

# Maritime Search and Rescue and offshore Oil Spill emergency Decision-Support System

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# CONTENTS

- 1 **Brief introduction of NCSFDMC**
- 2 **Decision support system for offshore oil spill**
- 3 **Decision support system for maritime search and rescue**
- 4 **Cooperation and Application**

01

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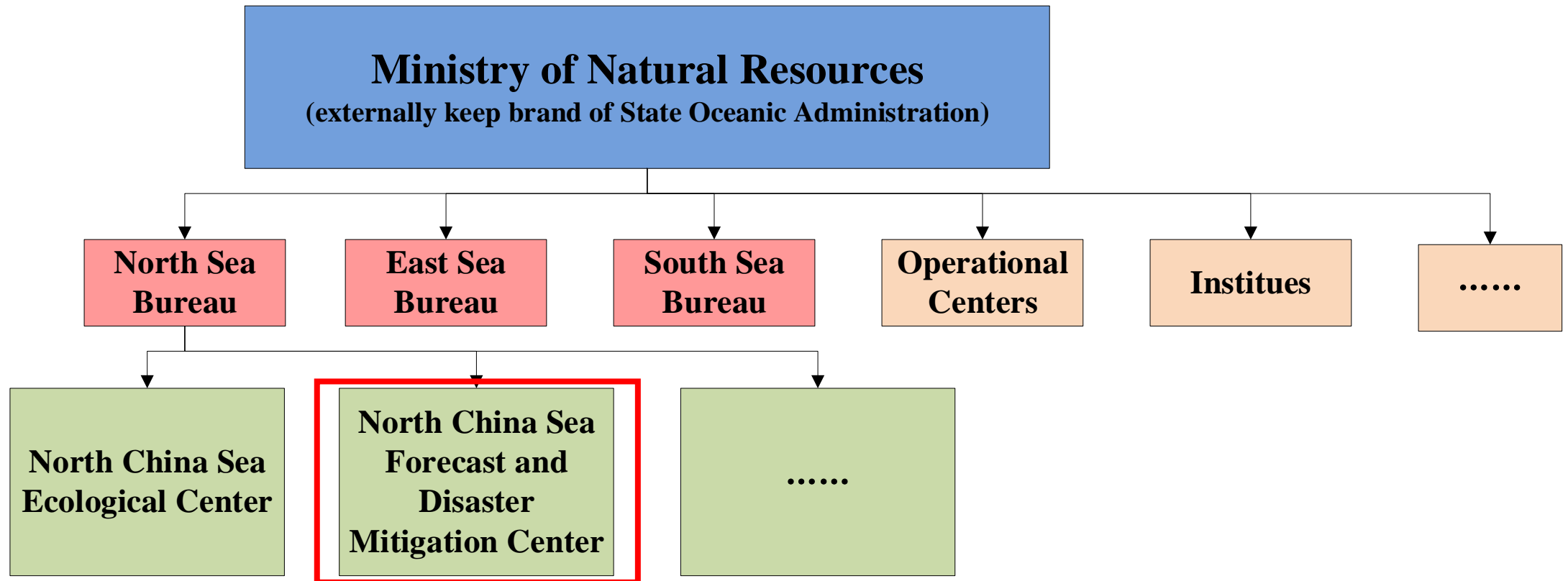
## Introduction of NCSFDMC

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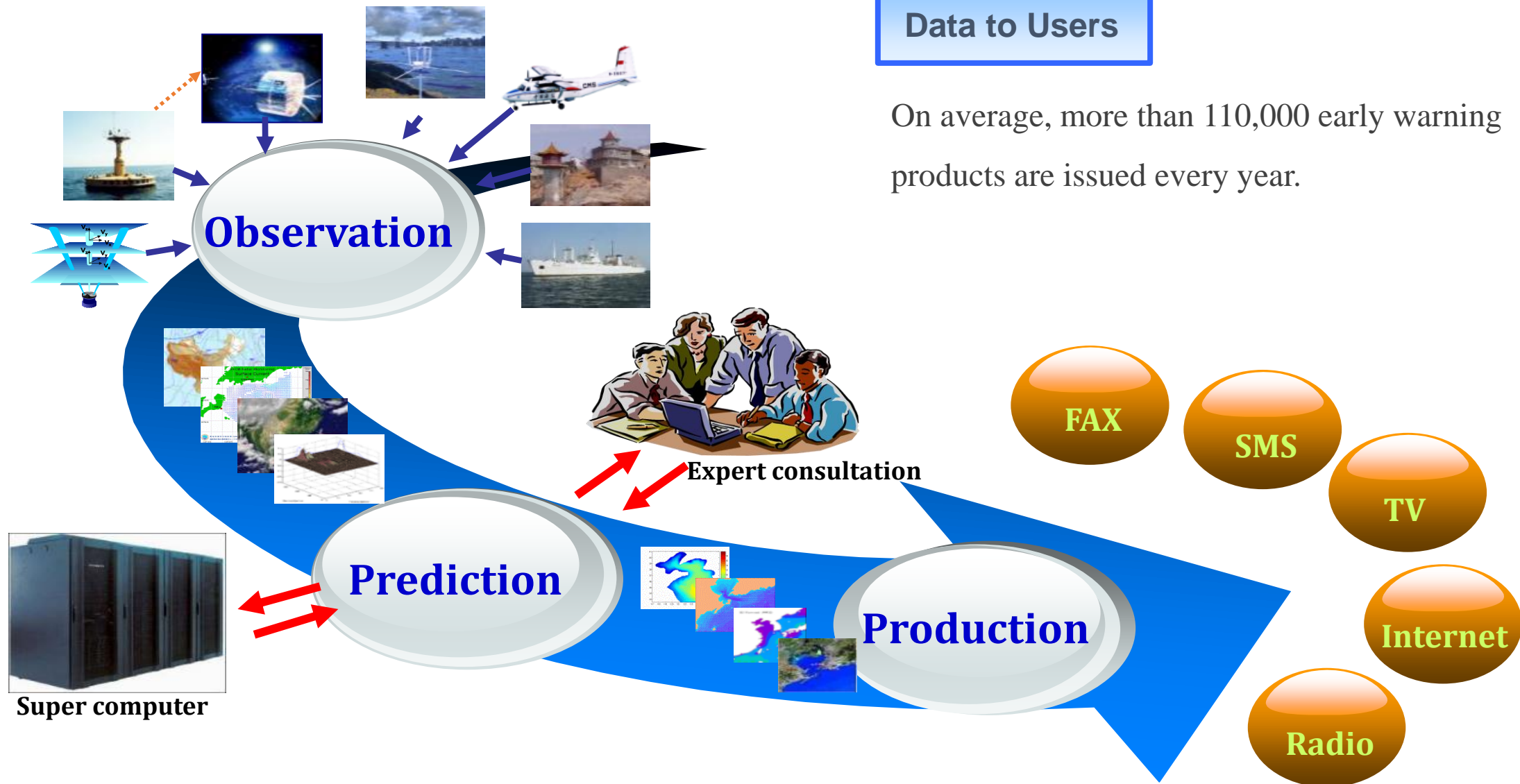
# 1. Introduction of NCSFDMC

- NCSFDMC was founded in 1965. It is affiliated to the North Sea Bureau of the Ministry of Natural Resources.
- It is a regional center that fully performs the duties of marine observation, forecast, early warning, disaster prevention and mitigation in the North China Sea region. It has issued marine forecasts, warnings and bulletins of various disasters, and participated in the emergency response of major marine disasters.
- There are 165 employees, including 11 professor-level Senior engineers, 50 senior engineers, 24 PhD.



