



UNESCO IOC – NOAA International Tsunami Information Center (ITIC)

NOAA Pacific Environmental Laboratory,
NOAA Center for Tsunami Research (PMEL/NCTR)

Pacific Tsunami Warning Center (PTWC)

Tsunami Coastal Assessment Tool

TsuCAT

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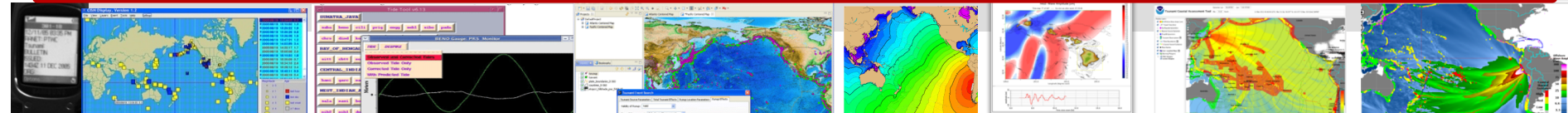


Tsunami Warning Decision Support Tools

ITIC-distributed, supported

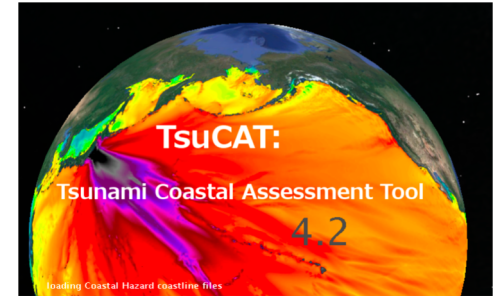


- ❑ **Tsunami Bull Board** (ITIC, 1995) ~450 science/tsu/govt
- ❑ **Real time EQ Display** (v1.7+ (CISN, USGS / NTHMP, 2005), ~250
- ❑ **Real-time Sea Level monitoring**
 - Tide Tool v10.55 – TWC operations monitoring (PTWC, 2005)
 - IOC Sea Level Monitoring web site (IOC, 2008)
- ❑ **Tsunami Travel Time Software** v4.0 (ITIC, NGDC, 2007) – upgrade 2018 to TTSDK4.0
- ❑ **Tsunami Historical Database** Online (WDS-NCEI), Offline (TsuDig, NCEI, ITIC, 2009)
- ❑ **Tsunami Hazard Assessment Tools (2017)**
 - ComMIT/MOST inundation modeling (PMEL 2000, update TEMPP evac map training 2015)
 - Tsunami Coastal Assessment Tool v4.2 Oct 2020 (TsuCAT, PMEL, ITIC)



TsuCAT: Tsunami Coastal Assessment Tool (NCTR, ITIC)

- ❑ **Why / What:** Request by Pacific Islands for warning DSS
Gives country capacity to assess tsunami hazard
- ❑ **Who:** Country agencies with Tsunami Hazard Assessment, Warning and Emergency Response responsibilities
- ❑ **Tool use:**
 - Planning tool - assess threat before – ‘energy beams’
 - Decision system support tool – Customize country sub-regions (polygons), Quick, early assessment through DB lookup
 - Exercise tool – develop scenarios to use (from v4.0, 2019)
- ❑ **Features:**
 - Database: ~5400 earthquake scenarios from along active subduction zones, Pacific, Caribbean, Indian Ocean (M6.5-9.5)
 - Scenarios from Expert Meetings (Caribbean, Pacific)
 - Results from NOAA models (MOST/SIFT (M8+), RIFT (M6.5-7.9))
 - Offshore max amplitude / coastal wave amplitude (Green’s Law)
 - PTWC or User custom forecast polygons



TsuCAT - Background



□ Requirements:

- Offline (no internet required) - portable
Online (internet, adds geographic map tiles (OpenStreet, ESRI))
- Platform: Windows, Linux, Macintosh; Java v1.8
- Storage: 27 GB; No installation - run from flash drive
- Bathymetric grid resolution: MOST (compute 4 arc-min),
RIFT (compute 4 arc-min decr to 30 arc-sec)

