National Marine Environmental Forecasting Center (NMEFC)
CHINA

Ocean forecasting information and its social benefits in China

Liying Wan and Xiaolei Yi

Structure of Chinese Forecast Organization

National Center

- National Marine Environmental forecasting Center

Regional Center

- North Marine Environmental forecasting Center
- East Marine Environmental forecasting Center
- South Marine Environmental forecasting Center

Province Center

- Liaoning
- Heibei
- Sandong
- more than 11 province

City Center

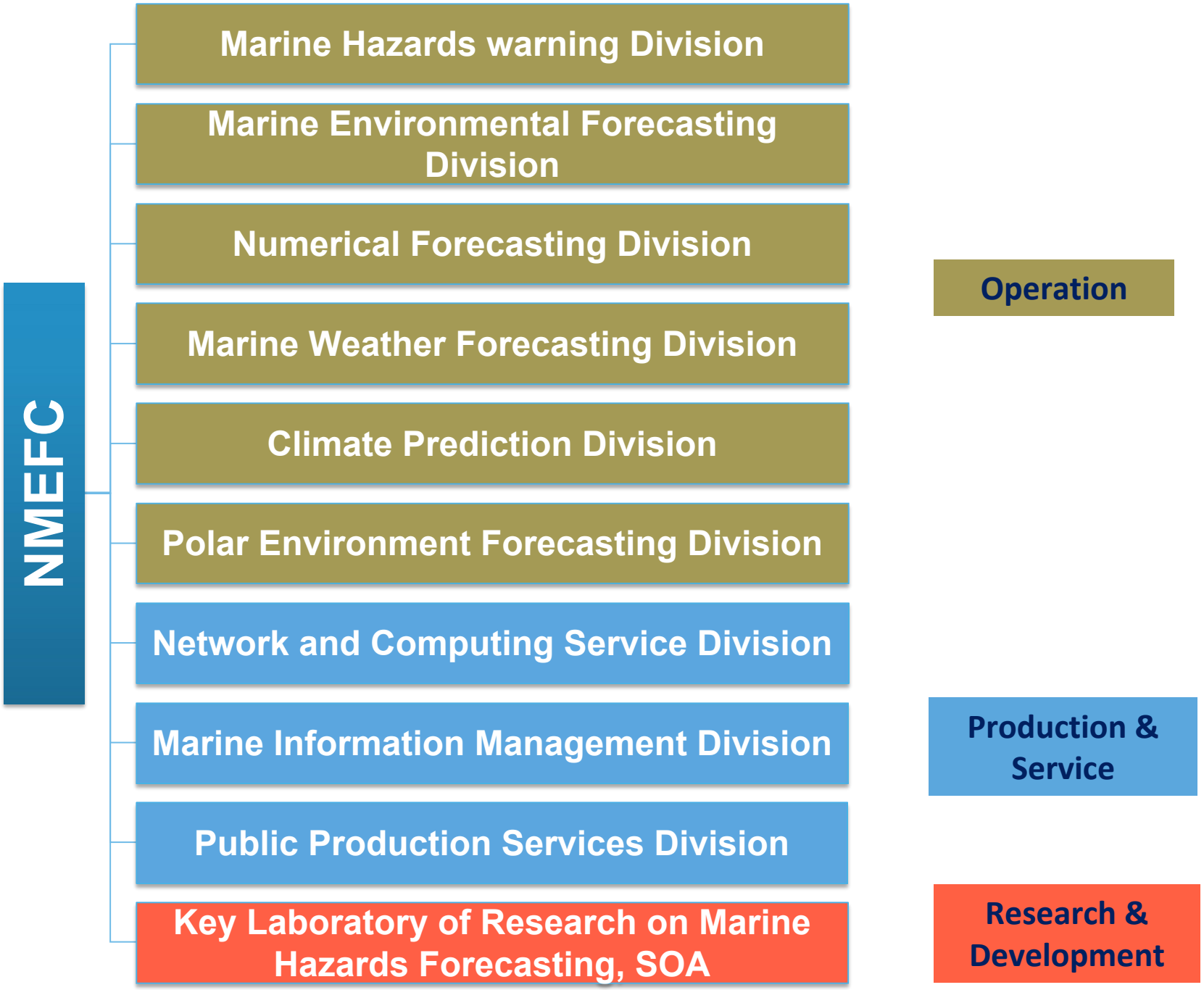
- Dalian
- Qinhuangdao
- Yantai
- more than 20 cities

Outline

- Introduction of NMEFC
- Status of marine forecasting and pre-warning
- Cases of Social benefits
- Summary and future

Overview

- NMEFC, Chinese national center for ocean forecasting
- Affiliated with the Ministry of Natural Resouces that receives financial support from the Chinese government
- Over 300 scientists and engineerings
- Authorized by the State Council Academic Degrees Committee of Physical Oceanography and Meteorology to grant Master's degrees
- Leading authority that specializes in marine environmental and disaster forecasting and warning systems, scientific research, and consulting services
- Actively engaged in partnerships with international scientists and agencies


NMEFC
Marine Hazards warning Division
Marine Environmental Forecasting Division
Numerical Forecasting Division
Marine Weather Forecasting Division
Climate Prediction Division
Polar Environment Forecasting Division
Network and Computing Service Division
Marine Information Management Division
Public Production Services Division
Key Laboratory of Research on Marine Hazards Forecasting, SOA
Operation
Production & Service
Research & Development

History

1965
Established as the Marine Hydro-meteorological Forecasting General Observatory

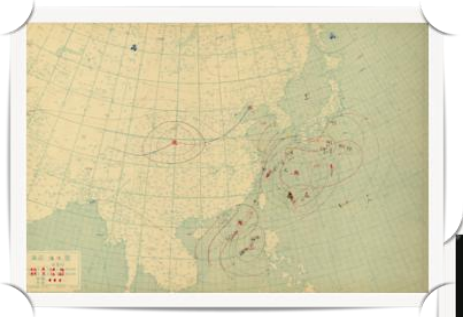
1966-1976
Marine weather and wave forecast(China sea)
Sea ice forecast(Bo hai sea)
Tropical cyclone storm surge forecast
Extra-tropical storm surge forecast
Sea temperature forecast (East China sea)

1983
Renamed as the National Marine Environmental Forecasting Center

1986-2010
release forecasts to public by radio and TV
El Niño forecast
numerical temperature-salinity-currents and ocean wave forecasting systems for the China Sea and Northwest Pacific Ocean
red tides forecast
tour and beach environment forecast
tsunami f...

2013
Tsunami Warning Center of SOA
Chinese Global Operational Oceanography Forecasting System(CGOFS)

2018
IOC/UNESCO South China Sea Tsunami Advisory Center (SCSTAC) starts to be trial-operational



Real-time data receiving system

Coastal observing stations

more than 20 key marine stations, including 109 observing points (till now):

Temperature, Salinity, Tide, Wave, Wind, Marine chemistry…

Buoys

25 large-size buoys for meteorology and wave height, temp.,

2 offshore small-size buoys；

2 Deep-sea Moorings；

4 offshore bottom-mounted moorings；

2 tsunami buoys.

Radars

5 Ground wave Radar for current, wave field;

2 X-band Marine Radar for wave field;

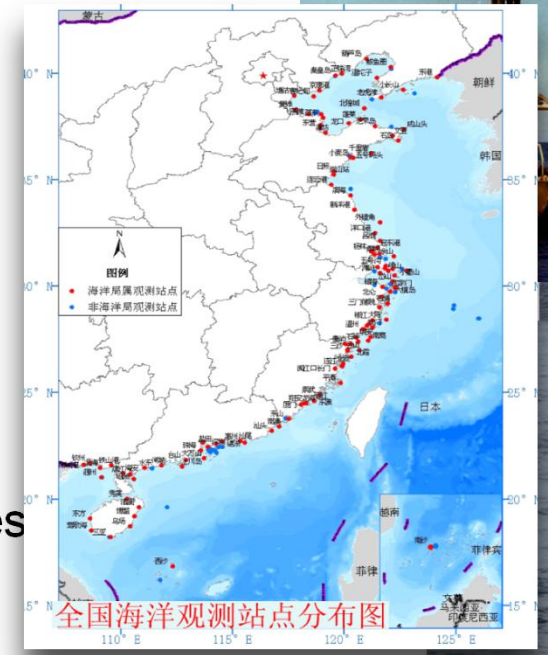
1 Radar Ice Sounder for Sea ice regime, thicknes

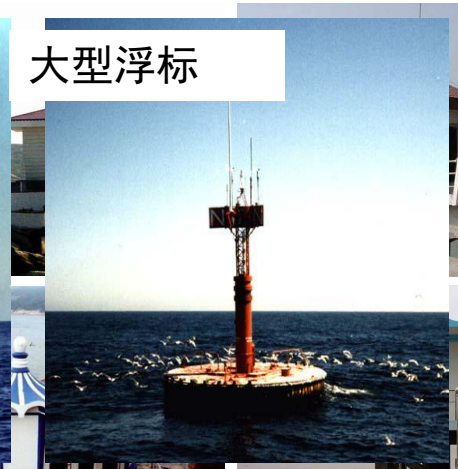
International sources

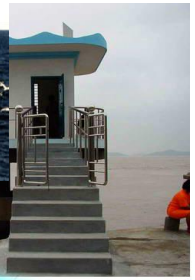
GTS

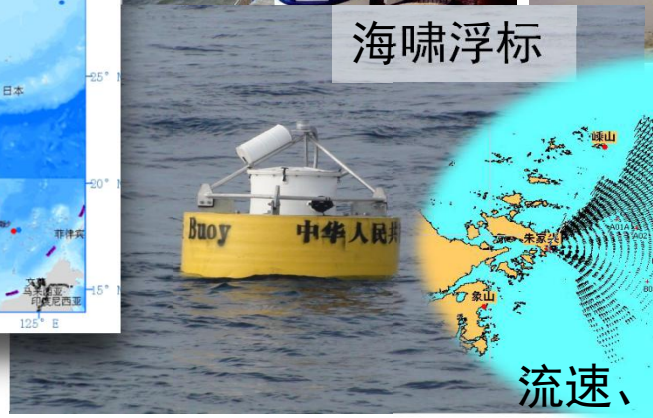
Agro

…









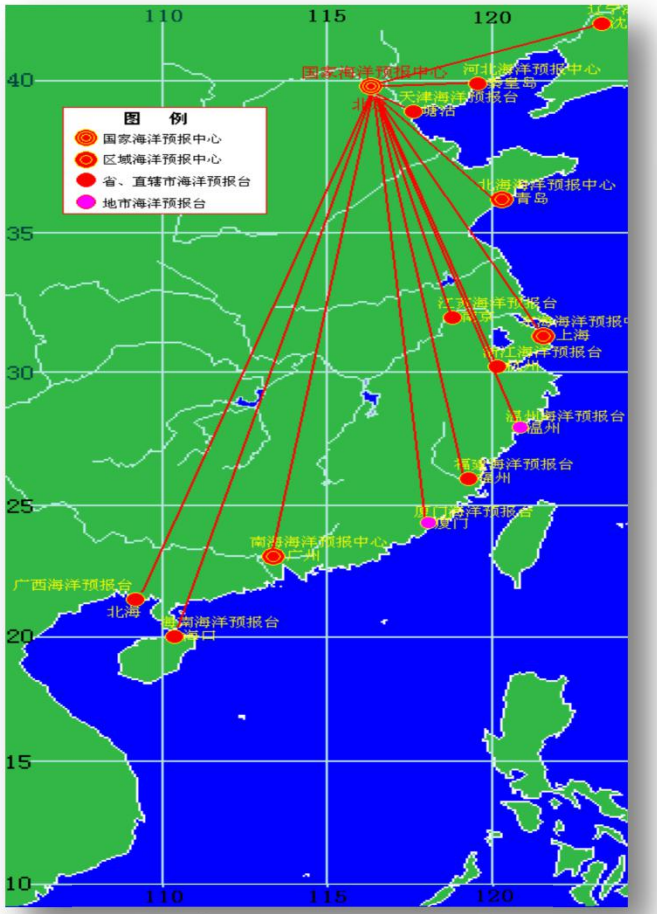
High Performance Computation Systems

Sunway Cluster

IBM Cluster

- Peak Performance ~ 350 TFlops
- Online Storage ~ 400 TB
- Supporting ~ 100 numerical forecast systems