# 1. Introduction of NCSFDMC

## Business Process

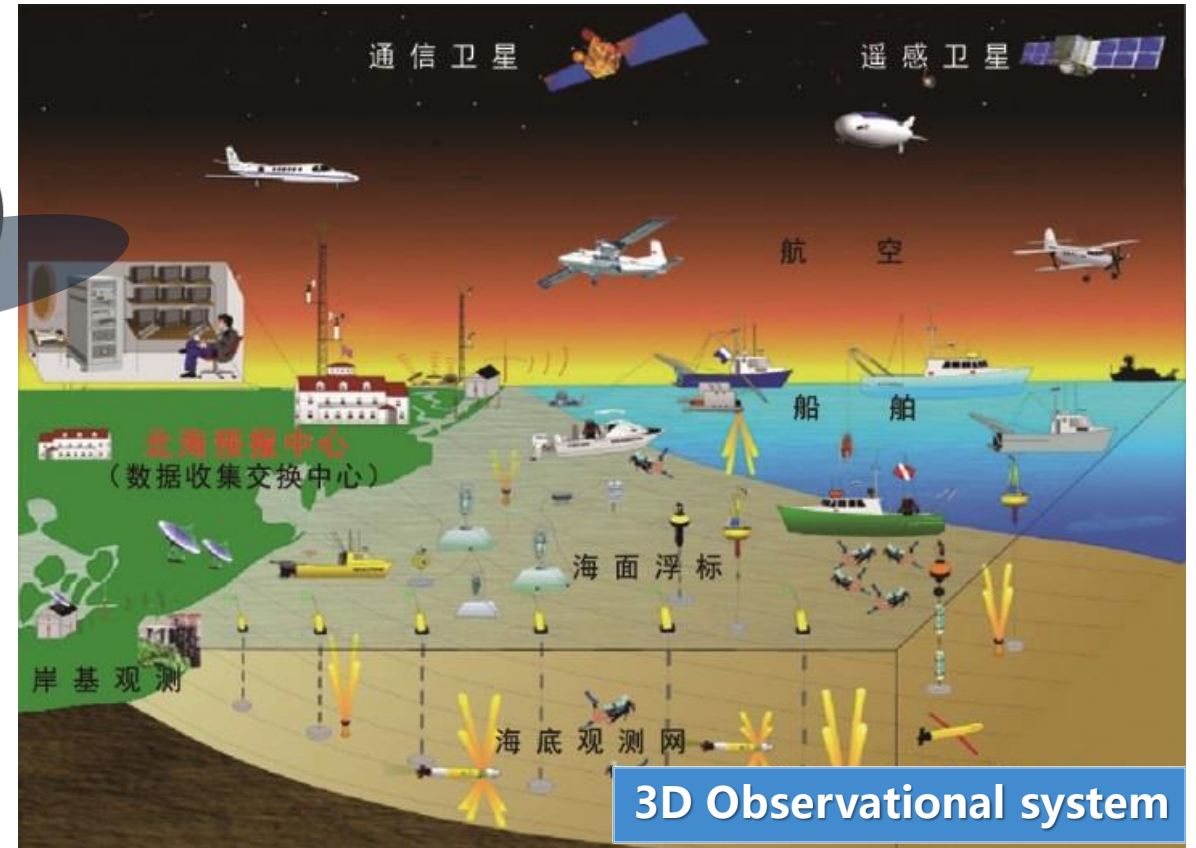
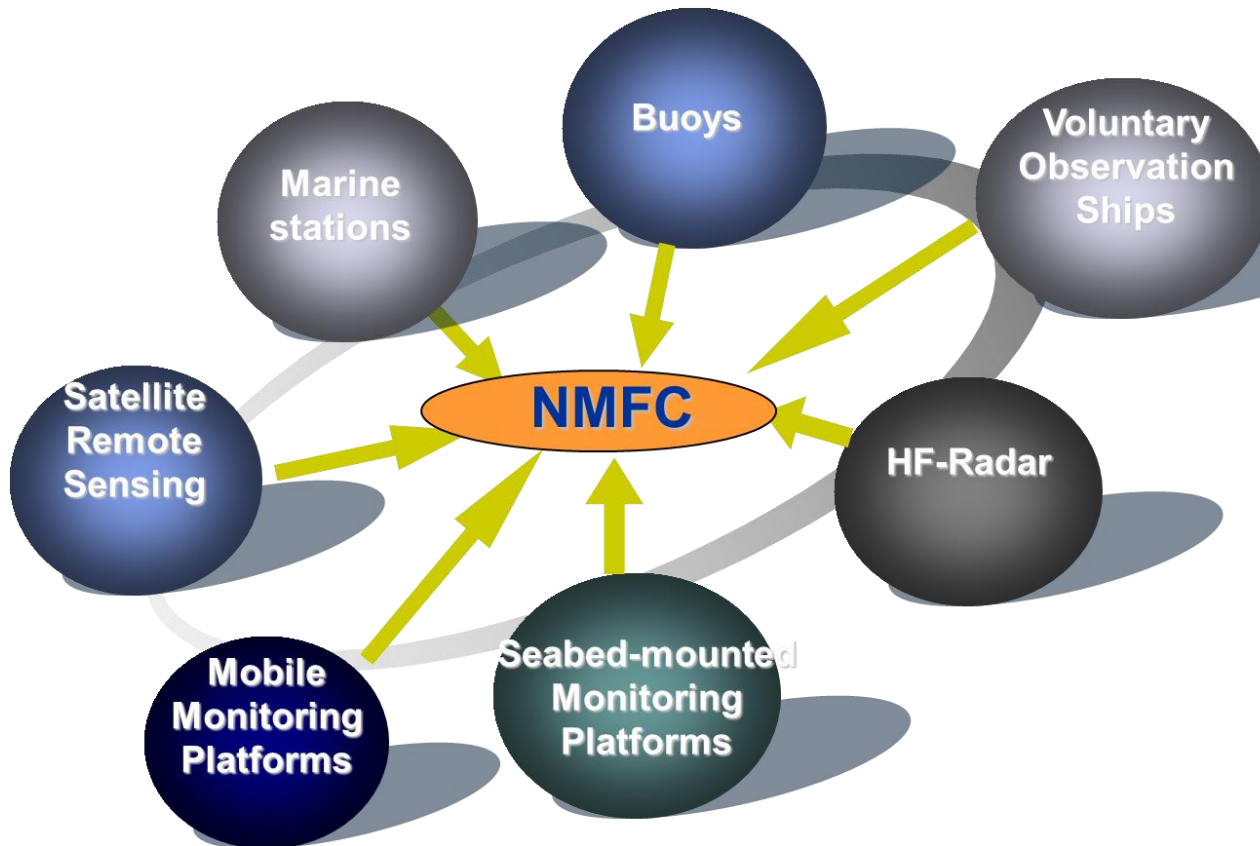




# 1. Introduction of NCSFDMC

## Observation

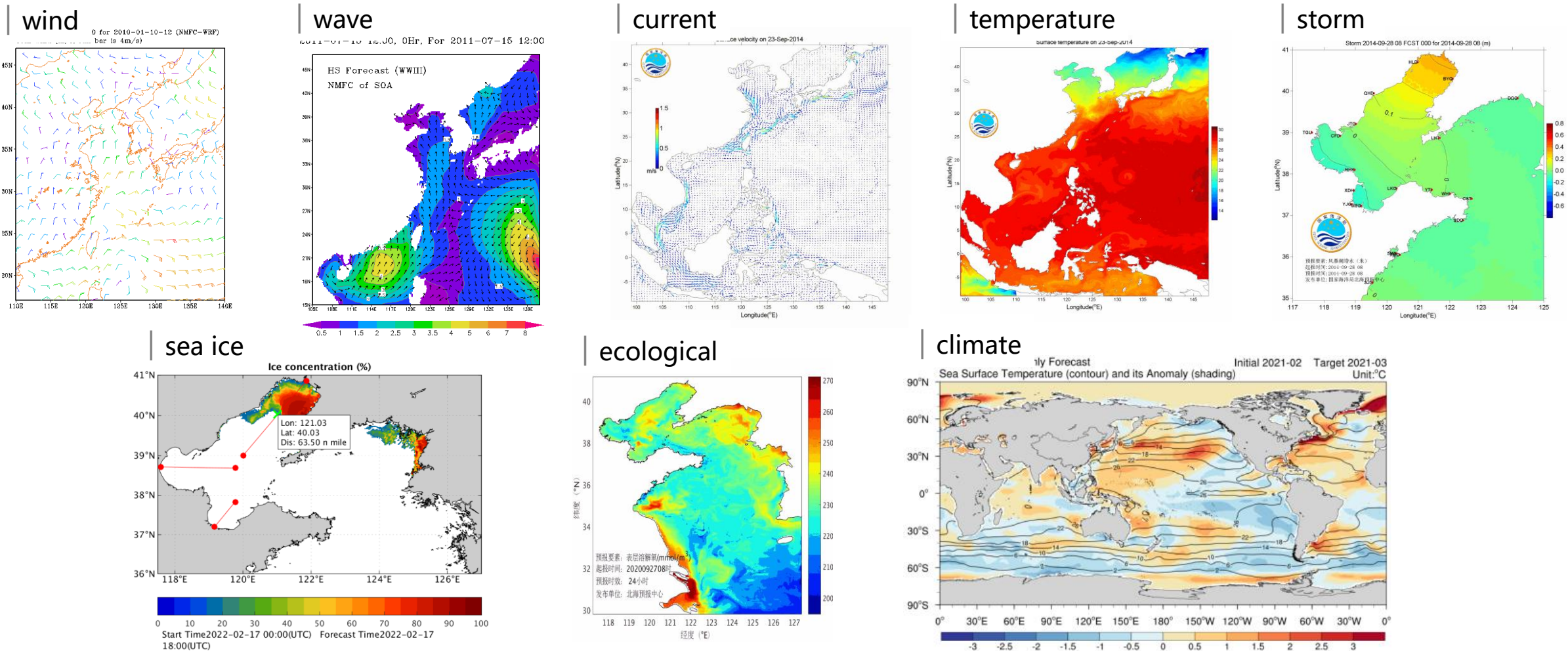
Over 50 years' development, our center has built a real-time marine environmental observation network, including marine stations, buoys, HF-Radar, voluntary ships, satellite remote sensing, etc.. Besides, operationally run tsunami warning and earthquake stations.



# 1. Introduction of NCSFDMC

## Prediction

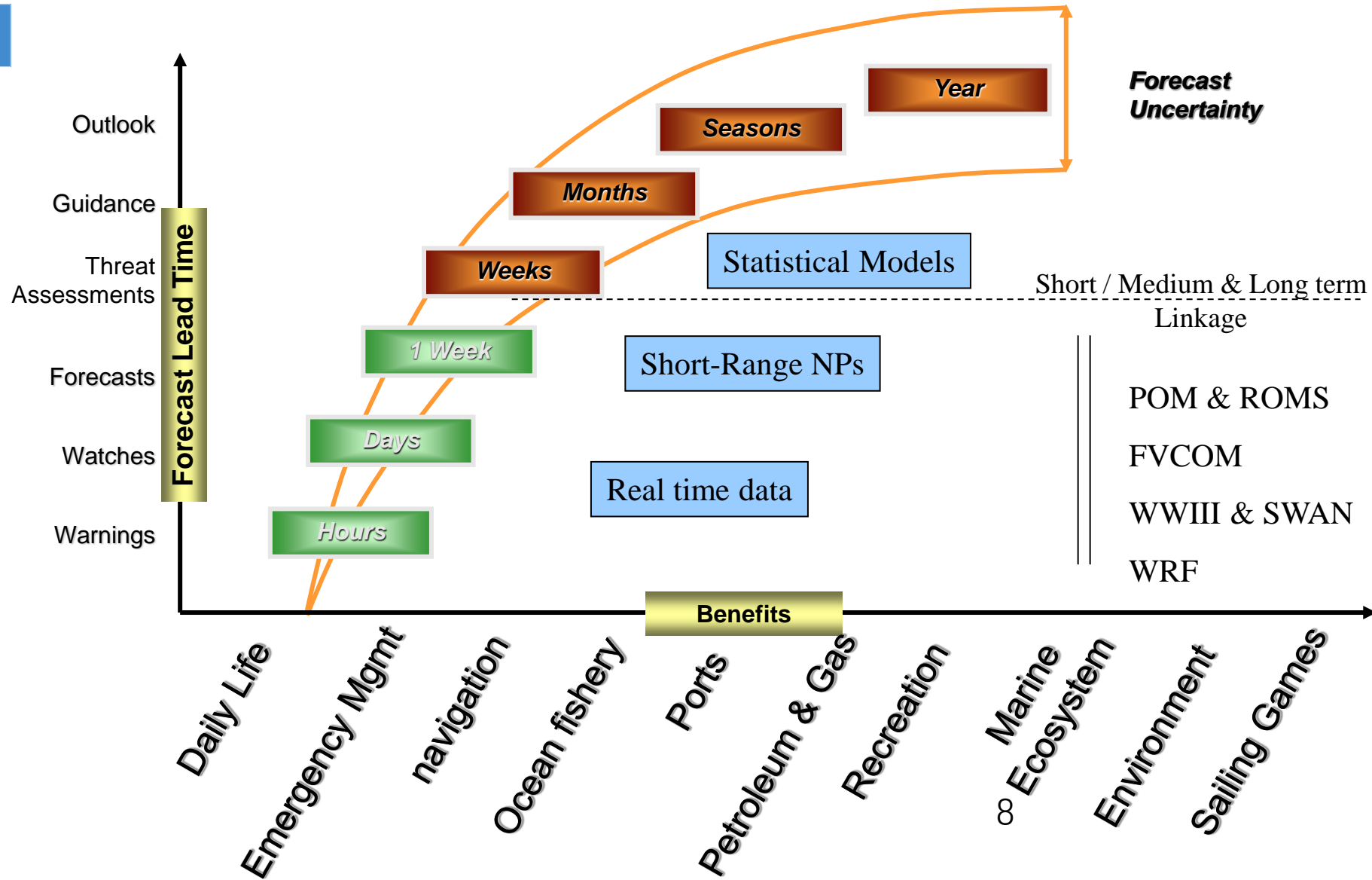
More than 100 kinds of products are generated every day, including wind, sea wave, tide, current, temperature, storm surge, sea ice, and climate, ecological product.