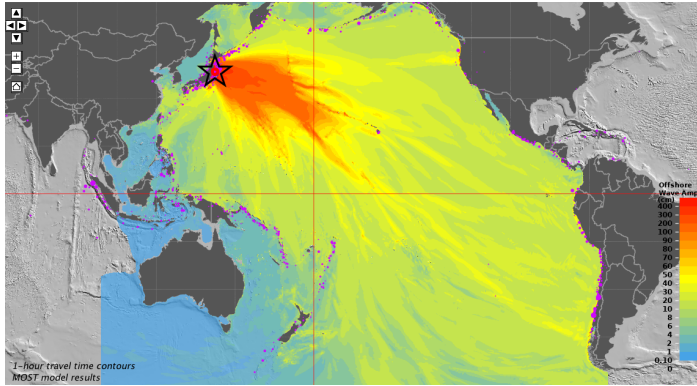
□ Layers

- Offshore Wave Amplitude, Coastal Hazard Guidance, Travel Time
- PTWC coastal polygons, or user-customized
- Results export – model, regional report
- Reference information: Historical Seismicity(USGS, NOAA NCEI Significant),
Tsunami Observations (NOAA NCEI), USGS Plate boundaries, Place names
- User-supplied maps (polygon shape files), Quick guide tutorial
- PTWC Enhanced Products Exercise messages

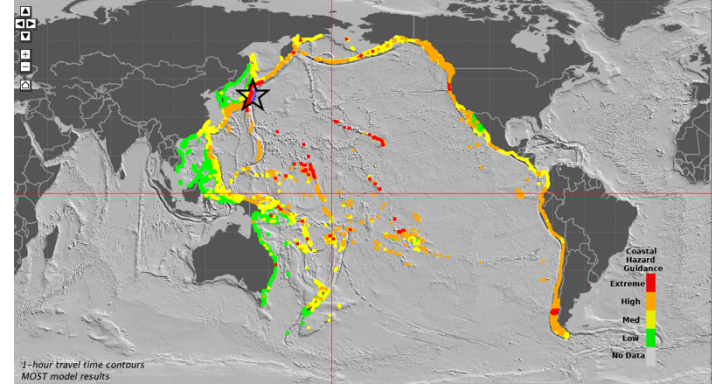
TsuCAT: Coastal Impact DB Tool



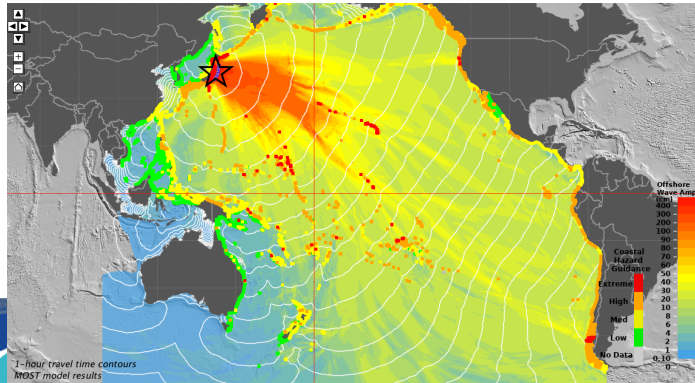
Deep-Ocean Offshore Max Ampl – Historical seismicity



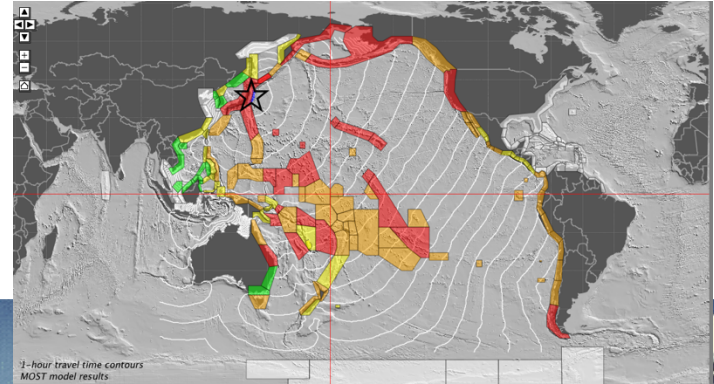
Coastal Hazard Guidance Ampl (CHG)



