NATIONAL REPORT

Submitted by Republic of Korea

BASIC INFORMATION

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4. Tsunami Standard Operating Procedures for a Local Tsunami (when a local tsunami hazard exists)

When an earthquake with a magnitude of 6.0 or lager occurs in the vicinity of the Korean Peninsula, Korea Meteorological Administration(KMA) estimates the magnitude and location of the earthquake and assesses the impact of tsunami using the Scenario database.

The scenario database is pre-calculated values of tsunami arrival time and height for the assumed earthquake sources in the surrounding seas of the Korean Peninsula (Figure 1). In Figure 1, the blue area and the red area have different settings.

[The blue area]

- Fault parameters at 5,901 locations were assumed.
- At each location, earthquakes were assumed to have magnitude 6.0~9.0 for the tsunami simulation
- Estimated tsunami arrival time and maximum height at 3,450 sites along the coastal line including Japanese tidal stations were used to construct scenario database.

[The red area]

- Fault parameters were assumed at 939 locations along subduction zone.
- Earthquakes with magnitude 8.0~9.0 were assumed for the tsunami simulation and the results for arrival time and maximum height were used to construct scenario database.

Based on the results, a tsunami warning is issued if the expected tsunami wave height is more than 1.0m and a tsunami advisory is issued if it is between 0.5 and 1.0m.

And a tsunami information statement is issued if the expected tsunami wave height is between 0.2m and 0.5m, or if domestic impact is anticipated although the expected tsunami wave height is below 0.2m.

In areas where warnings are issued, a tsunami alert message is automatically sent via the Cell Broadcasting System (CBS). This information is disseminated to the public through KMA website, TV broadcasts, portals, YouTube and SNS. Also, national and local authorities receive them via SMS, MMS, fax, email, and computer messages.

When a warning is issued, additional information on predicted data and observed data is provided for forecast points within the warning area. If necessary, the numerical model is used to obtain more accurate tsunami prediction information using fault parameters determined by seismic waveform analysis.

The arrival time and maximum height of the tsunami are observed by applying tsunami detection system to observed sea level data in real time (Figure 2), which consists of five algorithms (DART, TIDE, IS, CF, VAR). If the observed data is exceeded the thresholds of three or more algorithms, including the DART algorithm, tsunami is determined to be arrived and the arrival time is represented.

After the tsunami has arrived, the possibility of cancelling the tsunami warning is considered if the tsunami height remains below 0.2 meters for more than two hours (Figure 3).

