2nd INTERNATIONAL WORKSHOP ON WAVES, STORM SURGES AND COASTAL HAZARDS
10-15 November 2019, Melbourne, Australia

Marine early warning system at NMEFC

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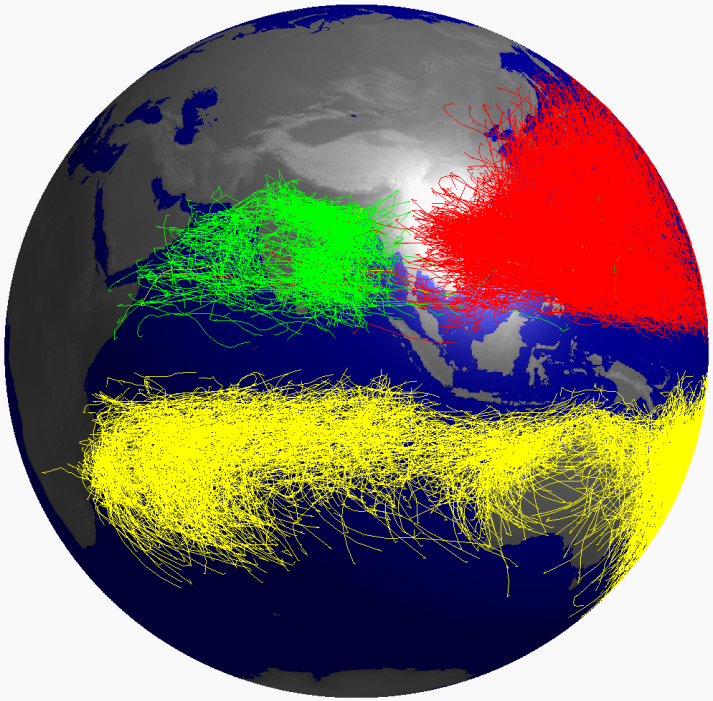
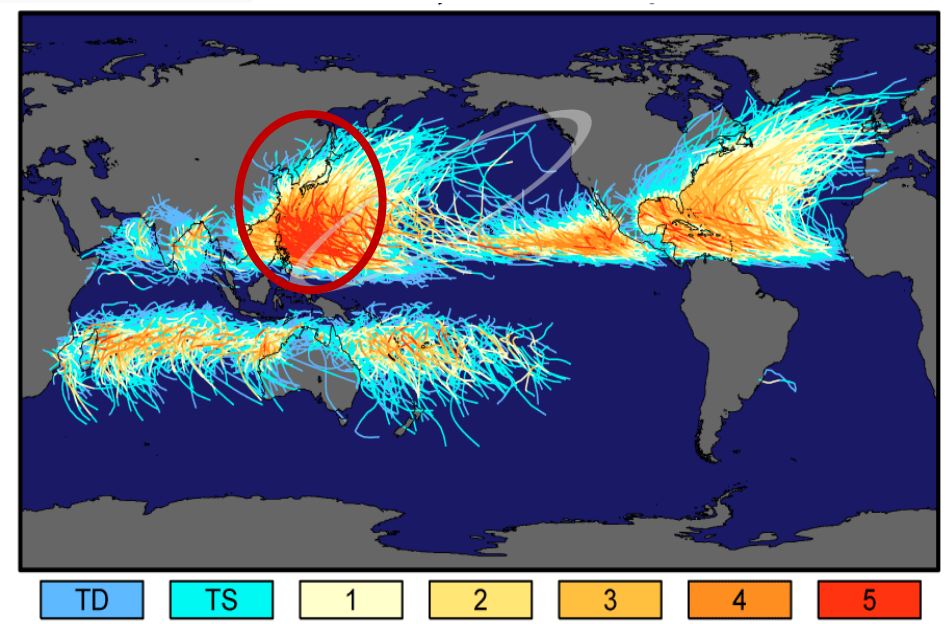
Ministry of Natural Resources of P.R.C.

Outlines

- Overview
- Marine calamity warning process
- Operational storm surge forecasting system
- Operational wave forecasting system
- Outlook

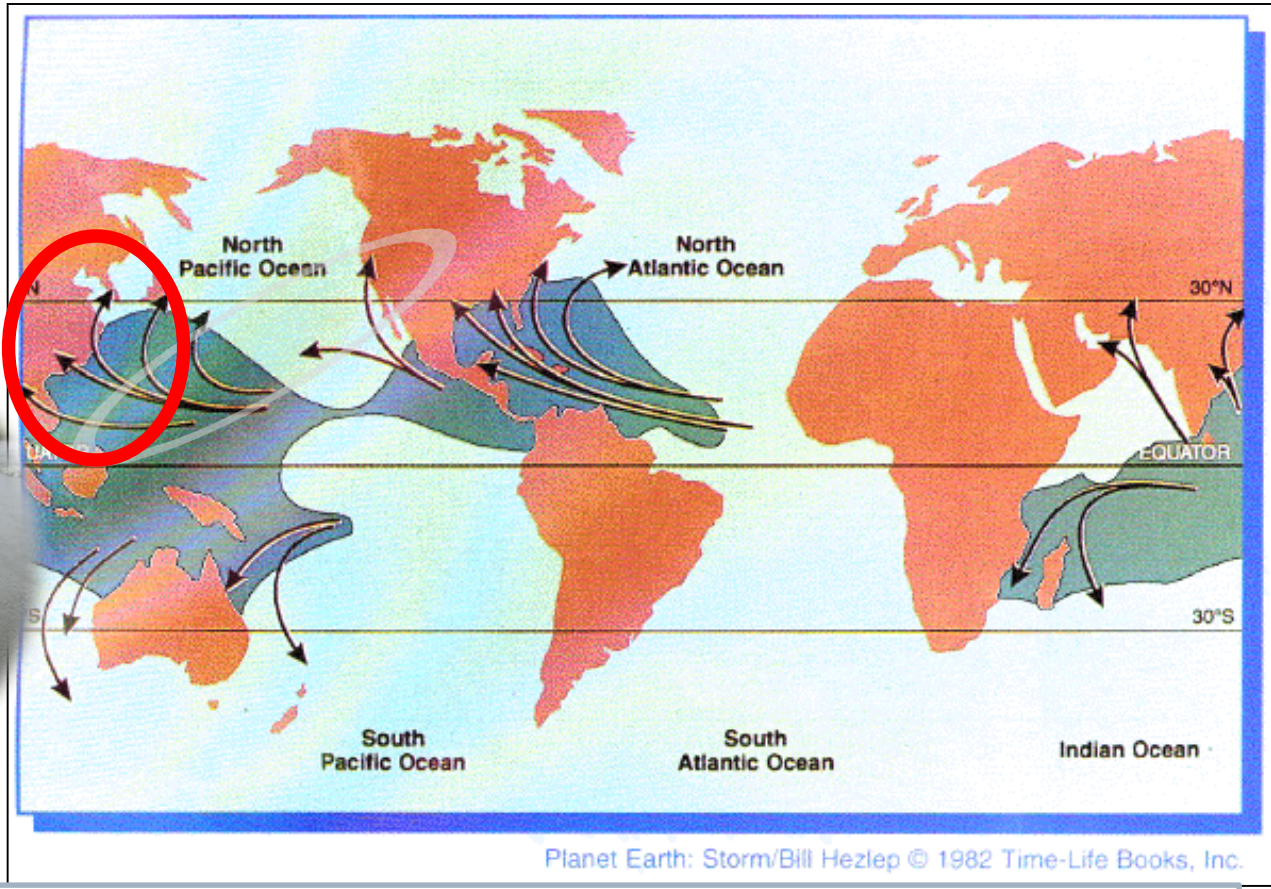
Overview





North-west Pacific is the region where global typhoon is most active, suffering from more easily super-strong typhoon, and about 30% typhoons originate here.

