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**Security and resilience — Emergency  
management —**

Part 3:  
**Guidelines for the implementation  
of a community-based early warning  
system for tsunamis**

*Sécurité et résilience — Gestion des urgences —*

*Partie 3: Lignes directrices pour la mise en œuvre d'un système  
d'alerte précoce des tsunamis à l'échelle de la collectivité*

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## Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see [www.iso.org/directives](http://www.iso.org/directives)).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see [www.iso.org/patents](http://www.iso.org/patents)).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see [www.iso.org/iso/foreword.html](http://www.iso.org/iso/foreword.html).

This document was prepared by Technical Committee ISO/TC 292, *Security and resilience*.

A list of all parts in the ISO 22328 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at [www.iso.org/members.html](http://www.iso.org/members.html).

## Introduction

In tsunami-prone countries, a tsunami causes catastrophic disaster, loss of lives, damage to the ecosystem and great socioeconomic losses.

The Tsunami Early Warning Systems framework, which was developed by the United Nations Office for Disaster Risk Reduction (UNDRR, formerly UNISDR) and agreed in Bonn, Germany in 2006, underlines the people-centred aspect of an early warning system (EWS).<sup>[9]</sup> To build a tsunami-resilient community, this idea has been translated in this document into more explicit guidance for a community-based tsunami EWS. The guidance gives more crucial roles for the community in managing the tsunami risk reduction activities, which are fully supported by the existing system and infrastructure that have been built by the local government.

The goal of the development of a tsunami EWS is to empower individuals and communities who are vulnerable to hazards to act in sufficient time and in appropriate ways to reduce the possibility of injuries, loss of life, and damage to property and the environment.

This document complements the generic guidelines on EWS given in ISO 22328-1<sup>[5]</sup> with specific information related to tsunamis. It is also complementary to the guidelines on public warning given in ISO 22322<sup>[4]</sup> as well as the guidelines on planning mass evacuations given in ISO 22315<sup>[3]</sup>.

The Intergovernmental Oceanographic Commission (IOC) of UNESCO coordinates the global development of end-to-end tsunami early warning systems, which have been adopted, tailored and implemented by several countries. This document complements the international standard for evidence-based community preparedness for tsunamis of the UNESCO-IOC Tsunami Ready program and indicators, and Guidelines for Indian Ocean Tsunami Ready Program.<sup>[7]</sup>

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# Security and resilience — Emergency management —

## Part 3:

# Guidelines for the implementation of a community-based early warning system for tsunamis

## 1 Scope

This document gives guidelines for the implementation of a community-based disaster early warning system (EWS) for tsunamis. It complements the generic guidelines in ISO 22328-1<sup>[5]</sup>. It describes the methods, procedures, implementation measures and activities specifically related to tsunamis.

This document is applicable to communities vulnerable to tsunamis, without taking secondary/indirect effects into consideration.

## 2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 22300, *Security and resilience — Vocabulary*

## 3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 22300 and the following apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <https://www.electropedia.org/>

### 3.1

#### **official warning**

warning issued by the national or regional authority to enable the local authority to consider and/or initiate evacuation of the people at risk

### 3.2

#### **earthquake**

sudden and violent shaking of the ground, sometimes causing great destruction, as a result of movements within the earth's crust or volcanic action

### 3.3

#### **tsunami**

series of travelling waves of extremely long length and period, usually generated by disturbances associated with an *earthquake* (3.2) occurring below or near the ocean floor, volcanic eruptions, a submarine landslide, liquefaction, melting glaciers, coastal rock falls or meteorites

### 3.4

#### **local tsunami**

near-field tsunami hazard

tsunami originating from a nearby source with destructive effects confined to coasts within 100 km of the source

[SOURCE: UNESCO IOC, Tsunami Glossary, modified, p.7<sup>[8]</sup>]

### 3.5

#### **distant tsunami**

far-field tsunami hazard

tsunami originating from a faraway source, generally more than 1 000 km

[SOURCE: UNESCO IOC, Tsunami Glossary, p.11<sup>[8]</sup>]

### 3.6

#### **estimated time of arrival**

##### **ETA**

tsunami arrival at some fixed location, estimated from modelling the speed and refraction of the waves travelling from the source

[SOURCE: UNESCO IOC, Tsunami Glossary, p.14<sup>[8]</sup>]

### 3.7

#### **inundation**

maximum horizontal penetration of the tsunami from the shoreline

Note 1 to entry: A maximum inundation is measured for each different coast or harbour affected by the tsunami.