Offshore – CHG – Tsunami Travel Times (TTT)



PTWC Coastal Polygons – TTT



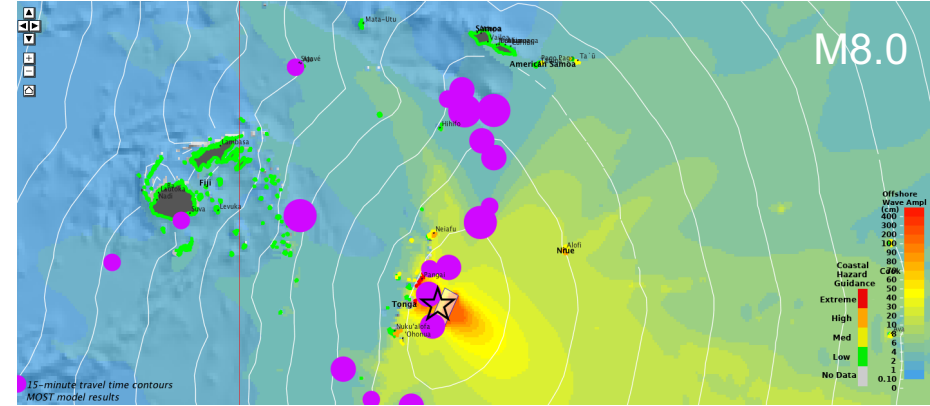
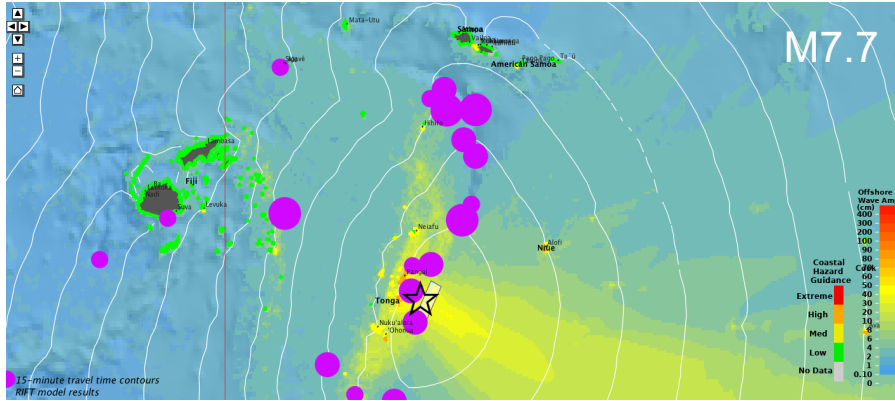
TsuCAT – Tool Applications



- ❑ **Hazard Assessment** - conduct study to determine worst case, or likely impact, to a country's coast from different scenarios
- ❑ **Exercise development** - decide which scenario to use for a tsunami exercise, generate PTWC exercise messages
- ❑ **Response Planning** – use scenarios to develop tsunami response plans, protocol and procedures (SOPs)
- ❑ **Warning decision making** – estimate tsunami impact using the nearest similar scenario during a real event (early assessment prior to receiving PTWC forecast products)

