Ocean Forecast System Thailand Progress

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Thailand-China Joint Laboratory for Climate and Marine Ecosystem

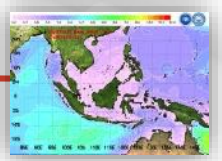
The 2nd Regional Scientific and Technical Committee of the SEAFDEC/UNEP/GEF Project on Establishment and Operation of a Regional System of Fisheries Refugia in the South China Sea and Gulf of Thailand
Kampot, Cambodia, 21-23 May 2019

The Layout

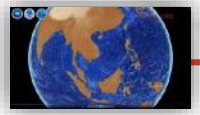
01 The Chronology of Ocean Forecast System Thailand

02 Scientific and framework

03 OFS practicing in Thailand



04 Establishing high resolution and its application



The Chronology of Thailand's Ocean Forecast System

2010 — OFDS Establishment

Ocean Forecasting Demonstration System (OFDS launched at the 8th IOC-WESTPAC Meeting in Bali, Indonesia

2012 — OFDS Website

operated by FIO funded by IOC-WESTPAC/SEAGOOS. It covered SCS

2013 — Joint Cruise

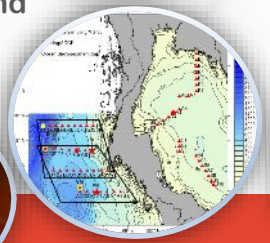
conducted in GoT cooperated by DMCR and FIO aim to do model validation.

2015 — OFS Thailand

official launched by cooperating between MNRE Thailand and SOA China.

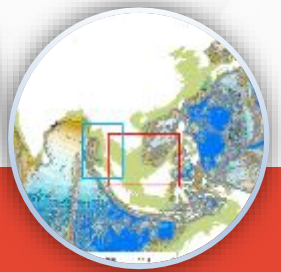
2019 — Validate and Develop

CTD and mooring buoy being conducted in both ADS and GoT for validating and getting higher resolution

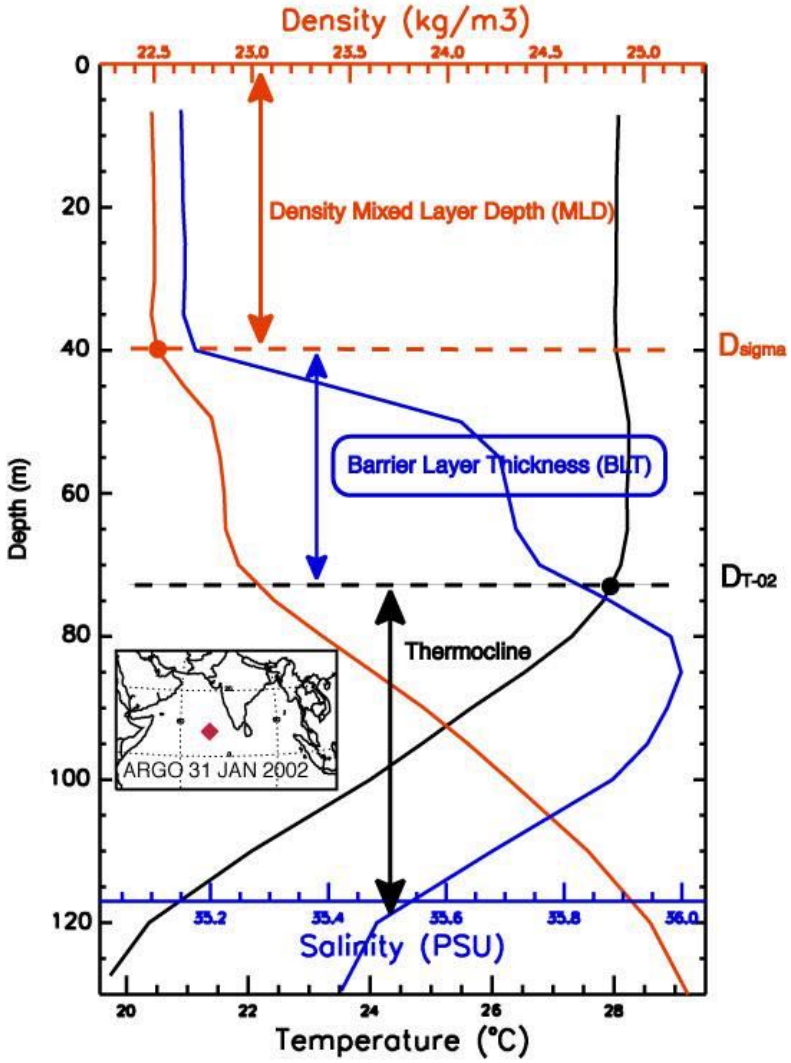


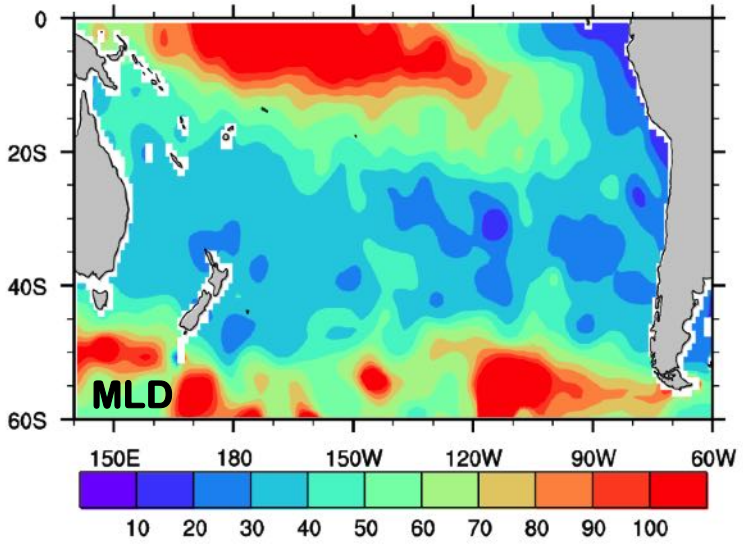
2020 — Hi Res OFS

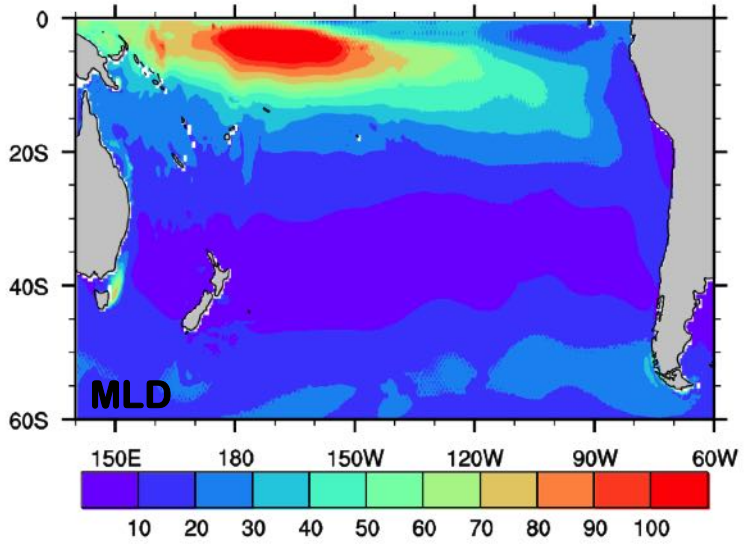
Intended to be completed end of 2019 to early of 2020.



In the half-century, it was understand that breaking wave mainly affected to the deep of mixed-layer depth, which really important for the primary productivity and fishing products







✓ Observation

✓ Model from POM

The challenge of ocean circulation model is that simulated sea surface temperature is overestimated while the sub-surface temperature is underestimated especially in summer time.

The non-breaking wave induced vertical mixing

Prof.Qiao Fangli and colleagues of First Institute of Oceanography, P.R. China proposed that the non-breaking surface wave could generate turbulence through wave-turbulence interaction and developed the wave-induced mixing theory.

It was the beginning of *MASNUM: Laboratory of MArine Sciences and NUmerical Modeling*

$$B_V = \alpha \iint_{\vec{k}} E(\vec{k}) \exp\{2kz\}\, d\vec{k}\, \frac{\partial}{\partial z} \left(\iint_{\vec{k}} \omega^2 E(\vec{k}) \exp\{2kz\}\, d\vec{k} \right)^{1/2}$$

E(K) is the wave number spectrum which can be calculated from a wave numerical model. It will change with (x, y, t), so Bv is the function of (x, y, z, t).

