Ocean Forecast System (OFS)

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FIO of China, UMT of Malaysia

Summary Outline

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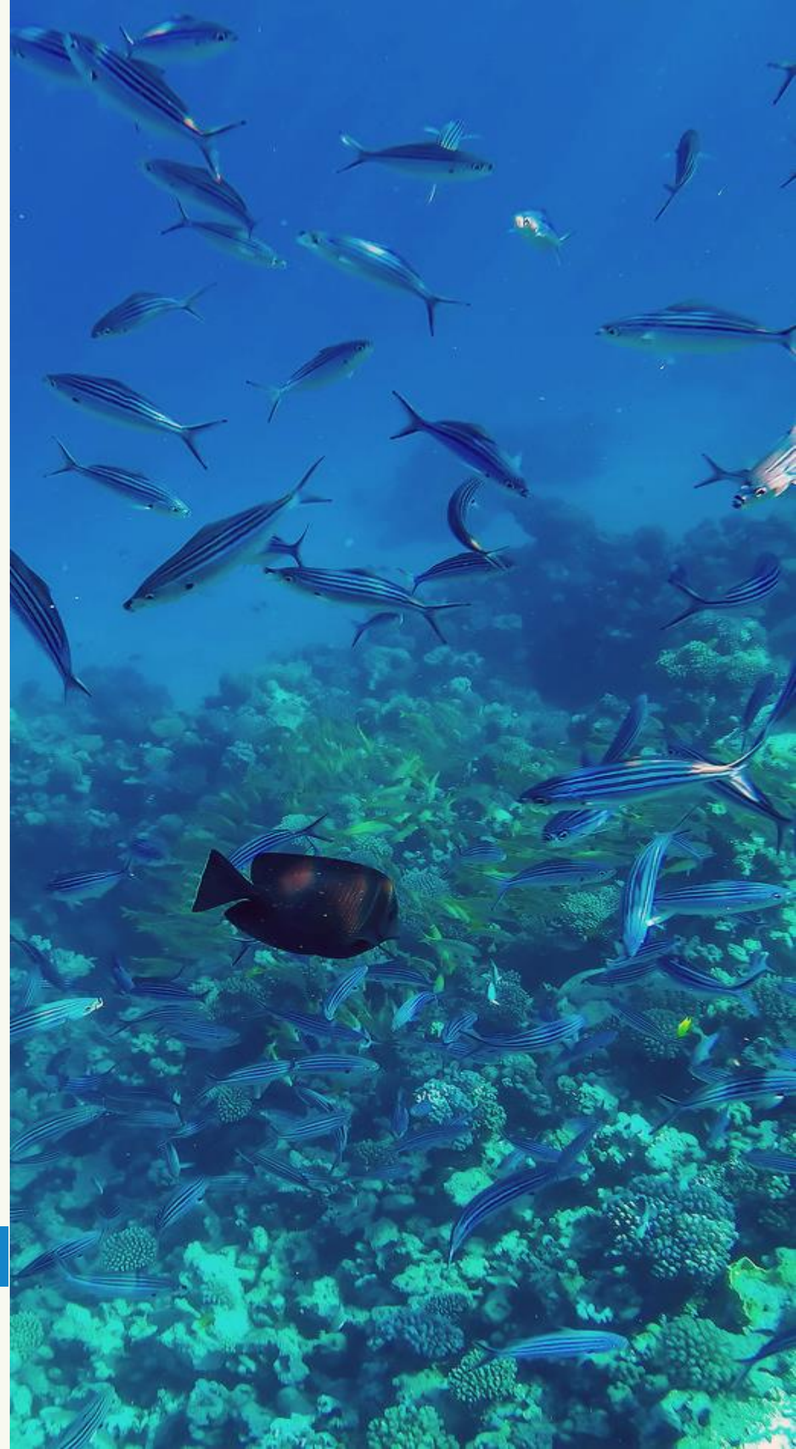
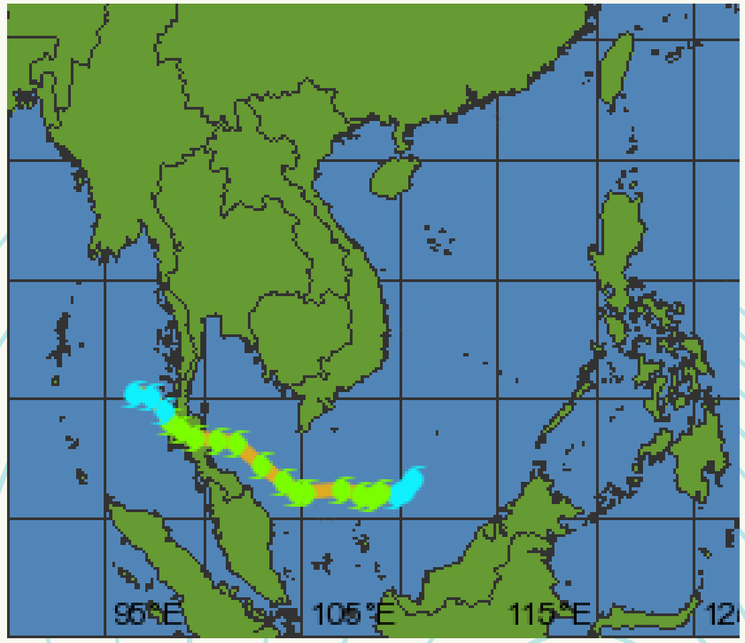


1. Justification

(Why this programme/project/working group is needed for the Sub-Commission)

The South-east Asian regions have been strongly affected by different ocean hazards, no operational OFS in this area before this project started in 2010. Ocean Forecasting System (OFS) program is planned to develop an operational ocean forecasting system for the entire Southeast Asia region and its adjacent seas, and demonstrate the value of this system through its applications to scientific research and ocean management, resources exploitation, reduction and prevention of the impacts of natural hazards, mitigation of the impact and adaptation to climate change and variability.



2. Objectives

- Establishing a regional ocean forecasting system with higher resolution model for the geographic coverage;
- Establishing several pilot ocean-forecasting systems for selected subdomains;
- Improving the application of OFS to scientific research and ocean governance;
- Enhancing regional and national capacity for ocean modeling development, data assimilation, and model validation.

Timeframe

Project start year: 2010

3. Major activities, outputs & outcomes

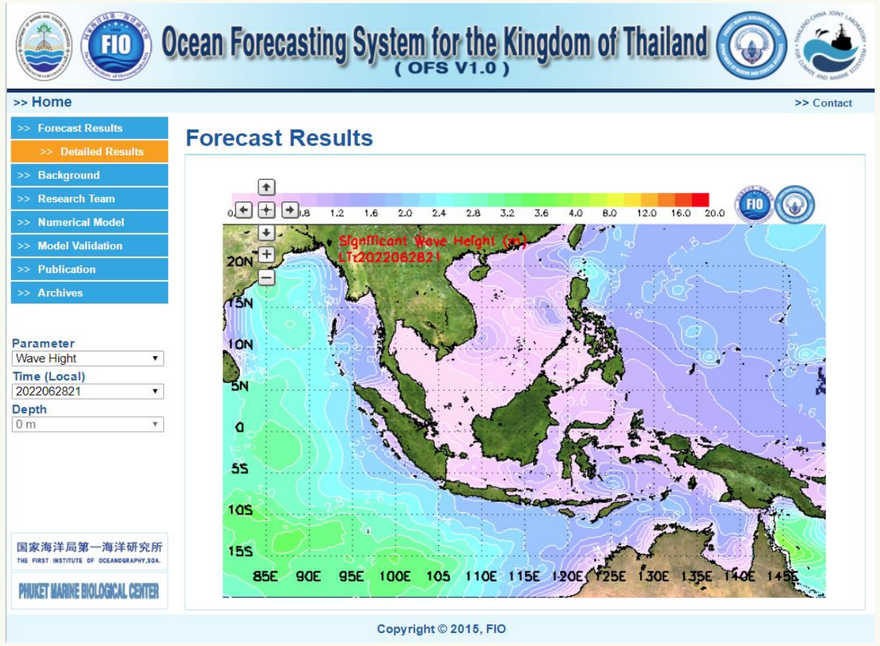
Latest accomplishment, particular those during 2023 to 2024