Video Consultation system in China



Covered all the coastal region

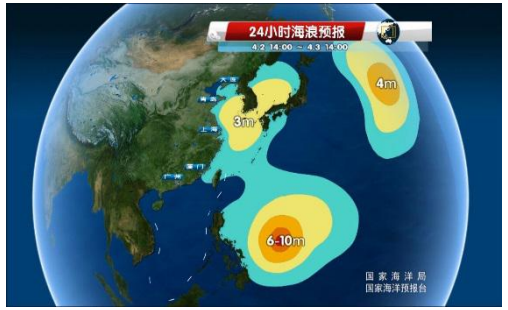
- To keep the operational video consultation
- Provide the guide of diffirent video consultation setup
- Provide the skill training
- More than 300 times video conference

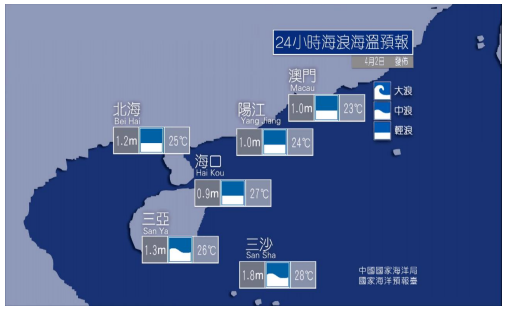
Release to public

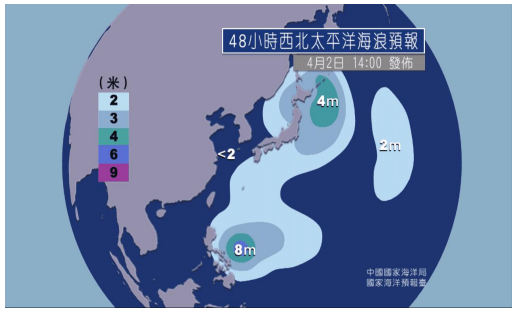
Operating maintenance a lot of News Clients,like Daily Headlines, Webchat and so on.

- **more than 430 papers and videos;**
- **more than 2 milions pageviews of Daily Headlines，3 millions pageviews of Netease News;**
- **more than 200 thousands pageviews of top news;**
- **more than 180 thousands of top video.**

Release to public







Central Media
CCTV
China National Radio
China Radio International

7 programs in CCTV, CETV, Phoenix Satellite TV and the Travel Channel

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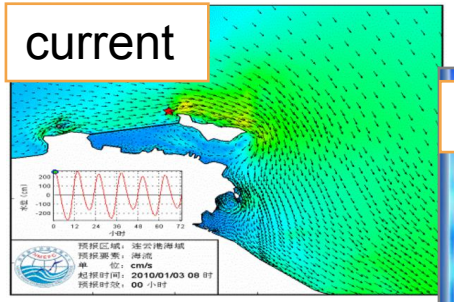
products

- marine Environmental forecast
  - temperature
  - current
- marine disaster pre-warning
  - storm surge
  - wave
  - tsunami
  - sea ice
- marine weather
- emergency forecast
  - oil spill
  - search and rescue



We hope we could

Integrated systems

from global to coast

01

02

Refined techniques

high resolution, more accuracy

Diversificated elements

temerature, salinity, wave hight, eddy,mix layer thickness and so on

03

04

Customized services

optimal ship route, optimal work window

Self-dependented innovation

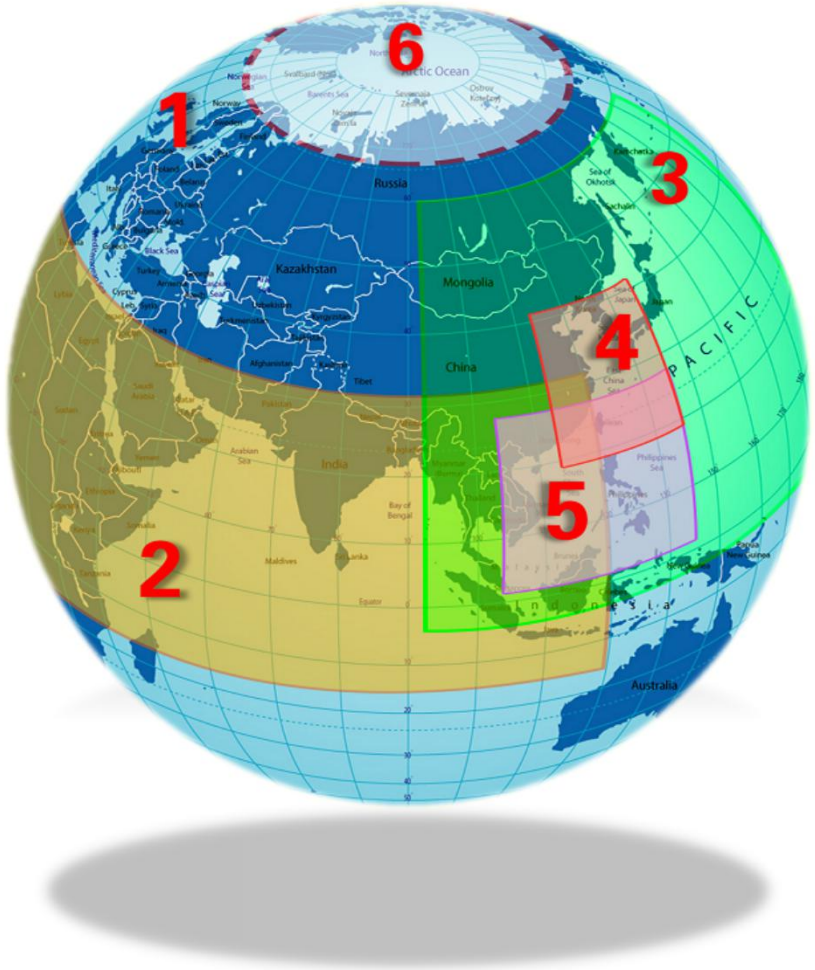
marginal sea model, storm surge model

05

1. 预报系统一体化
2. 预报技术精细化
3. 预报要素拓展化
4. 预报保障定制化
5. 预报创新自主化

Status of Operational Oceanography in NMEFC

Chinese Global operational Oceanography Forecasting System (CGOFS v1.0) and extended forecast system



Global Oceanography Forecasts:

- *Level 1: Global Ocean*
- *Level 2:*
  - *Northwest Pacific and Indian Ocean*
- *Level 3:*
  - *Bo-Yellow-East China Sea and South China Sea*
- *Level 4: Polar Region*

Refined forecasts:

- China Coastal Zone

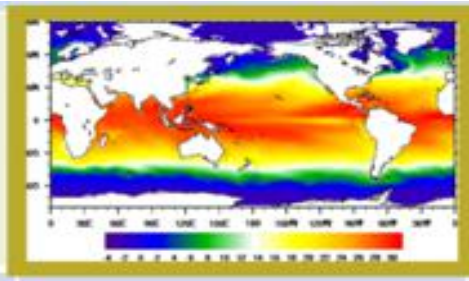
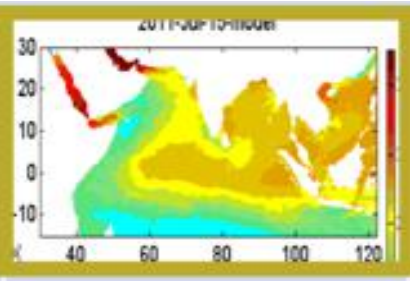
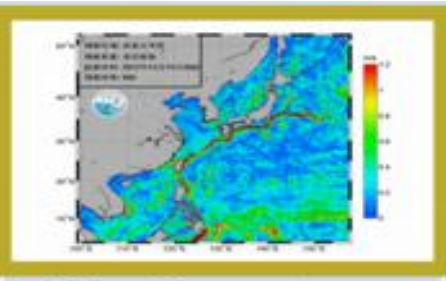
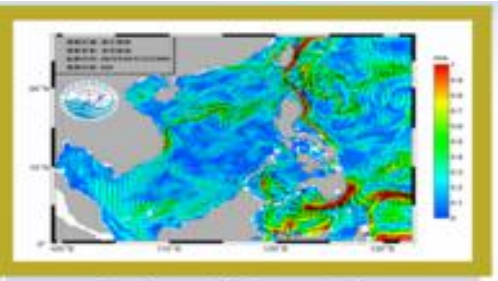
Ecological Forecasts:

- *Level 1: Northwest Pacific*
- *Level 2: East and South China sea*

Climate Prediction:

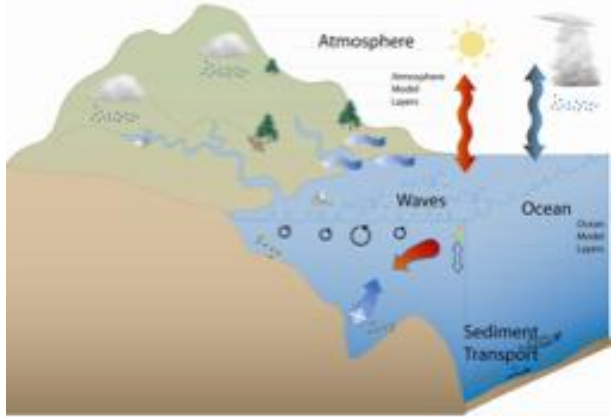
- *Level 1: Global*
- *Level 2: Asia & Northwest Pacific*

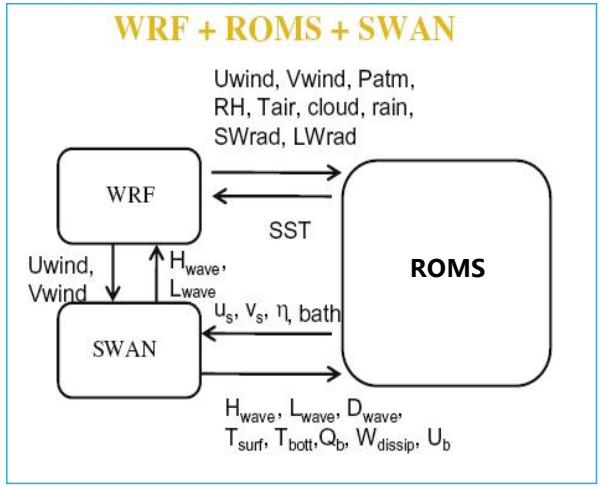
Detailed of systems

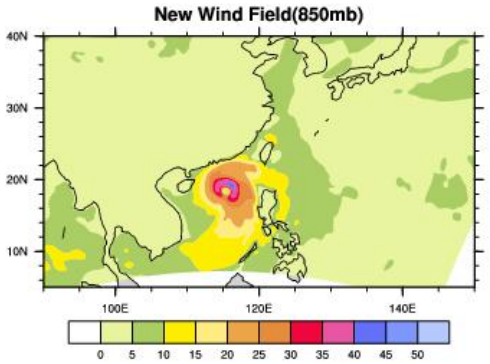
				
	Global	**Indian Ocean**	**Northwestern Pacific**	**East/South China Sea**
Resolution	1°/4 , 50 levels	1°/12,20levels	1°/20 , 22 levels	1°/30 , 30(36) levels
Model	MOM4	ROMSv3.5		
Atmospheric forcing	CGOFS-Wind	NMEFC-WRF		
Assimilation scheme	3DVar	EnOI		
Data assimilated	RTGSST , SSH , Argo T/S	MGDSST SSH	MGDSST SSH	MGDSST/MGDSST, SSH , Argo T/S
Product	temperature、current (surface，20m，50m，100m，200m，500m,1000m，profiles)			
Forecast range	120hr			

