Progress of the Tsunami Decision Supporting System at SCSTAC

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Outline

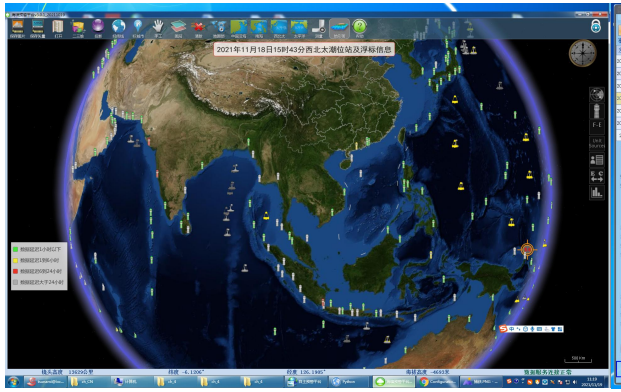
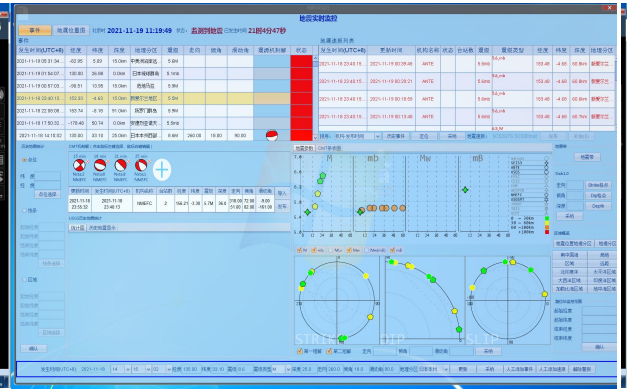
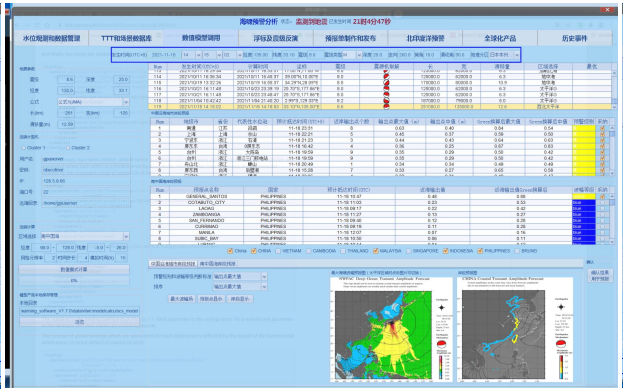
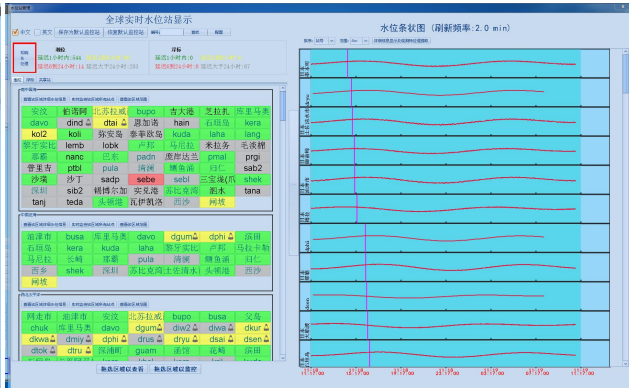
STIPS

- 1. Background
- 2. Modules of STIPS
- 3. Customized STIPS
- 4. Further Work

1. Background

STIPS

- In 2015, we initiated the development of a decision-making system through a technology company, and completed its 1.0 version in 2016, marking the beginning of its operational application.
- In the next few years, many operation actions were required to be continously adjusted and optimised for more efficient warning performance. So we need to closely cooperate with the technicians.
- The challenge was the high mobility rate of the technicians in company, coupled with the fact that different engineers specialized in different programming languages, which led to difficulties in system maintenance and upgrade.

1. Background

STIPS

Requirement of Module Funcitons for DSS:

- **1. GIS interface for visual warning analysis;**
- **2. Acquire the earthquake information from multiple sources;**
- **3. Receive sea level data in real time from multiple sources;**
- **4. Compute the Estimated Time of Arrival (ETA);**
- **5. Compute wave amplitudes of tsunamis for designated forecast points;**
- **6. Make tsunami products according to potential threat;**
- **7. Disseminate tsunami bulletins via multiple channels;**

1. Background

STIPS

- Smart Tsunami Processing System (STIPS) - a totally self-designed decision support system program - was established for the substitution. Dr Li, Hongwei was the main technician, cooperated by other colleagues.

2023 STIPS and STIPS(HK) started to be in full operation

2022.3 Trial operation of STIPS(HK) started

2022.1 Development of STIPS finished and trial operation started in NTWC

2021.3 STIPS was first deployed and tested in BSCSTAC(HongKong)

2018.10 Established development team and got started

1. Background

STIPS

Smart Tsunami Processing System (STIPS)

Interpreter:

Python 3.6.5

Package and dependency:

- **PyQt5** — Create frame of UI
- **Obspy** — Library of seismology
- **Numpy** — Fast array operations
- **GMT4/5** — Tsunami data visualization
- **Mysql** — Core database of the DSS

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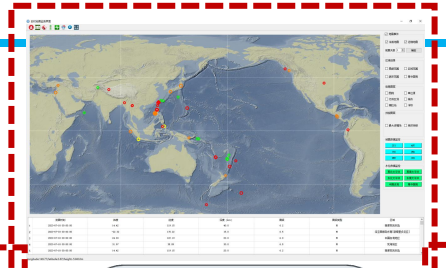
Data Processing framework

