

**Eleventh meeting of the ICG/PTWS Regional Working Group on Tsunami Warning and Mitigation System in the South China Sea Region (ICG/PTWS WG-SCS),
Guangzhou, 25 - 27 September 2023**

Tsunami Warning Operation and Services in China during 2022 ~ 2023 (National Report)

Zongchen WANG

**National Marine Environmental Forecasting Center(NTWC)
*Ministry of Natural Resources, P. R. China***

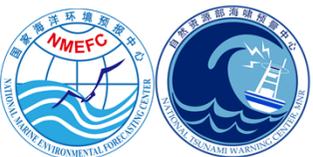
Outlines

1. Earthquake and Tsunami Monitoring Capability

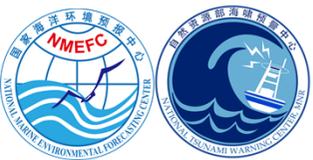
2. Tsunami Warning Technologies and Operation

3. Tsunami Mitigation and Publicity

4. Internatonal Communication and Coordination

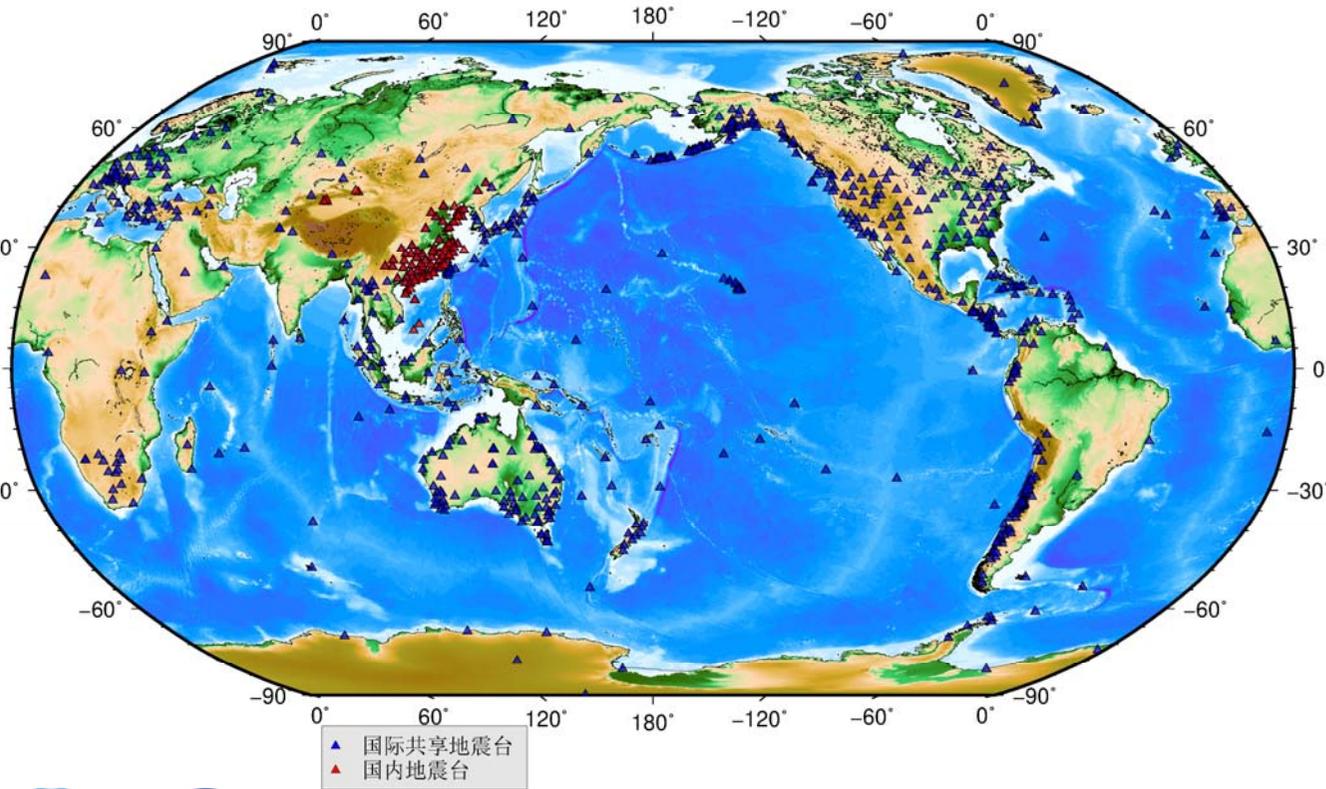


1. Earthquake and Tsunami Monitoring Capability



1.1 Global Seismic Monitoring

Global shared Seismic Station

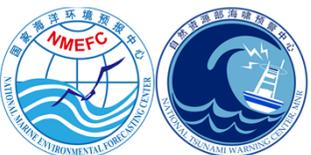


Real-time, broadband seismic waveform data from:

- MNR(27)
 - CEA(54)
 - IRIS
 - GEOFON
 - GEOSCOPE
- } • (700+)

