NATIONAL WEATHER SERVICE INSTRUCTION 10-701

June 8, 2017

Operations and Services

Tsunami Warning Services, NWSPD 10-7

TSUNAMI WARNING CENTER OPERATIONS

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OPR: W/AFS26 (M. Angove) **Certified by:** W/AFS26 (A. Allen)
Type of Issuance: Routine

SUMMARY OF REVISIONS: This version supersedes NWS Instruction 10-701, *Tsunami Warning Center Operations*, dated March 28, 2012. Changes made to reflect the NWS Headquarters reorganization effective April 1, 2015.

The following revisions were made to this directive:

1. Changed all occurrences of West Coast/Alaska Tsunami Warning Center (WC/ATWC) to National Tsunami Warning Center (NTWC)
2. Changed all occurrences of Areas of Responsibility (AOR) to Designated Service Areas (DSA)
3. Updated DSA Graphic
4. Replaced Product Example Table with link to TWC Product Example web page
5. Incorporated the following Product/Service changes:
    - SCN16-26: Convert NTWC Tsunami Products to Mixed Case Text
    - SCN16-25: Eliminate Tsunami EQI Products and Incorporate Content into TIB Products
    - SCN15-55: Transition Caribbean Products from NTWC to PTWC Responsibility for Puerto Rico and Virgin Islands
    - SCN14-52: International Tsunami Graphical and Statistical Forecast Products for the Pacific Basin
    - SCN14-45: Changes to the Tsunami Threat Message
    - SCN14-43: Corrected: New Domestic Tsunami Products for Guam and the Commonwealth of the Northern Mariana Islands (CNMI)
    - SCN14-39: NWS to Issue National Tsunami Warning Center Spanish Messages for Pacific
    - SCN14-24: Transition to Operational Status of Experimental Spanish Tsunami Messages for Puerto Rico, Virgin Islands, U.S. East Coast and the Gulf of Mexico
    - SCN14-18 Amended: New Domestic Tsunami Products for American Samoa
    - SCN14-04: NWS Capable of Activating Wireless Emergency Alerts for Tsunami Warnings

- SCN13-17: Termination of Interim Advisory Service for Tsunamis by the Pacific Tsunami Warning Center to Countries on the Indian Ocean
- SCN12-33: Changes to West Coast/Alaska Tsunami Warning Center (WCATWC) Products

Signed 5/25/2017

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Tsunami Warning Center Operations

Table of Contents **Page**

1. Tsunami Warning Centers

1.1 General

The National Tsunami Warning Center (NTWC), located at Palmer, Alaska, and the Pacific Tsunami Warning Center (PTWC), located on Ford Island in Pearl Harbor, Oahu, Hawaii, are responsible for the preparation and dissemination of tsunami information to their respective Designated Service Area (DSA). The National Weather Service (NWS) operates and maintains the Tsunami Warning Centers (TWCs). The TWCs monitor observational networks in order to analyze earthquakes, evaluate sea level data, disseminate tsunami alerts and advice, and coordinate with the National Tsunami Hazard Mitigation Program (NTHMP), government, academic, and international organizations. This function is further codified in the Tsunami Warning and Education Act, 33 U.S.C. §§ 3201 et seq.

TWC duty scientists react to earthquakes or other indicators that a tsunami may have been generated 24-hours a day. Two duty scientists are always available in the TWCs. In early 2015, the PTWC was relocated from Ewa Beach, Hawaii, to the NOAA Inouye Regional Center (IRC) on federally-owned property at Ford Island, Pearl Harbor, Honolulu, Hawaii.

1.2 Designated Service Area and Tsunami Source Region

A Designated Service Area (DSA) is the region for which a respective TWC is the U.S. authority to provide domestic tsunami products, or the international region it covers as a Tsunami Service Provider (TSP) for the United Nations Educational, Scientific, and Cultural Organization/ Intergovernmental Oceanographic Commission (UNESCO/IOC) Tsunami Program. All tsunami warning, advisory, watch, information, and threat messages for any location in the DSA originate from the authoritative TWC unless a TWC is operating in backup mode (see Section 1.3.1). Figure 1a graphically shows the TWC DSAs.

Each TWC also has a region, called its Tsunami Source Region (TSR), for which it has the primary responsibility for the detection and parameterization of large earthquakes and other potential tsunami sources for tsunami messaging purposes. The TSR generally corresponds to places where a tsunami, if generated, would strike that Center's DSA first. Specifics of each

Center's TSR are given below and shown in Figure 1b. The part of a Center's TSR that is in the U.S. or is immediately offshore is called its domestic TSR. Events in a Center's domestic TSR have special significance because of the local tsunami threat they may pose to U.S. coasts as well as the tsunami concern due to strong coastal shaking.

1.2.1 The NTWC DSA and TSR

The NTWC DSA is defined as the coasts and coastal waters of Canada and all U.S. States except Hawaii. The NTWC DSA is shown in detail in Section 3.1.

The NTWC TSR is defined as: the Pacific north of 32.5°N and east of 170°E, the U.S. north of the Mexico border, all of the Bering Sea, the Arctic north of the Arctic Circle (66.5°N), the Atlantic, Europe, and Africa north of the Tropic of Cancer (23.5°N) and west of 45°E, the Gulf of Mexico, and onshore areas of the contiguous U.S., Alaska, and Canada.

1.2.2 The PTWC DSA and TSR

The PTWC DSA is defined as Hawaii, American Samoa, Guam, the Commonwealth of the Northern Mariana Islands, U.S. insular possessions in the Pacific, Puerto Rico, the U.S. Virgin Islands, the British Virgin Islands, and the coasts and coastal waters of all other countries participating in the Pacific Tsunami Warning and Mitigation System (PTWS), and the Caribbean and Adjacent Regions Tsunami and Other Coastal Hazards Early Warning System (CARIBE-EWS); excluding regions within the NTWC DSA.

The PTWC TSR is defined as the region outside the NTWC TSR.