STIPS



Information Display

GTS

IOC Web

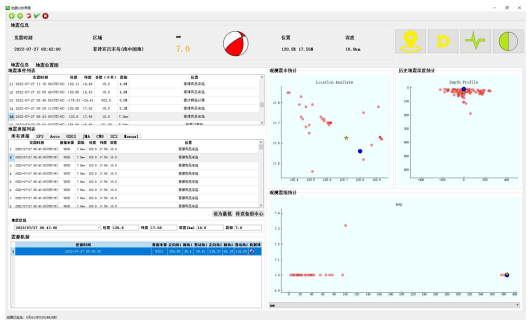
Local EQ System

EQ Agency

Sea level data Module

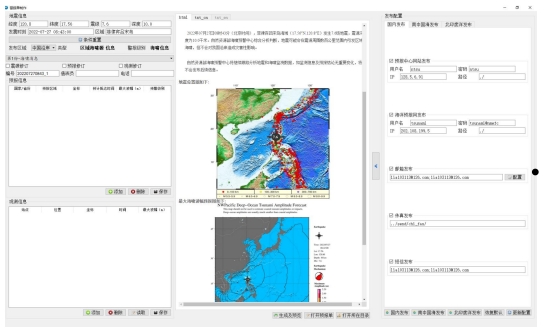
Local Database

EQ data Module

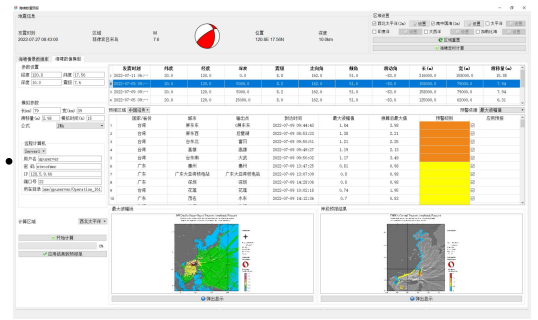


Sea level data analysis

EQ parameters analysis



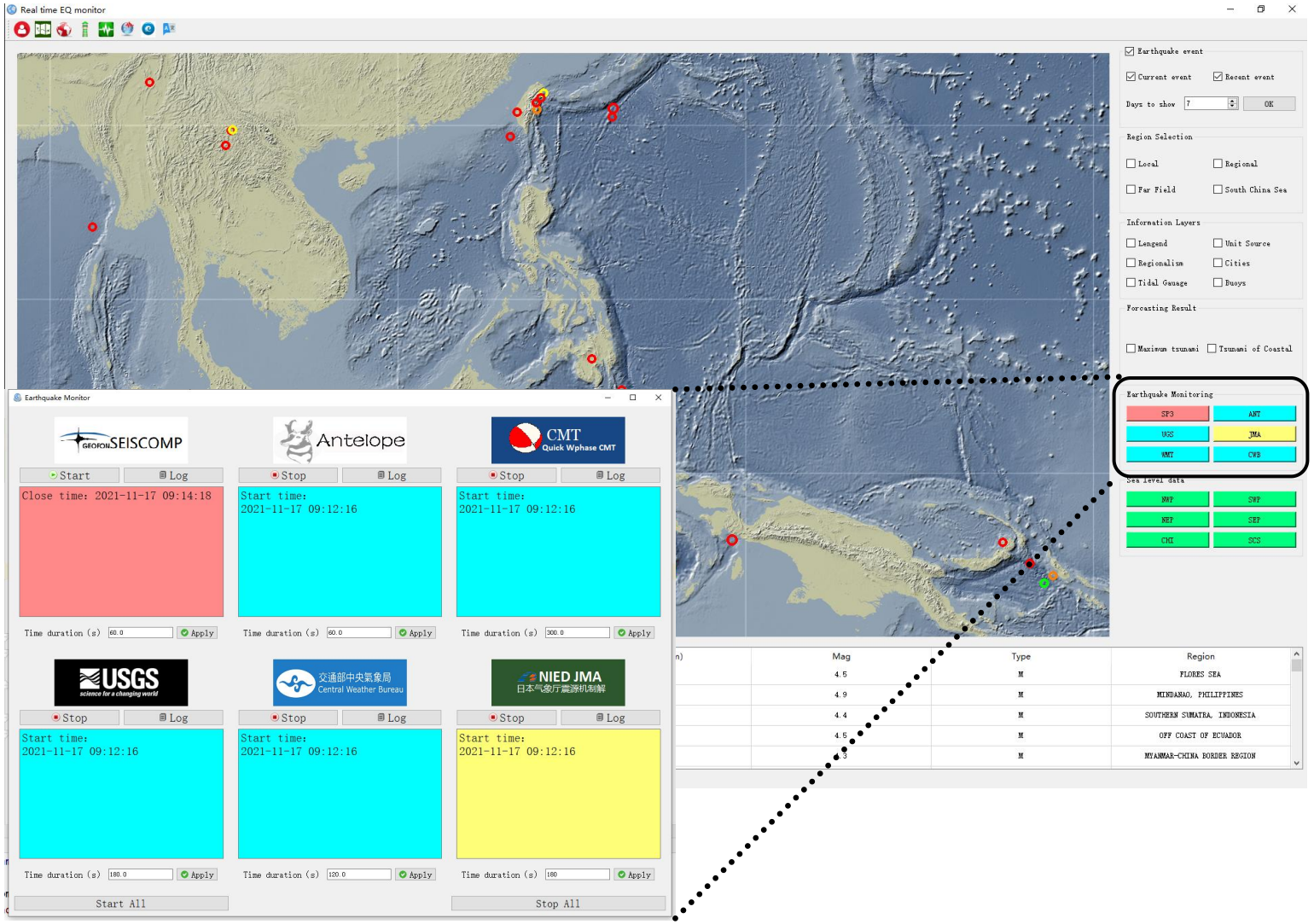
Tsunami Forecast



Bulletin generation and publishing

Earthquake Rapid Information

STIPS



Earthquake parameters crawling, displaying, archiving.