Earthquake Rapid Information Report

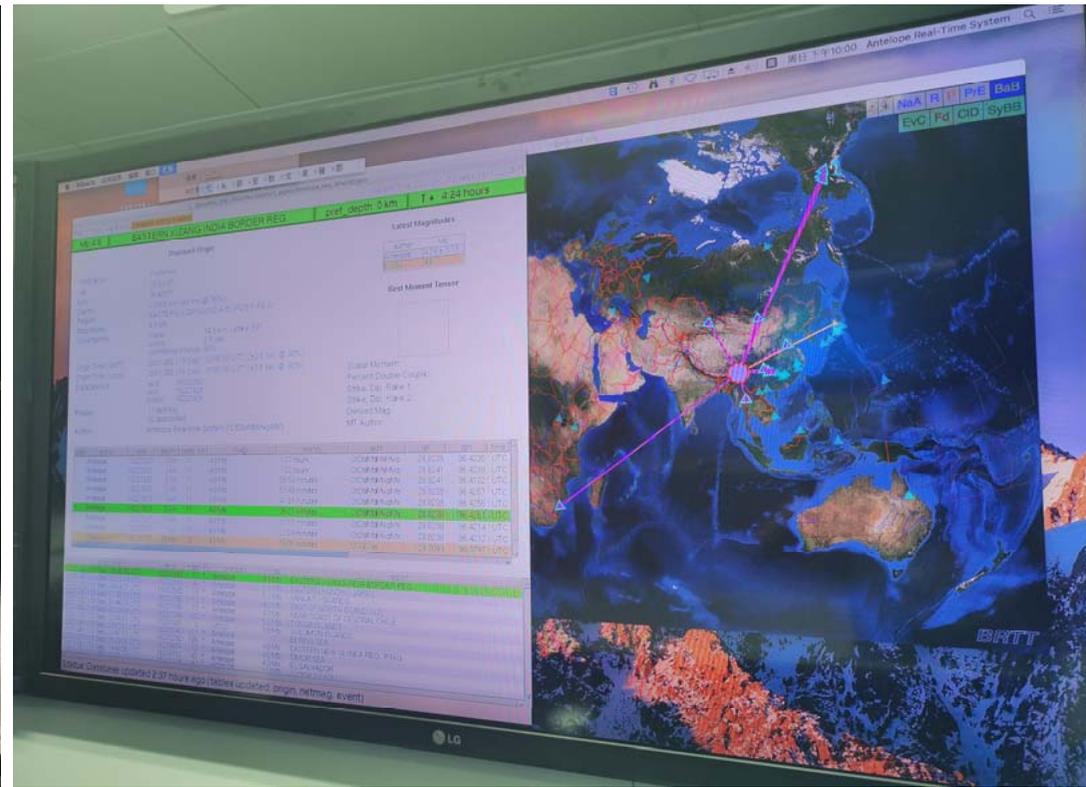
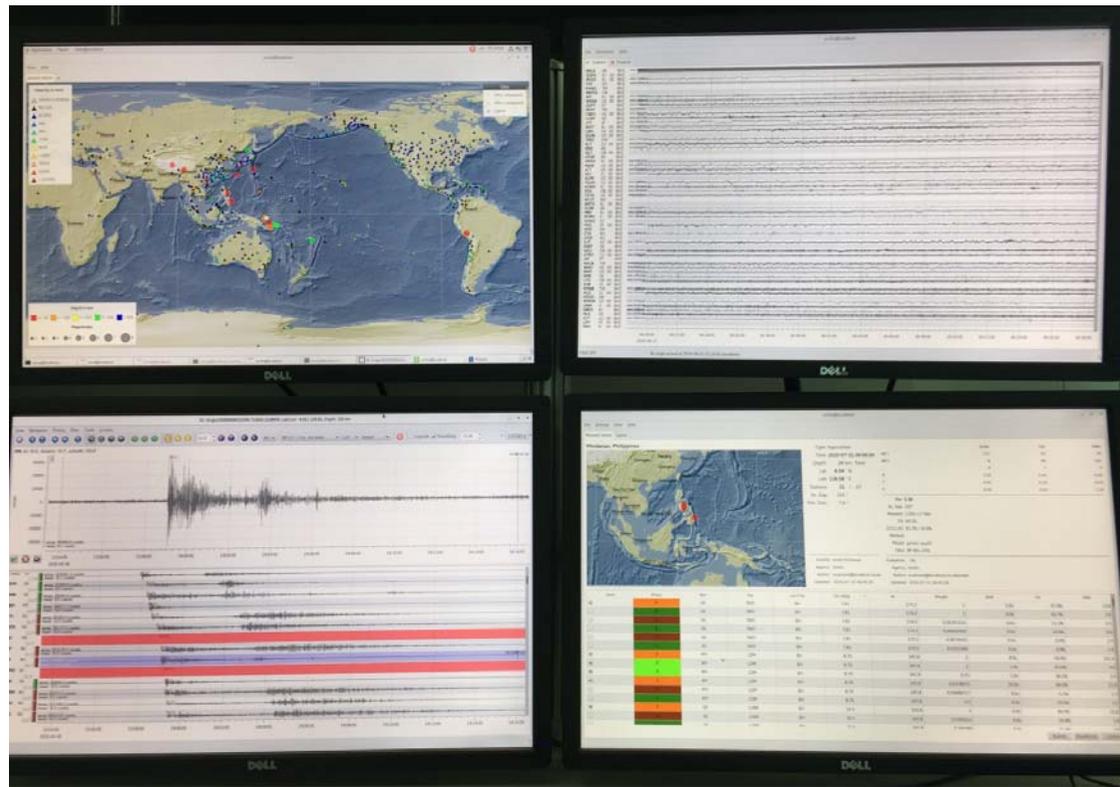
- Antelope
- SeisComp3
- CEA EQIM
- PTWC, USGS earthquake info



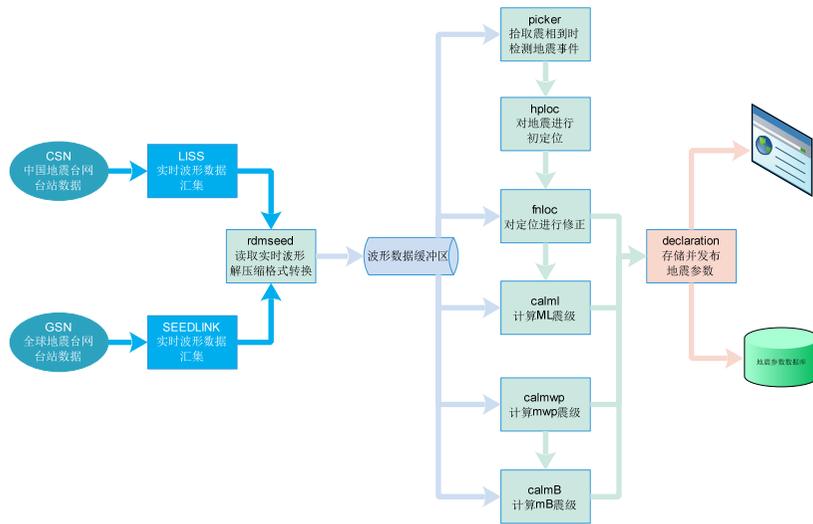
1.2 Seismic Analysis and Earthquake Detecting

SeisComp3

Antelope



1.2 Seismic Analysis and Earthquake Detecting



System function module architecture diagram

- 7×24h Running with good stability
- Global earthquakes (M>6.0) in near real-time;
- Autonomous and controllable usage

全球海底地震自动检测与定位系统

Global Earthquake Automatic Detecting and Location System

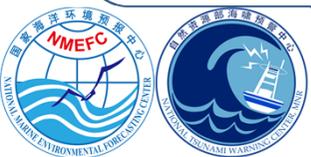
最新地震: 2023-01-08 20:32:46.6 166.75° -14.77° 50km M6.8 瓦努阿图群岛

