



Intergovernmental  
Oceanographic  
Commission



UNESCO/IOC – NOAA ITIC Training Program in Hawaii (ITP-Hawaii)  
TSUNAMI EARLY WARNING SYSTEMS  
AND THE PACIFIC TSUNAMI WARNING CENTER (PTWC) ENHANCED PRODUCTS  
TSUNAMI EVACUATION PLANNING AND UNESCO IOC TSUNAMI READY PROGRAMME  
7-18 August 2023, Honolulu, Hawaii USA

# PTWC Enhanced Products - Why, What, Criteria, Staging

**Web site:** [http://itic.ioc-unesco.org/index.php?option=com\\_content&view=category&layout=blog&id=2548&Itemid=2582](http://itic.ioc-unesco.org/index.php?option=com_content&view=category&layout=blog&id=2548&Itemid=2582)

Dr. Laura Kong  
Director, ITIC, USA, NOAA

Dr. Charles McCreery  
Director, PTWC, USA NOAA



# ITIC Training – videos

## TSUNAMI TRAINING

Videos on Tsunami Warning Operations, including from the Pacific Tsunami Warning Center

**Pacific Tsunami Warning Center (PTWC)**  
Graphical Tsunami Forecast Products for the PTWS

Dr. Charles "Chip" McCreery  
Director, PTWC

22:10

EN - PTWC Products, Pacific - ...

ITIC

**Pacific Tsunami Warning Center (PTWC)**  
Graphical Tsunami Forecast Products for the PTWS

Dr. Charles "Chip" McCreery  
Director, PTWC

22:10

EN - PTWC Products, Pacific - ...

ITIC

**Pacific Tsunami Warning Center (PTWC)**  
Graphical Tsunami Forecast Products for the PTWS

Dr. Charles "Chip" McCreery  
Director, PTWC

22:13

SP - PTWC

ITIC

unesco  
National Oceanic and Atmospheric Administration  
Servicio Hidrográfico y Oceanográfico de la Armada de Chile  
International Tsunami Information Center

UNESCO IOC / NOAA  
International Tsunami Information Center  
Tsunami Training Video, November 2022

**Pacific Tsunami Warning Center (PTWC)**  
What happens for a Pacific earthquake?

Dr. Charles "Chip" McCreery  
Director, PTWC

unesco  
National Oceanic and Atmospheric Administration  
Servicio Hidrográfico y Oceanográfico de la Armada de Chile  
International Tsunami Information Center

UNESCO IOC / NOAA  
International Tsunami Information Center  
Tsunami Training Video, August 2022

**Pacific Tsunami Warning Center (PTWC)**  
Product Staging from the earthquake, through data collection and analyses, to tsunami forecasting, and product generation and dissemination

10:09

EN - PTWC Product Staging, ...

ITIC

unesco  
National Oceanic and Atmospheric Administration  
Servicio Hidrográfico y Oceanográfico de la Armada de Chile  
International Tsunami Information Center

UNESCO IOC / NOAA  
International Tsunami Information Center  
Tsunami Training Video, November 2022

**Pacific Tsunami Warning Center (PTWC)**  
What happens for a Pacific earthquake?

Dr. Charles "Chip" McCreery  
Director, PTWC

18:59

EN - PTWC TWS Ops - Pacific...

ITIC

## ITIC / Collections / Showcases

Sort: Date | Alphabetical | Videos | Duration



BROWSE SHOWCASES

Showcases help you organize your videos, or create and share curated playlists of other videos on Vimeo.

ALSO CHECK OUT

More stuff from ITIC

65 Videos

17 Collections

HAWAII

KAHOOT

CaribeWave  
3 Videos / 05:40

2022 JANUARY 15 TONGA EVENT

IOC Wave Exercises:  
Exercise  
PacWave  
5 Videos / 5:27:44

TSUNAMI TRAINING

2021 MARCH 4 KERMADEC EVENT

Tsunami Ready

<https://vimeo.com/showcase/8956022>  
Password: training



UNESCO/IOC-NOAA SHOA  
International Tsunami Information Center



Intergovernmental  
Oceanographic  
Commission



UNESCO/IOC – NOAA ITIC Training Program in Hawaii (ITP-Hawaii)  
TSUNAMI EARLY WARNING SYSTEMS  
AND THE PACIFIC TSUNAMI WARNING CENTER (PTWC) ENHANCED PRODUCTS  
TSUNAMI EVACUATION PLANNING AND UNESCO IOC TSUNAMI READY PROGRAMME  
7-18 August 2023, Honolulu, Hawaii USA

# PTWC Enhanced Products – Use of Public Text Message

---

Charles McCreery, Stuart Weinstein  
NOAA Pacific Tsunami Warning Center

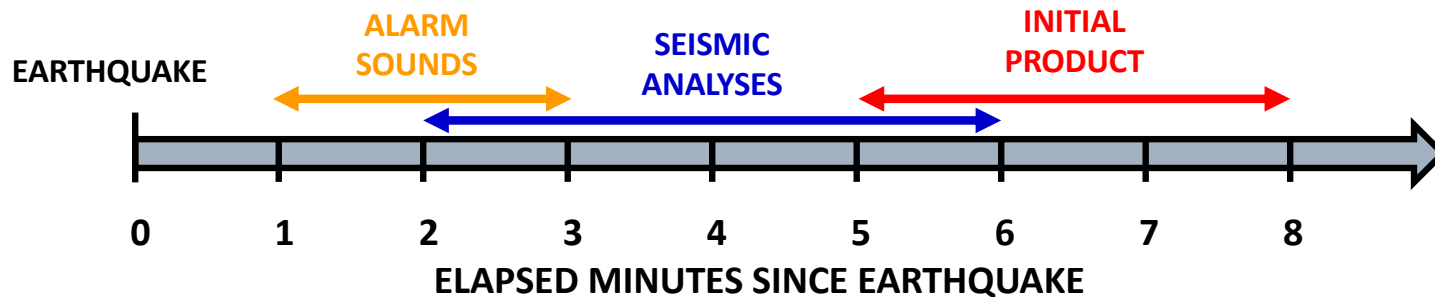
Laura Kong \*

UNESCO/IOC – NOAA International Tsunami Information Center



\*presenter

# Timeline of PTWC Activities – Initial Product



0 min	A large <b>earthquake occurs</b> .
1 - 3 min	Vibrations from the earthquake reach seismic stations near the earthquake epicenter, triggering <b>event alarms at PTWC</b> . PTWC duty analysts respond to the operations center and begin to analyze the event. [PTWC currently monitors 700+ seismic stations from around the world, with data collected at most of those stations reaching PTWC within a minute of when it is collected.]
2 - 6 min	Using a combination of automatic and interactive analyses, duty analysts complete their <b>preliminary determination of the earthquake epicenter, depth, and magnitude</b> .
5 - 8 min	If criteria are met, then an <b>initial product is issued</b> that is either a Tsunami Information Statement or a Tsunami Threat Message.