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

If we regard surface wave as a monochramatic wave,

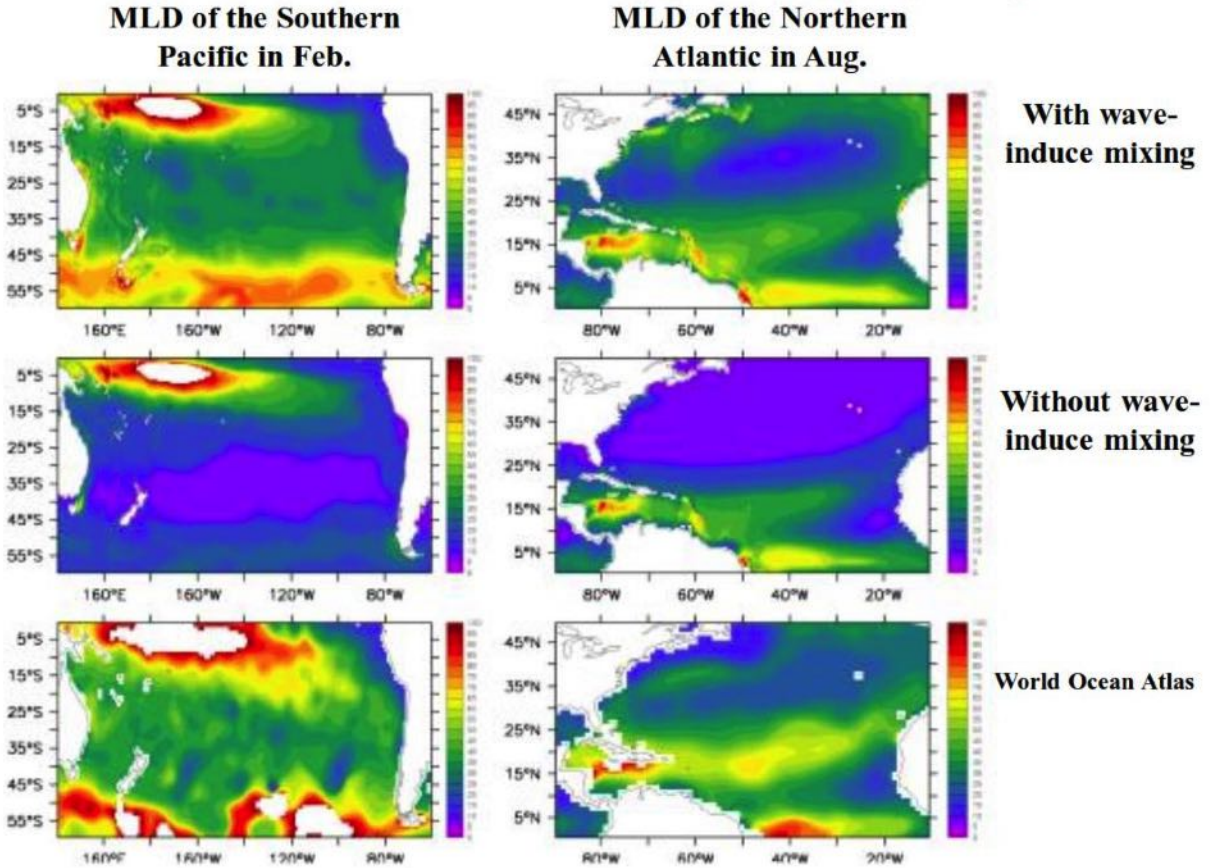
$$B_v = \alpha A^3 k \omega e^{(-3kz)} = \alpha A u_s e^{(-3kz)},$$

Stokes Drift

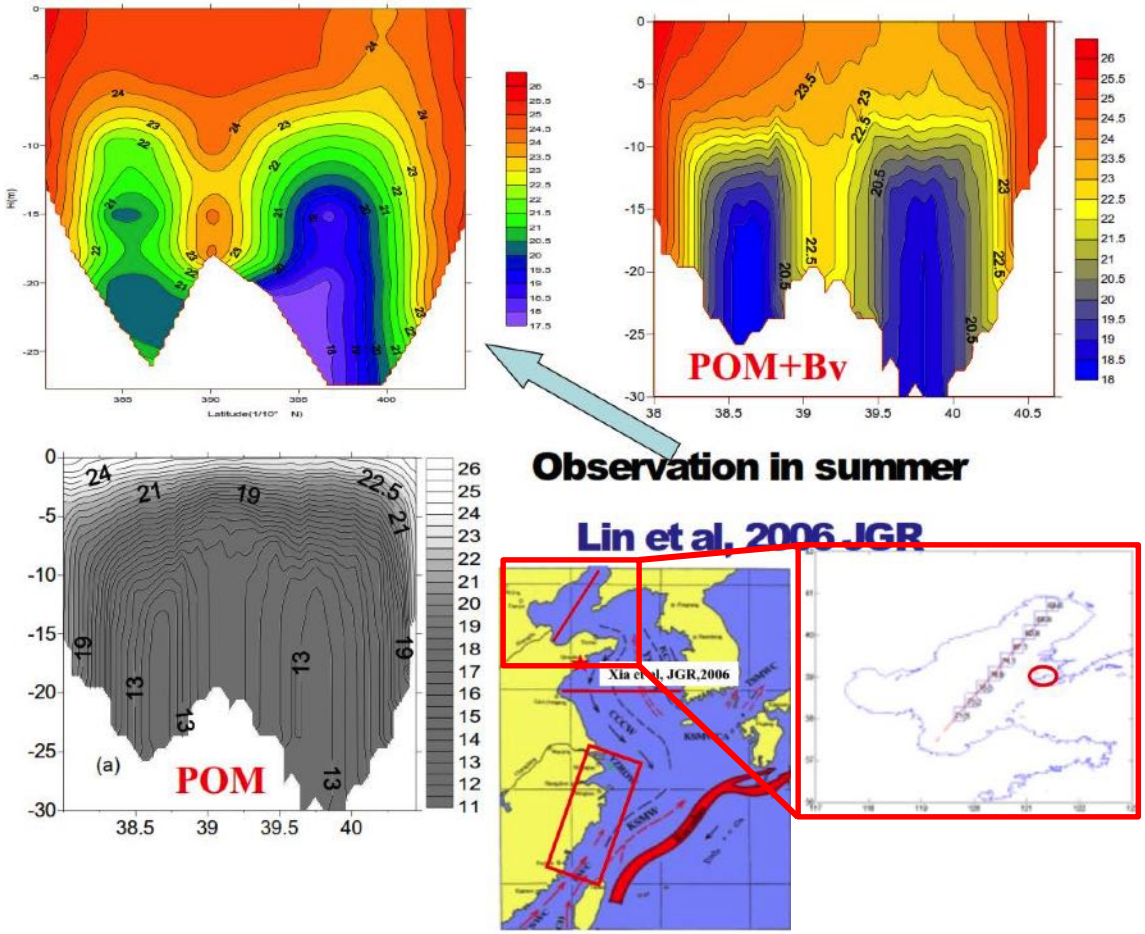
Bv is wave motion related vertical mixing instead of wave breaking.

Wave effects: MLD in summer (Qiao et al, OD, 2010)

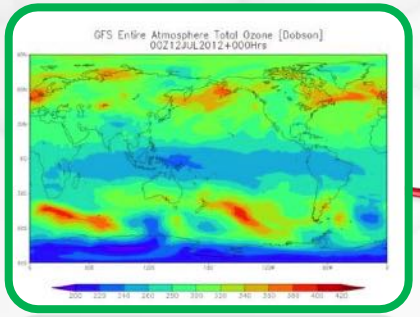
- After induced Bv to the model, the mixed-layer depth is more acceptable even in the south Pacific or the North Atlantic



- After induced Bv to the model, the mixed-layer depth is more acceptable even in the south Pacific or the North Atlantic
- The cross-section temperature in Bohai Sea is more reliable



Framework



Global Forecast System (NOAA)

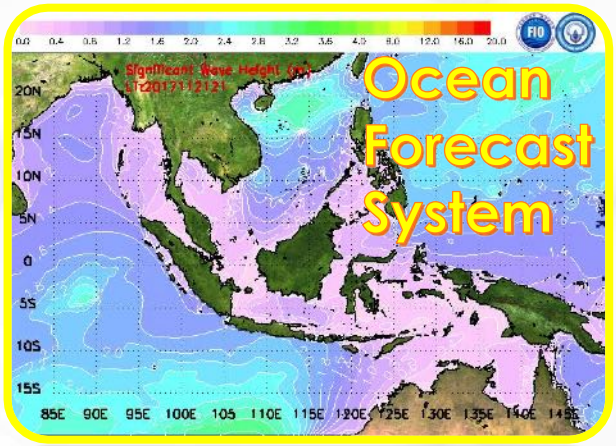
+

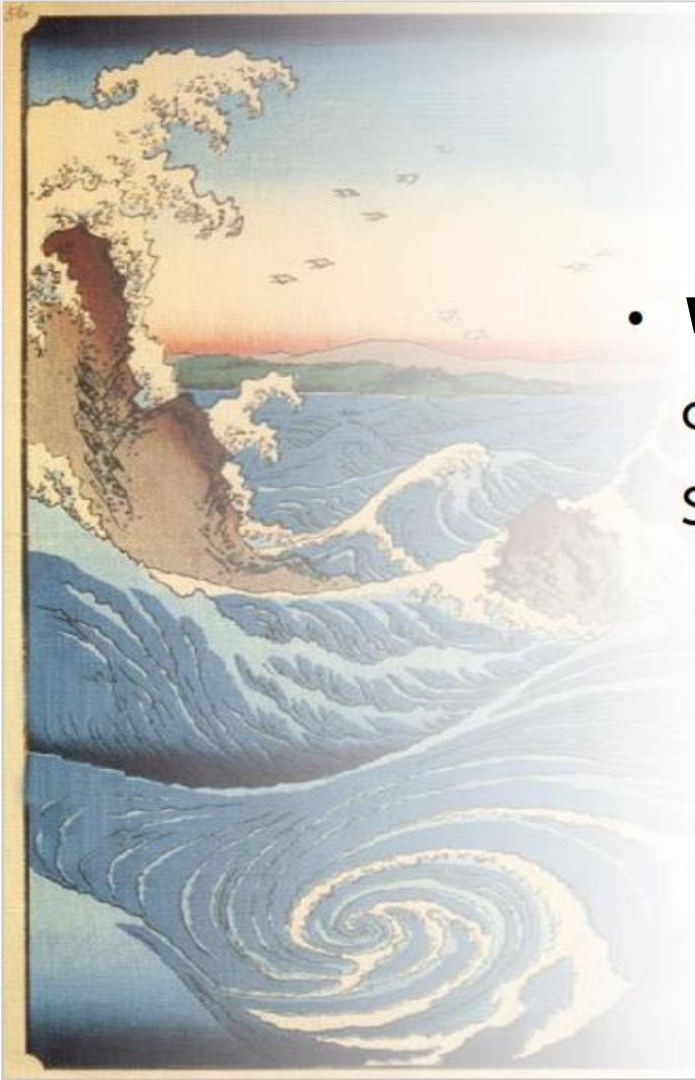
Sea Surface Temperature (JMA)