发震时刻	震级	位置
2023-01-08 20:32:46.6	6.8	瓦努阿图群岛
2023-01-05 22:25:52.1	5.9	兴都库什地区
2023-01-03 02:22:47.1	5.0	千岛群岛
2022-12-20 18:34:25.4	6.3	美国加利福尼亚州北部沿岸近海
2022-12-17 07:35:32.7	4.7	美国得克萨斯州西部
2022-12-15 12:03:19.7	5.8	中国台湾
2022-12-15 02:40:29.3	6.4	拉特群岛[阿留申群岛]
2022-12-13 22:25:26.1	5.7	日本琉球群岛
2022-12-11 22:31:35.4	6.1	墨西哥格雷罗州
2022-12-08 14:42:11.0	5.0	高加索东部
2022-12-05 03:24:24.8	6.2	萨摩亚群岛地区[太平洋]
2022-12-03 17:49:48.1	5.5	印尼爪哇岛
2022-11-30 23:17:45.7	5.5	伊朗南部
2022-11-28 10:51:23.3	5.7	葡萄牙亚速尔群岛地区
2022-11-25 21:46:55.4	5.7	所罗门群岛
2022-11-23 09:08:20.8	5.1	土耳其
2022-11-23 00:39:06.3	5.9	墨西哥下加利福尼亚
2022-11-22 10:03:08.2	7.1	所罗门群岛
2022-11-21 23:09:31.9	5.3	福克兰群岛[阿留申群岛]
2022-11-21 07:25:07.3	4.8	希腊佐泽卡尼索斯群岛
2022-11-14 16:08:26.7	6.2	日本本州南岸近海
2022-11-12 15:09:15.6	6.5	斐济群岛地区
2022-11-12 12:39:48.3	5.5	危地马拉
2022-11-11 18:48:48.8	7.5	汤加群岛地区
2022-11-10 13:01:06.3	5.2	西藏林芝市墨脱县
2022-11-09 18:14:31.8	6.0	斐济群岛以南

© 2023 Baidu - GS(2021)6026号 - 甲测资字11111342 - 京ICP证030173号 - Data © 百度智图 & Or

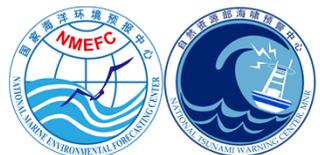
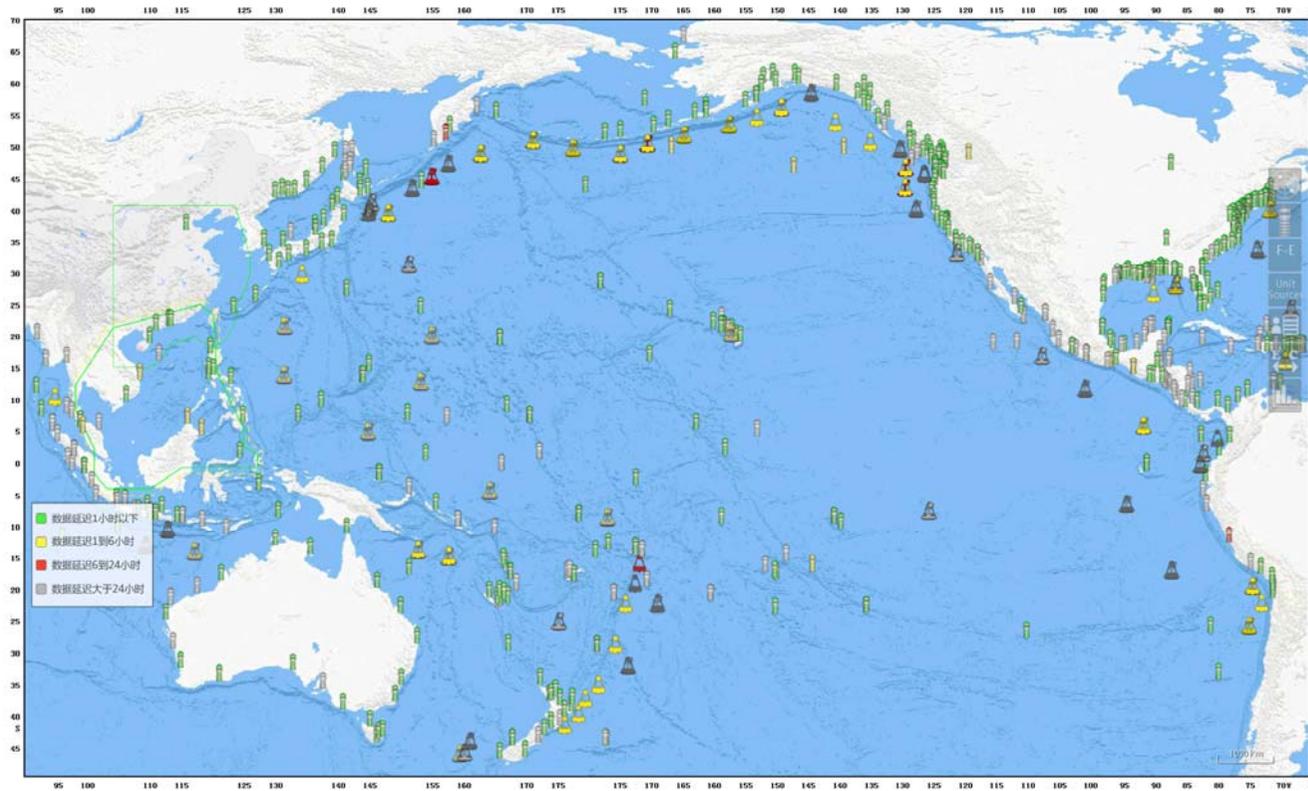
国家海洋环境预报中心 2022