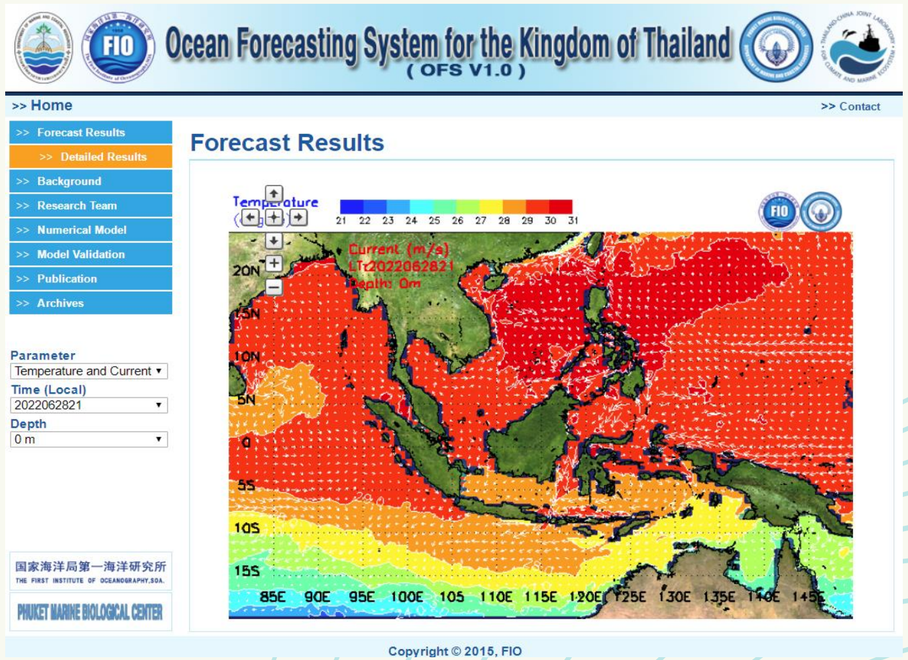
- Provide support for 2 (Thailand and Malaysia) regional OFS systems;
- Provide forecasting for tracking oil spill in Thailand in August 2023
- Developing the Southeast Asian Maritime Emergency Response System
- Developing the coral reef early warning system;
- Study on the circulation in GoT and its water exchange with the SCS
- Data collection and Analysis;
- Based on this OFS program, to initiate and implement the UN Ocean Decade Programme OSF;
- Organize the 12th and 13th ODC training courses.

3. Major activities, outputs & outcomes

Latest accomplishment, particular those during 2023 to 2024

- Provide operational support for Thailand regional OFS





Forecast Wave height , temperature and current product of Thailand regional OFS
http://61.19.77.149/thailand/results.jsp

3. Major activities, outputs & outcomes

Latest accomplishment, particular those during 2023 to 2024

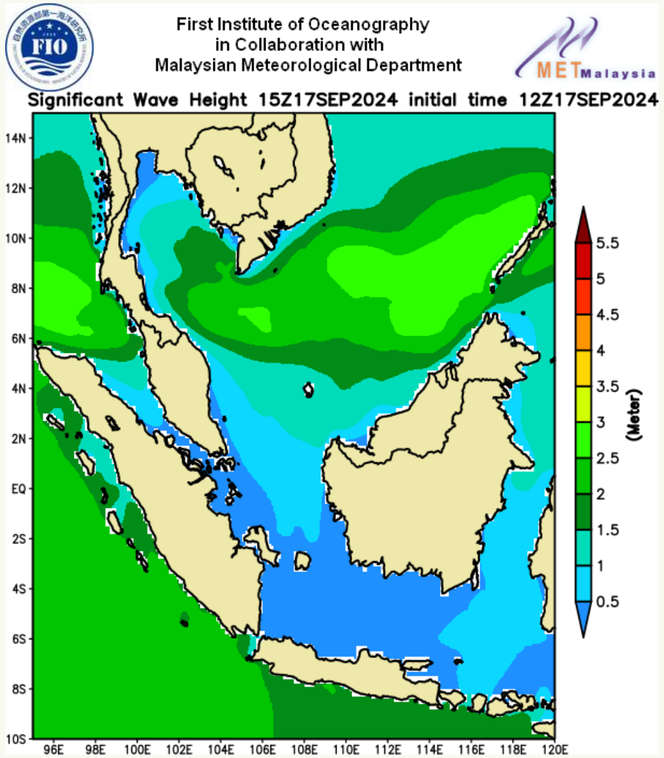
- **Provide operational support for Thailand regional OFS**

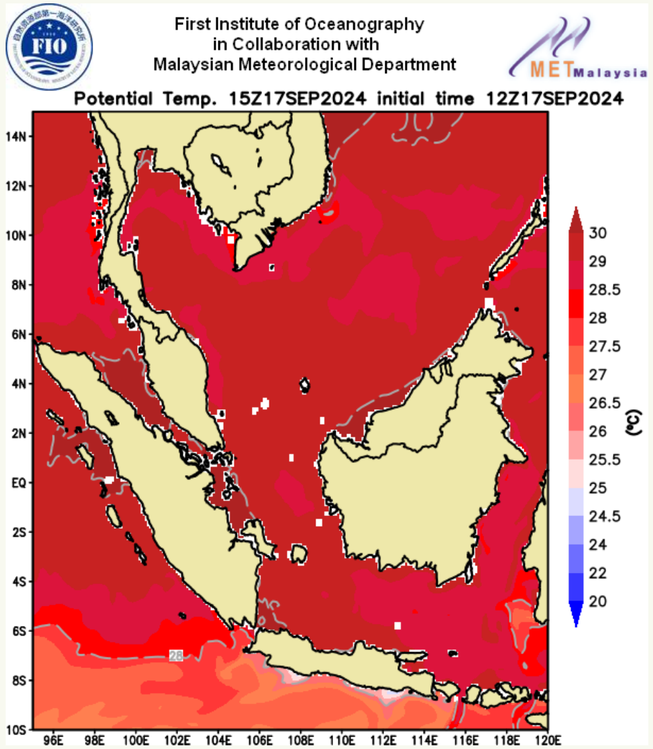
FIO team and PMBC team discuss OFS project progress and install the oil spill model during 6~10 June, 2023 and 24~27June, 2024

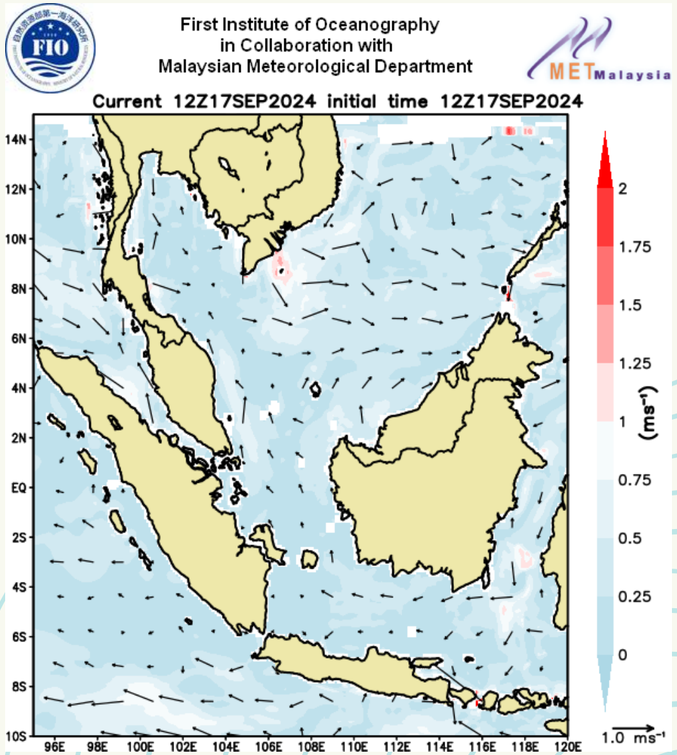
3. Major activities, outputs & outcomes

Latest accomplishment, particular those during 2023 to 2024

- Provide operational support for Malaysia regional OFS







OFS products provided to Malaysia Meteorological Department (MMD)

http://ideas.met.gov.my/MARINE_HTML/marine.html

3. Major activities, outputs & outcomes

Latest accomplishment, particular those during 2023 to 2024

- Provide operational support for Malaysia regional OFS

On March 3-6, 2024, Prof. MOHD FADZIL MOHD AKHIR, Director of Institute of Oceanography and Environment, University Malaysia Terengganu (UMT) visited FIO to discuss further cooperation on OFS development

