Twelfth Meeting of the ICG/PTWS Regional Working Group
on Tsunami Warning and Mitigation System in the South China Sea Region,
7-8 November 2024, Jakarta, Indonesia

Report on the South China Sea Tsunami Advisory Center (SCSTAC)

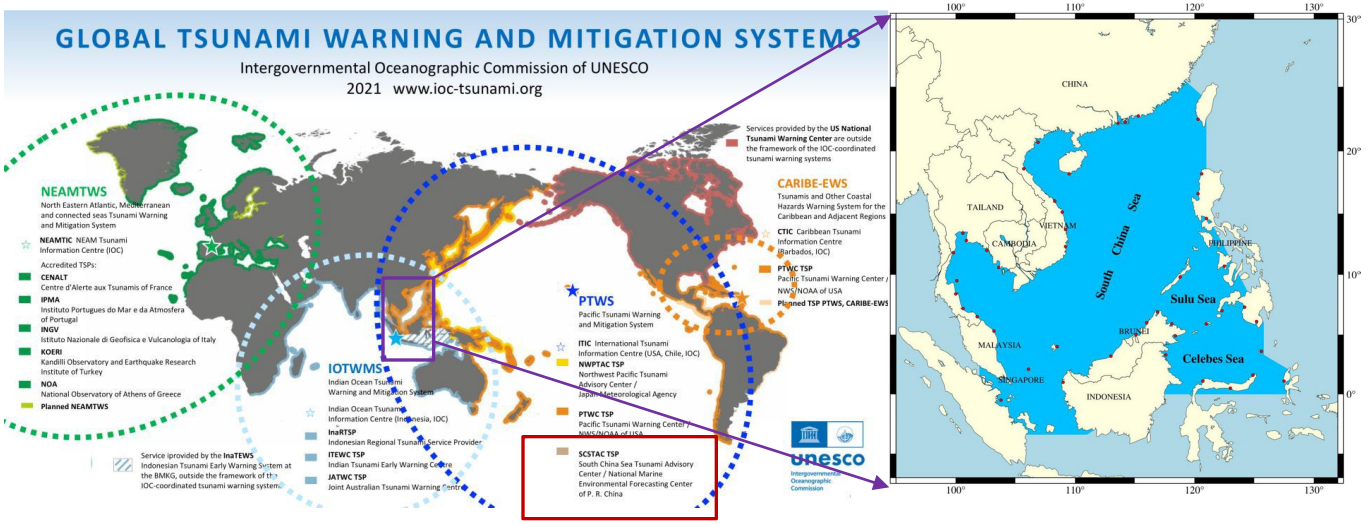
Zhiguo Xu
South China Sea Tsunami Advisory Center, UNESCO/IOC

Outline

1. SCS Tsunami Warning and Mitigation System
2. Operation of SCSTAC
3. Tsunami Warning Capacity Development
4. Cooperations and Communications
5. Further Plans

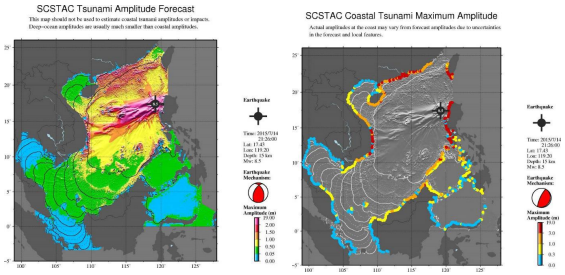
1. SCS Tsunami Warning and Mitigation System

1.1 UNESCO's IOC SCSTAC

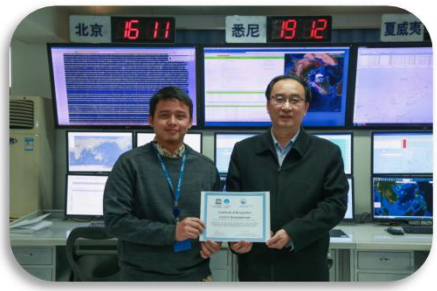


Tsunami Advisory Products

- Text messages
- Graphical Products



The Area of Service (AoS) for the SCSTAC specified by ICG/PTWS embraces all coasts of the South China Sea, and the adjacent Sulu Sea and Celebes Sea, separated by Palawan and Sulu Archipelago from north to south respectively. Nine Member States of the SCS region include **Brunei, Cambodia, China, Indonesia, Malaysia, Philippines, Singapore, Thailand, and Vietnam** (in alphabetic order).



The South China Sea Tsunami Advisory Center (http://scstac.oceanguide.org.cn) has been in full operation since November 5th, 2019.

1.SCS Tsunami Warning and Mitigation System

1.2 Standard Operating Procedures for SCSTAC

Magnitude(Mw)	Tsunami Potential Description
$6.0 \le M_w \le 7.0$	There is no tsunami threat from this earthquake
$7.1 \le M_w \le 7.5$	Possibility of a destructive local tsunami confined to 100-300 km of the epicenter
$M_w \ge 7.6$	Possibility of a destructive basin-wide tsunami

Bulletin type		Criteria	Content	Timeline
Tsunami Information	Only one bulletin	Mag. of 6.0-6.4; or on land; or depth≥100km	EQ parameters and statement of 'No tsunami threat'	8-10 min
	Only one bulletin unless minor waves observed and should be reported	Mag. of 6.5-7.0	EQ parameters and statement of 'No tsunami threat'	8-10 min
Tsunami Threat Message	Bulletin with quantitative forecast	7.1 and above	EQ parameters and quantitative forecasts on threat level and Estimated Time of Arrival (ETA)	8-15 min
	Supplementary with observations		EQ parameters, quantitative forecast and tidal gauge observations	If revision on EQ & tsunami forecasts, or observation available
	Final bulletin		Statement of 'No tsunami confirmed or threat passed'	hazardous waves has passed or no significant tsunami observations