# Public Text message

## Information Statement

- No Threat
- No Action

*PTWC guidance  
information  
to Country  
TWFP/NTWC*

### A. Tsunami Information Statement (no tsunami threat)

#### a. Initial Product (text only)

##### i. Text Product

ZCZC  
WEPA42 PHEB 010008  
TIBPAC

TSUNAMI INFORMATION STATEMENT NUMBER 1  
NWS PACIFIC TSUNAMI WARNING CENTER EWA BEACH HI  
0008 UTC WED OCT 1 2014

...TSUNAMI INFORMATION STATEMENT...

\*\*\*\* NOTICE \*\*\*\* NOTICE \*\*\*\* NOTICE \*\*\*\* NOTICE \*\*\*\* NOTICE \*\*\*\*

THIS STATEMENT IS ISSUED FOR INFORMATION ONLY IN SUPPORT OF THE  
UNESCO/IOC PACIFIC TSUNAMI WARNING AND MITIGATION SYSTEM AND IS  
MEANT FOR NATIONAL AUTHORITIES IN EACH COUNTRY OF THAT SYSTEM.

NATIONAL AUTHORITIES WILL DETERMINE THE APPROPRIATE LEVEL OF  
ALERT FOR EACH COUNTRY AND MAY ISSUE ADDITIONAL OR MORE REFINED  
INFORMATION.

\*\*\*\* NOTICE \*\*\*\* NOTICE \*\*\*\* NOTICE \*\*\*\* NOTICE \*\*\*\* NOTICE \*\*\*\*

#### PRELIMINARY EARTHQUAKE PARAMETERS

-----  
\* MAGNITUDE           6.7  
\* ORIGIN TIME        0000 UTC OCT 1 2014  
\* COORDINATES        20.0 SOUTH 173.4 WEST  
\* DEPTH              178 KM / 111 MILES  
\* LOCATION           TONGA

#### EVALUATION

-----  
\* AN EARTHQUAKE WITH A PRELIMINARY MAGNITUDE OF 6.7 OCCURRED  
IN THE TONGA ISLANDS AT 0000 UTC ON WEDNESDAY OCTOBER 1 2014.  
  
\* BASED ON ALL AVAILABLE DATA... THERE IS NO TSUNAMI THREAT  
FROM THIS EARTHQUAKE.

#### RECOMMENDED ACTIONS

-----  
\* NO ACTION IS REQUIRED.

#### NEXT UPDATE AND ADDITIONAL INFORMATION

-----

# Public Text message – Threat Message

## 1<sup>st</sup> Message

- Threat
- Take Action
- EQ-based

*PTWC guidance  
information to  
Country TWFP/NTWC*

TSUNAMI MESSAGE NUMBER 1  
NWS PACIFIC TSUNAMI WARNING CENTER EWA BEACH HI  
0005 UTC TUE SEP 8 2015

...TSUNAMI THREAT MESSAGE...

\*\*\*\* NOTICE \*\*\*\* NOTICE \*\*\*\* NOTICE \*\*\*\* NOTICE \*\*\*\* NOTICE \*\*\*\*

THIS MESSAGE IS ISSUED FOR INFORMATION ONLY IN SUPPORT OF THE  
UNESCO/IOC PACIFIC TSUNAMI WARNING AND MITIGATION SYSTEM AND IS  
MEANT FOR NATIONAL AUTHORITIES IN EACH COUNTRY OF THAT SYSTEM.

NATIONAL AUTHORITIES WILL DETERMINE THE APPROPRIATE LEVEL OF  
ALERT FOR EACH COUNTRY AND MAY ISSUE ADDITIONAL OR MORE REFINED  
INFORMATION.

\*\*\*\* NOTICE \*\*\*\* NOTICE \*\*\*\* NOTICE \*\*\*\* NOTICE \*\*\*\* NOTICE \*\*\*\*

PRELIMINARY EARTHQUAKE PARAMETERS

-----  
\* MAGNITUDE            8.2  
\* ORIGIN TIME         0000 UTC SEP 8 2015  
\* COORDINATES        10.0 SOUTH 165.0 EAST  
\* DEPTH                20 KM / 12 MILES  
\* LOCATION            SANTA CRUZ ISLANDS

EVALUATION

-----  
\* AN EARTHQUAKE WITH A PRELIMINARY MAGNITUDE OF 9.0 OCCURRED IN  
THE SANTA CRUZ ISLANDS AT 0000 UTC ON TUESDAY SEPTEMBER 8  
2015.

\* BASED ON THE PRELIMINARY EARTHQUAKE PARAMETERS... WIDESPREAD  
~~HAZARDOUS TSUNAMI WAVES ARE POSSIBLE.~~

TSUNAMI THREAT FORECAST

-----  
\* HAZARDOUS TSUNAMI WAVES FROM THIS EARTHQUAKE ARE POSSIBLE  
WITHIN THE NEXT THREE HOURS ALONG SOME COASTS OF

SOLOMON ISLANDS... VANUATU... NAURU... PAPUA NEW GUINEA...  
TUVALU... KOSRAE... NEW CALEDONIA... MARSHALL ISLANDS...  
WALLIS AND FUTUNA AND HOWLAND AND BAKER

# Public Text message – Threat Message

## 2<sup>nd</sup>-3<sup>rd</sup> Message

- Threat
- Take Action
- Wave Forecast

*PTWC guidance  
information to  
Country TWFP/NTWC*

TSUNAMI MESSAGE NUMBER 2  
NWS PACIFIC TSUNAMI WARNING CENTER EWA BEACH HI  
0025 UTC TUE SEP 8 2015

...TSUNAMI THREAT MESSAGE...

\*\*\*\* NOTICE \*\*\*\* NOTICE \*\*\*\* NOTICE \*\*\*\* NOTICE \*\*\*\* NOTICE \*\*\*\*

THIS MESSAGE IS ISSUED FOR INFORMATION ONLY IN SUPPORT OF THE  
UNESCO/IOC PACIFIC TSUNAMI WARNING AND MITIGATION SYSTEM AND IS  
MEANT FOR NATIONAL AUTHORITIES IN EACH COUNTRY OF THAT SYSTEM.

NATIONAL AUTHORITIES WILL DETERMINE THE APPROPRIATE LEVEL OF  
ALERT FOR EACH COUNTRY AND MAY ISSUE ADDITIONAL OR MORE REFINED  
INFORMATION.