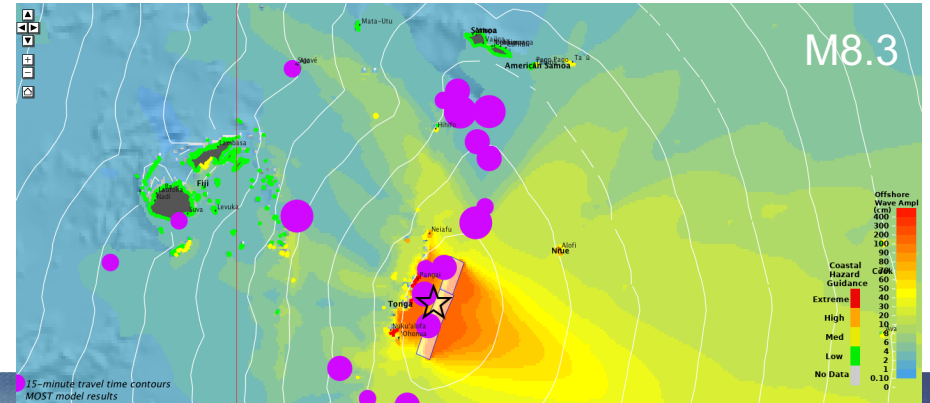


Threat Assessment



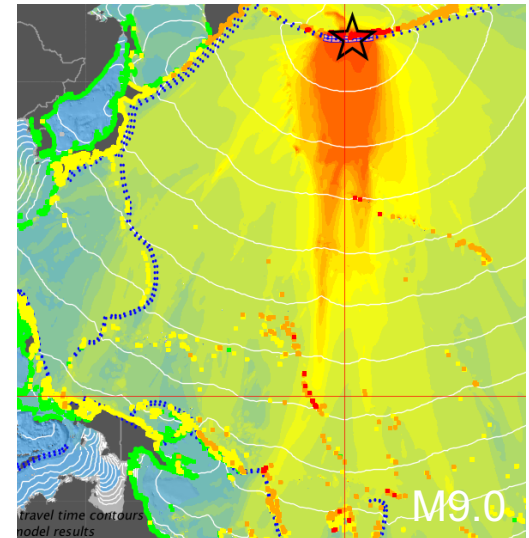
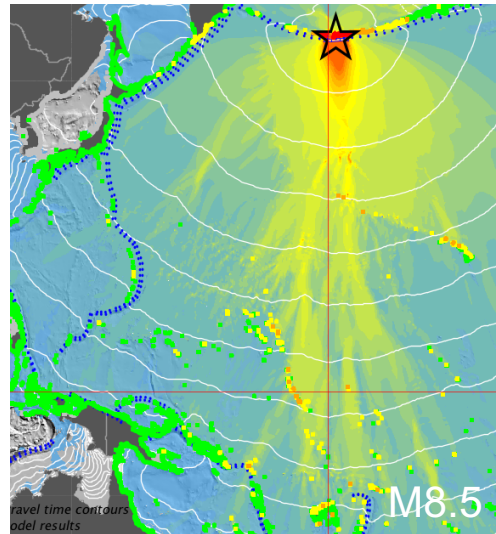
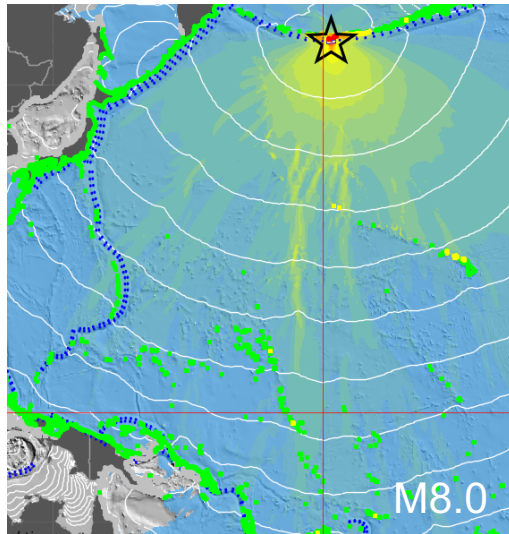
What size earthquake is most dangerous to Tonga?

