TT-Tsunami Watch Operations
TOWS-WG
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New Efforts to Provide Information on Volcanic Tsunamis in Japan

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Back ground

> A Large eruption occurred in the Tonga Islands on January 15,2022. In Japan, we observed tide level changes that are different from earthquake generated tsunamis.

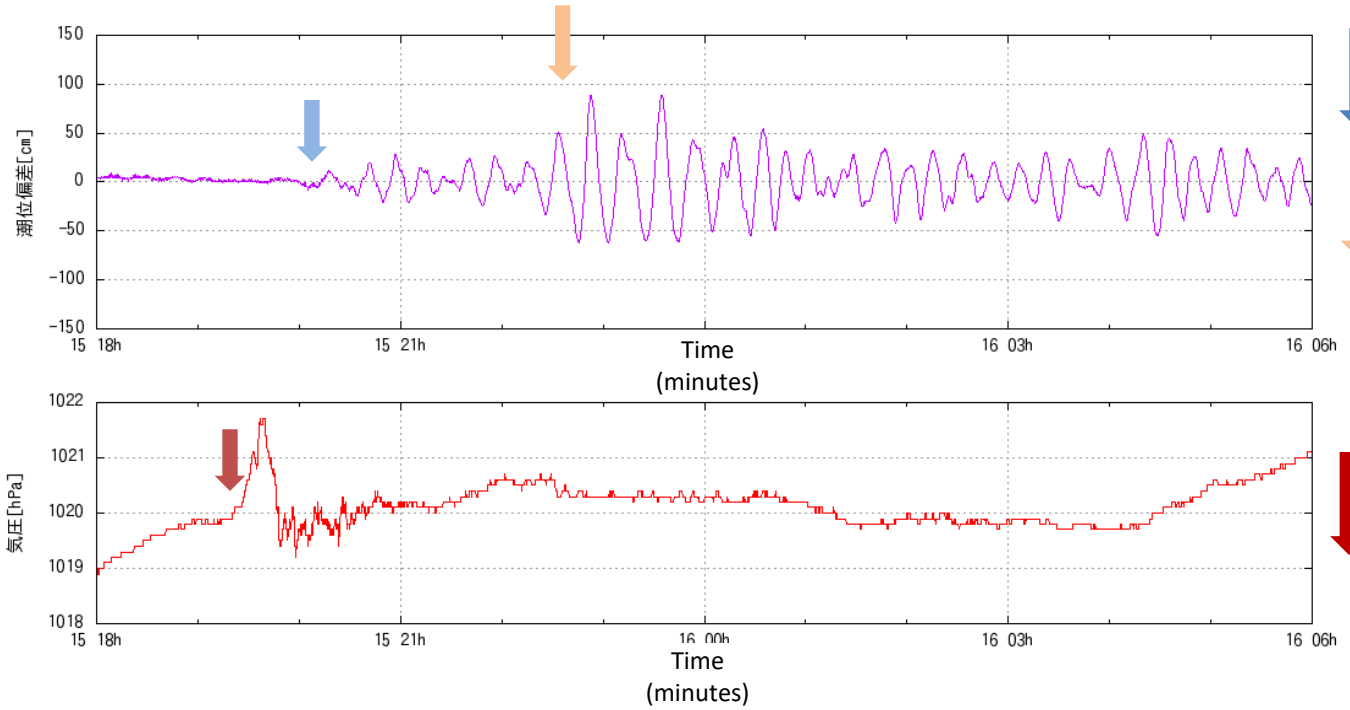
>In response to the tsunami generated by the volcanic eruption in Tonga, the Japan Meteorological Agency (JMA) held two study groups consisting of experts;

1. Study Group on Tsunami Forecasting Technology (the report was published on April 7, 2022)
2. Study Group on Information on Tidal Level Changes by Volcanic Eruptions (the report was published on July 27, 2022)

>Based on the reports of these study groups, JMA has established procedures for issuing information for volcanic tsunamis, mainly such as the tsunami caused by the volcanic eruption in the Tonga Islands.