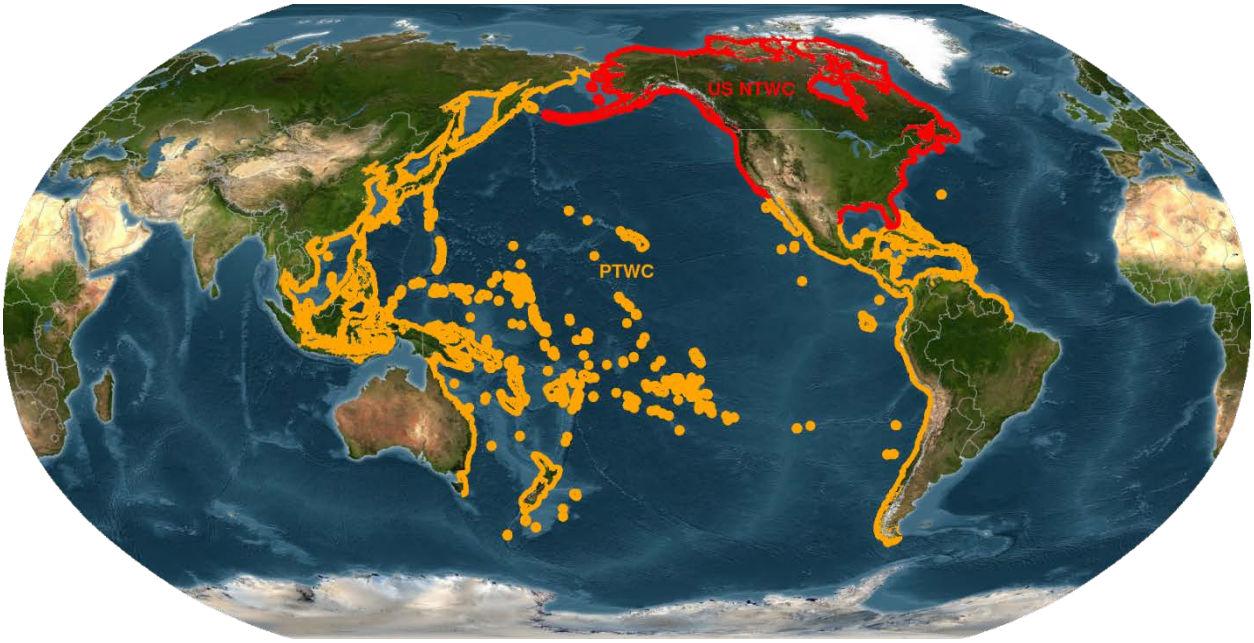

Figure 1a. TWC Designated Service Areas – the coastal and offshore areas for which each TWC has the responsibility to issue operational tsunami products. Note that PTWC is no longer covering the Java and Banda Seas adjacent to Indonesia and Timor-Leste in accordance with recent IOC decisions.

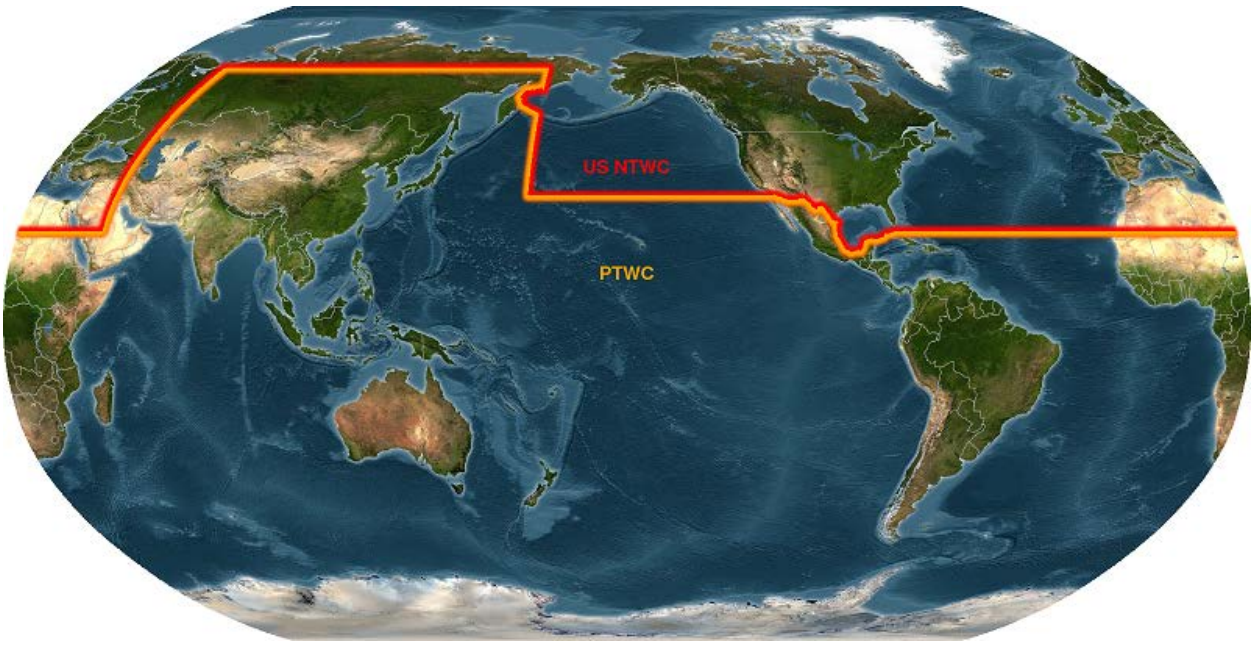

Figure 1b. TWC Tsunami Source Regions – the region for which a TWC has the primary responsibility for the detection and parameterization of large earthquakes and other potential tsunami sources for tsunami warning purposes.

1.3 Backup

1.3.1 Backup of the NTWC

In the event that the NTWC is disabled or otherwise unable to issue any of its critical products, the PTWC will issue those products on its behalf using the NTWC product identifiers. The PTWC will have full authority to issue NTWC products during a backup situation. The PTWC will issue these products when notified by the NTWC that backup is necessary. The PTWC will also issue NTWC products when a significant event has occurred, communications between the centers has ceased, and a time limit for the source region has been exceeded in which no critical products were issued by the NTWC. Time limits will be determined by the TWCs based on source regions and included in their Station Duty Manuals.

1.3.2 Backup of the PTWC

In the event that the PTWC is disabled or otherwise unable to issue any of its critical products, the NTWC will issue those products on its behalf using the PTWC product identifiers. The NTWC will have full authority to issue PTWC products during a backup situation. The NTWC will issue these products when notified by the PTWC that backup is necessary. The NTWC will also issue PTWC products when a significant event has occurred, communications between the centers has ceased, and a time limit for the source region has been exceeded in which no critical products were issued by the PTWC. Time limits will be determined by the TWCs based on source regions and included in the Station Duty Manuals.

1.4 Guidance Bodies

1.4.1 The National Tsunami Hazard Mitigation Program (NTHMP)

The National Tsunami Hazard Mitigation Program (NTHMP) is a partnership between the National Oceanic and Atmospheric Administration (NOAA), the United States Geological Survey (USGS), the Federal Emergency Management Agency (FEMA), and U.S. Coastal States, territories and commonwealths. Its Warning Coordination Sub-Committee (WCS) is the main mechanism for response organizations within the United States and Canada to provide input to NOAA's operational Tsunami Warning System (TWS). WCS members formulate and agree to actions and recommendations regarding domestic components of the TWS such as warning center products, warning procedures, message dissemination, system exercises, and Emergency Alert System (EAS) activation. Major changes, such as new warning center products, are proposed through the WCS and vetted through the NWS service change process. The NWS Directive and Instruction system is modified as appropriate. Minor changes proposed and approved through the WCS are implemented by the TWCs. Significant changes to TWS operations considered by the NWS are coordinated with the WCS.

1.4.2 The United Nations Educational, Scientific, and Cultural Organization/ Intergovernmental Oceanographic Commission (UNESCO/IOC)

The IOC, its Intergovernmental Coordination Groups (ICGs) for the Pacific Ocean, Indian Ocean, Caribbean Sea, and Northeast Atlantic/Mediterranean Sea Tsunami Systems, and their Working Groups and Task Teams are the primary mechanism for international input into NOAA's operational TWS. International responsibilities of the US TWCs are determined by agreement and in coordination with IOC tsunami programs. Significant changes to TWC international products are made in coordination with the appropriate ICG or Member State affected before implementation. International work plans of the International Tsunami Information Center (ITIC) and CTWP are determined in coordination with the IOC and the respective ICGs.