Independent developed Global Earthquake Automatic Detecting and Location System

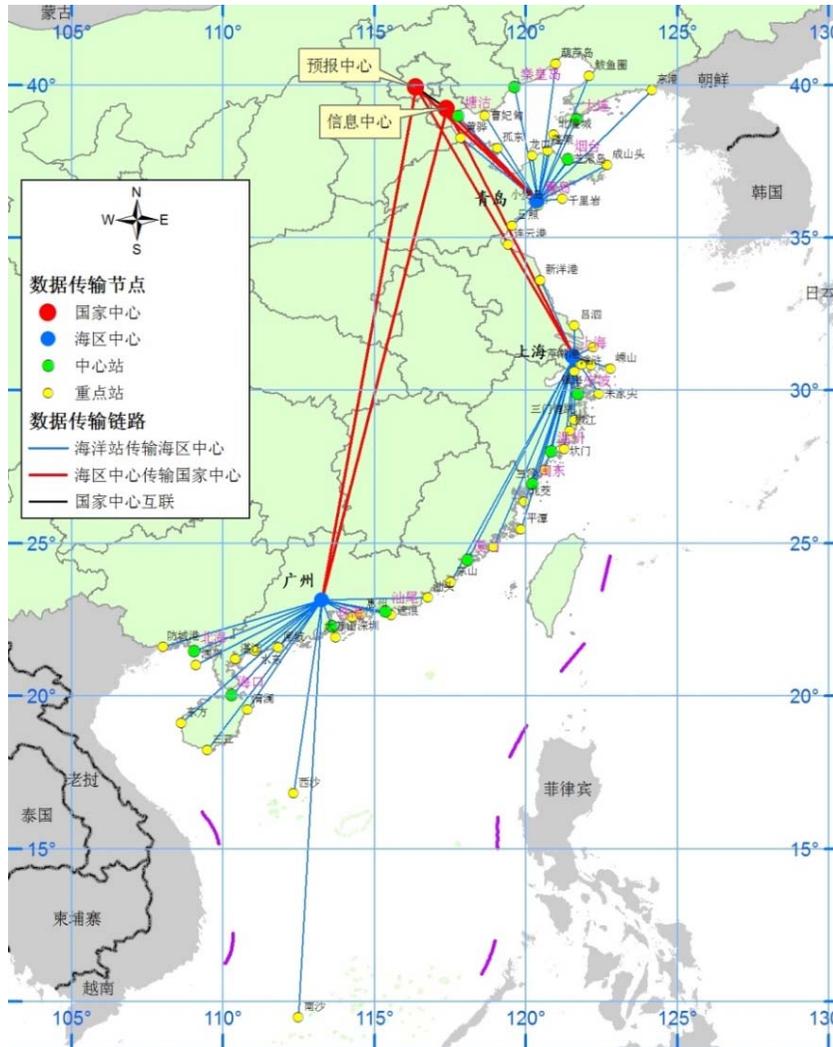


1.3 Global Sea Level Dataset

- Real-time sea level data from nearly **600** functional tidal gauges and Dart bouys via GTS and from sea-level monitoring facility website
- Metadata file and Tide Tool update following PTWC's Emails



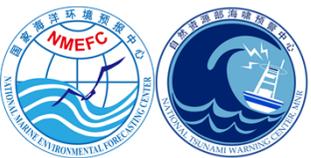
1.4 China Real-time Sea Level Station



- 130~ tidal gauges along the Chinese coasts
- Data sharing via GTS for tsunami warning and mitigation system in the SCS region:
 - ✓ Shenzhen (Chinese Mainland)
 - ✓ Zhapo (Chinese Mainland)
 - ✓ Qinglan (Chinese Mainland)
 - ✓ Quarry Bay (Hongkong)
 - ✓ Shek (Hongkong)

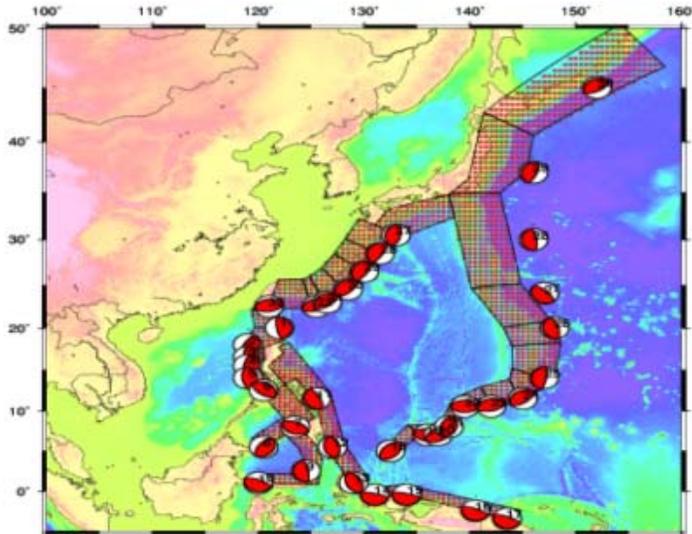


2. Tsunami Warning Technologies



2.1 Two Sets of Tsunami Database

NW Pacific Scenario Database



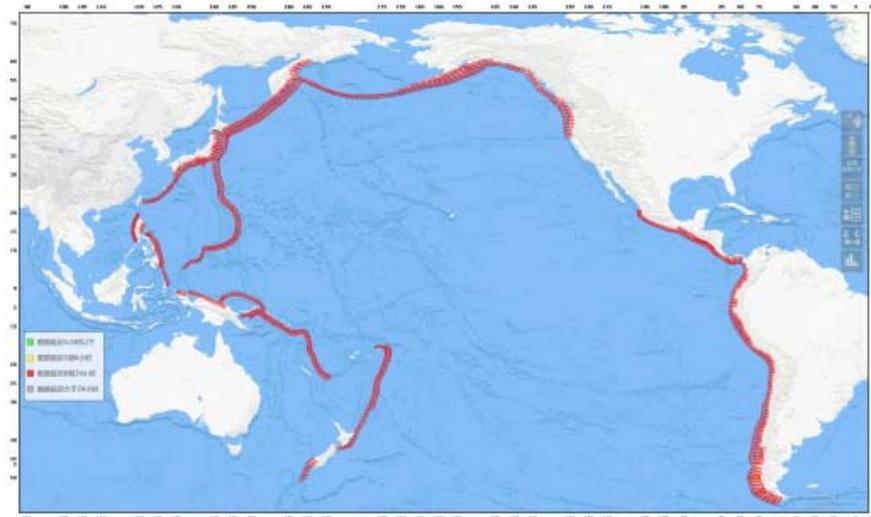
Source Coverage:

37 partitions, 1671 sources

Resolution: $0.5^\circ \times 0.5^\circ$

Totally: 60,156 tsunami scenarios

The Pacific Unit Source Database

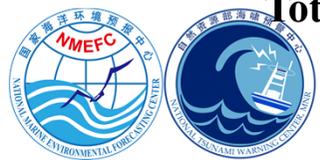


Source Coverage:

Length: 100 km

Width: 50 km

Totally: 1391 unit sources



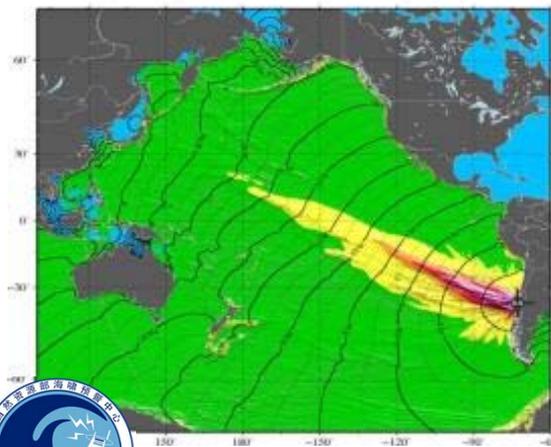
2.2 On-the-Fly Tsunami Forecast Model

Linear shallow water equation running performance on NVIDIA Tesla V100(GPU)

Forecast region	Space resolution	Forecast period (hours)	Consuming time (seconds)			Efficiency promotion	
			Series	OpenMP	GPU	OpenMP	GPU
Pacific Ocean	5 arc-min	32	6070	410	45	15	135
NW Pacific Ocean	4 arc-min	15	450	32	4	14	113
South China Sea	2 arc-min	15	467	31	4	15	117

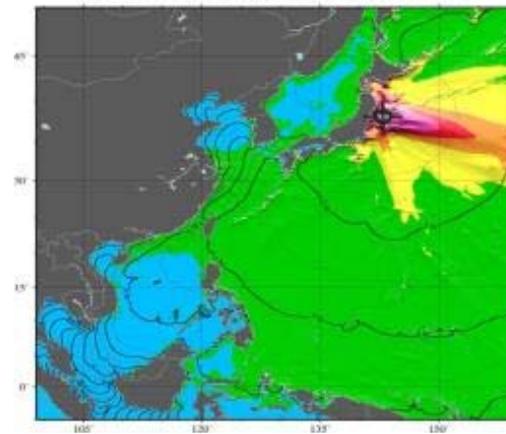
Pacific Deep-Ocean Tsunami Amplitude Forecast

This map should not be used to estimate coastal tsunami amplitudes or impacts. Deep-ocean amplitudes are usually much smaller than coastal amplitudes.