Air-Sea Coupled system for Typhoon

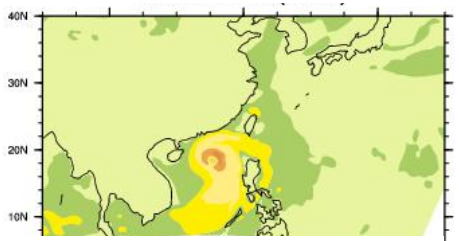
- harmonious physics processes
- synchronous forecast both atmosphere and ocean

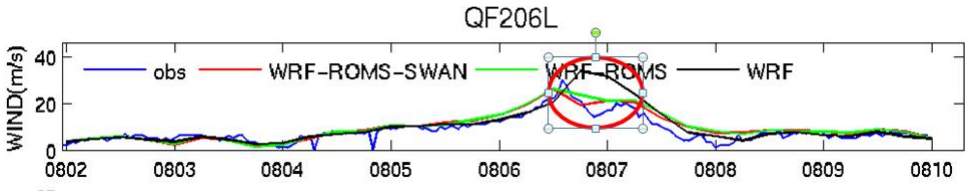




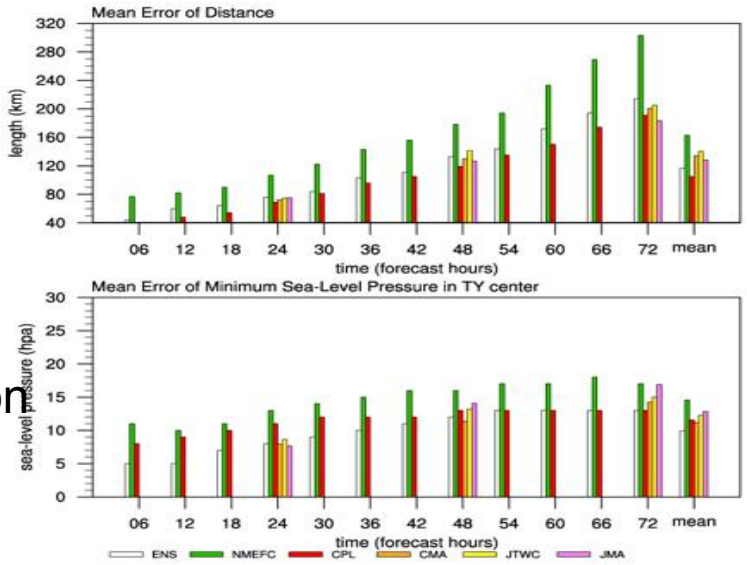


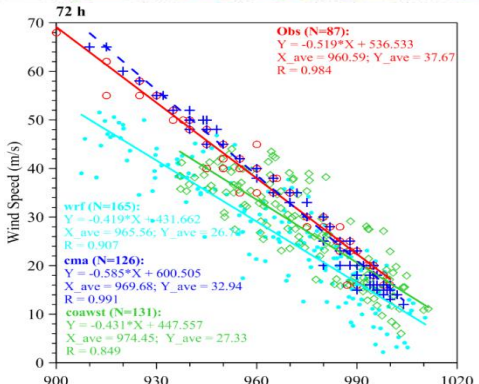
Initial location of Typhoon





more accuracy of typhoon intensity change





inproved more between track, intensity,wind and pressure

We hope we could

Integrated systems

from global to coast

01

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Refined techniques

high resolution, more accuracy

Diversificated elements

temerature, salinity, wave hight, eddy,mix layer thickness and so on

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marginal sea model, storm surge model

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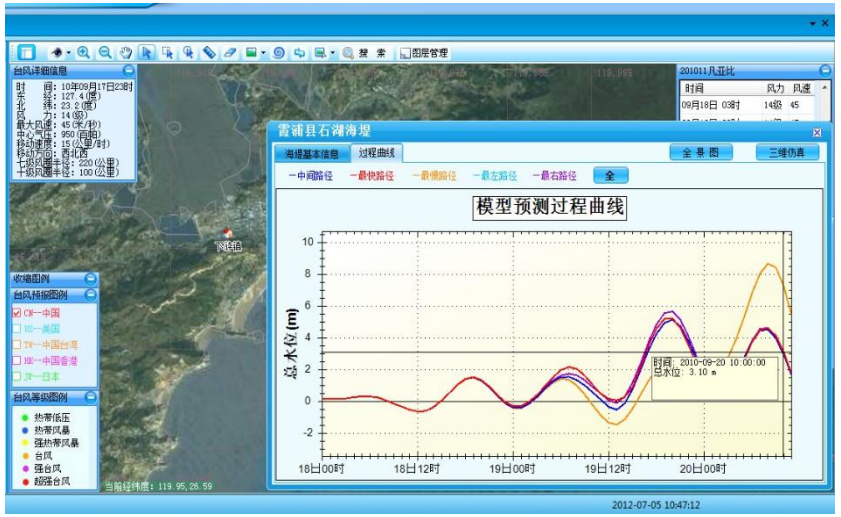
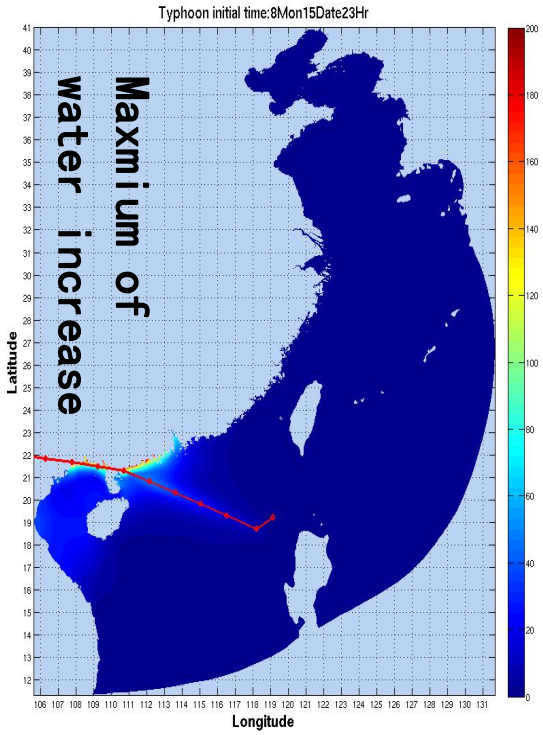
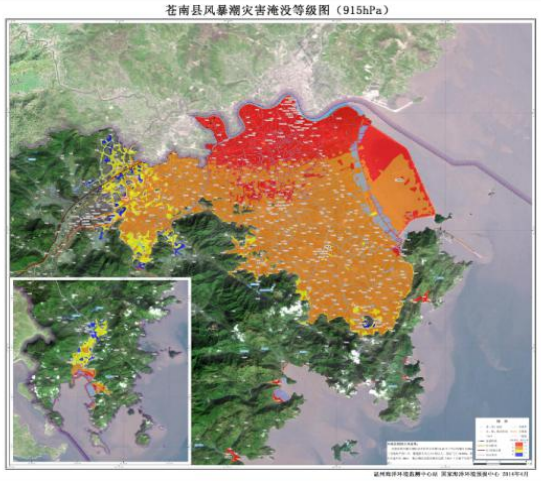
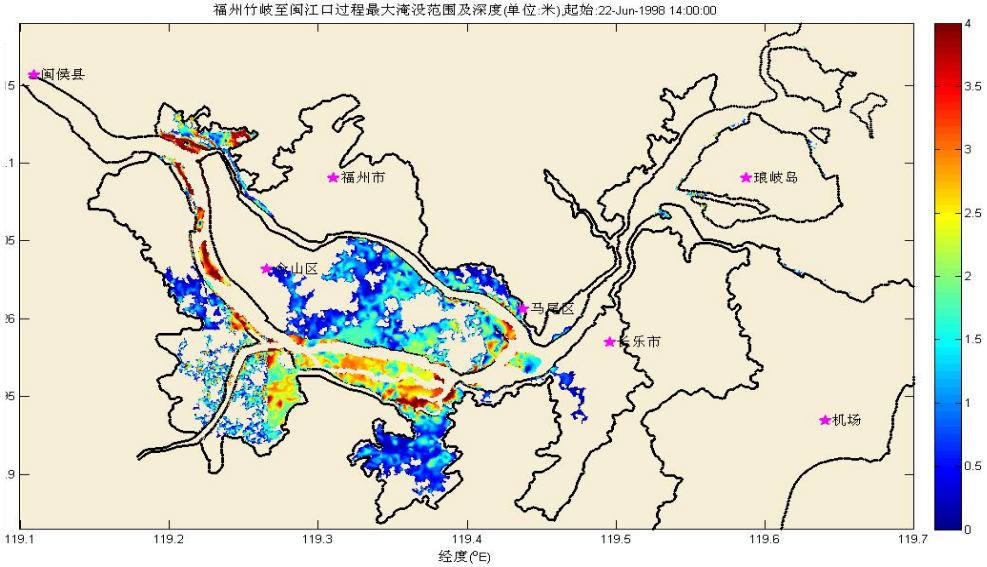
Storm Surge

- High resolusion storm surge numerical forecasting system
- Storm surge and Wave Overflow numerical forecasting system（SWOFS）
- Storm surge and Wave Floodpain numerical forecasting system（SWIFS）
- Risk evaluation and regionalization of storm surge disaster









Ocean Wave

A

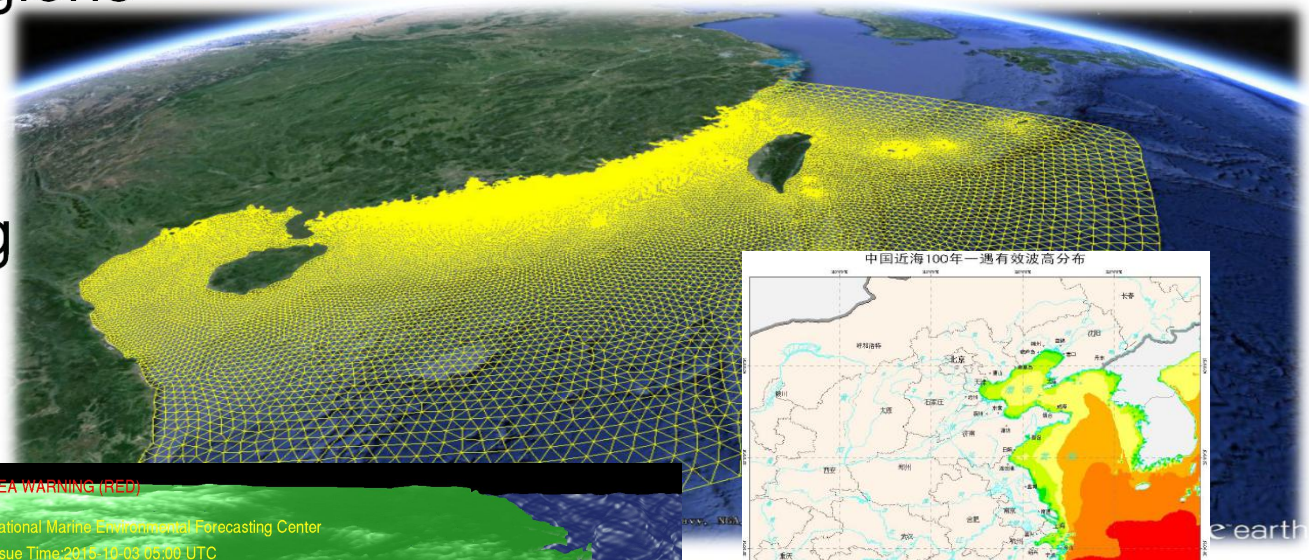
Unstructured refine ocean wave numerical forecasting system in coastal regions