- **Source:**

Local system: Seiscomp, Antelope

Others: USGS, JMA, CEA

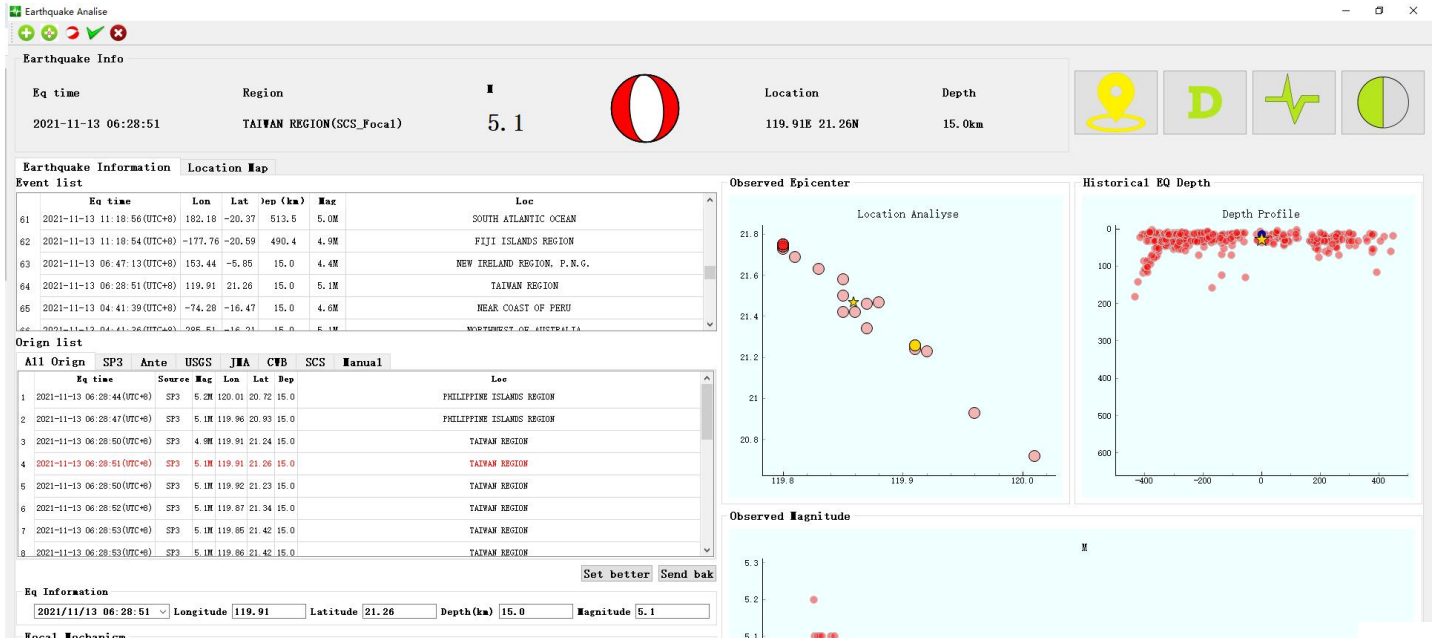
- **CMT source:**

Local system: Wphase， MT of SP3

Others: USGS

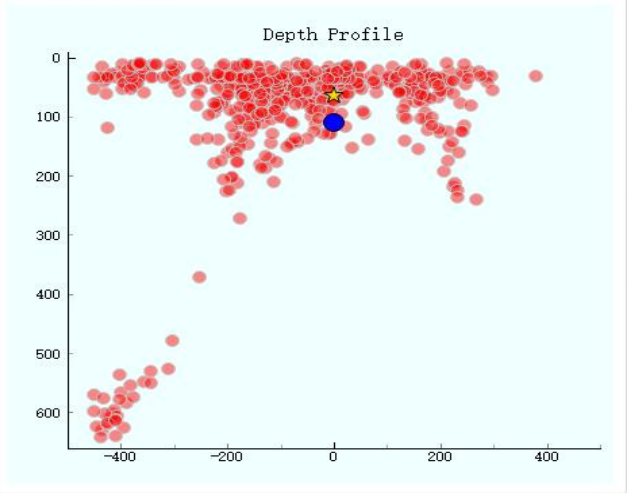
Determination of EQ. Parameters

STIPS

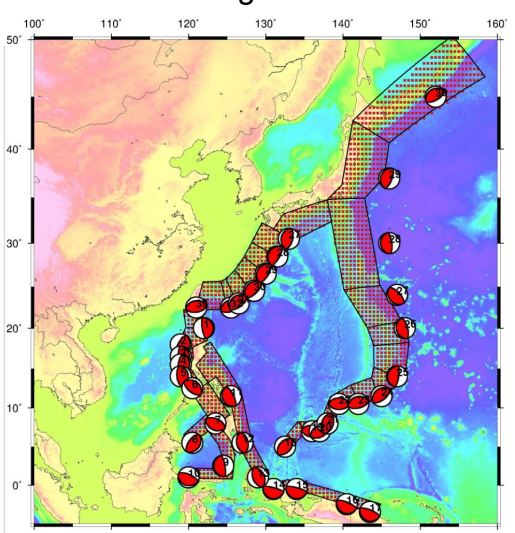


- Earhtuqake information table.
- Basic earthquake parameters assisting analysis based on historical events
- Estimation of CMT based on tectonic setting and W-phase inversion.