1.4.3 State Tsunami Hazard Committees

TWCs will work with US state/territory-level tsunami hazard committees within their DSAs to better prepare the states/territories for tsunami warning, advisory, or watch response. Proposals from state/territory tsunami hazard committees concerning changes to the operational TWS are introduced through the NTHMP WCS for consideration. Routine interactions such as exercises and EAS planning do not require coordination through the WCS.

1.5 Supporting Activities

1.5.1 International Tsunami Information Center (ITIC)

ITIC is a joint partnership of UNESCO IOC and NOAA. It supports the PTWS and other systems globally by monitoring and recommending improvements, assisting countries in establishing and strengthening their national and regional systems, and providing training and capacity building to ensure timely delivery and understanding of warnings to countries and

communities. It also serves as a clearinghouse for educational, preparedness, and research materials, facilitates post-event tsunami impact and damage assessment surveys, and cooperates with the World Data System to collecting and making available historical event data. ITIC is administratively overseen by the NWS Pacific Region.

1.5.2 Caribbean Tsunami Warning Program (CTWP)

The CTWP supports both US Territories in the Caribbean and Coastal Hazards Warning System for the Caribbean and Adjacent Regions (CARIBE-EWS) Member States in establishing and strengthening their national and regional systems, and in training and capacity building to ensure timely delivery and understanding of products to countries and communities. CTWP is administratively overseen by the NWS Southern Region.

2. TWC Products

2.1 Domestic Product Definitions

2.1.1 Tsunami Warning

A tsunami warning is issued when a tsunami with the potential to generate widespread inundation is imminent, expected, or occurring. Warnings alert the public that dangerous coastal flooding accompanied by powerful currents are possible and may continue for several hours after initial arrival. Warnings alert emergency management officials to take action for the entire tsunami hazard zone. Appropriate actions to be taken by local officials may include the evacuation of low-lying coastal areas, and the repositioning of ships to deep waters when there is time to safely do so. Warnings may be updated, adjusted geographically, downgraded, or canceled. To provide the earliest possible alert, initial warnings are normally based only on seismic information.

2.1.2 Tsunami Advisory

A tsunami advisory is issued when a tsunami with the potential to generate strong currents or waves dangerous to those in or very near the water is imminent, expected, or occurring. The threat may continue for several hours after initial arrival, but significant inundation is not expected for areas under an advisory. Appropriate actions to be taken by local officials may include closing beaches, evacuating harbors and marinas, and the repositioning of ships to deep waters when there is time to safely do so. Advisories are normally updated to continue the advisory, expand/contract affected areas, upgrade to a warning, or cancel the advisory.

2.1.3 Tsunami Watch

A tsunami watch is issued to alert emergency management officials and the public of an event which may later impact the watch area. The watch area may be upgraded to a warning or advisory - or be canceled - based on updated information and analysis. Therefore, emergency management officials and the public should prepare to take action. Watches are normally issued based on seismic information without confirmation that a destructive tsunami is underway.

2.1.4 Tsunami Information Statement

A tsunami information statement is issued to inform that an earthquake has occurred, or that a tsunami warning, watch or advisory has been issued for another section of the ocean. In most cases, information statements are issued to indicate there is no threat of a destructive basin-wide tsunami and to prevent unnecessary evacuations as the earthquake may have been felt in coastal areas. Information statements may indicate for distant regions that a large event is being evaluated and could be upgraded to a warning, advisory, or watch.

2.1.5 Cancellation

This is a final product indicating the end of the damaging tsunami threat. A cancellation is issued after an evaluation of water level data confirms that a destructive tsunami will not impact the Warning, Advisory, or Watch area, or has subsided to a non-damaging level.

2.2 International Product Definitions

The United States, through the Pacific Tsunami Warning Center, serves as an official UNESCO/IOC Tsunami Service Provider for both the PTWS and CARIBE EWS ICGs. Its support products in this role are in accordance with protocols agreed to by the regional ICGs. For all regions, the international TWC products are issued only as advice to designated national authorities. They are not intended as advice to the public although they may be disseminated to the public through news organizations and are publicly available through the TWC websites.

For the Pacific, PTWC will issue threat messages and information statements to its international DSA, and warnings, advisories, watches, and information statements to its domestic DSA. NTWC will also issue its domestic products for Canada. For the Caribbean Region, the PTWC will issue threat messages and information statements to its international DSA, and Warnings, Advisories, Watches, and information statements to its domestic DSA (Puerto Rico and Virgin Islands). International product definitions are agreed upon through individual ICGs. International Product definitions can be found in the User Guides listed in Section 6.

2.3 Product Codes and Names

All products issued by the TWCs along with their WMO IDs, Advanced Weather Interactive Processing System (AWIPS) IDs, Product Names, and regions can be found here: http://tsunami.gov/?page=product_list.

2.4 Break Points/Warning and Threat Zones

2.4.1 NTWC Break Points

The geographical extent of tsunami warnings, watches and advisories in the NTWC's Pacific DSA are defined by breakpoints which correspond with NWS public zone boundaries:

Attu, AK	Salisbury Sound, AK	Horse Mountain, CA
Amchitka Pass, AK	Cape Decision, AK	Gualala River, CA
Samalga Pass, AK	BC/AK Border	Davenport, CA

Unimak Pass, AK	North Tip Vancouver Island, BC	Ragged Point, CA
Chignik Bay, AK	WA/BC Border	Point Conception, CA
Kennedy Entrance, AK	OR/WA Border	Rincon Point, CA
Hinchinbrook Entrance, AK	Cascade Head, OR	Orange/San Diego
Cape Suckling, AK	Douglas/Lane County Line, OR	County Line, CA
Cape Fairweather, AK	CA/OR Border	Mexico/CA Border

The geographical extent of tsunami warnings, watches, and advisories in the NTWC's Atlantic DSA are defined by breakpoints which correspond with NWS Weather Forecast Office (WFO) DSAs:

Brownsville, TX	Ocean Reef, FL	Watch Hill, RI
Baffin Bay, TX	Jupiter Sound, FL	MA/NH Border
Port O'Connor, TX	Flagler Beach, FL	Stonington, ME
High Island, TX	Altamaha Sound, GA	US/Canada Border
Shell Island, LA	South Santee River, SC	Charlesville, NS
MS/AL Border	Surf City, NC	Chezzetcook Inlet, NS
Destin, FL	Duck, NC	Meat Cove, NS
Suwannee River, FL	New Point Comfort, VA	Cape Ray, NL
Bonita Beach, FL	Cape Henlopen, DE	La Manche, NL
Flamingo, FL	Sandy Hook, NJ	Strait of Belle Isle, NL
		Cape Chidley, NL

2.4.2 PTWC Warning and Threat Zones

2.4.2.1 Hawaii Product

For tsunamis generated outside of the State of Hawaii and its coastal waters, warnings, watches, and advisories will be issued to the entire State of Hawaii.