# 1. Introduction of NCSFDMC

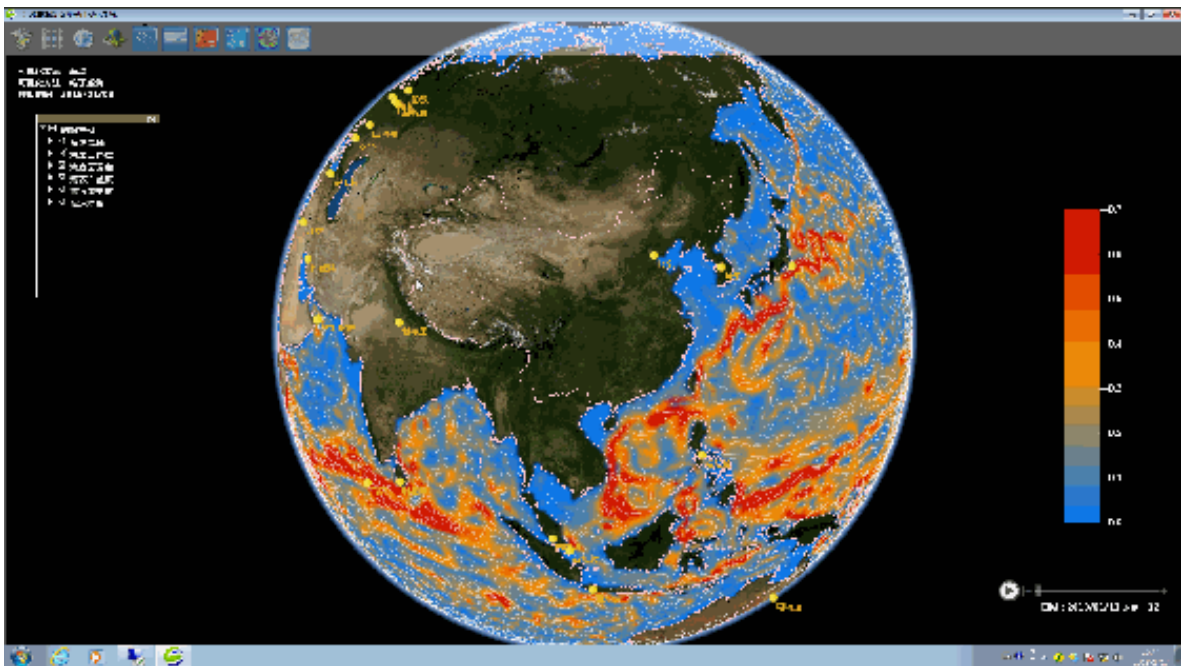
## Prediction



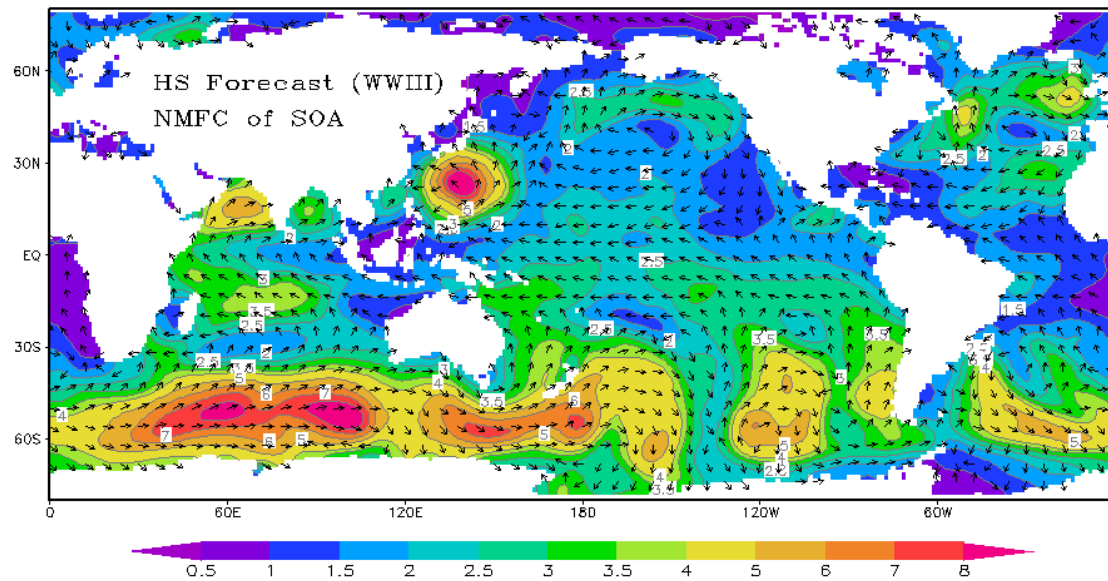




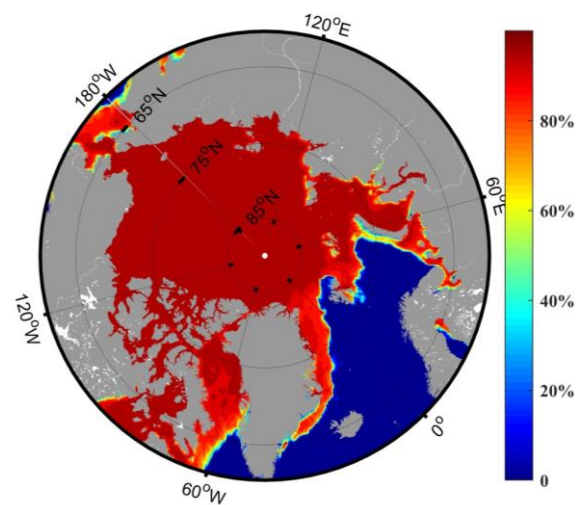
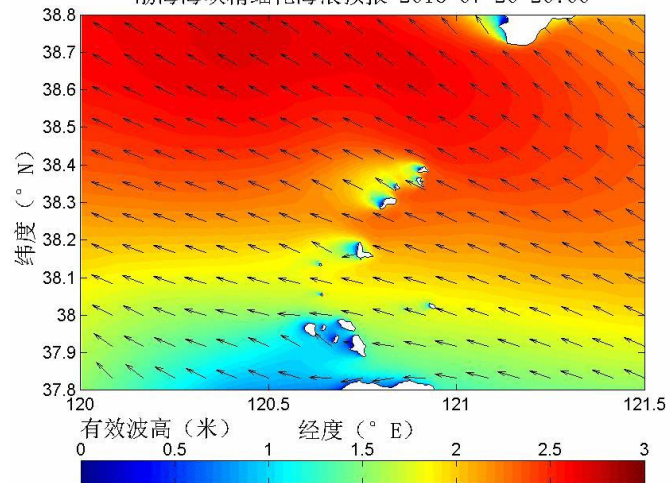
# 1. Introduction of NCSFDMC



2011-07-16 12:00, 0Hr, For 2011-07-16 12:00

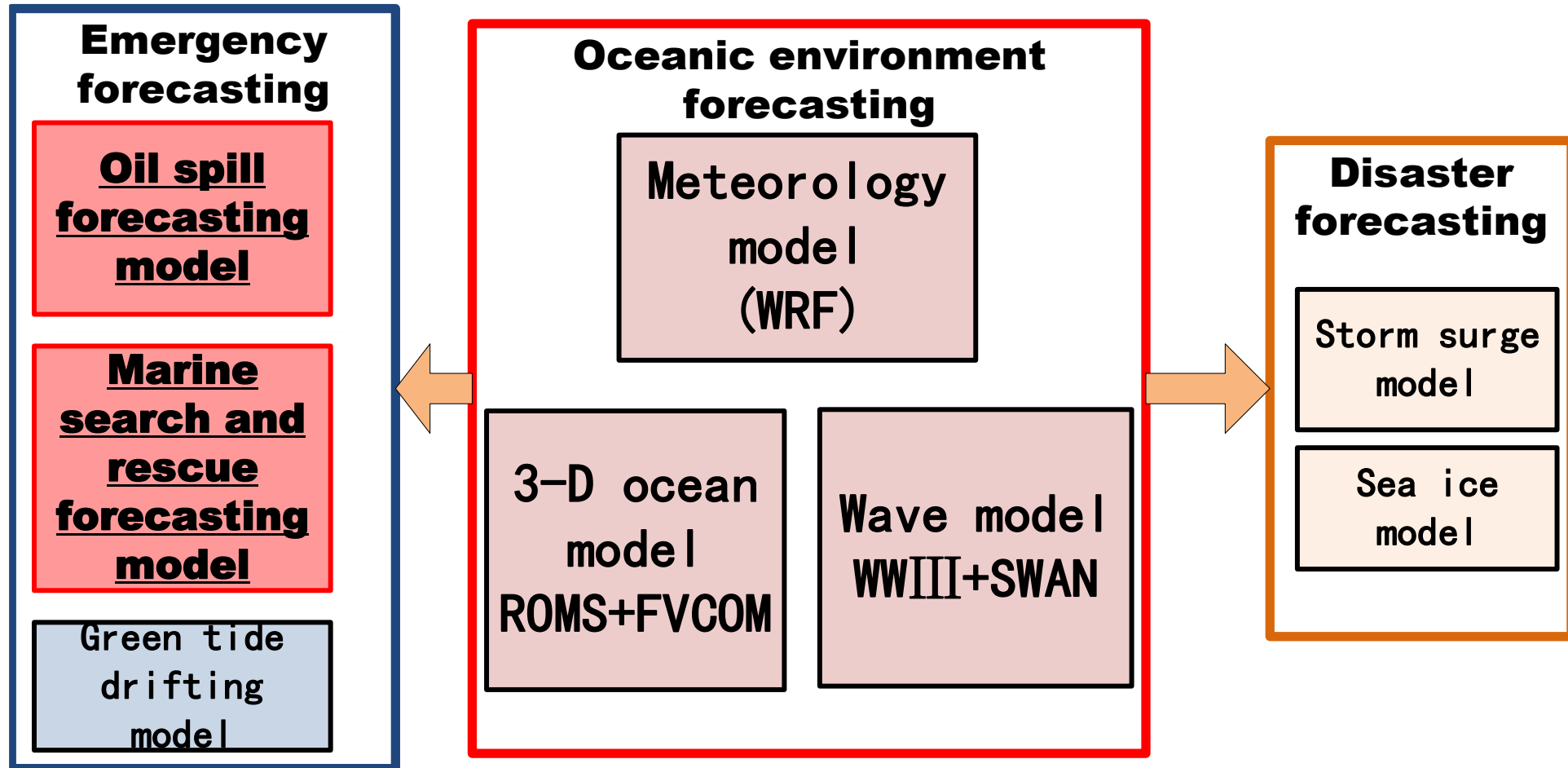


渤海海峡精细化海浪预报 2016-07-20 20:00



# 1. Introduction of NCSFDMC

## Prediction--Numerical models





# 1. Introduction of NCSFDMC

There are two sets of high-performance computers with computing power of 90 trillion times per second and 600T of available storage.