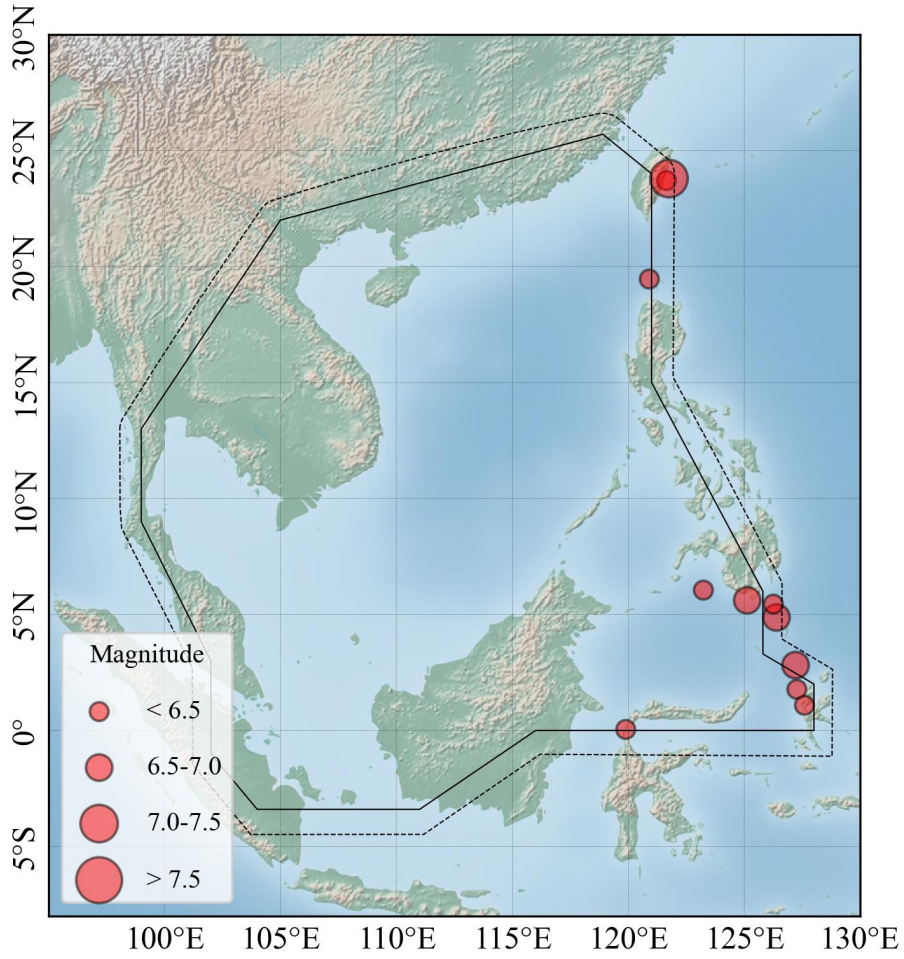
2. Operation of SCSTAC

2.1 Issued Tsunami Bulletins（Sep. 2023- Nov. 2024）

No	Mag	Origin Time (UTC)	Depth (km)	Lon (°)	Lat (°)	Location	Message
1	6.1	2024-09-23 19:51:00	140	122.9°E	0.17°S	MINAHASSA PENINSULA, SULAWESI	Detail..
2	6.3	2024-07-11 02:13:00	613	123.21°E	6.06°N	MINDANAO, PHILIPPINES	Detail..
3	6.1	2024-04-22 18:26:00	15	121.63°E	23.72°N	TAIWAN	Detail..
4	6.6	2024-04-09 09:48:00	15	127.2°E	2.82°N	NORTHERN MOLUCCA SEA	Detail..
5	7.3	2024-04-02 23:58:00	12	121.74°E	23.81°N	TAIWAN	Detail..
6	6.7	2024-01-08 20:48:00	102	126.37°E	4.89°N	TALAUD ISLANDS, INDONESIA	Detail..
7	6.0	2023-11-22 02:48:00	112	127.25°E	1.79°N	HALMAHERA, INDONESIA	Detail..
8	7.0	2023-11-17 08:14:00	80	125.1°E	5.63°N	MINDANAO, PHILIPPINES	Detail..
9	6.5	2023-10-04 11:21:00	131	126.23°E	5.45°N	MINDANAO, PHILIPPINES	Detail..
10	6.4	2023-09-12 11:03:00	10	120.89°E	19.46°N	PHILIPPINE ISLANDS REGION	Detail..
11	6.1	2023-09-11 12:51:00	157	127.57°E	1.09°N	HALMAHERA, INDONESIA	Detail..
12	6.1	2023-09-09 14:43:00	15	119.87°E	0.05°N	MINAHASSA PENINSULA, SULAWESI	Detail..

2. Operation of SCSTAC

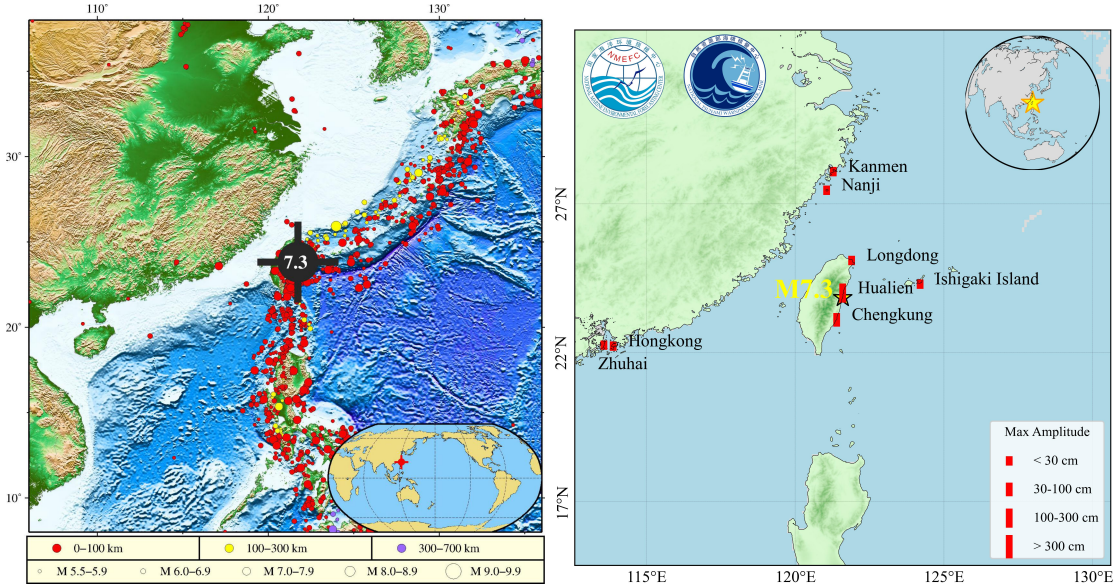
2.1 Issued Tsunami Bulletins（Sep. 2023- Sep. 2024）