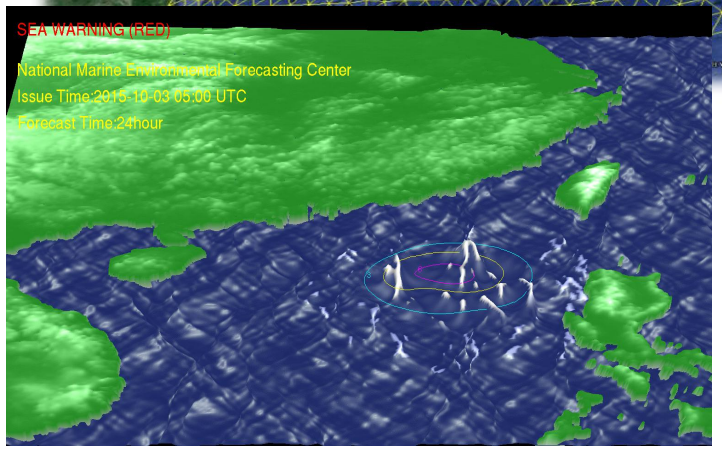
B

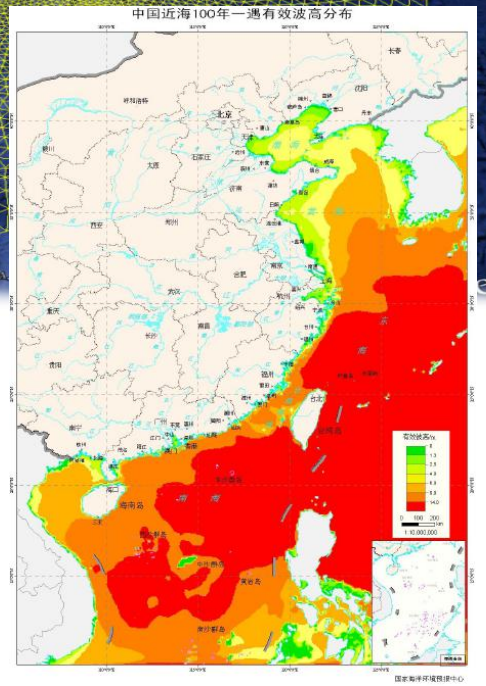
Visualization of wave forecasting products

C

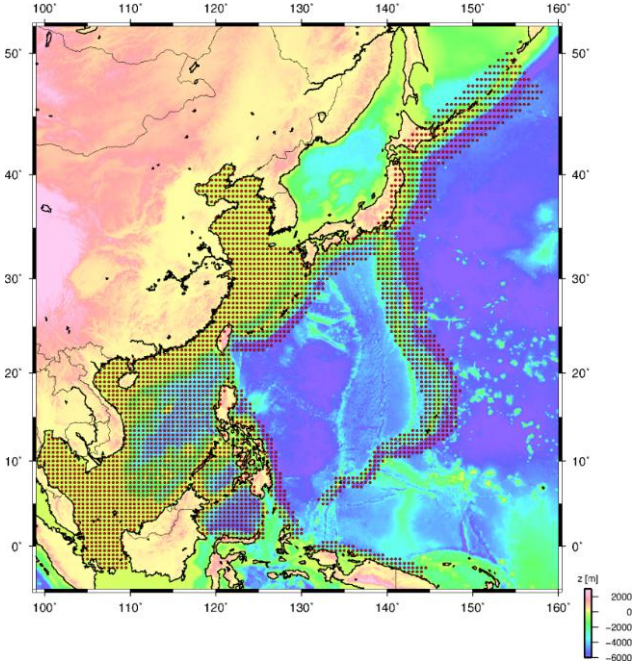
Analysis of the centennial recurrence period

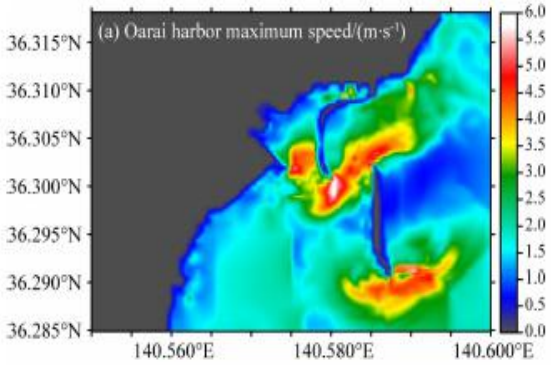


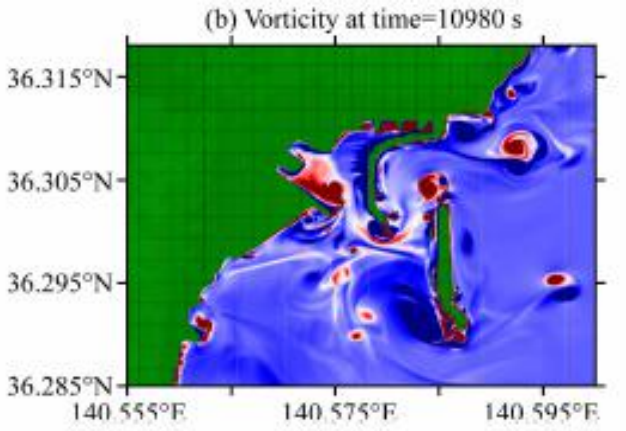


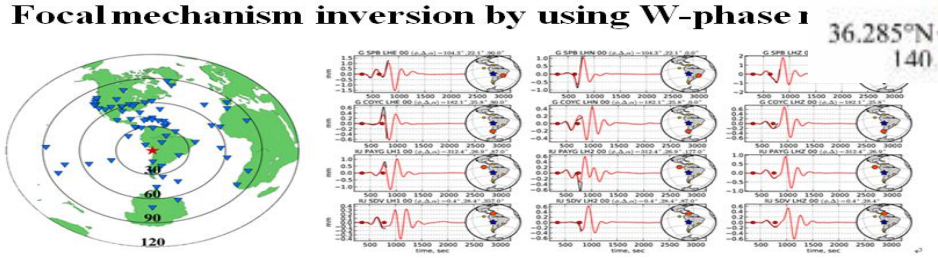


Tsunami









- Quantified tsunami pre-warning data set
- Timed and refined tsunami numerical forecasting system
- Risk evaluation and regionalization of Tsunami

IOC/UNESCO South China Sea Tsunami Advisory Center (SCSTAC) starts to be trial-operational in 2018

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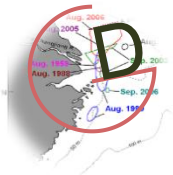
Ecological Forecasts

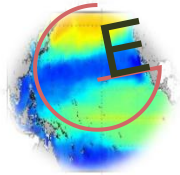
Ocean carbon cycle forecast in NWP & China Seas

Jellyfish blooms in East China Sea

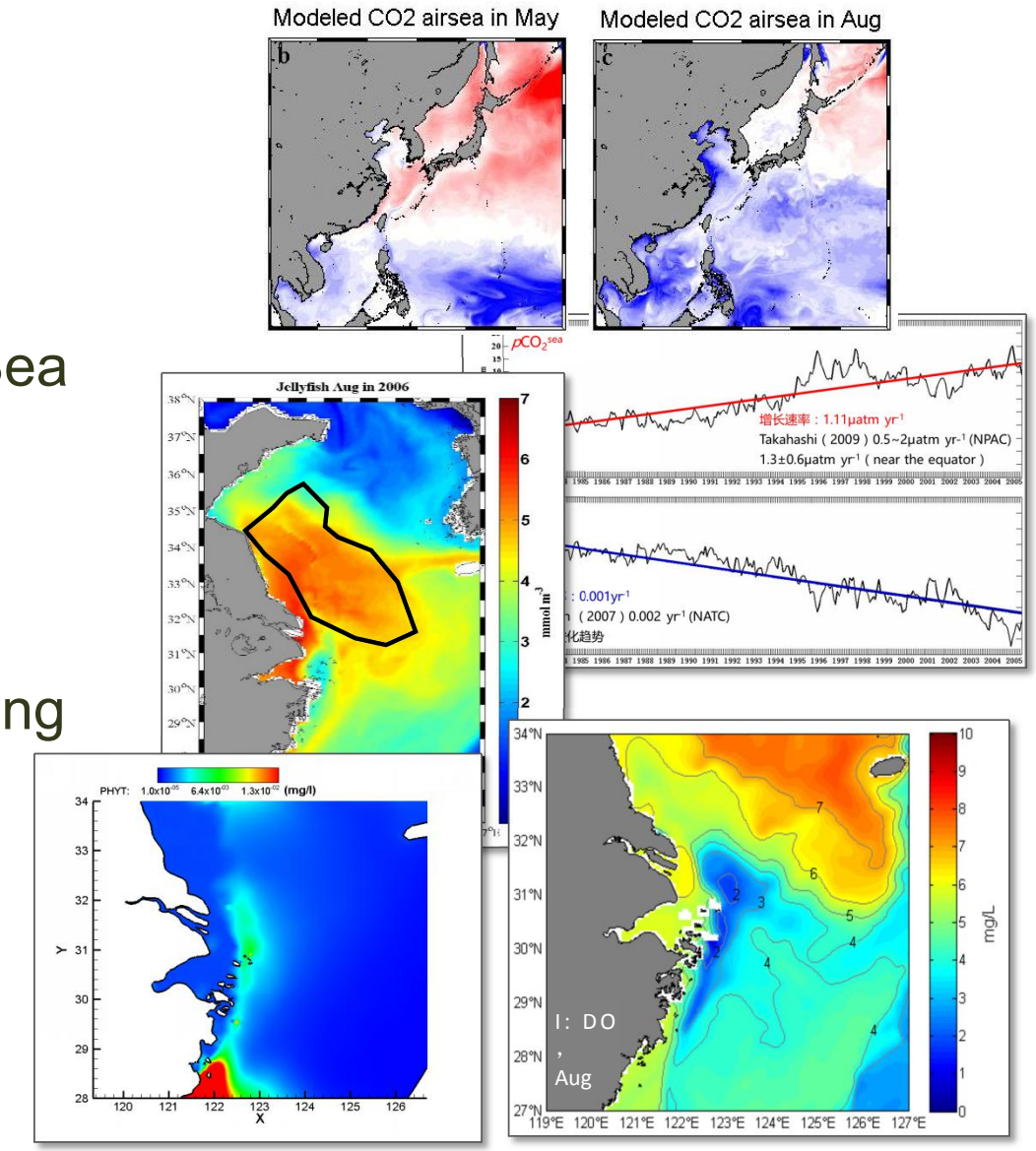
Red tide numerical warning



Hypoxia area numerical simulating



Marine Ecosystem numerical forecst system in NWP, ECS, SCS

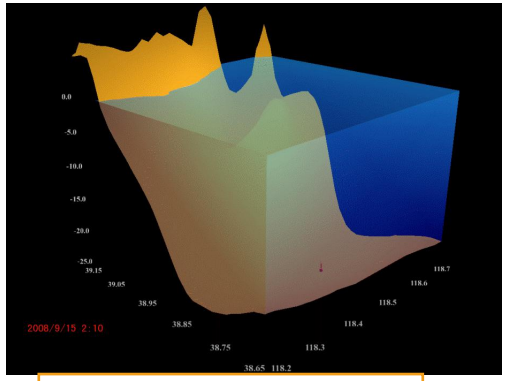


Oil Spill and Pollutant

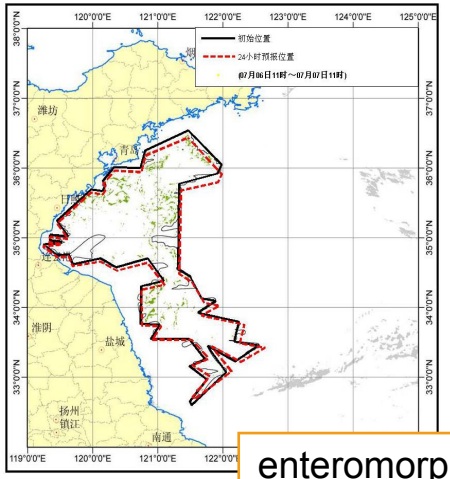
01 Forcing by wind, temperature, salinity, wave and current