\*\*\*\* NOTICE \*\*\*\* NOTICE \*\*\*\* NOTICE \*\*\*\* NOTICE \*\*\*\* NOTICE \*\*\*\*

PRELIMINARY EARTHQUAKE PARAMETERS

-----  
\* MAGNITUDE 9.0  
\* ORIGIN TIME 0000 UTC SEP 8 2015  
\* COORDINATES 10.0 SOUTH 165.0 EAST  
\* DEPTH 20 KM / 12 MILES  
\* LOCATION SANTA CRUZ ISLANDS

EVALUATION

-----  
\* AN EARTHQUAKE WITH A PRELIMINARY MAGNITUDE OF 9.0 OCCURRED IN  
THE SANTA CRUZ ISLANDS AT 0000 UTC ON TUESDAY SEPTEMBER 8  
2015.  
\* BASED ON ALL AVAILABLE DATA... HAZARDOUS TSUNAMI WAVES ARE  
FORECAST FOR SOME COASTS.

TSUNAMI THREAT FORECAST...UPDATED

-----  
\* TSUNAMI WAVES REACHING MORE THAN 3 METERS ABOVE THE TIDE  
LEVEL ARE POSSIBLE ALONG SOME COASTS OF  
AUSTRALIA... NEW CALEDONIA... VANUATU... SOLOMON ISLANDS...  
AND PAPUA NEW GUINEA.  
\* TSUNAMI WAVES REACHING 1 TO 3 METERS ABOVE THE TIDE LEVEL ARE  
POSSIBLE ALONG SOME COASTS OF

NEW ZEALAND... CHUUK... FIJI... KIRIBATI... TONGA... AND



UNESCO/IOC – NOAA ITIC Training Program in Hawaii (ITP-Hawaii)  
TSUNAMI EARLY WARNING SYSTEMS  
AND THE PACIFIC TSUNAMI WARNING CENTER (PTWC) ENHANCED PRODUCTS  
TSUNAMI EVACUATION PLANNING AND UNESCO IOC TSUNAMI READY PROGRAMME  
7-18 August 2023, Honolulu, Hawaii USA

# PTWC Enhanced Products Guidance for National Warnings and Evaluation: Land and Marine Threats and Public Safety

---

Laura Kong  
International Tsunami Information Center

Charles McCreery  
Pacific Tsunami Warning Center





# Country NTWC tsunami event - Key SOPs:

---

- **Alert Criteria Table.** Gives alert thresholds and **Emergency Response actions**  
(TSP-SCS Guidance 2018; PTWC Enhanced Products User's Guide App VI, VIII)
  - **Message templates and Checklists** Facilitates quick standard responses. Checklists remind Duty Staff
  - **Communication Flow Chart.** Shows primary agencies / stakeholders of warning chain (TSP => Natl / Local Warning / Emergency Authorities => Public)
  - **Timeline-driven SOPs.** Describe by Time, Who, What, How, and To whom.
- => Exercises** practice / improve TWC / TER SOPs

# Alert Criteria Table

---

- **Thresholds** are used to assign Alert Levels (Warning, Advisory, Watch, Information)
- **Alert Levels** correspond to country's
  - Forecast Maximum Coastal Wave Amplitude and/or Earthquake Magnitude, along with
  - Estimated time to first impact and certainty or confirmation of forecast
- **Emergency Response Actions** correspond to Alert Level

## Simple Criteria Table

---

Countries can further customize by assigning different thresholds for different source regions. 2 cases:

- **NO TSP QUANTITATIVE FORECAST**

TSP Information Statement or Threat Message issued within 10 minutes after M6.5+ earthquake.

- **TSP QUANTITATIVE FORECAST**

TSP Threat Message issued 10 minutes to 1 hour after a large earthquake with tsunamigenic potential

- Warning / Watch Alerts (1.0 m threshold)

- Warning / Advisory / Watch Alerts (0.3 / 1.0 m thresholds)

# PTWC, NWPTAC, SCSTAC

## Alert Criteria Table: OT + 8-10 min – Case 1

### 1. CRITERIA TABLE - NO QUANTITATIVE TSP FORECAST PRODUCT

Criteria Table for NTWC tsunami alerts and emergency response actions based upon the initial TSP product, typically issued within 10 minutes of any large South China Sea region earthquake, prior to the computation of a quantitative tsunami forecast. Key criteria for each situation are indicated in bold red letters.

TSP Product Type	Earthquake Parameters	Potential Tsunami Type	Are Possible Hazardous Tsunami Waves Indicated for Your Country or Area	Threatened Coast	Time left to Initial Wave Arrival (ETA)	NTWC Alert Level for Threatened Coast	Emergency Response Action
<b>PTWC Information</b> <b>NWPTA</b> <b>SCSTAC Information</b>	Magnitude of 6.5-7.0, or on land, or $\geq 100$ km depth	None or Very Minor	No	None	Not applicable	INFORMATION	No action required
<b>PTWC Threat</b> <b>NWPTA</b> <b>SCSTAC Threat</b>	<b>Magnitude of 7.1-7.5</b> , undersea or very near the sea, and $< 100$ km depth	Local Tsunami	<b>Yes</b>	$< 300$ km from earthquake	$< 1$ hour typical	WARNING	Evacuate threatened coast
			<b>No</b>	$\geq 300$ km from earthquake	$> 1$ hour typical	INFORMATION	Monitor subsequent messages
	<b>Magnitude of 7.6 and greater</b> , undersea or very near the sea, and $< 100$ km depth	Regional Tsunami	<b>Yes</b>	$< 1000$ km from earthquake	<b><math>&lt; 3</math> hours</b>	WARNING	Evacuate threatened coast
			<b>Yes</b>	$\geq 1000$ km from earthquake	<b>3 to 6 hours</b>	WATCH	Prepare to evacuate
<b>No</b>	$\geq 1000$ km from earthquake	<b><math>&gt; 6</math> hours</b>	INFORMATION	Monitor subsequent messages			

#### NOTES for 1., 2A, 2B:

- In a local tsunami situation, in order to provide the fastest alert, earthquake magnitude criteria should be used. Issuance of a Warning, Watch, or Information is dependent on the size of the earthquake and its closeness to coastlines. Smaller magnitude earthquakes that are closer to the coast may warrant issuance of a Warning.
- Local tsunami criteria based solely on magnitude should be determined after examining a country historical earthquake tsunami hazard. In some places, the local tsunami magnitude threshold may need to be lower than M7.1. The M7.1 threshold is used by PTWC for its Caribbean Tsunami Watch Service and was used by the PTWC for its Indian Ocean Tsunami Watch Service.
- The 3-hour time criteria is based on the amount of time required for a country to safely complete a coastal evacuation. The 3-hr threshold used by PTWC is considered a conservative, but reasonable time criteria. Historically, the value is from a requirement from Hawaii State Emergency Management Agency as the time required to safely evacuate all coasts of the State of Hawaii. Each country should consider their situation.
- The 6-hour time criteria is based on the amount of time required for a country to activate its emergency response personnel to be able to carry out an orderly evacuation. The 6-hr threshold used by PTWC is considered a conservative, but reasonable time criteria. Historically, the value is from a requirement from Hawaii State Emergency Management Agency as the time required, given the location of likely tsunami sources that will impact Hawaii. Each country should consider their situation.

