Informational Webinar
6 September 2022, 2200-2300 UTC

Pacific Tsunami Warning Center Interim Procedures for Tsunamis from the Hunga Tonga – Hunga Ha`apai Volcano

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General Challenges with Non-Seismic Tsunamis from Volcanoes, Landslides, Meteo, Bolides, etc.

No rapid alert

- Seismic waves give an alert within minutes of any large earthquake
- But no such alert for a landslide, volcano, bolide or meteo-tsunami
- Alert is only on later detection of tsunami waves

No source location

- Earthquake hypocenter and origin time quickly determined
- Landslide, volcano, meteo-tsunami source location only estimated later from tsunami arrival times on different gauges

No source mechanism

- Earthquake parameters and tsunami source mechanism can be determined quickly to estimate tsunami impacts and drive forecast models
- Landslide, volcano, and meteo-tsunami source mechanisms are only determined later – after event is over

No Forecast

- Earthquake-driven tsunami impacts can be numerically forecast
- Non-seismic tsunamis can only be observed and reported

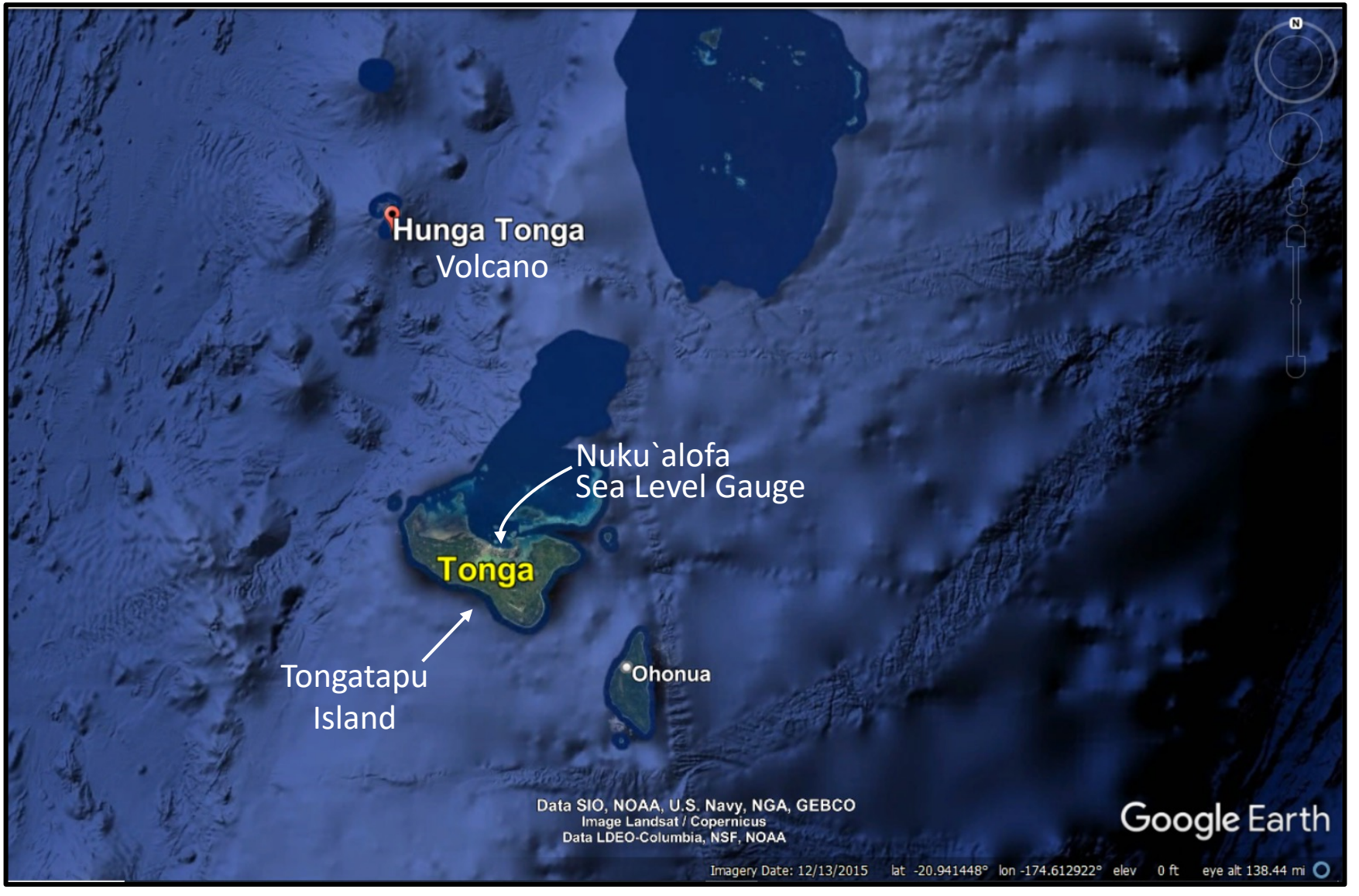
No Pre-Scripted Standard Products

- Appropriate products may need to be constructed on-the-fly to fit the situation
- Recipients may not respond appropriately to these products