Depth assisting determination

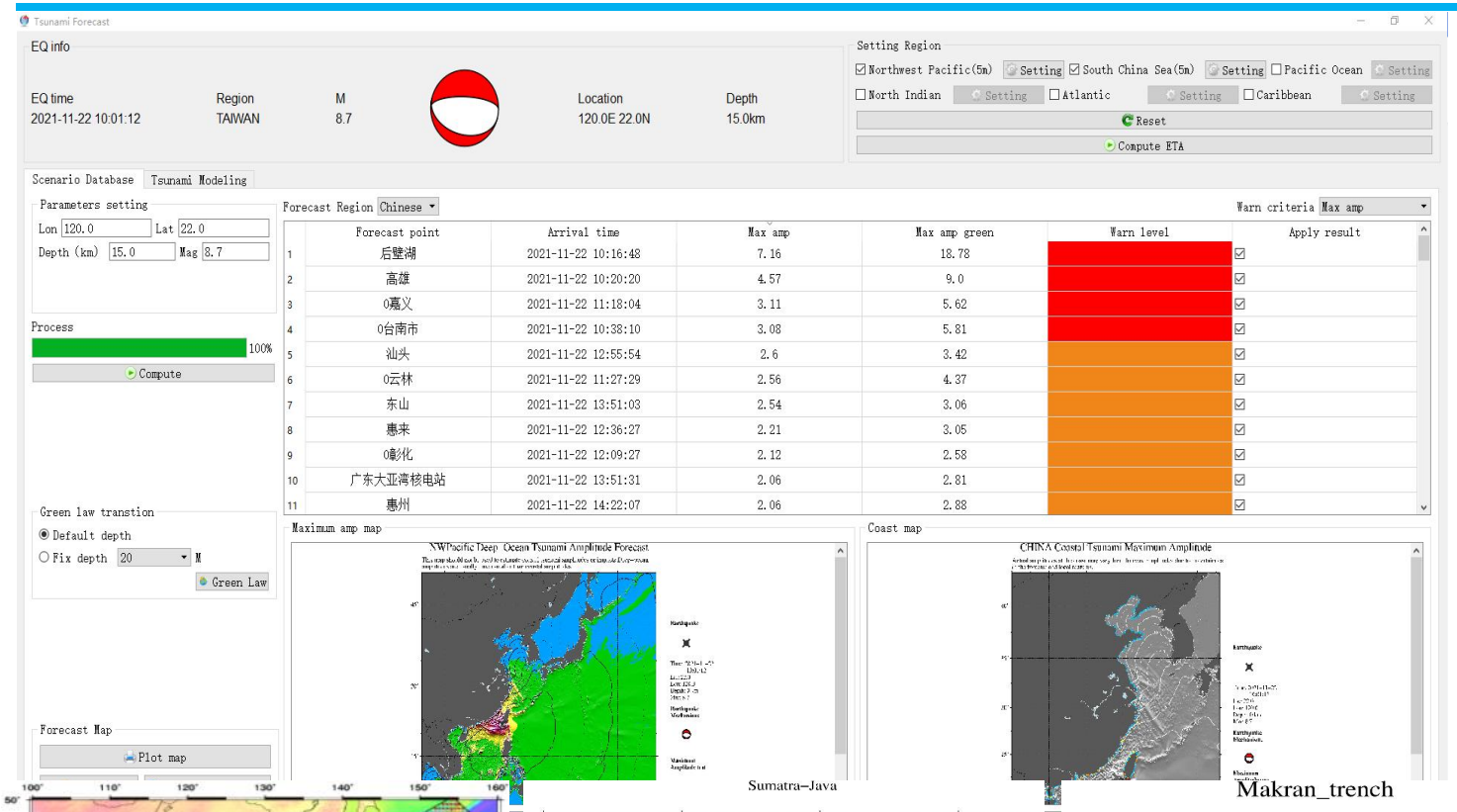


CMT assisting determination

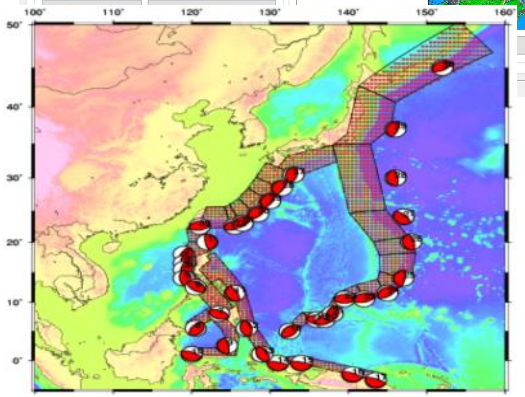


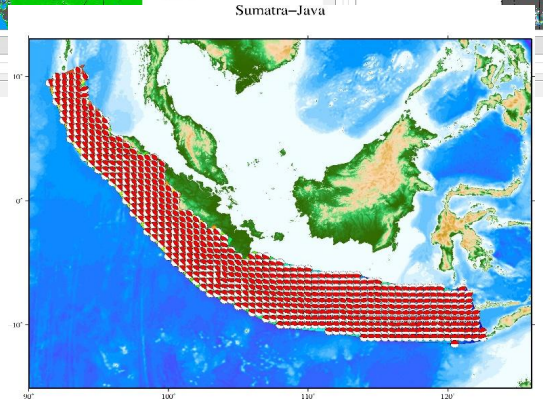
Tsunami Forecast

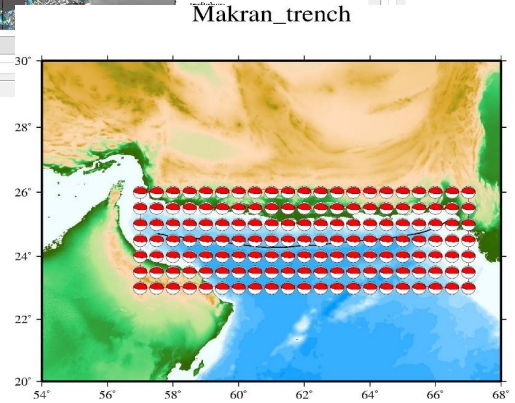
STIPS

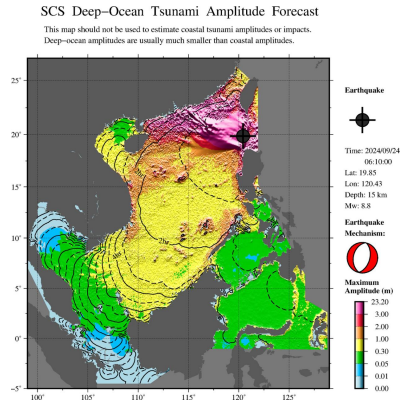


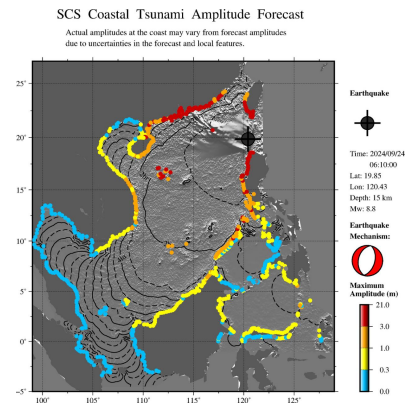
- Estimation of tsunami arrival time
- Scenario database
- On-the-fly tsunami model
- Automatic plotting and visualization.