[SOURCE: UNESCO IOC, Tsunami Glossary, p.22<sup>[8]</sup>]

### 3.8

#### **runup**

elevation reached by seawater which is measured relative to mean sea level, mean low water and sea level at the time of the tsunami attack, etc., and ideally at a point that is a local maximum of the horizontal *inundation* (3.7)

### 3.9

#### **natural warning**

forewarning of a tsunami including ground shaking from earthquakes, unusual sea-level fluctuations, draining away of sea surface at coastal area, waveforms, sounds and sudden unusual animal behaviour

Note 1 to entry: Other natural warning signs of tsunamis can occur.

### 3.10

#### **self-evacuation**

immediate/spontaneous response by a community at risk to a *natural warning* (3.9) of a tsunami, prompting individual movement prior to an *official warning* (3.1)

## 4 Tsunami early warning system

### 4.1 General

The community-based tsunami EWS should be based on ISO 22328-1<sup>[5]</sup>. It should involve community participation in the tsunami risk reduction plan based on their understanding of tsunami hazard and vulnerability.

## 4.2 Risk assessment

### 4.2.1 General

In addition to the guidelines on risk assessment given in ISO 22328-1:2020<sup>[5]</sup>, 4.2, the following actions should be taken.

The community disaster preparedness teams should conduct a risk identification to understand the combination of tsunami hazard and vulnerability at one particular location. This includes identifying knowledge for developing a tsunami risk reduction plan that includes:

- the identification of past tsunami events with the potential for recurrence in the same source (e.g. paleo-tsunami);
- an understanding of the tsunami risk potential (e.g. arrival time, runup height, inundation) in and around coastal areas;
- the current and future exposure potential and vulnerability of people;
- the assets to move development away from affected coastal areas and to restrict future development near the shoreline;
- the prioritization of investment in an EWS and evacuation infrastructure.

### 4.2.2 Understanding the tsunami hazard

Proper understanding of the tsunami hazard requires knowledge of probable tsunami sources (e.g. earthquakes, landslides, volcanic eruptions), the likelihood of occurrence, the long-lasting nature, the multiple arrival of tsunami waves, and the characteristics of tsunamis from those sources at different places along the coast (local tsunami, regional tsunami and distant tsunami).

A tsunami hazard map should be developed and updated by community-preparedness teams to identify the geographical areas susceptible to a tsunami. The tsunami hazard map should:

- actively involve public participation in its development;
- address local knowledge;
- follow guidance from tsunami experts (see [Annex E](#)).

### 4.2.3 Understanding the tsunami vulnerability

A vulnerability assessment analyses the exposure, conditions, assets and capacities the community at risk has to deal with related to the tsunami hazard. It considers the physical, economic, social and cultural dimensions of community vulnerability.

The hazards should be documented and mapped for people or communities located along the identified coastline.

### 4.2.4 Development of tsunami risk reduction plan

The vulnerability assessment should be linked to the higher-level tsunami risk reduction plan (district, province, national), integrated with the results of the risk assessment, documented and accessible to interested parties, and updated as required following regular review.

In addition to the guidelines on developing the general risk reduction plan given in ISO 22328-1<sup>[5]</sup>, the tsunami risk reduction plan should consider the tsunami inundation map, tsunami height and estimated time arrival of the tsunami.

### 4.3 Dissemination and communication of knowledge

In addition to the guidelines on dissemination and communication of knowledge given in ISO 22328-1:2020<sup>[5]</sup>, 4.3, the community disaster preparedness team should take the following actions:

- a) develop a public display of tsunami information, which describes:
  - 1) a tsunami hazard map;
  - 2) how to respond in the community;
  - 3) information such as the tsunami danger area and historical data, evacuation map and routes, shelters and assembly points;
  - 4) a tsunami response guide;

NOTE See [Annexes A](#) and [B](#).
- b) develop and disseminate customized public education materials to address local information, which describes:
  - 1) the tsunami hazard in the area;
  - 2) understanding the disaster risk, natural warnings and self-evacuation;
  - 3) location-specific tsunami threats;
- c) conduct public education, campaigns and/or advocacy, for example:
  - 1) annual public outreach and educational activities;
  - 2) national, state and regional campaigns using social media;
  - 3) community tsunami safety workshops, town hall meetings or similar public meetings;
  - 4) door-to-door safety campaigns targeted at residents and businesses living or working in the community's tsunami hazard zone.