3. Major activities, outputs & outcomes

Latest accomplishment, particular those during 2023 to 2024

- Provide operational support for Malaysia regional OFS

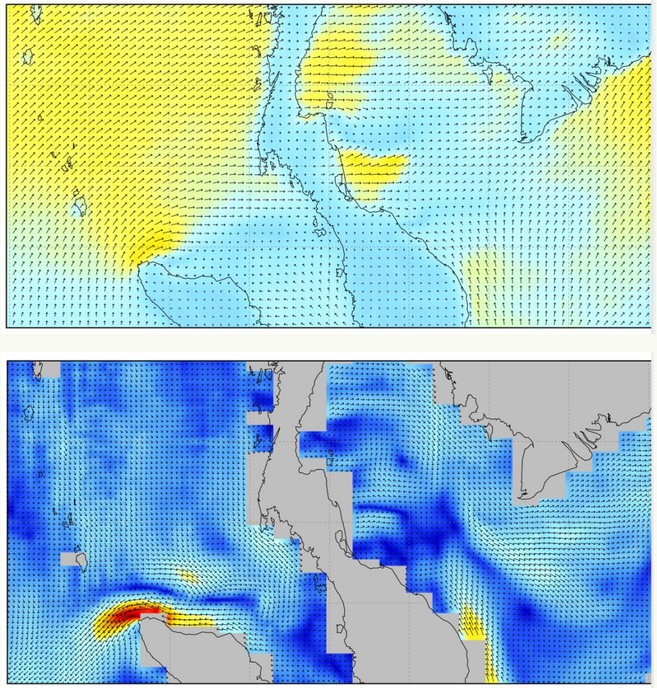
On May 13-16, 2024, Mr. Ambun Dindang, Deputy Director General of the Malaysian Meteorological Department(MMD), and Dr. Diong Jeong visited FIO to express gratitude for our six years of operational support for their national ocean forecasting, and to discuss the joint construction of Malaysia's high-resolution ocean forecasting system

3. Major activities, outputs & outcomes

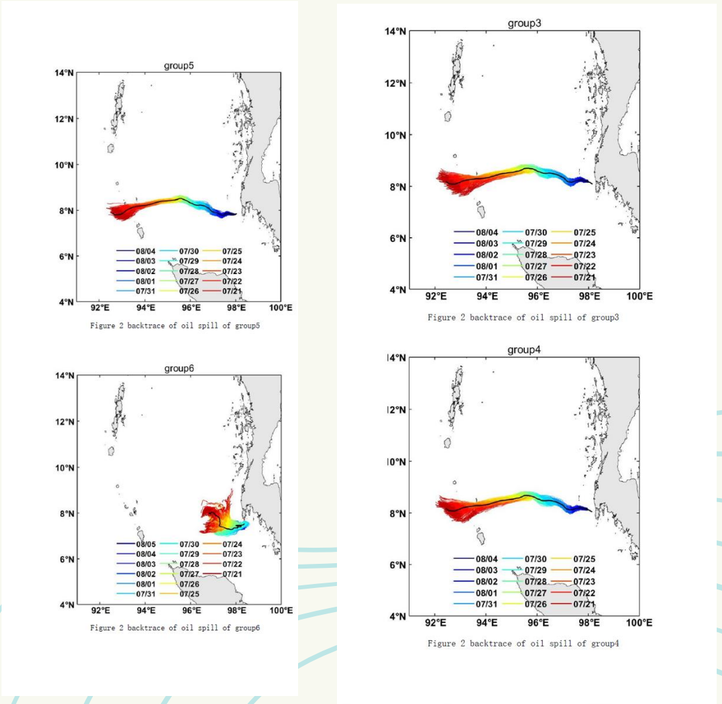
Latest accomplishment, particular those during 2023 to 2024

- Provide forecasting for tracking the oil spill in Thailand in August 2023

In August 2023, there were groups of tarballs landing on Phuket Beaches from north to south. The OFS project traced their trajectory and submit the calculated trajectories in overlap with typical shipping routes, reported to the DMCR of Thailand to identify the source.



Model wind and current field

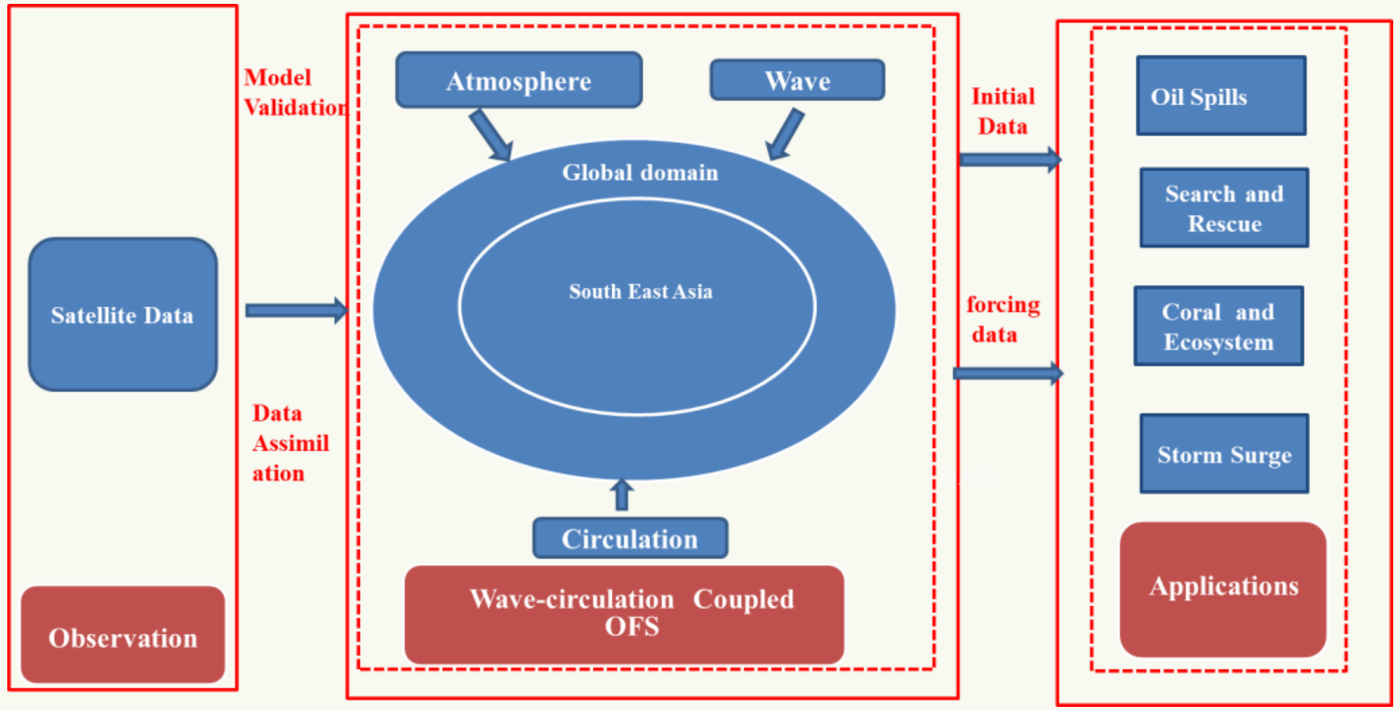


Traced possible trajectory of the oil spill bleached on Phuket Island, Thailand, overlap with typical ship routes

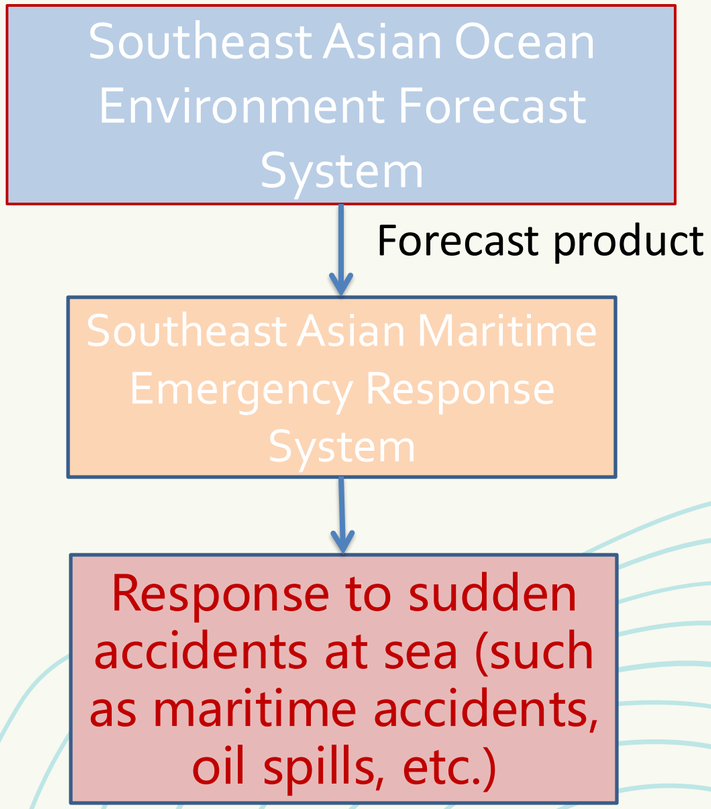
3. Major activities, outputs & outcomes

Latest accomplishment, particular those during 2023 to 2024

- Developing the Southeast Asian Maritime Emergency Response System



Structure Figure of the Ocean Forecast and Marine Disaster Mitigation System for Southeast Asia Areas



