Tsunami Warning System and Contingency Plan in Hong Kong

WG/SCS-VII, Hanoi, 6-8 March 2018

Hong Kong Observatory
S.T. Chan
Outline

• Risk of Tsunami in Hong Kong
• Monitoring of earthquake and tsunami
• Forecasting of tsunami amplitudes
• Warning & contingency plan
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Risk of Tsunami in Hong Kong

- Chance of Hong Kong affected by a significant tsunami (tsunami height of 0.5 m or higher) is very small
- HK not been seriously affected by any tsunami in recorded history
- Sheltering effect of the land masses of Taiwan and the Philippines against tsunamis originated in the Pacific
- Largest threat of tsunami comes from the Manila Trench west of Luzon
Sea level records of tsunamis detected in Hong Kong

<table>
<thead>
<tr>
<th>Date</th>
<th>Origin</th>
<th>Moment magnitude Mw</th>
<th>Maximum sea level change recorded in Hong Kong (Height above normal tide level)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1952/11/5</td>
<td>Kamchatka</td>
<td>9.0</td>
<td>0.15 m</td>
</tr>
<tr>
<td>1960/5/23</td>
<td>Chile</td>
<td>9.5</td>
<td>0.3 m</td>
</tr>
<tr>
<td>1985/3/4</td>
<td>Chile</td>
<td>7.9</td>
<td>less than 0.1 m</td>
</tr>
<tr>
<td>1988/6/24</td>
<td>Luzon Strait</td>
<td>5.7</td>
<td>0.3 m</td>
</tr>
<tr>
<td>2006/12/26</td>
<td>Over the sea near Southern Taiwan</td>
<td>7.1</td>
<td>less than 0.1 m</td>
</tr>
<tr>
<td>2010/2/28</td>
<td>Chile</td>
<td>8.8</td>
<td>less than 0.1 m</td>
</tr>
<tr>
<td>2011/3/11</td>
<td>Over the sea east of Honshu, Japan</td>
<td>9.0</td>
<td>0.2 m</td>
</tr>
</tbody>
</table>
Tsunami Travel Time Chart and Sea-level Monitoring Stations

- Okinawa
- Ishigakijima
- Quarry Bay
- Subic Bay
- Quinhon
- Buoy 52404
- Buoy 52405
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香港地震台網
Hong Kong Seismograph Network

- 尖鼻咀 (Tsim Bei Tsui)
- 鹿頸 (Luk Keng)
- 鉛礦凹 (Lead Mine Pass)
- 元五頤 (Yuen Ng Fan)
- 天文台 (HKOHQ)
- 宝珊 (Po Shan)
- 鶴咀 (Cape D'Aguilar)
- 長洲 (Cheung Chau)

图例:
- 红圆圈: 短週期地震儀 (Short period seismograph)
- 蓝圆圈: 寬頻地震儀 (Broadband seismograph)
- 绿三角: 強震儀 (Strong motion accelerograph)
Seismic Data Processing System

HKPS, HKC and 7 local stations
IRIS Data Management Centre
GEOFON (Mediterranean, NE Atlantic and Indian Ocean)

SeiscomP3

Antelope
Quick Earthquake Message (QEM) on mobile

SMS

Weibo for the Chinese community
Press Release on Earthquake Reports

Earthquake Report

Bulletin issued at 10:58 HKT 28/Feb/2018

Strong Earthquake Report
Initial analysis from the Hong Kong Observatory indicated that an earthquake of magnitude 6.1 has occurred at 10:46 a.m. on 28 February 2018 (Hong Kong Time) in New Guinea, Papua New Guinea. The epicentre is located near 6.2S, 142.5E, about 620 kilometres west-northwest of Port Moresby.