Central Tonga source
M7.7, 8.0, 8.3



Threat Assessment

What size earthquake is most dangerous?
Aleutian Trench source: M8.0, 8.5, 9.0



TsuCAT – Generate Exercise messages



- ❑ **PTWC Public Text and Enhanced Products for events in TsuCAT pre-computed database**
- ❑ **Select Menu - “Export Exercise Messages”**
 - Set Event (historical database or by mouse, origin time, magnitude)
 - Choose Generate (PTWC Text Messages, Enhanced Products (graphical, polygon table, kmz file)
 - Output folder, e.g., message/2019-04-02_0000_M9.0_Russia_PTWCproducts
- ❑ **Varying issue time and magnitude update**



GUI – Export Exercise Messages – 1957 Kamchatka M9.0



Export Exercise Messages

Mag: 9.0 Epicenter: 52.688°N, 160.549°E

Adjust for date of Exercise: 10/16/2020 02:38 Generate 00:06 Message 1

00:33 Coastal Forecast Polygons

00:23 Coastal Forecast Amplitude

00:23 Deep Ocean Forecast Amplitude

00:23 Coastal Forecast Polygons

00:23 Regional West Central Pacific

00:23 Regional South Central Pacific

00:23 Regional South China Sea

00:23 Regional Northwest Pacific

Text Messages Graphical Products

TEST...TSUNAMI MESSAGE NUMBER 1...TEST
NWS PACIFIC TSUNAMI WARNING CENTER EKA BEACH HI
0244 UTC FRI OCT 16 2020
...THIS MESSAGE IS FOR TEST PURPOSES ONLY...
...TEST PTWC TSUNAMI THREAT MESSAGE TEST...

**** 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 ****

TEST... PRELIMINARY EARTHQUAKE PARAMETERS ...TEST

- * MAGNITUDE 8.8
- * ORIGIN TIME 0238 UTC FRI OCT 16 2020
- * COORDINATES 52.7 NORTH 160.5 EAST
- * DEPTH 22 / 14 MILES
- * LOCATION OFF THE EAST COAST OF THE KAMCHATKA PENINSULA, RUSSIA

TEST... EVALUATION ...TEST

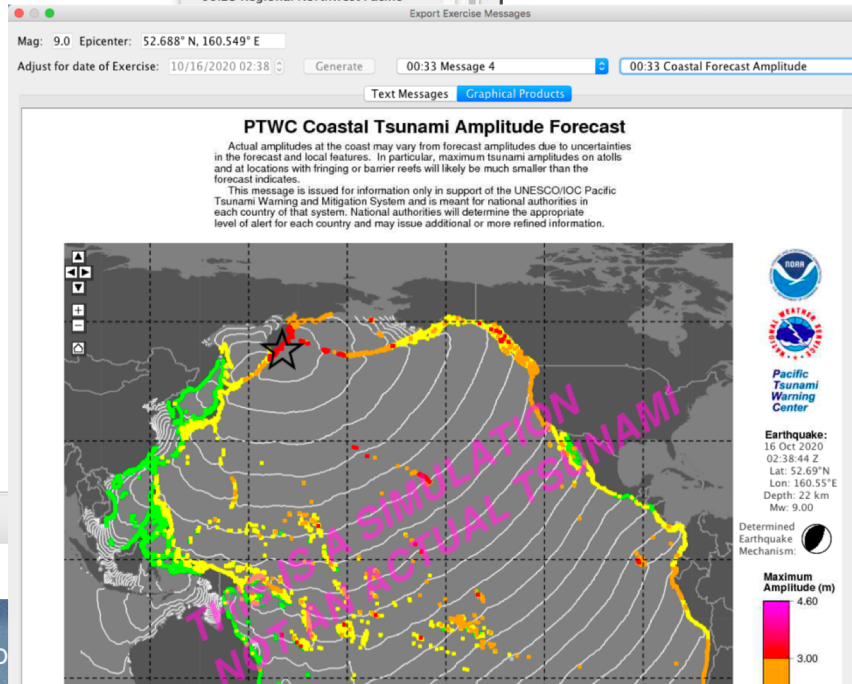
- * AN EARTHQUAKE WITH A PRELIMINARY MAGNITUDE OF 8.8 OCCURRED
OFF THE EAST COAST OF THE KAMCHATKA PENINSULA, RUSSIA AT 0238 UTC FRIDAY
OCTOBER 16 2020
- * THIS IS A TEST MESSAGE.
- * BASED ON THE PRELIMINARY EARTHQUAKE PARAMETERS... WIDESPREAD
HAZARDOUS TSUNAMI WAVES ARE POSSIBLE.