MASNUM
- Wind speed
- Sea level pressure
- 2 meter air temperature
- Shortwave radiation
- Relative humidity

POM
- Current

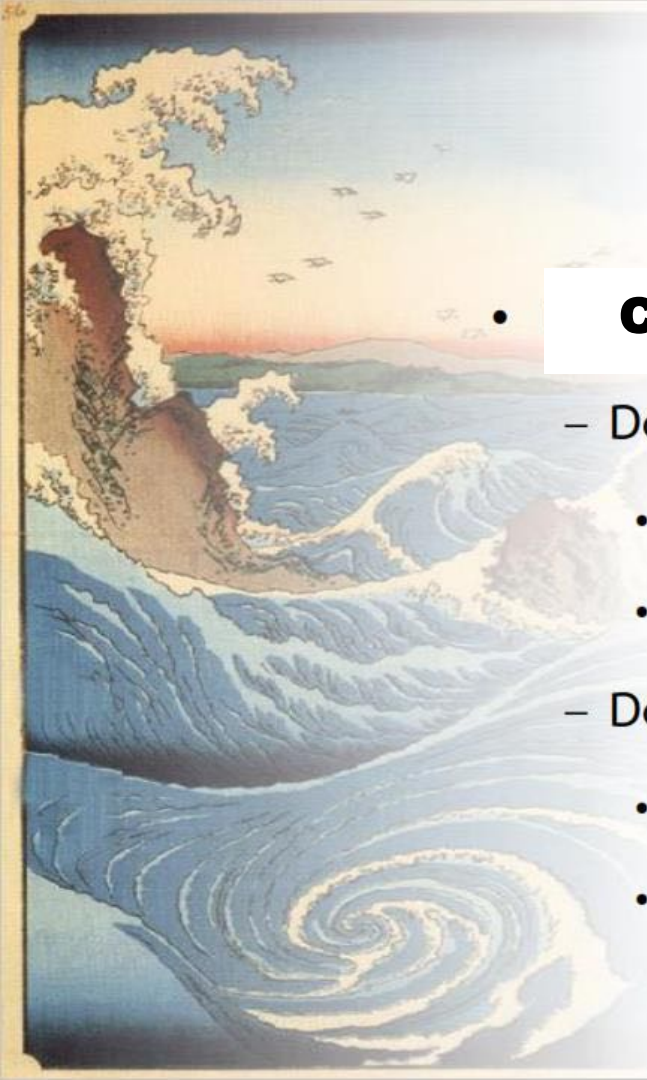
DATA ASSIMILATION
- Sea surface assimilation from Japan Meteorological Agency





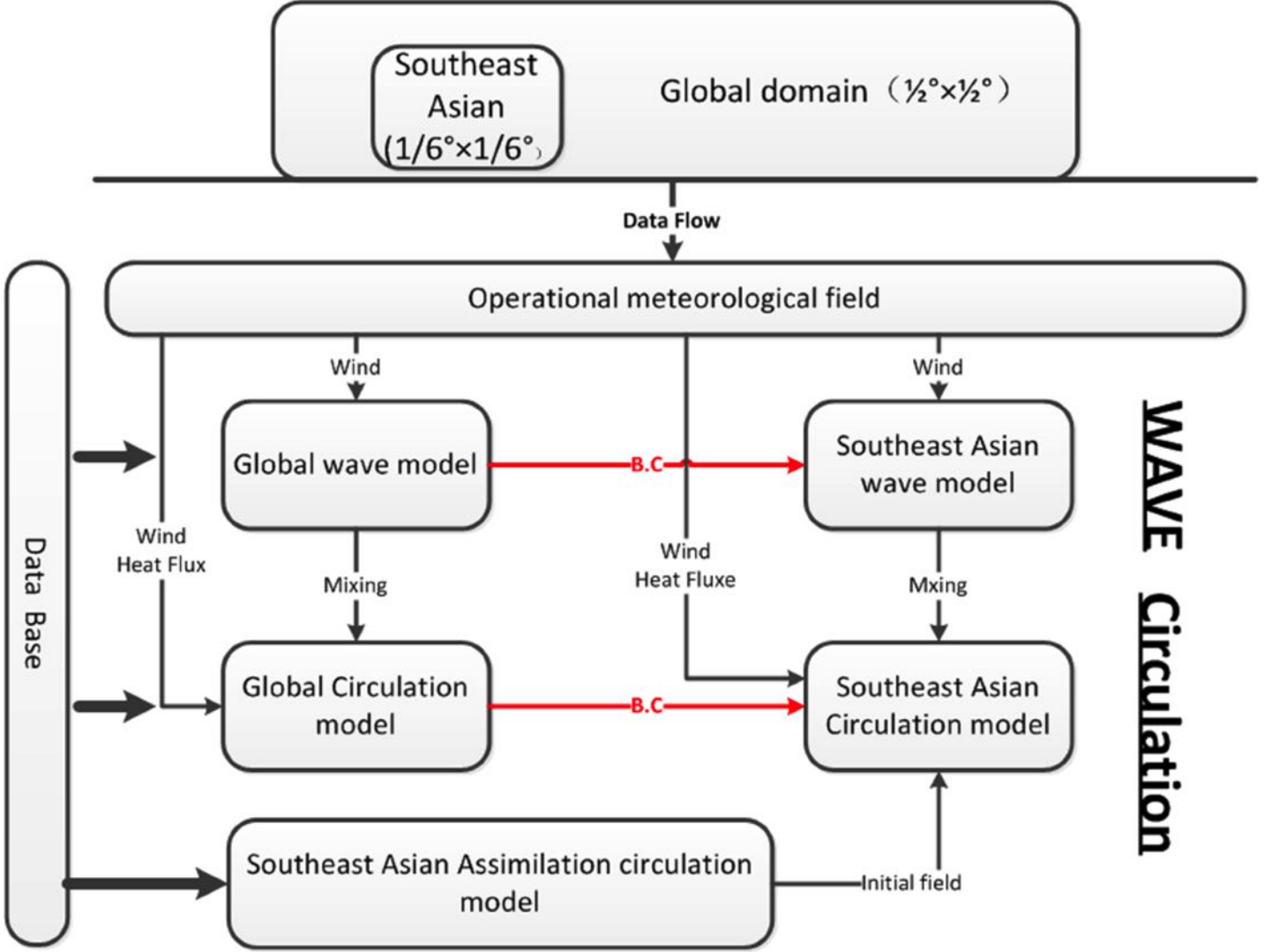
Numerical Model @ PMBC

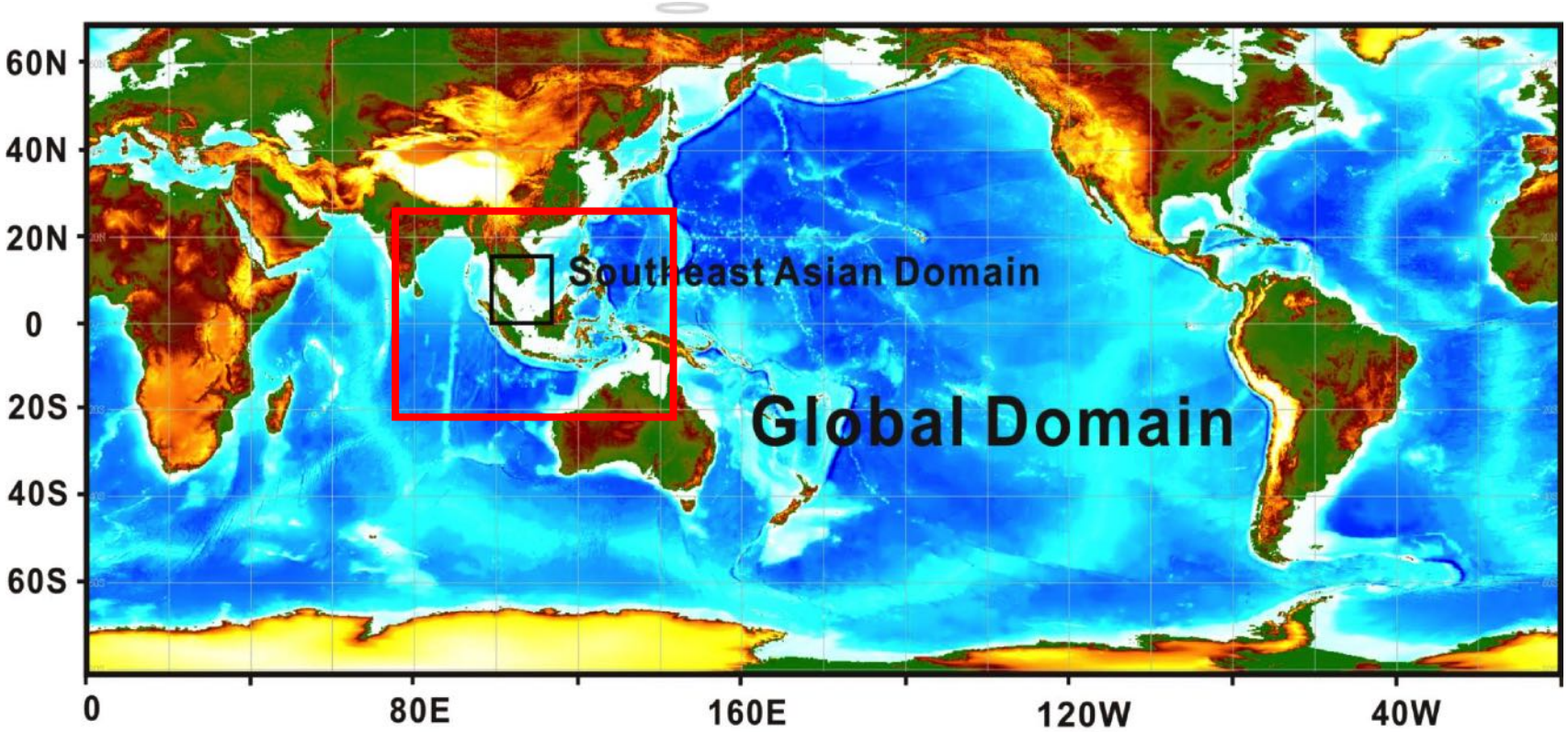
- **Wave model:** MASNUM (Laboratory of *MA*rine *S*ciences and *Nu*merical *M*odeling, State Oceanic Administration (SOA))
  - Domain: Global (Lat. 78S – 65N Lon. 0E – 360E)
  - Resolution: ½ x ½ Degree (~55 km)
  - Grids: Horizontal 721x 287