2. Operation of SCSTAC

2.2 The Mw7.3 Hualien earthquake generated a tsunami

Original Time: 2024-04-02 23:58:00 (UTC) **Epicenter**: 121.74° E Lat:23.81° N
Depth: 12km



Tsunami waves recorded in tide gauge

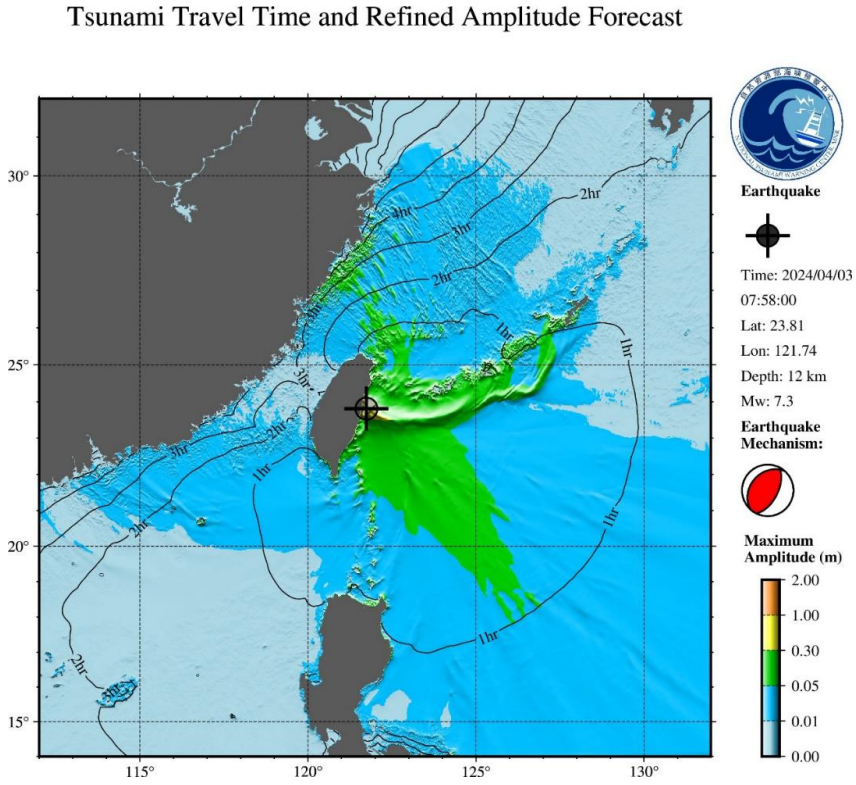
Tide gauge	Arrival time(CST)	Max height
Hualien Taiwan	8:08	105cm
Longdong Taiwan	8:29	21cm
Ishigaki Island, Japan	8:30	30cm
Chengkung Taiwan	8:41	45cm
Nanji Zhejiang	11:52	14cm
Kanmen Zhejiang	13:30	21cm
Zhuhai Guangdong	13:50	7cm
Shibi Hongkong	~13:00	7cm

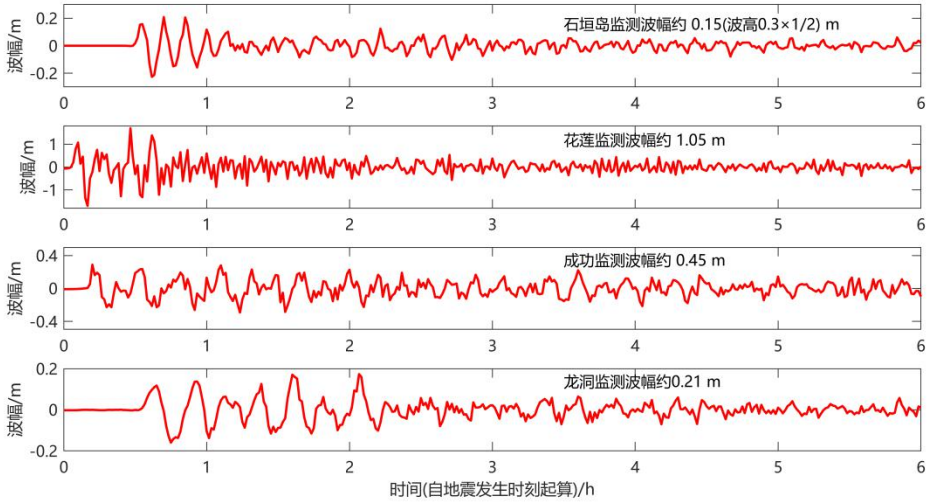
- The earthquake occured on 23:58 2th April (UTC);
- Tsunami waves are observed about 10min after the earthquake;
- The earthquake generated a local and regional tsunami.