The public education materials described in b) should be distributed appropriately, e.g. to schools within the community.

### 4.4 Monitoring and warning service

In addition to the guidelines on the monitoring and warning service given in ISO 22328-1:2020<sup>[5]</sup>, 4.4, the following actions should be taken.

Tsunami monitoring and warning should be conducted by the national authority and/or regional capacity.

The monitoring system should at least be able to:

- measure earth movements by recording seismic waves;
- monitor changes in the water's surface from onshore.

Data from the monitoring system should be sent in real time to the national authority to be processed to produce early warning messages in different formats, e.g. short-text formats (e.g. text messages) and long-text formats (e.g. fax, email, warning receiver system).

Once the national authority issues a tsunami threat, four stages of warning may follow. Sequentially, these are as follows:

- Bulletin-1: Disseminates the threat based on earthquake parameters and the estimated impact of the tsunami reflected by a warning level (Major Warning, Warning, Advisory) for every affected area.
- Bulletin-2: Updates the earthquake parameters and tsunami threat level in Bulletin-1, and disseminates the tsunami estimated time of arrival (ETA) onshore.
- Bulletin-3: Confirms the tsunami arrival based on real tsunami observation data, and updates the warning level and tsunami arrival times. The warning may be updated several times depending on the sea observations.
- Bulletin-4: Announces that the tsunami threat has ended/completed.

Exceptional tsunami cases should be considered, which include the following:

- Where the location of the tsunami source is close to the coast, the tsunami most likely will hit immediately before the bulletin is successfully delivered.
- Where tsunamis are caused by non-seismic phenomena such as landslides, volcanoes, etc., evaluation, prediction and natural warning can be underestimated or are not available. In this case, a tsunami warning should still be issued.

The dissemination and communication system for a tsunami warning should be integrated between the national authority, the community preparedness teams and the community at risk.

The community preparedness team should have the capacity and capability to receive tsunami warning messages from the local and national authority and to disseminate the message to the community at risk.

Multiple communication mediums should be used for warning dissemination and redundancies enforced so back-up systems are in place in the event of failure.

See [Annex C](#) for an example of tsunami warning communication modes.

See [Annex D](#) for an example of tsunami warning bulletins.

#### 4.5 Response capability

In addition to the guidelines on response capability given in ISO 22328-1:2020<sup>[5]</sup>, 4.5, the following actions should be taken:

- a) assigning tasks to the community disaster preparedness team, including:
  - 1) receiving earthquake information/tsunami early warning;
  - 2) disseminating tsunami evacuation guidance and information to residents;
  - 3) activating the evacuation plan/self-evacuation;
- b) determining the evacuation shelters, which should fulfil the following criteria:
  - 1) strong enough to withstand a large earthquake without breaking;
  - 2) placed either in a low inundated area or in a high inundated but strategically better area to accommodate a large sum of people to take shelter in a short amount of time;
- c) developing a tsunami evacuation map and routes, which should:
  - 1) consider tsunami hazard zone mapping from inundation modelling as a basis for preparing the evacuation map;

- 2) involve the community in the preparation of the map to incorporate local knowledge concerning accessibility and difficulties to reach or to take certain path; for communities who do not have inundation mapping, a “baseline tsunami hazard zone” can be used;
- d) developing a standard operating procedure (SOP) containing evacuation decisions related to the tsunami alert level in accordance with ISO 22328-1<sup>[5]</sup>, which should:
  - 1) explain the who, what and how of the tsunami warning chain from the authority to the community;
  - 2) announce the level of the tsunami warning;
  - 3) be confirmed by local governments as the official reference for all those involved in tsunami early warning.

Self-evacuation measures should be encouraged where the location of the tsunami source is close to the coast or is caused by non-seismic phenomena such as landslides, volcanoes, etc.

In health emergency situations all evacuation processes should always comply with the existing protocol for each community. If the protocol is not yet exist, community should adapt the internationally recognized guideline.

[Annex A](#) gives an example of a public display of a tsunami risk/hazard map.

[Annex B](#) gives an example of an evacuation map and route, including the symbols used.

[Annex C](#) gives an example of a framework of tsunami monitoring and dissemination.

[Annex D](#) gives an example of tsunami warning bulletins.

[Annex E](#) gives an example of an evacuation SOP for each tsunami alert level.

