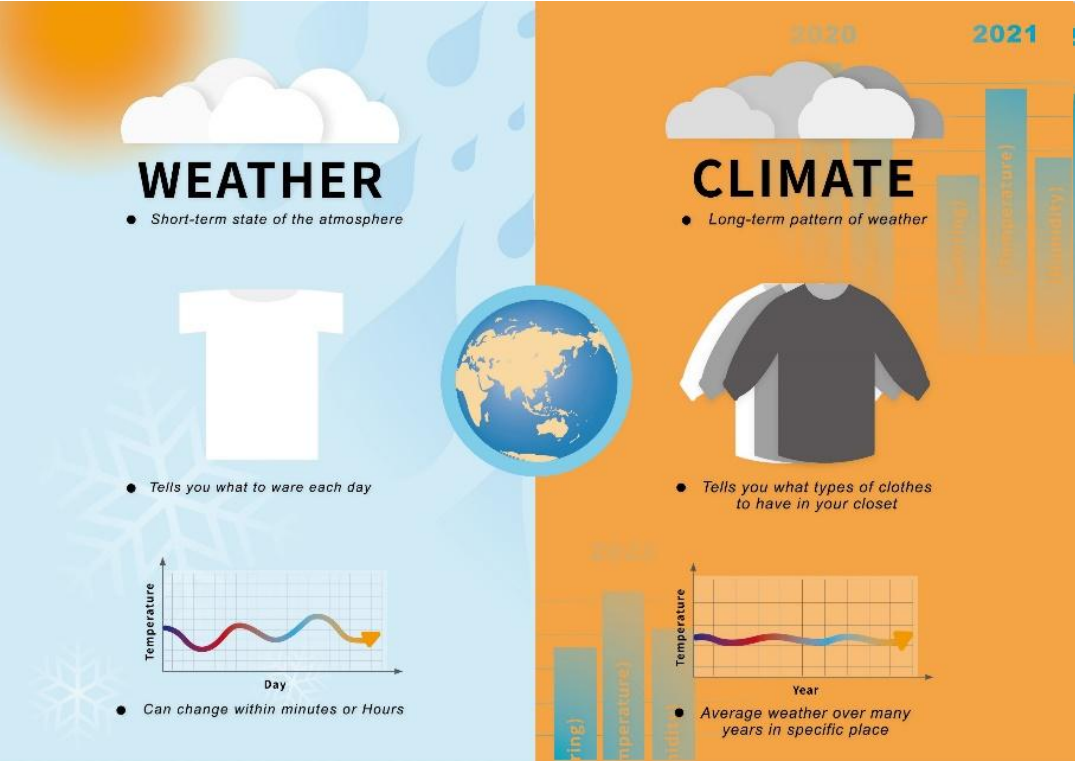
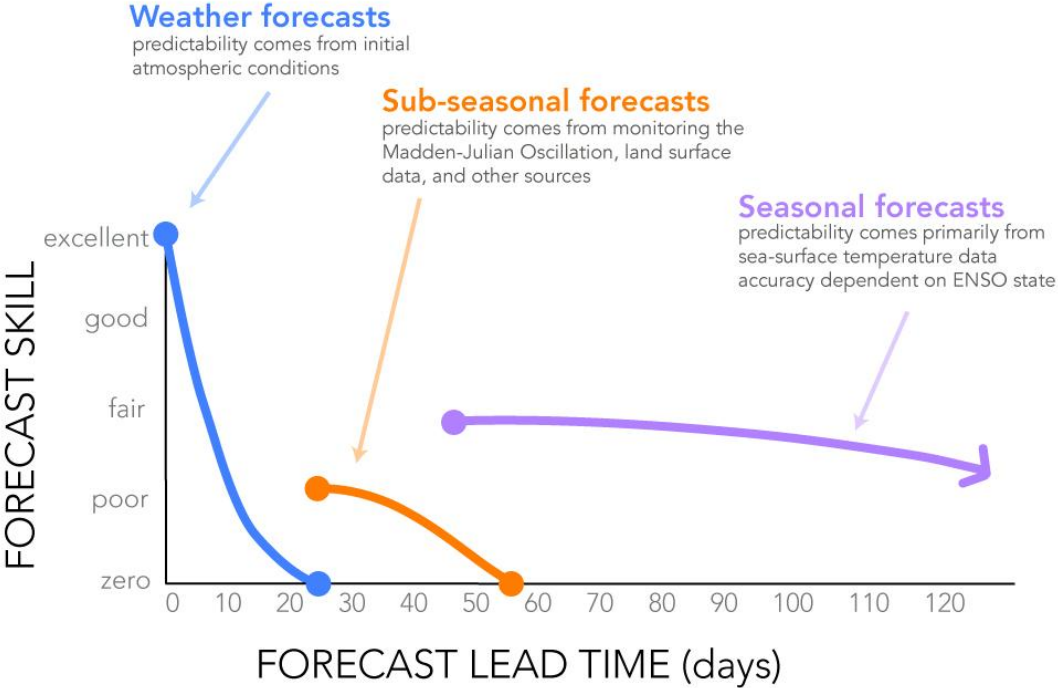
• Small, medium and large loss events

US\$224bn
Economic Losses in 2025

Significant and Urgent Societal Needs

Solution-driven disaster mitigation and adaptation based on seamless forecasting

Knowledge Gap between Weather Forecasting and Climate Prediction



OSF Programme



Endorsement of OSF Programme



2021.10

Call for Decade
Actions No. 02/2021



INTERGOVERNMENTAL OCEANOGRAPHIC COMMISSION
COMMISSION OCÉANOGRAPHIQUE INTERGOUVERNEMENTALE
COMISIÓN OCEANOGRÁFICA INTERGUBERNAMENTAL
МЕЖПРАВИТЕЛЬСТВЕННАЯ ОКЕАНОГРАФИЧЕСКАЯ КОМИССИЯ
اللجنة الدولية الحكومية لعلوم المحيطات
政府间海洋学委员会

UNESCO - 7 Place de Fontenoy - 75352 Paris Cedex 07 SP, France
<http://ioc.unesco.org> - contact phone: +33 (0)1 45 68 03 18
E-mail: v.ryabinin@unesco.org

Ref. : IOC/VR/22.278/JB/AC/ml

3 June 2022

Subject: Endorsement letter of Decade Action No.18.2

Dear Mr. Qiao

It gives me a great pleasure to inform you of the endorsement of the Decade Action entitled "No 18.2. Ocean to climate Seamless Forecasting system", as a programme forming part of the UN Decade of Ocean Science for Sustainable Development 2021-2030. Please accept my sincere congratulations for this achievement. Let me also thank you for your engagement and commitment to the Ocean Decade vision of the science we need for the ocean we want.



2021-2022

Programme Design
& Preparation



2022.06

Official Endorsement



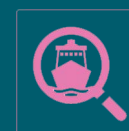
Challenge 5

Unlock ocean-
based solutions to
climate change



Challenge 6

Increase community
resilience to ocean
hazards



Challenge 7

Expand the Global
Ocean Observing
System



A predicted ocean

where society understands and can respond
to changing ocean conditions.