2. Operation of SCSTAC

2.2 The Mw7.3 Hualien Taiwan earthquake generated a tsunami

Tsunami simulation



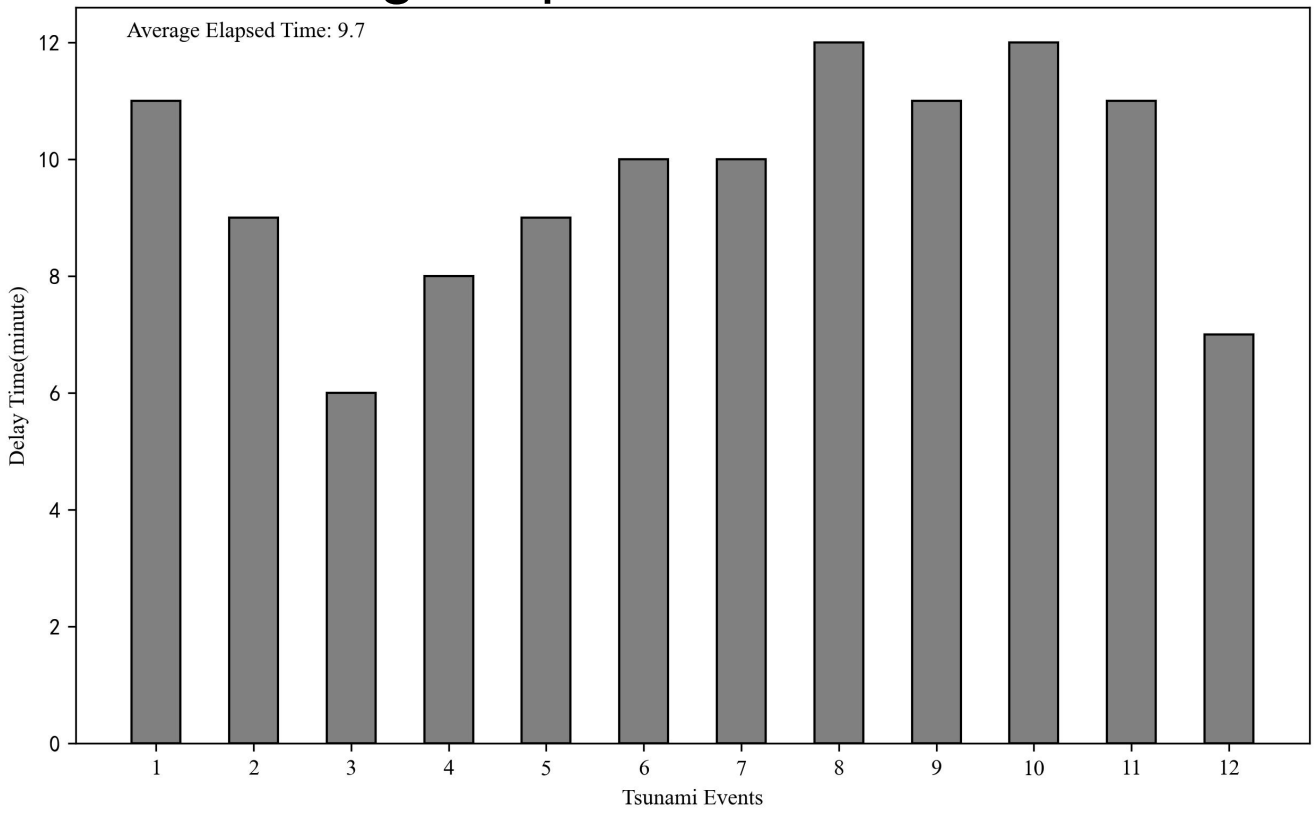


2. Operation of SCSTAC

2.3 Evaluation of earthquake parameters for full Operation

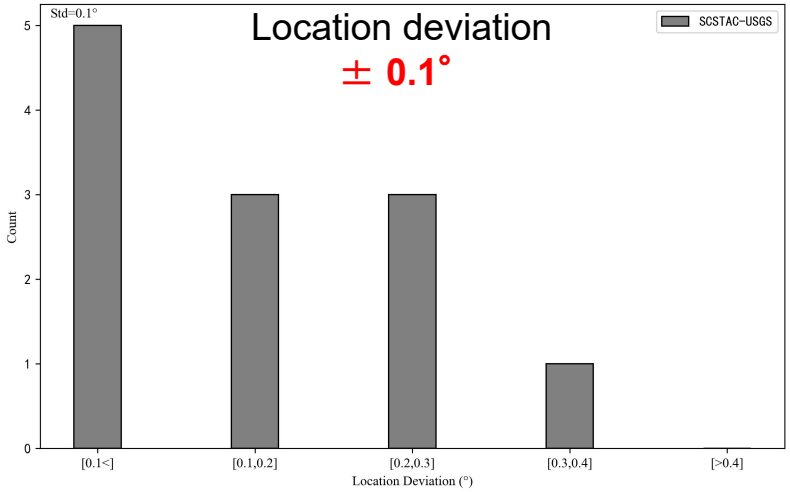
Elapsed time from earthquake to issuance of initial tsunami products