For local tsunamis generated within the State of Hawaii and its coastal waters, warnings will be issued to one or more of the following:

The Big Island (Hawaii County)
Maui County
Honolulu County
Kauai County
All counties in the State of Hawaii

2.4.2.2 American Samoa Products

For tsunamis generated nearby as well as far away from American Samoa, any warnings, watches, and advisories will be issued for all of American Samoa.

2.4.2.3 Guam / Commonwealth of the Northern Mariana Islands (CNMI) Products

For tsunamis generated nearby as well as far away from Guam and the Commonwealth of the Northern Mariana Islands, any warnings, watches, and advisories will be issued for all of Guam and CNMI.

2.4.2.4 Puerto Rico (PR), US Virgin Islands (USVI) and British Virgin Islands (BVI)

For tsunamis generated nearby as well as far away from PR, USVI, and BVI, any warnings, watches, and advisories will be issued for all of these areas.

2.4.2.5 PTWS Products

The geographical extent of products issued by PTWC for the PTWS in the text products are defined by the following threat zones. The zones are delineated no finer than individual countries, territories, or other entities in accordance with PTWS protocols and represent only coasts bordering the oceans or seas covered by the PTWS. The level of threat assigned will be the highest level determined for any part of the covered coast of that entity:

American Samoa
Antarctica
Australia
Brunei
Cambodia
Chile
China
Chuuk
Colombia
Cook Islands
Costa Rica
Democratic People's Republic of Korea
Ecuador
El Salvador
Fiji
French Polynesia
Guam
Guatemala
Hawaii
Honduras
Howland and Baker
Indonesia
Japan
Jarvis Island
Johnston Atoll
Kermadec Islands
Kiribati
Kosrae
Malaysia
Marshall Islands
Mexico
Midway Island
Nauru
New Caledonia
New Zealand
Nicaragua
Niue
Northern Marianas
Northwestern Hawaiian Islands
Palau
Palmyra Island
Panama
Papua New Guinea
Peru
Philippines
Pitcairn Islands
Pohnpei
Republic of Korea
Russia
Samoa
Singapore
Solomon Islands
Taiwan
Thailand
Tokelau
Tonga
Tuvalu
Vanuatu
Vietnam
Wake Island
Wallis and Futuna
Yap

2.4.2.6 Tsunami and other Coastal Hazards Warning System for the Caribbean and Adjacent Regions (CARIBE-EWS) Products

The geographical extents of tsunami products issued by PTWC for the CARIBE-EWS are defined by the following threat zones. The zones are delineated no finer than individual countries, territories, or other entities in accordance with CARIBE-EWS protocols and represent only coasts bordering the oceans or seas covered by the CARIBE-EWS. The level of alert assigned will be the highest level determined for any part of the covered coast of that entity:

Belize
Brazil
Colombia
Costa Rica
Cuba
Dominican Republic
French Guiana
Guatemala
Guyana
Haiti
Honduras
Mexico
Nicaragua
Panama
Suriname
Venezuela
Anguilla
Antigua and Barbuda
Aruba
Bahamas
Barbados
Bermuda
Bonaire
Cayman Islands
Curacao
Dominica
Grenada
Guadeloupe
Jamaica
Martinique
Montserrat
Puerto Rico and Virgin Islands
Saba and Saint Eustatius
Saint Barthelemy
Saint Kitts and Nevis
Saint Lucia
Saint Martin
Saint Vincent and the Grenadines
San Andres and Providencia
Sint Maarten
Trinidad and Tobago
Turks and Caicos Islands

2.5 Product Content

Warnings, Advisories, and Watches can include both segmented products and non-segmented products. Segmented products are intended for automated and text-to-speech applications. Non-segmented products are intended to be readable messages for emergency management and the public. Segmented products are WEPA41 PAAQ, WEXX20 PAAQ, and WECA60 PHEB.

2.5.1 Product Format

TWC domestic products will conform to NWS text product format standards (reference National Weather Service Instructions (NWSI) 10-1701, *Text Produce Formats and Codes*, and 10-1702, *Universal Geographic Code*, on product format). Table 2 indicates whether the products contain Valid Time Event Codes (VTEC), Universal Geographic Codes (UGCs), and whether or not they are segmented.

Product	VTEC	Marine UGC	Public UGC	Segmented	English (E) or Spanish (S)
WEPA41 PAAQ	X		X	X	E
WEXX20 PAAQ	X	X	X	X	E
WECA60 PHEB	X	X	X		E
WEHW40 PHEB, WEZS40 PHEB, WEGM40 PHEB	X		X		E
WEHW42 PHEB			X		E
WEAK51 PAAQ, WEAK53 PAAQ, WEXX30 PAAQ, WEXX32 PAAQ, WECA40 PHEB, WECA42 PHEB, WEPA40 PHEB, WEPA42 PHEB, WECA41 PHEB, WECA43 PHEB					E
WEAK61 PAAQ, WEAK63 PAAQ, WEXX40 PAAQ, WEXX42 PAAQ, WECA50 PHEB, WECA52 PHEB					S

Table 2. TWC products and related UGC/VTEC information.

The categories of information and their basic arrangement in tsunami warnings, watches, and advisories will be:

- **Product header**: Standard NWS header with WMO and AWIPS codes
- **Mass News Disseminator Header**: Type of message, origin, date and time
- **Changes since last message**: Short description of updates since last message
- **Headline(s):** For warning, watch, and advisories the area in alert will be listed
- **Earthquake Parameters**: Information on the earthquake source. Can be moved lower in the message after message #2
- **Tsunami Forecasts**: Can provide tsunami arrival time, height, and duration estimates
- **Tsunami Observations**: Provides tsunami observations at specific sites
- **Recommended Actions**: Provides specific response advice
- **Impacts**: Provides expected impact information for areas in alert
- **Additional Information and Next Update**: Amplifying information if needed, and when next update is expected

For segmented products, there may be a series of segments. These contain both UGC and VTEC. VTEC usage for tsunami products is explained further in Section 2.5.2.

Tsunami Observations and Forecasts: Tsunami observations and forecast arrival times, heights, and duration are listed in the main body of Warning, Advisory, and Watch products. The TWCs formulate tsunami forecasts taking into account the limitations and constraints of seismic, sea level, and any other available data. The TWCs may provide specific numerical height forecasts when sufficiently justified by seismic or sea level constraints. Tsunami height is defined as the elevation of the wave above ambient sea level, and is the maximum expected for the duration of the event. Observation/forecast points are grouped by countries, states,

territories, or islands. The forecast/observed height column(s) indicates no forecasts or observations are available when no forecasts are issued or observations reported. The estimated arrival times column can be removed when the tsunami has passed, or in the cancellation product, an observation time column can be included. Products intended for domestic audiences will list the arrival time in local time and heights in feet. Products intended for international audiences will list the time in UTC and heights in meters. Products may specify ranges or uncertainties for forecast heights.