# PTWC, NWPTAC, SCSTAC

## Alert Criteria Table: OT + 8-50 min – Case 2A

### CASE 2A, 2B: TSP FORECAST AVAILABLE

Earthquake: Magnitude 7.1 or greater, undersea or very near the sea, and < 100 km depth

#### 2.A. CRITERIA TABLE – QUANTITATIVE TSP FORECAST PRODUCT:

Warning / Watch Alerts (1.0 m threshold)

Criteria Table for NTWC tsunami alerts and emergency response actions based upon TSP messages that includes a quantitative tsunami forecast typically issued between 8 minutes to one hour after a large South China Sea region earthquake with a tsunami-genic potential. Key criteria for each situation are indicated in bold red letters. This uses the same criteria (> 1 m) used by PTWC until September 30, 2014 to designate Warning/Watch alert levels.

**Threat Level Criteria Table (1m Warning threshold)**

TSP Product Type	TSP Forecast of Maximum Coastal Amplitude	Country's Threat Level	Estimated Time of Wave Arrival (ETA)	Emergency Response Action
PTWC Threat NWPTA SCSTAC Threat	H >= 1 m	WARNING	< 3 hours	Evacuate tsunami evacuation zones
PTWC Threat NWPTA SCSTAC Threat	H >= 1 m	WATCH	3 to 6 hours	Prepare to evacuate
PTWC Threat NWPTA SCSTAC Threat	H >= 1 m	INFORMATION	> 6 hours	Monitor event, alert EM stakeholders
PTWC Threat or Information NWPTA SCSTAC Threat or Information	H < 1 m	INFORMATION		No Action
PTWC Threat	H >= 1 m at distant coastline	Determine from distant tsunami threat: PTWC message nbr 1	> 3 hours	Monitor event, alert EM stakeholders

# PTWC, NWPTAC, SCSTAC

## Alert Criteria Table: OT + 8-50 min – Case 2A

**Threat Level Criteria Table (0.3m Advisory, 1m Warning threshold)**

TSP Product Type	TSP Forecast Coastal Amplitude	Country's Threat Level	Estimated Time of Wave Arrival (ETA)	Emergency Response Action
<b>PTWC Threat</b> <b>NWPTA</b> <b>SCS Threat</b>	<b>H &gt;= 1 m</b>	<b>WARNING</b>	<b>&lt; 3 hours</b>	<b>Evacuate tsunami evacuation zones</b>
<b>PTWC Threat</b> <b>NWPTA</b> <b>SCS Threat</b>	<b>0.3 m &lt;= H &lt; 1 m</b>	<b>ADVISORY</b>	<b>&lt; 3 hours</b>	<b>Clear Beaches, low lying coastal areas, harbors, waterways</b>
<b>PTWC Threat</b> <b>NWPTA</b> <b>SCSTAC Threat</b>	<b>H &gt;= 0.3 m</b>	<b>WATCH</b>	<b>3 to 6 hours</b>	<b>Prepare to evacuate</b>
<b>PTWC Threat</b> <b>NWPTA</b> <b>SCSTAC Threat</b>	<b>H &gt;= 0.3 m</b>	<b>INFORMATION</b>	<b>&gt; 6 hours</b>	<b>No Action</b>
<b>PTWC Information</b> <b>NWPTA</b> <b>SCSTAC Information</b>	<b>H &lt; 0.3 m</b>	<b>INFORMATION</b>		<b>No Action</b>
<b>PTWC Threat</b>	<b>H &gt;= 1 m at distant coastline</b>	<b>Determine from distant tsunami threat: PTWC message nbr 1</b>	<b>&gt; 3 hrs</b>	<b>Monitor event, alert EM stakeholders</b>

**2.B. CRITERIA TABLE – QUANTITATIVE TSP FORECAST PRODUCT:**  
Warning / Advisory Watch Alerts (0.3 / 1.0 m thresholds)

Criteria Table for NTWC tsunami alerts and emergency response actions based upon TSP messages that includes a quantitative tsunami forecast typically issued between 8 minutes to one hour after a large South China Sea region earthquake with a tsunami-genic potential. Key criteria for each situation are indicated in bold red letters. This adds another NTWC alert level; the Advisory corresponds to a lower level of Warning, and calls for evacuating the beaches and harbors only.

Laboratory studies complementing empirical structural damage and casualty data collected from recent tsunamis show that tsunami inundation or flow depths of less than one meter, and as small as tens of centimeters, can be dangerous and destructive (e.g., Arikawa et al., 2006; Suppasri et al., 2013)<sup>1,2</sup>. The data suggest that a lower level of warning for a marine threat may be desirable. The response to this lower level of warning would be for people to avoid beaches and low-lying coastal areas, and for vessels in harbors and waterways to take precaution against unusually strong water currents. This lower level of warning is used in the United States, and is termed an Advisory. In an Advisory status, a full scale land

## ENHANCED PRODUCTS GUIDANCE: FORECAST => WARNING => EVACUATION

- **Amplitude  $\geq 3$  m    WARNING**  
=> *Major Land Threat:*  
*Evacuate Tsunami Coastal Evacuation Zones*
- **1 m  $\leq$  Amplitude < 3 m    WARNING**  
=> *Land Threat:*  
*Evacuate Tsunami Coastal Evacuation Zones*
- **0.3 m  $\leq$  Amplitude < 1 m    ADVISORY**  
=> *Marine Threat:*  
*Clear beaches, harbors, low lying coastal areas*
- **Amplitude < 0.3 m => No Threat, No Evacuation**
- **Value not computed => Monitor Event**

# ADVISORY - Marine Threat – CLEAR BEACH

---



*Eddies generated by the interactions of tsunami waves as they hit the coast of Sri Lanka, 26 December 2004. Photo courtesy of Digital Globe.*



# ADVISORY – Marine Threat - Harbors

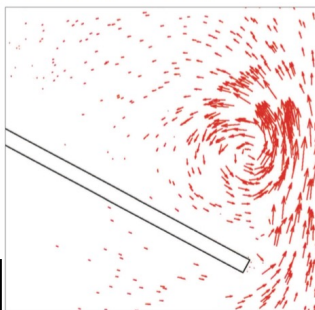
**2011 Japan tsunami  
Crescent City, CA  
USA**