average eapsed time ~9.7 min

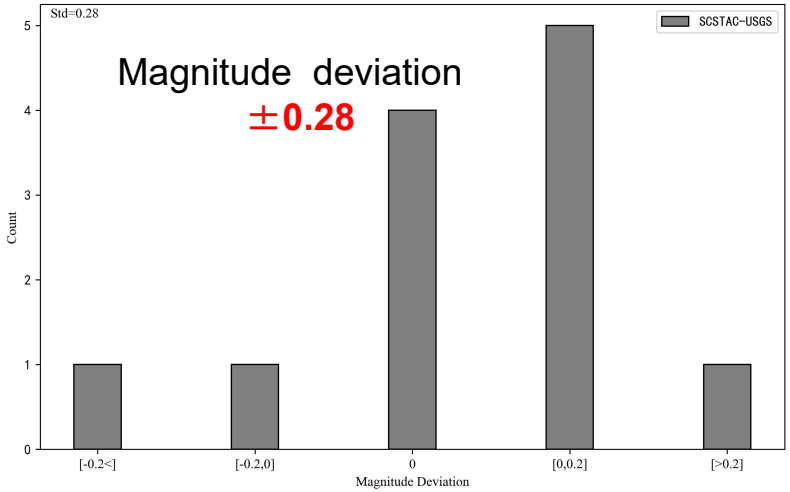


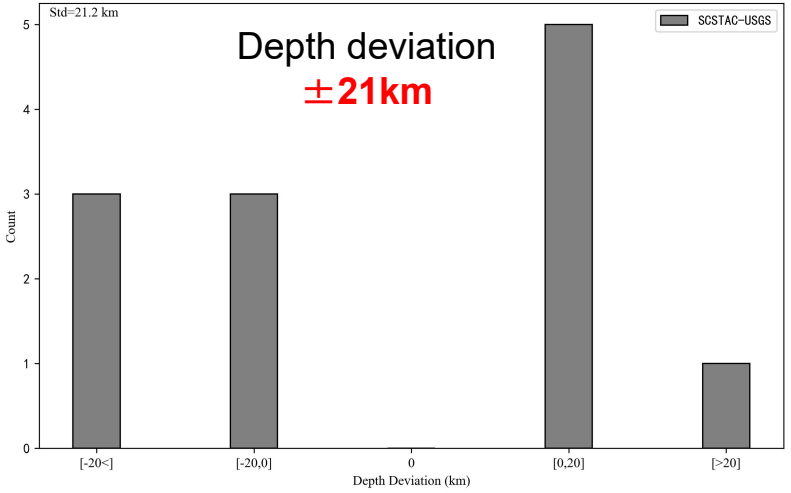
2. Operation of SCSTAC

2.3 Evaluation of earthquake parameters for full Operation



Epicentral location/magnitude /depth contrasting with USGS final PDE





2. Operation of SCSTAC

2.3 Evaluation of earthquake parameters for full Operation

Key Performance Indicators	Target values	Evaluation Result	Yes/No
Elapsed time from earthquake to issuance of initial tsunami products with preliminary earthquake parameters	Within 8-15 min	average elapsed time ~9.7 min	**Yes**
Probability of detection of earthquakes with Mw>=6.0	100%	11 events with Mw>=6.0, **100%**	**Yes**
Accuracy of preliminary earthquake parameters on hypocenter location/magnitude/depth	0.3° /0.3/30km	The difference for location/magnitude /depth contrasting with USGS **0.1° /0.28/21km**	**Yes**
Accuracy of the Estimated Time of Arrival (ETA) and amplitudes of the tsunamis actually is triggered	Within 10% of travel time	**1 $M \geq 7.1$** earthquakes occurred in AoS of SCSTAC	**Yes**
Percentage of Member States that receive products issued by SCSTAC	100%	GTS/Fax/email/website **100%**	**Yes**
Percentage of time the SCSTAC is operating and able to respond to a tsunami event	100%	24 hours × 365 days; two watch standers,**100%**	**Yes**
Regular communication tests	4 times per year	**each quater**	**Yes**

All results meet the key performance indictors

2 Operation of SCSTAC

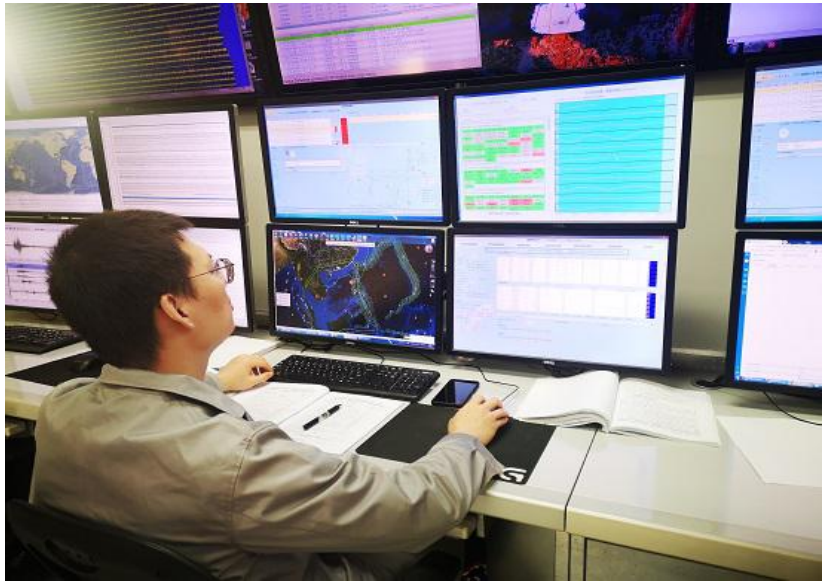
2.4 The First Scheduled Activation of BSCSTAC

- Communication test was performed before the scheduled activation
- Switchover procedure laid down at ICG/PTWS-WG-SCS-X was followed. Messages were issued:
  - by BSCSTAC upon the activation of BSCSTAC under scheduled activation via email, fax, and GTS
  - by SCSTAC at the end of scheduled operation, via email, fax, and GTS
- No event occurred during the scheduled activation of BSCSTAC on 11-22 December 2023
- BSCSTAC will gradually increase the scheduled activation up to 2.4 months per year.

2 Operation of SCSTAC

2.5 Communications tests and tsunami warning drill

- **SCSTAC conducted 4 communications tests since Sep. 2023**



Thanks to the coordination of the secretariat and the Member States.

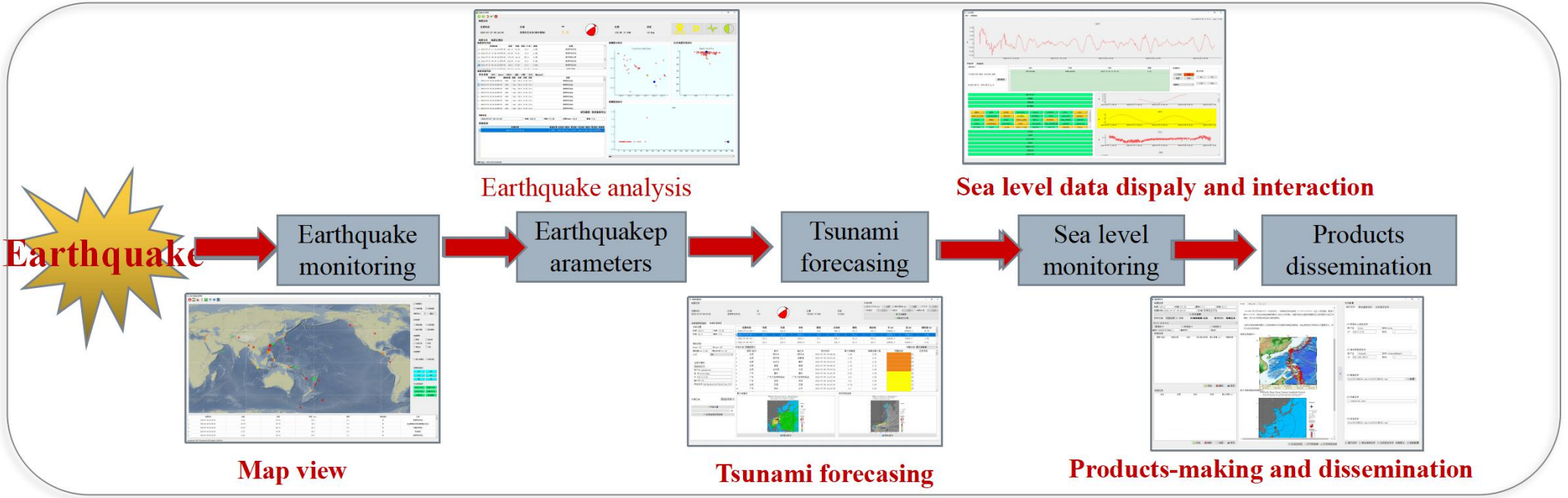
- **SCSTAC conducted a tsunami warning drill on 5th Nov. 2024**