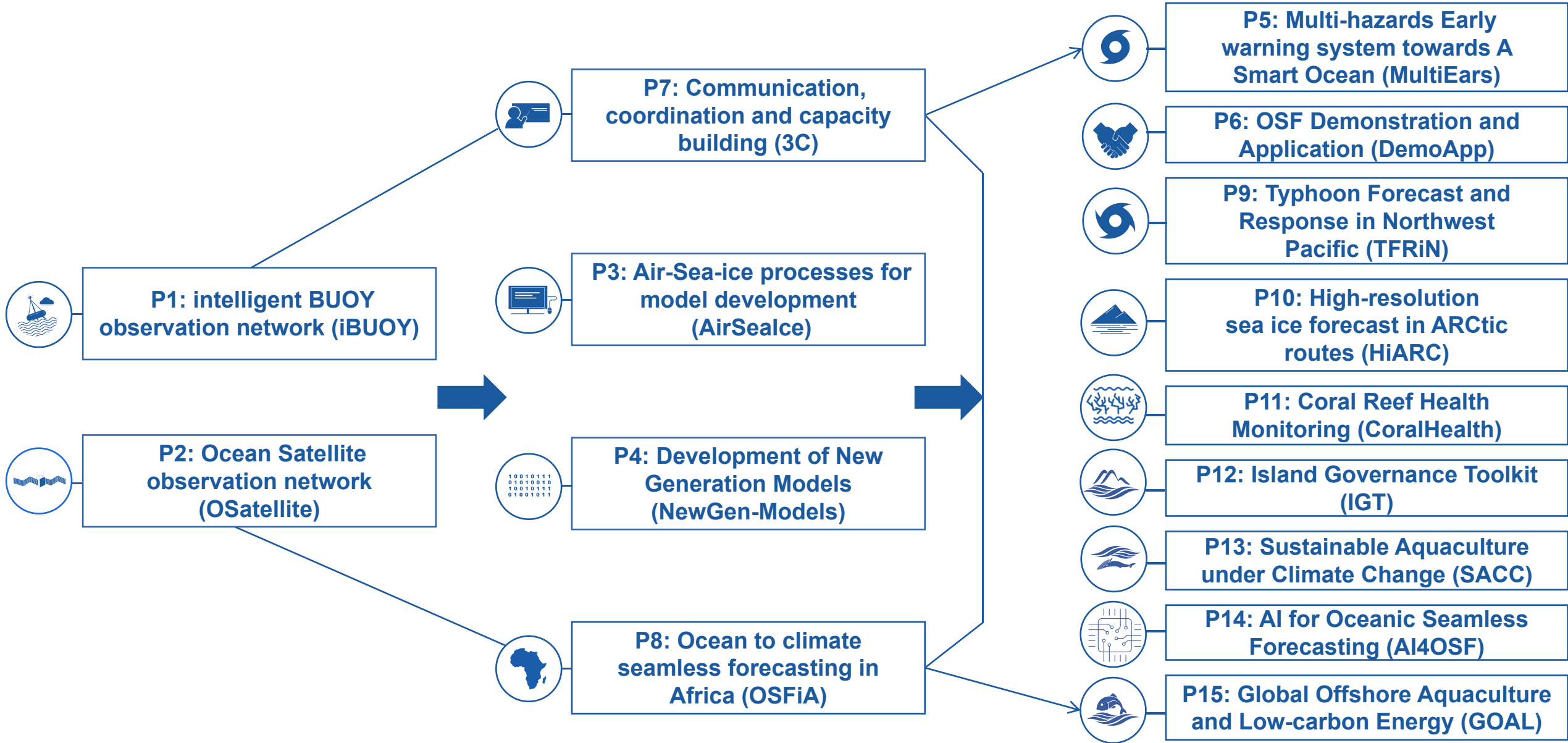
Vision

To advance ocean-climate nexus
understanding
To provide high-quality seamless
prediction

Objective

A system that will provide ocean-
climate seamless forecasting in a
timescale from hours to years and in a
spatial scale from kilometers to global.

15 Projects



OSF Overall Framework

From Ocean Science to Societal Impact





Fangli Qiao
Programme
PI



Yanxiong Liu
FIO, China



Eduardo Siegle
USP, Brazil



Bin Zou
NSOAS, China



Lotfi Aouf
Météo-France



Alexander Babanin
UniMelb, Australia



Anna Rutgersson
UU, Sweden



Jiping Liu
SYSU, China



Gerrit Lohmann
AWI, Germany



Joël Hirschi
NOC, UK



Zhenya Song
FIO, China



Mohd Fadzil Akhir
UMT, Malaysia



Chalermrat
Sangmanee
PMBC, Thailand



Azam Chowdhury
DU, Bangladesh



Jennifer Veitch
SAEON, South Africa



Zacharie Sohoun
IRHOB, Benin



Amr Hamouda
MHMC, Egypt



Emmanuel Eresanya
OAAD, Nigeria



Zexun Wei
FIO, China



Atsushi Sunami
OPRI-SPF, Japan



Jiechen Zhao
FIO, China



Leif Eriksson
Chalmers, Sweden



Wee Cheah
UM, Malaysia



Aidah Baloch
QIC, Pakistan



Fabiano Thompson
UFRJ, Brazil



Bo Lei
CASP, China



Naihao Ye
XGFL, China



Changming Dong
NHST, China



Weixin Zhou
CASP, China

Global Partnership Network



2021
2030 United Nations Decade
of Ocean Science
for Sustainable Development



Partnerships with more
than **80** research
institutions across **52**
countries, together with **5**
international
organizations

**GLOBAL
PARTNERSHIPS**

50+ Countries
80+ Institutes
5 International Organizations



IOC Sub Commission for Africa
and the Adjacent Island States



1. Advancing Ocean Observation Capability



5~10%
of the cost of
commercially
available wave
buoys



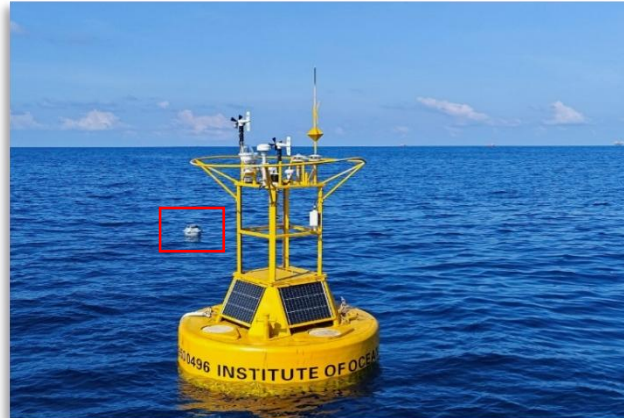
- Utilizes next-generation Global Navigation Satellite System (GNSS) positioning technology to enable real-time observation and data transmission of ocean waves, currents, sea level, sea surface temperature (SST), atmospheric water vapor, wind, temperature, humidity, pressure, and air–sea fluxes. It features ultra-low cost, high precision, and intelligent operation.
- Key breakthroughs in several core technologies, including high-precision positioning algorithms, signal separation and processing, and AI-based intelligent control.



1. Advancing Ocean Observation Capability



2021
2030 United Nations Decade
of Ocean Science
for Sustainable Development



Offshore Malaysia, June–July 2024



Offshore Bangladesh, September 2025



Multiple Countries Have Expressed Interest in Trial Use, Procurement, and Donations of “Jingwei” Multi-Parameter Buoy

1. Advancing Ocean Observation Capability

Expanding Global Ocean Observation Capacity through International Cooperation



The OSF Programme has initiated the international deployment and shipping of **Jingwei GNSS buoys** to partner countries.

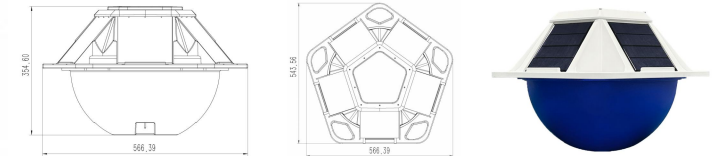


Jingwei GNSS Buoy

JINGWEI GNSS BUOY

- High-precision GNSS for sea level monitoring
- Real-time data for ocean observations
- Robust & cost-effective design for global use
- Supporting ocean monitoring and early warning capabilities

"Jingwei" Beidou multi-parameter buoy (basic type)



Qualification

Wave height	Measurement range:0~20m, Accuracy:0.1m±5%H (H is the wave height), Resolution:1cm
Wave period	Measurement range:2~30s, Accuracy:±0.5s, Resolution:0.1s
Wave direction	Measurement range:0~360°, Accuracy:±15°, Resolution:2°
Stage	Measurement range:±30m, Accuracy:±5cm, Resolution:1mm
Surface current (drift)	High Precision (Horizontal Space Positioning ~1dm)
Atmospheric water vapor content	Measurement range:0~256mm, accuracy:5mm, resolution:1mm
Surface temperature	Measurement range:-2°C to +40°C, Accuracy:±0.01°C/±0.1°C
Shell material	ABS plastic
Size	Φ56.6cm×35.5cm
Solar panel	5 block
Body weight	≤13kg
Weight of counterweight chain	2.5kg
Power supply	Disposable lithium battery pack+rechargeable battery pack
Rechargeable battery pack	Nominal capacity≥51.2Ah
Disposable lithium battery pack	Nominal capacity≥190Ah
Data Return Time	Default:1hour, Adjustable.
Communication mode	Tiantong, Beidou, Iridium, or Tianqi (optional)
Location mode	Beidou and others
Positioning accuracy	H≤15m, V≤3m (1σ, PDOP≤4)
Life span	≥1 year
Powe-on self-test parameter	Calibration validity of wave sensors, voltage, longitude, latitude, time, temperature, etc.