02 Input time, place, oil mass and discharge value and so on

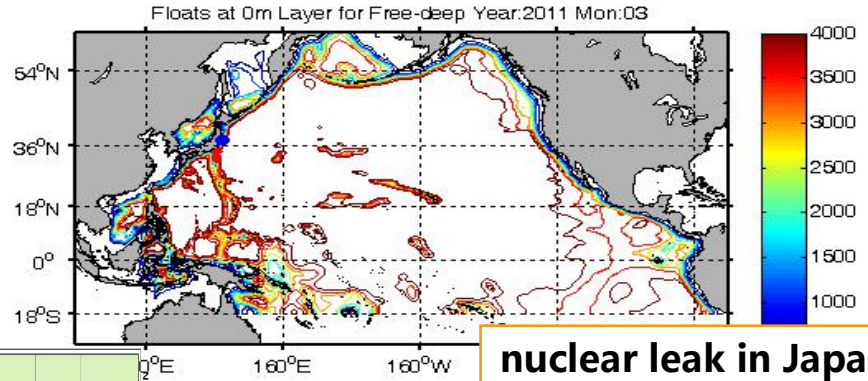
03 Ensemble diffusion models



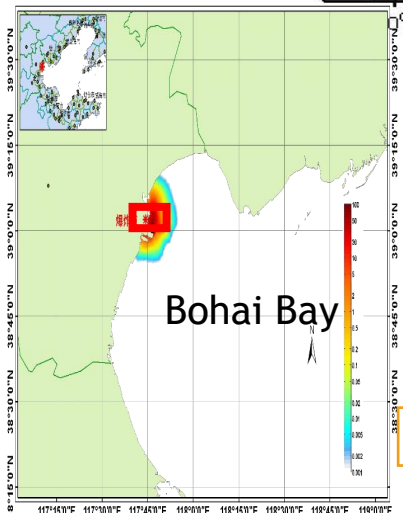
oil spill of pipeline

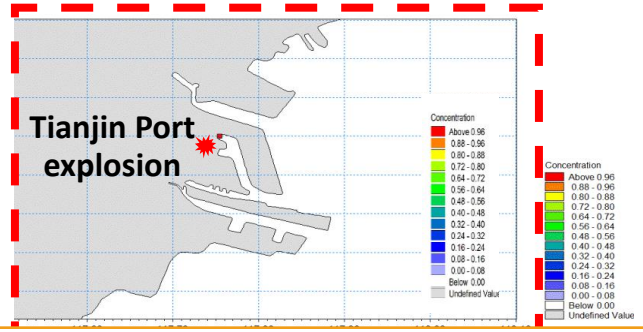


enteromorpha



nuclear leak in Japan





Dangerous chemicals explode near Tianjin City

Search and Rescue

- Marine Dynamic Forecast
- Calculate drift speed
- Calculate drift path
- Visually display
- Forecast products

high resolution forecast of wind and current

NMEFCSAR model + LEEWAY model

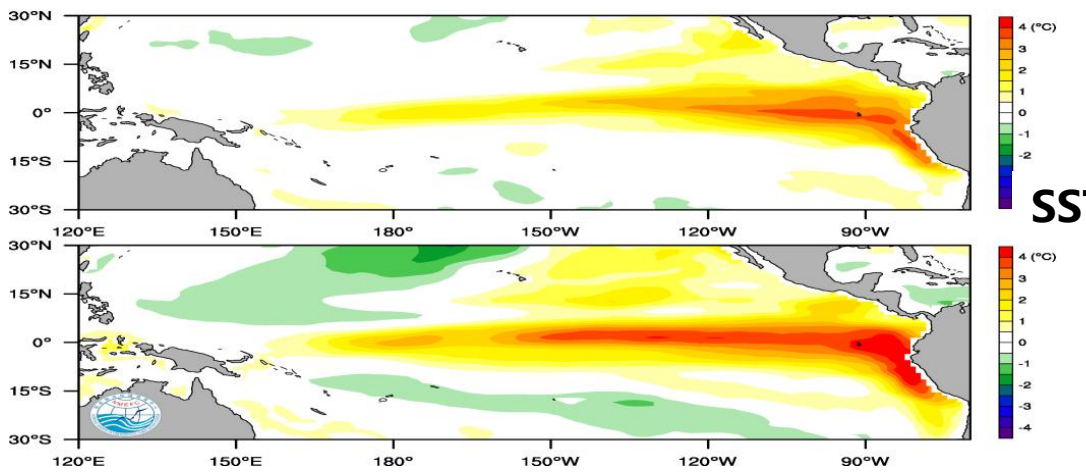
four order lagrange drift path model

visualization

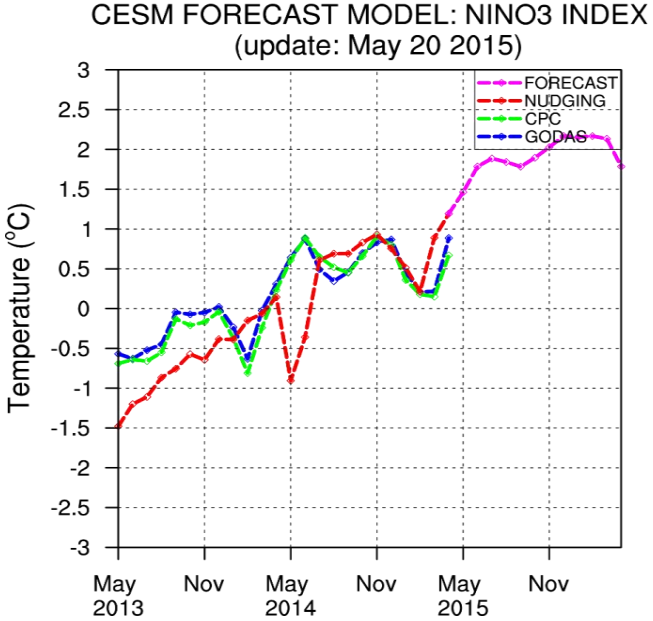
drift path and search area of wrecked target

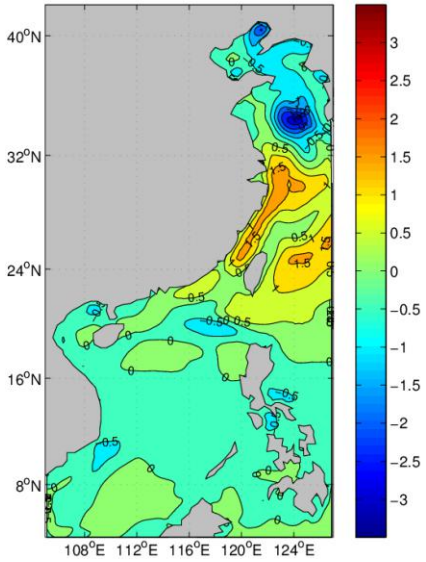
Climate prediction

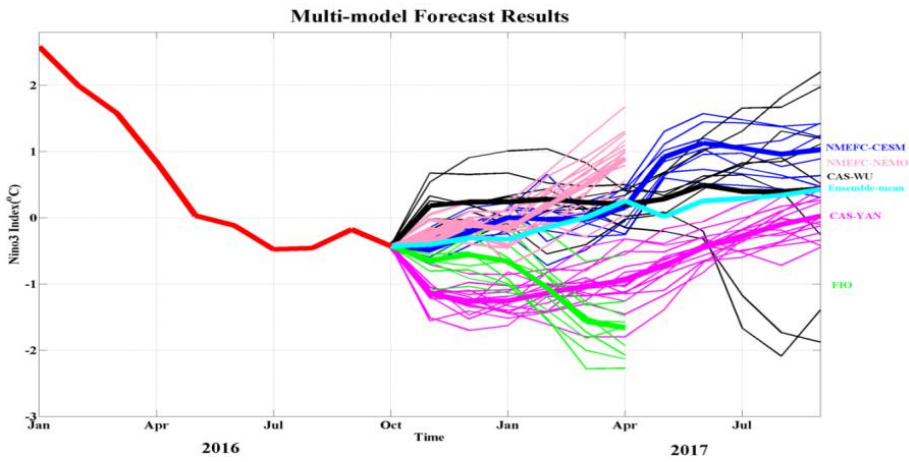
- Time scale from monthly to annual
- El nino dynamic and statistic prediction
- Ensemble prediction of different models