Crescent City, California boat harbor damage after the 2011 Japan tsunami. Strong wave currents entering the enclosed harbor (from top of photo) formed an eddy, which was left in the sediment swirls. The tsunami caused USD \$55 million in damage to moorings and vessels in two dozen harbors in California. (Credit: R. Hiser and L. Dengler)

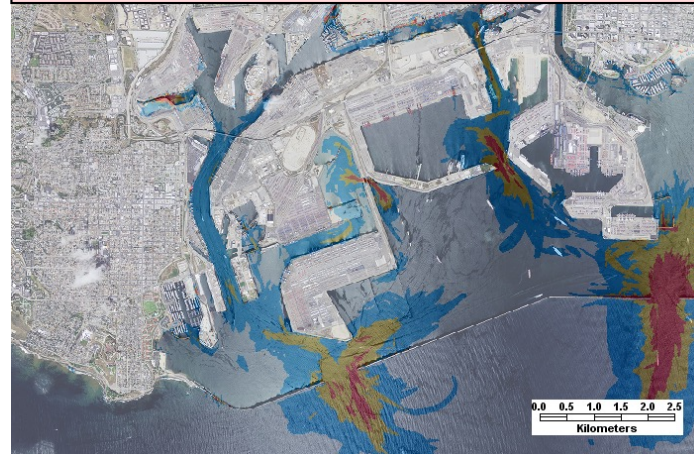


**Wave Tank -  
modeling**



Numerical model of eddy forming around breakwater long pier. The length of each arrow is proportional to the current speed. (Credit: Univ. of Southern California)

**M9.2 Alaska-Aleutian Scenario  
Los Angeles / Long Beach, CA USA**



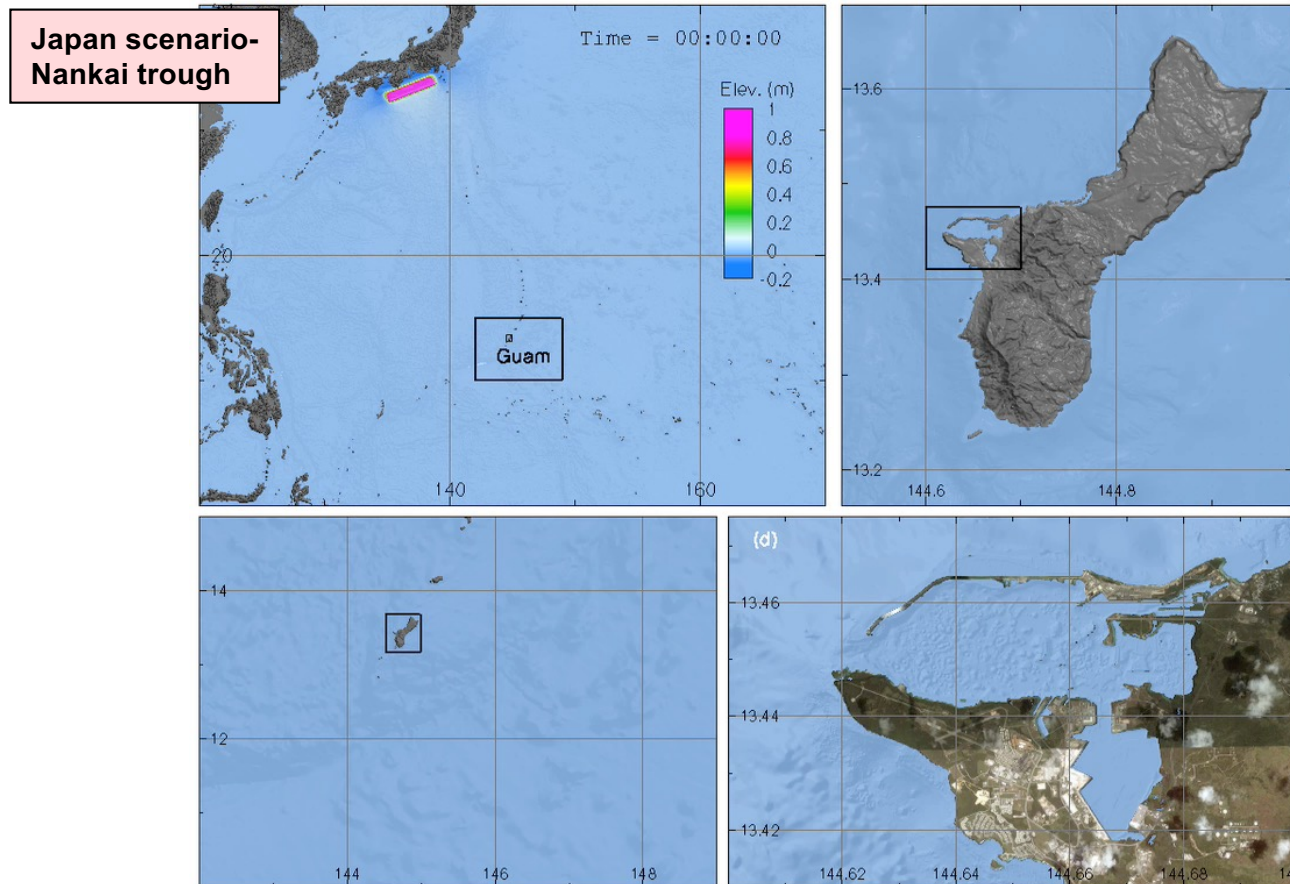
Wilson et al, US NTHMP (2016)