The location of epicentre is now available in KML file:
Download epicentre information in KML file
(Note: require geo-browser software supporting KML data format, see "Method to Use" below)

• Issued for strong earthquakes anywhere in the world (M 6.0 or above)

• Locally felt tremors
Performance Statistics in 2017

• Total 135 press releases on earthquake reports issued

• Median time lapse from the occurrence of earthquake to Quick Earthquake Message (QEM) posted on Twitter: 8 minutes

• Median time lapse from the occurrence of earthquake to Strong Earthquake Report posted on HKO’s Internet website: 12 minutes

• No Tsunami Warning/Information Bulletin issued
Tsunami / Sea Level Monitoring

- Similar to storm surges caused by approaching tropical cyclones
- Because of historical concern about storm surges, Hong Kong is already well prepared against tsunamis
- Coastal designs of built-up areas in Hong Kong and general land use have catered for storm surges. This offers protection against tsunamis of considerable height
• Monitors warning messages issued by PTWC, NWPTAC & SCSTAC

• Keeps close watch on the sea-levels recorded by monitoring stations in the western Pacific, South China Sea and Hong Kong

• If necessary, the Observatory will issue a tsunami warning to the public.
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• **Forecasting of tsunami amplitudes**
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Hong Kong Observatory Tsunami Prediction System

- Under Tsunami Inundation Exchange (TIME) project of Intergovernmental Oceanographic Commission (IOC), Hong Kong Observatory run a Tsunami Numerical Model since late 2006 to simulate tsunami propagation in the South China Sea

- Use high resolution topographical and bathymetric data near Hong Kong to simulate tsunami height distribution along Hong Kong coastline

- A tsunami scenario database has been developed for fast retrieval of maximum tsunami heights in different coastal areas of Hong Kong arising from earthquakes in the South China Sea

- More than 1200 hypothetical earthquake cases were used for numerical tsunami simulation

- Provides a good and quick reference for the tsunami height when tsunami occurs in South China Sea
Tsunami Numerical Modelling

- 5 layers grid
- Outermost covers South China Sea, resolution 2.4 km
- Innermost covers whole Hong Kong region, resolution 30m

Outermost layer (low resolution)  Innermost layer (high resolution)
Combination of the hypothetical earthquake cases:

1. Epicentre:
   Northern part of the South China Sea and 80 neighbouring regions

2. Depth: 10, 20, 50, 100 km

3. Magnitude (Mw):
   8.0, 7.7, 7.4, 7.1, 6.8, 6.5
Products of the Tsunami Prediction System

- Arrival time and tsunami height

<table>
<thead>
<tr>
<th>Region</th>
<th>Max Tsunami Ht</th>
<th>Max Runup Ht</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hong Kong Island</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Harbour West</td>
<td>0.3 m</td>
<td>0.3 m</td>
</tr>
<tr>
<td>Harbour Central</td>
<td>0.5 m</td>
<td>0.5 m</td>
</tr>
<tr>
<td>Deep Water Bay</td>
<td>0.3 m</td>
<td>0.4 m</td>
</tr>
<tr>
<td>Stanley</td>
<td>0.5 m</td>
<td>0.5 m</td>
</tr>
<tr>
<td>Tai Tam Wan</td>
<td>1.0 m</td>
<td>1.1 m</td>
</tr>
<tr>
<td>Shek O</td>
<td>0.6 m</td>
<td>0.6 m</td>
</tr>
<tr>
<td>NT East</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
南海海嘯模擬
Simulation of a tsunami over the South China Sea
Trial of Real-time Tsunami Simulation - COMCOT

2011.3.11 日本東北海嘯模擬
Simulation on 2011.3.11 Tohoku tsunami
Tsunami recorded in Hong Kong

13:41 UTC
### Tide Gauge in Hong Kong

<table>
<thead>
<tr>
<th>Location</th>
<th>Predicted Tsunami Arrival Time (UTC)</th>
<th>Actual Tsunami Arrival Time (UTC)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Waglan</td>
<td>13:09</td>
<td>13:16</td>
</tr>
<tr>
<td>Quarry Bay</td>
<td>13:38</td>
<td>13:29</td>
</tr>
<tr>
<td>Tai Miu Wan</td>
<td>13:44</td>
<td>13:27</td>
</tr>
<tr>
<td>Shek Pik</td>
<td>13:50</td>
<td>13:41</td>
</tr>
</tbody>
</table>
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Tsunami Warning System in Hong Kong

- **Tsunami warnings** will be issued to the public if a significant tsunami (height of 0.5+ m above the normal tide level) is expected to arrive in Hong Kong within 3 hours.