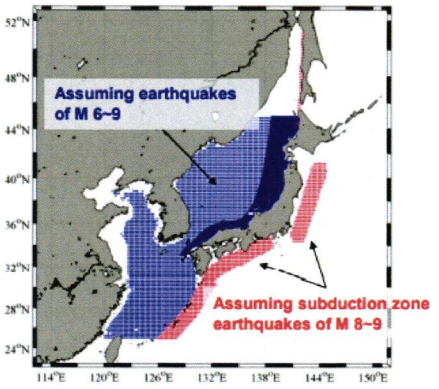

Figure 1. Scenario Database

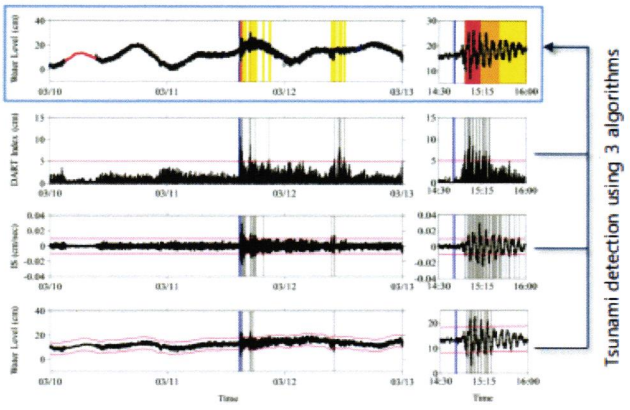

Figure 2. Detection Algorithm

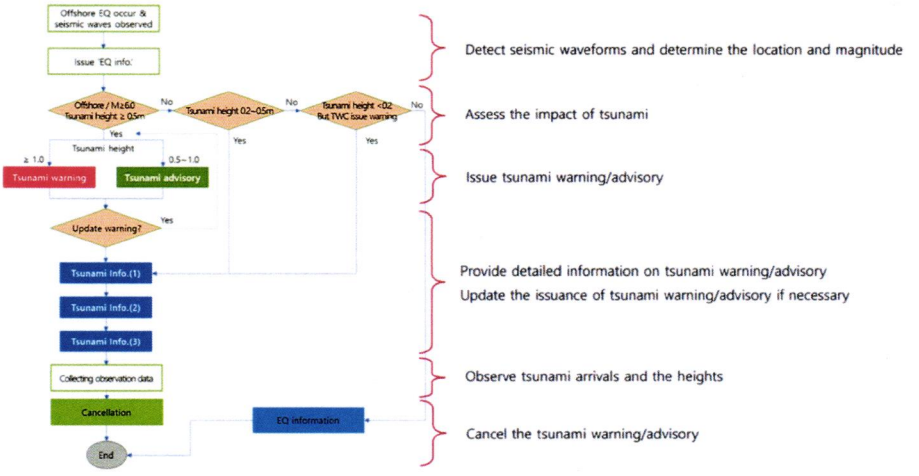

Figure 3. Workflow of tsunami information and alert

5. Tsunami Standard Operating Procedures for a Distant Tsunami (when a distant tsunami hazard exists)

Similar to local tsunami, KMA issues the tsunami warning and advisory based on the expected he ight of the tsunami, disseminate information and end the situation.

For the events that precalculated database is not available, tsunami prediction information is ob tained based on numerical model.

And if international Tsunami Warning Center, such as NWPTAC, PTWC, JMA, predicts the impact to the Korean peninsula, KMA can issue tsunami information. There are a total of eight forecast p oints that NWPTAC provides tsunami information for the Korean peninsula: Ulleungdo, Sokcho, Bu san, Tongyeong, Nohwado, Heuksando, Jeju, and Seogwipo.

6. National Sea Level Network

KMA collects sea-level data from various organizations. KMA measures sea-level at 26 points and collects sea-level data from 55 tidal stations observed by Korea Hydrographic and Oceanographic Agency (KHOA) every one minute (Figure 4).

Among them, 3 wave gauge and 72 tidal station data are applying to the tsunami detection system in realtime.

In addition, sea-level data from 22 tidal stations of Japan Meteorological Agency (JMA) are collected in real time and used for monitoring tsunamis (Figure 5).