Overview

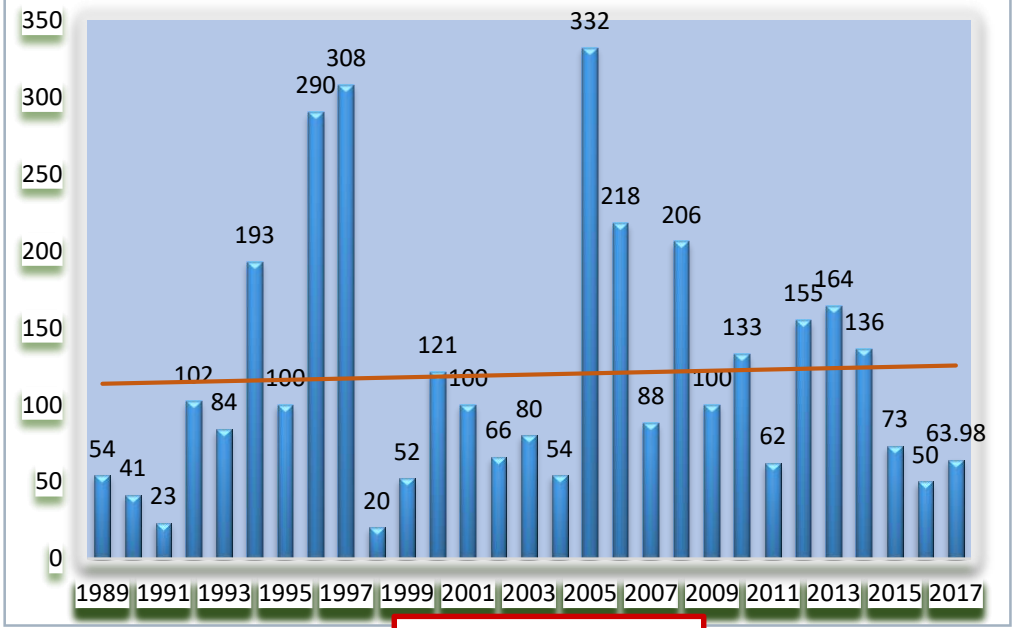


Planet Earth: Storm/Bill Hezlep © 1982 Time-Life Books, Inc.

Because China is adjacent to North-west Pacific, China seas suffer from serious marine calamity, such as storm surge, and huge waves.

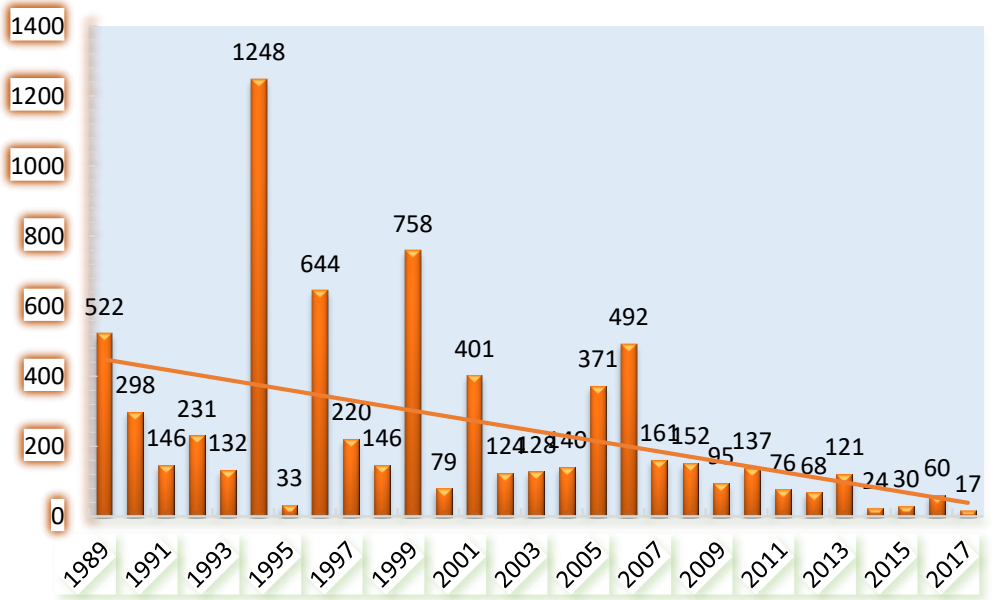
Overview

Direct economic losses due to marine calamities



According to data from《Bulletin of China Marine Disaster》, since 1989, annually economic losses due to marine disaster is about 100 million China-Yuan, about 200 people are lost or die from marine calamities each year.

The total death due to marine calamities



Marine calamity warning process

When tropical, extratropical cyclones or strong cold weather are expected to influence the China's seas

Issuing pre-warning message 72 hours in advance

Issuing warning products in 24hours ahead of time

- Broadcast
- Television
- Internet
- Fax
- MMS

Warning cancel

An example of warning product

国家海洋预报台 橙色

风暴潮、海浪警报

时间：2016 年 10 月 20 日 08 时

编号：风暴潮 1622-2，海浪 1622-3 签发：

国家海洋预报台根据《风暴潮、海浪、海啸和海冰灾害应急预案》发布风暴潮Ⅲ级警报（黄色）、海浪Ⅱ级警报（橙色）。

一、风暴潮Ⅲ级警报（黄色）

受今年第 22 号强台风“海马”的影响，预计：10 月 20 日上午到 21 日上午，福建闽江口到广东江门沿海将出现 40 到 130 厘米的风暴增水。上述岸段内的福建厦门和东山潮位站将于 20 日下午出现达到当地蓝色警戒潮位的高潮位，广东港口和汕头潮位站将分别于 21 日凌晨和清晨出现接近当地警戒潮位的高潮位，广东盐田潮位站将于 21 日凌晨出现超过当地警戒潮位的高潮位。广东省惠州市和深圳市的风暴潮预警级别为黄色，福建省厦门市、漳州市和广东省汕头市的风暴潮预警级别为蓝色。

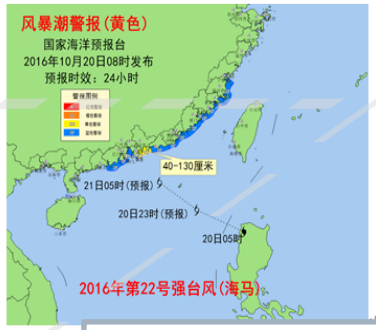
请沿海政府及相关部门按照职责做好防御风暴潮的应急准备工作；各涉海相关单位采取积极有效的措施，组织渔船、养殖渔排、养殖场等做好防御工作；加固沿海渔业养殖水产设施和渔港设施，做好防潮准备。