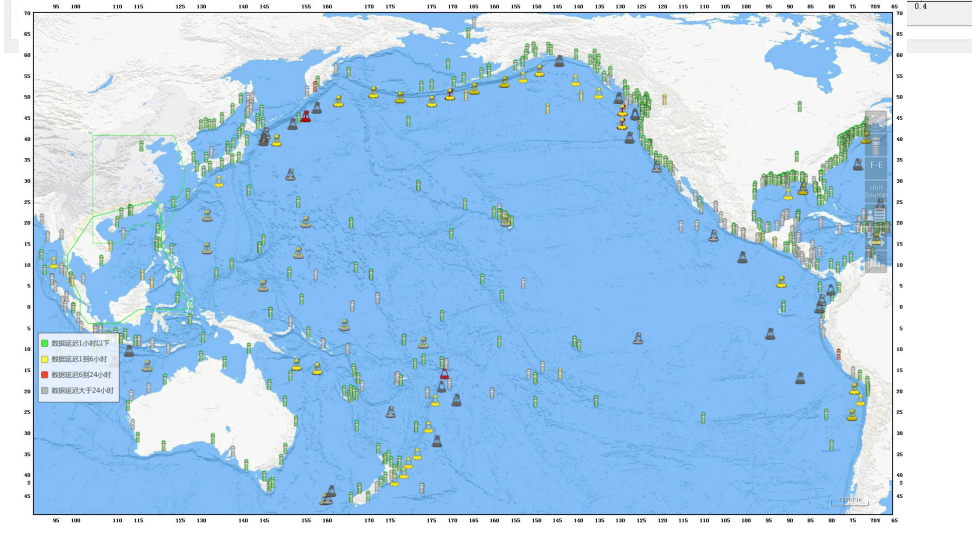




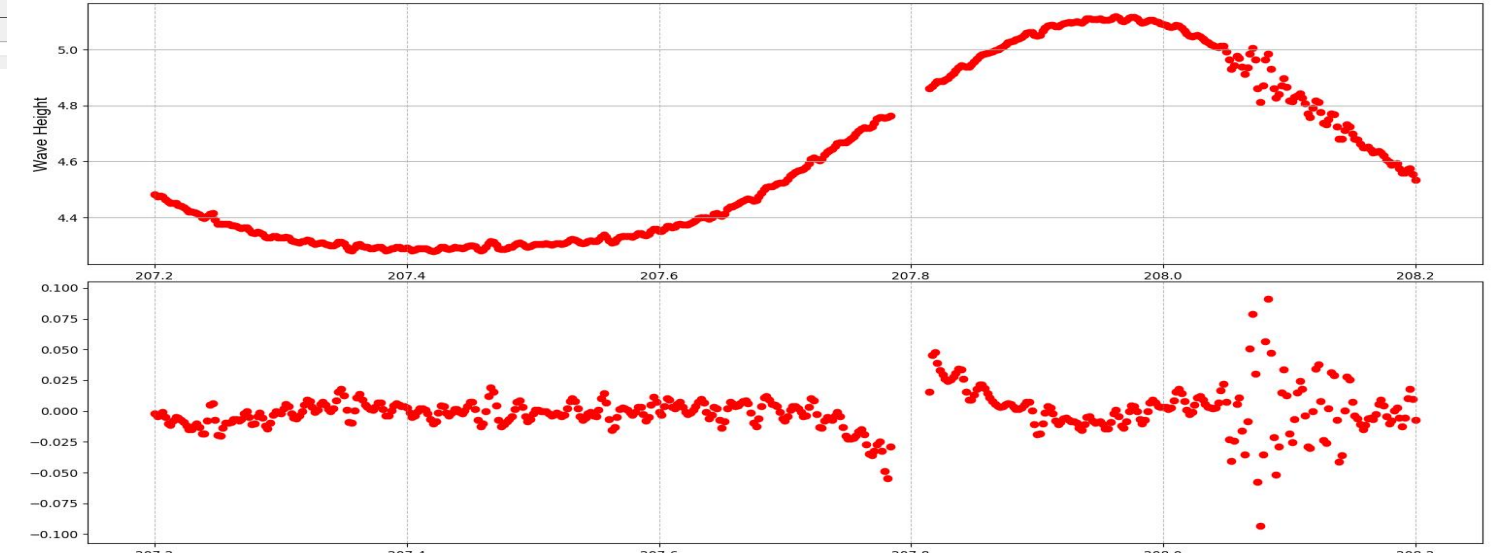


Tsunami Monitoring

STIPS

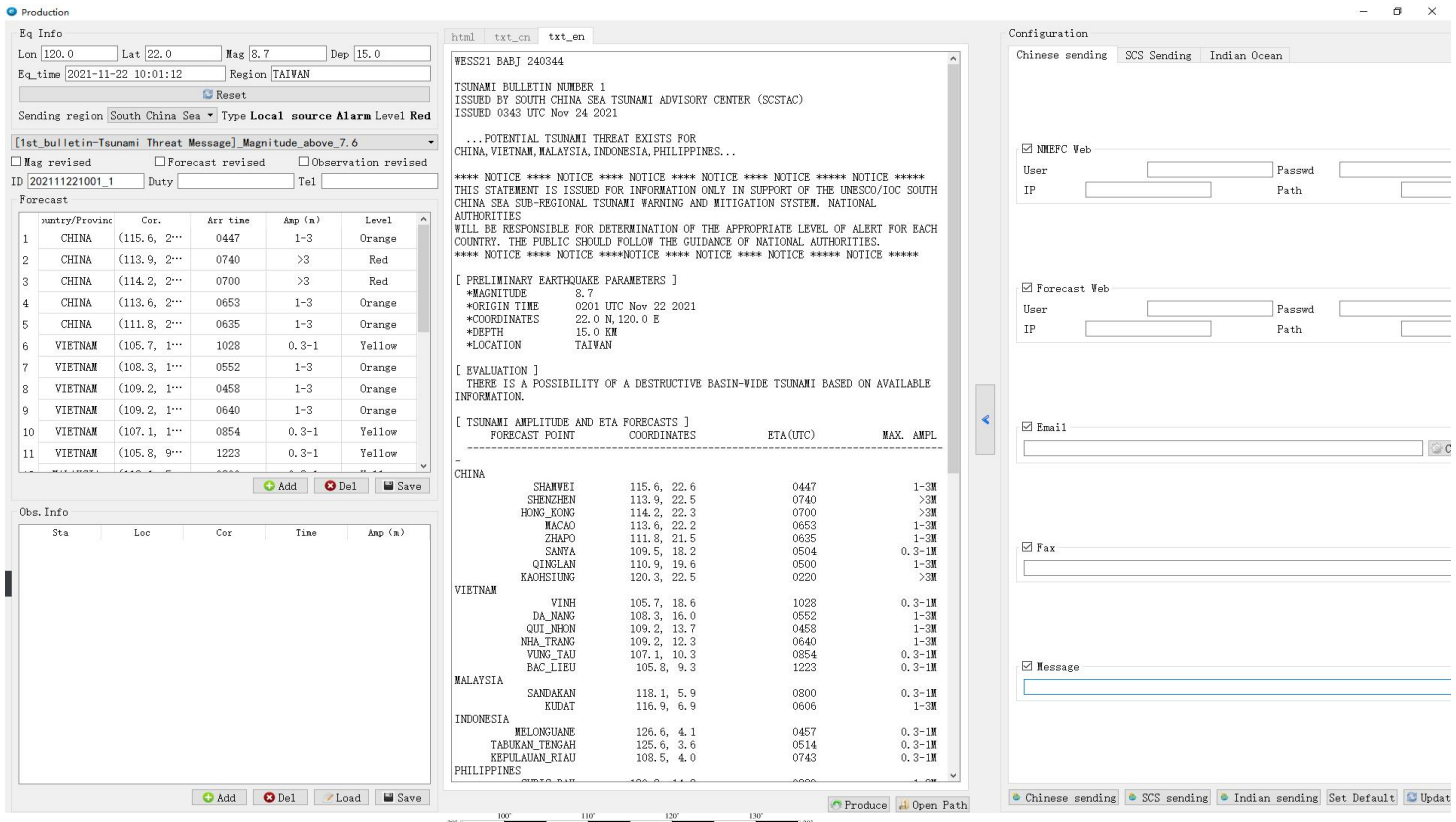


- Real-time Data from Tidal gauges and Dart bouys
- Tsunami frequency band filtering
- Pickup of tsunami amplitude

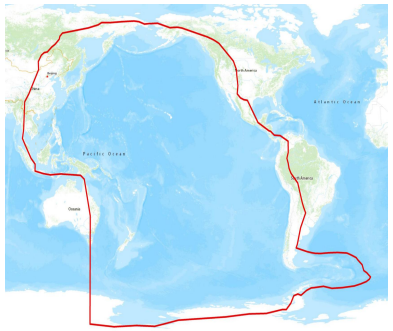


Product Making and Dissemination

STIPS



- Templates based on SOP.
- Rapid generation of tsunami products (doc, txt, html)
- Multiple release channels
- One-Click Communication Test



Region	Fax	SMS	E-mail	Website	GTS
China	√	√	√	√	
SCS	√		√	√	√

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A Lightweight Version of STIPS

STIPS

- **Real-time tsunami hazard analysis for Macau trigered by earthquakes occuring in SCS Reigon**
  - **Automatically modelling for earthquake with *M*w 7.0+ in SCS**
  - **Refined-scale numerical model**
  - **120s time consuming for 12-hour simulation (Based on NVIDIA RTX 2080Ti)**
  - **Cost-effictive and well-maintained**