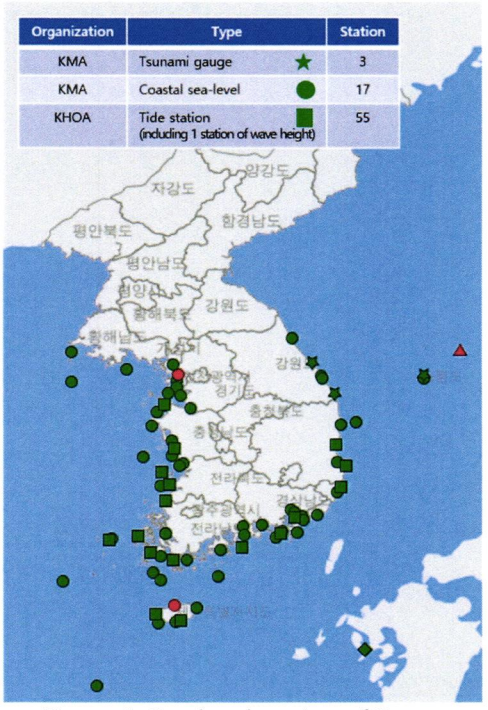

Figure 4. Sea-level station of Korea

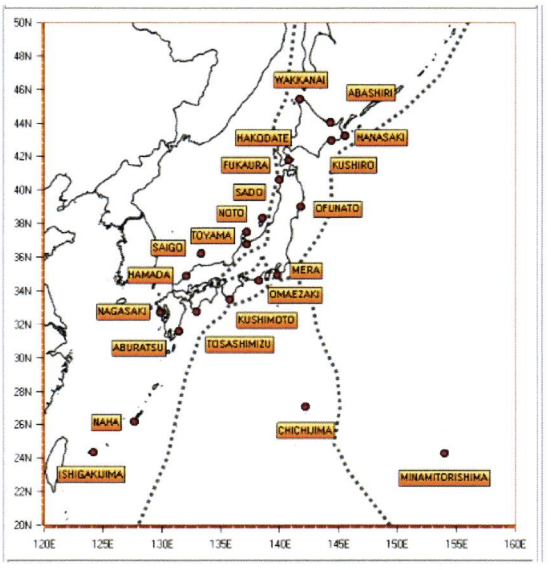

Figure 5. Sea-level station of JMA

7. Information on Tsunami occurrences

On January 1, 2024 due to the occurrence of the Mw 7.5 Noto Peninsula Earthquake(Japan), a tsunami hit the East coast of our country.

The Korea Meteorological Administration (KMA) issued a total of five notifications. At 16:23 KST (Earthquake occurrence time: 16:10), we released earthquake information on the Noto Peninsula earthquake, and based on the earthquake data, the earthquake tsunami scenario database was activated. The first tsunami information was issued 12 minutes later
(after the announcement of earthquake information) for Ulleungdo, Dokdo, and the entire East coast. This initial tsunami alert include the estimated time of arrival, maximum wave height, and tidal conditions.

Approximately 80 minutes after the earthquake, tsunami waves began to be observed. Accordingly, the second and third tsunami information reports were issued, providing updated details on the arrival times and maximum wave heights. These reports were disseminated to Central Administrative Agencies, local governments, and the media through various channels such as CBS(Cell Broadcasting Service), text messages, faxes, websites, TV subtitles, online portal sites, and social media. On the following day at 09:00 KST, the initial arrival times and maximum tsunami wave heights recorded at major locations were officially announced via a press release.

Figure 6. Maximum tsunami height observed at 12 Major observation points on the East Coast

Observation point	Initial arrival time(KST)	Maximum tsunami height	
		Observed Time(KST)	Height(cm)
Ulleungdo	2024-01-01 17:30	2024-01-01 22:23	11
Sokcho	2024-01-01 17:59	2024-01-01 21:37	41
Namhangjin	2024-01-01 17:57	2024-01-01 19:59	20
Mukho	2024-01-01 18:03	2024-01-01 20:35	82
Donghae	2024-01-01 18:00	2024-01-01 23:31	33
Imwon	2024-01-01 18:12	2024-01-01 20:37	25
Hupo	2024-01-01 18:16	2024-01-01 20:36	54
Yeongdeok	2024-01-01 18:52	2024-01-01 21:27	19
Pohang	2024-01-01 19:14	2024-01-02 01:02	32
Guryongpo	2024-01-01 18:50	2024-01-02 00:42	12
Ulsan	2024-01-01 19:13	2024-01-02 00:32	11
Busan	2024-01-01 19:45	2024-01-02 04:07	15

Data from the Korea Hydrographic and Oceanographic Agency's tidal well-type tide gauge are used. Data were collected from 12 major observation points on the East Coast (Sokcho, Mukho, etc.).

Analysis of tsunami observation data indicates that minor sea level changes were observed in Ull eungdo at 17:30, about 80 minutes after the earthquake. These changes were subsequently recor ded at multiple observation points along the East Coast, including Namhangjin and Sokcho. Maximum tsunami heights were analyzed to be less than 0.5 meters in general. At the Mukho an d Hupo observation points, the maximum tsunami heights were recorded approximately 120 ~ 150 minutes after the initial arrival, measuring 82 cm and 54 cm, respectively. These relatively higher tsunami at Mukho and Hupo are thought to be affected by local topograp hy.