具体预报如下：

站位	日期	时间	高潮位(cm)	警戒潮位(cm)	预警级别
福建厦门	20日	15:30	380	373（蓝色）*	蓝色
福建东山	20日	16:00	260	255（蓝色）*	蓝色
广东海门	21日	01:30	445	451	蓝色
广东汕头	21日	04:00	310	337	蓝色
广东港口	21日	01:00	120	135	黄色
广东盐田	21日	01:00	355	353	黄色

*：该警戒潮位为按照《警戒潮位核定规范》（GB/T 17839-2011）核定的四色警戒潮位，其值为 85 高潮。

风暴潮警报图如下：

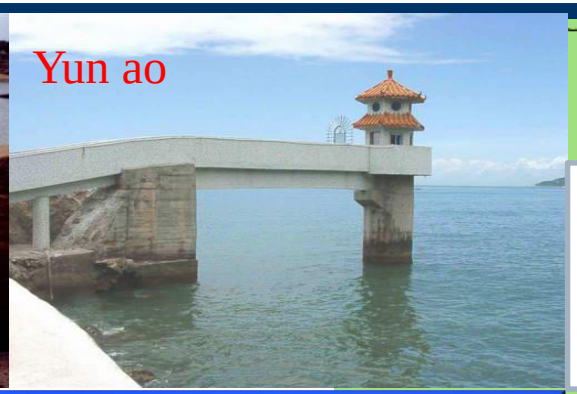


- **Four grades of warning**
  - ✓ Red warning
  - ✓ Orange warning
  - ✓ Yellow warning
  - ✓ Blue warning