Modular deletion as follow

☑ **GIS interface**

☒ **Acquire the earthquake information from multiple sources;**

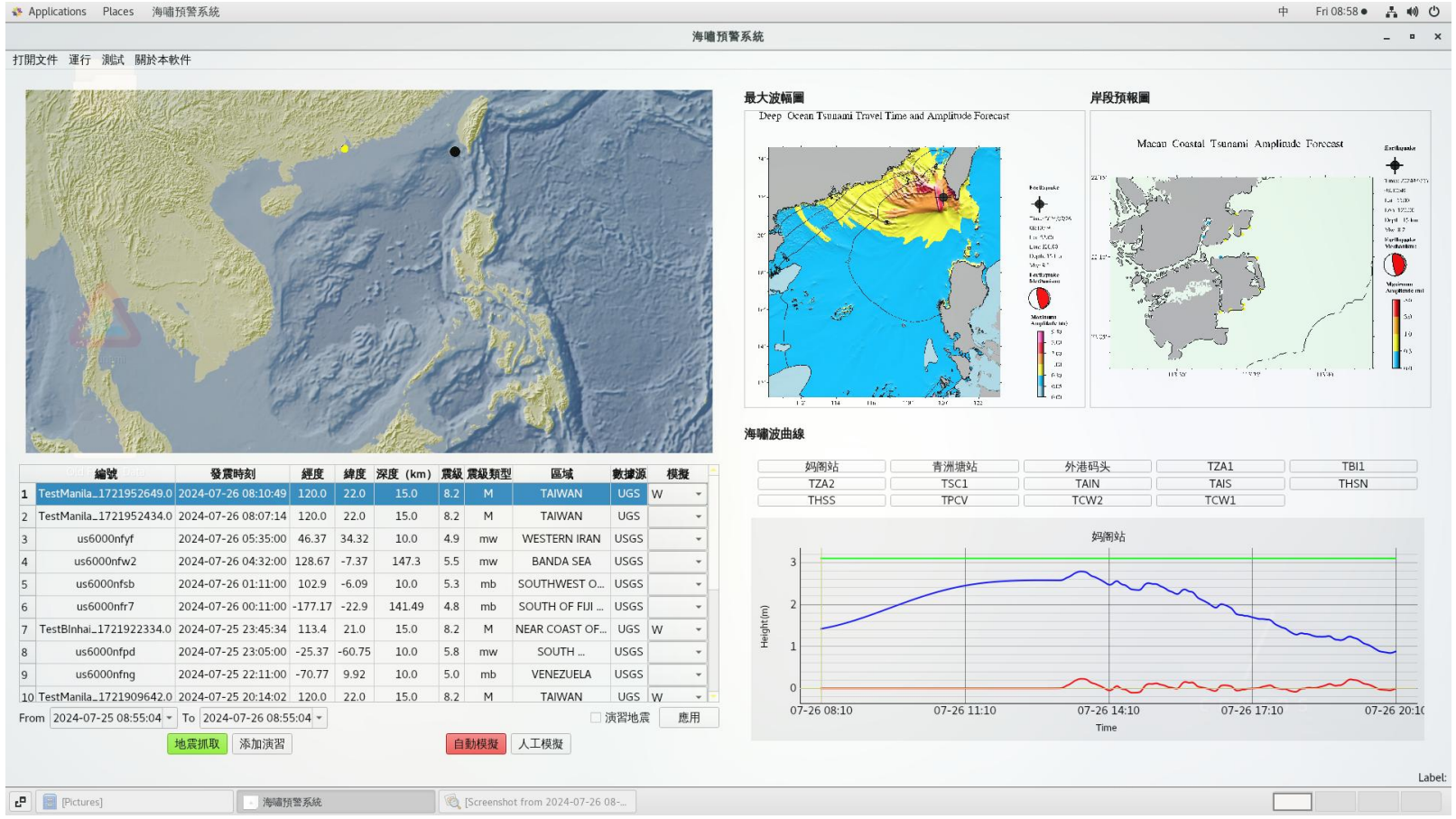
☒ **Receive sea level data in real time;**