SST anomaly

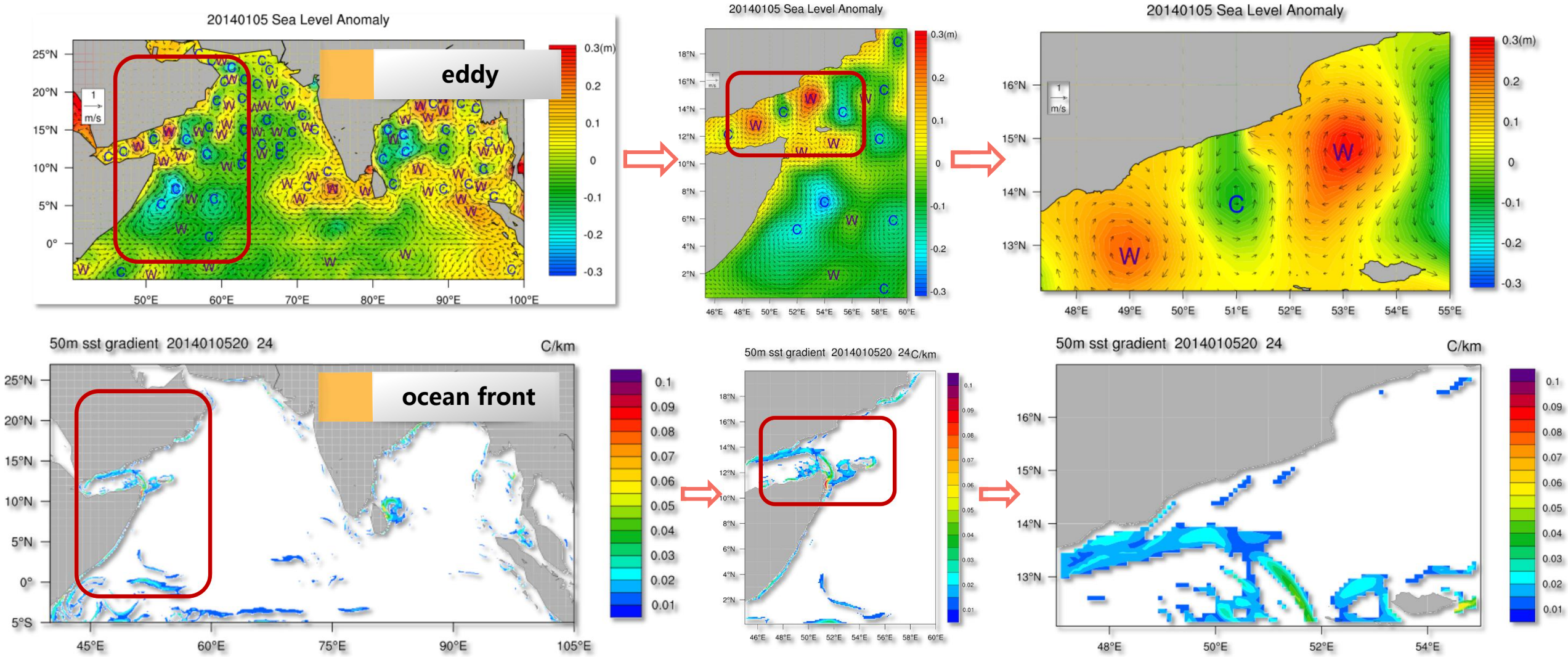






NINO3 index emseble prediction

Diagnostic products



We hope we could

Integrated systems

from global to coast

01

02

Refined techniques

high resolution, more accuracy

Diversificated elements

temerature, salinity, wave hight, eddy,mix layer thickness and so on

03

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Customized services

optimal ship route, optimal work window

Self-dependent innovation

marginal sea model, storm surge model

05

1. 预报系统一体化
2. 预报技术精细化
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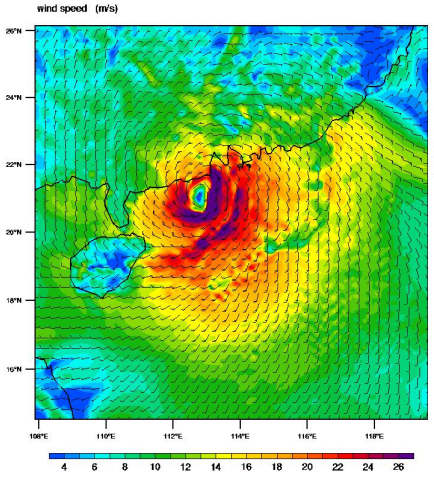
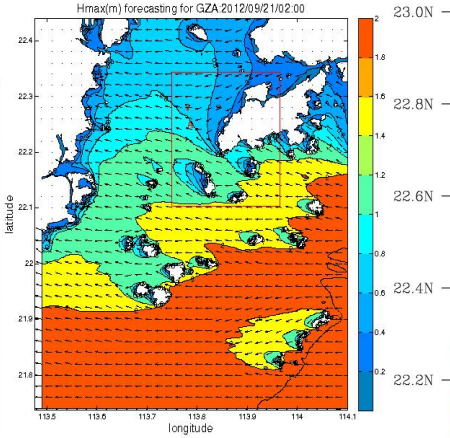
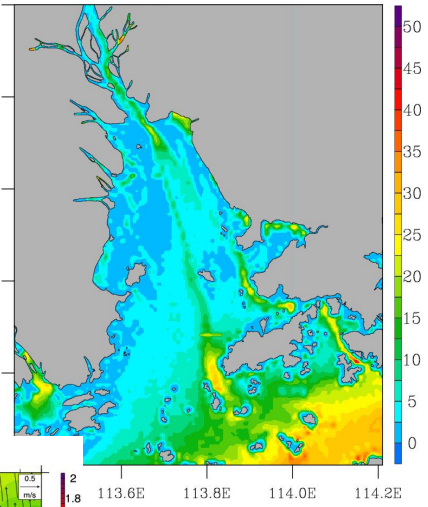
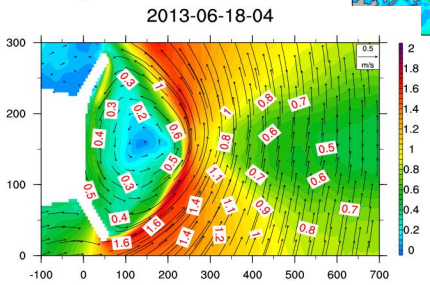
Safe construction of Hong Kong-Zhuhai-Macao Bridge

observation		forecasting		
channel	foundation trench	weather	wave	current







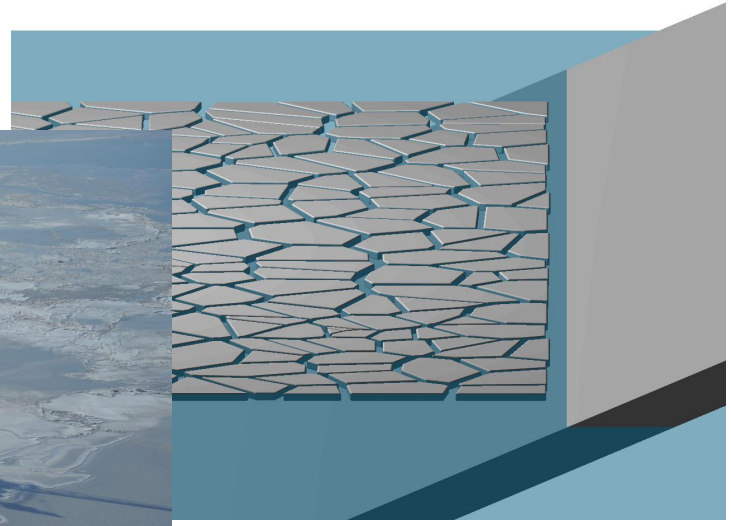


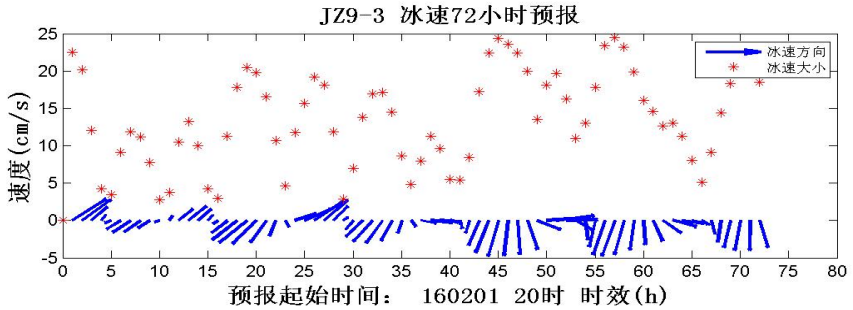
before one month → before 5 days → before 1 day → Construct

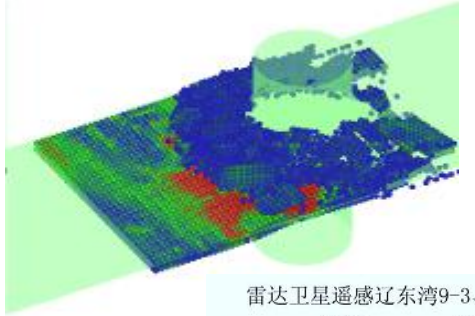
select time window	decide time window	confirm time window	insitu garantee

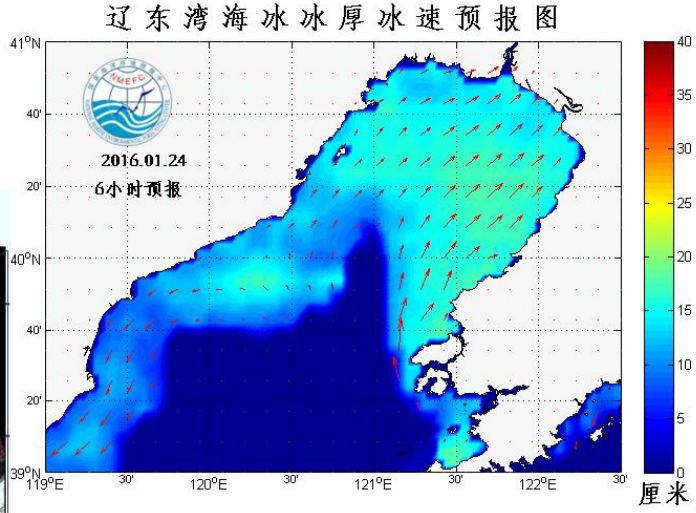
Sea Ice

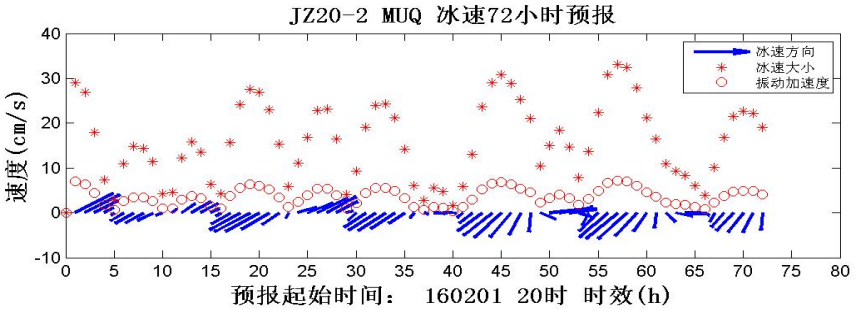
- High resolution Sea Ice numerical forecasting systemin Bohai Sea and north of Yellow Sea
- Sea ice vibration forcasting system near oil platfo
- New techniques like Sea ice discrete element method and so on.