Current Thresholds for Potential Damage

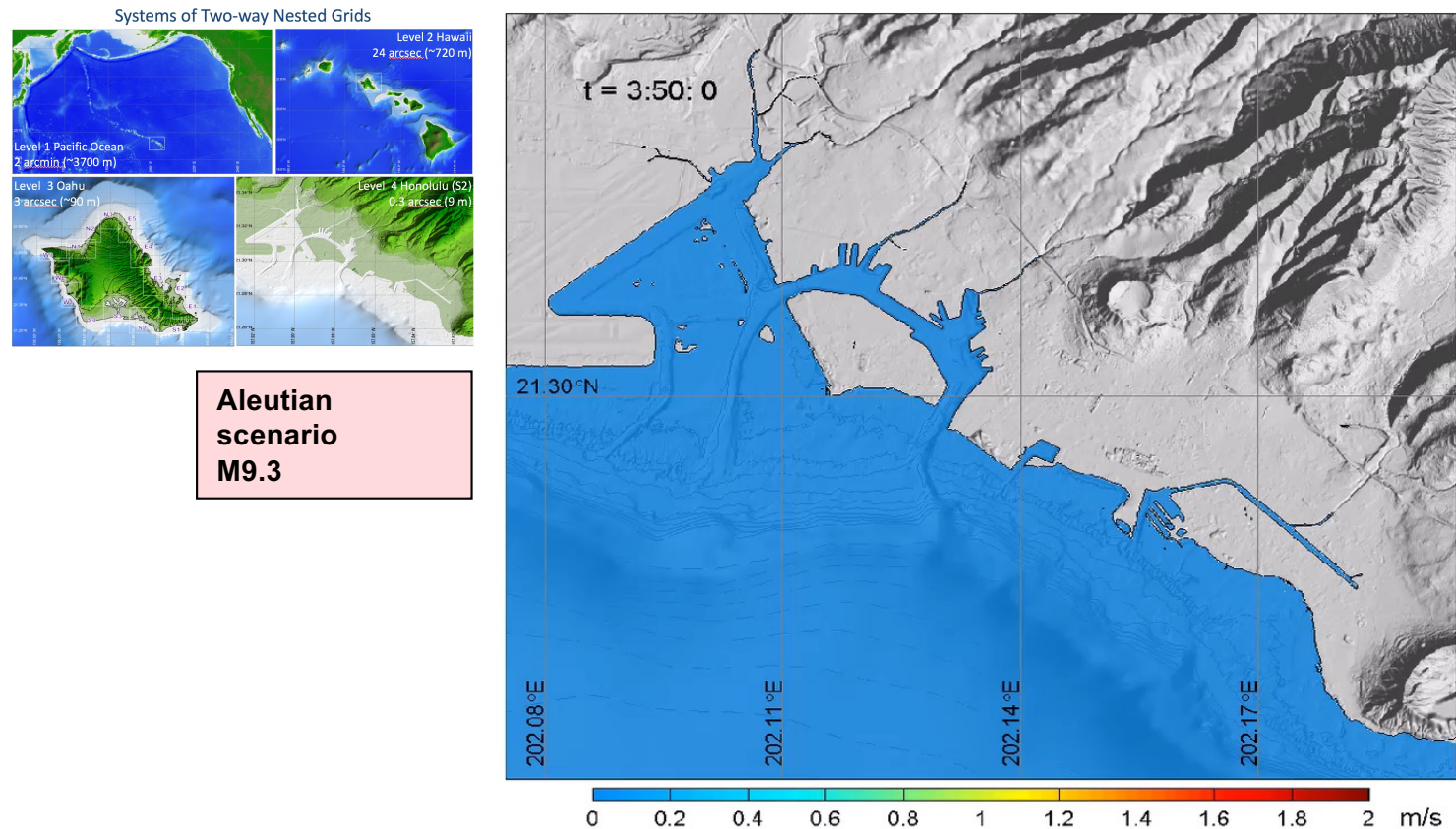
- Minor to moderate damage
- Moderate to major damage
- Major damage/complete destruction

*Pacific Tsunami Warning System:  
A Half-Century of Protecting the Pacific (1965-2015)  
NOAA, ITIC, NCEI, 2015*

# Apra Harbor, Guam – modeling wave ampl

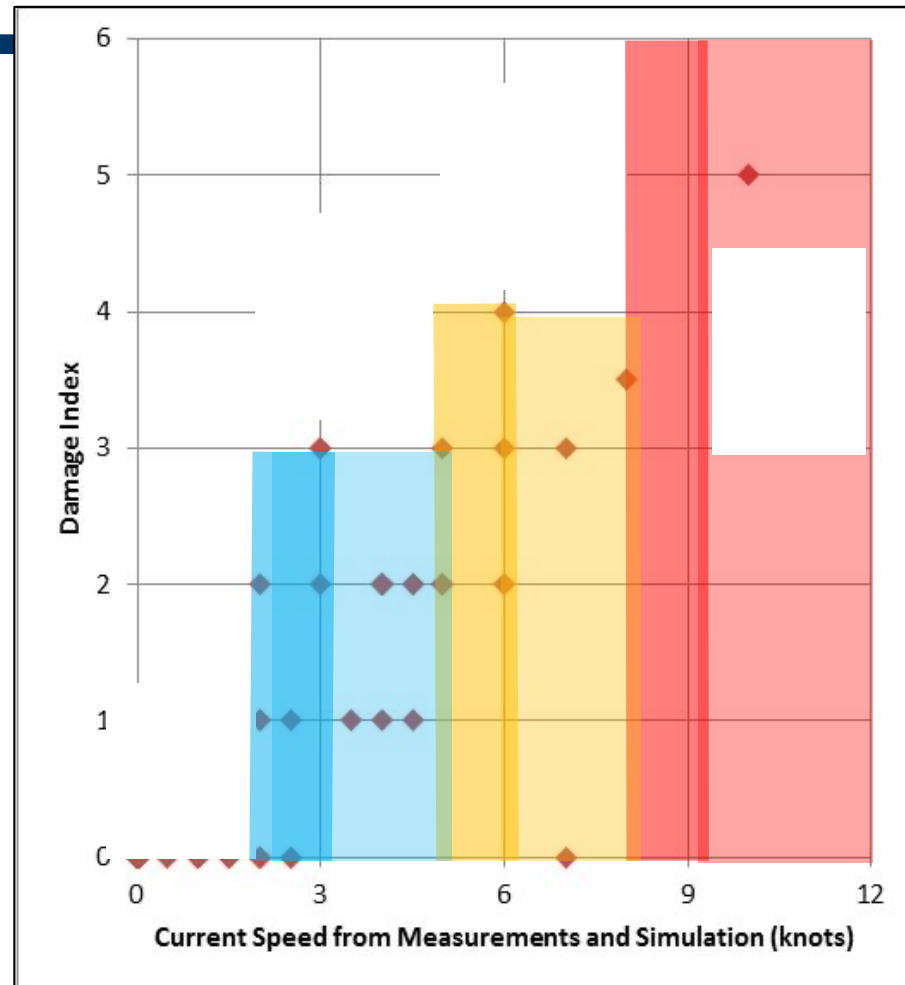


# Honolulu Harbor, Hawaii – modeling currents



# Tsunami Current Hazard

Damage Index:	Damage Type:
0	no damage
1	small buoys moved
2	1-2 docks/small boats damaged, large buoys moved
3	Moderate dock/boat damage, mid-sized vessels off moorings
4	Major dock/boat damage, large vessels off moorings
5	Complete destruction



Lynett et al. (2013)