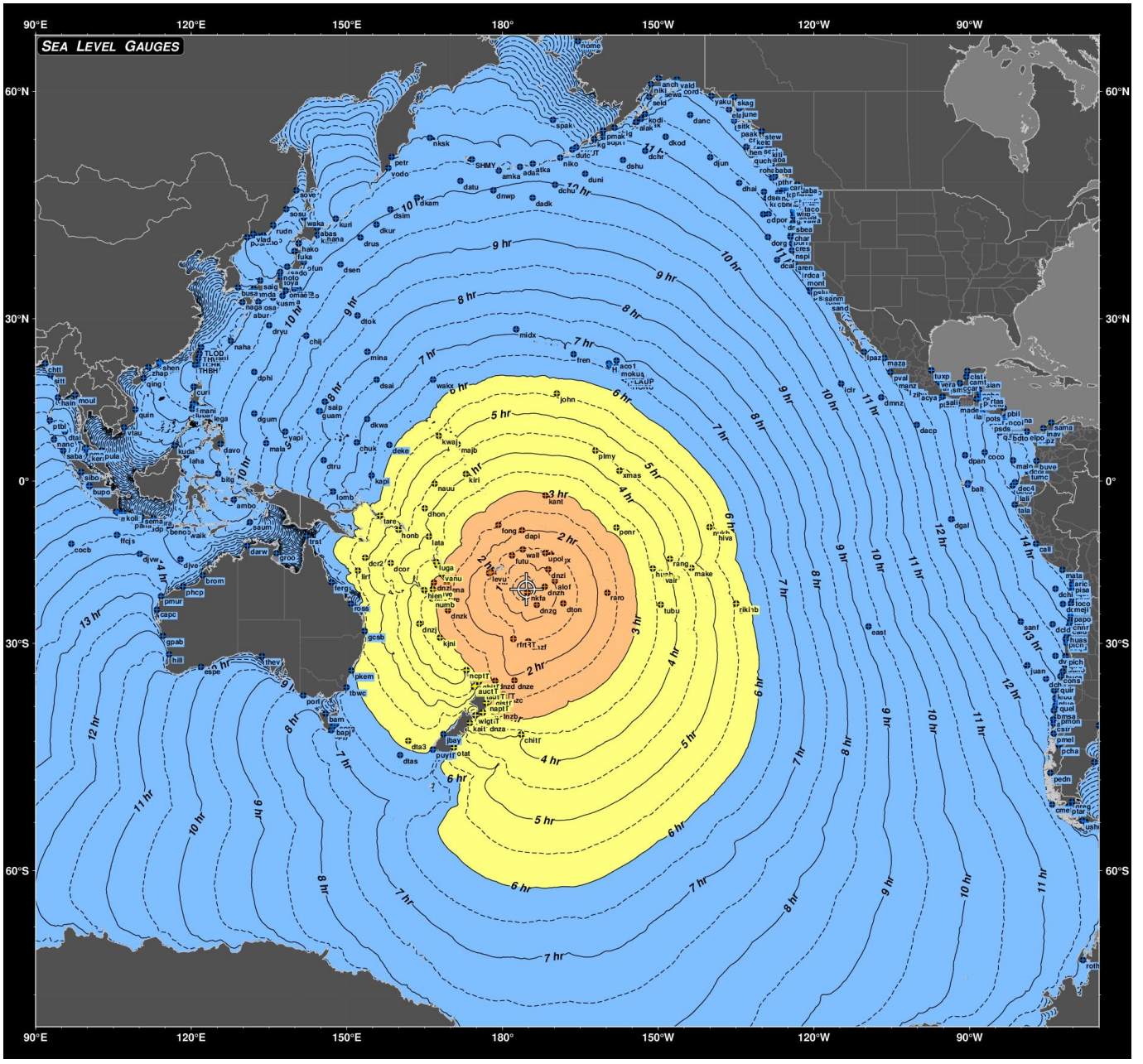
Alerting and Forecasting for Future HTHH Tsunamis