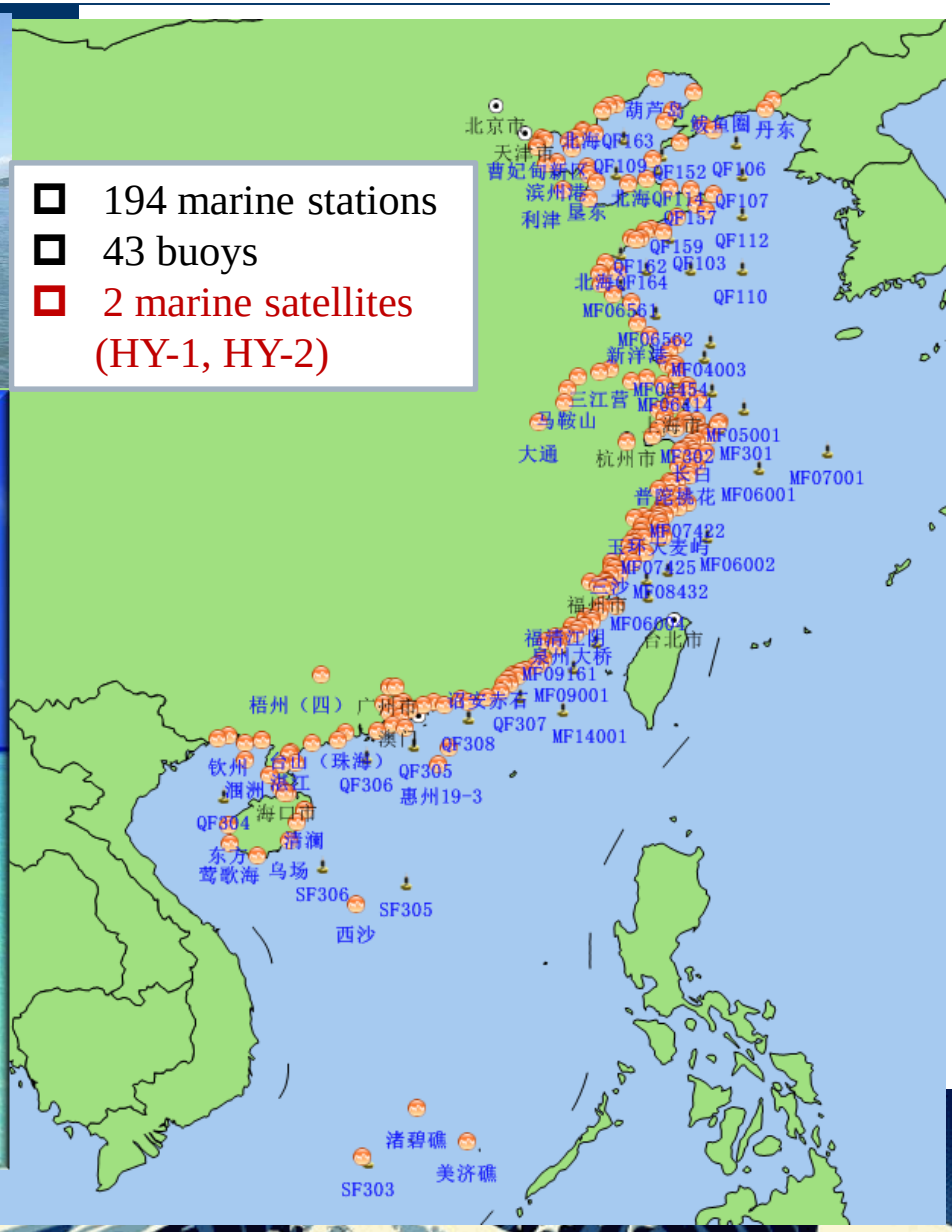
More serious

Nationwide Emergency meeting

Marine observation stations and buoys in China Seas

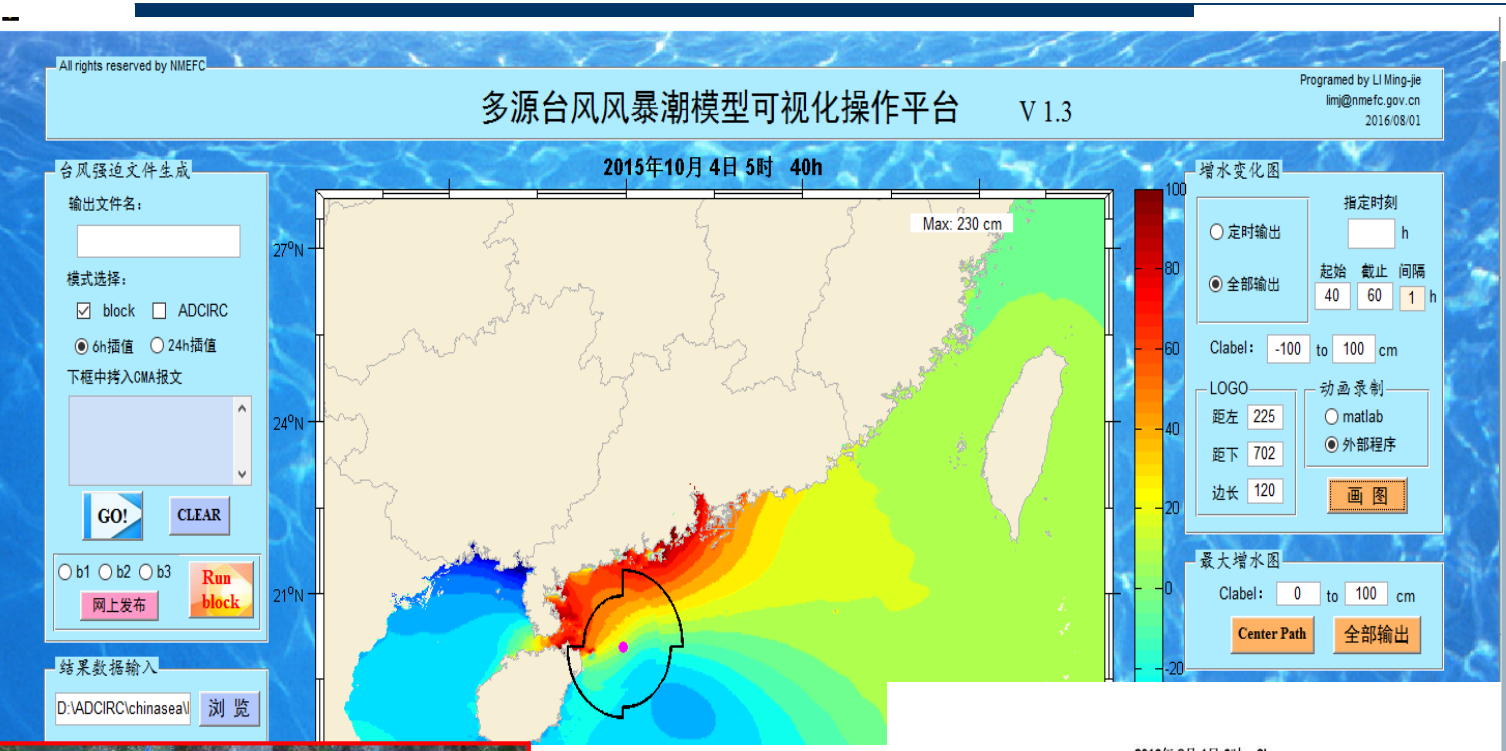


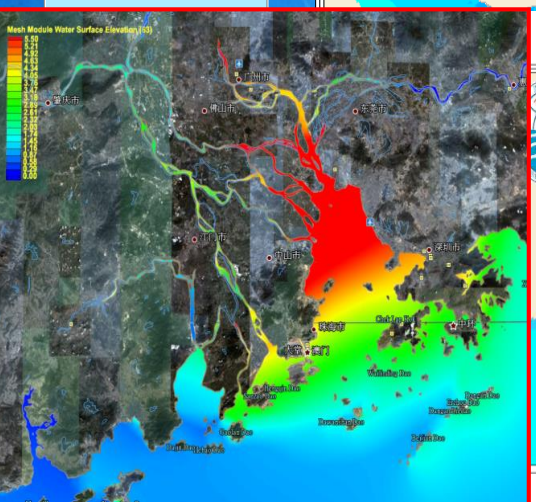
- 194 marine stations
- 43 buoys
- 2 marine satellites (HY-1, HY-2)

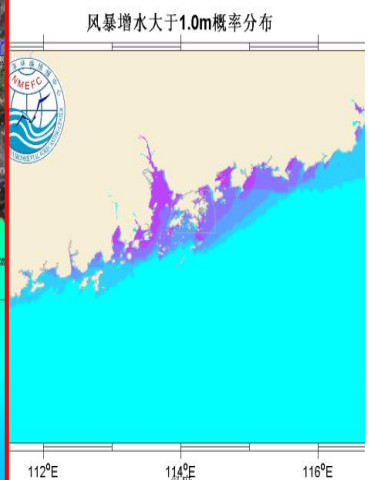


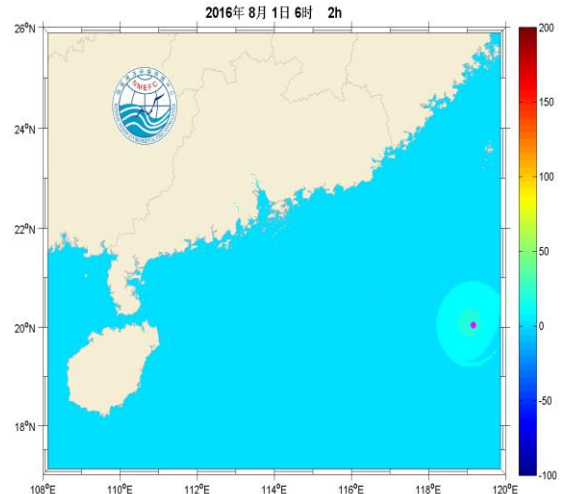
Operational storm surge forecasting system

China's Typhoon Storm Surge Forecasting System (CTS)