#### **4.6 Commitment of the authority and the community at risk to the sustainability of the tsunami early warning system**

In addition to the guidelines given in ISO 22328-1<sup>[5]</sup>, and in order to maintain the sustainability of the tsunami EWS, the authority and the community should commit to support the tsunami disaster preparedness team to function 24 hours a day and to readily receive and disseminate warning messages when a tsunami threat emerges.

For the sustainability of the EWS, the authority and the community should conduct a joint complete assessment for evaluation and improvement following a tsunami threat which involves all levels (community, local authority, national authority) and which should be reported back to all levels (community, local authority, national authority).

# Annex A (informative)

## Example of a public display of a tsunami risk/hazard map

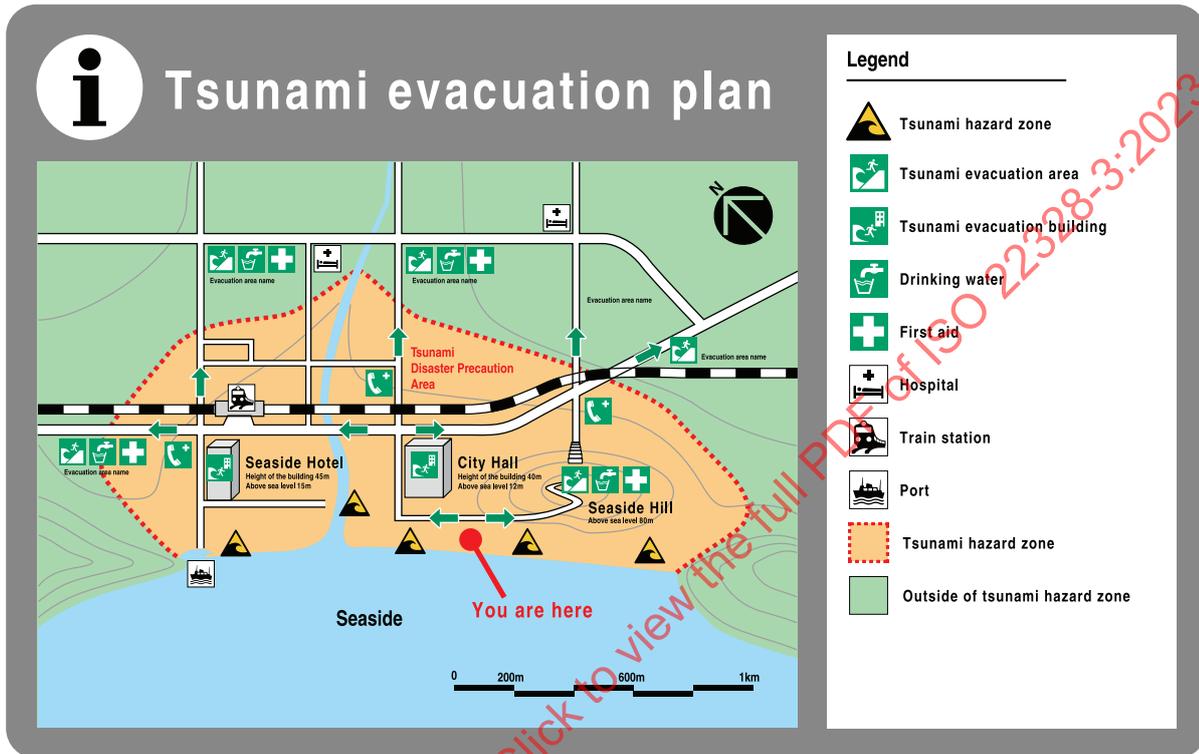


Figure A.1 — Example of a public display of a tsunami risk/hazard map

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## Annex B (informative)

### Example of an evacuation plan sign



NOTE 1 This plan is an example and can be adjusted or improved.

NOTE 2 Source: ISO 22578:2022, Figure A.2.[6]