Numerical Model @ PMBC

- **Current model:** POM (Princeton Ocean Model)
  - Domain: Global (Lat. 78S – 65N Lon. 0E – 360E)
    - Resolution: ½ x ½ Degree (~55 km)
    - Grids: Horizontal 721x287, Vertical 21 Layers
  - Domain: Southeast Asia (Lat. 20S – 25N Lon. 80E – 150E)
    - Resolution: 1/6 x 1/6 Degree (~18 KM)
    - Grids: Horizontal 560x360, Vertical 51 Layers

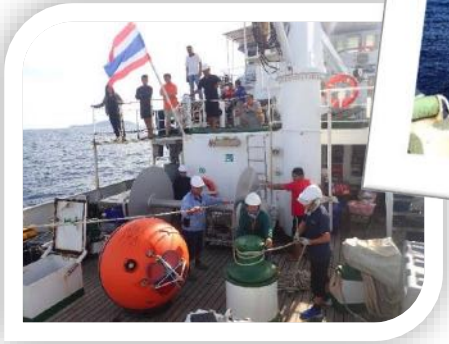

Southeast Asian (1/6°×1/6°)
Global domain（½°×½°）
Data Flow
Operational meteorological field
Data Base
Wind
Wind
Global wave model
B.C
Southeast Asian wave model
Wind Heat Flux
Mixing
Wind Heat Fluxe
Mxing
Global Circulation model
B.C
Southeast Asian Circulation model
Southeast Asian Assimilation circulation model
Initial field
WAVE
Circulation



Southeast Asia model details

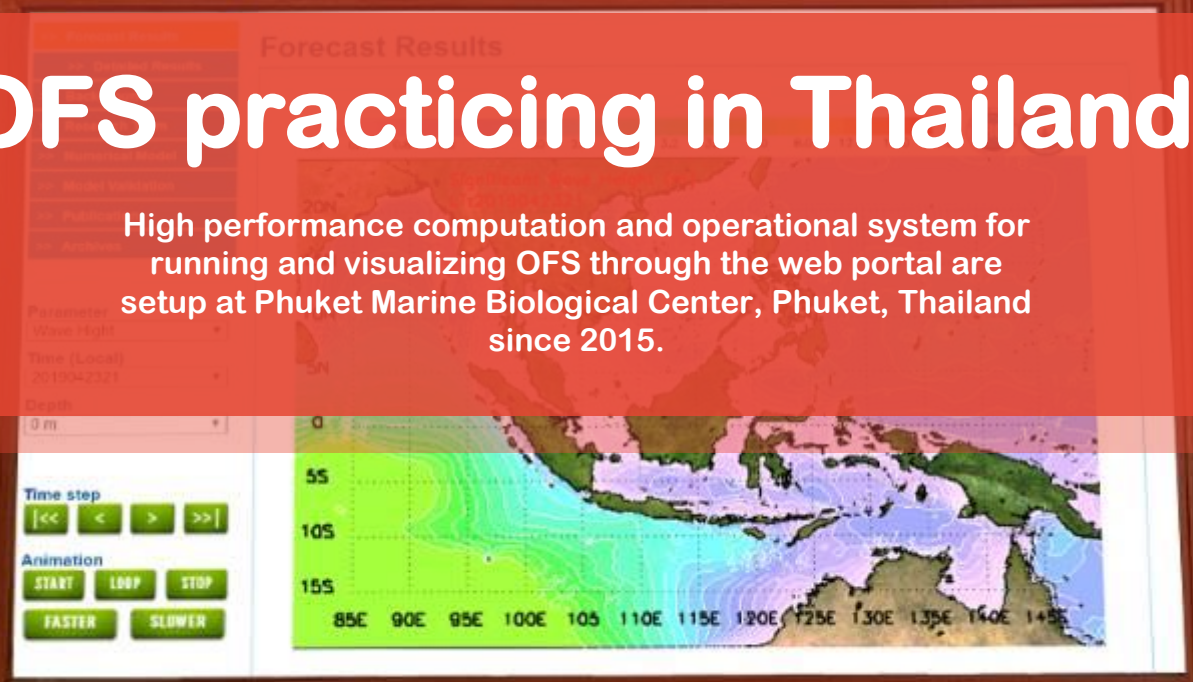
Domain	80° E – 150° E, 20° S – 25° N
Resolution	1/6° x 1/6°
Grids	Horizon: 421x271, Vertical: 21 layers
Results	July, 2015 – present

OFS joint cruises survey between 2013-2018



OFS practicing in Thailand

High performance computation and operational system for running and visualizing OFS through the web portal are setup at Phuket Marine Biological Center, Phuket, Thailand since 2015.



https://marinegiscenter.dmcr.go.th

ระบบฐานข้อมูลกลางและมาตรฐานข้อมูลทรัพยากรทางทะเลและชายฝั่ง
Central Database System and Data Standard for Marine and Coastal Resources

กรมทรัพยากรทางทะเลและชายฝั่ง
DEPARTMENT OF MARINE AND COASTAL RESOURCES

KM
Knowledge Management
ฐานข้อมูลองค์ความรู้

MIS
Management Information Systems
ฐานข้อมูลสารสนเทศ

GIS
Geographic Information Systems
ระบบแผนที่ออนไลน์

RIS
Research Information Systems
ฐานข้อมูลงานวิจัย

CN
Conservation Network
ฐานข้อมูลกลุ่มเครือข่ายอนุรักษ์

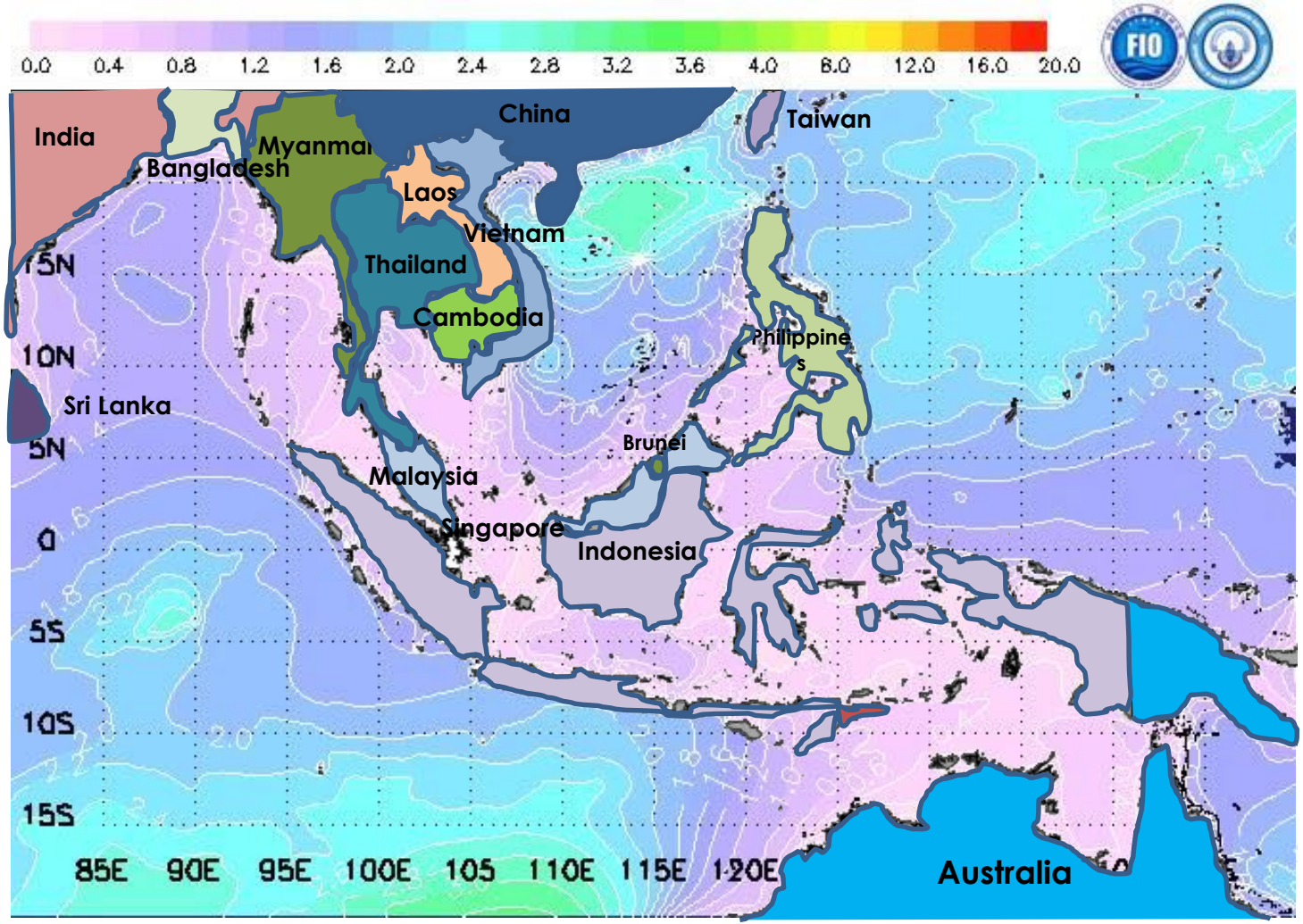
AB
Artificial reef - Buoy
ฐานข้อมูลปะการังเทียม
และทุ่นในทะเล

e-PM
e-Permission
on Mangrove Area
ขออนุญาตใช้ประโยชน์
ในพื้นที่ป่าชายเลน

MR
Marine Rangers
อาสาสมัครพิทักษ์ทะเล

OFS
Ocean Forecasting System
ระบบพยากรณ์
ด้านสมุทรศาสตร์

MgIS
Mangrove Information System
ระบบรายงานผลการปฏิบัติงาน
ด้านทรัพยากรป่าชายเลน


0.0 0.4 0.8 1.2 1.6 2.0 2.4 2.8 3.2 3.6 4.0 6.0 12.0 16.0 20.0
India
Bangladesh
Myanmar
China
Taiwan
Laos
Vietnam
Thailand
Cambodia
Philippines
Sri Lanka
Brunei
Malaysia
Singapore
Indonesia
Australia
15N
10N
5N
0
5S
10S
15S
85E 90E 95E 100E 105 110E 115E 120E