Flow chart of the Southeast Asian Maritime Emergency System

3. Major activities, outputs & outcomes

Latest accomplishment, particular those during 2023 to 2024

- Developing the Southeast Asian Maritime Emergency Response System

User Interface of the Southeast Asian Maritime Emergency System-

Maritime Accidents Forecast

User can input the date, location, type of drifter, then the system can forecast the trajectory

User Interface of the Southeast Asian Maritime Emergency System-

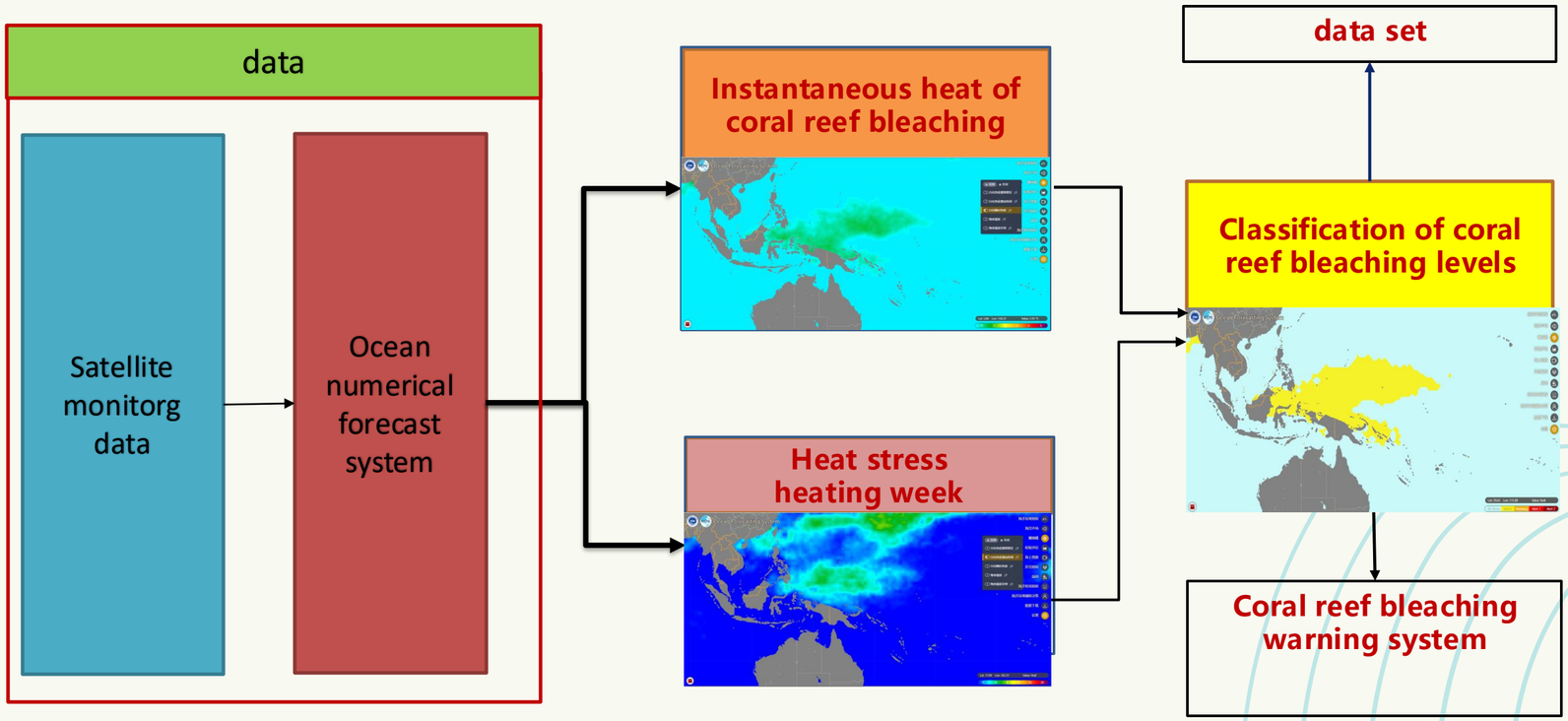
Oil spill forecast

User can input the date, location, type and amount of oil spill , then the system can forecast the oil path