Example of barometric pressure change and tidal level change in Japan

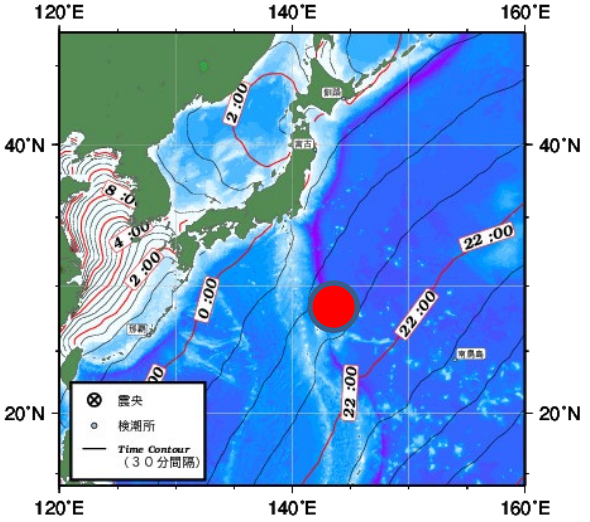
Chichijima island



Time of start of tide level change

Estimated arrival time

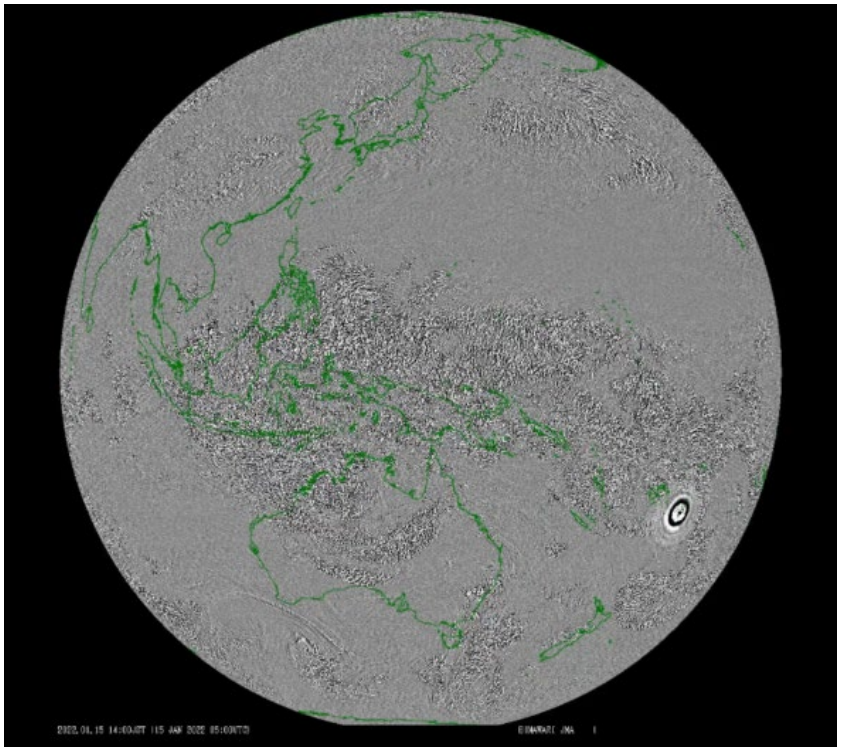
Time of start of barometric pressure change



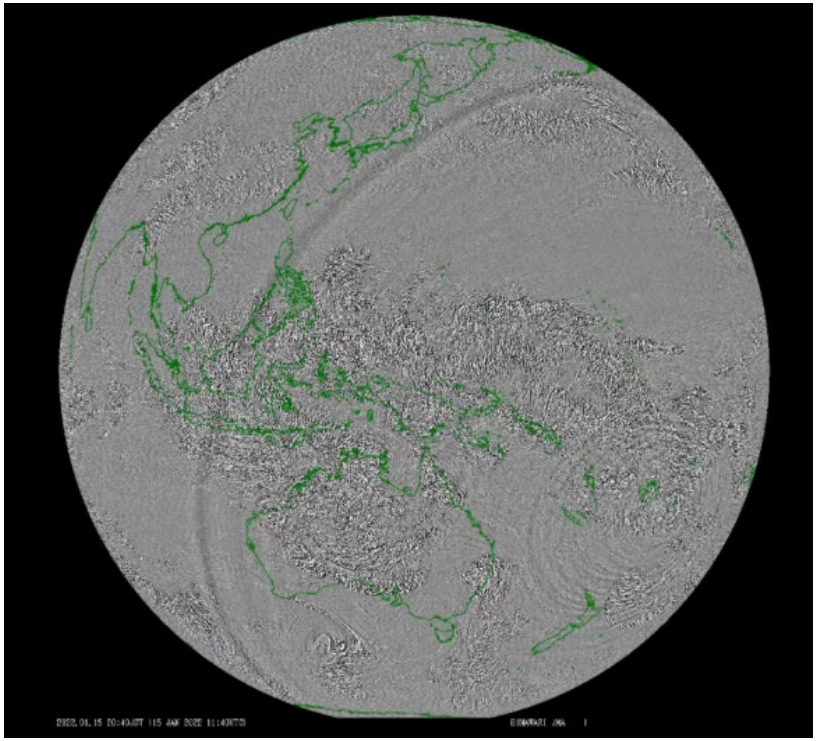
Time series of barometric pressure change and tide level change
(January 15, 18:00 - January 16, 06:00)

Upper: Tidal level deviation (cm)
Lower: barometricc pressure (hPa)

Barometric pressure waves observed by the Himawari meteorological satellite



January 15,5:00(UGT)



January 15,20:40(JST)

Brightness temperatures of full-disk images taken every 10 minutes by the Himawari weather satellite in Band 10, which is sensitive to water vapor in the upper and middle troposphere.