2.5.2 VTEC Usage in Tsunami Products

VTEC (see NWSI 10-1703) are given in the products indicated in Table 2. The VTEC elements provided in tsunami products are:

Fixed Identifier
O – Used in normal Warning/Advisory/Watch product delivery
T – Used for communication tests and example messages for exercises

Action
NEW – used the first time a Warning, Advisory, or Watch is issued for an event,
CON – used when a Warning, Advisory, or Watch is continued for the same region,
EXA – used when a Warning, Advisory, or Watch is expanded to include other zones, and
CAN – used when a Warning, Advisory, or Watch is cancelled.

Office ID
PAAQ – National Tsunami Warning Center
PHEB – Pacific Tsunami Warning Center

Phenomenon
TS – Tsunami

Significance
W – Warning
Y – Advisory
A – Watch

Event Tracking Number (ETN)
The ETN resets to 1 on January 1st of each year at 00:00 UTC. Each tsunami event constitutes one ETN. For example, an earthquake in Chile which triggers Warnings, Advisories, and Watches for different regions of the DSAs has the same ETN over the entire event for each message product from each TWC. The ETN for one event may not be the same between different TWCs, or different message products within a TWC. Communication tests and live exercises also constitute one ETN. The ETN increments to the next integer after each event, communications test, or live exercise.

Event Beginning Date/Time

Beginning times are provided for "NEW" events only. The beginning time is the first message issue time. Continuations (CON), expansions (EXA), and cancellations (CAN) have zeroes for the time and date. Communication tests and live exercises also provide beginning times.

Event Ending Date/Time

Ending times are set to zeroes for all issued products as all Warning, Advisories, and Watches are canceled (CAN) with a Cancellation message. Communication tests and live exercises contain an ending time which is normally in the range of 20-60 minutes after the beginning time.

PTWC Examples

A series of UGC and VTEC lines created at PTWC WEHW40 products for Hawaii. The example shown is a large distant earthquake for which the entire State of Hawaii is initially put into a watch, is then upgraded to a warning, and then after wave passage has the warning cancelled.

Bulletin 1: Initial Watch

```
HIZ001>003-005>009-012>014-016>021-023>026-241905-
/O.NEW.PHEB.TS.A.0013.100324T1705Z-000000T0000Z/
```

Bulletin 2: Upgrade Watch to Warning

```
HIZ001>003-005>009-012>014-016>021-023>026-242005-
/O.CAN.PHEB.TS.A.0013.000000T0000Z-000000T0000Z/
/O.NEW.PHEB.TS.W.0012.100324T1805Z-000000T0000Z/
```

Bulletin 3: Continue Warning

```
HIZ001>003-005>009-012>014-016>021-023>026-242105-
/O.CON.PHEB.TS.W.0012.000000T0000Z-000000T0000Z/
```

Bulletin 10: Cancel Warning

```
HIZ001>003-005>009-012>014-016>021-023>026-250405-
/O.CAN.PHEB.TS.W.0012.000000T0000Z-000000T0000Z/
```

NTWC Examples

A series of examples is shown below which provide VTEC for two zones. The zones are first placed in a watch, then upgraded to a warning, downgraded to an advisory, expanded to another zone, and finally canceled.

Bulletin 1: Initial Watch

```
AKZ187-191-260202-
/O.NEW.PAAQ.TS.A.0013.100726T0102Z-000000T0000Z/
COASTAL AREAS BETWEEN AND INCLUDING NIKOLSKI ALASKA TO ATTU ALASKA
```

Bulletin 2: Upgrade Watch to Warning

```
AKZ187-191-260302-
/O.CAN.PAAQ.TS.A.0013.000000T0000Z-000000T0000Z/
/O.NEW.PAAQ.TS.W.0013.100726T0202Z-000000T0000Z/
COASTAL AREAS BETWEEN AND INCLUDING NIKOLSKI ALASKA TO ATTU ALASKA
```

Bulletin 3: Continue Warning

```
AKZ187-191-260402-
/O.CON.PAAQ.TS.W.0013.000000T0000Z-000000T0000Z/
COASTAL AREAS BETWEEN AND INCLUDING NIKOLSKI ALASKA TO ATTU ALASKA
```

Bulletin 4: Downgrade Warning to Advisory

```
AKZ187-191-260502-
/O.CAN.PAAQ.TS.W.0013.000000T0000Z-000000T0000Z/
/O.NEW.PAAQ.TS.Y.0013.100726T0402Z-000000T0000Z/
COASTAL AREAS BETWEEN AND INCLUDING NIKOLSKI ALASKA TO ATTU ALASKA
```

Bulletin 5: Continue Advisory

```
AKZ187-191-260602-
/O.CON.PAAQ.TS.Y.0013.000000T0000Z-000000T0000Z/
COASTAL AREAS BETWEEN AND INCLUDING NIKOLSKI ALASKA TO ATTU ALASKA
```

Bulletin 6: Expand Advisory Region

```
AKZ185-260702-
/O.EXA.PAAQ.TS.Y.0013.000000T0000Z-000000T0000Z/
COASTAL AREAS BETWEEN AND INCLUDING UNIMAK PASS ALASKA/80
MILES NE OF DUTCH HARBOR/ TO NIKOLSKI ALASKA

AKZ187-191-260702-
/O.CON.PAAQ.TS.Y.0013.000000T0000Z-000000T0000Z/
COASTAL AREAS BETWEEN AND INCLUDING NIKOLSKI ALASKA TO ATTU ALASKA
```

Bulletin 7: Continue Advisory in Expanded Region

```
AKZ185-187-191-260802-
/O.CON.PAAQ.TS.Y.0013.000000T0000Z-000000T0000Z/
COASTAL AREAS BETWEEN AND INCLUDING UNIMAK PASS ALASKA/80
MILES NE OF DUTCH HARBOR/ TO ATTU ALASKA
```

Bulletin 8: Cancel Advisory in Expanded Region

```
AKZ185-187-191-260324-
/O.CAN.PAAQ.TS.Y.0013.000000T0000Z-000000T0000Z/
COASTAL AREAS BETWEEN AND INCLUDING UNIMAK PASS ALASKA/80
MILES NE OF DUTCH HARBOR/ TO ATTU ALASKA
```

2.5.3 Graphical Tsunami Products

TWC graphical, Internet-based products may be produced and displayed at the following sites:

tsunami.gov
ntwc.arh.noaa.gov
ptwc.weather.gov

All graphical images posted to these sites will have the official NOAA and NWS logos included. Graphical images include a brief description of the graphic. Graphical products may be web site overlays driven by interactive mapping capabilities such as GoogleMaps or ESRI products.

The following are possible NWS Internet-based products produced by the TWCs:

Product
Web-based tsunami forecast and observation tables
Digital cell phone text message (Short Messaging Service - SMS)
Email
FAX
CAP/XML format products
Really Simple Syndication (RSS) feeds for tsunami products
Social media feeds (e.g., Twitter, Facebook, YouTube)

2.6 Communication Tests

Tsunami communications tests verify communication pathways between the TWCs and primary recipients, and the timeliness of message delivery over those pathways. Each TWC will verify communications via periodic tests at least quarterly. Primary recipients include: designated national focal points, state/territorial warning points, coastal WFOs, U.S. Coast Guard, and critical military dissemination points. TWCs document the results of each test.