3. Major activities, outputs & outcomes

Latest accomplishment, particular those during 2023 to 2024

- Developing the Southeast Asian coral reef early warning system

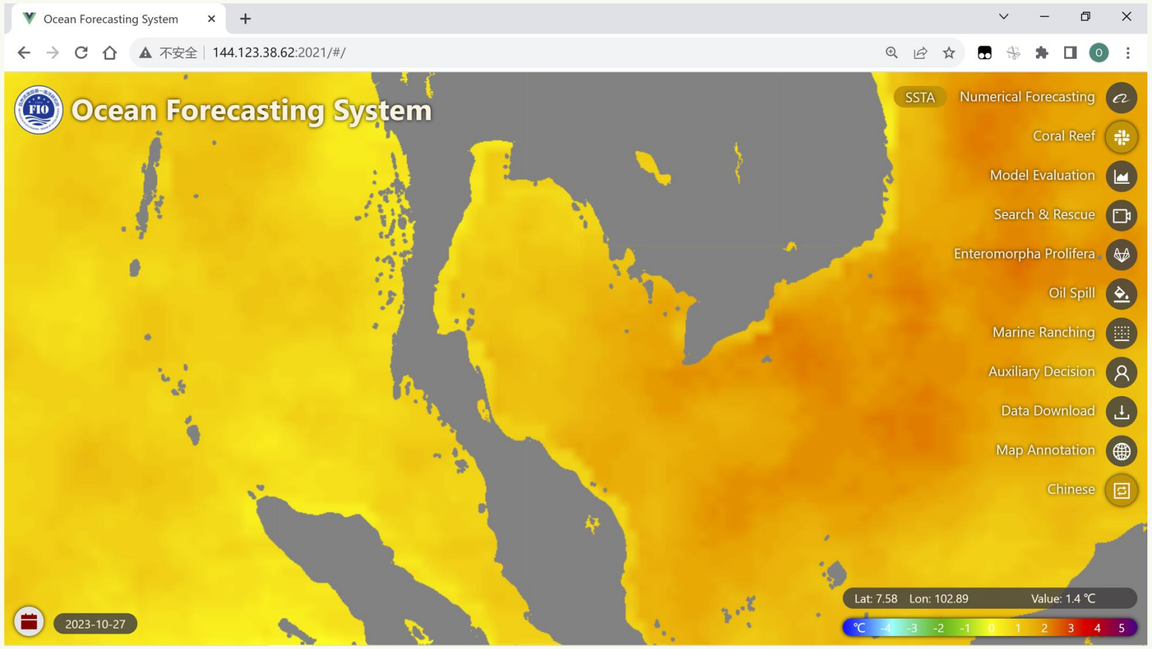


Flow chart of then coral reef bleaching warning system

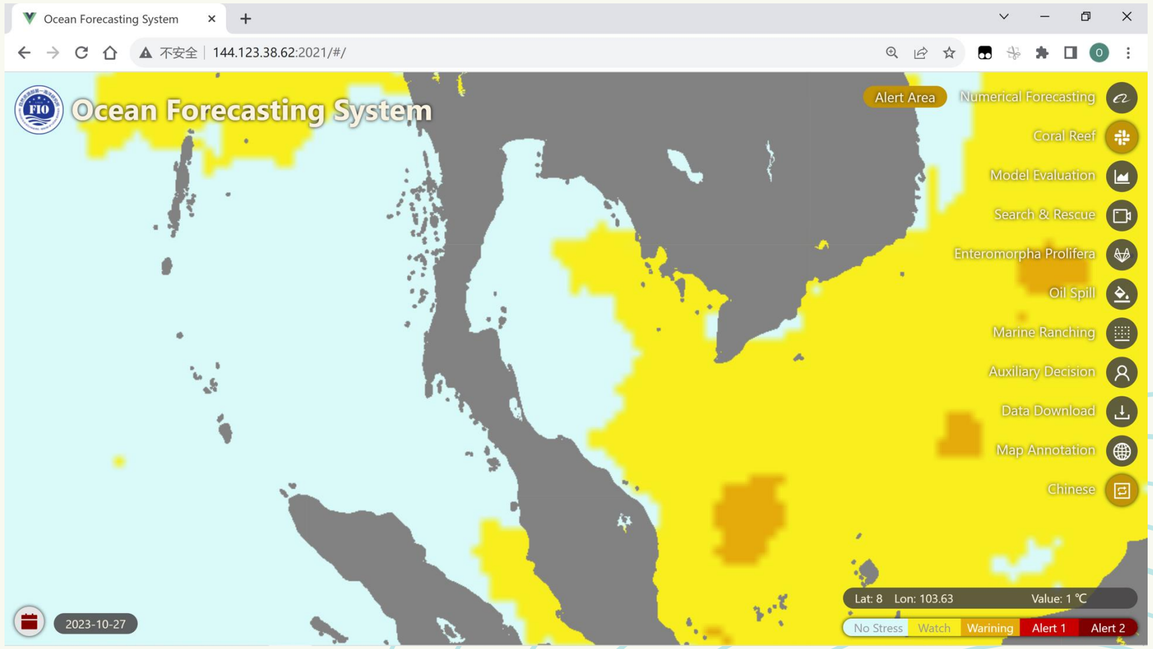
3. Major activities, outputs & outcomes

Latest accomplishment, particular those during 2023 to 2024

- Developing the Southeast Asian coral reef early warning system



Forecasted SSTA on 27 October, 2023

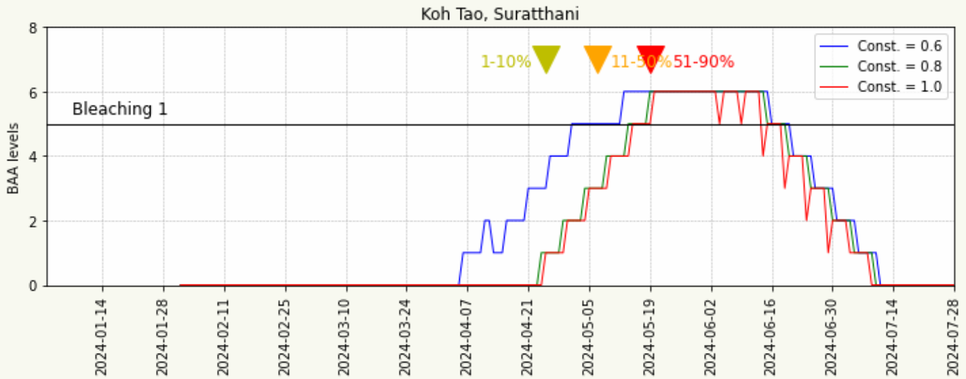


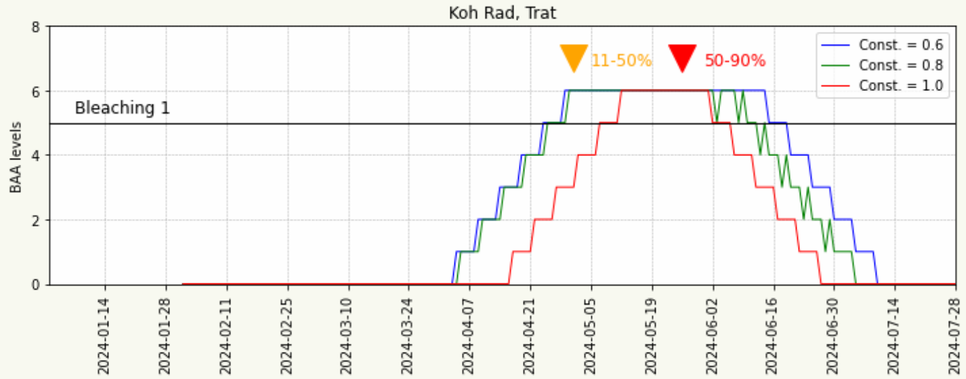
Forecasted coral reef bleaching alert area on 27 October, 2023

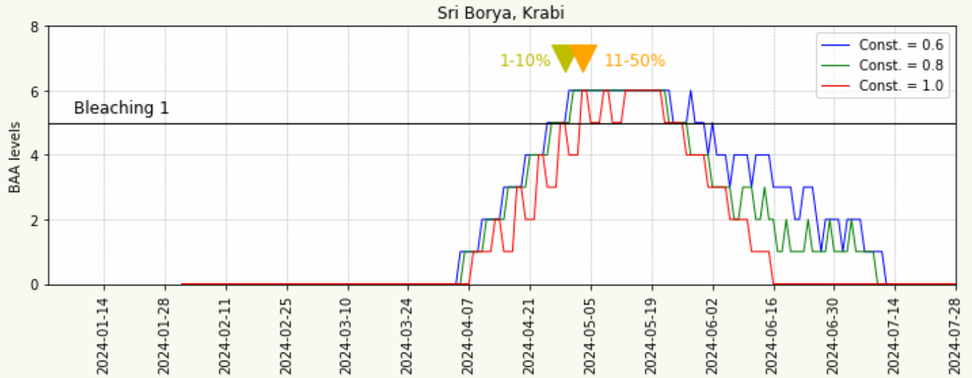
3. Major activities, outputs & outcomes

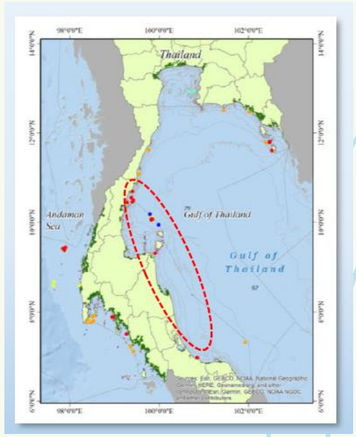
Latest accomplishment, particular those during 2023 to 2024

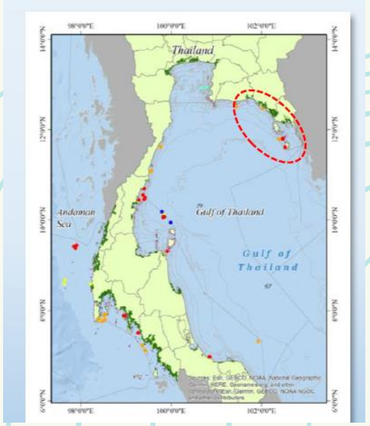
- Coral reef early warning system is already used in Thailand in early 2024