TEST... TSUNAMI THREAT FORECAST ...TEST

- * HAZARDOUS TSUNAMI WAVES FROM THIS EARTHQUAKE ARE POSSIBLE
WITHIN THE NEXT THREE HOURS ALONG SOME COASTS OF
RUSSIA... ALASKA AND JAPAN.

TEST... RECOMMENDED ACTIONS ...TEST

completed.



2020-10-16_0238_M9.0_Russia_PTWCproducts

View Arrange Action Share Edit Tags

Name

- PTWC_msg10_2020_10_16_0238.rtf
- PTWC_msg17_2020_10_16_0238.rtf
- PTWC_msg18_2020_10_16_0238.rtf
- PTWC_msg19_2020_10_16_0238.rtf
- PTWC_msg20_2020_10_16_0238.rtf
- PTWC_msg21_2020_10_16_0238.rtf
- PTWC_msg22_2020_10_16_0238.rtf
- PTWC_msg23_2020_10_16_0238.rtf
- PTWC_msg24_2020_10_16_0238.rtf
- PTWC_msg25_2020_10_16_0238.rtf
- PTWC_msg26_2020_10_16_0238.rtf
- PTWC_msg27_2020_10_16_0238.rtf
- PTWC_msg28_2020_10_16_0238.rtf
- PTWC_msg29_2020_10_16_0238.rtf
- PTWC_msg30_2020_10_16_0238.rtf
- PTWC_msg31_2020_10_16_0238.rtf
- PTWC_msg32_2020_10_16_0238.rtf
- ThreatGraphical_msg3_regional
 - ptwcregionalmaps1of2
 - Coastal_Forecast_Northwest_Pacific.png
 - Coastal_Forecast_South_America.png
 - Coastal_Forecast_South_Central_Pacific.png
 - Coastal_Forecast_South_China_Sea.png
 - Coastal_Forecast_Southwest_Pacific.png
 - Coastal_Forecast_South_Central_Pacific.png
 - ptwcregionalmaps2of2
 - ptwcregionalmaps2of2
 - ptwcregionalmaps2of2
 - coastal_amp.kmz
 - Coastal_Forecast_Regional.png
 - Deep_Ocean_Forecast_Regional.png
 - polygons_table.txt
 - PTWS_Forecast_Polygons_Regional.png
 - ThreatGraphical_msg4_BasinWide
 - ptwcregionalmaps1of2
 - ptwcregionalmaps2of2



PTWC Messages – Test - Exercise only



1957 Kamchatka M9.0

TEST...TSUNAMI MESSAGE NUMBER 31...TEST
NWS PACIFIC TSUNAMI WARNING CENTER EWA BEACH HI
0500 UTC WED APR 3 2019

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

**** 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 ****

THE TSUNAMI FORECAST IS UNCHANGED IN THIS MESSAGE.

TEST... PRELIMINARY EARTHQUAKE PARAMETERS ...TEST

* MAGNITUDE 9.0
* ORIGIN TIME 0000 UTC TUE APR 2 2019
* COORDINATES 52.8 NORTH 160.1 EAST
* DEPTH 22 / 14 MILES
* LOCATION OFF THE EAST COAST OF THE KAMCHATKA PENINSULA, RUSSIA

TEST... EVALUATION ...TEST

* AN EARTHQUAKE WITH A PRELIMINARY MAGNITUDE OF 9.0 OCCURRED
OFF THE EAST COAST OF THE KAMCHATKA PENINSULA, RUSSIA AT 0000 UTC TUESDAY
APRIL 2 2019

* THIS IS A TEST MESSAGE.