# 1. Introduction of NCSFDMC

## Disaster prevention and mitigation

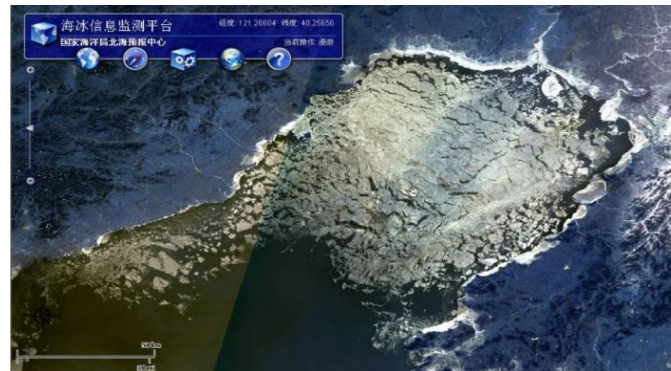
Release early warning for marine disasters, including storm surge, huge waves, sea ice. Publish monitoring and forecast for marine ecological disasters, like Green Tide and Red Tide, as well as oil spill or other pollution leakage.



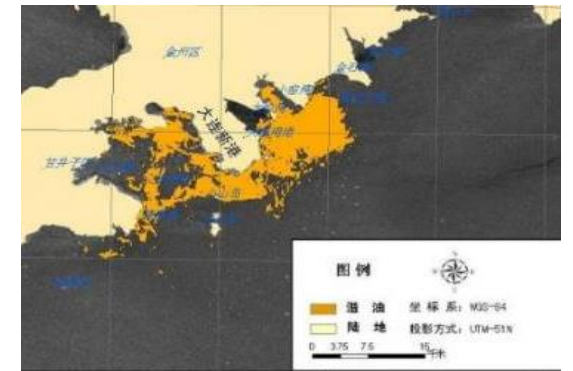
Storm surge



Huge wave



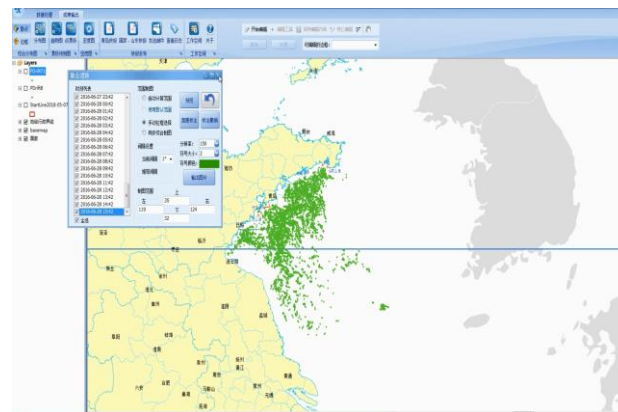
sea ice



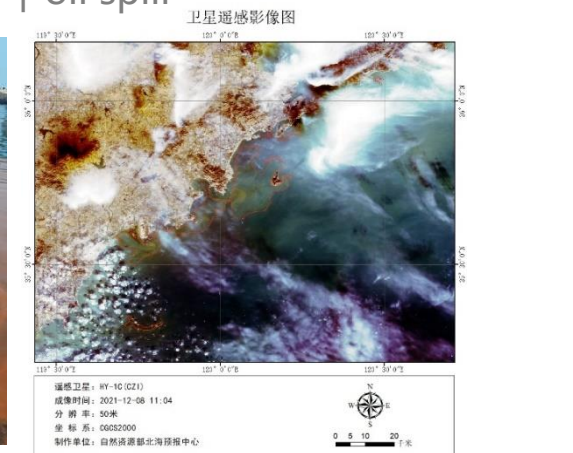
oil spill



Green Tide



Red Tide



02

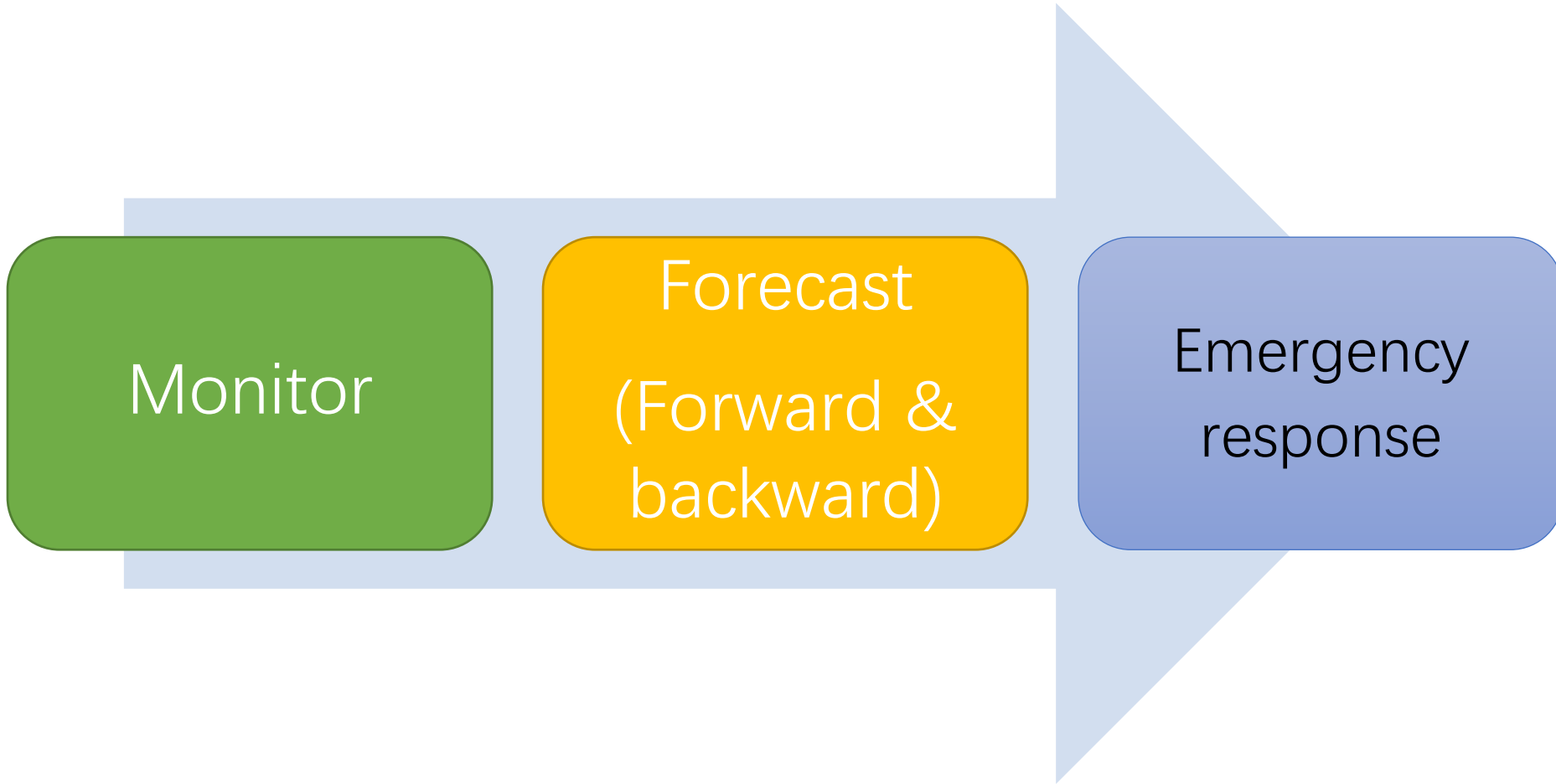


## Decision support system for offshore oil spill

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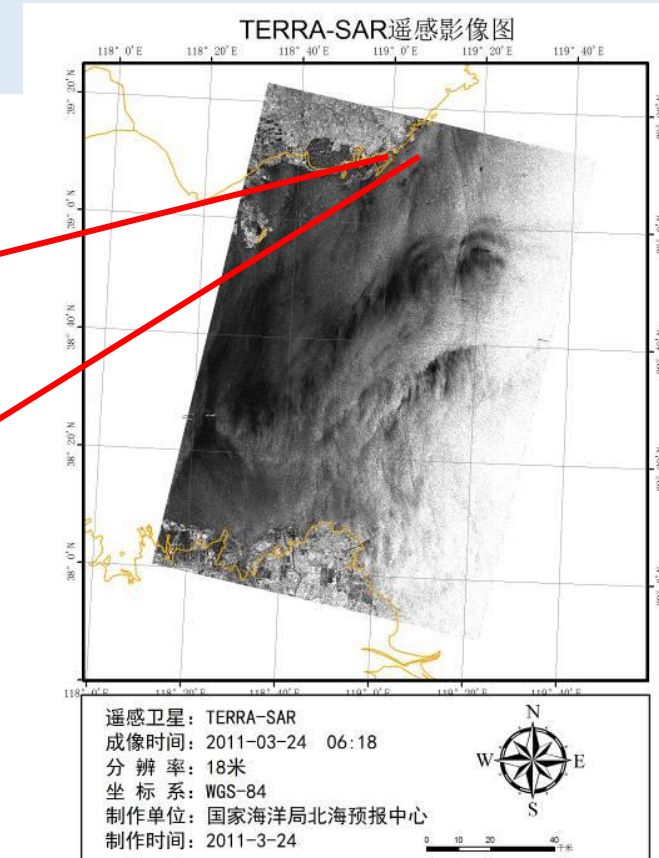
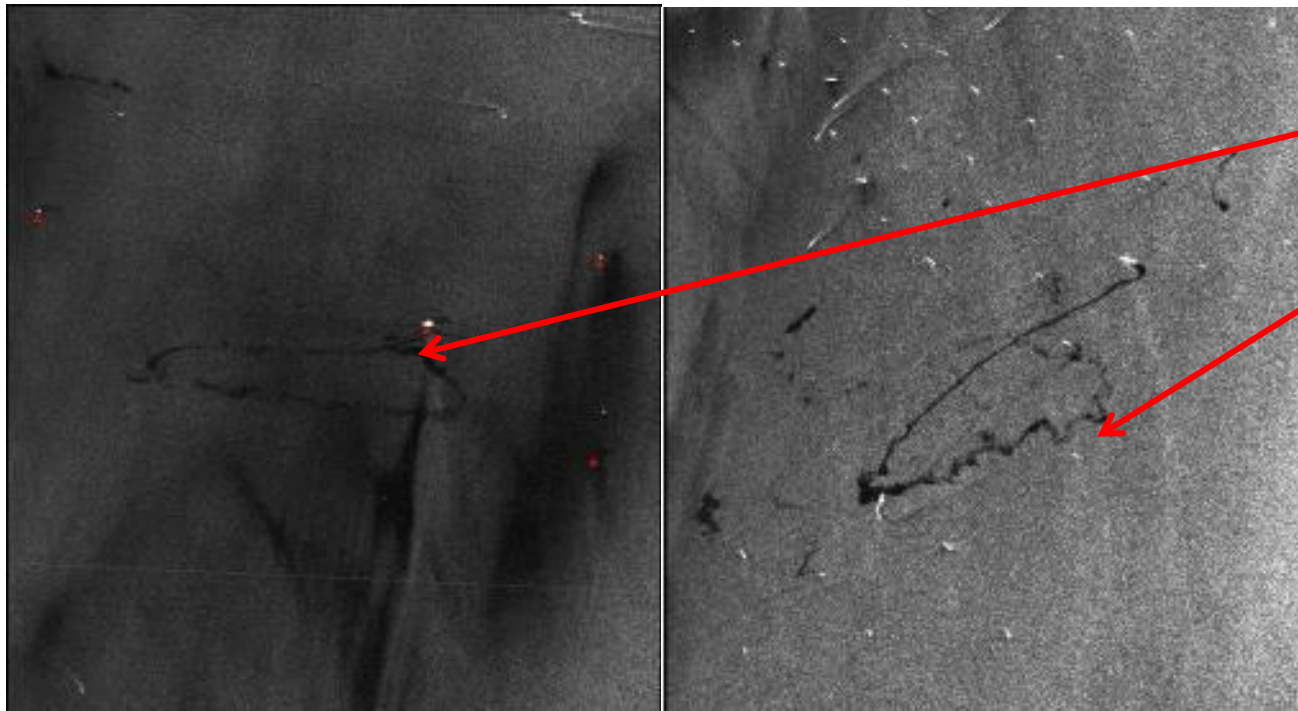
## 2. Emergency response system for offshore oil spill





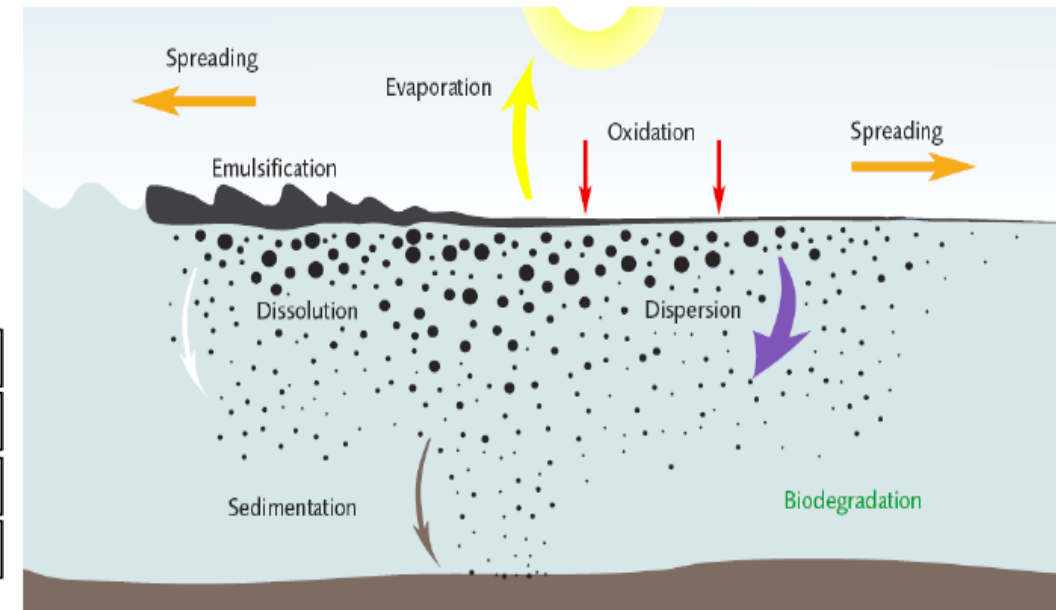
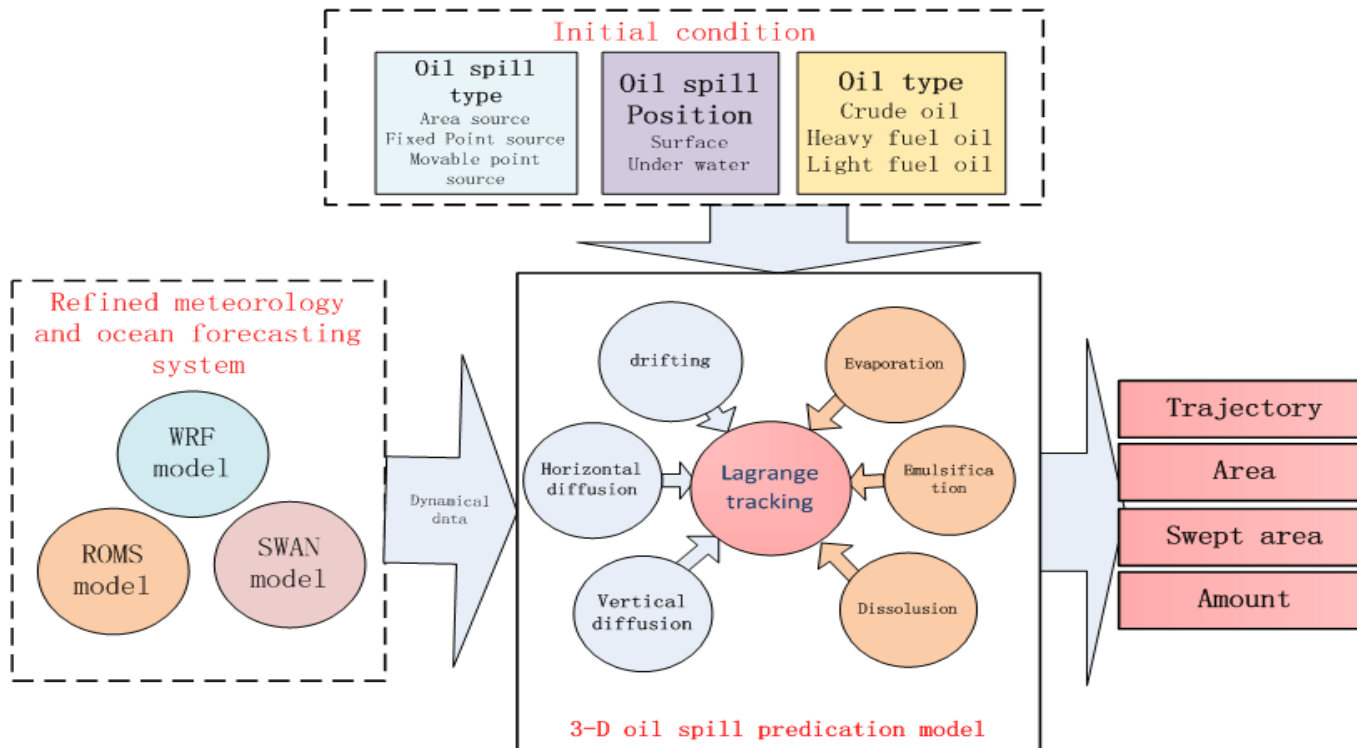
## 2. Monitoring technology of offshore oil spill

- Since the 1990s, research has been conducted on offshore oil spill accidents and has played an important role in technical support.
- Using multi-source SAR and domestic optical satellite remote sensing data, oil spill remote sensing monitoring technology has been developed to form full coverage and all-weather monitoring of oil spill in the North Sea.
- **Multiscale segmentation algorithm of SAR images for oils monitoring.**
- **Optical image extraction technology for oil spill information .**



## 2. Prediction model of offshore oil spill

- Based on Lagrange method, we established numerical ‘oil model’ to simulate the behavior and fate of spilled oil in the water, including oils’ spreading, evaporation on the surface, as well as its dissolution and sedimentation in the water.
- The model is driven by oceanic environment operation forecast system run by our center, which is composed of WRF, ROMS, FVCOM and SWAN models.
- The input of the model is information about oil, such as its type, amount, position and so on. The outputs are its trajectory, swept area, region of influence, and residual oil amount.