Expand global
ocean observation
network



Support marine hazard
monitoring and
forecasting



Enhance international
cooperation and
capacity building



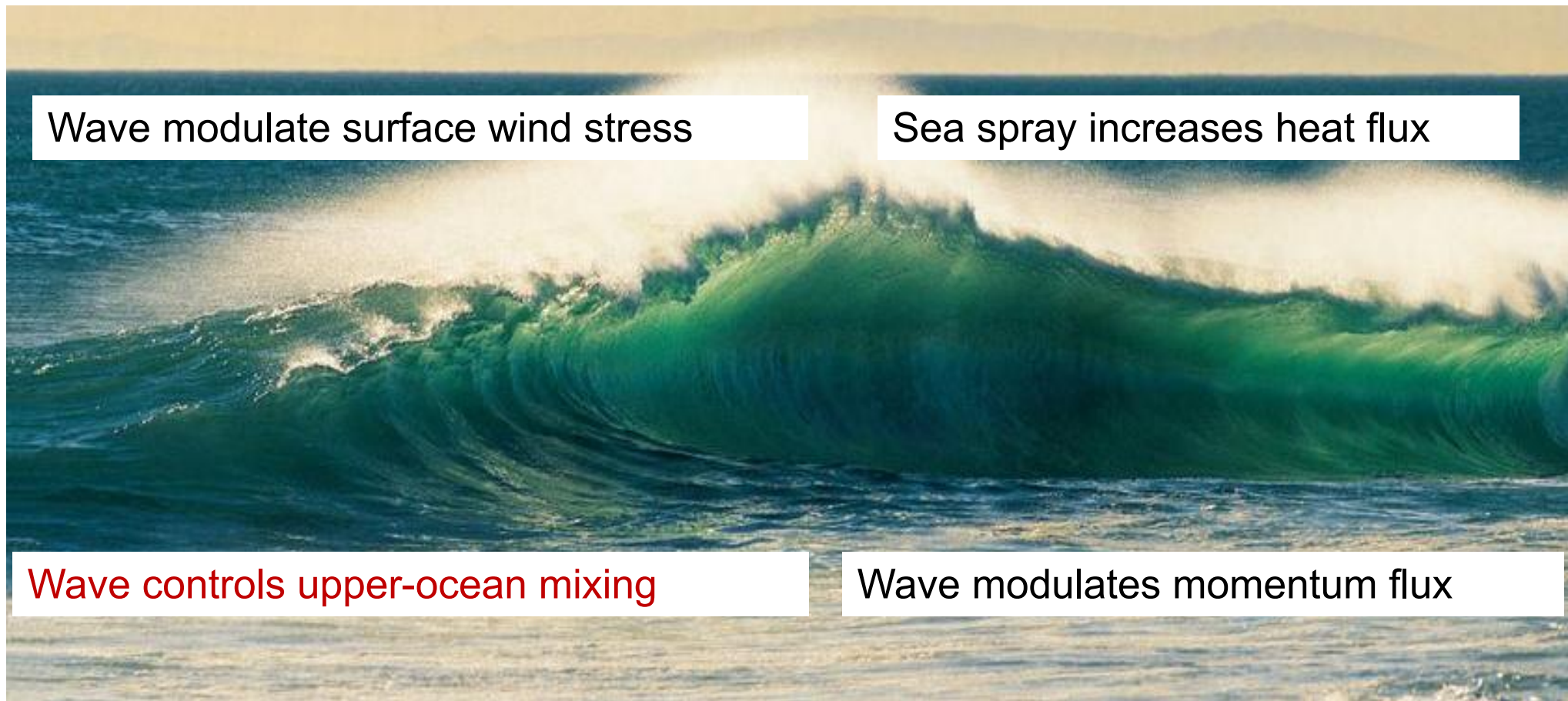
Contribute to the goals of
the UN Ocean Decade for
Sustainable Development



Shipping & Deployment
Underway to
8 Partner Countries

2. Advancing Forecasting Models and Technologies

Theoretical Foundation: Role of Ocean Waves



2. Advancing Forecasting Models and Technologies

□ Wave is a major source of upper-ocean turbulence

$$B_V = \alpha \iint_{\vec{k}} E(\vec{k}) \exp(2kz) d\vec{k} \frac{\partial}{\partial z} \left[\iint_{\vec{k}} \omega^2 E(\vec{k}) \exp(2kz) d\vec{k} \right]^{\frac{1}{2}} \quad (Qiao et al, 2004, 2010)$$

□ The key of wave-turbulence interaction in intensifying ocean turbulence (Qiao et al, 2016) ;

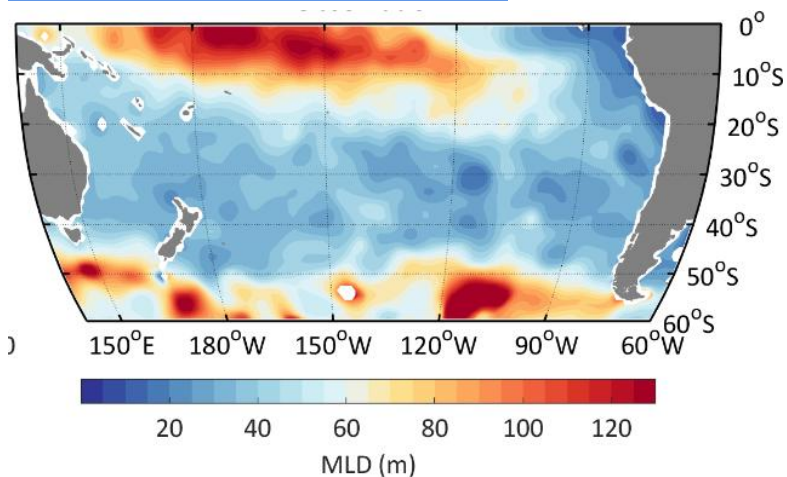
□ Reviewed by D'Asaro

□ Overturn the statement of J. Lumley (1983):
“wave does not generate turbulence”

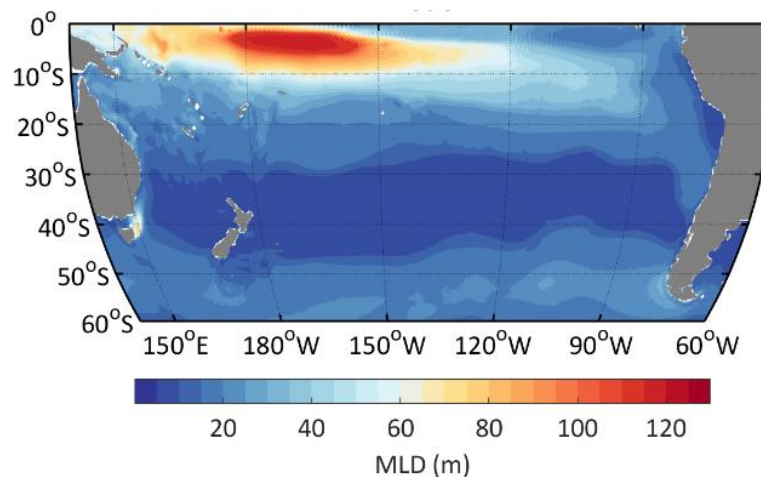


2. Advancing Forecasting Models and Technologies

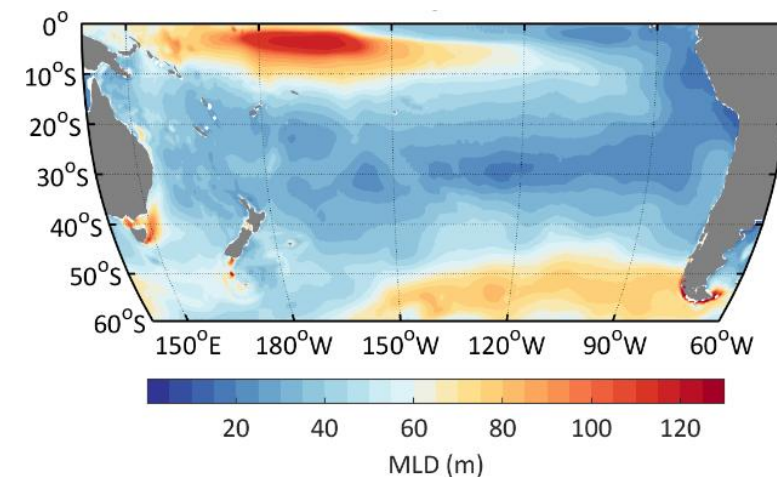
Observation data



Model without Bv



Model with Bv



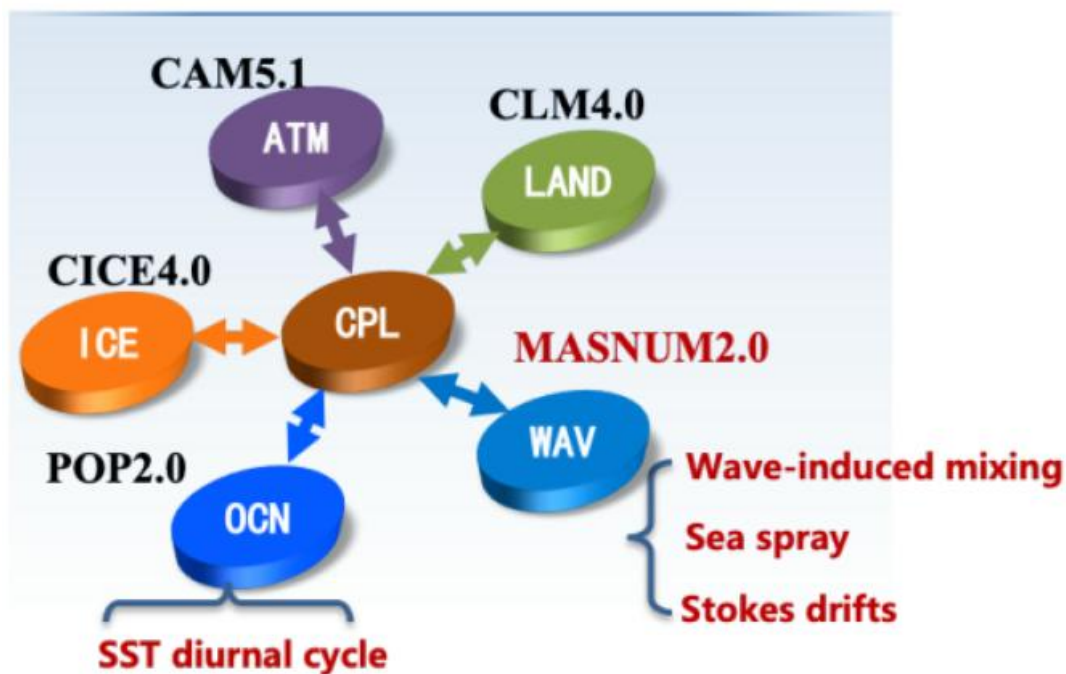
▣ MLD biases reduce from 10.8 m to 1.5 m (86% improvement)