2.7 Dissemination

Message dissemination routes used by the TWCs are summarized in Table 3. Primary routes are the National Warning System (NAWAS), the NOAA Weather Wire System (NWWS), OneNWS and/or private circuits to the NWS Telecommunications Gateway, the Federal Aviation Administration's (FAA) National Airspace Data Interchange Network (NADIN2), the Aeronautical Fixed Telecommunications Network (AFTN) communication systems, and the Global Telecommunications System (GTS) of the World Meteorological Organization (WMO).

Both TWCs feed messages into AWIPS through the NWS Telecommunications Gateway (NWSTG). Other routes include the Emergency Managers' Weather Information Network (EMWIN), FAX, email, web sites, RSS feeds, cell phone text messaging, CAP/XML feeds, social media, USGS dissemination systems including the NEIC website and the California Integrated Seismic Network (CISN) earthquake display, and telephone calls.

In January 2014, NWS established the capability of activating Wireless Emergency Alert (WEA) capable cell phones. With this capability, NWS activates WEA for the initial Tsunami Warning for an area delineated by UGCs.

Service	Communication Link	User Audience	PTWC	NTWC
AWIPS	Advanced Weather Interactive Processing System	U.S. Weather Forecast Offices and NOAAPort Users	X	X
NWWS	NOAA Weather Wire System via NWSTG	State/Territory/Canadian warning points, US Coast Guard	X	X
NAWAS	National Warning System circuit	State/Territory warning points, U.S. Coast Guard, Federal Emergency Management	X	X

Service	Communication Link	User Audience	PTWC	NTWC
		Agency, US Coast Guard.		
HAWAS	Hawaii NAWAS circuit	State of Hawaii Emergency Response Offices	X	
AKWAS	Alaska NAWAS circuit	State of Alaska Emergency Response Offices		X
IDN	Inter-island Data Network circuit	State of Hawaii Civil Defense Offices	X	
OneNWS	NOAA network dedicated circuit with VSAT backup	NWSTG	X	X
Private Internet Service Provider (ISP)	Private ISP	NWSTG	X	X
NADIN2 and AFTN	FAA National Airspace Data Interchange Network and Aeronautical Fixed Telecommunications Circuit via NWSTG	FAA Offices, NWS Offices, Foreign National Tsunami Warning Focal Points.	X	X
GTS	Global Telecommunications System through NWSTG	Foreign National Tsunami Warning Focal Points	X	X
EMWIN	Emergency Manager's Weather Information Network through NWSTG	National/State/Local Emergency Management Agencies, Foreign National Tsunami Warning Focal Points	X	X
FAX	TeleFAX with near simultaneous delivery through a commercial service	National/State/Local Warning Points, U.S. Coast Guard, Foreign National Tsunami Warning Focal Points	X	X
Email	Private lists with near simultaneous delivery through a commercial service	All primary domestic and international contacts	X	X
RANET SMS	Digital cell phone text messaging	Foreign National Tsunami Warning Focal Points	X	
SMS	Digital cell phone text messaging	All primary contacts	X	X
Web	TWC web sites	All primary contacts and the general public	X	X
RSS	Really Simple Syndication	All primary contacts and the general public	X	X
CAP/XML	Common Alerting Protocol	All primary contacts and the		X

Service	Communication Link	User Audience	PTWC	NTWC
	issued through web sites	general public		
EIDS and CISN	USGS Earthquake Information Dissemination System	National/State/Local Warning Points, Foreign National Tsunami Warning Focal Points	X	X
Twitter	Feed to Twitter	General Public	X	X
Facebook	Feed to Facebook	General Public	X	X

Table 3. TWC product dissemination paths.

3. Message Information and Operational Procedures

3.1 Specific Regionalization of Procedural Regions and DSAs

Criteria used by TWCs to determine which product to issue are organized by geographic regions as defined in Table 4 and the Figures 3 through 5.

Region	NTWC DSA	PTWC DSA
U.S. West Coast	X	
British Columbia	X	
Alaska/Aleutian Islands	X	
Bering Sea – Shallow water	X	
Bering Sea – Deep Water	X	
Pacific Basin and all its marginal seas except the Bering Sea		X
Hawaii		X
Alaska/Canada Arctic coast	X	
U.S. East Coast	X	
U.S. Gulf of Mexico Coast	X	
Eastern Canada	X	
Gulf of St. Lawrence	X	
Puerto Rico/Virgin Islands		X
Caribbean Sea		X

Table 4. TWC procedural regions

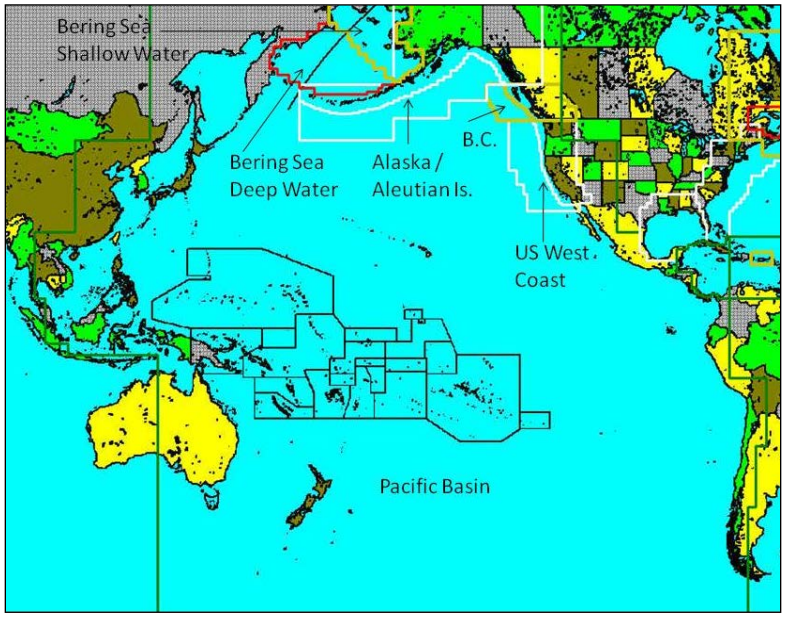

Figure 3. Pacific regions. Note that the line offshore of the US West Coast, Canada, and Alaska indicates the delineation from near shore to far offshore for warning issuance criteria purposes.

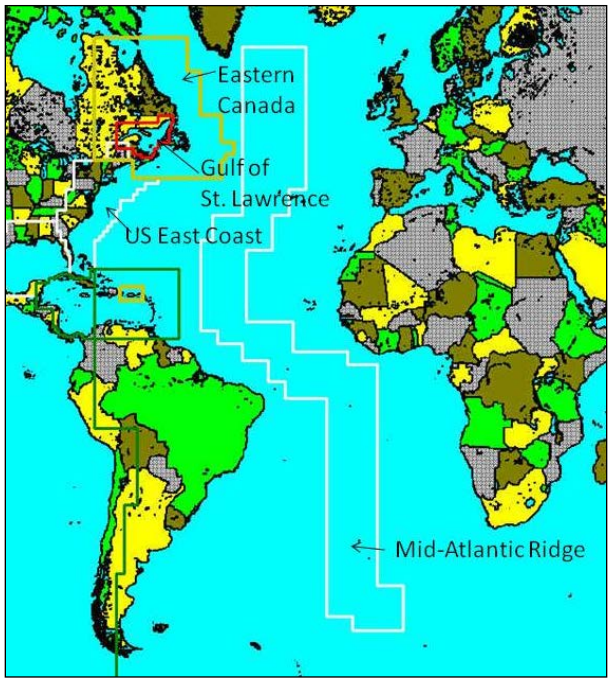

Figure 4. Atlantic Regions.