The image was created by second-order differentiation in the time direction (representing the minima and maxima of luminance temperature). The gradations are large for white (2.0 K) and small for black (-2.0 K).

1.Report by the Study Group on Tsunami Forecasting Technology

>Generating Mechanisms of Tidal Level Change

>>The beginning of the tidal wave change caused by the propagation of Lamb waves generated by the recent volcanic eruption arrives earlier than the estimated time of arrival of a tsunami caused by fault movement near the volcano that propagates in shallow water long waves

>>The tidal level change of more than 1 m observed along the Pacific coast of Japan may be due to barometric gravity waves, etc. However, barometric pressure changes that may be caused by barometric gravity waves have not been clearly identified in Japan

>Possibility of forecasting similar phenomena

>>Quantitative forecasting of the height of tidal change along the Japanese coast is difficult at this time

>>Detailed analysis is needed to determine the contribution of barometric gravity waves to the recent tide level change, taking into account their dispersion.

>>If there is a possibility of tidal change caused by Lamb waves, it is possible to predict the onset time of the tidal change to some extent based on the typical propagation velocity of Lamb waves, which can be used for disaster prevention by promptly announcing the time of the change.

>Information on tide level changes generated by barometric pressure changes by volcanic eruptions

>>Use the tsunami warning / advisory system based on tidal level observations and barometric pressure to call for caution.

>>Easy to understand is important for disaster prevention measures. Information provided as "tsunami".

>>For tide level changes caused by barometric pressure waves caused by volcanic eruptions, we will provide detailed explanations and information by utilizing the grace period until the tide level changes reach Japan.

>Public Awareness for tsunamis generated by volcanic phenomena and earthquakes

>>In order to connect to disaster prevention measures even for rare phenomena that occur infrequently, it is important to raise public awareness during normal times and to provide detailed explanations at press conferences when the phenomenon occurs.

>>For public awareness, informational Scenarios for tsunamis caused by volcanic phenomena and earthquakes and precautions for disaster mitigation should be organized by dividing them into "long and short lead times" and "presence or absence of shaking".

Informational Scenario at large-scale eruptions far from Japan

Case of a tsunami or barometric pressure caused by a large-scale volcanic eruption far from Japan is observed

Large eruptionan occurred

a large-scale eruption with an eruption altitude of about 15,000 m or more was observed.

Information #1

・Large-scale eruption

・the estimated arrival time of a tsunami based on velocity of Lamb wave, etc.

Confirm clear change at brightness temperature on satellite image

Observe tsunami at overseas observation cites

Information #2

・Observation of tsunami overseas

・Clear barometric pressure wave analysis with satellite images

(Isuring information as needed)

(as needed)

Press Release

Explain the phenomena that are occurring, similar cases, scenarios for timing of information and precautions

Observe the tsunami at domestic cite

Tsunami warning/advisory
(for observed area)

Observe the tsunami in various domestic cites

Tsunami warnings /advisories
(for each observed areas)