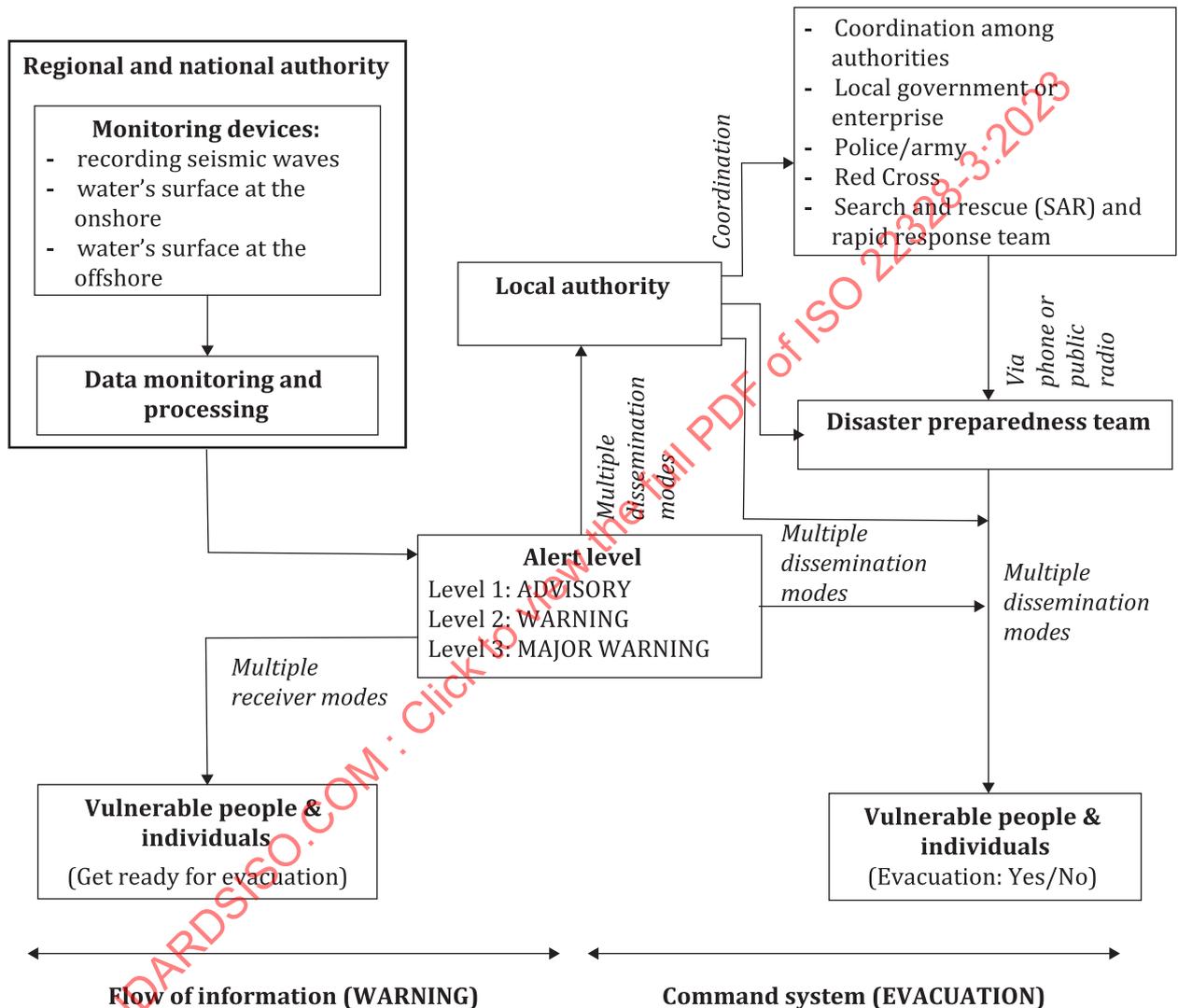
**Figure B.1 — Example layout of an evacuation plan sign for disaster precaution areas for tsunamis, with available facilities**

The evacuation map does not need to include the scale but only indicate the north direction, which can be placed in the legend. The north direction does not necessarily face up, depending on the local customs.

When setting up an evacuation route, the appropriate symbols from ISO 7001[1] and ISO 7010[2] should be used.

## Annex C (informative)

### Example of a framework of tsunami monitoring and dissemination



**Figure C.1 — Example of a framework of tsunami monitoring and dissemination**

NOTE 1 The alert level and recommendation for each country can be determined in accordance with the national situation and regulations.

NOTE 2 Receiver modes that can be used are, for example, short message service (SMS), public radio, television, or social media.

NOTE 3 Dissemination modes that can be used, for example, are SMS, television, public radio, social media, internet/satellite-based, sirens and public communication (e.g. mosque speaker or church bell).