PRODUCT

Animation graphic

Zooming

Downloading archives data

Wave Hight
Temperature and Current
Sea Level
Wind

2018071921
2018072000
2018072003
2018072006
⋮
2018072212
2018072215
2018072218
2018072221

Ocean Forecasting System for the Kingdom of Thailand
(OFS V1.0)

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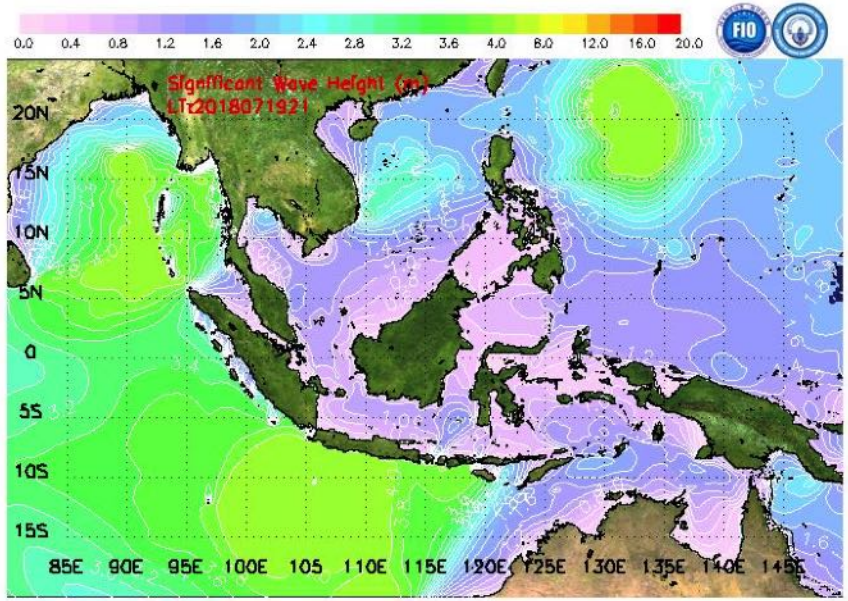
>> Forecast Results
>> Detailed Results
>> Background
>> Research Team
>> Numerical Model
>> Model Validation
>> Publication
>> Archives

Forecast Results



Parameter: Wave Hight
Time (Local): 2018071921
Depth: 0 m

Time step: |<< < > >>|

Animation: START LOOP STOP FASTER SLOWER

Lon Lat PROFILE Lon1 Lat1 Lon2 Lat2 SECTION

DOUBLE CLICK on the map to show the current profile. Or **INPUT** the coordinate and **CLICK** the button.

国家海洋局第一海洋研究所 THE FIRST INSTITUTE OF OCEANOGRAPHY,SOA.

PHUKET MARINE BIOLOGICAL CENTER

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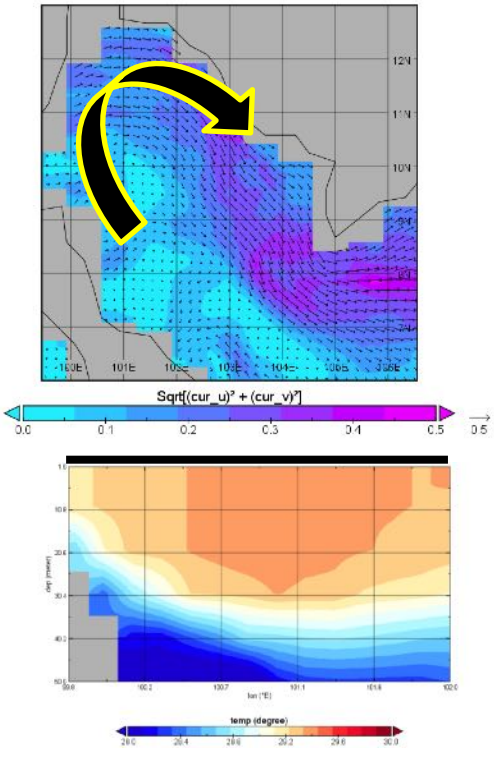
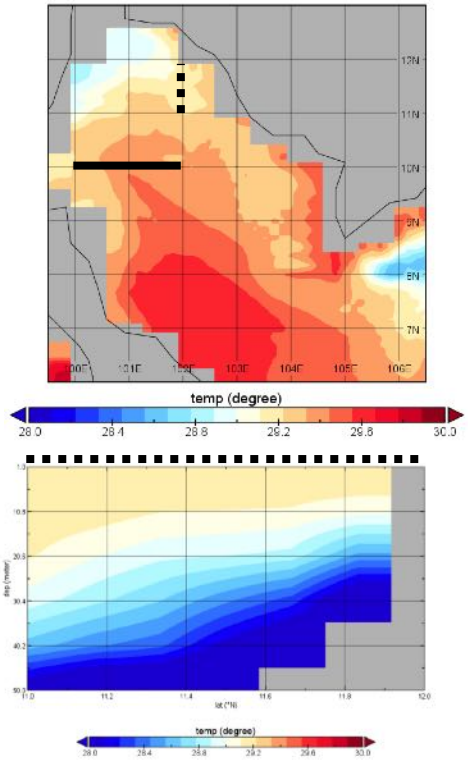
PRODUCT