☑ **Compute the ETA;**

☑ **Compute wave tsunami amplitudes for designated forecast points;**

☑ **Make tsunami products;**

☒ **Disseminate tsunami bulletins via multiple channels;**

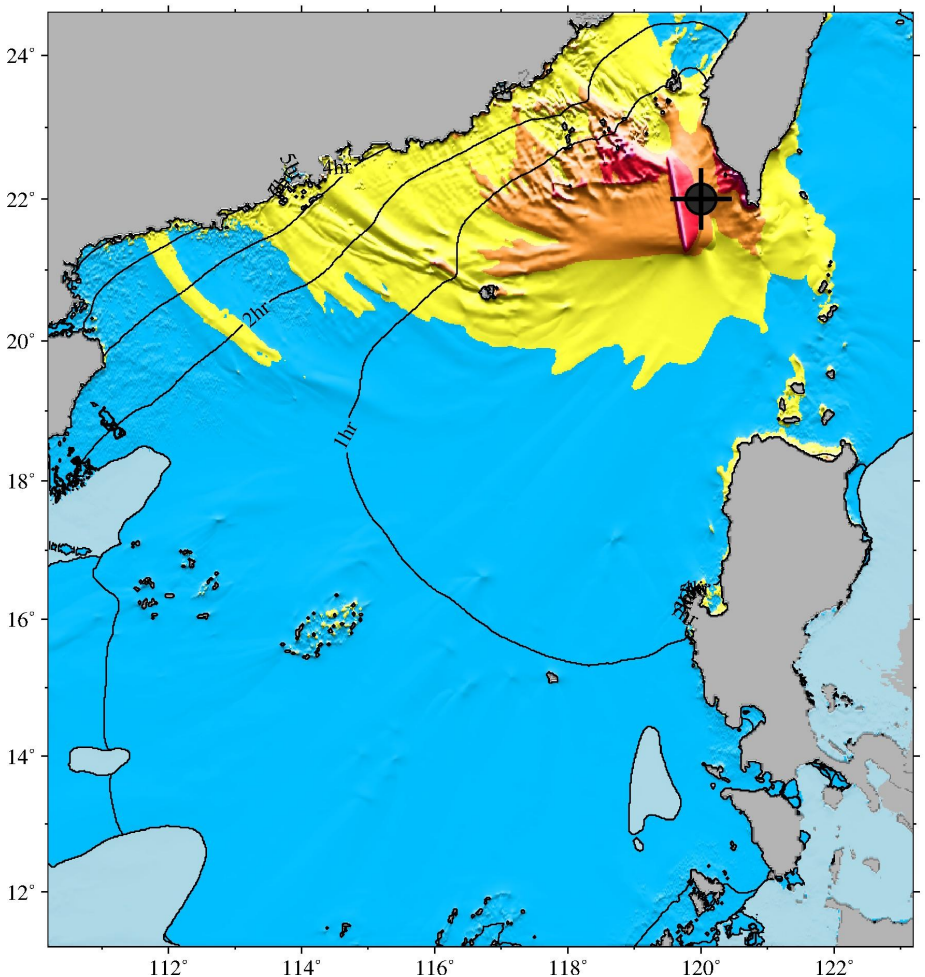


A Lightweight Version of STIPS

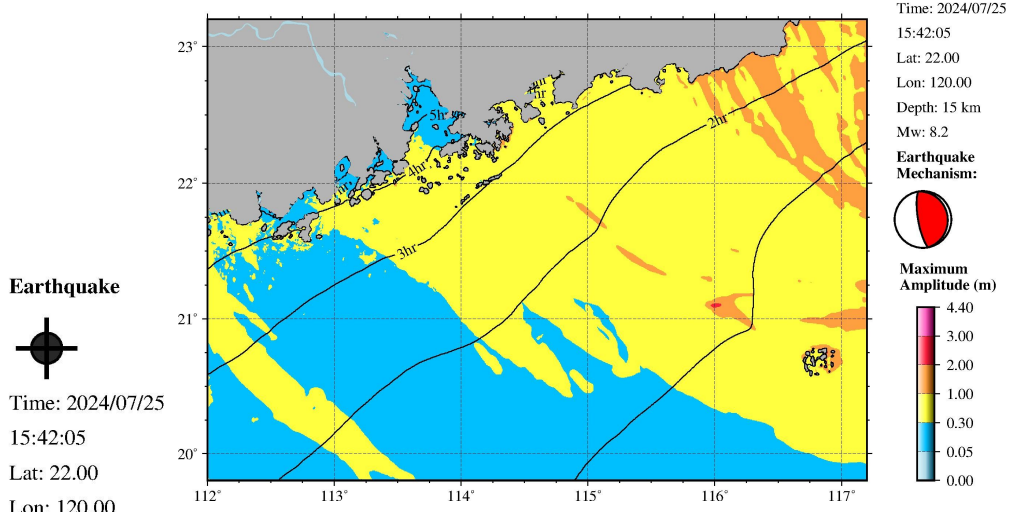
STIPS

Map products:

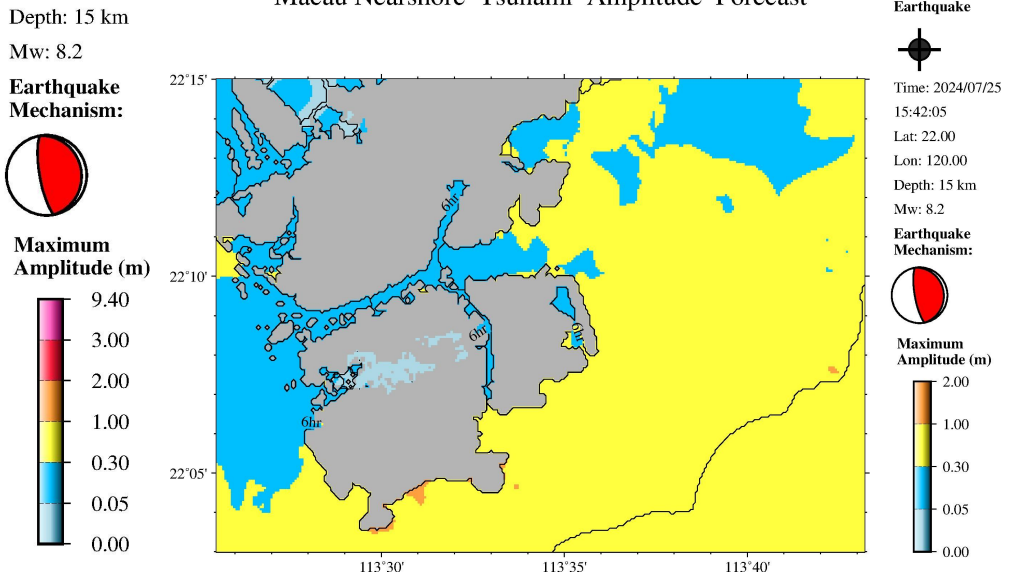
Deep–Ocean Tsunami Travel Time and Amplitude Forecast



Macau offshore Tsunami Amplitude Forecast



Macau Nearshore Tsunami Amplitude Forecast



A Lightweight Version of STIPS

STIPS

XML Products:

Applications Places Text Editor

Open

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                <Tsunami>
                        <sta>
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[Pictures] 海嘯預警系統 A1_202407260810

CSV Products:

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ts91_record.nc	2024/7/26 11:09	NC 文件	44 KB
ttt_layer01.nc	2024/7/26 11:09	NC 文件	2,457 KB
ttt_layer02.nc	2024/7/26 11:09	NC 文件	3,992 KB
ttt_layer03.nc	2024/7/26 11:09	NC 文件	320 KB
zmax_layer01.nc	2024/7/26 11:09	NC 文件	2,457 KB
zmax_layer02.nc	2024/7/26 11:09	NC 文件	3,992 KB
zmax_layer03.nc	2024/7/26 11:09	NC 文件	320 KB
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B.csv	2024/7/26 11:09	XLS 工作表	32 KB
C.csv	2024/7/26 11:09	XLS 工作表	32 KB
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I.csv	2024/7/26 11:09	XLS 工作表	32 KB
J.csv	2024/7/26 11:09	XLS 工作表	32 KB
K.csv	2024/7/26 11:09	XLS 工作表	32 KB
MPE.csv	2024/7/26 11:09	XLS 工作表	32 KB
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SDV.csv	2024/7/26 11:09	XLS 工作表	32 KB

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Further Work

STIPS

- Continously Optimization
- Upgrade according to SOP changes
- Tsunami amplitude picking based on machine learning method
- Bug fixed and stability enhancement.

Thank you!

Main Technician: Dr. Li, Hongwei(lihw@nmefc.cn)
South China Sea Tsunami Advisory Center, UNESCO/IOC
National Marine Environmental Forecasting Center, MNR