* BASED ON ALL AVAILABLE DATA... THE TSUNAMI THREAT FROM
THIS EARTHQUAKE HAS NOW PASSED.

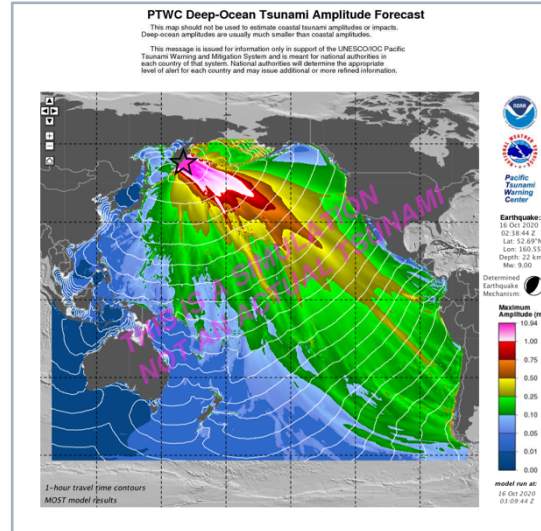
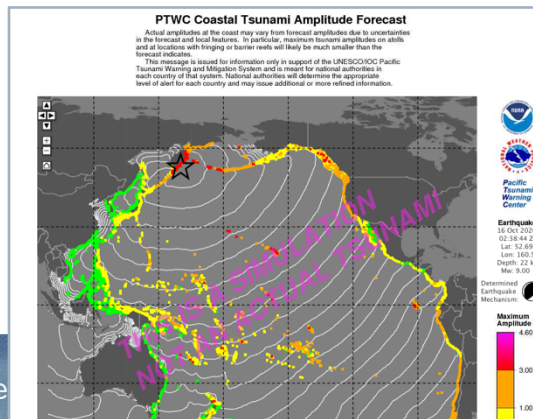
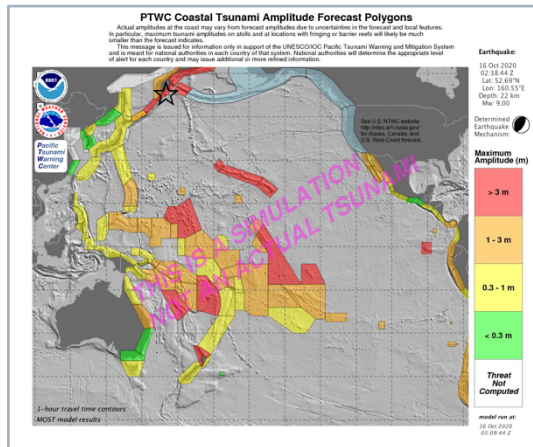
TEST... TSUNAMI THREAT FORECAST...UPDATED ...TEST

* THE TSUNAMI THREAT HAS NOW LARGELY PASSED.

TEST... RECOMMENDED ACTIONS ...TEST

* THIS IS A TEST MESSAGE.

* GOVERNMENT AGENCIES RESPONSIBLE FOR THREATENED COASTAL AREAS
SHOULD TAKE ACTION TO INFORM AND INSTRUCT ANY COASTAL



*** THIS IS A SIMULATION, NOT AN ACTUAL TSUNAMI ***

*** THIS IS A SIMULATION, NOT AN ACTUAL TSUNAMI ***

PTWC TABLE OF FORECAST STATISTICS FOR REGIONAL POLYGONS - RUN ID 20201016030944

(For internal use only - not for distribution)

Earthquake - Origin: 10/16/2020 02:38:44 UTC Coordinates: 52.7N 160.5E Depth: 022km Magnitude: 9.0

This table 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.

Actual amplitudes at the coast may vary from forecast amplitudes due to uncertainties in the forecast and local features. In particular, maximum tsunami amplitudes on atolls will likely be much smaller than the forecast indicates.