Qiao et al, 2004, GRL; 2010, OD; 2016, RS

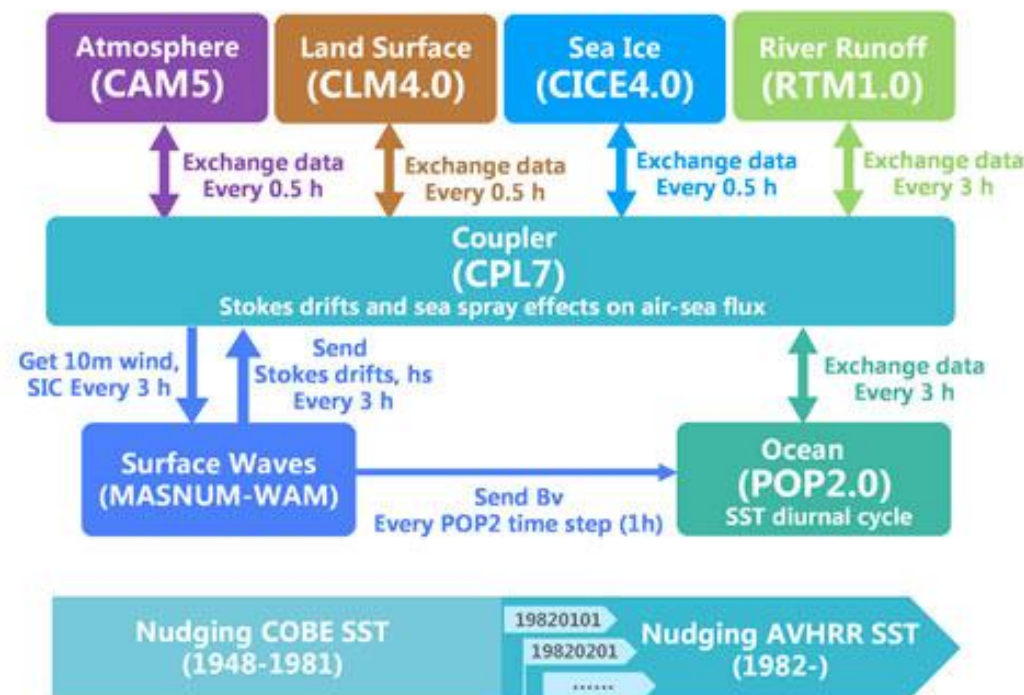
2. Advancing Forecasting Models and Technologies

Earth System Model: From FIO-ESM v2.0 to FIO-CPS

FIO-ESM v2.0



FIO-CPS v2.0

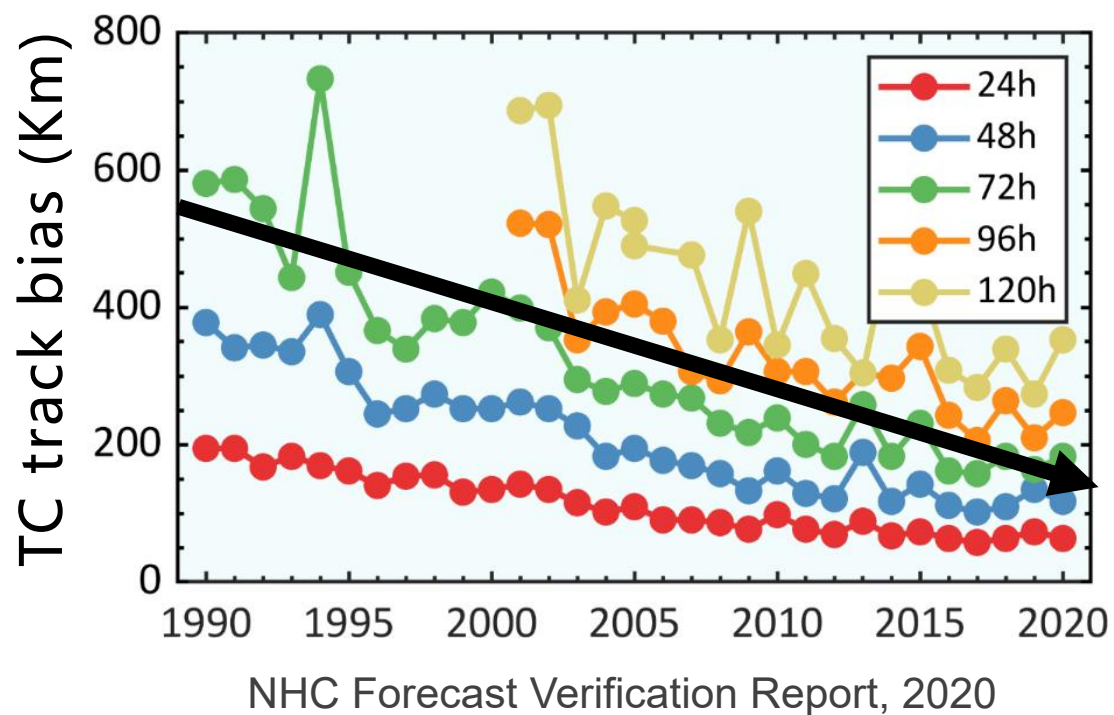


Short-term climate prediction in the coming 13 months.

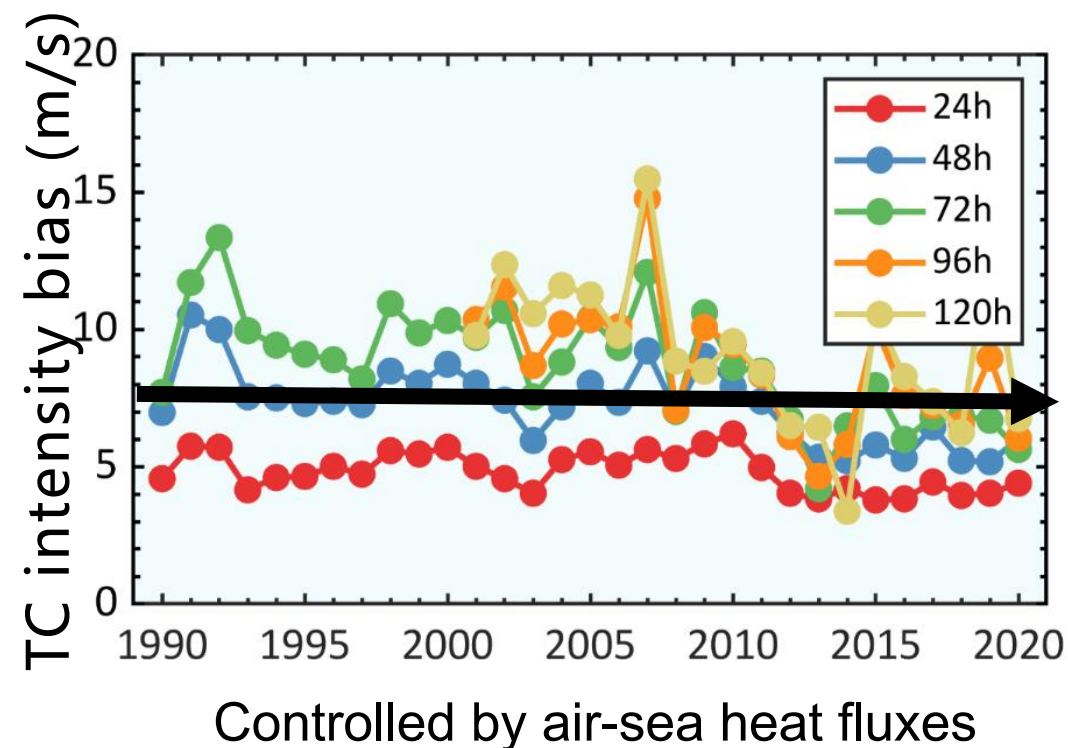
2. Advancing Forecasting Models and Technologies