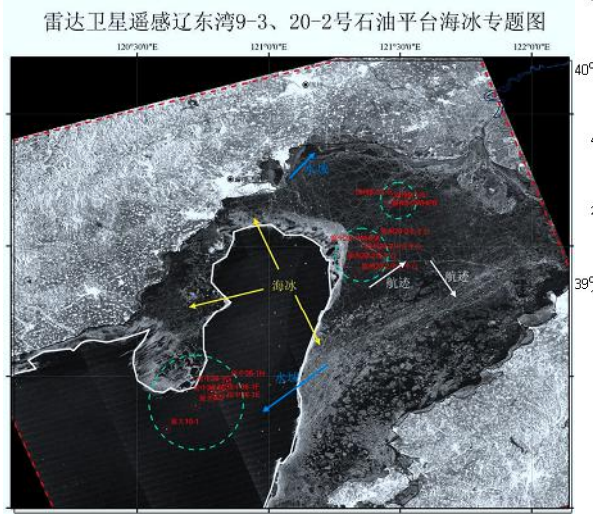












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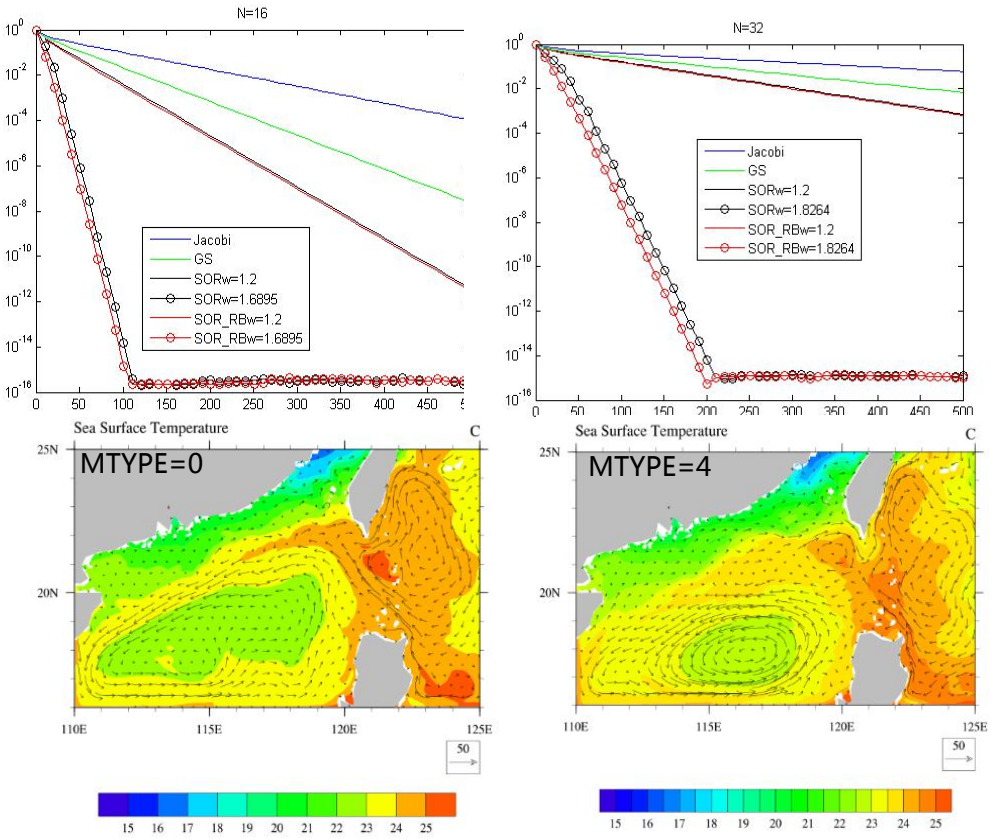
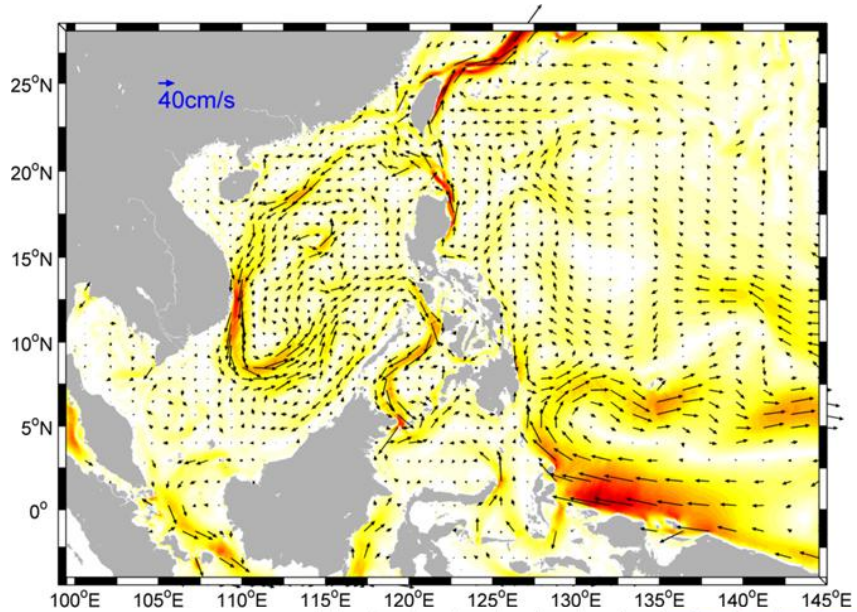
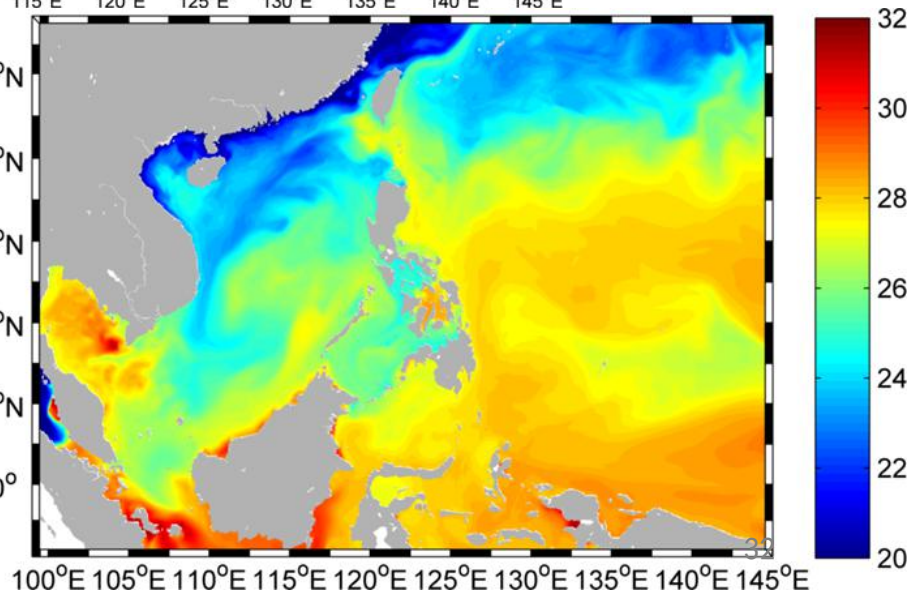
Marginal sea model





test case in SCS

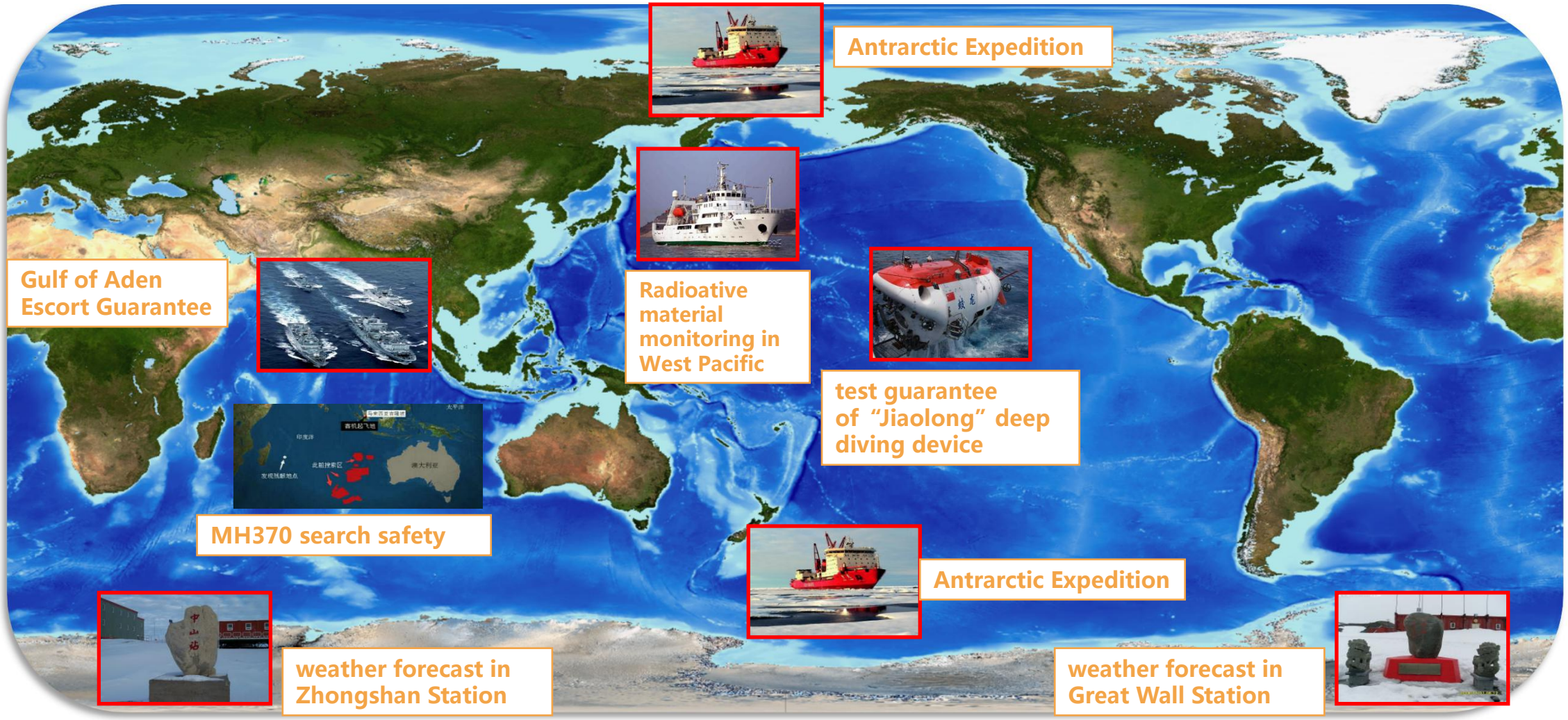


A Non-hydrostatic coordinates model has been build in China Seas
non-hydro static parameter MTYPE=4

Outline

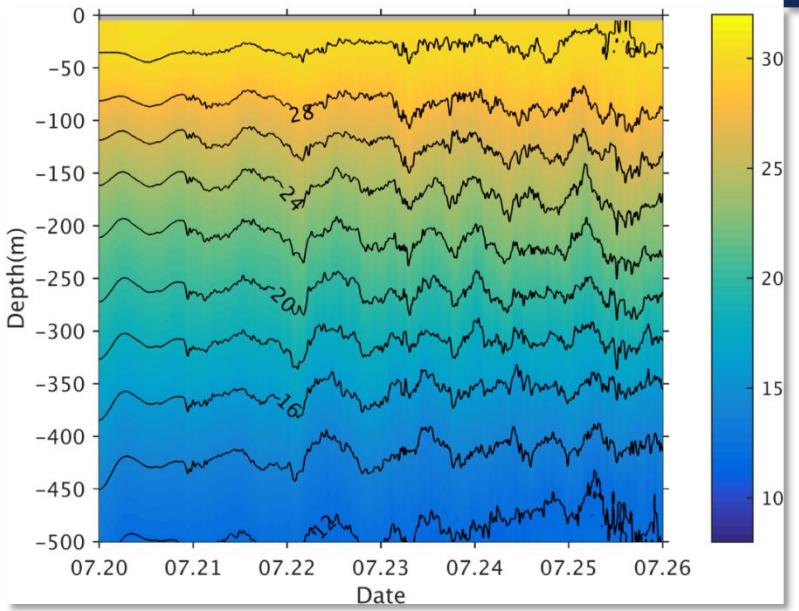
- Introduction of NMEFC
- Status of marine forecasting and pre-warning
- Cases of Social benefits
- Summary and future