Region Name	Coastal Forecast (meters)					Offshore Forecast (meters)					Total
	Maximum	Mean	Median	STD	STD	Maximum	Mean	Median	STD	STD	
Pacific_Coast_of_Kamchatka_Russia	28.83	17.63	21.31	7.55	4.68	2.93	3.58	1.29	157		
Komandorsky_Islands_Russia	11.03	5.96	2.86	4.00	1.91	1.01	0.46	0.69	38		
Bering_Sea_Coast_of_Eastern_Russia	8.92	2.37	2.41	1.03	1.44	0.40	0.41	0.17	264		
Kuril_Islands_Russia	6.16	1.42	0.87	1.35	1.08	0.25	0.15	0.24	94		
Line_Islands_Kiribati	4.86	2.53	2.01	1.14	0.81	0.42	0.34	0.19	147		
Marquesas_Islands	4.51	2.18	1.13	1.65	0.74	0.35	0.16	0.28	3		
Galapagos_Islands	4.38	1.74	1.66	0.63	0.53	0.27	0.26	0.07	24		
Midway_Island	4.32	1.97	1.77	0.71	0.76	0.33	0.30	0.12	94		
Northwestern_Hawaiian_Islands	3.79	3.24	3.39	0.41	0.54	0.51	0.54	0.06	13		
Vanuatu	3.68	2.52	2.36	0.81	0.61	0.41	0.36	0.13	5		
Vanuatu:Tafea	2.98	0.58	0.52	0.28	0.40	0.10	0.09	0.04	188		
Society_Islands	2.98	0.51	0.45	0.41	0.40	0.09	0.08	0.05	38		
South_Central_Chile	2.74	1.53	1.40	0.34	0.46	0.27	0.25	0.06	156		
Southern_Chile	2.74	1.48	1.51	0.54	0.46	0.25	0.26	0.09	349		
New_Caledonia	2.68	0.41	0.40	0.27	0.38	0.07	0.07	0.04	153		
Palmyra_Island	2.63	2.63	2.63	0.00	0.42	0.42	0.42	0.00	1		

Summary Information

□ 2018-19 improvements (v3 and v4):

- 2018 (v3.0) – security, global bathymetric DB (remove seam), higher-resolution SIFT/RIFT runs
- 2019 (v4.0) - PTWC messages (text and enhanced graphical products) so countries able to conduct exercises on their own)
- 2019 (v4.x) – Include Scenarios from Expert Meetings (Caribbean, Pacific); input addtl data layers (such as ComMIT layer/inundation)

□ Information, questions, feedback:

Web site

http://itic.ioc-unesco.org/index.php?option=com_content&view=category&layout=blog&id=2239&Itemid=2763

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Christopher.Moore@noaa.gov, Marie.C.Eble@noaa.gov



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Thank You

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Dr. Laura Kong
ITIC

Dr. Charles McCreery
PTWC

How to use

- ❑ **Run from flash drive (or can copy to hard disk, 27 GB)**
- ❑ **Requirement – Java 1.8x installed**

<https://java.com/en/download/>

- ❑ **Click on application (Window, Mac, Linux)**
 - On 1st time opening, set password (unique to user)
 - Default is 'No Internet'
 - With Internet, will
 - ❑ Seek updates EQ & Tsunami database files (not needed often)
 - ❑ Use additional online map databases (more detailed but requires bandwidth)
 - Enter 'start' password, Set 'personal' password

TsuCAT hands-on activity

- **Open TsuCAT, set your password**

- **Explore TsuCAT features**

1. Understand user preferences. Setting Coastal Hazard Guidance ranges.
2. Selection and variation of source using menu and mouse
3. PTWC polygons and Customized polygons
4. Understand what is (and what is not) in regional reports

- **Hazard Assessment – Country response planning**

1. Create a summary of what distant or regional source region is most hazardous to your country

- **Tsunami Warning – Country TWC Warning Criteria**

Based on the database assessment and your country's warning criteria, what will you place your country in for the following:

1. MX1 earthquake in Y1 trench (or off Z1 country)
2. MX2 earthquake in Y2 trench (of off Z2 country)

- **Generate PTWC messages for exercise** - Choose scenario, create messages