# WARNING - Minor Land Threat – EVACUATE

---



# **WARNING - Major Land Threat - EVACUATE**

---



# Message Products for Alert Levels

---

- **User's Guide – Appendix VII**
- **Emphasize NTWC and NDMO/DMO are authorities**, not PTWC or other international
- **Create Templates for easy fill-in**  
(or automatically fill-in with incoming PTWC message). Basic text does not change.  
Duty Staff only need to fill in event information.
- **Include Review option:** If automated process or GUI used, need to make sure there are 'REVIEW BEFORE SEND' and 'MANUAL ENTRY' options

# Message Products for Alert Levels

---

- **Mimic PREVIOUS PTWC Text Bulletin (Warning, Watch, Information)**
- **Structure:** Header, EQ Info, Evaluation, Forecast (if applicable), Recommended Actions (depending on Threat Level), ETA, Potential Impacts, Tsunami Observations, Next Update and Additional Info
- **Customize for country**
  - Use Local Time
  - Replace PTWC with Country's NTWC
  - Retain only country locs (for threat, ETA). Delete other
  - Specify Local Authority for Public Safety Action (Evacuation), Contact info / how to obtain evac status
  - Specify update schedule



# New Products – Sharing of TWFP products

---

**Decide whether to share Graphical Products (currently only to TWFP by email)**

- Which Products to share
- To Whom
- Should products be adjusted / customized before sharing?
- Need to socialize/train for shared products

# NTWC – TER SOPS

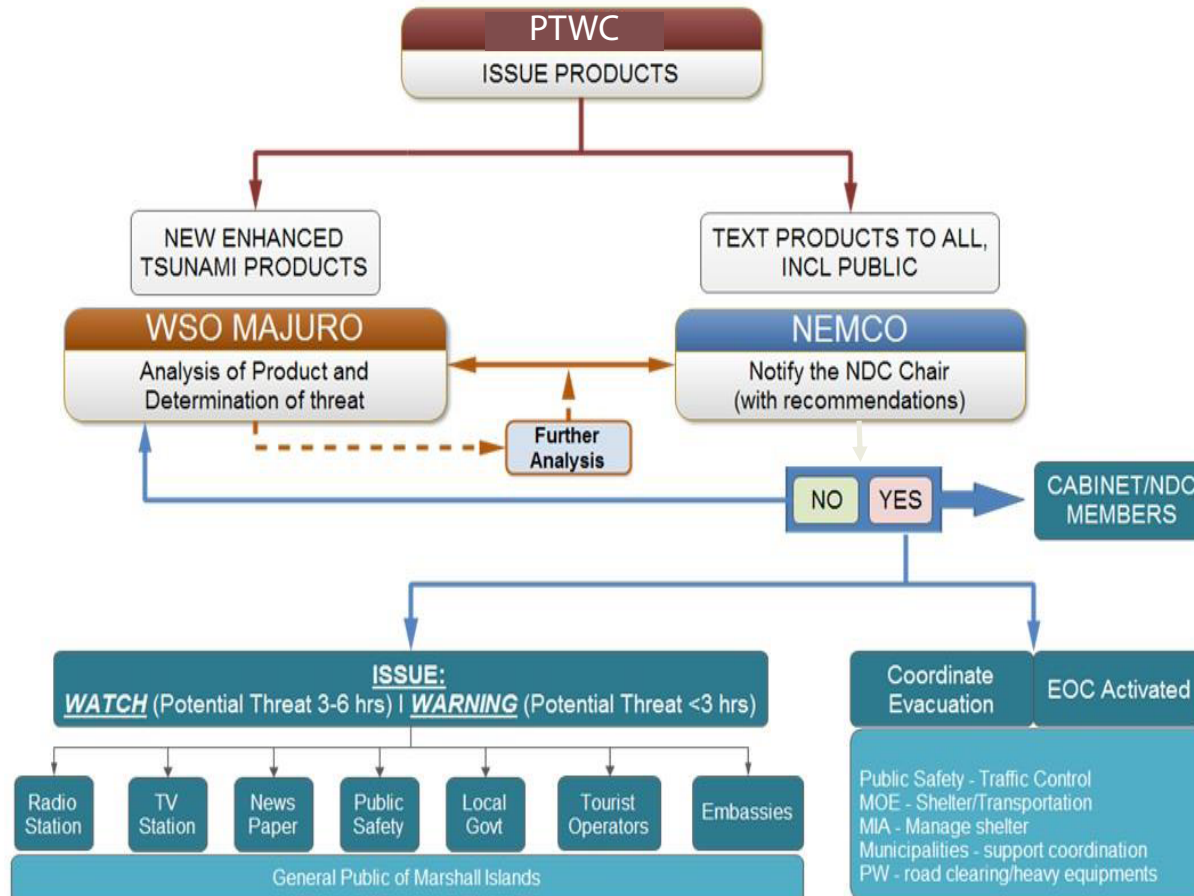
---

- **Identify Stakeholders. Specify roles.**
- **Describe end-to-end (detection to evacuation)**
- **Warning Communication Flow Chart**
  - Who does What
  - Distant / Regional – Local
  - Warning, Watch, Information Alerts
- **Timeline-driven SOPs**
  - Who does What and When
  - Time, Products, Actions