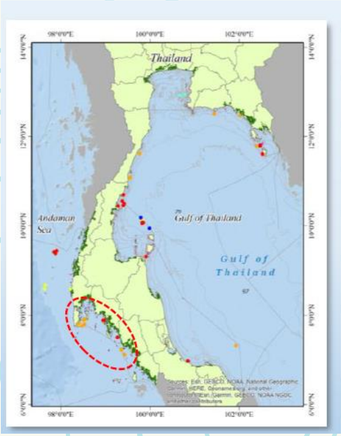










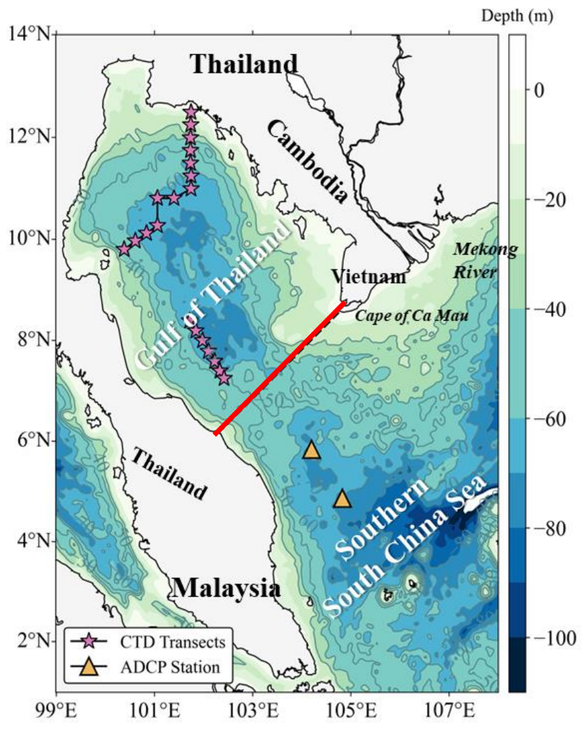


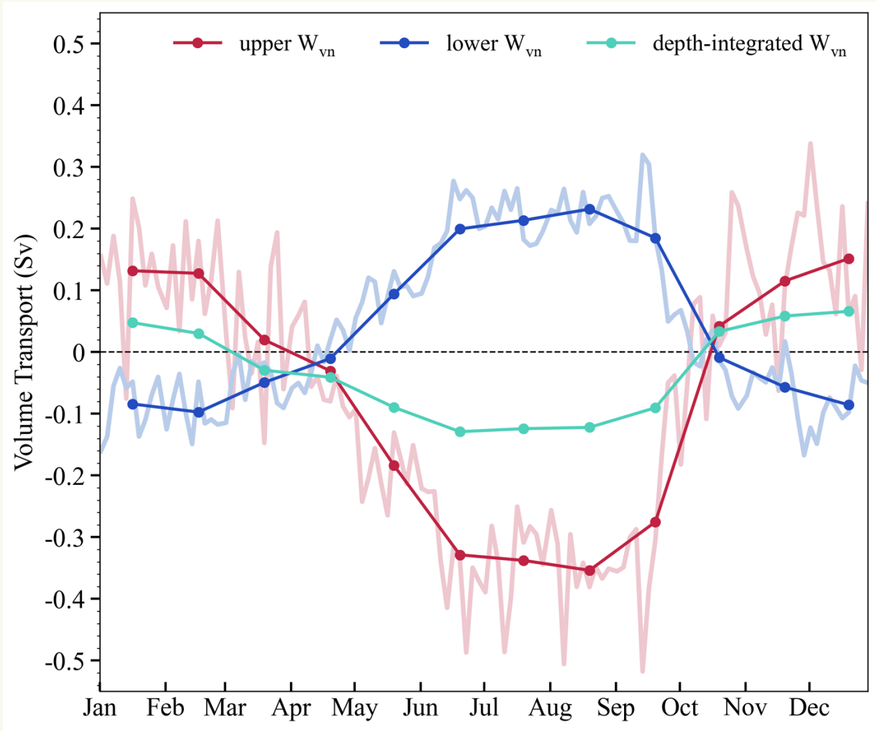
Coral bleaching results on the stations in Southwestern Gulf of Thailand, East Gulf of Thailand and the Andaman Sea in 2024

3. Major activities, outputs & outcomes

Latest accomplishment, particular those during 2023 to 2024

- Study on the circulation in GOT and its water exchange with the SCS





Monthly net flux in the upper layer (red line,0-30m), lower layer (blue, below 30m), and at all depths (green) through the red transect. Positive: out of GOT

3. Major activities, outputs & outcomes

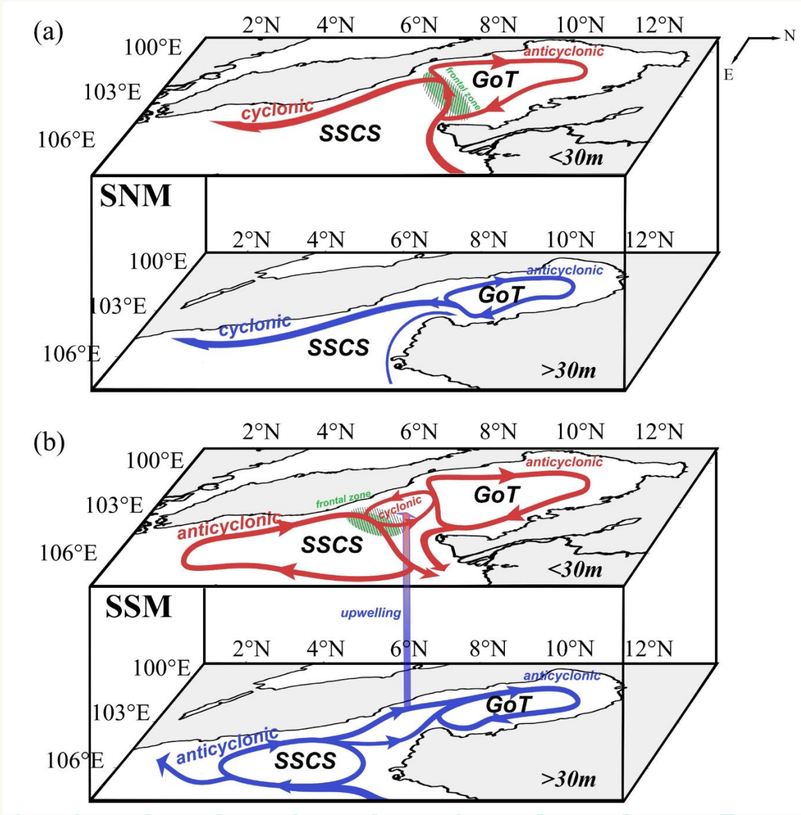
Latest accomplishment, particular those during 2023 to 2024

- **Study on the circulation in GOT and its water exchange with the SCS**

(1) The meridional wind direction in the southern South China Sea is a key factor determining the direction of water exchange between sea areas

(2) During the SNW period (November to the following March):
Water exchange direction: up in and down out,
Circulation structure:
Anticyclonic eddies in GOT vs. cyclonic circulation in SSCS

(3) During the SSW period (April–October)
Water exchange direction: up out and down in,
Circulation structure:
Anticyclonic in GOT vortex vs anticyclonic vortex in SSCS



Schematic of the three-dimensional circulation patterns in the upper layer (red) and lower layer (blue) during the SNW period (upper) and the SSW period (lower).

Wu and Qiao et al., Seasonal circulation and water exchange in the Southern South China Sea and Gulf of Thailand, CSR, 2024 submitted