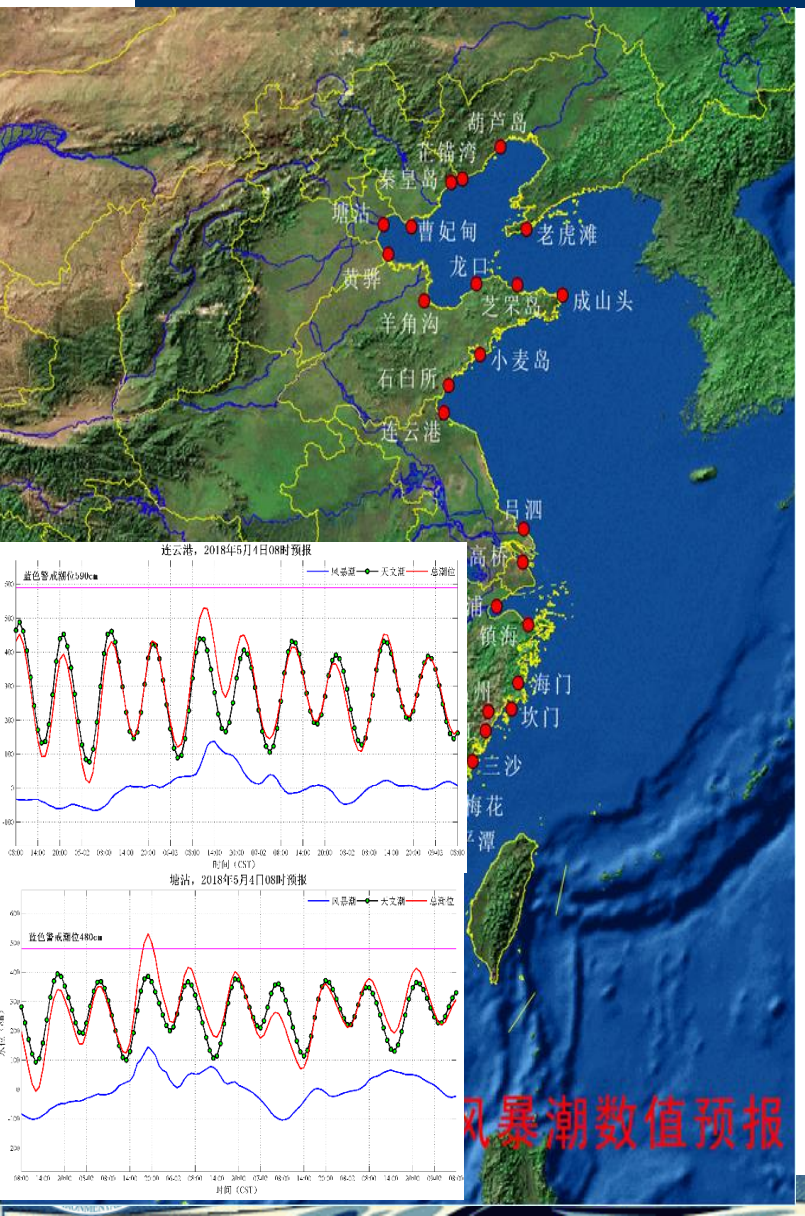


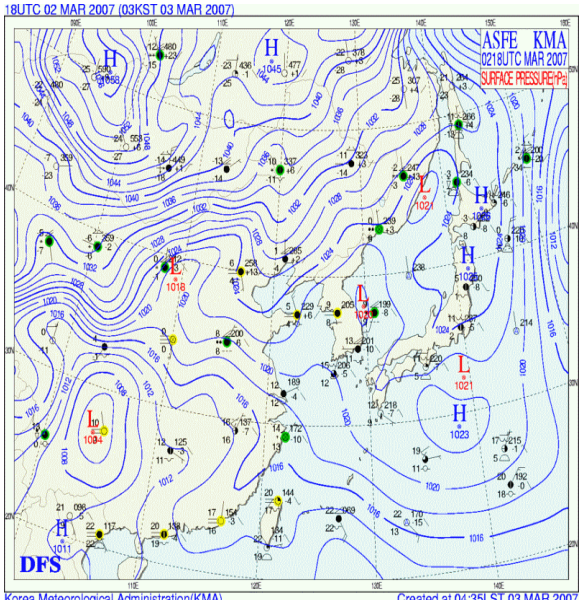


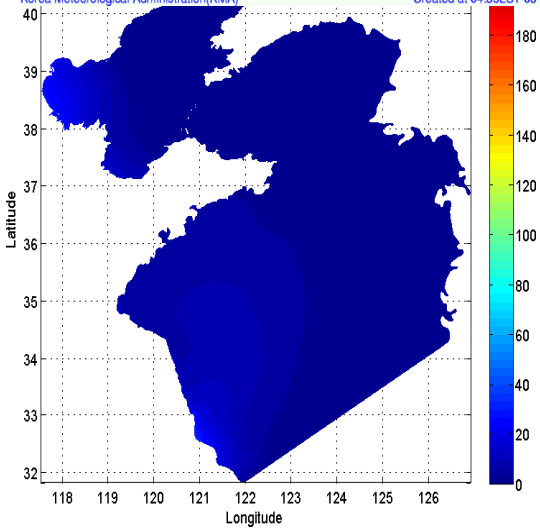
System Characteristics:

- Developed by NMEFC, run operationally in 2003;
- Base on spherical coordinates semi-implicit finite difference; grid resolution reached 2′
- ensemble forecast -- accounting for the uncertainty of typhoon forecast in moving speed and central track

China's extra-tropical storm surge forecasting system(CES)



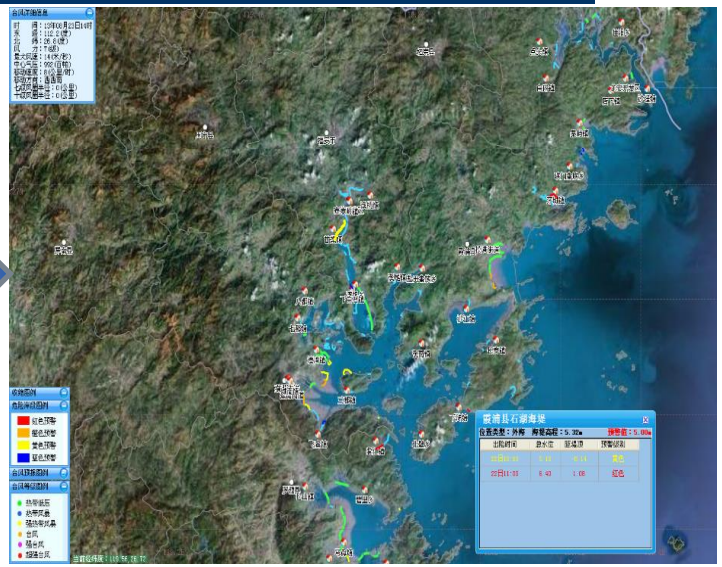




System Characteristics:

- Developed by NMEFC, run operationally in 2004;
- Computing area including Bohai sea and Yellow Sea
- grid Resolution reached 6'
- Driven by WRF model and run twice per day Automatically

Storm surge overtopping barrier forecasting system



System Characteristics:

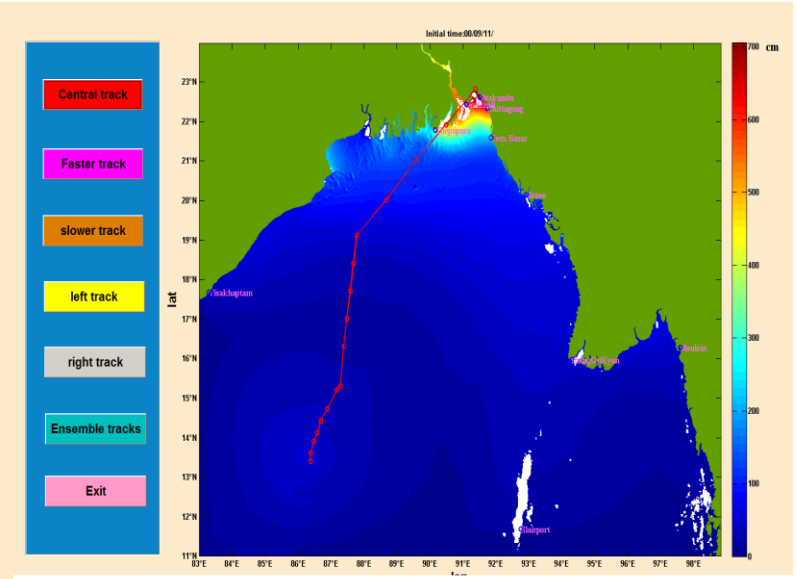
- Based on unstructured mesh and Using FEA method.
- High–resolution topography and water depth data, the height and structure of barrier
- including astronomical tide, storm surges, coastal wave and wave run-up in the front of barrier.
- less than 15min simulating 3 days storm surge in HPCs
- run operationally in NMEFC