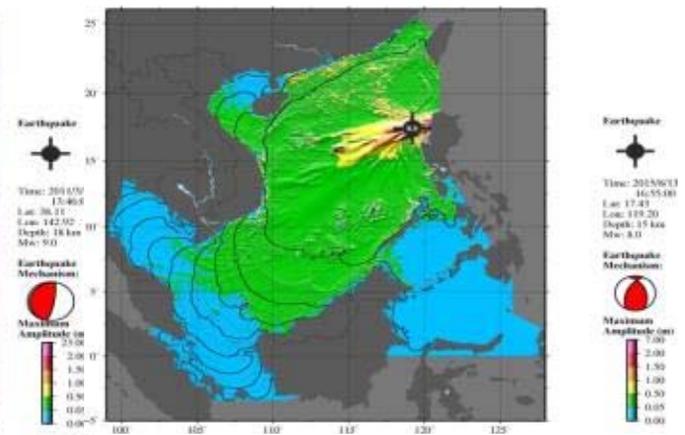
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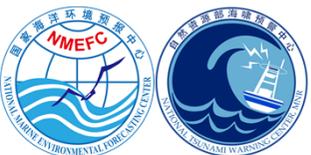
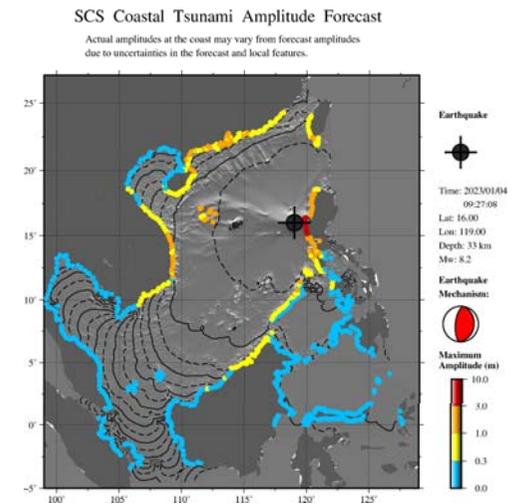
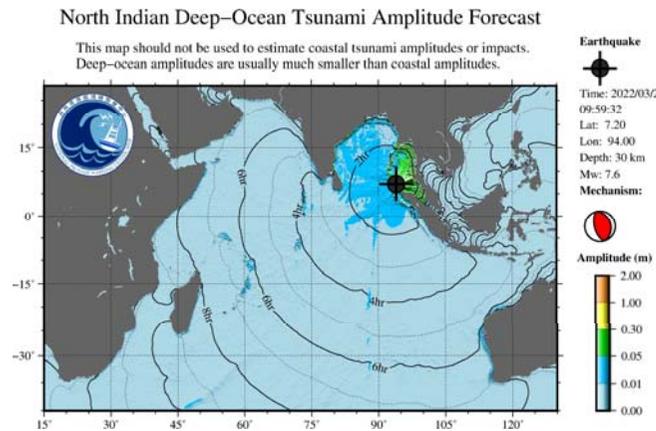
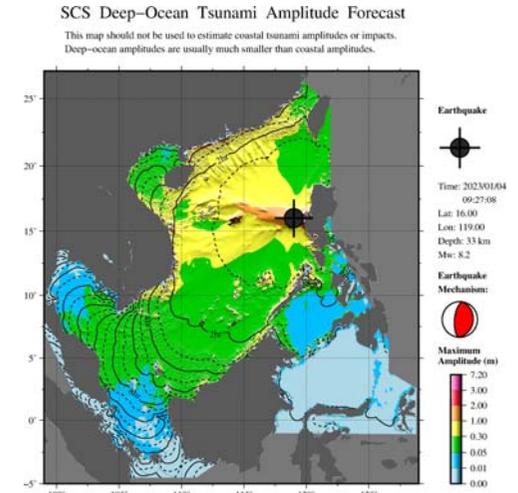
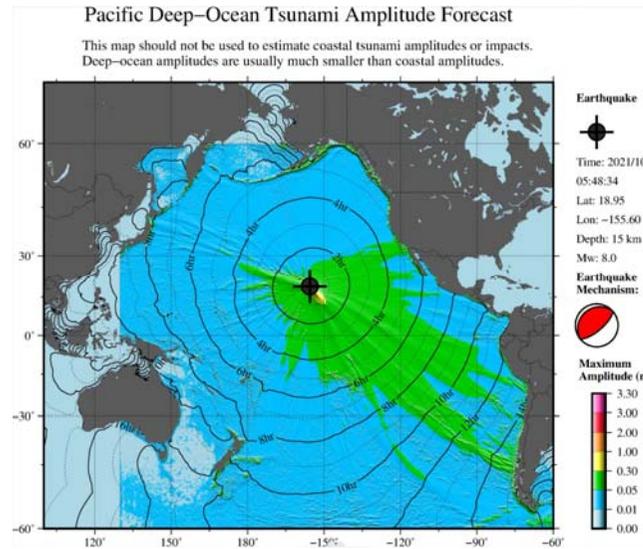
SCS Deep-Ocean Tsunami Amplitude Forecast

This map should not be used to estimate coastal tsunami amplitudes or impacts. Deep-ocean amplitudes are usually much smaller than coastal amplitudes.