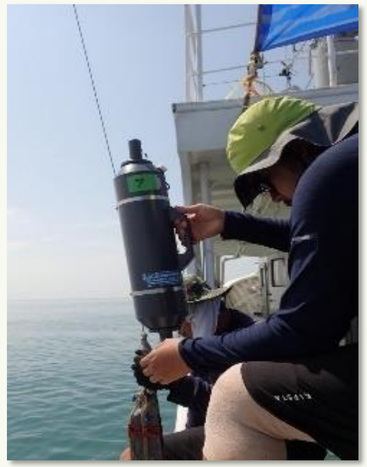
3. Major activities, outputs & outcomes

Latest accomplishment, particular those during 2023 to 2024

- Data collection and Analysis



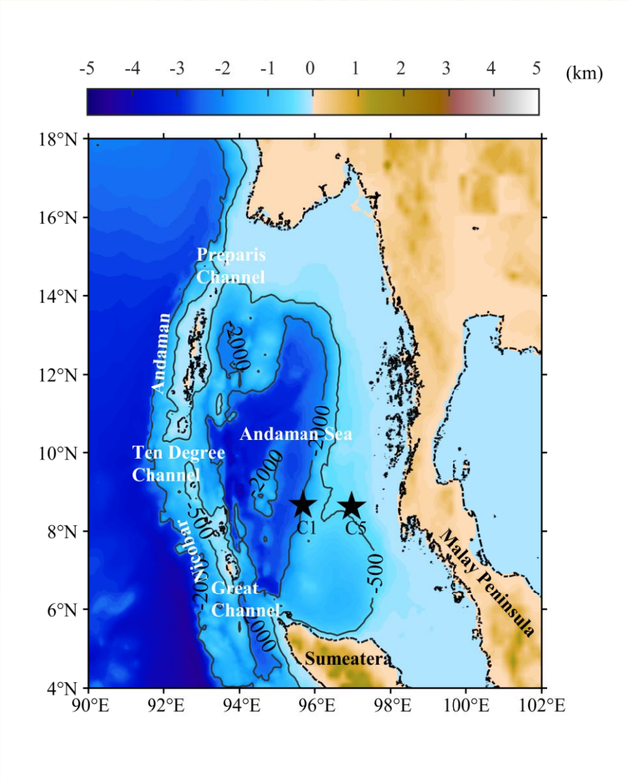


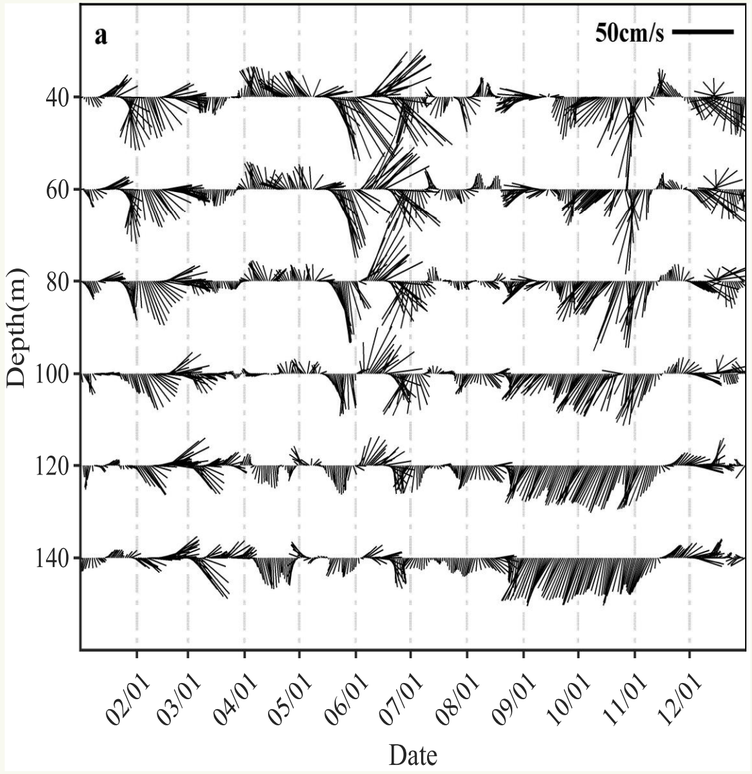
3. Major activities, outputs & outcomes

Latest accomplishment, particular those during 2023 to 2024

- Data collection and Analysis



Mooring systems C1 and C5 in 2017 in the Andaman Sea



Obs. Current at C1 in 2017

- Rapid changes of current speed and direction occurred in May and June , significant increase in current velocity
- Southward flow dominated at the C1 mooring in the second half of the year

Journal of Oceanology and Limnology
Vol. 42, No. 2, pp. 484-491, 2024
https://doi.org/10.1007/s00343-023-2405-1
Research Paper

Current observation and analysis based on mooring systems in the Andaman Sea*

Yimeng WANG[1,3], Jingsong GUO[1,2,3,**], Dapeng QU[1,2,3], Zhixin ZHANG[1,2,3], Chalermrat SANGMANEE[4], Varintha VASINAMEKHIN[5], Binghuo GUO[1]

3. Major activities, outputs & outcomes

Latest accomplishment, particular those during 2023 to 2024

- **Based on this OFS program, to initiate the UN Ocean Decade Programme "Ocean to climate Seamless Forecasting system OSF".**

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

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

Again, on behalf of the entire Ocean Decade Team, please accept my heartfelt congratulations on the endorsement of your Decade Action. Together, let us work towards the ocean we want!

Sincerely,

Vladimir Ryabinin
Executive Secretary, IOC

Based on this OFS program, to initiate the UN Ocean Decade Program Ocean to climate Seamless Forecasting system (OSF),OSF was approved in June 2022

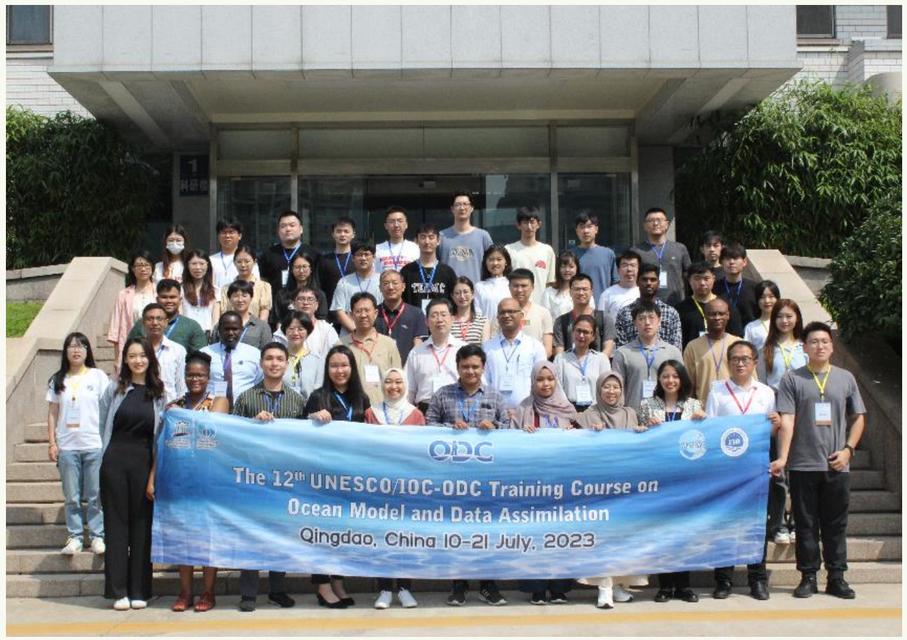
The Ocean to climate Seamless Forecasting system (OSF) Program

1st General Assembly, 27-28 September 2023 in Qingdao

3. Major activities, outputs & outcomes

Latest accomplishment, particular those during 2023 to 2024

- Organize the 12th and 13th ODC training courses;



12th training course in July 2023

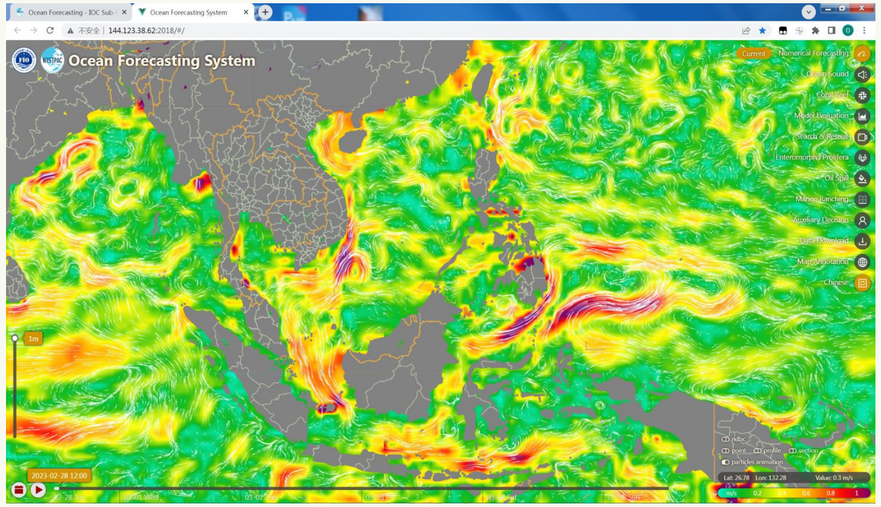
13th training course in July 2024

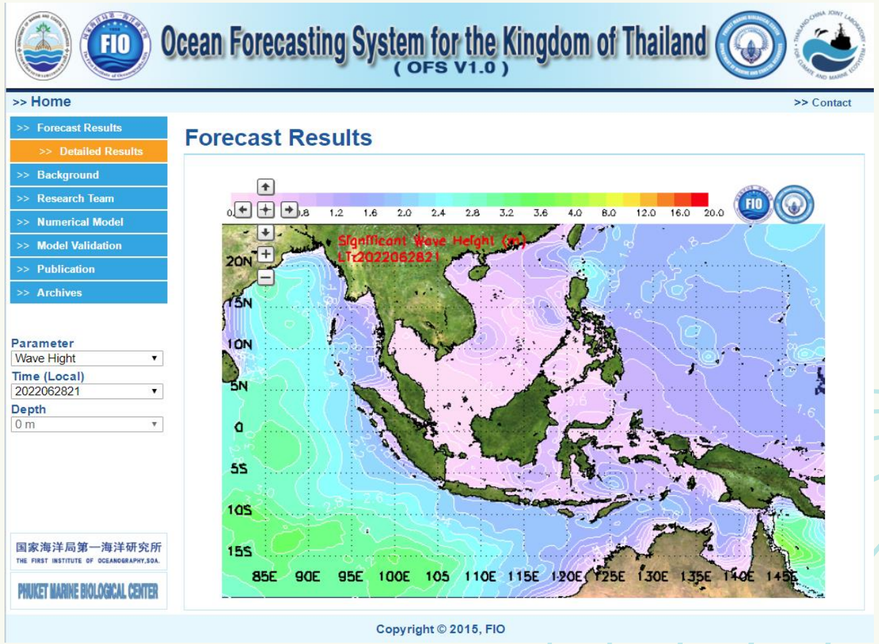
3. Major activities, outputs & outcomes

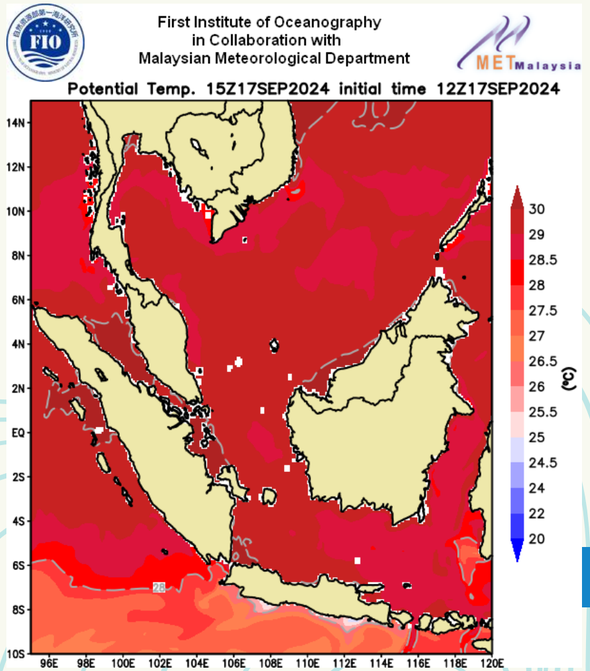
Latest accomplishment, particular those during 2023 to 2024