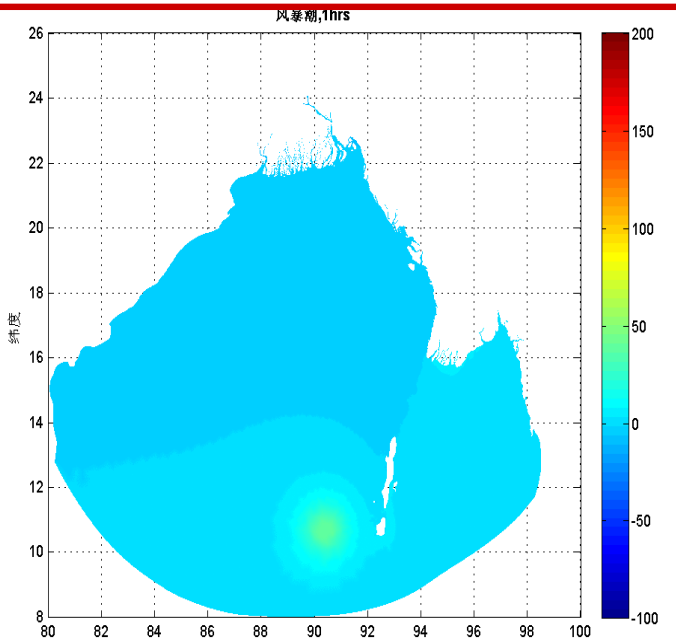
Storm surge around the world

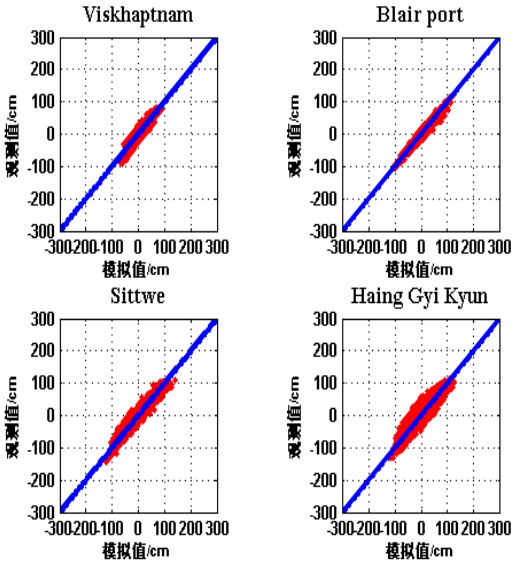
The bay of Bengal is an important node of "The Belt and Road initiative" and affected by storm surge seriously.

Year	Date	Wind &surge	Affected region	Deaths
1970	12-13,November	W=222km/h,s=5.5m	Khulna-Chittagong	300,000
1971	28-30,November	W=110km/h s=1.0m	Sunderban	11,000
1985	24-25,May	W=154km/h,s=3.2m	Noakhali-Cox's Bazar	11.069
1988	29,November	W=160km/h,s=3.5m	Sunderban	5.708
1991	29,April	w=236km/h,s=5.8m	Patuakhali-Cox's Bazar	14,500
2008	2,May	w=215km/h	Myamar	138,000

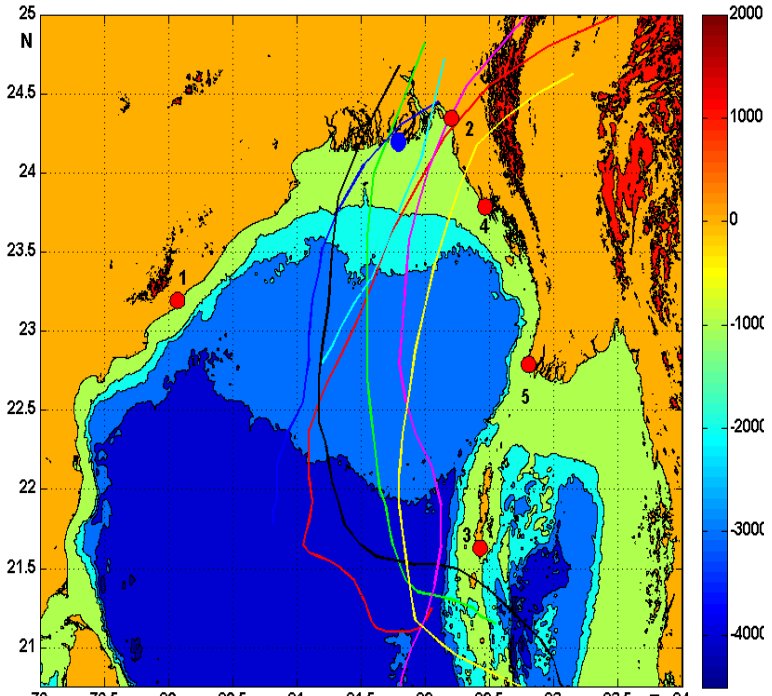
Storm surge forecasting system in the bay of Bengal

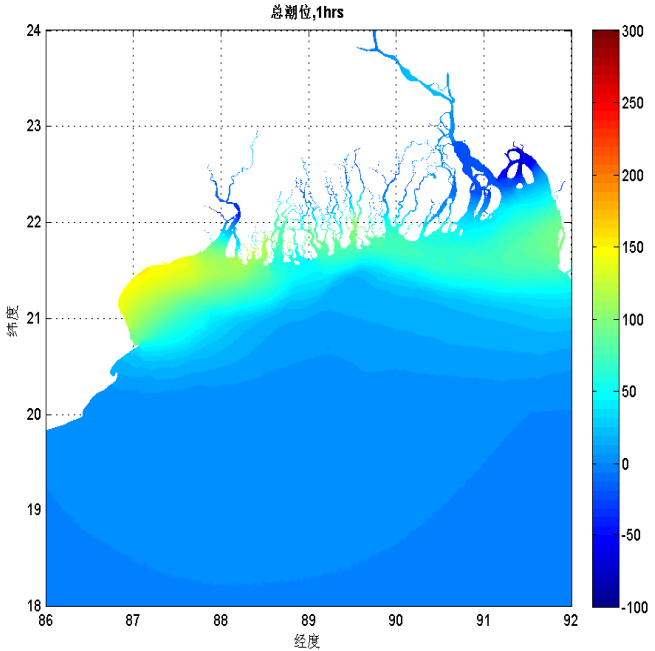


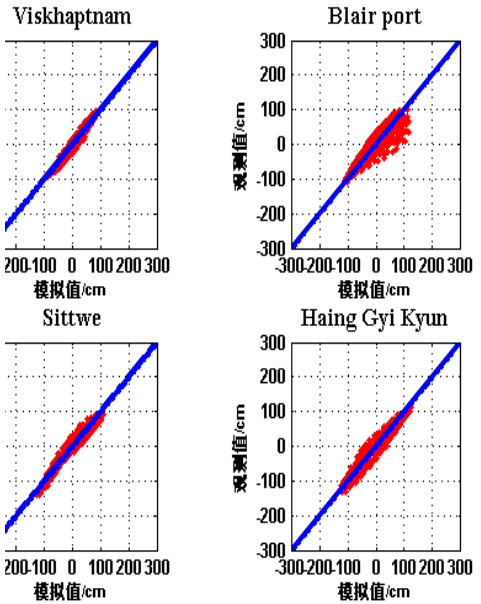




5月

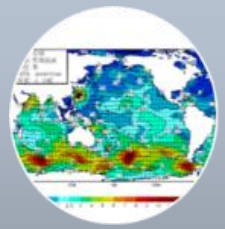




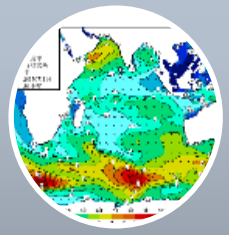


Operational wave forecasting system

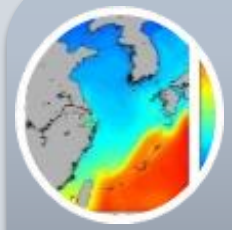
China Operational Wave Forecasting System