Observation data for OFS validation

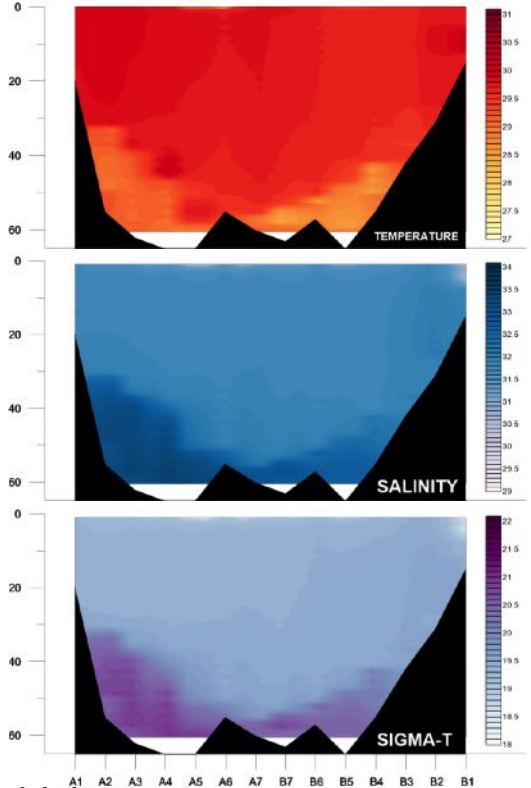
OFS surface current

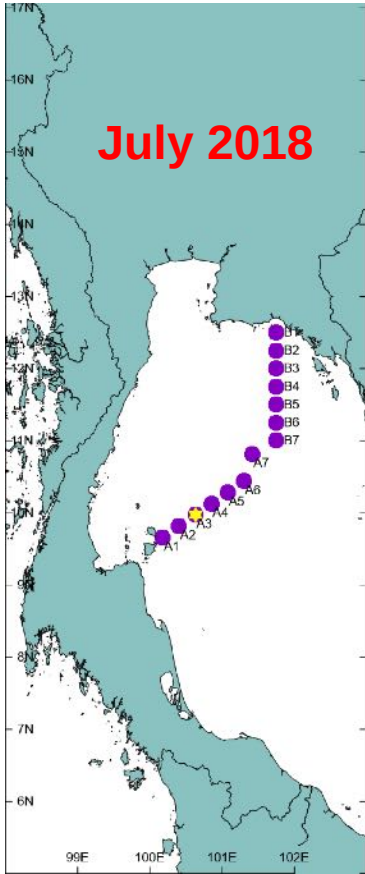


OFS sea



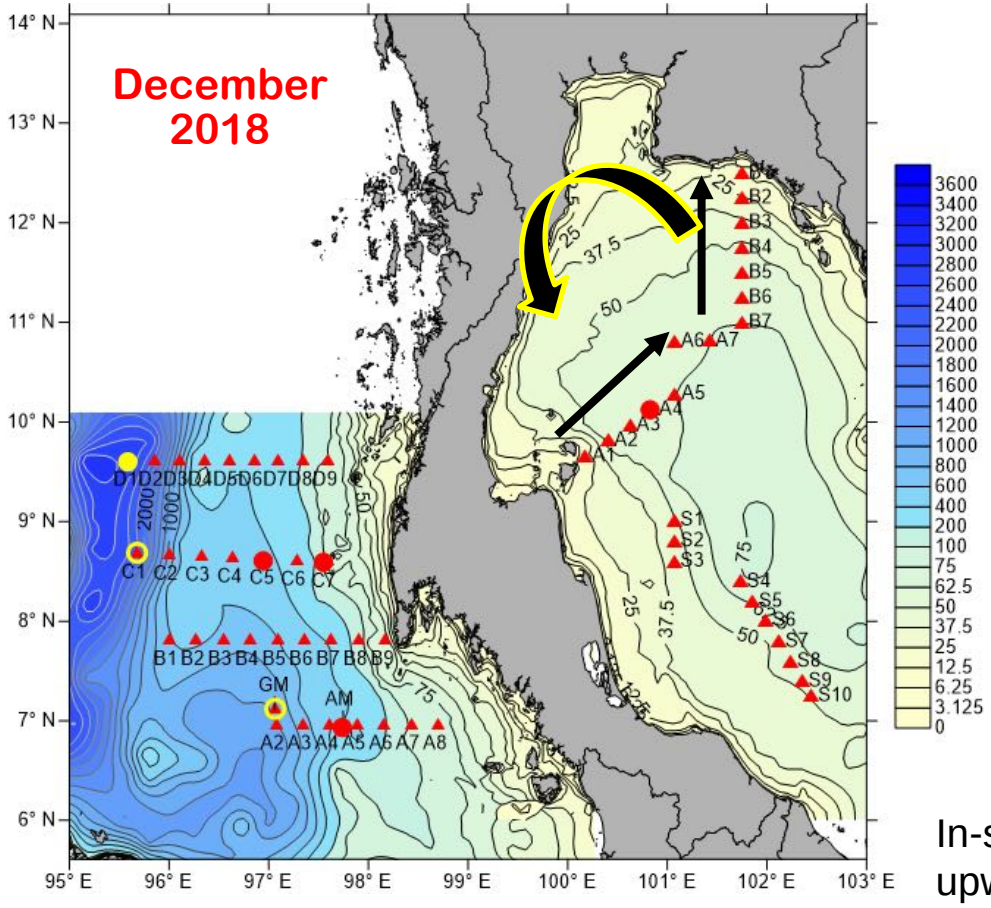
CTD data

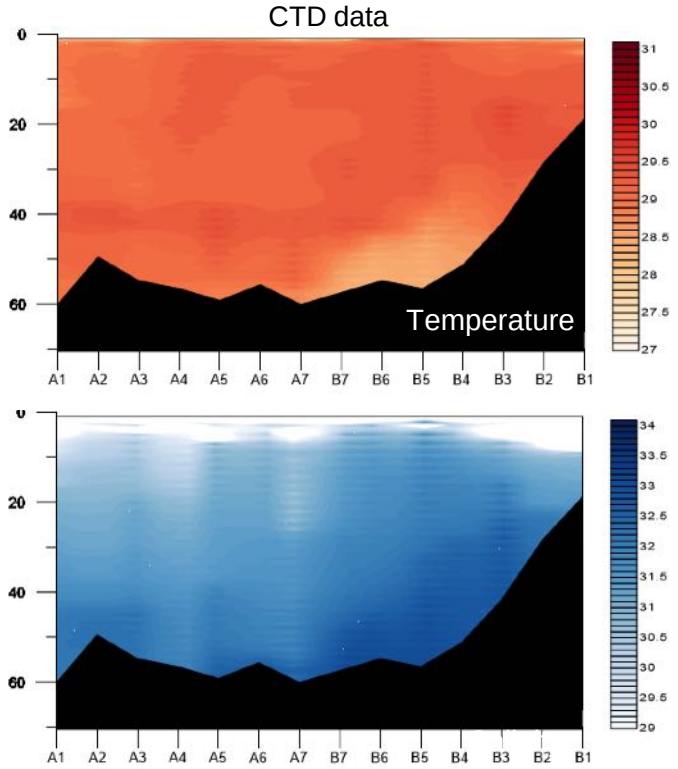




OFS surface current represents clockwise circulation which affects to upwelling occurring nearby western Gulf of Thailand

Observation data for OFS validation





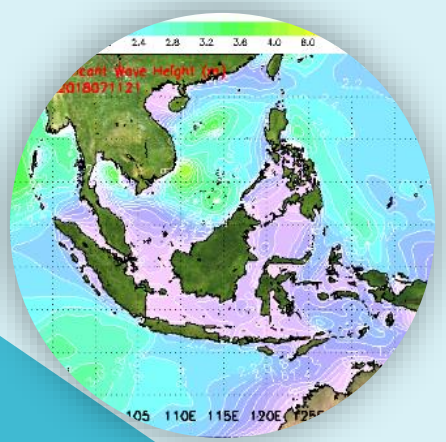
In-situ data in December 2018 shows upwelling nearby eastern Gulf of Thailand

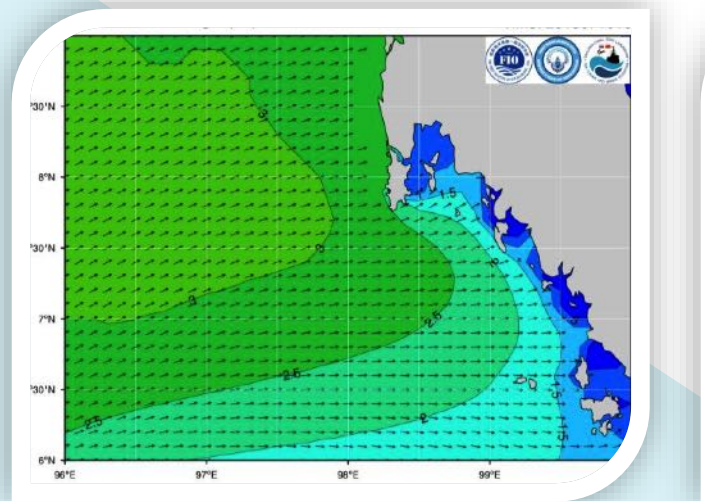
OFS practicing – search and rescue

OFS (initial cond) (13kmx13km)

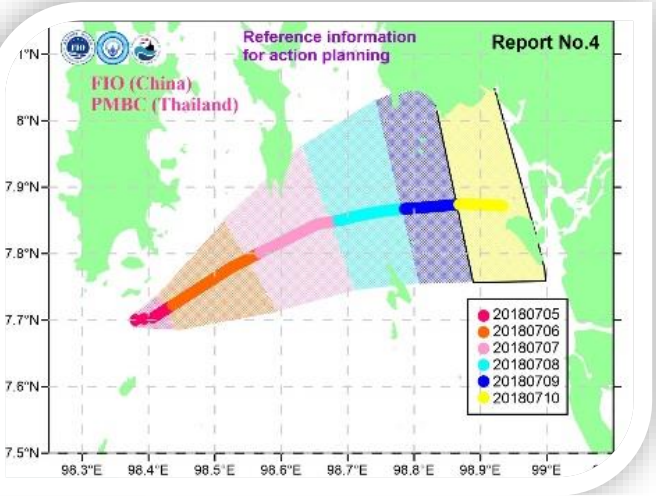
High-resolution OFS + M_2 3kmx3km

wave • circulation + tracer





Rescue mission

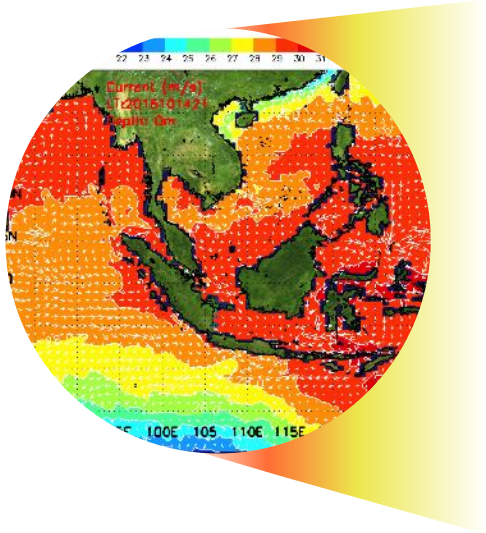


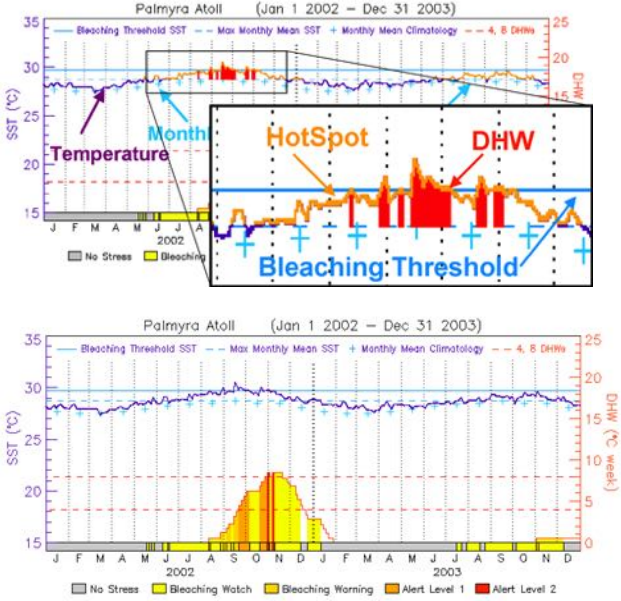
July 5th, 2018 – more than 100 passengers lost cause by Phuket boat sank