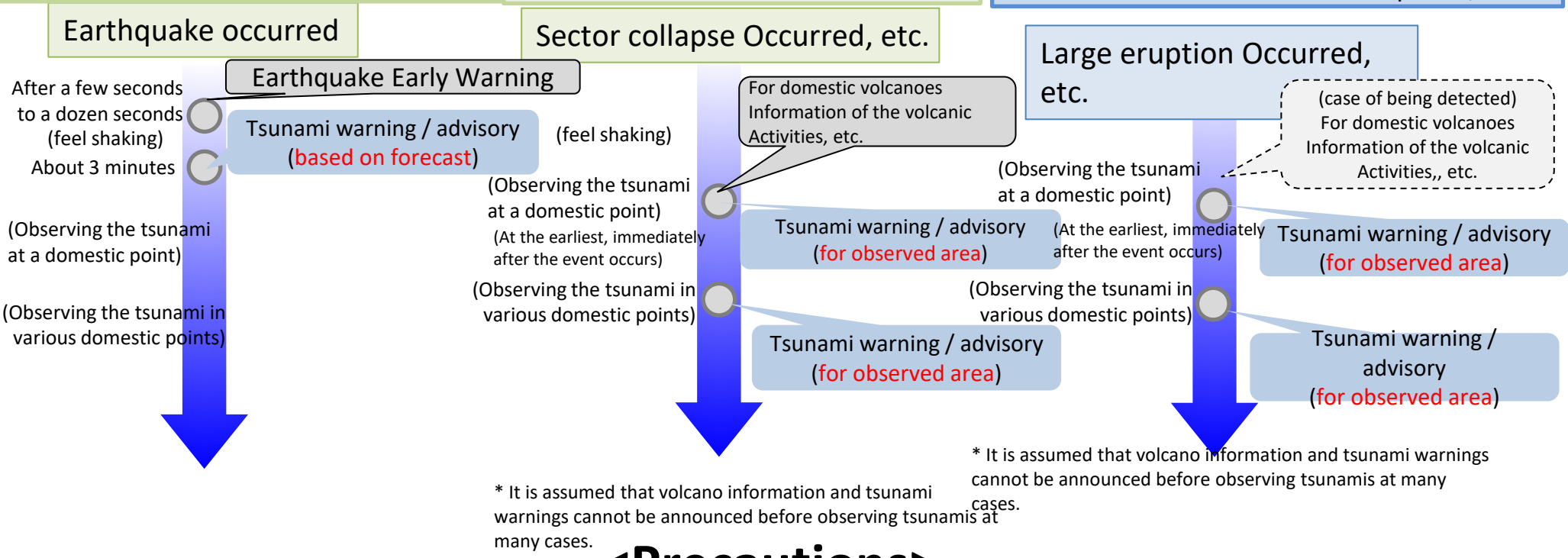
Scenario and Precautions in Case of Tsunami with "Short Lead Time"

<Scenario>

2011 off the Pacific coast of Tohoku Earthquake, etc.
<case1> Lead time is short and feel shaking
・Tsunami caused by an earthquake whose epicenter is near Japan

1792 Unsen Fugendake eruption and tsunami, etc.
<case1> Lead time is short and feel shaking
・Sector collapse due to volcanic activity near the coast and tsunami caused by submarine eruptions

2021 eruption of Fukutoku Okanoba, etc.
<case2> lead time is short and feel no shaking
・Tsunami caused by submarine landslide
・Topographic changes due to volcanic eruptions near the coast and islands
・Tsunamis due to submarine eruptions, etc.



* It is assumed that volcano information and tsunami warnings cannot be announced before observing tsunamis at many cases.

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<Precautions>

>If you feel shaking (if you notice the sector collapse of a volcano or an eruption of the seabed), evacuate immediately.

> If you see or hear a tsunami warning, evacuate immediately.

Scenario and Precautions in Case of Tsunami with "Long Lead Time"

<Scenario>

2022 eruption of Tonga Islands, etc.
<case3> Lead time is long and feel no shaking
・Topographic changes caused by overseas volcanic eruptions, tsunamis caused by barometric pressure waves
・Tsunami caused by submarine landslides and collapse of mountains due to overseas volcanic activity

Large Eruption occurred

Confirm clear change at brightness temperature on satellite image
Information
・Large-scale eruption

Information
・Observation of tsunami overseas
・Clear barometric pressure wave analysis with satellite images
(Isuring information as needed)

Observe tsunami at overseas observation points

(as needed)
Press release

Observe the tsunami at a domestic point
Tsunami warning / advisory (for observed area)

Observe the tsunami in various domestic points
Tsunami warning / advisory (for observed area)

*** It is assumed that the tsunami advisory will be issued in the relevant tsunami forecast area when the tide level change of the tsunami warning announcement standard (0.2m) is observed.**

1960 Chile Earthquake Tsunami, etc.
<case3> Lead time is long and feel no shaking
・Tsunami caused by a teleseism

Earthquake occurred

About 30min later
Distant Earthquake Information
・Large earthquake

Observe tsunami at overseas observation points
Distant Earthquake Information
・Observation of tsunami overseas
(Isuring information as needed)

(as needed)
Press release

About two hours before the tsunami arrival time
Tsunami warning / advisory (based on forecast)

Observe the tsunami at a domestic point

Observe the tsunami in various domestic areas

* Information on teleseism is scheduled to be renamed in the medium to long term, but here it is explained using the current name.

<Precautions>

>For phenomena that can be forcasted even partially, recognize that the information will be updated from time to time, obtain the latest information, prepare for evacuation, etc., and evacuate immediately after hearing the tsunami warning.

Summary

>JMA has decided to carefully disseminate information and provide explanations in large-scale volcanic eruptions overseas in order to prepare for tsunamis caused by them.

>JMA will issue tsunami warnings related to volcanic tsunamis based on tide level observations.

>In order to connect to disaster mitigation measures even for rare phenomena that occur infrequently, it is important to conduct public awareness activities from normal times, and we will work on this.