Global



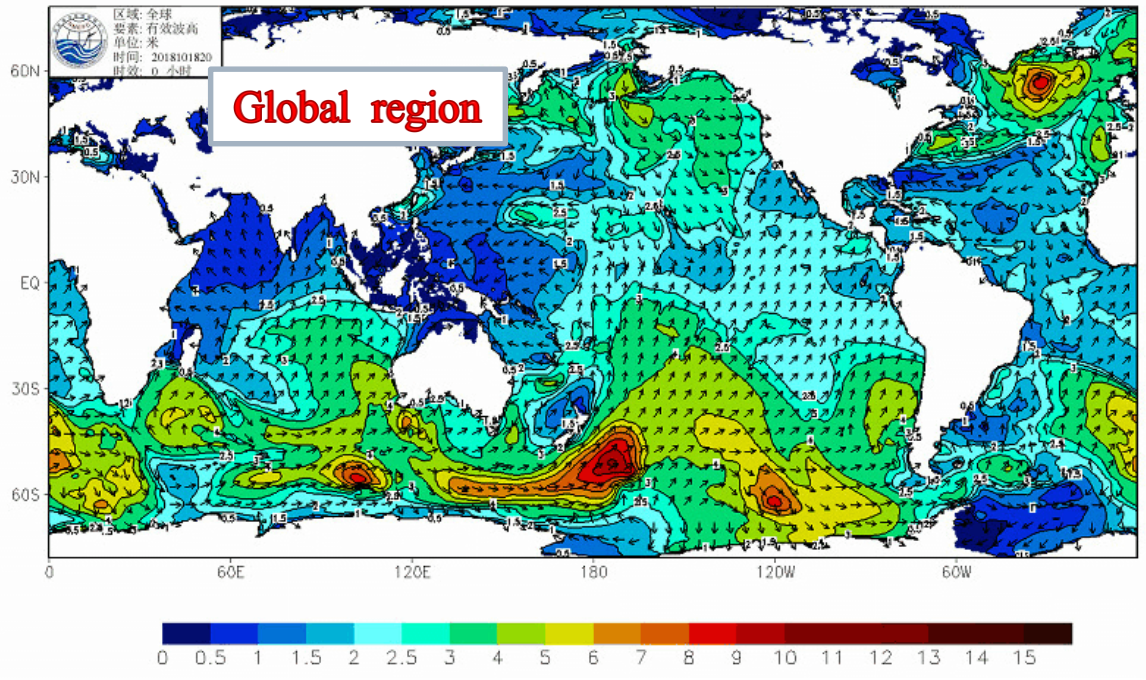
Regional

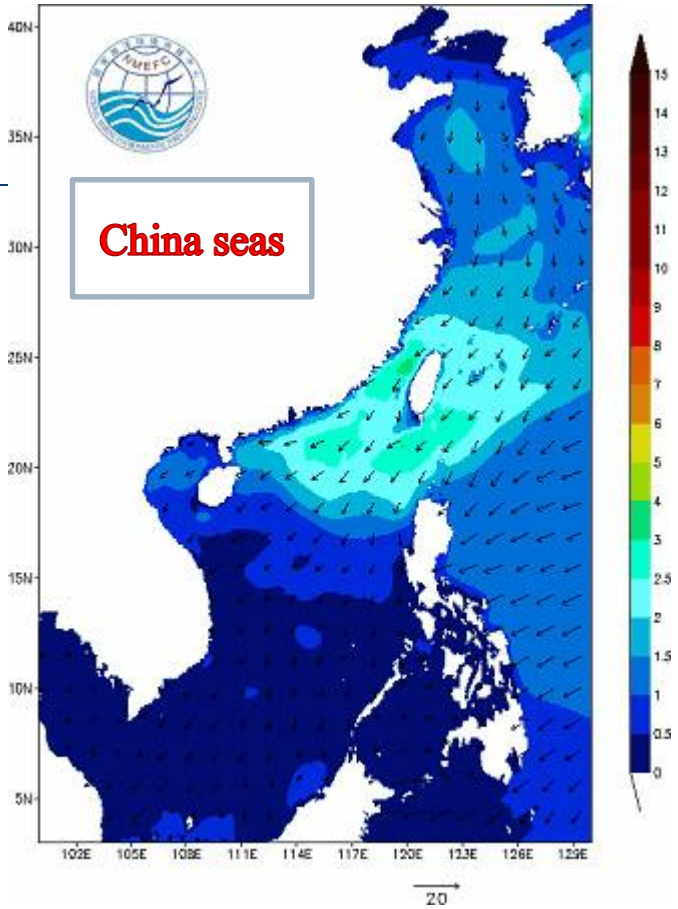


China seas

Parameters setting of operational wave forecasting system

- **Resolution**
  - ✓ Global: 1/3° ×1/3°
  - ✓ Indian Ocean：1/6° ×1/6
  - ✓ North-West Pacific：1/10° ×1/10°
  - ✓ China seas：1/30° ×1/30°
- **Forecasting products**
  - ✓ SWH, Peak wave period, mean wave direction
- **Forecasting duration**
  - ✓ 72-120hours
- **Wave model**
  - ✓ Global, Indian, North-west Pacific：NWW3
  - ✓ China seas: SWAN
- **Forcing wind**
  - ✓ NCEP/GFS, WRF, Grapes
- **Data assimilation**
  - ✓ HY-2 satellite altimeter SWH using optimal interpolation


区域: 全球
要素: 有效波高
单位: 米
时间: 2018101820
时效: 0 小时
Global region
60N
30N
EQ
30S
60S
0
60E
120E
180
120W
60W
0 0.5 1 1.5 2 2.5 3 4 5 6 7 8 9 10 11 12 13 14 15


China seas
40N
35N
30N
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5N
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105E
108E
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114E
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123E
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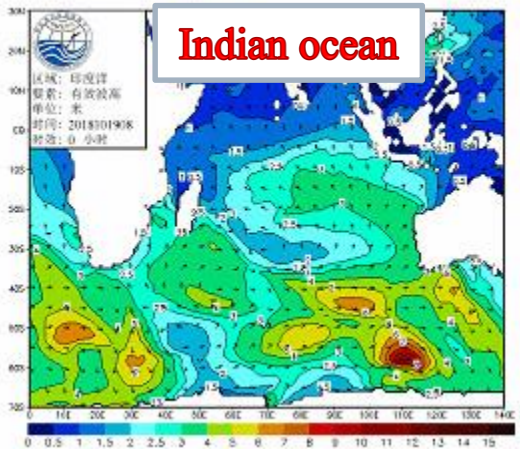
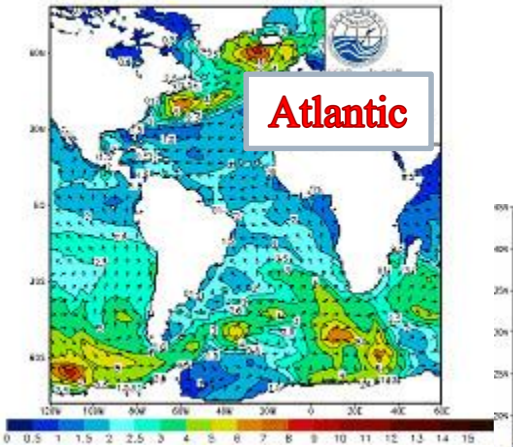
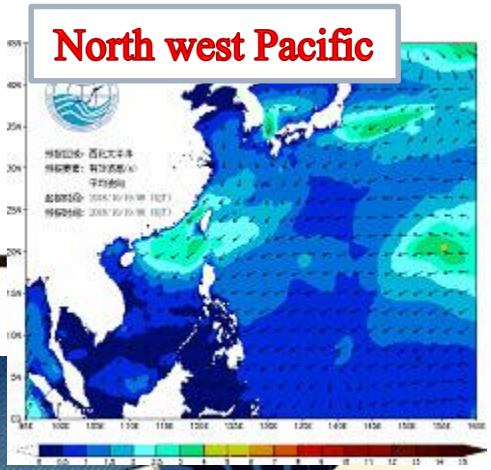
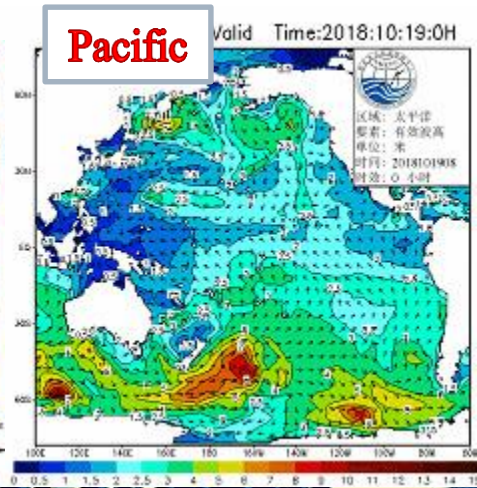
129E
20