- **Messages use the same PTWC Product IDs as PTWC uses for earthquake - generated tsunamis in the PTWS**
- **Message content is similar but modified for the HTHH source**
- **Amplitude forecast is based on scaling the 1/15/2022 observations to match current event observations**
- **This is a "Best Effort" forecasting approach with caveats**
  - Tsunami generation mechanism at the HTHH may not be the same as on 1/15/22
  - Atmospheric pressure wave generation may or may not be present for a future event
  - Scaling for either type of generation mechanism may not be linear (e.g., if half as big on one gauge then half as big everywhere)
  - Amplitude forecasts are only for gauge locations, not entire coasts
  - Estimated arrival times are only based on the normal tsunami travel time calculation from the volcano – not on the atmospheric disturbance generation.

HTHH is about 70 km north of Tongatapu Island



Normal Tsunami Travel Times from HTHH



HTHH Event Response at PTWC

- **PTWC will be alerted by tsunami waves at the Nuku`alofa gauge or any other nearby gauge (~15 minutes after volcanic event)**
- **PTWC will immediately call the Tonga NTWC (Met Office) to report the waves**
- **The first arrival time and tsunami amplitude at the Nuku`alofa gauge will be measured and recorded.**
- **An initial PTWS Threat Message will be issued, nominally for all coasts within 3 hours tsunami travel time, that includes:**
  - **ETAs from HTHH based on the Nuku`alofa arrival time**
  - **An amplitude forecast at tide gauges based on scaling from the Nuku`alofa amplitude**
  - **ETAs at those tide gauges**

Sample Message Product

```
ZCZC WEPA40 PHEB 041555
TSUPAC

TEST...TSUNAMI MESSAGE NUMBER 1...TEST
NWS PACIFIC TSUNAMI WARNING CENTER HONOLULU HI
1555 UTC FRI MAR 4 2022

...THIS MESSAGE IS FOR TEST PURPOSES ONLY...
...TEST PTWC TSUNAMI THREAT MESSAGE TEST...


**** NOTICE **** NOTICE **** NOTICE **** NOTICE **** NOTICE *****

 THIS IS A TEST MESSAGE. 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.

 THIS IS A TEST MESSAGE. 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 *****
```

Sample Message Product

```
ZCZC WEPA40 PHEB 041555
TSUPAC
 ------------------------------------------------------------
TEST... VOLCANIC ACTIVITY IN TONGA GENERATED A TSUNAMI ...TEST
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TEST... PRELIMINARY VOLCANO PARAMETERS ...TEST
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  * ACTIVITY TIME  1530 UTC MAR 4 2022
  * COORDINATES    20.5 SOUTH  175.4 WEST
  * LOCATION       TONGA


TEST... EVALUATION ...TEST
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  * THIS IS A TEST MESSAGE. VOLCANIC ACTIVITY OCCURRED IN THE
    TONGA ISLANDS AT 1530 UTC ON FRIDAY MARCH 4 2022.
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Sample Message Product

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TEST... TSUNAMI THREAT FORECAST ...TEST
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  * THIS IS A TEST MESSAGE. HAZARDOUS TSUNAMI WAVES FROM THIS
    VOLCANIC ACTIVITY ARE POSSIBLE ALONG SOME COASTS OF

      TONGA... NIUE... AMERICAN SAMOA... WALLIS AND FUTUNA...
      SAMOA... KERMADEC ISLANDS... FIJI... TOKELAU... COOK
      ISLANDS... VANUATU... TUVALU... NEW ZEALAND... KIRIBATI...
      HOWLAND AND BAKER... NEW CALEDONIA... FRENCH POLYNESIA...
      JARVIS ISLAND... SOLOMON ISLANDS... PALMYRA ISLAND...
      NAURU... MARSHALL ISLANDS... KOSRAE... JOHNSTON ISLAND...
      PAPUA NEW GUINEA... AUSTRALIA... PITCAIRN... POHNPEI...
      WAKE ISLAND... HAWAII AND NORTHWEST HAWAII

  * THIS IS A TEST MESSAGE. BASED UPON THE INITIAL
    OBSERVATIONS... THIS TSUNAMI IS FORECAST TO BE ABOUT 0.5
    TIMES THE SIZE OF THE JANUARY 15 2022 TSUNAMI FROM THE SAME
    VOLCANO IN TONGA.
```