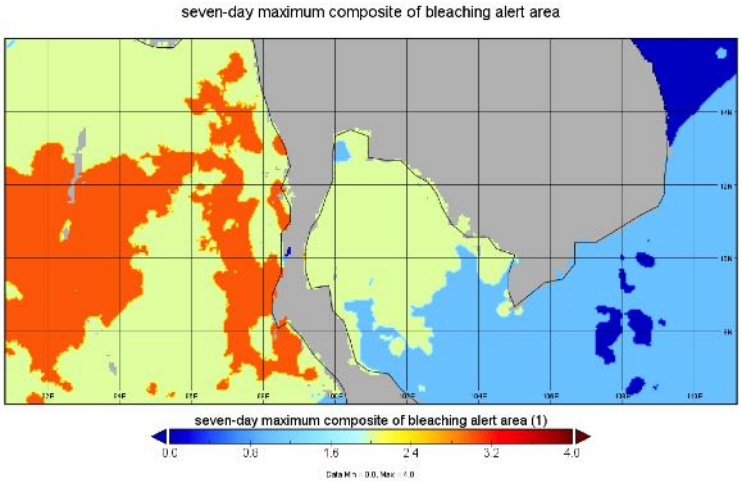
OFS was one of model that run for search and rescue passengers between 5-11 July 2018

OFS practicing – coral bleaching alert

OFS can be used sea temperature data to calculate bleaching threshold to construct bleaching alert area which higher accumulate than global scale

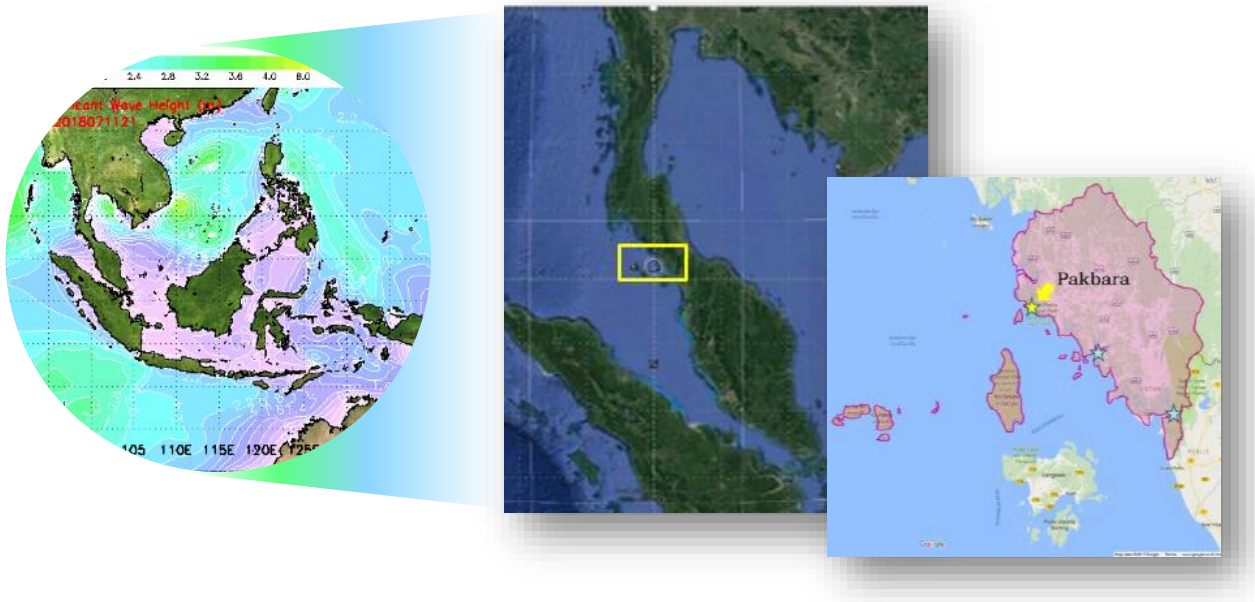






OFS practicing – sediment transport

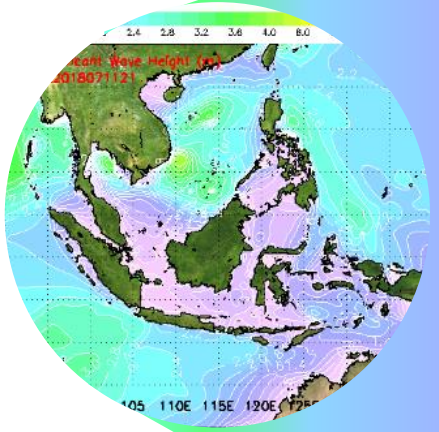
OFS can be used spatial and temporal wind data to do environmental impact assessment by suspended sediment near coastal zones

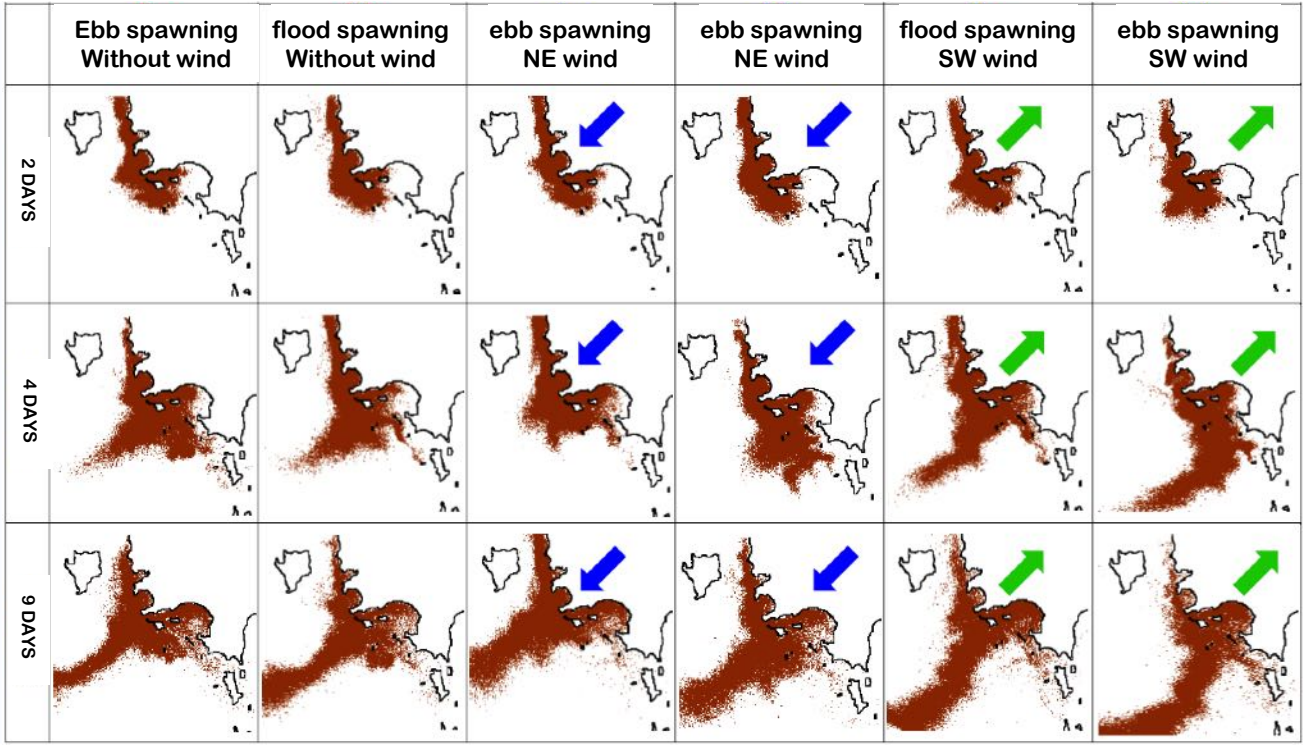


OFS practicing – larvae dispersal

Nested-grid to study coral larvae distribution in 2, 4, and 9 days

OFS (initial cond)

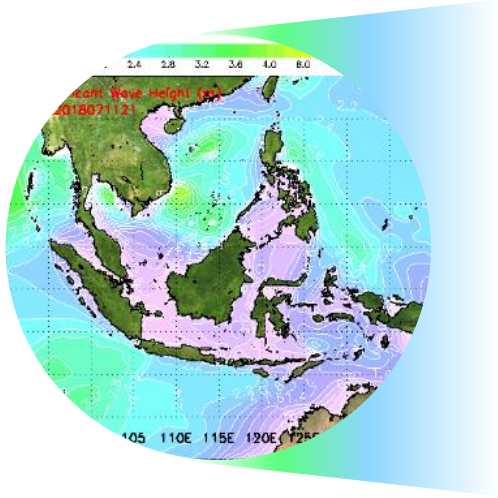


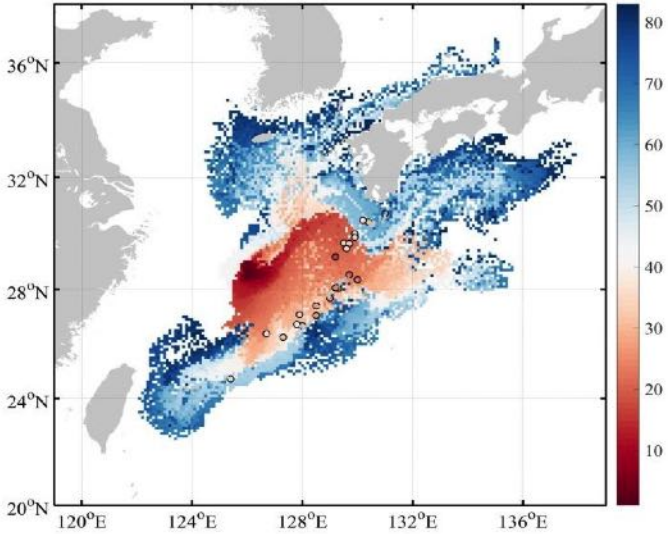


(Chanthasiri, 2015)