Indian ocean

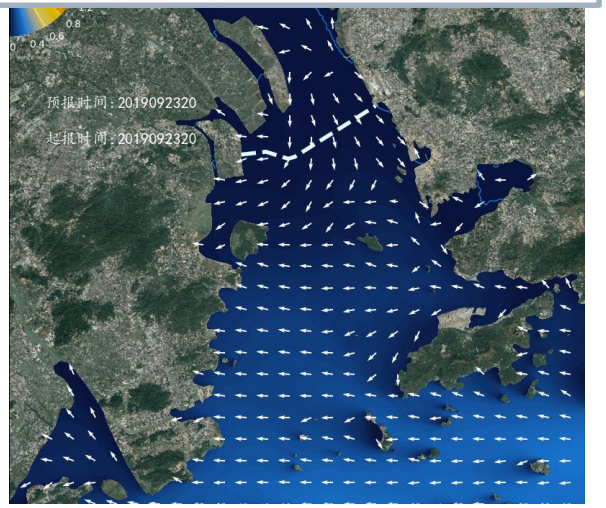

Atlantic


North west Pacific

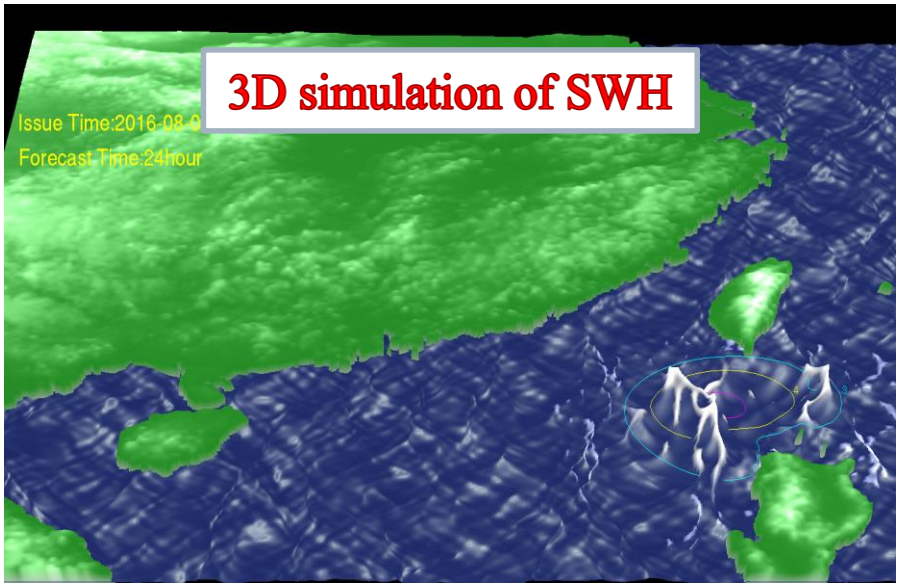

Pacific
Valid Time:2018:10:19:0H

Wave forecasting products

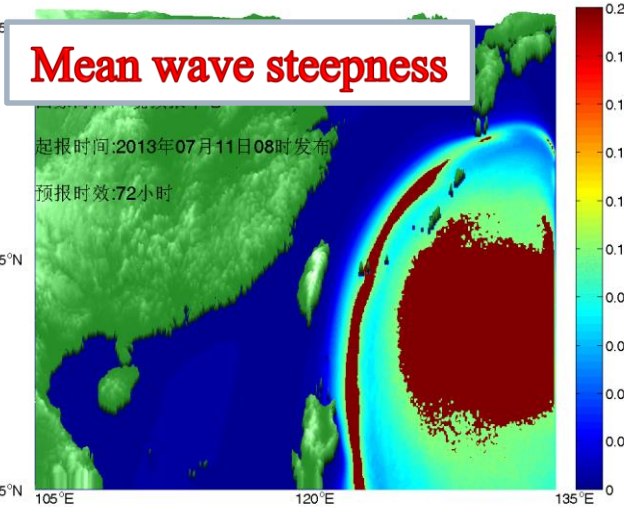
SWH, T, and Wave direction



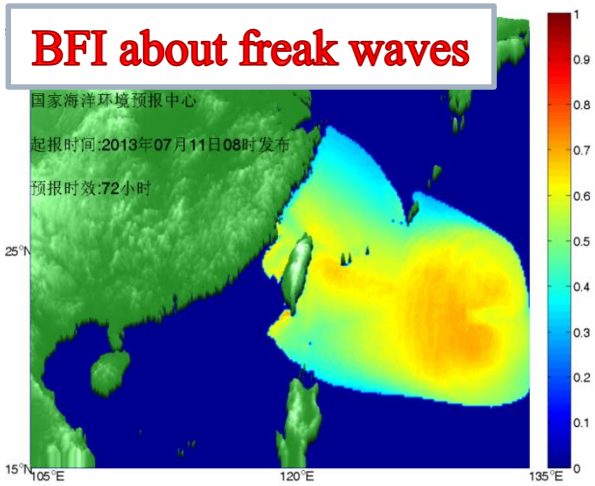
3D simulation of SWH



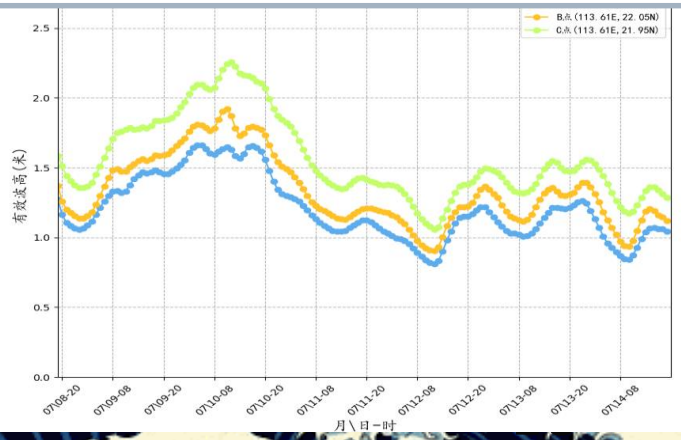
Mean wave steepness



BFI about freak waves



Time series of SWH at a certain point



Outlook

- Forecasting and warning of extreme sea state
- Coastal process forecast: wave run-up, wave overtopping, flooding
- More precise storm surge forecast, such as including urban sewerage system, recognizing city streets
- Application of artificial intelligence（AI）technique in marine forecasting and warning

Thank you for your attention

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http://www.nmefc.cn