0000114500
001
WESS31 BABJ 050000
TEST PACWAVE24 TSUNAMI EXERCISE **TEST**
ISSUED BY SOUTH CHINA SEA TSUNAMI ADVISORY CENTER (SCSTAC)
ISSUED AT 0000Z 05 NOV 2024
THIS IS A COMMUNICATION TEST BULLETIN FOR PACWAVE24 TSUNAMI EXERCISE.
THIS IS A TEST TO VERIFY COMMUNICATION LINKS AND DETERMINE
TRANSMISSION TIMES INVOLVED IN THE DISSEMINATION OF OPERATIONAL
TSUNAMI ADVICE PRODUCTS FROM THE SOUTH CHINA SEA TSUNAMI ADVISORY
CENTER TO DESIGNATED 24-HOUR TSUNAMI WARNING FOCAL POINTS OF THE SOUTH
CHINA SEA TSUNAMI WARNING SYSTEM.
THIS TEST MESSAGE IS SENT BY GTS, FAX AND EMAIL.
RECIPIENTS ARE REQUESTED TO PLEASE RESPOND BACK TO ICG PTWS TASK TEAM
ON PACWAVE24. GUIDANCE FOR THE EXERCISE CAN BE FOUND IN
THE PACWAVE24 EXERCISE MANUAL LOCATED AT
WWW.PACWAVE.INFO
PLEASE RESPOND BEFORE THE DUE DATE SPECIFIED IN THE EXERCISE MANUAL.
THANK YOU FOR YOUR PARTICIPATION IN THIS COMMUNICATION TEST
PLEASE TAKE NOTE OF THE TIME YOU RECEIVE THIS MESSAGE AND THE METHOD(S)
BY WHICH YOU RECEIVE THIS MESSAGE AND REPORT BACK THROUGH THE EXERCISE
PACWAVE POST-EXERCISE ONLINE EVALUATION SURVEY BY 15 DECEMBER 2024
NNNN

3. Tsunami Warning Capacity Enhancement

3.1 Smart Tsunami Information process System in full operation

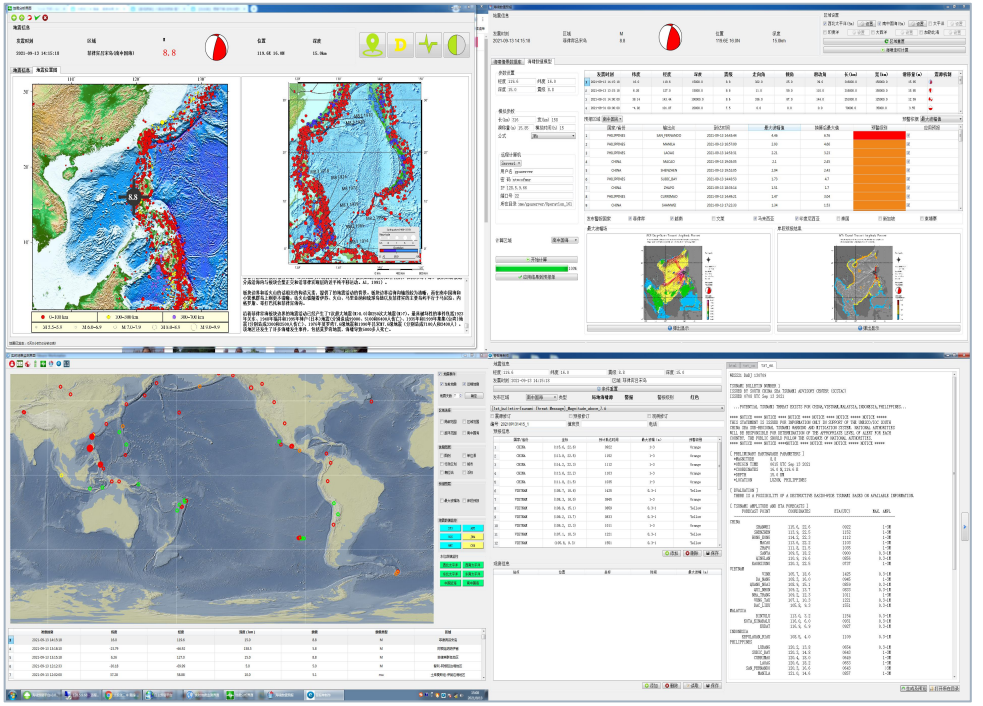
The Smart Tsunami Information Processing System (STIPS) is a tsunami early warning and decision-making products release system, which developed by SCSTAC's staff using Python language, and it has been put into full operation at the end of 2022.



