Tsunami Warning Center Operations

UNESCO/IOC
TSUNAMI Early Warning Overview

Earthquake
Tsunami

Tsunami Warning Center

National Government
Local Government
Mass Media

National Warning System

Public Awareness

- Hazard Risk Assessment
- Warning Guidance
- Mitigation - Preparedness

Cabinet Office Japan
What we need for Tsunami Warning

Components of tsunami warning system

- Network of seismographs
- Real time data transmission
- Real time data processing system
- Criteria for Tsunami grade
- Communication facility to disseminate Tsunami Warning
- Network of tide gauge to monitor tsunami

Generation of Tsunami

Occurrence of Earthquake

Detection of Seismic Wave

Determination of Magnitude and Hypocenter

Evaluation of Tsunami

Issuance of Tsunami Warning

Detection of Tsunami

Re-evaluation of Tsunami

Issuance of Tsunami Information

Network of seismographs

Real time data transmission

Real time data processing system

Criteria for Tsunami grade

Communication facility to disseminate Tsunami Warning

Network of tide gauge to monitor tsunami
Flowchart after Rupture Analysis

Rupture Analysis by the System for Automatic Estimation of Earthquake Mechanism using observational data within about 10-20min. after eq. occurrence

Compare Magnitude in the first tsunami warning (M) with Moment Magnitude (Mw)

- **Mw<M**:
  - Evaluate by tsunami DB
  - Cancel
  - Watch 1st & 2nd wave

- **Mw>M**:  
  - Evaluate by tsunami DB
  - Evaluate by observation
  - Advisory
  - Warning
  - Advisory

- **Strike Slip Fault**
  - Revise/Cancel by rupture analysis
  - Revise/Cancel by observation

- **Mechanism**
  - Cancel
  - Warning
  - Advisory
  - Cancel

- **2-3 min.**
  - 2-3 min. warning
  - Advisory

- **10-20 min.**
  - 10-20 min. warning
  - Advisory

Tsunami Observation

- Watch tsunami attenuation
Dissemination of Tsunami Warning to Residents

JMA Tsunami Warning Center

- Satellite
- Local Meteorological Observatory
- Dedicated telephone line
- Government

Local Governments

Police, Fire office

TV

Radio

Etc.

Residents
<table>
<thead>
<tr>
<th>High-sensitive seismograph</th>
<th>Broadband seismograph</th>
<th>GPS continuous observation facility</th>
</tr>
</thead>
<tbody>
<tr>
<td>A seismograph capable of registering very faint shaking undetectable by humans (1,257 stations*)</td>
<td>A seismograph capable of registering vibrations over a very wide range of frequencies, from rapid to extremely slow (105 stations*)</td>
<td>A system using satellites to observe plate motion and crustal movements (1,430 stations*)</td>
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<tr>
<td>Strong motion seismograph</td>
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<tr>
<td>A seismograph for recording strong shaking that would overload high-sensitivity instruments (4,525 stations*)</td>
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Distributed SATWAS (SSAM)
<table>
<thead>
<tr>
<th>País</th>
<th>Estaciones Mareográficas</th>
<th>Ubicación</th>
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<td>San Lorenzo</td>
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<td>Esmeraldas</td>
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<td>Bahía de Caraquén</td>
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<td>02° 13' N</td>
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<td>Puerto Nuevo</td>
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<td>Puerto Montt</td>
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<td>San Félix</td>
<td>26° 16' S</td>
</tr>
<tr>
<td></td>
<td>Juan Fernández</td>
<td>33° 37' S</td>
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</tbody>
</table>
Location and status of other sea level stations that are operational with provision of RT data (red), operational without provision of RT data (blue) or are planned (green). White icon indicates that the status is not known.
Regional Meteorological Telecommunication Network for Region III (South America)

point-to-point and multipoint circuits implementation (transmission speed in bit/s)
GTS & EMWIN

- **GTS**
  - **Intelsat Delivery**
    - 128,000 baud (receive)
    - C – Band
    - Less than a minute
  - **Required Hardware**
    - Dish 2.4 meter (~ 8 feet)
    - Computer
    - Receiver Modem/Cable
  - **Costs**
    - ~ $54,000 to $81,000 U.S. (initial)
    - ~ $7,032 U.S. (recurring per year)

- **EMWIN**
  - **GOES Delivery**
    - 9,600 baud (going to 19,200 baud with GOES 13)
    - L – Band
    - Less than a minute
  - **Required Hardware**
    - Dish 1 or 2 meter
    - Computer
    - Demodulator/Cable
  - **Costs**
    - ~ $3,000 U.S. (initial)
    - $0 (recurring per year)
EMWIN – How does it Work?

Standard Pentium PC → Receiver → EMWIN Satellite Dish → Optional Alarm Controller → To Alarm Units
EMWIN – Hardware Requirements?

- 1 Meter (shown) or 2M Satellite Dish
- EMWIN Receiver
- Coaxial Cable
- Computer
- Data signal converted to text & graphical information that is displayed on your PC.
- Vendors (see web site)
  - http://iwin.nws.noaa.gov/emwin/winven.htm
1. Tsunami Information Statement
   A. Earthquake is in the Caribbean and 6.0 <= Mw <=7.0.
   B. Earthquake is in the Atlantic and 6.5 <= Mw <=7.8
   C. Earthquake is in the Caribbean or Atlantic but deep or inland.

2. Local Tsunami Watch Message
   Shallow underwater earthquake in the Caribbean where 7.0 < Mw < 7.5.

3. Regional Tsunami Watch Message
   Shallow, underwater earthquakes in the Caribbean Ocean Basin where
   7.5 < Mw <= 7.8.

4. Basin-Wide Tsunami Watch Message
   Shallow, underwater earthquakes in the Caribbean/Atlantic Ocean
   Basin where Mw >= 7.9.

- NOAA’s West Coast/Alaska Tsunami Warning Center (WC/ATWC) provides backup capability
  http://wcatwc.arh.noaa.gov/index.php

Products issued by PTWC* for Caribbean
http://www.prh.noaa.gov/ptwc/?region=4
Tsunami and Earthquake Monitoring System

Operation and maintenance
24 hours a day 7 days a week

*Battle against time*