- **Operational Ocean Forecast Products:**

Significant Wave height , 3-D temperature and current







3. Major activities, outputs & outcomes

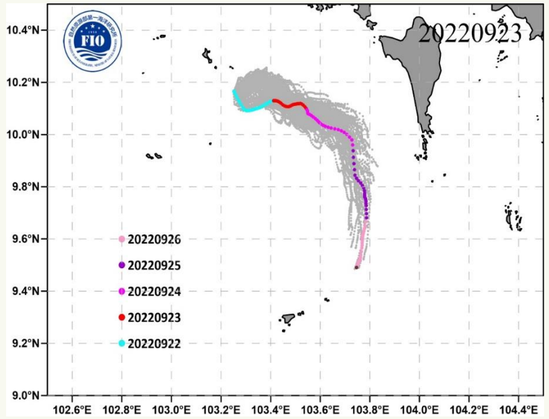
Latest accomplishment, particular those during 2023 to 2024

- Operational **Maritime Emergency System products and services**

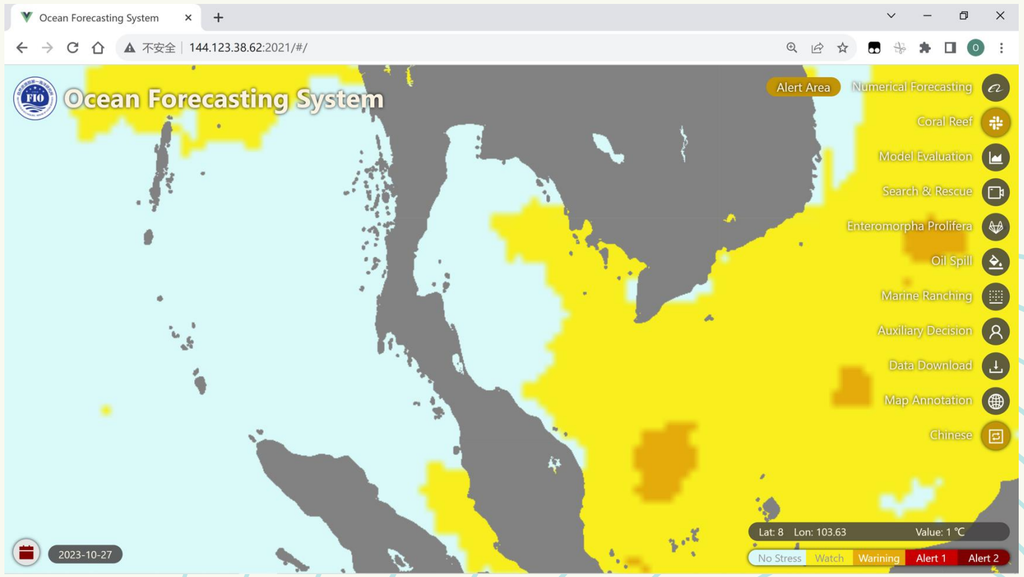
Ocean drift trajectory, oil spill and coral bleaching alert forecast

Shipwreck accident near Sihanouk Port in September 2022, with 23 people missing

photo source: *The Cambodia China Times*



Forecasted key searching area for the missing people



Forecasted coral reef bleaching alert area on 27 October, 2023

3. Major activities, outputs & outcomes

Latest accomplishment, particular those during 2023 to 2024

- **Papers and technical reports:**

- Yimeng WANG, Jingsong GUO, Dapeng QU, Zhixin ZHANG, Chalermrat SANGMANEE, Varintha VASINAMEKHIN, Binghuo GUO, Current Observation and analysis based on mooring systems in the Andaman Sea, 2024, *Journal of Oceanology and Limnology*, 42(2): 484-491.
- Min Zhang, Yangyan Cheng, Haoyu Zhang, Chuanjiang Huang, Gang Wang, Chang Zhao, Yuanling Zhang, Qinghua Yang, Zhengya Song, Fangli Qiao, Spatiotemporal variability of air–sea CO2 fluxes in response to marine heatwaves in the tropical Pacific Ocean, 2024, *Marine Environmental Research*, Submitted.
- Min Zhang, Yangyan Cheng, Gang Wang, Qi Shu, Chang Zhao, Yuanling Zhang, Fangli Qiao, Long-term ocean temperature trend and marine heatwaves. *J. Ocean. Limnol.* 2024. https://doi.org/10.1007/s00343-023-3160-z
- Biao Zhao, Lichuan Wu, Guansuo Wang, Jun A. Zhang, Li Liu, Chang Zhao, Zhanpeng Zhuang, Changshui Xia, Yuhuan Xue, Xinfang Li, Fangli Qiao, A Numerical Study of Tropical Cyclone and Ocean Responses to Air-sea Momentum Flux at high winds, 2024, *Journal of Geophysical Research - Oceans*, 129(7): e2024JC020956

4. Problems encountered & recommended actions

Problems encountered

- Problem 1 : The high cost for maintaining the operational OFS is a challenge;
- Problem 2: The lack of ocean modelling and forecast talents in this region;
- Problem 3: The lack of in-situ observations to validate and improve the model

Actions

- Action 1: To apply more financial supports for OFS, and combine this OFS with the UN Ocean Decade Programme OSF for sharing resources;
- Action 2: Conduct more training for students and early career scientists through ODC center
- Action 3 :To implement in-situ observations with partners from different countries.

5. Strategic considerations/thoughts for future development

- To combine this OFS with the UN Ocean Decade Programme OSF for sharing resources;
- Conduct more training courses for students and early career scientists through ODC center;
- To provide master and PhD ocean scholarships for students in China;
- To implement in-situ observations with partners from different countries.

6. Potential action plans for future implementation

for the period of 2025-2026 and beyond

- To operationally run the OFS in the following 2 years;
- To provide forecasting products and services for IOC/WESTPAC community;
- To initiate the operational Southeast Asian Maritime Emergency Response System
- To initiate the operational coral reef early warning system;
- To cooperate with ODC center for organizing 2 training courses;
- To extend ocean forecasting to ocean extremes and climate forecasting.

Planned activities

Program	Plan				Funding Required		Remark
	Activities	Objectives	Expected outputs/outcomes	Date and place	IOC	Other sources (i.e. from national or international)	
Ocean Forecast System for Southeast Asia Areas (OFS)	1. To operationally run the OFS in the following 2 years, and provide technical support for Thailand and Malaysia OFS	To provide operational forecast every day and distribute through WESTPAC website; and to provide operational forecast for two subdomains	Significant Wave height ,Temperature, and current within the following 5 days	Everyday, through internet Thailand OFS at PMBC of Thailand, and Malaysia OFS at UMT of Malaysia	20K	600K USD	
	2. To provide forecasting products and services for IOC/WESTPAC community	To provide forecasting and services for emergent marine hazards and events	Significant Wave height ,Temperature, and current within the following 5 days	As needed		20K USD	
	3. To initiate the operational coral reef early warning system	To provide operational early warning for coral bleaching	An operational early warning system for coral reef bleaching	2026,through internet	10K	120K USD	
	4. To initiate the operational Southeast Asian Maritime Emergency System	To provide operational Maritime Emergency forecast such as oil spill and search and rescue	An operational Southeast Asian Maritime Emergency System	2026,through internet	10K	120K USD	
	5. To cooperate with ODC center for organizing 2 training courses	To provide young scholars updated knowledge on model development, through cooperation with ODC center	Two training courses	2025 and 2026, both in Qingdao			
	6. To extend ocean forecasting to ocean and climate forecasting	To provide monthly climate prediction products for the region	Climate prediction system	Start in 2026		340K USD	

ThankYou

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Website: www.fio.org.cn/en