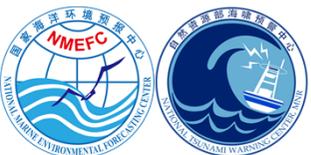
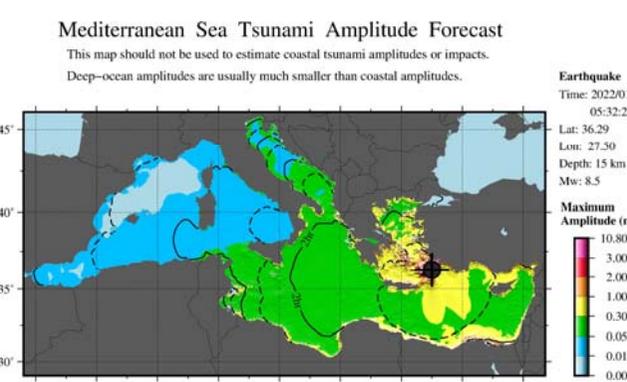
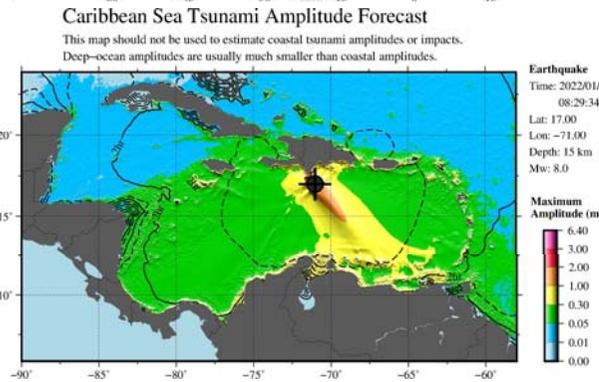
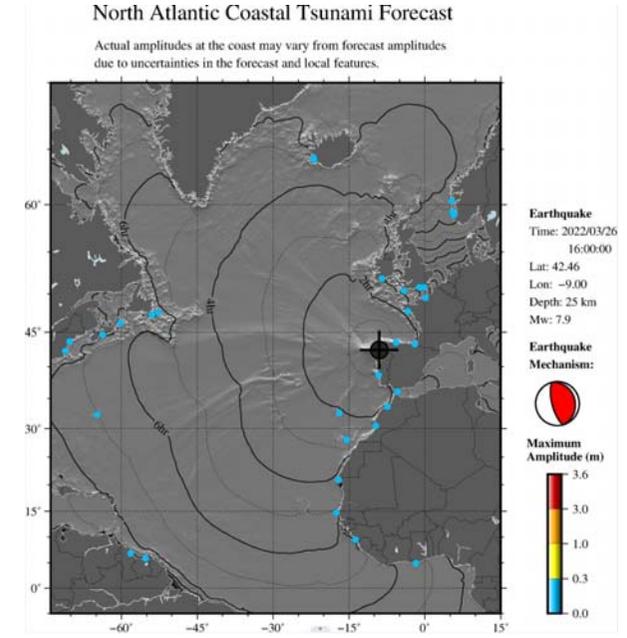
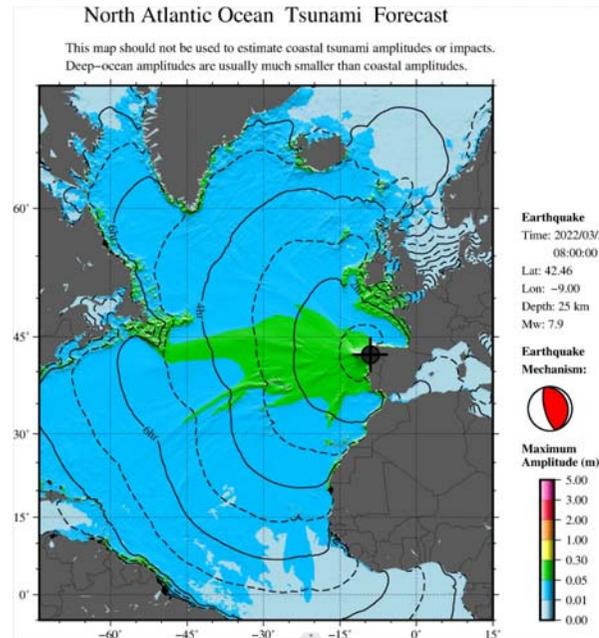
2.3 Coverage Expanding of Tsunami Modeling

- Total six regions
- Pacific Ocean
- South China Sea
- Indian Ocean
- North Atlantic Ocean
- Mediterranean Sea
- Caribbean Sea



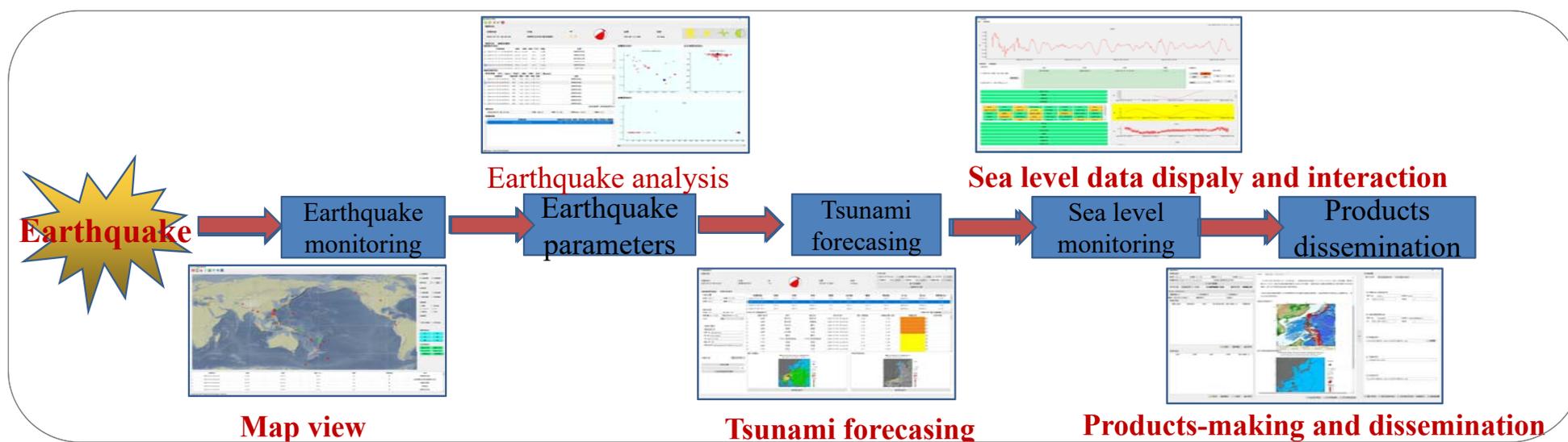
2.3 Coverage Expanding of Tsunami Modeling

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- **North Atlantic Ocean**
- **Mediterranean Sea**
- **Caribbean Sea**