# 2. Prediction model of offshore oil spill

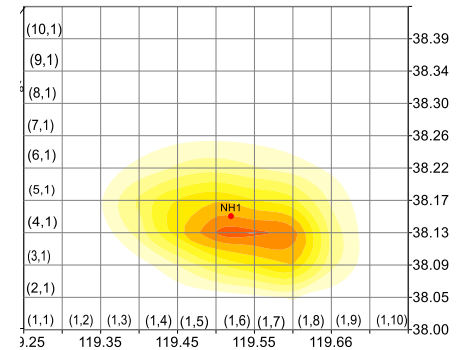
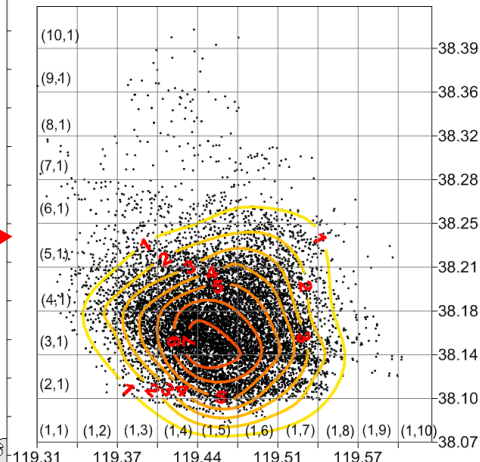
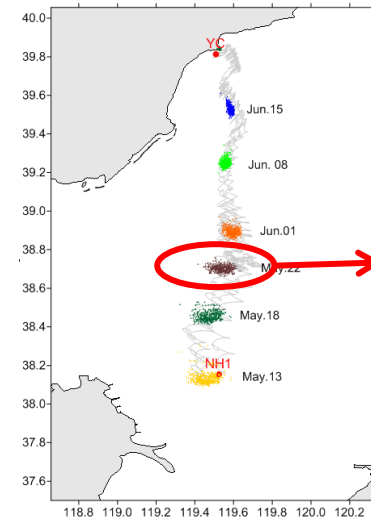
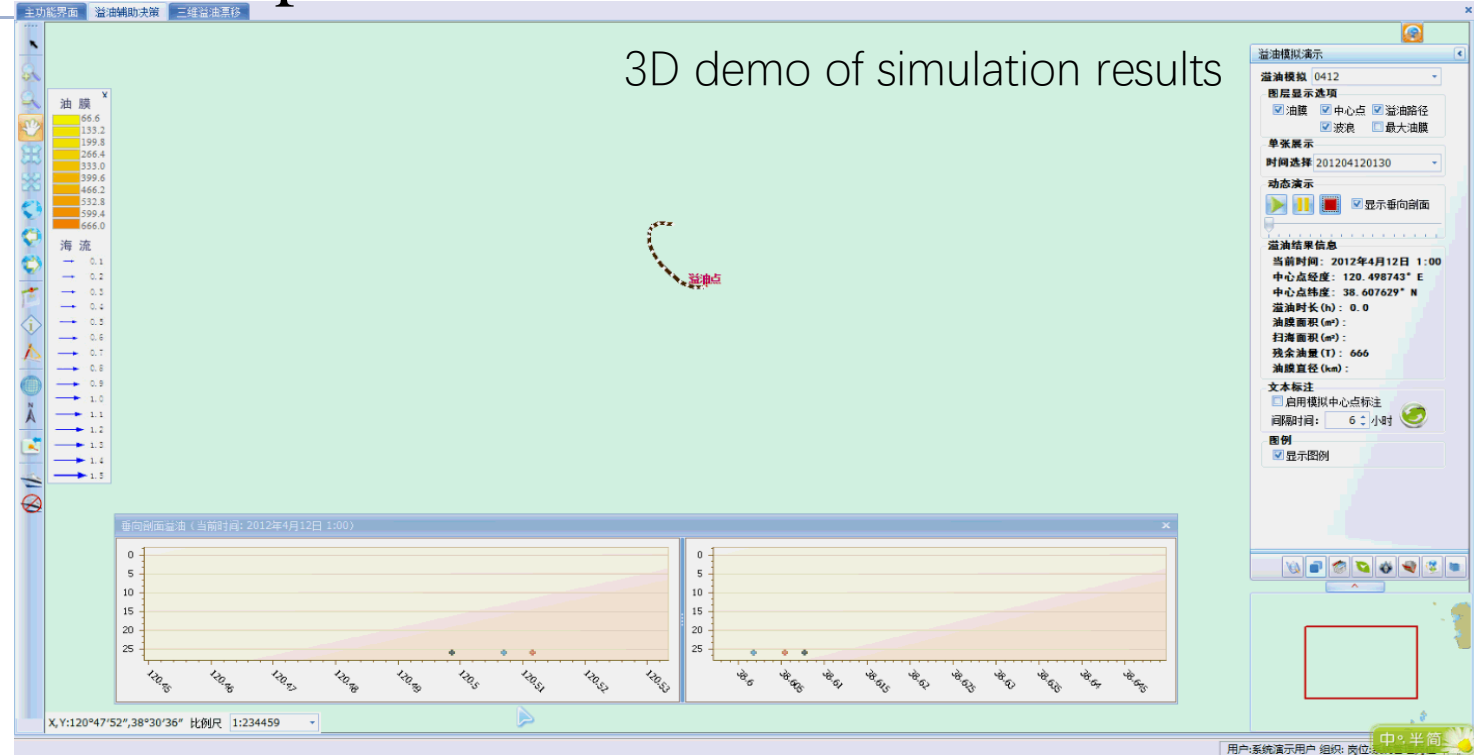
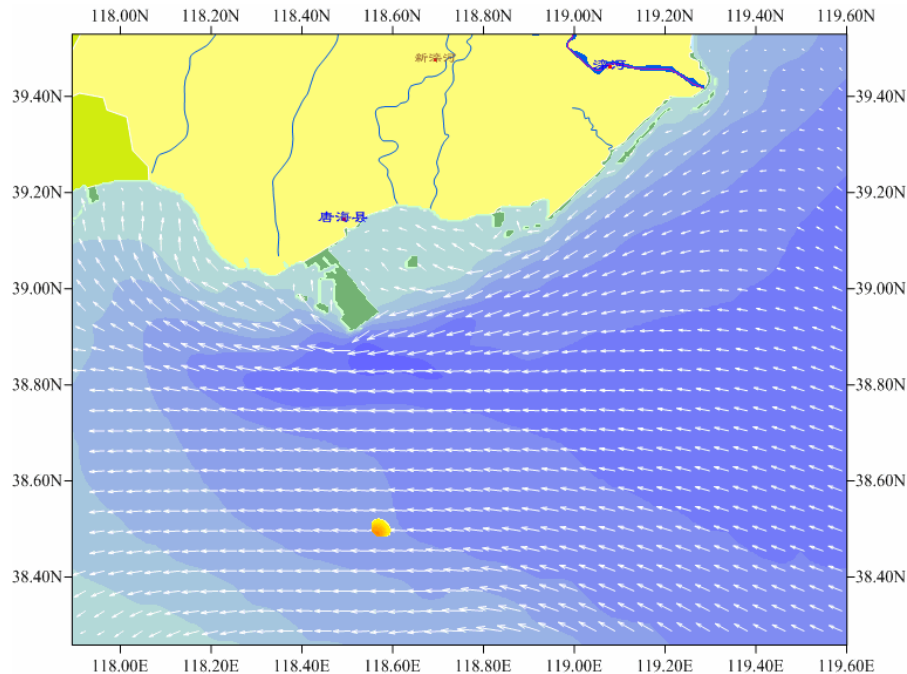
Emergency prediction system of oil spill

Rapid forecast of trajectory

2d drifting forecast

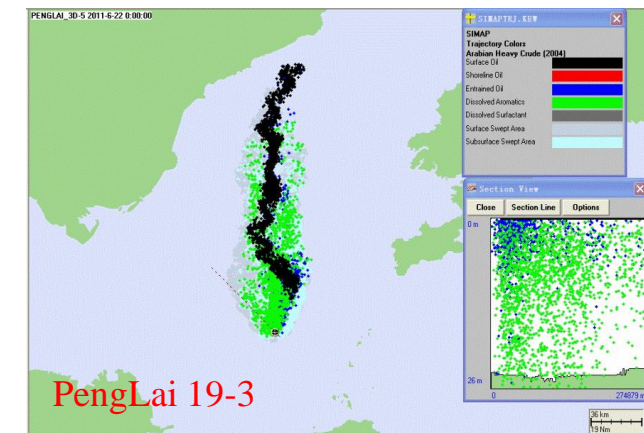
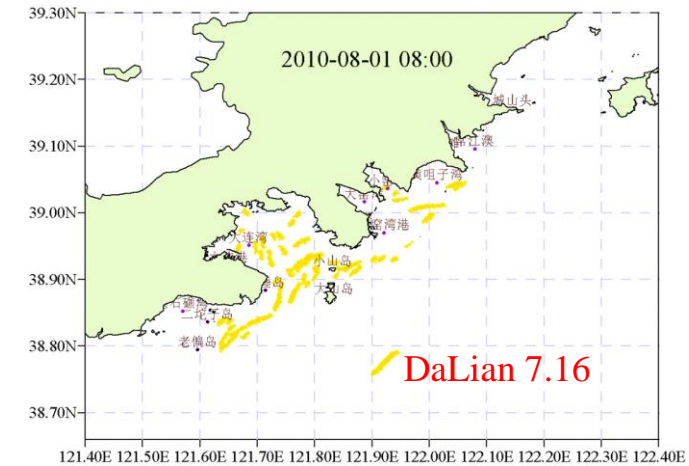
3d drifting and fate forecast

Back-tracing



## 2. "One map" for emergency response of offshore oil spill

Developed "One map" for emergency response of offshore oil spill, which integrates present status of oil spill and its drifting tendency, disposal resources, environmental forecasting and real-time monitoring, gives the analysis on development of oil pollution, and the disposal plan or strategies. That will help managers make their decisions quickly.



## 2. Decision support system for offshore oil spill

The screenshot displays the '海上溢油应急处置决策支持子系统' (Offshore Oil Spill Emergency Response Decision Support Subsystem) interface. The main map shows a central oil spill area with a yellow and red core, surrounded by a red circular boundary. A blue trajectory line indicates the path of the spill, and a cyan swept area is shown. The map includes wind vectors (yellow arrows) and wave forecasts (blue arrows). The interface features a top navigation bar with '青岛 海风: 东南风2级' (Qingdao Sea Wind: Southeast Wind Level 2) and '海上突发事件应急处置综合决策支持系统 (2017YFC1405000)'. A right-hand panel provides '当前海况信息' (Current Sea Condition Information) and '应急力量信息' (Emergency Force Information). A video player at the bottom left shows a live disposal video.