# Example – Tsunami Warning Communication Flow

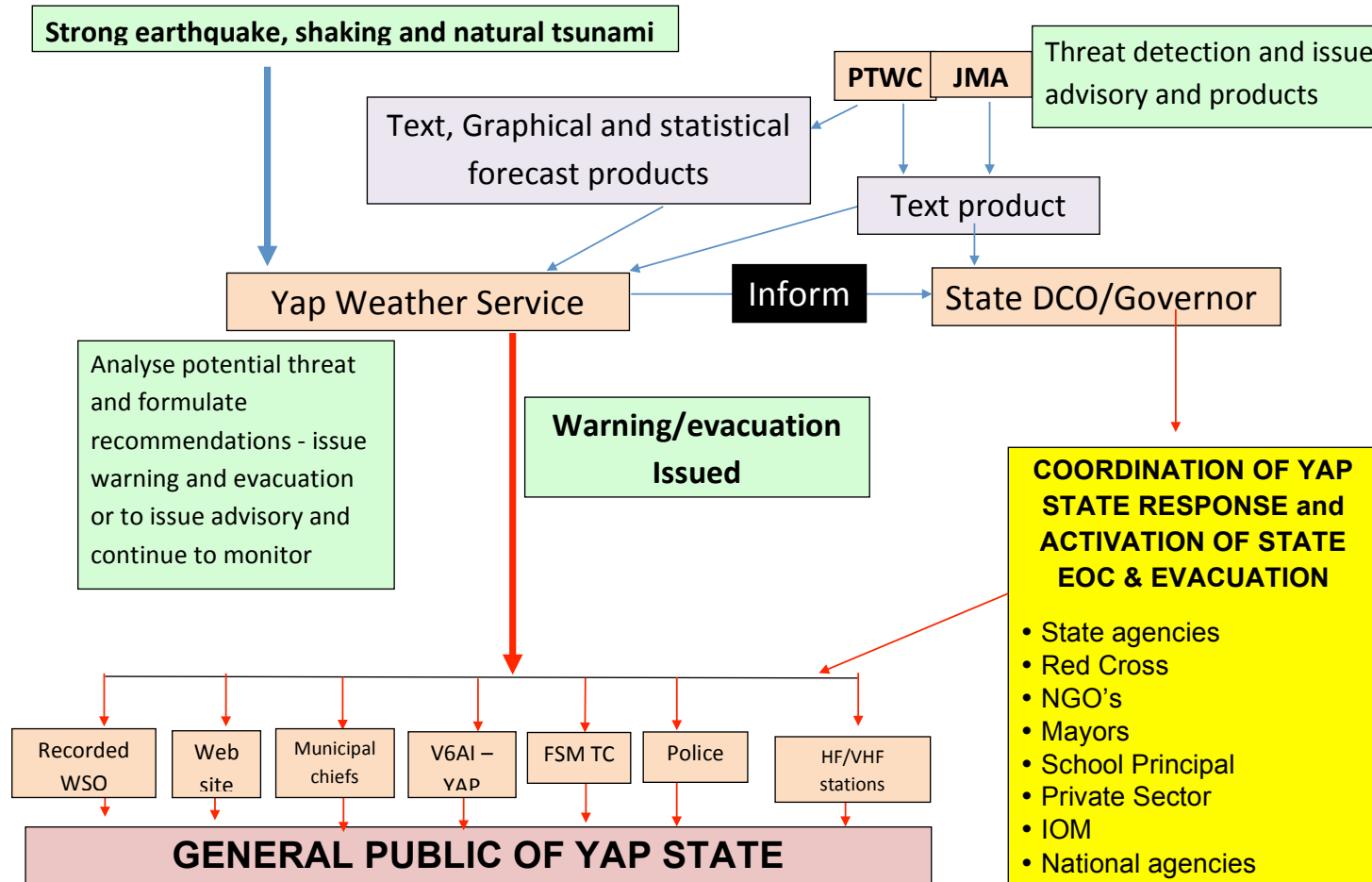
WSO MAJURO SOP

July 24, 2014



# Example – Tsunami Warning Communication Flow

## YAP STATE, FSM - LOCAL TSUNAMI OR < 2 HRS



# Timeline-driven SOPs

---

- Planning for seamless, effective response. Manage expectations.
- Specify critical actions / decision points. What decision, and when it must occur
- Add TIME to Communication Flow Chart
- When, What, Who, How, To whom

EVENT	TIME (When)	ACTIVITY (What actions)	AUTHORITY (Who)	MEDIUM (How)	TO (Target audience)
EQ Occurs					
Assess Threat - Tsunami might come					
Evacuate					
Tsunami comes					
Safe to return / Declare "All Clear"					

**EXAMPLE: TIMELINE-DRIVEN SOP**

**TSUNAMI SCENARIO: Distant Tsunami (8 hrs to arrive)  
TIMELINE-DRIVEN INFORMATION FLOW AND SOP for REPUBLIC OF MARSHALL ISLANDS**

Draft 0.2, April 2014, ITIC

**Notes:**

- PTWC will issue 1<sup>st</sup> Message in 5-15 min, 2<sup>nd</sup> Message in 30-60 min, and as new information received and/or regularly (nominally hourly). PTWC Text,, Graphical, Statistical Forecast Products only to PTWS TWFP (WSO Majuro) by email; PTWC Text Product is public and goes to many and posted on PTWC web site.
- WSO will issue TIS, Watch, Warning based on PTWC Messages and monitoring of earthquake and tsunami as it propagates across the Pacific. Updates as new information received and/or regularly

TIME (HRS AFTER EQ)	TIME (HRS BEFORE WAVE ARRIVAL)	TIME (WHEN)	EVENT	ACTIVITY - ACTION (WHAT IS DONE AND BY WHOM / INFO AVAILABLE)	AUTHORITY (WHO FROM)	MEDIUM (HOW)	TO (TARGET)	IMPACT
0	8	0000	EQ Occurs	WSS on Duty				
0.08	7.8	0005	PTWC EQ Observatory Message	WSS on Duty responds to Alarm / Email	PTWC	CISN (internet) Alarm / PTWC Email	All with CISN, or WSO	Unknown
0.12	7.75	0007	PTWC Message 1	PTWC Message – earthquake info WSO read and interpret message	PTWC	Email, Fax, Phone from WFO Guam, EMWIN?	WSO	
0.5	7.5	0030	PTWC Message 2	PTWC Message – W-phase Forecast. WSO read and interpret message.	PTWC	Email, Fax, Phone from WFO Guam, EMWIN?	WSO	3ft forecast in RMI
0.75	7.25	0045	TIS	WSO recommends to NDMO/NDC to issue TIS to inform that earthquake has occurred, and is monitoring	WSO issues?	Fax, Phone, ?	NDMO	
0-2	8-6	0000-0200	Large earthquake occurred	Read & Interpret PTWC Bulletins. WSO assess hazard (check for historical impact (online NGDC, offline TsuDig), monitor Tide Tool, contact WFO Guam/PTWC as needed). Inform & coordinate with NDMO.	WSO	Fax, Phone, ?	Natl Govt	Possible Tsunami at source. Waiting for confirmation

# Final Guidance

---

- ❑ Remember Goal: Early warning to save lives
- ❑ **Successful warning must be in time, understood, and actionable (e.g., Warning => Evacuate)**
- ❑ **For local threat (< 30-45 min), Education priority.**  
People must: 1. Act on Natural Warnings,  
2. Self-Evacuate - do not wait for NTWC warning
- ❑ **NTWC issue Alert using pre-determined criteria.**  
Duty Staff know what to look for in PTWC products
- ❑ **NTWC can decide Alert Level using only Public Text**  
(e.g., map forecast height to Warning).  
NTWC does NOT need to use all products  
(these add value, further detail).



UNESCO/IOC – NOAA ITIC Training Program in Hawaii (ITP-Hawaii)  
TSUNAMI EARLY WARNING SYSTEMS  
AND THE PACIFIC TSUNAMI WARNING CENTER (PTWC) ENHANCED PRODUCTS  
TSUNAMI EVACUATION PLANNING AND UNESCO IOC TSUNAMI READY PROGRAMME  
7-18 August 2023, Honolulu, Hawaii USA

# Thank You

---

Dr. Laura Kong  
Director, ITIC, USA, NOAA

Dr. Charles McCreery  
Director, PTWC, USA NOAA