## Annex D (informative)

### Example of a tsunami warning bulletin

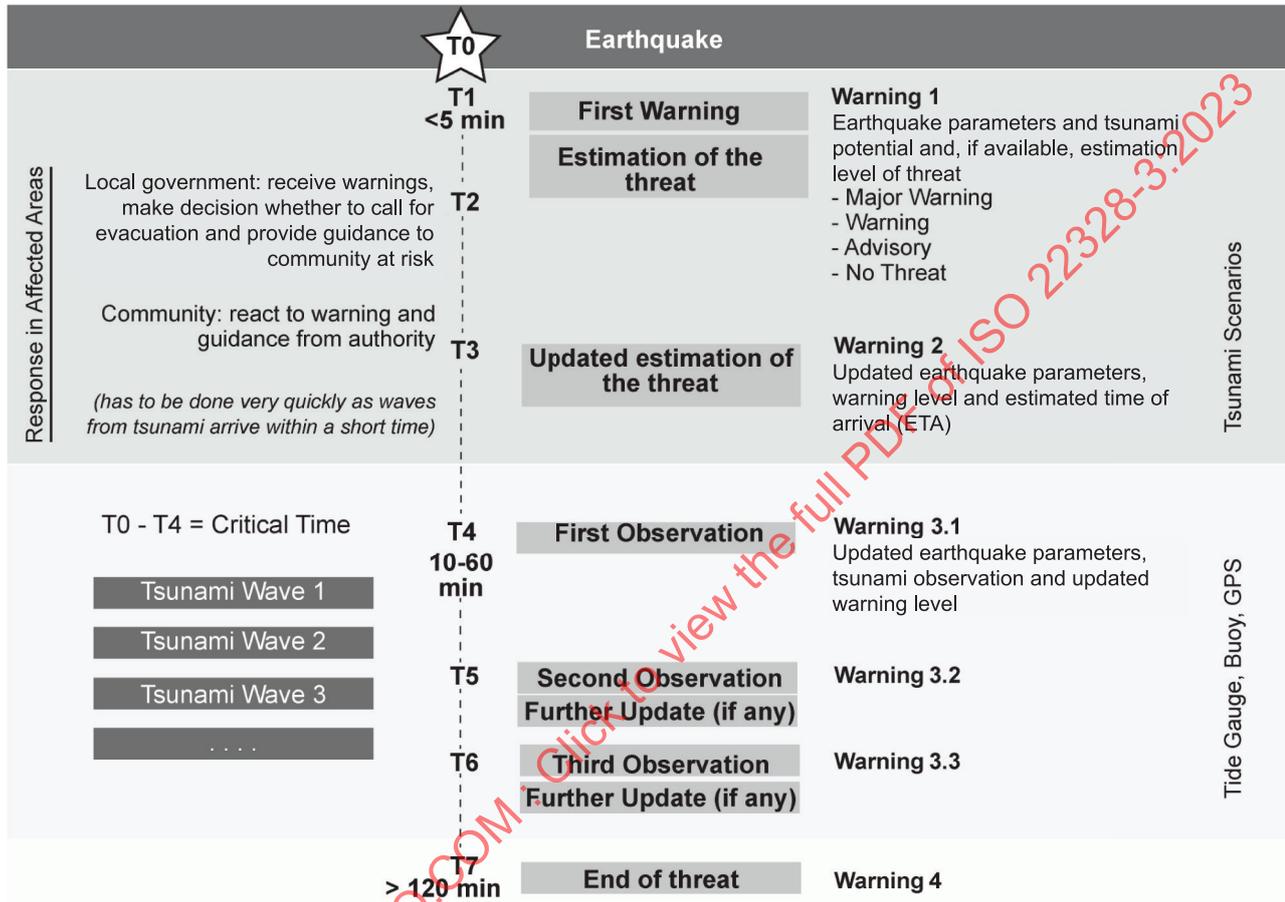


Figure D.1 — Example of a tsunami warning bulletin

The alert threat levels in the early warning messages may be classified into three categories based on the estimated tsunami height at the coastal line:

- Advisory
- Warning
- Major Warning

NOTE The criteria of alert level and recommendation for each country can be adjusted in accordance with regional/national policy and/or regulation.

EXAMPLE Alert level<sup>[9]</sup>:

- Advisory, where the tsunami height at the coast line is lower than 0,5 m;
- Warning, where the tsunami height at the coast line is between 0,5 m and 3,0 m;
- Major Warning, where the tsunami height at the coast line is higher than 3,0 m.

## Annex E (informative)

### Example of an evacuation standard operating procedure

An example is given in Table E.1. All evacuation processes should adapt the internationally recognized guidelines<sup>[11][12]</sup> if respective regional guidelines do not yet exist.

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