There was no damage caused by the tsunami. At the time, a wind wave advisory was in effect along the East Coast due to swells, restricting access for vessels and citizens.

8. Tsunami response capacity enhancement training exercise and Education

KMA conducted a training exercise on October 18, 2024, to assess the response capabilities of re levant agencies and their cooperation system in the event of a tsunami affecting major coastal fac ilities along the East Coast.

Jointly organized by the Ministry of the Interior and Safety and the KMA, the exercise involved ei ght central government agencies, including the Korea Coast Guard and the Nuclear Safety and Sec urity Commission, as well as 26 local governments, including Busan and Ulsan.

The focus of the training was to quickly disseminate information at each phase of the tsunami's ar rival and to review the procedural response systems of relevant agencies. Additionally, measures for the safety management of key coastal facilities and evacuation methods for residents and ship s were explored.

This exercise was particularly significant as it reviewed the implementation of discussions amo ng relevant ministries following the Noto Peninsula earthquake on January 1, 2024 and assesse

d the preparedness of local governments expected to be affected by a potential tsunami.

9. Web sites (URLs) of national tsunami-related web sites

KMA is responsible for issuing and disseminating an earthquake and tsunami warning and inform ation. All the related information is reported in its web site (https://www.kma.go.kr/eng/weather /current_state/current_introduction.jsp).

10. Summary of future plans for tsunami warning and mitigation system improvements.

KMA is preparing the following plans to strengthen tsunami monitoring and improve prediction t echnology.

(1) Expansion of the tsunami observation network
- KMA is planning to develop tsunami observation technology using RTK(Real Time Kinematic)-GPS method and establish offshore observation network.
- An automatic tsunami observation technology using CCTV based on Artificial intelligence technique is under research.

(2) Improvement of tsunami impact analysis and prediction information production
- Tsunami warning system for non-typical sources will be developed.
- A high-resolution multi-grid tsunami prediction model will be developed to enhance forecast accuracy.
- The coverage of the existing scenario database will be expanded.

NATIONAL PROGRAMMES AND ACTIVITIES INFORMATION

11. EXECUTIVE SUMMARY

The Korea Meteorological Administration(KMA) is conducting various technological development and research to enhance the tsunami prediction capabilities. Recently, the prediction area of the tsunami has been expanded to the global scale, enabling the calculation of prediction information for the Pacific tsunami. Additionally, a real-time preprocessing algorithm and new detection algorithm have been incorporated into the detection system to improve accuracy.

To strengthen observation capability of the tsunami, KMA plans to apply the RTK-GPS method and utilize artificial intelligence(AI) technology for CCTV-based monitoring. Furthermore, A high-resolution multi-grid tsunami prediction model will be developed to enhance forecast. Additionally, the coverage of the existing scenario database will be expanded.

KMA has been operated 24/7 Earthquake Early Warning System (EEWS) to issue earthquake warni ng when an earthquake with magnitude of 5.0 or higher occurred and tsunami warning system to issue tsunami alert when the expected tsunami height is over 0.5m.
KMA disseminates official earthquake or tsunami alerts using Cell Broadcasting System(CBS).

On January 1, 2024, the Mw 7.5 Noto Peninsula earthquake (Japan) triggered a tsunami along Kor ea's East Coast. Although no damage was reported, tsunami waves were observed at 12 major obs ervation points approximately 2 to 2.5 hours after the earthquake.

Additionally, KMA conducts tsunami training to enhance its response capabilities and carries out j oint exercises in cooperation with disaster management agencies and local governments. A trainin g exercise was also conducted on October 18, 2024 (after January 1, 2024), to assess the response capabilities of relevant agencies and their cooperation system in the event of a tsunami affecting m ajor coastal facilities along the East Coast.

To enhance understanding of earthquake and tsunami, we conduct education programs on earthq uake, tsunami, and volcano every year. These programs include educational courses for students a nd safety training courses for institution. Additionally, KMA establishes clubs for middle and high sc hool students to provide education and experiential learning on earthquake and tsunami.

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