- For significant tsunamis that are not expected to reach Hong Kong in 3 hours or insignificant, a **Tsunami Information Bulletin** will be issued to notify members of the public.
OVERVIEW OF HONG KONG TSUNAMI WARNING SYSTEM

THREAT / INFORMATION from PTWC /NWPTAC/ SCSTAC

HKO to gather information & conduct assessment and monitoring

HKO analysis using Antelope, SeiscomP3, COMCOT

Tsunami Information Bulletin (no immediate action)

M>=6.5 in SCS, or M>=7.5 in Pacific

Tsunami Warning

H ≥ 0.5m in 3 hrs

HKSARG Emergency Monitoring and Support Centre (EMSC) to coordinate response & evacuation

H ≥ 0.5m in 3 hrs or H ≥ 0.5m beyond 3 hrs

Information Services Department

Local TV and Radio stations

HKO web page and social networking platforms e.g. Twitter, Weibo

XML for special users incl. public utilities

Public to take note of the info. or to take actions

Police

Fire Service

Hospital Authority, …

Remark
HKO sends out messages through various channels including FTP, HTTP, FAX, SMS and social networking platforms
Tsunami Information and Warning

There is no Tsunami Information Bulletin or Tsunami Warning in force.

For Tsunami Information and Warning in the past three months, click here.

http://www.weather.gov.hk/gts/equake/tsunami_info_warn_e.htm

PRESS WEATHER NO. 170 - TSUNAMI INFORMATION BULLETIN

TSUNAMI INFORMATION BULLETIN

TSUNAMI INFORMATION BULLETIN UPDATED BY THE HONG KONG OBSERVATORY AT 10:00 P.M. ON 11 MAR 2011.


THE TSUNAMI GENERATED BY THE EARTHquake MAINLY AFFECTS THE PACIFIC. AFFECTED BY THE TSUNAMI, THE SEA LEVEL IN PARTS OF THE TERRITORY IN HONG KONG ROSE SLIGHTLY IN THE PAST HOUR.

THE LATEST TSUNAMI HEIGHTS RECORDED IN HONG KONG:
ABOUT 0.1 M AT WAGLAN
ABOUT 0.1 M AT QUARRY BAY
ABOUT 0.2 M AT TAI MIU WAN

IT IS EXPECTED THAT THE SEA LEVEL RISE IN HONG KONG WOULD BE LESS THAN HALF A METRE, WHICH IS MUCH LOWER THAN THE NORMAL DAY-TO-DAY TIDAL VARIATION OF ABOUT ONE METRE.

PRECAUTIONARY ANNOUNCEMENT:

1. PLEASE STAY TUNED TO THE RADIO OR TELEVISION FOR FURTHER INFORMATION.

DISPATCHED BY HONG KONG OBSERVATORY AT 22:07 HKT ON 11.03.2011
Contingency Plan for Earthquake and Tsunami


CONTINGENCY PLAN FOR NATURAL DISASTERS
(INCLUDING THOSE ARISING FROM SEVERE WEATHER CONDITIONS)

Emergency Support Unit
Security Bureau
Government Secretariat
July 2009

File Ref. SEC 8/3/12 Part 30

The Government’s Contingency Plan for Natural Disasters can be accessed via the website of Security Bureau (http://www.sb.gov.hk/). Actions to be taken during tsunami situation are given in section 6.4 of the plan. In the event of a damaging earthquake or other unspecified serious scenarios affecting Hong Kong, the Emergency Monitoring and Support Centre of the Security Bureau will be activated to coordinate necessary response actions to be taken by various government departments.

The latest earthquake reports issued by the Hong Kong Observatory are given at:
http://www.hko.gov.hk/gts/eqquake/eqreports_e.htm

The latest tsunami warnings and tsunami information bulletins are given at:
http://www.hko.gov.hk/gts/eqquake/tsunami_info_war_e.htm

Earthquake safety rules are available at:
http://www.hko.gov.hk/gts/eqquake/eq_safety_e.htm

Tsunami precautions are available at:
http://www.hko.gov.hk/gts/eqquake/tsunami_precautions_e.htm
Thank you