Sample Message Product

* THIS IS A TEST MESSAGE. THE FOLLOWING ARE FORECAST MAXIMUM TSUNAMI AMPLITUDES RELATIVE TO NORMAL SEA LEVEL AT COASTAL GAUGES WITHIN CURRENT THREAT AREA. THE FORECAST FOR EACH GAUGE IS BASED UPON SCALING THE MAXIMUM TSUNAMI AMPLITUDE MEASURED ON THAT GAUGE FOR THE JANUARY 15 2022 TSUNAMI USING THE SCALE FACTOR GIVEN ABOVE. TSUNAMI WAVES ALONG OTHER COASTS IN THE REGION OF EACH GAUGE MAY BE LARGER OR SMALLER THAN AT THE GAUGE. A SIMILAR SCALING OF ANY KNOWN JANUARY 15 IMPACTS ALONG THOSE COASTS CAN BE USED AS A GUIDE.

GAUGE LOCATION	COORDINATES LAT	LON	FIRST WAVE ETA (UTC)	FORECAST MAX TSUNAMI AMPLITUDE
NUKUALOFA TO	21.1S	175.2W	03/04 1548	0.41M/ 1.34FT
DART 5401003	23.4S	173.4W	03/04 1612	0.10M/ 0.34FT
DART 5401002	29.7S	175.0W	03/04 1655	0.05M/ 0.16FT
PAGO PAGO AS	14.3S	170.7W	03/04 1656	0.31M/ 1.02FT
APIA UPOLU WS	13.8S	171.8W	03/04 1706	0.09M/ 0.28FT
SUVA VITI LEVU FJ	18.1S	178.4E	03/04 1712	0.13M/ 0.43FT
DART 5401001	36.0S	177.7W	03/04 1737	0.04M/ 0.11FT
RAROTONGA CK	21.2S	159.8W	03/04 1745	0.45M/ 1.48FT
DART 5501004	36.1S	178.6E	03/04 1757	0.05M/ 0.18FT
EAST CAPE NZ	37.5S	178.2E	03/04 1814	0.13M/ 0.43FT
FONGAFALE TV	8.5S	179.2E	03/04 1819	0.06M/ 0.20FT
MARE NEW CALEDONIA F	21.5S	167.9E	03/04 1822	0.38M/ 1.23FT

Sample Message Product

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TEST... RECOMMENDED ACTIONS ...TEST
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  * THIS IS A TEST MESSAGE. GOVERNMENT AGENCIES RESPONSIBLE FOR
    THREATENED COASTAL AREAS SHOULD TAKE ACTION TO INFORM AND
    INSTRUCT ANY COASTAL POPULATIONS AT RISK IN ACCORDANCE WITH
    THEIR OWN EVALUATION... PROCEDURES AND THE LEVEL OF THREAT.

  * THIS IS A TEST MESSAGE. PERSONS LOCATED IN THREATENED COASTAL
    AREAS SHOULD STAY ALERT FOR INFORMATION AND FOLLOW
    INSTRUCTIONS FROM NATIONAL AND LOCAL AUTHORITIES.
```

Sample Message Product

TEST... ESTIMATED TIMES OF ARRIVAL ...TEST

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* THIS IS A TEST MESSAGE. ESTIMATED TIMES OF ARRIVAL -ETA- OF THE INITIAL TSUNAMI WAVE FOR PLACES WITHIN THE THREAT REGION. ACTUAL ARRIVAL TIMES MAY DIFFER AND THE INITIAL WAVE MAY NOT BE THE LARGEST. A TSUNAMI IS A SERIES OF WAVES AND THE TIME BETWEEN WAVES CAN BE FIVE MINUTES TO ONE HOUR.

LOCATION	REGION	COORDINATES	ETA(UTC)
NUKUALOFA	TONGA	21.0S 175.2W	1540 03/04
HOLEVA	TONGA	18.6S 173.9W	1606 03/04
NIUE ISLAND	NIUE	19.0S 170.0W	1631 03/04
NIUATOPUTAPU	TONGA	15.9S 173.8W	1635 03/04
PAGO PAGO	AMERICAN SAMOA	14.3S 170.7W	1652 03/04
FUTUNA ISLAND	WALLIS AND FUTUN	14.3S 178.2W	1655 03/04
WALLIS ISLAND	WALLIS AND FUTUN	13.2S 176.2W	1659 03/04
APIA	SAMOA	13.8S 171.8W	1706 03/04
RAOUL ISLAND	KERMADEC ISLANDS	29.2S 177.9W	1709 03/04
SUVA	FIJI	18.1S 178.4E	1712 03/04
NUKUNONU ISLAND	TOKELAU	9.2S 171.8W	1737 03/04
PUKAPUKA ISLAND	COOK ISLANDS	10.8S 165.9W	1739 03/04
RAROTONGA	COOK ISLANDS	21.2S 159.8W	1745 03/04

Sample Message Product

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TEST... POTENTIAL IMPACTS ...TEST
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  * THIS IS A TEST MESSAGE. A TSUNAMI IS A SERIES OF WAVES. THE
    TIME BETWEEN WAVE CRESTS CAN VARY FROM 5 MINUTES TO AN HOUR.
    THE HAZARD MAY PERSIST FOR MANY HOURS OR LONGER AFTER THE
    INITIAL WAVE.

  * THIS IS A TEST MESSAGE. IMPACTS CAN VARY SIGNIFICANTLY FROM
    ONE SECTION OF COAST TO THE NEXT DUE TO LOCAL BATHYMETRY AND
    THE SHAPE AND ELEVATION OF THE SHORELINE.

  * THIS IS A TEST MESSAGE. IMPACTS CAN ALSO VARY DEPENDING UPON
    THE STATE OF THE TIDE AT THE TIME OF THE MAXIMUM TSUNAMI
    WAVES.

  * THIS IS A TEST MESSAGE. PERSONS CAUGHT IN THE WATER OF A
    TSUNAMI MAY DROWN... BE CRUSHED BY DEBRIS IN THE WATER... OR
    BE SWEPT OUT TO SEA.
```