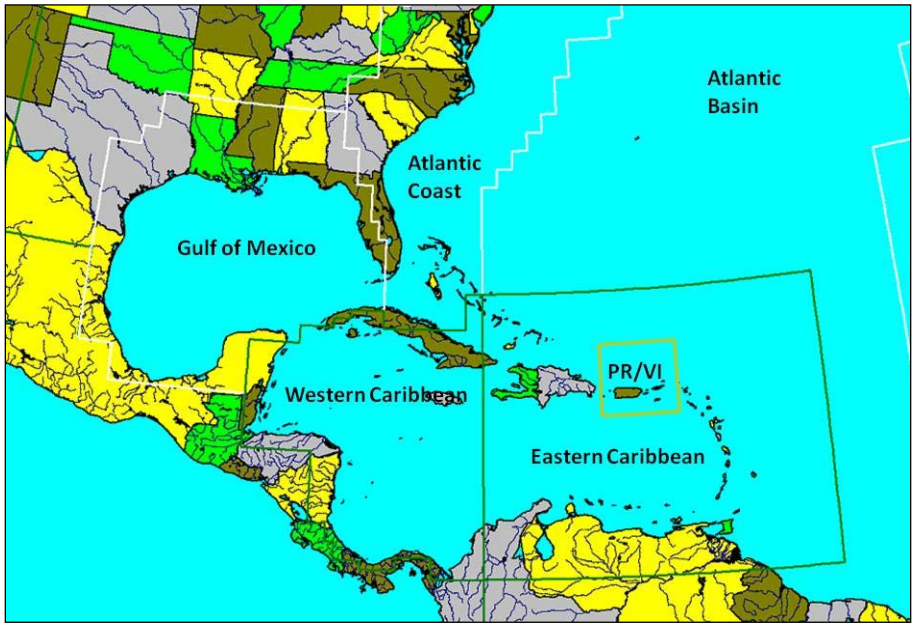

Figure 5. Caribbean and southeast USA regions.

3.2 Criteria for Initial Messages

Criteria for the issuance of most initial tsunami alerts or potential tsunami threats in TWC products are based solely on the preliminary earthquake location, depth and magnitude since that is all the information developed by and available to the TWCs within the first few minutes after the earthquake. Such criteria depend on factors including the character of the particular coasts covered by the products, the source proximity to likely tsunamigenic seismic zones, known characteristics of tsunami generation and propagation, historical tsunami data, and numerical simulations. The criteria may define the initial alert zones based on distance or travel time from the source, or by preset zones considering the factors listed above.

Criteria that define the initial TWC product types are discussed further in User Guides listed in Section 5 and are summarized at:

http://ntwc.arh.noaa.gov/images/procChartLargeAtlantic.gif, and
http://ntwc.arh.noaa.gov/images/procChartLargePacific.gif.

3.3 Coordination of Earthquake Parameters

Given the ocean-wide impact of some tsunamis, and that the two TWCs may be responsible for different aspects of the same event, timely coordination of the earthquake parameters between the TWCs is essential for the overall effectiveness of tsunami services. Normally the TWC with the earthquake inside its TSR issues its products first and the other TWC follows, copying the earthquake parameters. However, to ensure the fastest possible response when both DSAs may be affected by the event within an hour of earthquake origin time, or when the event can be felt in both DSAs, the initial message may be issued by both TWCs without coordination. Supplemental messages will then be fully coordinated between the TWCs concerning the earthquake parameters.

3.4 Supplemental Messages

In cases where a significant tsunami has been observed following an information statement or bulletin, or when a tsunami Warning, Advisory, or Watch has been issued, supplemental messages are required. Decisions regarding supplemental messages to initiate, continue, upgrade, downgrade, or cancel, are based upon all available seismic and sea level data, any reliable tsunami observations, and the output of numerical tsunami forecast models. Each of these information sources is evaluated in the context of the historical tsunami data, knowledge of the general behavior of tsunamis and the hazard they pose, and in consideration of the consistency of all available information. Tsunami impact forecasts such as coastal heights and expected inundation or current levels are not issued until the forecast is calibrated or verified with at least one sea level gauge.

In the NTWC DSA and the PTWC domestic DSAs, where both Warnings and Advisories indicate threat level, Warnings are issued for regions where the forecast or observed tsunami height (elevation of the wave above ambient sea level) is over 1 meter, or the expected impact is unknown. Advisories are issued for regions where the maximum forecast height is between 0.3 and 1.0 meter or the observed height is between 0.5 and 1 meter. The difference between the forecast and observed level for Advisories is based on forecast accuracy and a safety factor. Since tsunami impacts can be variable throughout a region, duty-scientist judgment is used when forecasts range over different threat levels within a region. Warnings, Advisories, and Watches are cancelled when the expected or observed height is below 0.3 meters and the trend is diminishing in most places being monitored in the area being cancelled. Specific cancellation procedures are outlined in each TWC's Station Duty Manual.

Given the broad geographic extent of TWC messages and the variability of tsunami height along the coast, warning and advisory areas may have to be grouped so that Warning and/or Advisory regions do not fluctuate rapidly along coasts. Further, due to the changes in the forecast as it is refined by additional incoming data, the alert levels for each region may have to be altered so they do not fluctuate rapidly in time.

Warning, Advisory, and Watch messages indicate the time interval when the next message will be issued. For domestic products, this interval normally will be 30 to 60 minutes when the source is within the DSA and 60 minutes when the source is outside the DSA. For international products, this is normally 60 minutes. In events where a significant tsunami is generated and TWC products are issued over a period of more than several hours, time intervals between messages may be increased up to 120 minutes after the third message.

Cancellations are issued whenever a Warning, Advisory, or Watch, is ended (as opposed to an upgrade or downgrade). The cancellation provides a summary of known tsunami impacts and observations, as well as an evaluation which provides an indication of tsunami impacts.

Note: In the PTWC international DSA, alerting terms such as Warning, Advisory, and Watch are not used to avoid confusion with the authoritative alert levels issued by the responsible national agencies within each country or territory. Instead, by agreement through the ICG process, only the more general term "tsunami threat" is used. Once a forecast becomes available the tsunami threat for pre-determined sections of coast are categorized by the maximum expected tsunami height in the ranges 0.3 to 1 meter, 1 to 3 meters, and greater than 3 meters. These

ranges are intended to correspond respectively to a marine hazard, a coastal flooding hazard, and a major destructive tsunami hazard. The level of hazard may differ, however, based on the characteristics of each coast. A final threat message is issued by PTWC when the expected or observed height is below 0.3 meters and the trend is diminishing in most places being monitored in the area designated with a threat.