Typhoon Forecasting Model: FIO-AOW

Typhoon Track

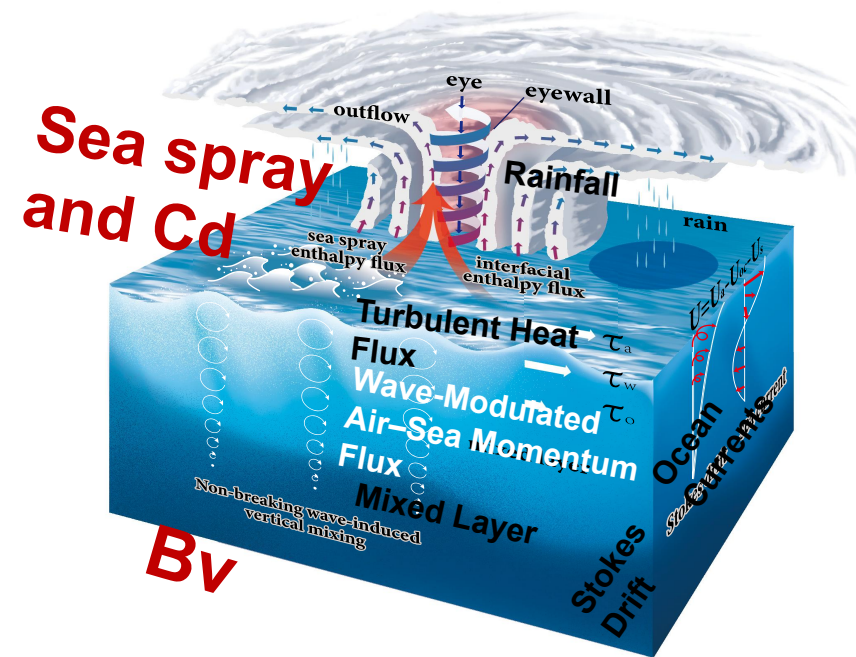
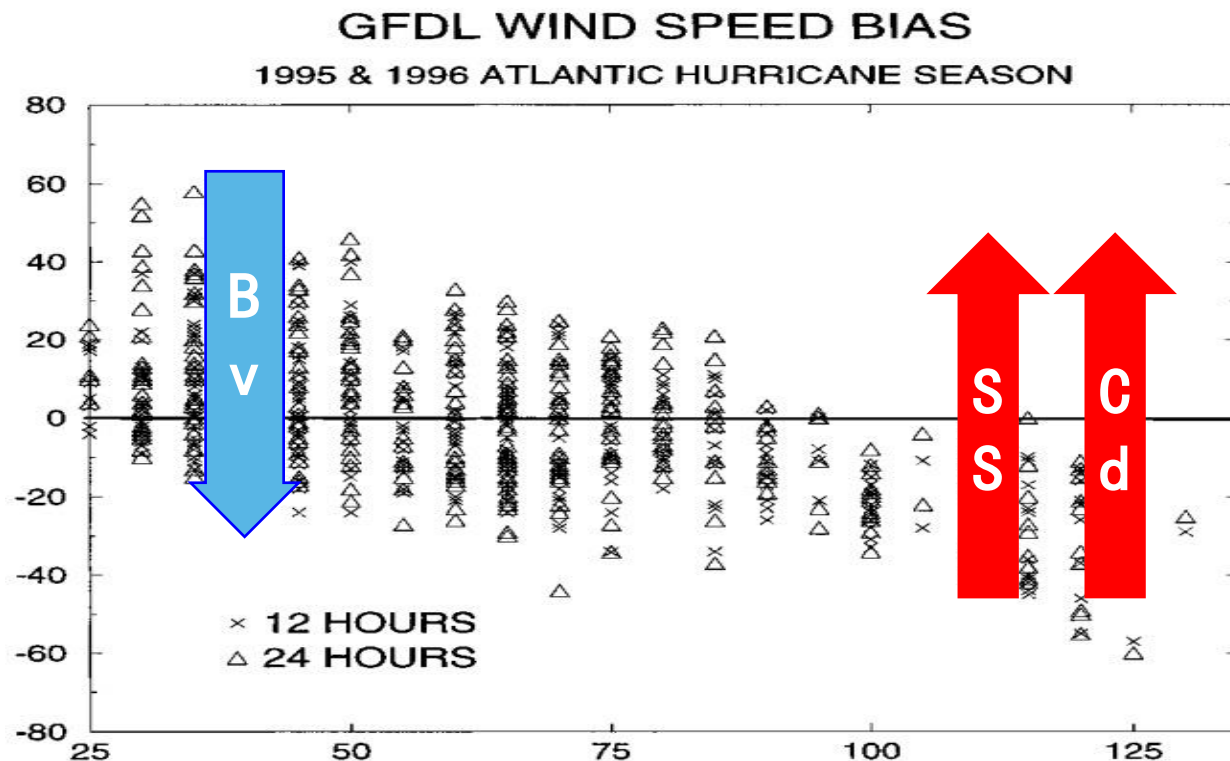


Typhoon intensity



2. Advancing Forecasting Models and Technologies

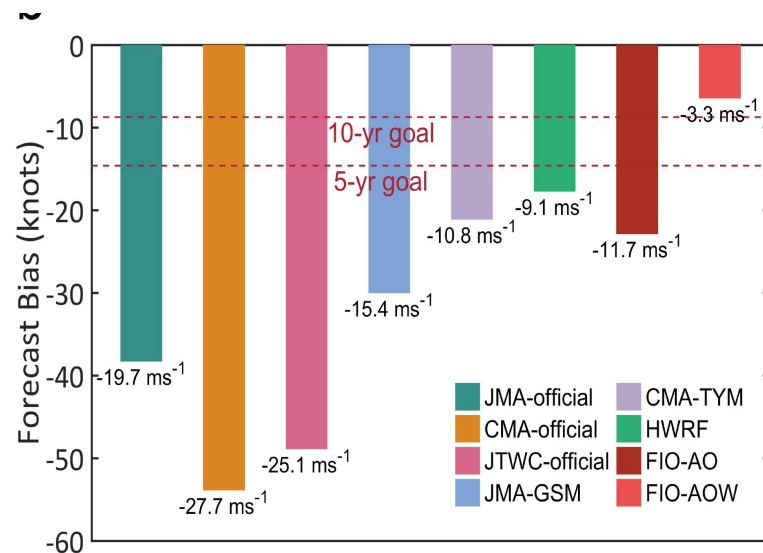
Typhoon Forecasting Model: FIO-AOW



2. Advancing Forecasting Models and Technologies

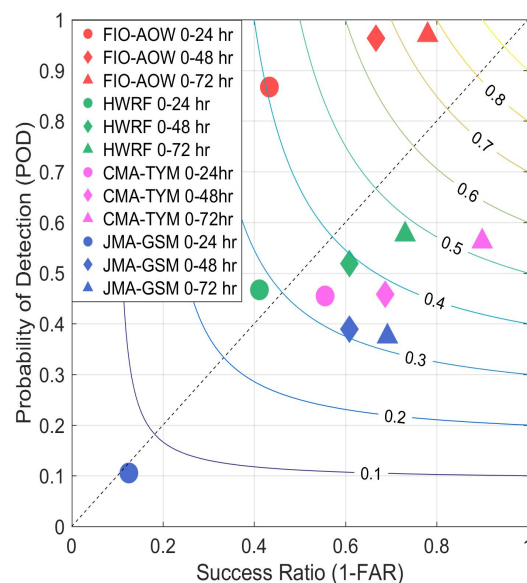
Addressing Three Long-standing Bottlenecks

High Intensity Prediction Bias



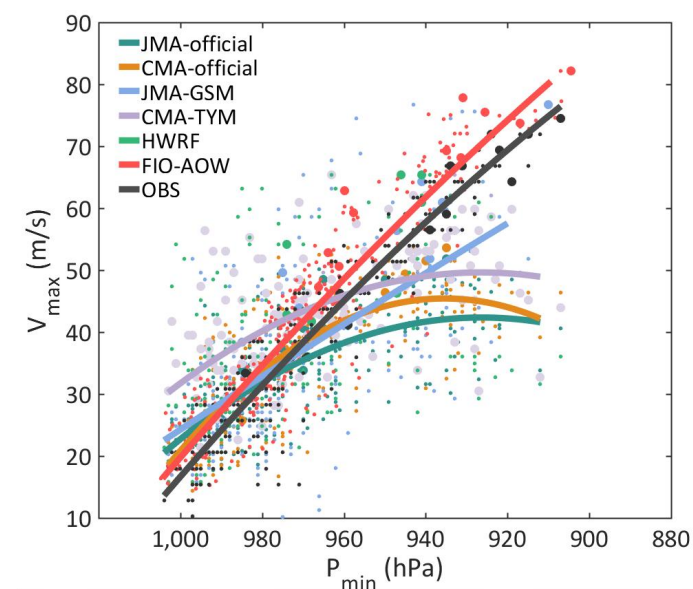
Exceeding Weather Act
Performance Targets