3. Tsunami Warning Capacity Enhancement

3.1 Smart Tsunami Information process System in full operation

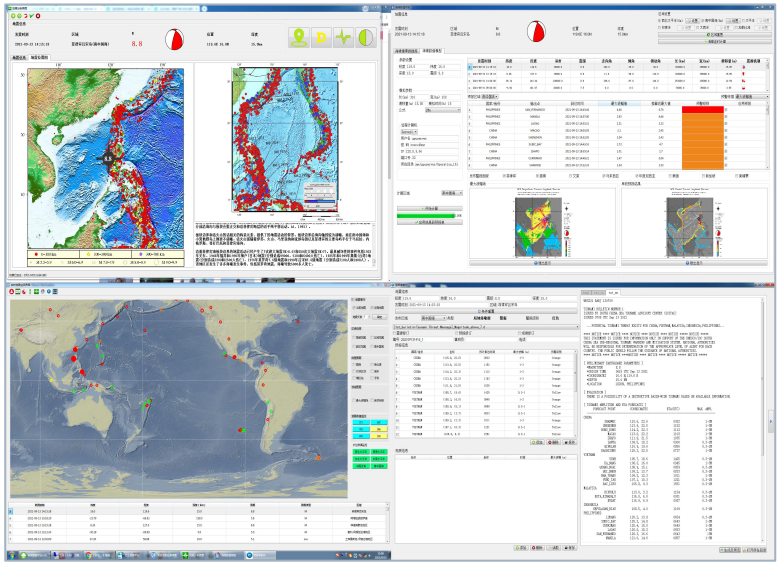
- An integrated decision support system for tsunami warning;
- User-friendly, comprehensive, well-maintained and open source software.
- Real-time monitoring, receiving and processing of seismic and sea level data;
- Tsunami scenario database;
- GPU parallel tsunami numerical simulation;
- Automatic generation and release of tsunami warning products;

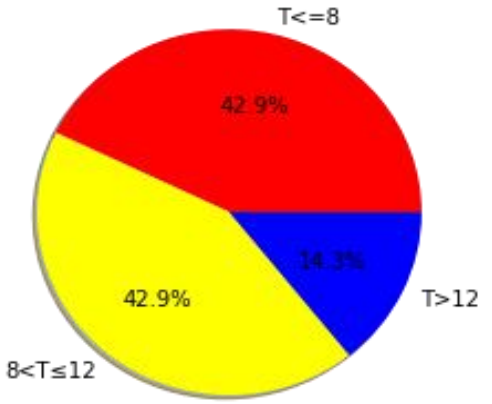


3. Tsunami Warning Capacity Enhancement

3.1 Smart Tsunami Information process System in full operation

- Debugged and upgraded to ensure that the system can issue tsunami information successfully;
- According to the suggestions from watchstanders to optimize the functions of the water level and earthquake information processing module;
- Research and development of the earthquake parameters acquisition module based on the message triggering mechanism, and the development and deployment of the message communication service have been completed and tested;
- Since 2023, the average elapsed time of the first tsunami warning information issued is about 10 minutes, which satisfied the needs of tsunami warning services.

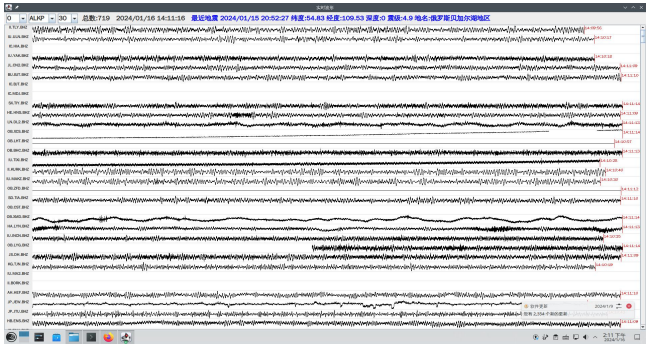




3. Tsunami Warning Capacity Enhancement

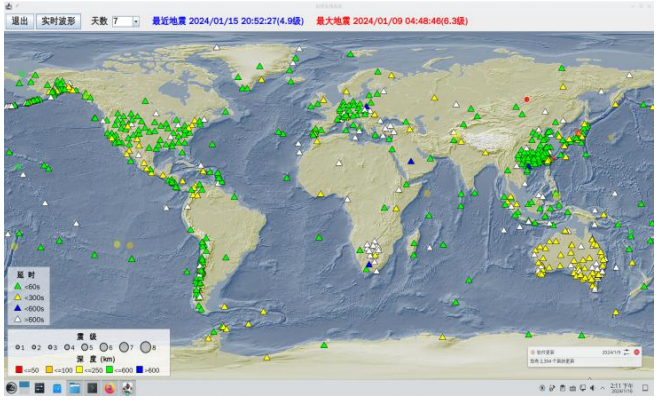
3.2 Global Earthquake Automatic Detecting and Location System

- ✓The near real-time waveform reading and format conversion module;
- ✓Earthquake phase picking module;
- ✓ Automatic location and Magnitude calculationmodule;
- ✓ Parameters storage and release module;
- ✓Realizes the near real-time automatic location to the global moderate-strong earthquake.