3.5 Enhanced Coordination with Primary Domestic Users

In addition to products issued via standard methods, TWCs may conduct enhanced coordination efforts with primary domestic users [NWS Weather Forecast Offices (WFO) and Weather Service Offices (WSO)], state/territory emergency management officials, the U.S. Coast Guard, and the U.S. Military) as well as with officially designated foreign tsunami contacts. The intent of these enhanced communications is to deliver information not provided in the standard messages such as extra arrival times, forecast heights and inundation potential, coastal areas of special concern, and other useful information. These communications can take the form of teleconferences, individual phone calls, and/or conferences over dedicated communications circuits.

3.6 Experimental Products

The implementation of a TWC experimental product or service or making a substantial change to an existing operational product or service follows NWS Instruction 10-102 New or Enhanced Products or Services. Significant experimental products, such as model guidance, are only issued by the TWCs during a tsunami event when the experimental product has an approved Product Description Document (PDD) and Service Description Document (SDD) in accordance with NWSI 10-102.

Once the experimental product's PDD/SDD is approved, the TWCs will begin distributing the product/service for the primary purpose of gathering partner/user feedback. The product's labels will clearly identify it as experimental (e.g., Experimental Tsunami Forecast Model). If the product/service is available via the internet, the Uniform Resource Locator (URL) of the web page will be included in the PDD/SDD. A locally-generated or national Public Information Statement (PNS) will be issued before distribution of any experimental product/service. The PNS will include a brief description of the product/service, Web address, evaluation period, and a point of contact.

4. NWS Weather Forecast Offices Support and Responsibilities

NWS WFOs, and in some cases WSOs, disseminate tsunami Warnings, Advisories, Watches, and/or Information Statements from the TWCs in conjunction with actions taken by state, territory, and local emergency management agencies and in accordance with their Regional Supplemental Instructions. WFOs and Pacific Region WSOs are responsible for issuing tsunami messages over NOAA Weather Radio All Hazards (NWR) and are responsible for the activation of the Emergency Alert System (EAS) in accordance with individual state EAS plans.

Emergency management agencies have the ultimate responsibility for calling for evacuations of threatened populations. The WFOs and WSOs serve an important link in disseminating tsunami information and in working with emergency management agencies prior to, during, and after an

event.

NWS Regions with WFOs or WSOs involved in the TWS (Eastern, Southern, Western, Alaska, and Pacific) may create a regional supplement with specific instructions for WFO or WSO actions regarding tsunami information dissemination. WFOs and WSOs are responsible for creating and maintaining specific instructions relating to tsunami information dissemination within their Station Duty Manuals.

In addition to forwarding tsunami information over NWR and EAS, WFOs and WSOs may issue Special Weather Statements (SPS) to supplement information contained in TWC tsunami messages. These SPSs follow a specified format as provided in regional supplements to ensure consistency between WFOs and WSOs in a Region.

WFOs and WSOs provide tsunami outreach and educational services to users and the general public within their County Warning Area (CWA). The TWCs will support these efforts as time and budget allow. WFOs and WSOs will oversee the TsunamiReady program within their CWA (reference NWSI 10-704 on the TsunamiReady program).

5. User Guides

User Guides serve as key reference manuals for participants of the TWS within a specific region and for a specific set of TWC products. They may provide a general overview of the nature of tsunamis, the tsunami history and threat within the region covered by the products, a brief history of the warning service, criteria for the issuance of specific products and alert levels, and may list the sea level and seismometer stations that transmit data to the TWCs responsible for the region. The Guides also provide examples of TWC tsunami products and list product dissemination routes.

Links to User Guides, their respective regions, and the agency(ies) responsible for maintaining the document are listed in Table 6. *Note: Currently inactive links will become active once the guides are uploaded to the respective URLs.*

Region	Link to User Guide	Responsible Organization
NTWC DSA	http://ntwc.arh.noaa.gov/operations/opsmanual.pdf	NTWC
Pacific Ocean and marginal seas	http://itic.ioc-unesco.org/index.php?option=com_content&view=category&layout=blog&id=1303&Itemid=1303&lang=en	PTWC, JMA, NTWC, ITIC, IOC
Caribbean Sea and adjacent regions	http://www.ioc-tsunami.org/index.php?option=com_oe&task=viewDocumentRecord&docID=6354&lang=en	PTWC, CTWP, IOC
PTWC Enhanced Products for the CARIBE-EWS	http://www.weather.gov/media/ctwp/PDF/CARIBE-EWS%20Users%20Guide%20-%20V1.2a.pdf	PTWC
Hawaii	http://ntwc.arh.noaa.gov/operations/HawaiiUserGuide.pdf	PTWC

American Samoa	http://ntwc.arh.noaa.gov/operations/AmSamoaUserGuide.pdf	PTWC
Guam/CNMI	http://ntwc.arh.noaa.gov/operations/GuamCNMIUserGuide.pdf	PTWC
Puerto Rico and the Virgin Islands	http://tsunami.gov/operations/PRVIUserGuide.pdf	PTWC, CTWP

Table 6. TWC User Guides.

APPENDIX – Acronyms

AFTN	Aeronautical Fixed Telecommunications System
AKWAS	Alaska Warning System
AOR	Area of Responsibility
AWIPS	Advanced Weather Interactive Processing System
CAP	Common Alerting Protocol
CARIBE-EWS	Tsunami and other Coastal Hazards Warning System for the Caribbean and Adjacent Regions
CWA	County Warning Area
DSA	Designated Service Area
EAS	Emergency Alert System
EIDS	Earthquake Information Dissemination System
EMWIN	Emergency Managers Weather Information Network
ETN	Event Tracking Number
FAA	Federal Aviation Administration
GTS	Global Telecommunications System
HAWAS	Hawaii Warning System
ICG	Intergovernmental Coordinating Group
IDN	Inter-island Data Network
IOC	Intergovernmental Oceanographic Commission
IOTWS	Indian Ocean Tsunami Warning and Mitigation System
ITIC	International Tsunami Information Center
JMA	Japan Meteorological Administration
MND	Mass News Disseminator
NADIN2	National Airspace Data Interchange Network
NAWAS	National Warning System
NEIC	National Earthquake Information Center
NOAA	National Oceanic and Atmospheric Administration
NTHMP	National Tsunami Hazard Mitigation Program
NTWC	National Tsunami Warning Center
NWPTAC	Northwest Pacific Tsunami Advisory Center
NWR	NOAA Weather Radio
NWS	National Weather Service
NWSI	National Weather Service Instruction
NWWS	NOAA Weather Wire System
PTWC	Pacific Tsunami Warning Center
PTWS	Pacific Tsunami Warning and Mitigation System
RSS	Really Simple Syndication
SMS	Short Messaging Service
SPS	Special Weather Statement
TSR	Tsunami Source Region
TWC	Tsunami Warning Center
TWS	Tsunami Warning System

UGC	Universal Geographic Code
UNESCO	United Nations Educational, Scientific, and Cultural Organization
USGS	United States Geological Survey
VTEC	Valid Time Event Code
WCS	Warning Coordination Subcommittee
WFO	Weather Forecast Office
WMO	World Meteorological Organization
XML	Extensible Markup Language