Rapid Intensification (RI) Prediction



>90% RI Detection Rate

Wind–Pressure Relationship



Improved Wind–Pressure
Consistency

3. Demonstration Applications of OSF Products

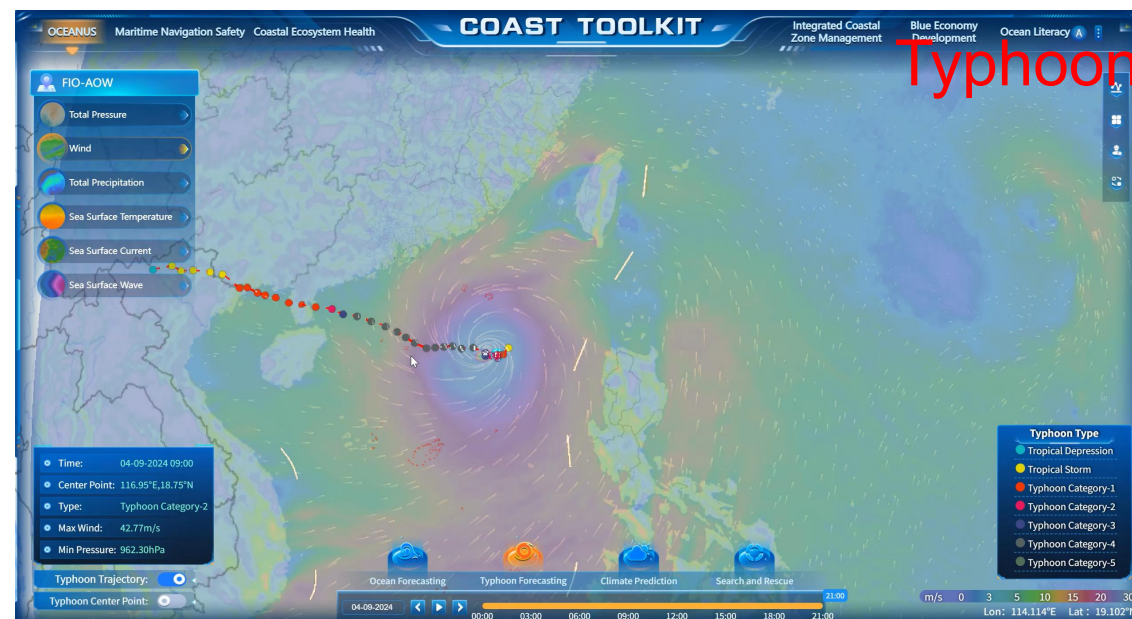
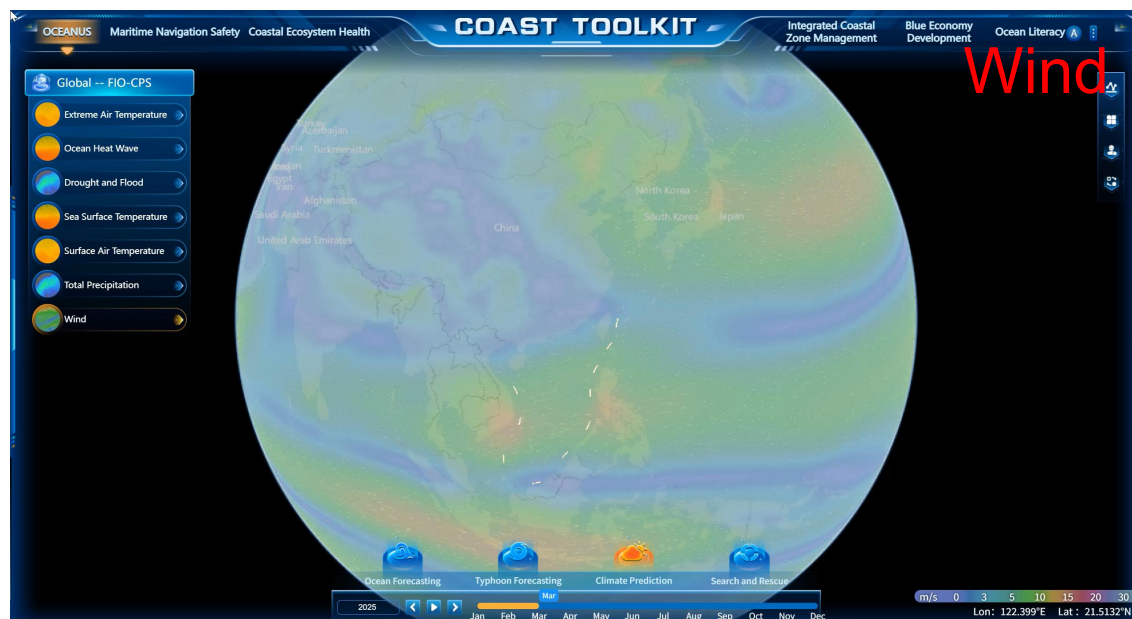
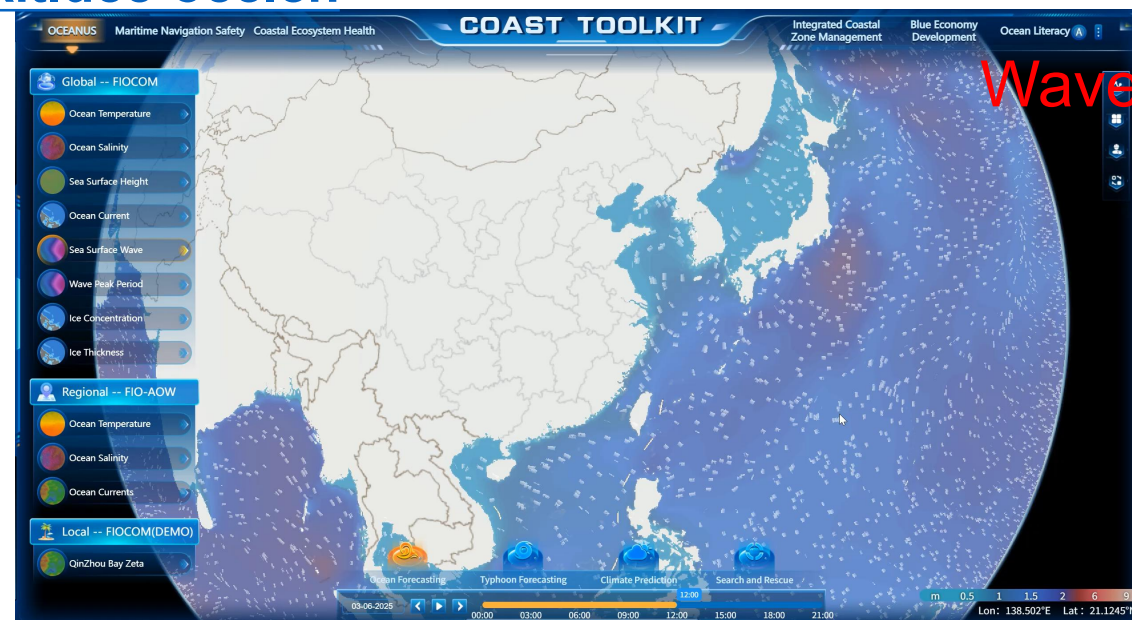
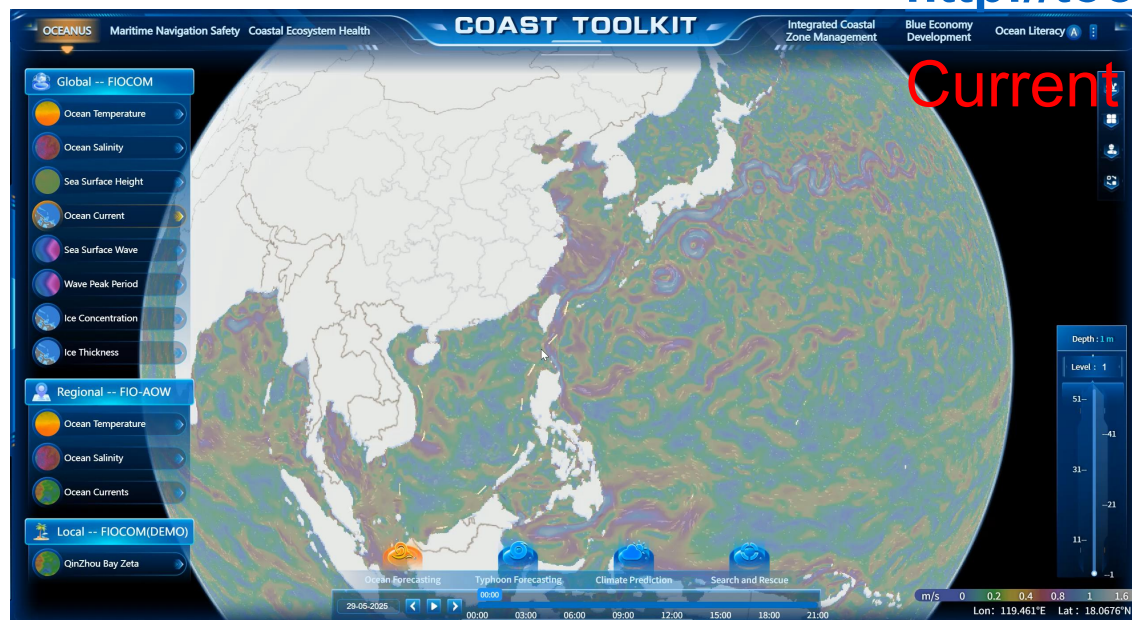
<http://toolkit.dcc-occ.cn>



2021
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Ocean to climate Seamless
Forecasting system



COAST (Coastal city Ocean-based Solution Toolkit for sustainable development) Demonstration Application in Africa

Policy Making

- Coastal Management
- Disaster risk reduction
- Marine Resource Management
- Sustainable development



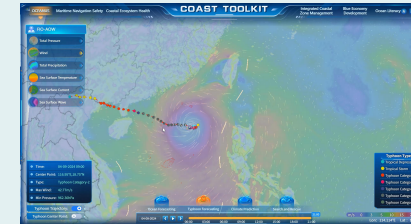
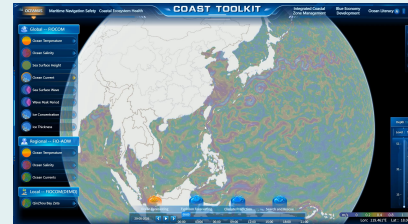
Capacity Building

- Training & workshops
- Technical exchange
- Knowledge sharing
- Community engagement



COAST Toolkit

- Data integration and management
- Modelling and analysis tools
- User-friendly applications



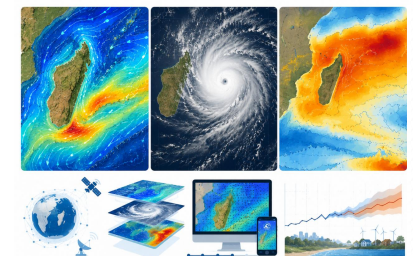
Observation

GNSS-based *in-situ* observation around Madagascar waters



Forecasting

- Ocean forecasting
- Tropical cyclone
- Climate projection



3. Demonstration Applications of OSF Products



COAST Demonstration Application in Africa Project

Under the Global Development and South-South Cooperation Fund
Coastal city Ocean-bAsed Solution Toolkit for Sustainable Development (COAST)



FUNDING & APPROVAL



Approved by China International Development Cooperation Agency (CIDCA) in January 2026 under the Global Development and South-South Cooperation Fund

Total Funding Amount
USD 3.9852 million

PROJECT OVERVIEW



Implemented under the framework of the United Nations Decade of Ocean Science for Sustainable Development



UNESCO and CIDCA will sign the implementation agreement

Focus Country:
Madagascar



PROJECT OBJECTIVE

Strengthen Madagascar's capacity to respond to climate change, sea-level rise, and marine hazards through demand-driven ocean and coastal decision-support tools.