Sample Message Product

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TEST... TSUNAMI OBSERVATIONS ...TEST
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  * THIS IS A TEST MESSAGE. THE FOLLOWING ARE TSUNAMI WAVE
    OBSERVATIONS FROM COASTAL AND/OR DEEP-OCEAN SEA LEVEL GAUGES
    AT THE INDICATED LOCATIONS. THE MAXIMUM TSUNAMI AMPLITUDE IS
    MEASURED WITH RESPECT TO THE NORMAL TIDE LEVEL.

                            GAUGE        TIME OF    MAXIMUM      WAVE
                         COORDINATES     MEASURE    TSUNAMI    PERIOD
    GAUGE LOCATION        LAT    LON      (UTC)    AMPLITUDE     (MIN)
    ------------------------------------------------------------------
    NUKUALOFA TO         21.1S 175.2W     1550    0.39M/ 1.3FT   04
```

Sample Message Product

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TEST... NEXT UPDATE AND ADDITIONAL INFORMATION ...TEST
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  * THIS IS A TEST MESSAGE. THE NEXT MESSAGE WILL BE ISSUED IN
    ONE HOUR... OR SOONER IF THE SITUATION WARRANTS.

  * THIS IS A TEST MESSAGE. FURTHER INFORMATION ABOUT THIS EVENT
    MAY BE FOUND AT WWW.TSUNAMI.GOV.

  * THIS IS A TEST MESSAGE. COASTAL REGIONS OF HAWAII... AMERICAN
    SAMOA... GUAM... AND CNMI SHOULD REFER TO PACIFIC TSUNAMI
    WARNING CENTER MESSAGES SPECIFICALLY FOR THOSE PLACES THAT
    CAN BE FOUND AT WWW.TSUNAMI.GOV.

  * THIS IS A TEST MESSAGE. COASTAL REGIONS OF CALIFORNIA...
    OREGON... WASHINGTON... BRITISH COLUMBIA AND ALASKA SHOULD
    ONLY REFER TO U.S. NATIONAL TSUNAMI WARNING CENTER MESSAGES
    THAT CAN BE FOUND AT WWW.TSUNAMI.GOV.
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The PTWC Interim Procedures - Dissemination

- **Dissemination will be through all the normal ways that current PTWS messages are sent**
  - **GTS**
  - **Email**
  - **Fax**
  - **AFTN**
- **There are no graphical products**
- **An SMS will be sent with the first message to alert key government officials in Tonga**
- **The Tonga Meteorological Office will be called to**
- **Messages will appear on the tsunami.gov website, but will indicate an earthquake with a magnitude of 1**
- **Messages will be issued at least once an hour until the threat has passed**

HTHH Event Response at PTWC - Continued

- The tsunami will be monitored on sea level gauges as it propagates and additional measurements will be made
- Based on the additional tide gauge readings:
  - The forecast will be adjusted if necessary
  - The threat area will be expanded or contracted
- A final Threat Message will be issued when readings on all (or most) gauges are below 0.3m amplitude and when no further impacts above 0.3m are anticipated elsewhere.

Note: An HTHH Information Statement has also been implemented to cover any non-threat situation where a message may be useful.

Thank You

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