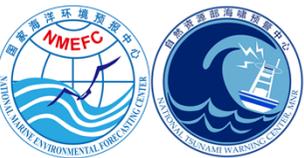


2.4 Smart Tsunami Information Processing System

Independent development

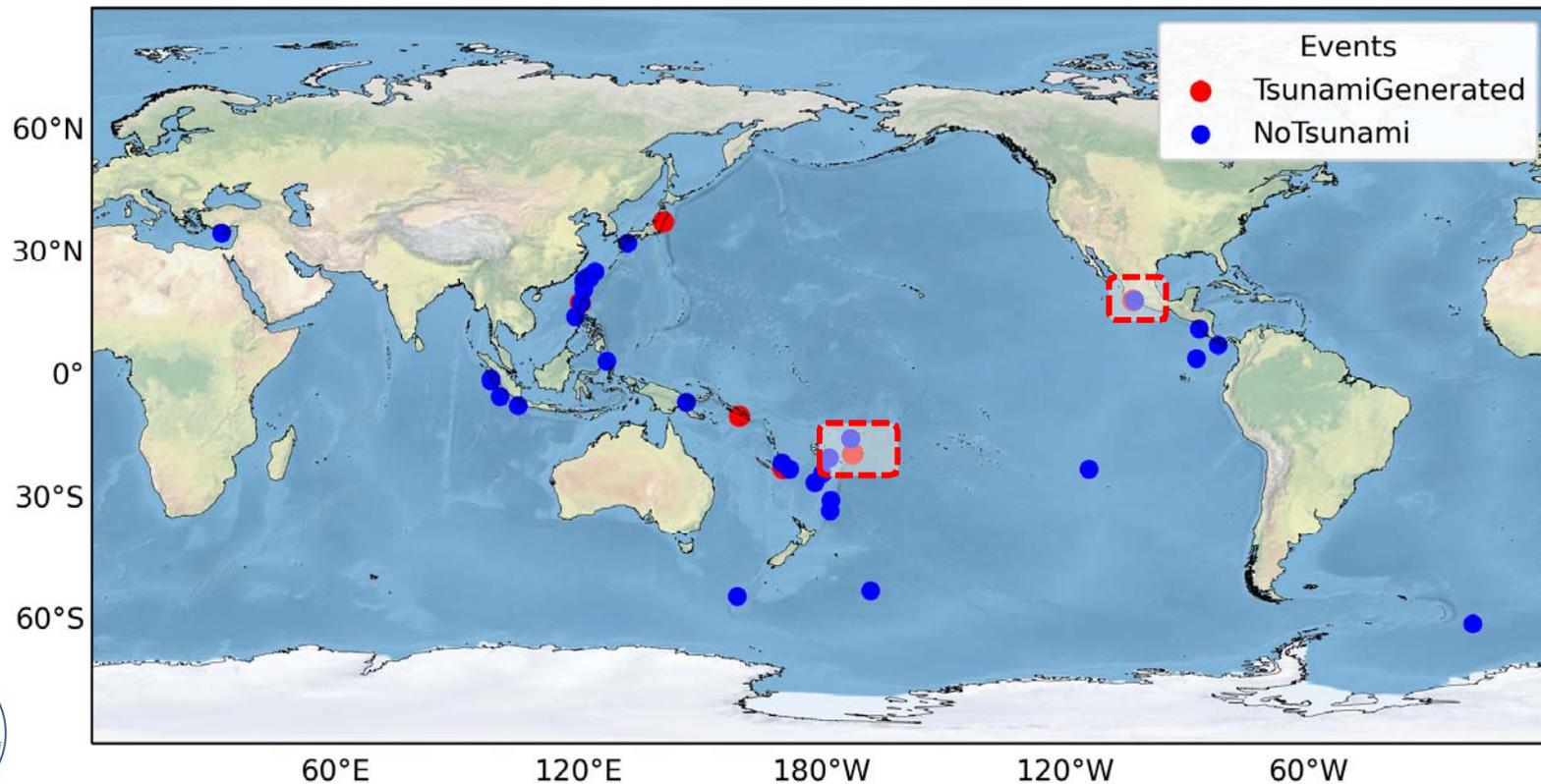


Smart Tsunami Information Processing System(STIPS): A fully independent developed tsunami warning and decision support system based on Python language is in operation for domestic tsunami service, and SCSTWS.



2.5 Issue Performance in 2022

- ❖ Responded to 46 major Earthquakes
- ❖ Issued 92 tsunami information bulletins
- ❖ Average latency is **9.0 mins** for the first message, **not including Tanga Tsunami**



2.6 Domestic Tsunami Desk-top Exercise, 2022

World Tsunami Awareness Day

Hypothesis Source: Earthquake with $M_w 8.8$ in Manila trench

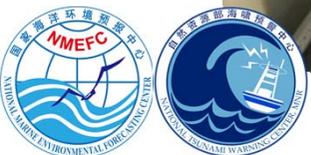
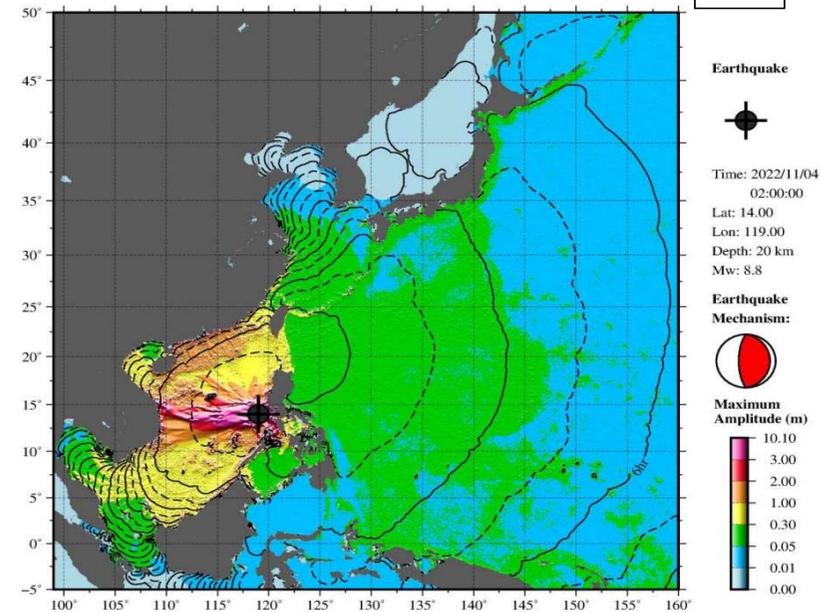
Warning: Catastrophic impact in Hainan, Guangdong, Guangxi and Fujian