Climate Change
Adaptation



Disaster Risk
Reduction



Sustainable
Development

KEY ACTIVITIES



Enhance coastal
observation networks



Improve marine data
integration



Support application of the
COAST Toolkit for coastal
resilience planning



EXPECTED OUTCOMES



Support the development of Sustainable Ocean Plans (SOPs)



Reduce risks from coastal disasters



Promote ocean-based solutions for sustainable economic development



Strengthen resilience and support the sustainable use of marine resources



Contribute to the long-term development of ocean-based industries in Madagascar



Generate broader regional benefits aligned with the priorities of the UN Ocean Decade in Africa



4. Capacity Development and Global Outreach



2021
2030 United Nations Decade
of Ocean Science
for Sustainable Development



Ocean to climate Seamless
Forecasting system



2025 UN Ocean Conference



Participated in organizing the side event “Toolkits: Bridging Ocean Science and End Users,” where the COAST Toolkit was showcased as a flagship outcome.



COP 30

On 18 November 2025, at the COP30, OSF presented to the global community its wave-induced turbulence theory and the third-generation typhoon modeling framework developed on the basis of this theory.



IOCINDIO-1

Report on “Initiative on Disaster Risk Mitigation and Prevention in the Indian Ocean Region”



BACO-25

OSF Programme successfully convened the session “Ocean and Climate Seamless Forecasting” (JPM03).

4. Capacity Development and Global Outreach



From April to June 2025, Dr. Leonardo Bachá from the Federal University of Rio de Janeiro (UFRJ), Brazil, completed a short-term internship at the OSF Programme Office.



Capacity Development

- GNSS buoy deployment and maintenance
- Testing of the OCEANUS early warning system
- Numerical modeling and data analysis



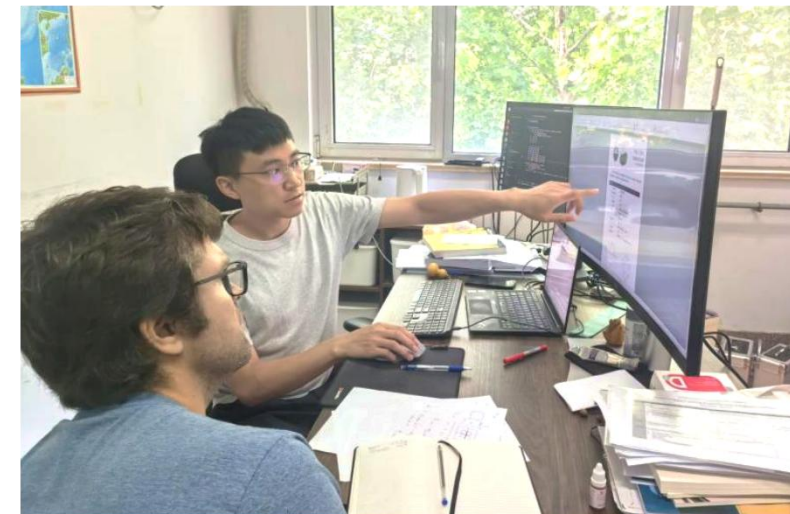
Outcome-Oriented Applications

- Development of a coral reef monitoring and early warning system for Brazilian waters
- Deployment planning for buoy observation systems in Brazilian waters



Support Mechanisms

- Supported by China International Young Talents Exchange Programme

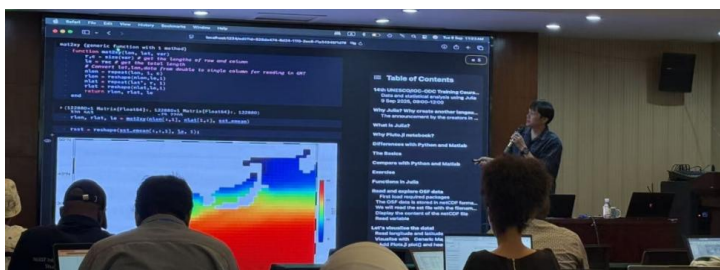


Dr. Bachá exchanged research experiences with members of the OSF Programme Office

4. Capacity Development and Global Outreach

Professional Capacity Development

- ODC Centre Training
- Lectures delivered by OSF project Co-PI



Dr. Wee Cheah, Co-PI of OSF-affiliated project, delivered lectures during the 14th ODC Centre Training Session.



Financial support for participating trainees was secured through the CEP Program.

Professional and Career Development

- OSF Co-PI provided specialized training and mentoring



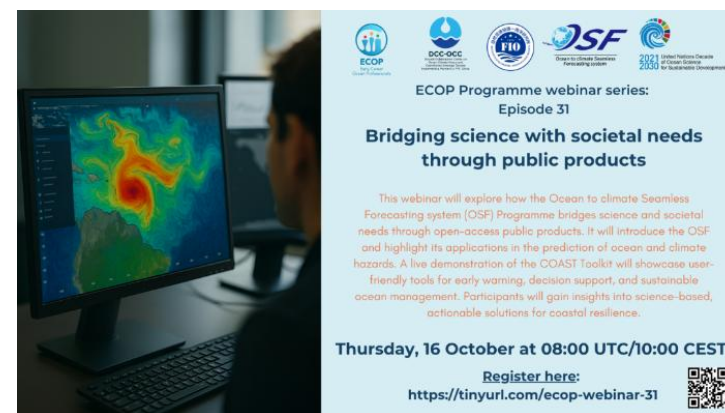
Workshop on "Academic Writing and International Collaboration" was organized during the ODC training

- 18 countries
- 35 trainees



Interdisciplinary Capacity Building

- Collaboration with ECOP
- From Scientific Outcomes to Public Products



OSF and ECOP Programme jointly organized the webinar: "Bridging Science with Societal Needs through Public Products"



4. Capacity Development and Global Outreach



Peter Thomson • Following
UN Secretary General's Special Envoy for the Ocean
6h •

In Qingdao this morning, a wonderful statement was read out by these representatives of the World Association of Young Scientists, in cooperation with the UN Decade Collaborative Centre on Ocean-Climate Nexus Coordination.

"The Ocean connects the world, and young people shape the future! Let us join hands to protect the ocean, empower the future, build a blue partnership, and work together to create a thriving blue planet where all life flourishes." [United Nations Department of Economic and Social Affairs](#)
[Friends of Ocean Action World Economic Forum UNESCO Ocean Vidar Helgesen](#)



9



At 2025 Global Ocean Development Forum, five young scholars invited by OSF, from Bangladesh, Togo, Russia, Brazil and China, jointly released Qingdao Declaration of Young Ocean Talents. They each delivered their pledge in their native language, demonstrating the shared determination of global youth to protect the ocean together.

4. Capacity Development and Global Outreach

2023

Foundation: Building Trust Through Scientific Exchange

On 28 September 2023, Togolese young scientist Dr. Mathé Ablodévi Jean-Paul Attiglah participated in the First General Assembly of the OSF Programme.



2024

Key Stage: Deep Youth Engagement as a “Connector”

From July to September 2024, Dr. Mathé completed a three-month internship at the OSF Programme Office.



2025

Transformation: From Individual Development to Institutional Cooperation

On 7 September 2025, FIO and the University of Lomé signed a Memorandum of Understanding on cooperation.



Scaling Up: Government-Level Engagement

From 20 to 22 October 2025, an OSF delegation visited Togo. Dr. Mathé participated in bilateral discussions and joined the China–Togo field survey and site assessment activities.



Empowering Regional Cooperation Through Youth: The Spillover Effects of OSF Capacity Building

SeaForAll Initiative



International Ocean Climate **Seamless Forecasting Alliance** (SeaForAll)



An international, academic and non-profit organization.



Professionals and organizations in the field of marine and climate prediction and forecasting worldwide.