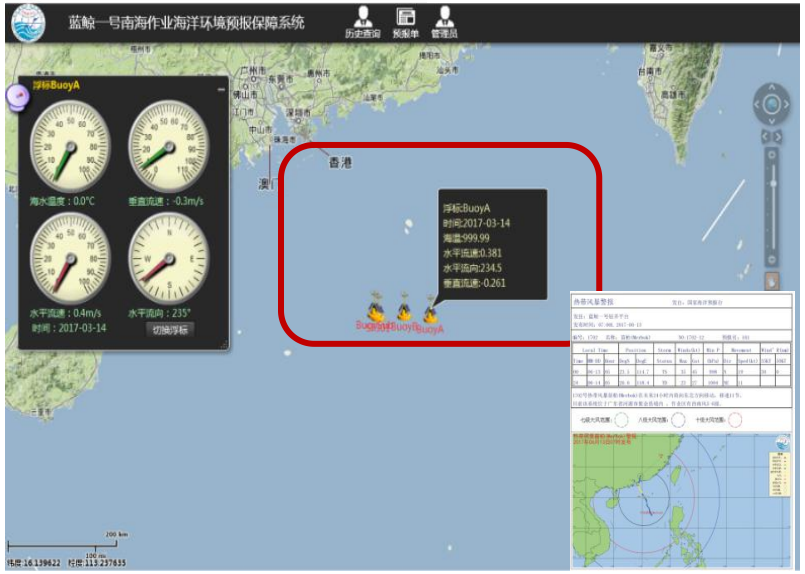
Services to Goverment



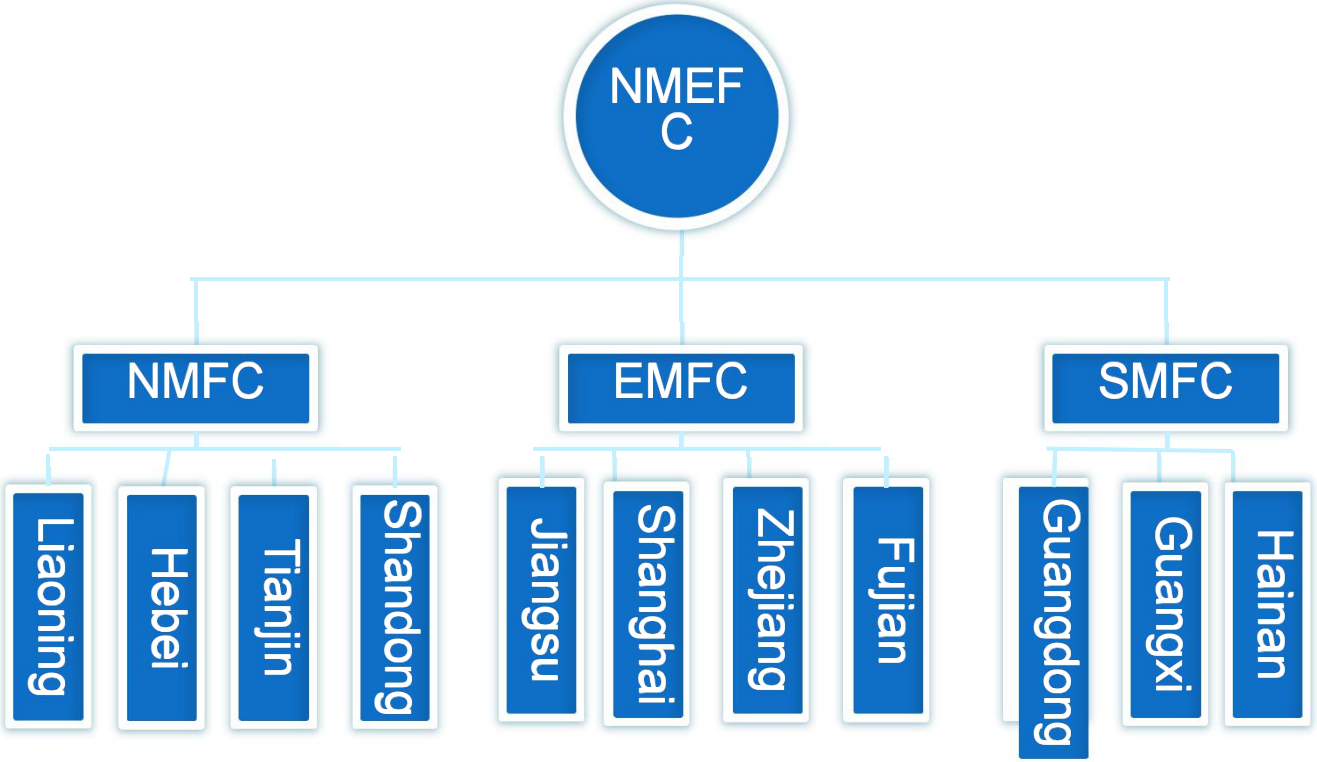
Services to Society

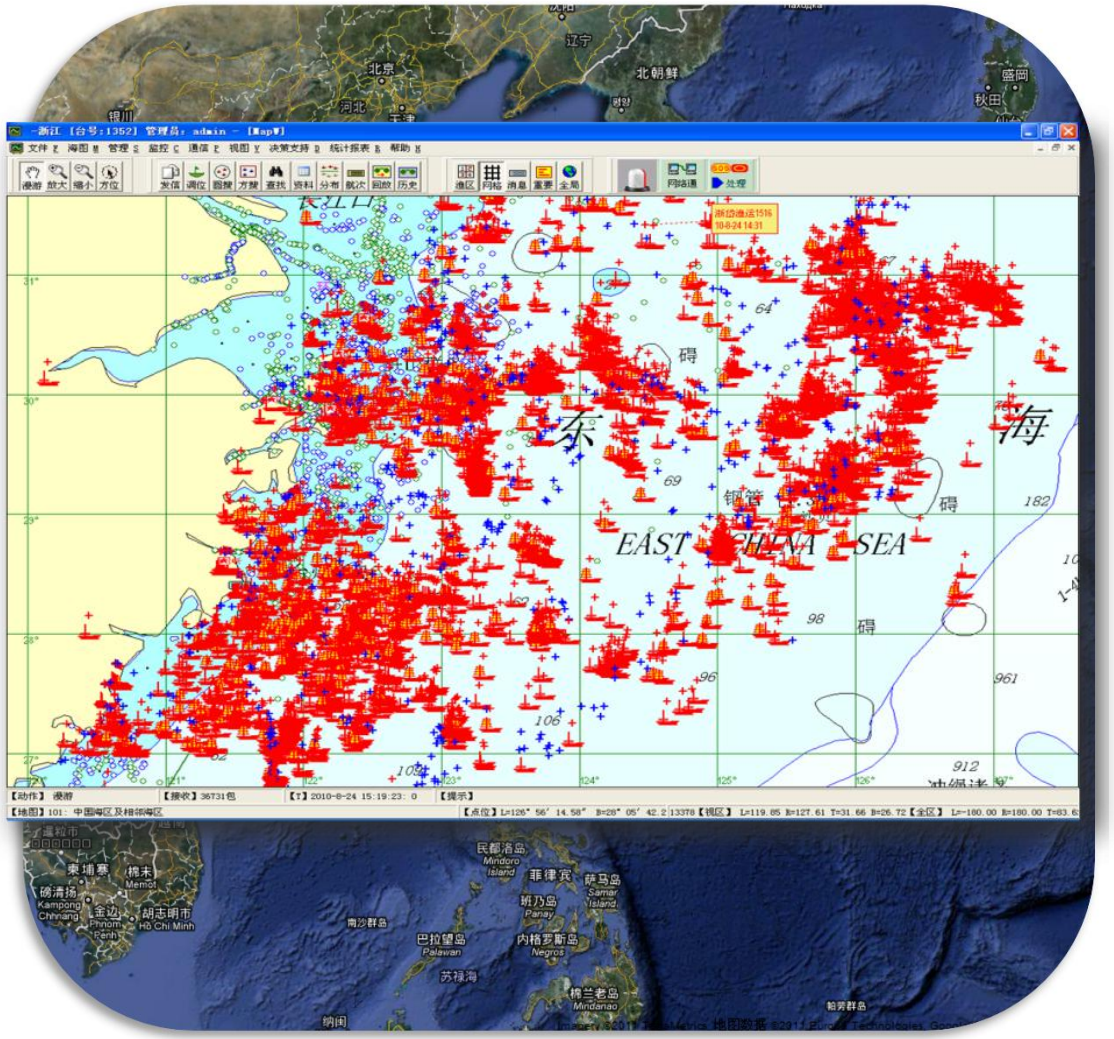
- February to July, 2017
- First time mining of Gas hydrate in SCS
- Optimal time window
- Wind, wave, current, temperature, density and internal wave





Services to People





- Started from June, 2012 ;
- Ship monitoring, statistical analysis and website display
- leading time 72 hours
- wind, wave, temperature and so on

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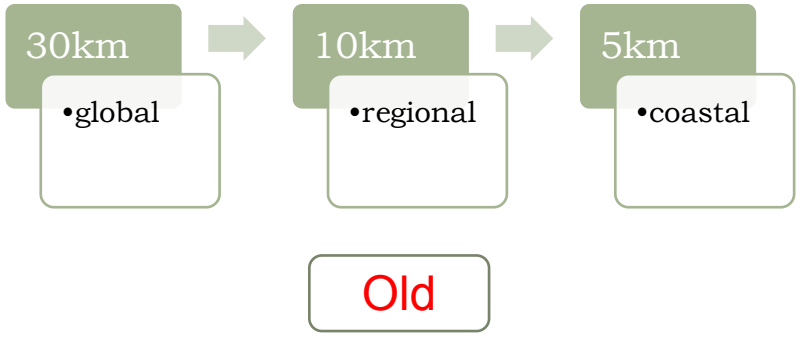
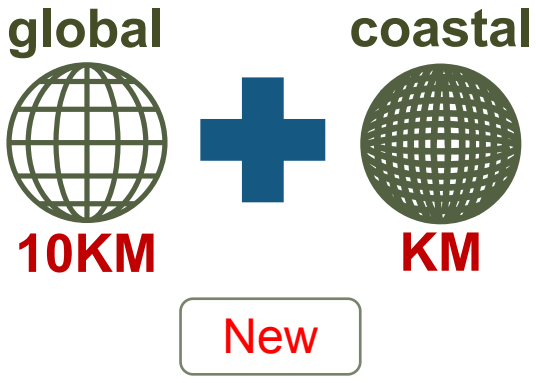
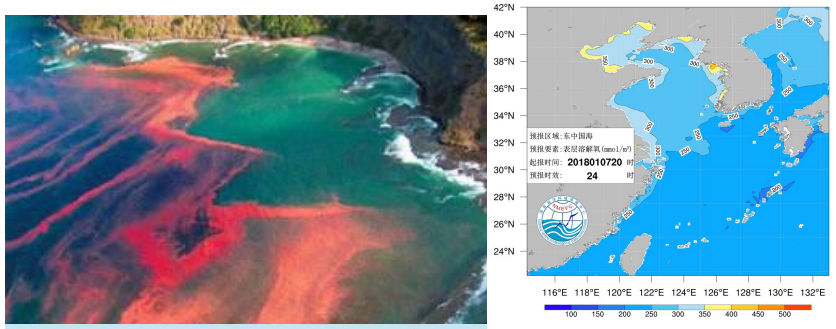
System structure update

- 3 levels to 2 levels

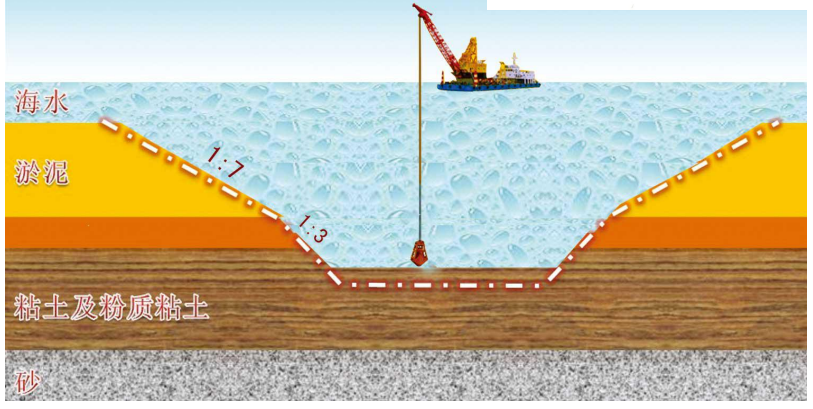




- More focus on marine ecological system



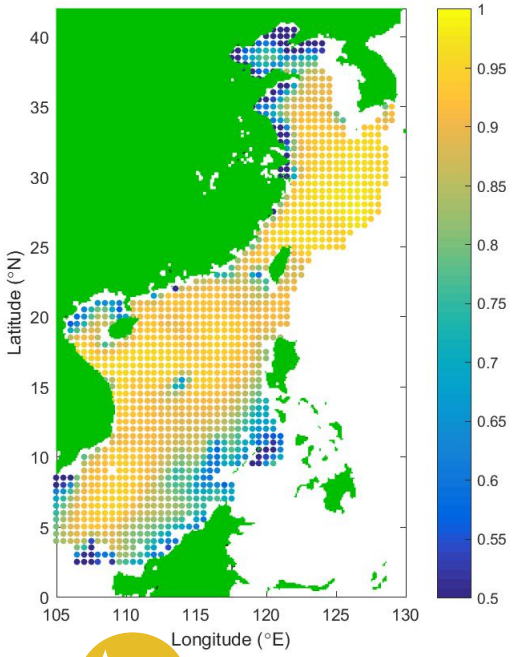
- Customized services improvement



Two innovative development projects

- Intelligentialize

include intelligent gridding forecasting products, nowcast AI prewarning products and coastal basic forecasting products



- Independent development

New self-dependented models include storm surge, ocean wave, circulation, climate, Tsunami

Thank you for attention!

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