Dissemination: Received Effectively in 10 minutes



NWPAC Deep-Ocean Tsunami Amplitude Forecast

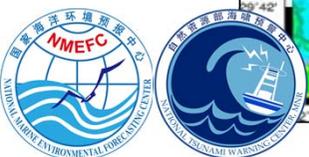
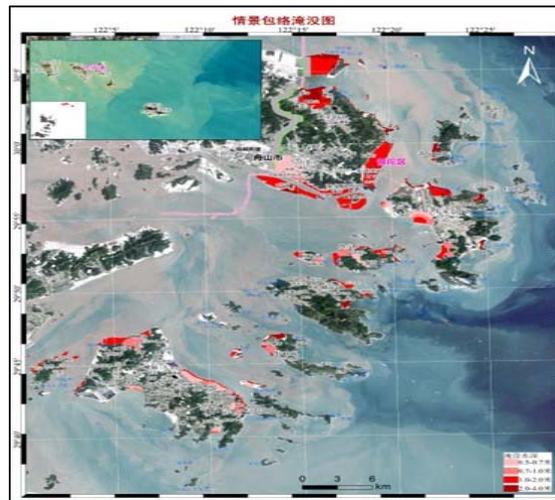
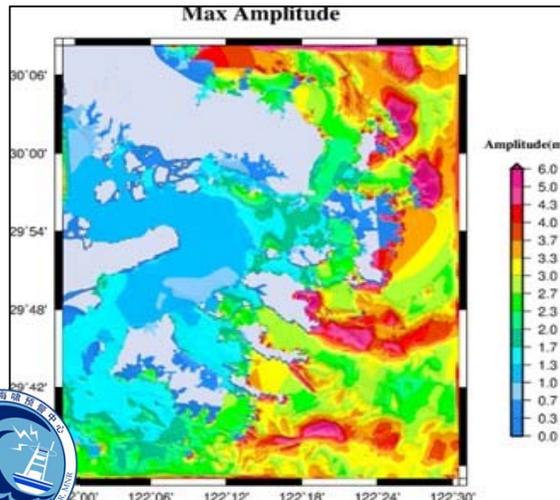
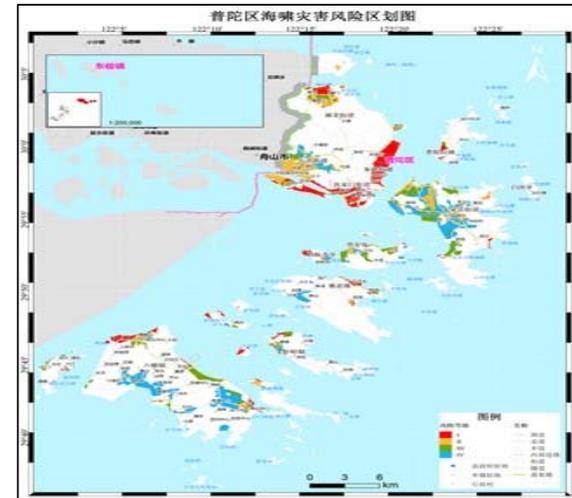
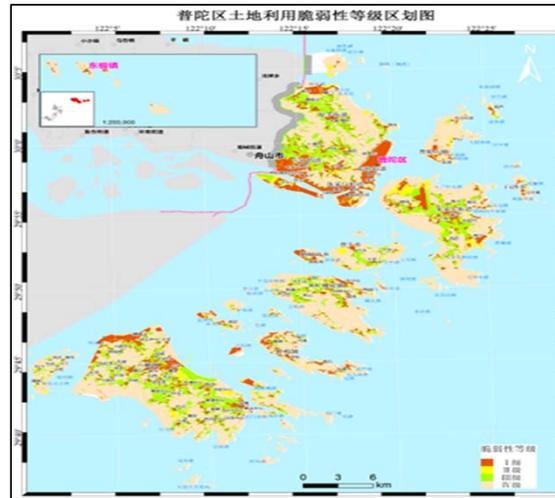
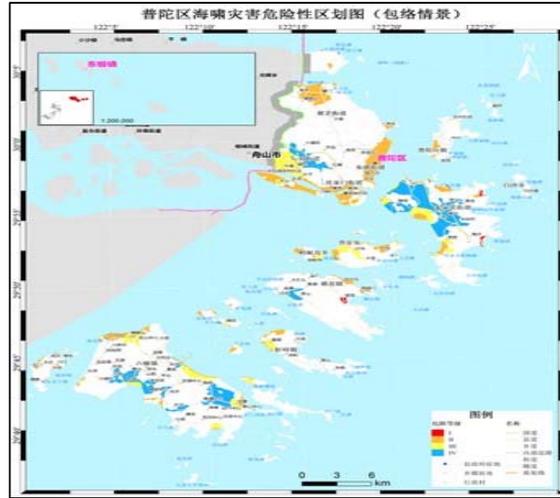
This map should not be used to estimate coastal tsunami amplitudes or impacts.
Deep-ocean amplitudes are usually much smaller than coastal amplitudes.



3. Tsunami Mitigation and Publicity



3.1 Tsunami Risk Identification and Assessment



3.2 Earth Day, 22 April

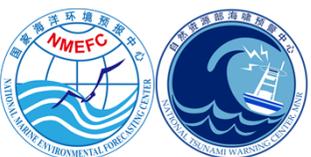


Lessons in the National Maritime Museum, Tianjin, 22 April 2023

3.3 National Disaster Prevention and Mitigation Day



Live webcast of publicity on tsunami hazard, Beijing, 12 May 2023



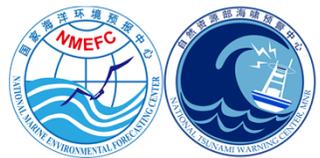
3.4 Tsunami Science Popularization



Polularization Activities in Beijing Science Center, May, 2023

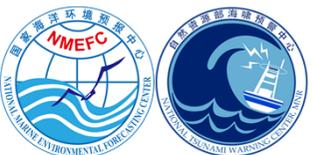


4. International Communication and coordination



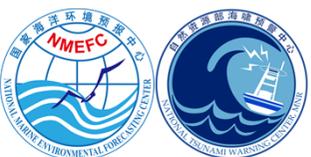
4.1 International communication

The NMEFC-BMKG International Conference on Non-seismic Tsunamis and Complex Tsunamis (online), 14 July, 2022



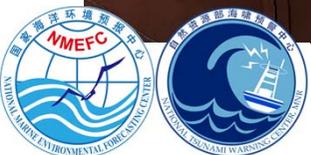
4.2 International communication

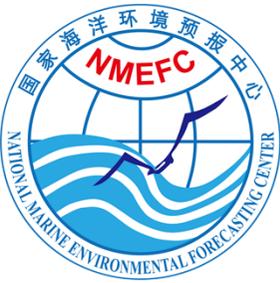
International Symposium on Applied Technologies for Earthquake and Tsunami Monitoring, Early Warning and Disaster Mitigation in the South China Sea Region (online), 20 December, 2022



4.3 International coordination

Thirtieth Session of the Intergovernmental Coordination Group for the Pacific Tsunami Warning and Mitigation System, Nuku' alofa, Kingdom of Tonga, 11–15 September 2023





**Eleventh meeting of the ICG/PTWS Regional Working Group on Tsunami Warning and Mitigation System in the South China Sea Region (ICG/PTWS WG-SCS),
Guangzhou, 25 - 27 September 2023**

Thank You!

**National Marine Environmental Forecasting Center
National Tsunami Warning Center
Ministry of Natural Resources, P. R. China**