Make technological breakthroughs in seamless forecasting, providing science-based solutions to disaster prevention and mitigation

Leading Scientists



**President
Xueshun Shen**

Academician of Chinese Academy of Engineering, Deputy Director of the Earth System Numerical Prediction Center of the China Meteorological Administration

Leading Scientist of numerical modelling



**Secretary-General
Fangli Qiao**

Member of the European Academy of Sciences, Professor at FIO

Dedicated over 30 years to the research and development of seamless numerical models for the ocean and climate

VP: Mauro Cirano, Professor at UFRJ.



VP: Joel Hirschi, Principal Research Scientist at National Oceanography Centre, UK.



VP: Kouadio Affian, Chair of IOCAFRICA.



VP: Alexander Babanin, Professor at the University of Melbourne.

Scope of Work



Evaluate and analyze the trends of the international seamless forecasting, conduct cutting-edge research and innovation, organize international meetings.



Oversee the implementation of UN Ocean Decade OSF Programme.



Develop and promote public products, and provide ocean-based solutions for climate change.



Organize international trainings and workshops to empower young professionals.



Provide technological consultation and offer technological support for relevant decision-making in international ocean governance.



Set up benchmarks for global seamless forecasting development.



Publish international journals on seamless forecasting.



Carry out lectures and exhibitions for ocean-climate literacy.



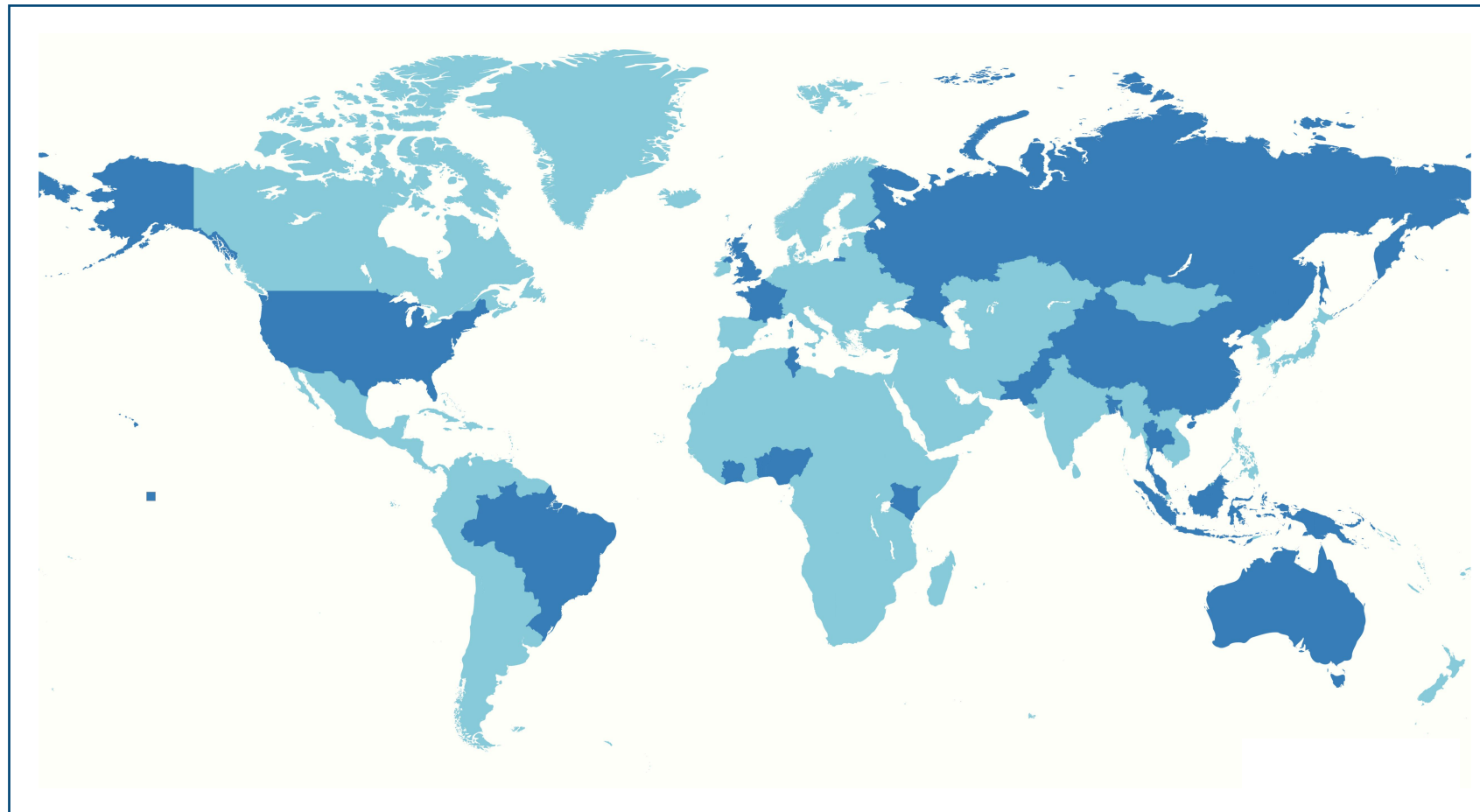
Establish and maintain a data-sharing platform to promote information exchange and sharing within the field.



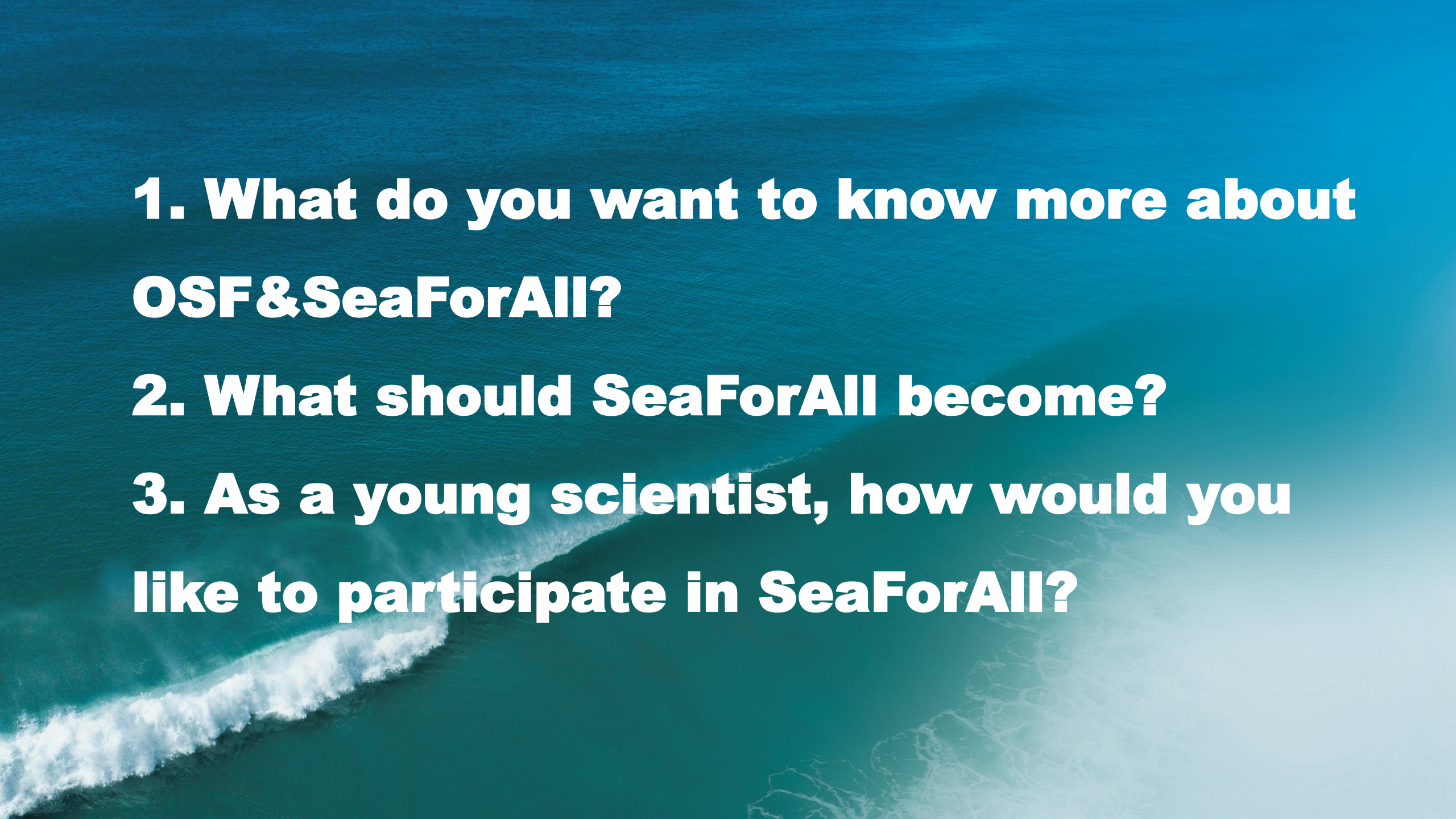
Actively participate in global marine governance and UN-related affairs.

Founding Members

21 Countries
20 organizations
50 Individuals



osf@fio.org.cn



1. What do you want to know more about OSF&SeaForAll?

2. What should SeaForAll become?

3. As a young scientist, how would you like to participate in SeaForAll?