**Trajectory forecasting**

**Swept area forecasting**

**Monitoring location design**

**Clean up scheme, including equipment and itinerary.**

**Video of live disposal**

**Realtime monitoring  
Wind, current and wave forecast**

**应急力量信息**

- 围油船(万达9): 完成任务
- 围油船(东茂8): 完成任务
- 吸油船(德润): 完成任务
- 监测直升机: 执行任务

03

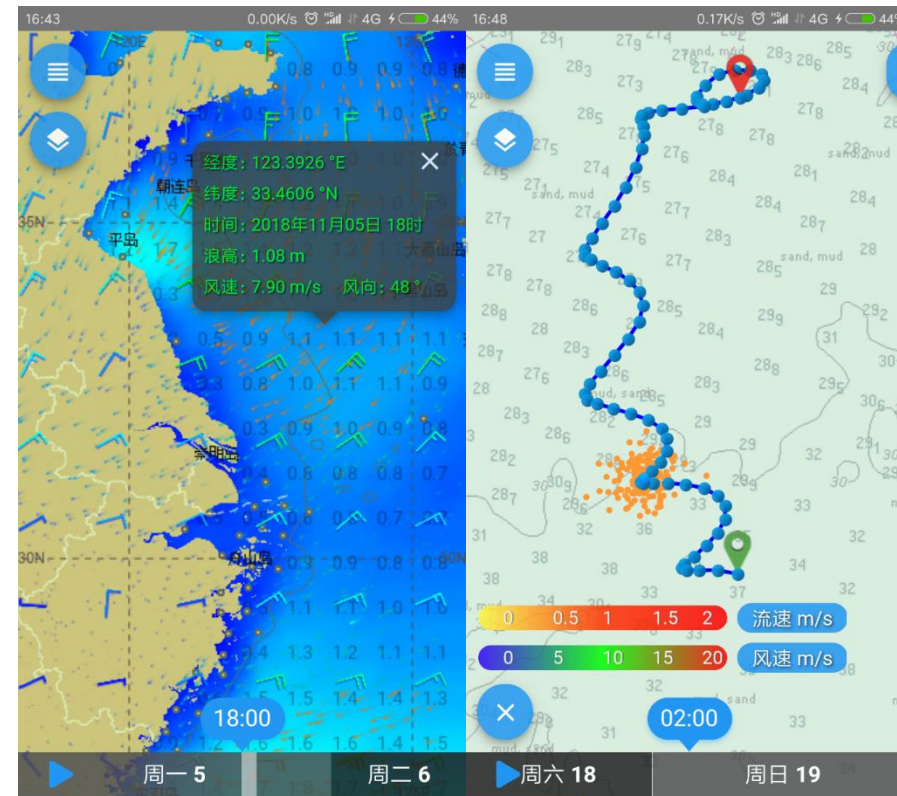
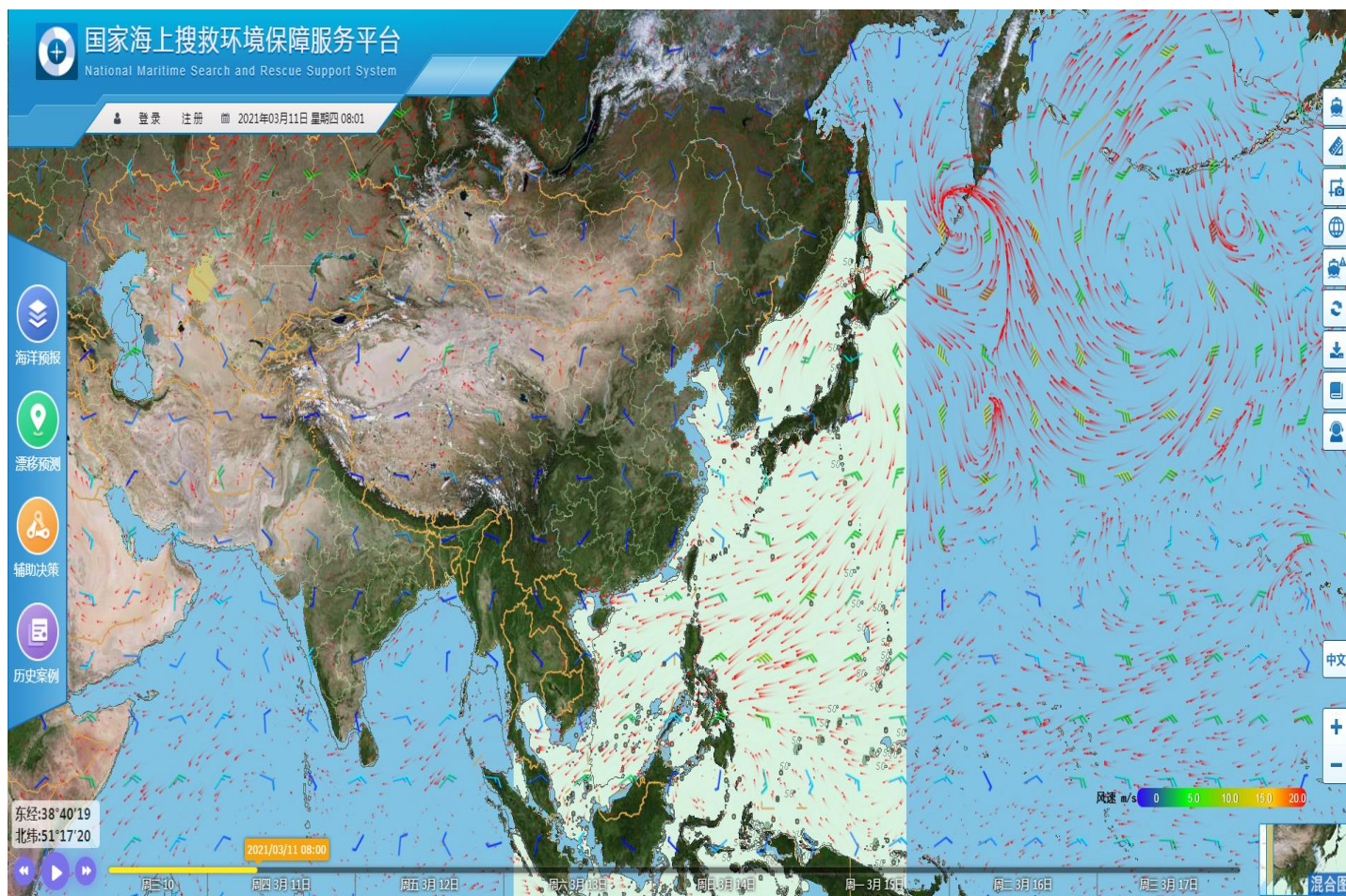


## **Decision support system for maritime search and rescue**

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### 3. Decision support system for maritime search and rescue

As a member of the National Maritime Search and Rescue (SAR) joint meeting, our main responsibility is to provide oceanic forecast and decision support information. We developed the national maritime search and rescue support platform, which has been applied to the maritime search and rescue centers in various provinces and cities across the country. The users are more than 900.



# 3. Decision support system for maritime search and rescue

## Trajectory forecast

< 2 min

The screenshot displays the 'National Maritime Search and Rescue Support System' interface. It features a '普通预测' (General Forecast) dialog box with the following settings:

- 日期时刻: 2023-03-31 16:05
- 预测时长: 24 h
- 目标类型: 救生衣-平躺
- 经度: 121 度 07 分 00 秒
- 纬度: 38 度 07 分 00 秒
- 风场作用参数: 0.02
- 流场作用参数: 1

The main map shows a trajectory forecast starting from a blue dot and ending at a red dot, with a green line connecting them. A red box highlights the '风场作用参数' slider in the dialog box, which is set to 0.02. A red arrow points from this slider to a diagram below.

On the right, there is a '历史案例列表' (Historical Case List) table:

案例编号	起始时间	预测时长	经度	纬度
<input checked="" type="checkbox"/> bh0202303280001	2023-03-28 00:00	72	122°30'0"E	35°36'4"N
<input type="checkbox"/> bh0202303270018	2023-03-27 11:34	72	123°39'44"E	35°36'4"N
<input type="checkbox"/> bh0202303270010	2023-03-27 10:54	24	120°30'56"E	35°36'4"N
<input type="checkbox"/> bh0202303270006	2023-03-27 10:42	72	121°7'0"E	35°36'4"N
<input type="checkbox"/> bh0202303240005	2023-03-24 10:12	24	121°20'30"E	35°36'4"N
<input type="checkbox"/> bh0202303230014	2023-03-23 09:46	24	121°7'0"E	35°36'4"N
<input type="checkbox"/> bh0202303230001	2023-03-23 08:00	72	121°45'4"E	35°36'4"N
<input type="checkbox"/> bh0202303230001	2023-03-23 08:00	72	121°45'4"E	35°36'4"N
<input type="checkbox"/> bh0202303210001	2023-03-21 00:00	72	122°30'0"E	35°36'4"N



### 3. Decision support system for maritime search and rescue

#### Searching area forecast and path planning

The screenshot displays the National Maritime Search and Rescue Support System interface. The main map shows a search area forecast with a red outline and a path planning route with time markers. A search unit parameter settings dialog box is open, showing search area, search mode, and search unit parameters. A historical case list table is visible on the right, and a case information table is shown below it.

**国家海上搜救环境保障服务平台**  
National Maritime Search and Rescue Support System

当前用户: BH-PT-test15

**搜索单元参数设置**

搜索区域: [选择] 搜索模式: [选择] 搜索单元: [选择]

搜寻路线参数

航线间距: 0.2 nm  
扫视宽度: 0.5 nm

搜寻模式选择

周边船舶推荐(艘/架): 3 [推荐]

平行线(整体)  平行线(局部)  扩展方形  扇形

搜救力量部署 (周边船舶/公务船舶)

船号	航速(nm/h)	经度°	纬度°	船长(m)
412202861	3	120.564817	38.585165	0
937305678	0	120.513112	38.588062	144
412202862	3	120.579227	38.582290	23

**历史案例列表**

案例编号	起始时间	预测时长	经度°	纬度°
bh22018103004	2018-10-30 13:31	24	120°30'56"	
bh22018103003	2018-10-30 09:53	24	120°30'56"	
bh22018103002	2018-10-30 09:23	24	120°30'56"	
bh22018103001	2018-10-30 09:23	24	120°30'56"	
bh22018102802	2018-10-28 22:19	24	120°30'56"	
bh22018102801	2018-10-28 20:21	24	120°30'56"	
bh22018102701	2018-10-27 17:03	24	120°30'56"	
bh22018102401	2018-10-24 19:49	24	120°30'56"	
bh22018102301	2018-10-23 15:33	24	120°30'56"	
bh22018102202	2018-10-22 20:08	24	120°30'56"	
bh22018102201	2018-10-22 15:51	24	120°30'56"	
bh22018102001	2018-10-20 22:19	24	120°30'56"	

**案例信息** bh22018102401

编号	时间	经度°	纬度°	距离°	速度(m)
1	20181024194900	120°30'57"	38°30'30"N	111.3	0.58
2	20181024204900	120°32'22"	38°30'13"N	117.0	0.62
3	20181024214900	120°33'37"	38°29'50"N	125.5	0.52
4	20181024224900	120°34'27"	38°29'31"N	140.2	0.31
5	20181024234900	120°34'41"	38°29'24"N	210.3	0.14
6	20181025004900	120°34'15"	38°29'32"N	275.2	0.33
7	20181025014900	120°33'19"	38°29'21"N	227.4	0.67

04



# Cooperation and Application

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# 4. International Cooperation