OFS practicing – Oil spill

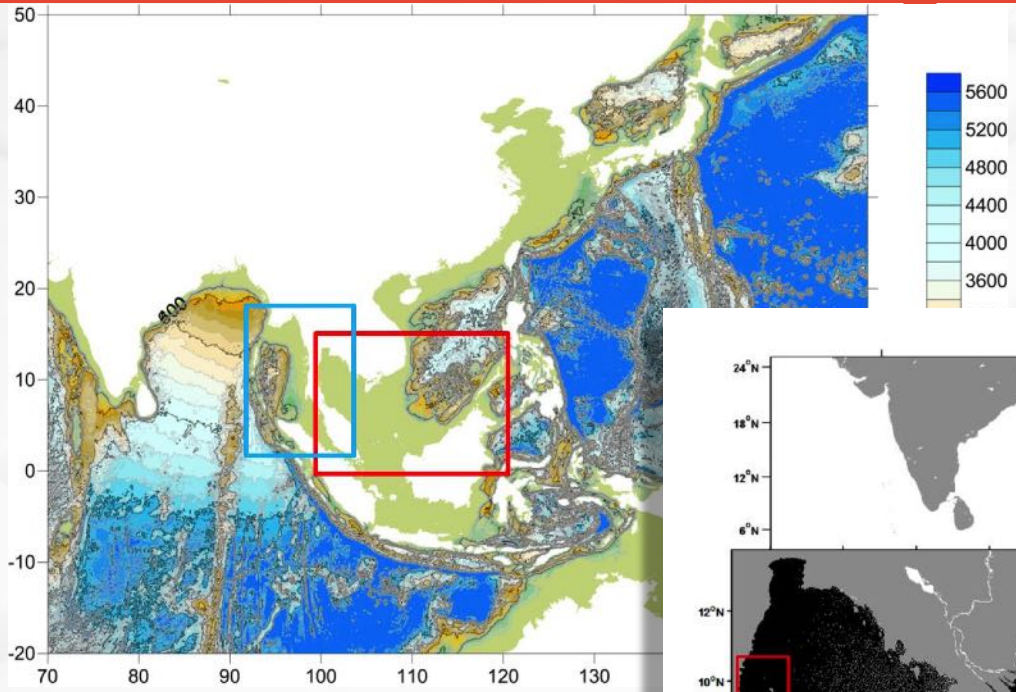
The Gulf of Thailand have several oil rig that might be risk if it's leaked OFS can provide initial condition for forecast oil spill

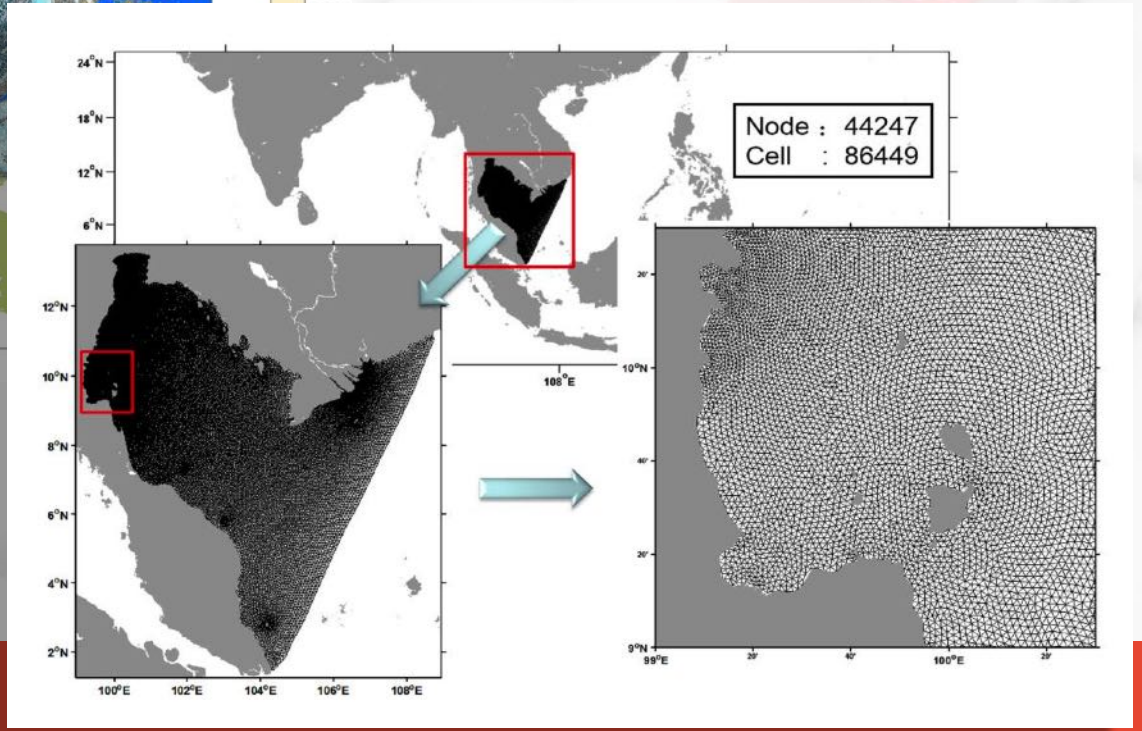




Comparison between simulated virtual oil particles (colored dots) and the reported oil pollution sites (colored circles,) up to April 1, 2018.

High Res OFS



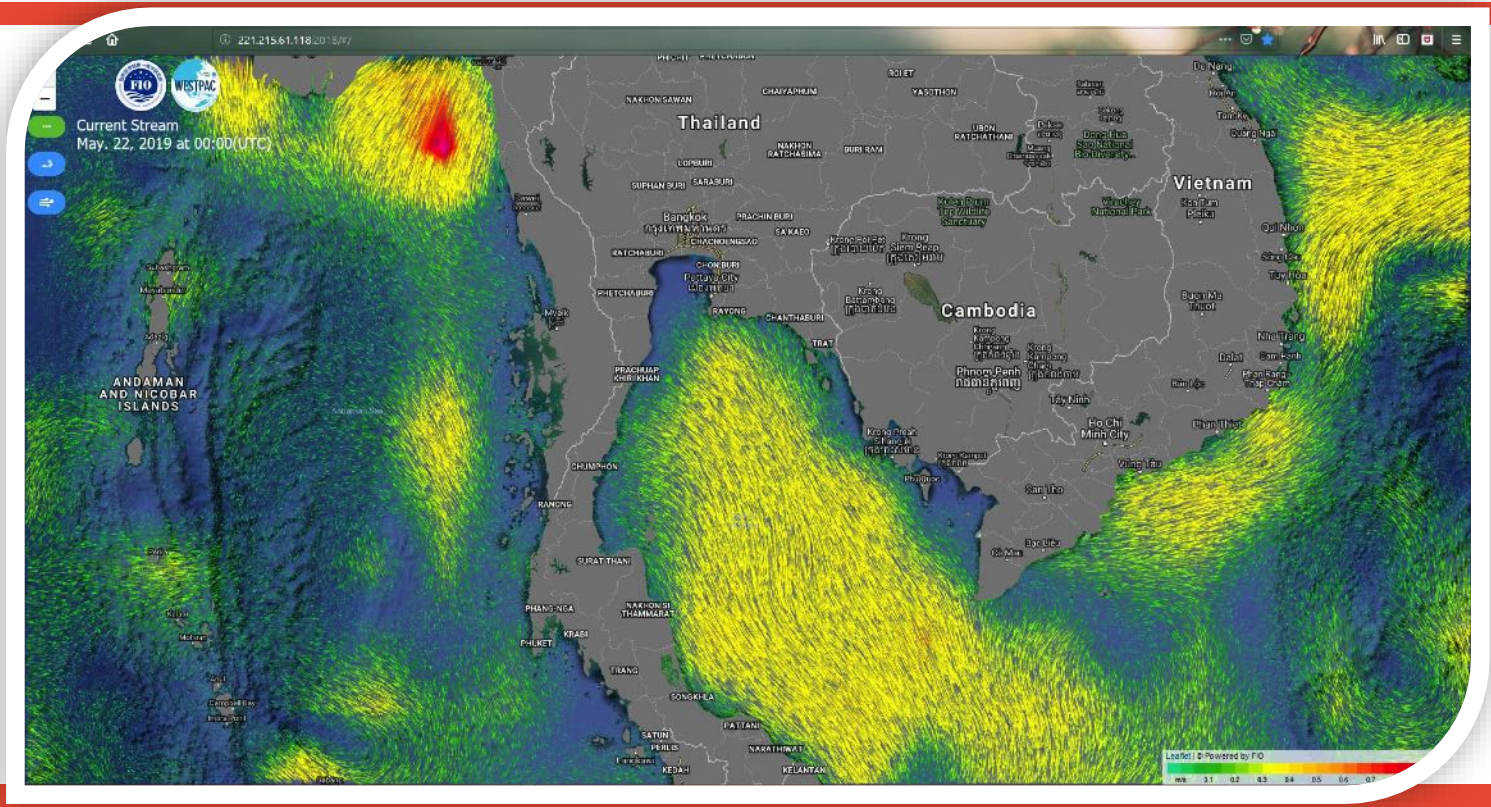


- Testing refined-grid model on OFS's HPC at PMBC
- Seeking to upgrade HPC cores at PMBC
- Arranging local data to set up data assimilation and validation

OFS application

- The forecasting products can be easily accessed through cell phone APP of “Global Ocean On Desk” (GOOD)

OFS application (testing hi res domain)



http://221.215.61.118:2018/#/

Acknowledgement

1. OCEAN FORECASTING AND MARINE DISASTER SYSTEM FOR SOUTHEAST ASIA SEAS (OFS)

Period : 2010 – present

Contact person : Dr. Somkiat Khokiattiwong, DMCR
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Thank you