Real-time waveform display

Stations Map

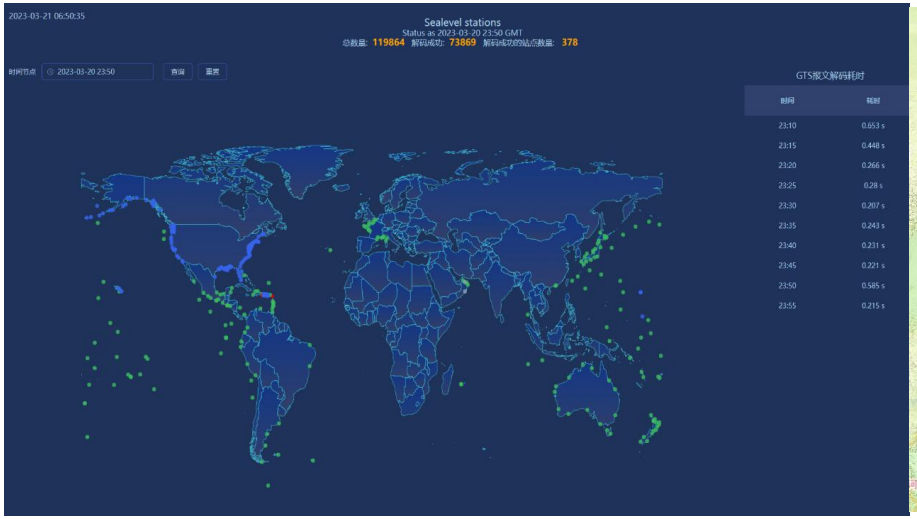


3. Tsunami Warning Capacity Enhancement

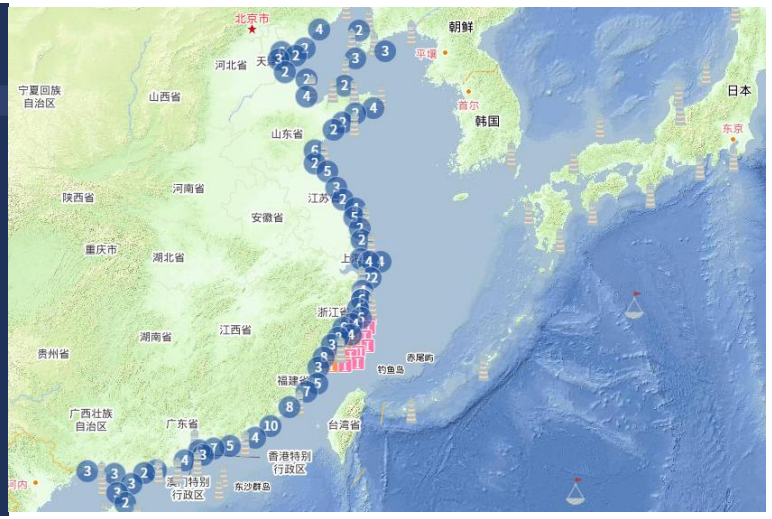
3.3 GTS sea level data decoding and processing module

Independently developed GTS sea level data decoding and processing module, effectively expanding the channels for acquiring sea level data and enhanc the automatic capability of tsunami monitoring; Realized controllable decoding and processing function of shared sea level observation data.

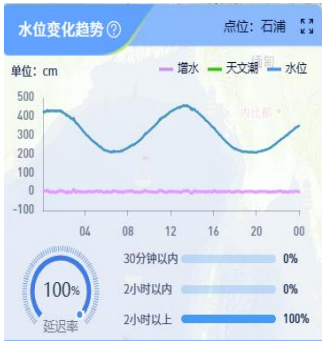
sea level monitoring



GTS transmission data decoding



Data mergng and Monitoring Analysis System



data interactive

4. Cooperations and Communications

4.1 Regional Training and Workshop

- **Hold 11th Meeting of the ICG/PTWS Regional Working Group on Tsunami Warning and Mitigation System in the South China Sea Region in Guangzhou;**

4. Cooperations and Communications

4.1 Regional Training and Workshop

International Training Course on Numerical Tsunami models for the South China Sea Region

Hosted by the Intergovernmental Oceanographic Commission (IOC) and the National Marine Environmental Forecasting Center (NMEFC), about 100 people from Indonesia, Malaysia, the Philippines, Vietnam, Tonga, China and other countries.

Management and operation seminar on seismic station for tsunami wavrning services

Hosted by the National Marine Environmental Forecasting Center (NMEFC), domestric technicians from Marine bureaus, central stations, ocean observation stations et al..

4. Cooperations and Communications

4.2 Short-Term visits of International Staff in 2024

SCSTAC continues International Secondment Programme with full funding by hosting 3 experts from SCS-WG Member States from Jul. to Sept. 2024 for a two-month period.

- Mr. Mohammad Obie Restianto from BMKG of Indonesia,
- Mr. Bhenz Rodriguez from PHIVOLCS of the Philippines
- Mr. Yip Weng Sang from MMD of Malaysia.

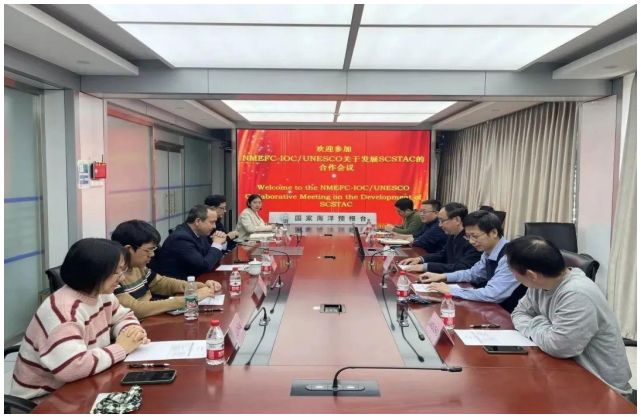
the major activities will be involved in are:

- ✓ Receive training on the earthquake location and focal mechanism inversion and tsunamiscenario database, forecast model and decision support system of the SCSTAC;
- ✓ Serve as a watch-stander once every week with shift time of 12 hours;
- ✓ Conduct communication and coordination among WG-SCS Member States regarding theactivities related to the full operation of SCSTAC.

4. Cooperations and Communications

4.3 Attend Meetings and Sessions

- Take active in the ITIC Trainning Program (Hawaii) in 2023;
- Attend the ICG/PTWS-XXX hosted by Tonga in 2023;
- The Director of the Tsunami Resilience Department of the IOC/UNESCO visited NMEFC in 2024;
- Signed a Memorandum of Understanding (MoU) with STMKG of Indonesia;
- Participation in the 57th session of the Executive Council;
- Carry out technical exchanges on Marine disaster prevention and reduction with Italy, South Pacific island countries, Indonesia, Bangaladesh
- Director of the Solomon Islands Meteorological Service visited NMEFC
- Attends to 12th Meeting of the ICG/PTWS SCS-WG and the second tsunami global symposium



5. Further Plans

- Ensures the continuous and stable operation of SCS tsunami warning and mitigation system;
- Continues to provide opportunities for in-person education, outreach and training activities in the region;
- Conducts an online Training Workshop on Tsunami Warning Technology and Platforms in the South China Sea region hosted by China.
- Preparing for the next year's ICG/PTWS meeting.

Thank You

Zhiguo Xu
South China Sea Tsunami Advisory Center, UNESCO/IOC