University of Hamburg

Arctic Council

Bedford Institute of Oceanography

Danish meteorological institute

NOAA GLERL

Finnish meteorological institute

North Carolina State University

PICES

China-ASEAN

Malaysia, Indonesia

Commonwealth Scientific and Industrial Research Organization, Australia



# 4. Cooperation on offshore oil spill

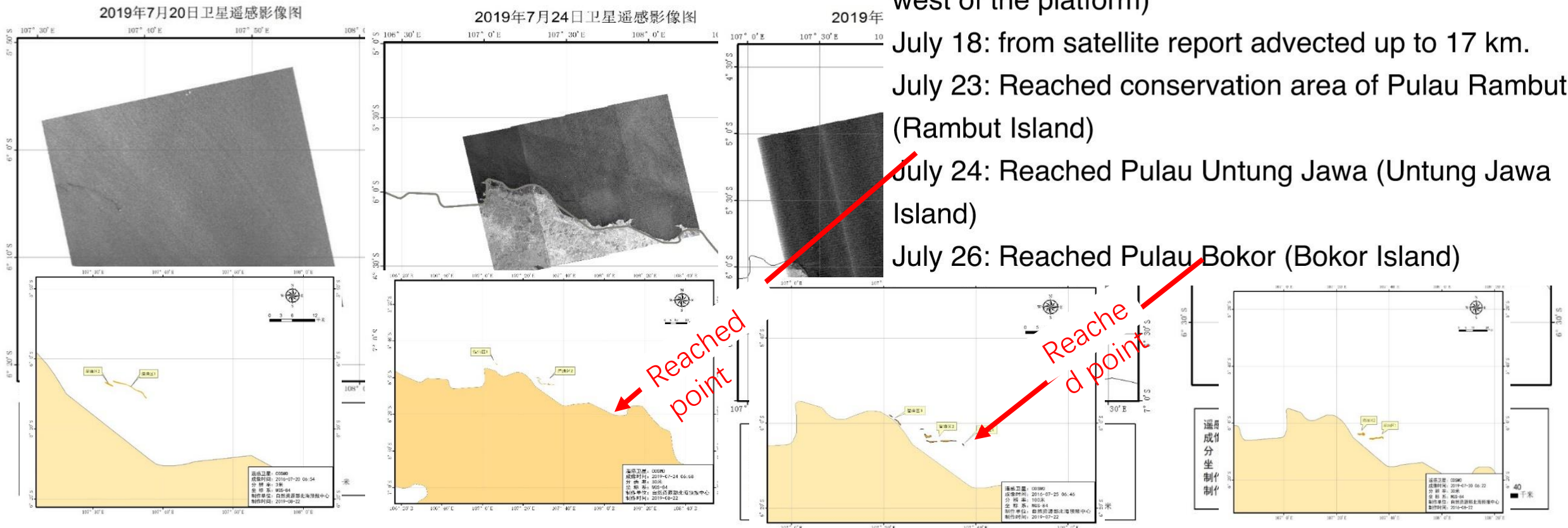
There was one oil spill case happened in Indonesia on July 12, 2019. With our monitoring technology, we obtained the distribution information of spilled oils from 20th to 30th, and sent the results to our partner (Institute Technology of Bandung, ITB). And they confirmed that the monitoring results were consistent with the actual location.

Q:Where and when did you find the oil on the coast?  
 A: July 18: coastal impact started to occur (2 km from west of the platform)

July 18: from satellite report advected up to 17 km.  
 July 23: Reached conservation area of Pulau Rambut (Rambut Island)

July 24: Reached Pulau Untung Jawa (Untung Jawa Island)

July 26: Reached Pulau Bokor (Bokor Island)



## 4. Application of National maritime search and rescue platform

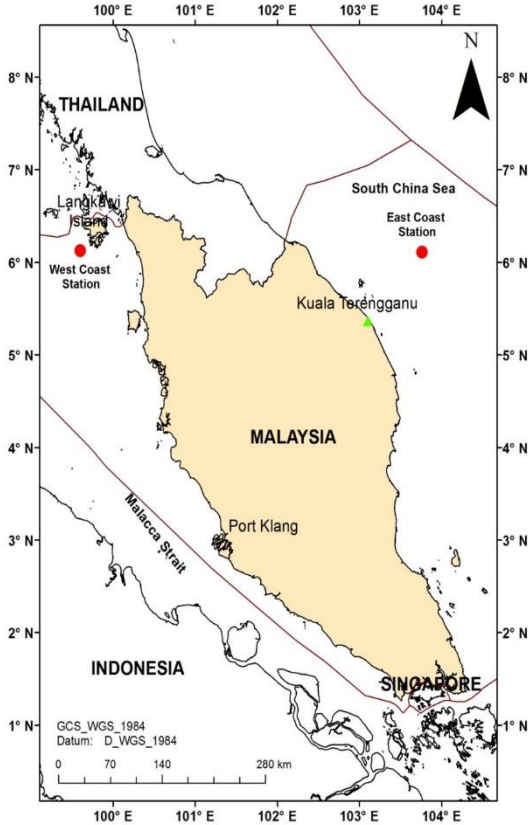
- 2018.01, China-Indonesia Maritime Search and Rescue Technology Training Conference.
- 2018.03, signed the memorandum of understanding between Institut Teknologi Bandung (ITB) of Indonesia and NCSFDMC of China.



## 4. Application of National maritime search and rescue platform

- Jointly drifting experiment

2018.07.21-31, our center and the University Malaysia Terengganu (UMT) jointly carried out the drift tracking test of search and rescue targets in the east and west coast of Malaysia.



## 4. Application of National maritime search and rescue platform

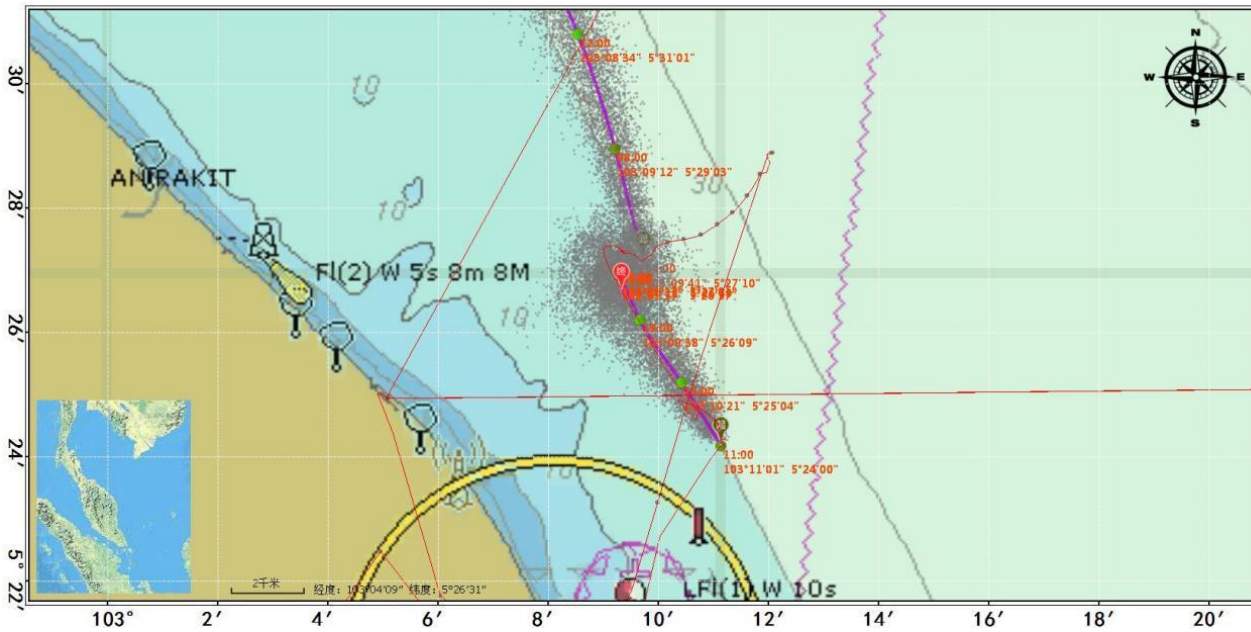
- Independently developed dummy for drift simulation
- The density of the dummy is the same as that of the human body, and its weight is equal to the average body weight
- Automatic location with real-time transmission,
- Diving grade seal, collision protection



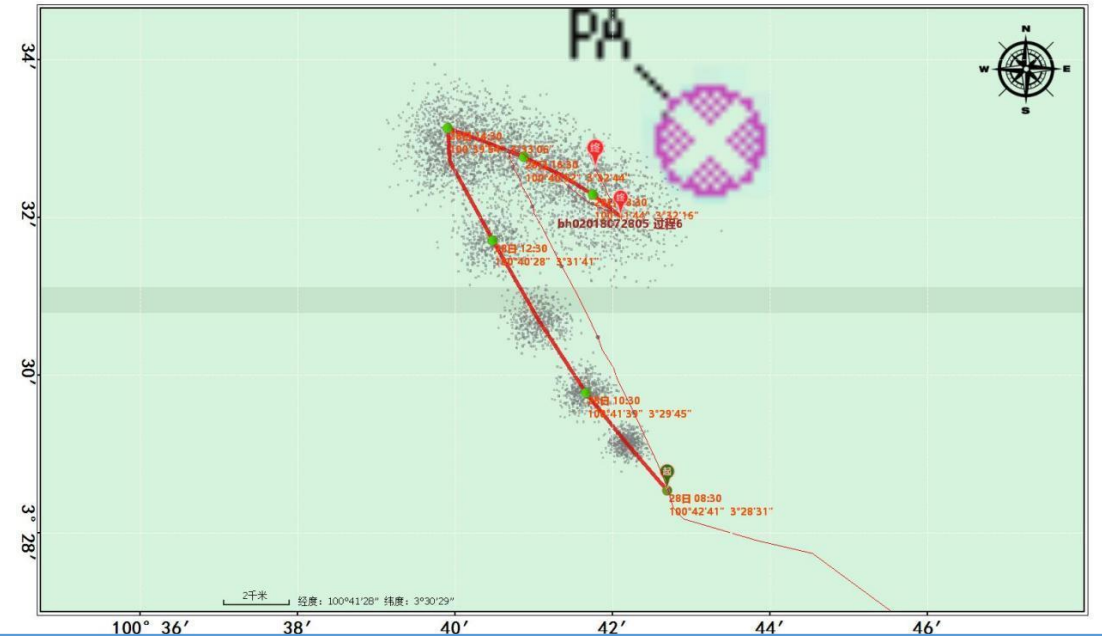


## 4. Application of National maritime search and rescue platform

- Based on this experiments, we calculate the forecast error of our platform. The results show, that our forecast trajectories agree very well with the actual ones, with the average distance deviation less than 1km and the average direction angle deviation less than  $15^\circ$ .



Observational trajectory (purple) vs forecast trajectory (red), in the east coast.



Observational trajectory (thick) vs forecast trajectory (thin), in the west coast.

谢谢!

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Thank You