unesco
Intergovernmental Oceanographic Commission

MICRONESIA MANAGER'S MEETING
TSUNAMI EVENTS and TSUNAMI READY
26-27 February 2024, Hilton Guam, Tamuning, Guam, USA
Update January 2026

Review – 2 Dec 2023, Philippines
WSO Decision-making challenges
Tsunami SOPs

Dr. Laura Kong
International Tsunami Information Centre (ITIC)

2 Dec 2023 – off Philippines (Pacific) - Timeline

Clock	Time since	ACTION
1437 Z	0	ORIGIN TIME EARTHQUAKE:
143706	0	Earthquake occurs at [08.61N, 126.45E], MINDANAO, PHILIPPINES
144247	05	PTWC sends observatory message: H 14:37:05Z DEC 02 2023Z LAT 8.48N LONG 126.87E DEPTH 72.3km Mwp 7.67 (5 STATIONS)
1444 Z	07	PTWC MSG 1: M7.7, EQ-based tsunami hazard, HAZARDOUS TSUNAMI WAVES FROM THIS EARTHQUAKE ARE POSSIBLE WITHIN 1000 KM OF THE EPICENTER ALONG THE COASTS OF PHILIPPINES... INDONESIA... PALAU AND MALAYSIA
1501 Z	24	NWPTAC MSG 1: M7.7, EQ using PTWC parameters, DESTRUCTIVE REGIONAL TSUNAMI, FORECAST: 0.3-1 M EAST COASTS OF PHILIPPINES, MARIANA ISLANDS, MICRONESIA, 1-3 M PALAU
1525 Z	48	NWPTAC MSG 2: M7.5, GRAPHICAL PRODUCTS, REVISED FORECAST DESTRUCTIVE LOCAL TSUNAMI NEAR THE EPICENTER, FORECAST: 0.3-1 M EAST COASTS OF PHILIPPINES, 1-3 M PALAU
1535 Z	58	PTWC MSG 2: M7.6, FORECAST, 1-3 PHILIPPINES, 0.3-1 PALAU
1645 Z	2:08	PTWC MSG 3: FINAL
1713 Z	2:36	NWPTAC MSG 3: M7.6,0.3-1 M EAST COASTS OF PHILIPPINES, 1-3 M PALAU. OBSERVATION: DAVAO MAXIMUM TSUNAMI WAVE 1525Z 02 DEC 0.1M
1953 Z	5:16	NWPTAC MSG 4: TOSASHIMIZU 0.2 M
2055 Z	6:18	NWPTAC MSG 5: OMAEZAKI 0.1 M

WHEN DID WSO TELL NEMO TO SOUND SIRENS?

PTWC ETA MALAKAL PALAU 1618 12/02

Detailed Timeline

2 Dec 2023 – Detailed Timeline 1/3

Detailed Timeline

BACKGROUND

PTWC On duty: Main event: DL (shift), AN (standby), CM (came in at 15:32Z, before bulletin #2). aftershock: AN (shift), CM, DL (standby)

ITIC: Laura Kong in contact with PTWC throughout the event (talked to PTWC: Dailin, Andre, Chip, @ 1505 1506, 1515, 1519, 1543, 1632, 1653, 1655, 1805), ROC Patrick Cioffi (1536, 1704Z); contacting nearby countries and relayed to use the JMA forecasts since no PTWC.

Laura (email 0026Z)- Called WSO Palau 3 times after talking to PTWC (1510Z, 1557Z, 1641Z).
WSO on duty Rick Dizon, no Meteorologists in office, MIC off island. Joined later by Godwin

TIMELINE (aftershock M6.9 at 1604 UTC)

Clock	Time since	ACTION
1437 Z	0	ORIGIN TIME EARTHQUAKE:
143706	0	Earthquake occurs at [08.61N, 126.45E], MINDANAO, PHILIPPINES
143917	02	PTWC Operations alerted by: EQ: EAST INDIAN O: TNTI DAV PENDING TO All
144111	04	PTWC Operations alerted by: 7.0Mwp dt=245s ALL MINDANAO, PHILIPPINES 8.5N 127.0E 50km N=8 gap=200 RMS=1.5 Csta=1.9 2023/12/02 14:37:06
144247	05	PTWC sends observatory message: H 14:37:05Z DEC 02 2023Z LAT 8.48N LONG 126.87E DEPTH 72.3km Mwp 7.67 (5 STATIONS)
1444 Z	07	PTWC MSG 1: M7.7, EQ-based tsunami hazard, HAZARDOUS TSUNAMI WAVES FROM THIS EARTHQUAKE ARE POSSIBLE WITHIN 1000 KM OF THE EPICENTER ALONG THE COASTS OF PHILIPPINES... INDONESIA... PALAU AND MALAYSIA

Decision 1.
Knowing PTWC ETA MALAKAL 1618
What time do you need to make decision by?

The time needed to evacuate determines when you need to sound sirens (1 hr, 2 hrs before wave arrival?)

2 Dec 2023 – Detailed Timeline 2/3

1444 Z	07	PTWC MSG 1: M7.7, EQ-based tsunami hazard, HAZARDOUS TSUNAMI WAVES FROM THIS EARTHQUAKE ARE POSSIBLE WITHIN 1000 KM OF THE EPICENTER ALONG THE COASTS OF PHILIPPINES... INDONESIA... PALAU AND MALAYSIA
1501 Z	24	NWPTAC MSG 1: M7.7, EQ using PTWC parameters, DESTRUCTIVE REGIONAL TSUNAMI, FORECAST: 0.3-1 M EAST COASTS OF PHILIPPINES, MARIANA ISLANDS, MICRONESIA, 1-3 M PALAU
1510 Z	33	Laura to WSO Palau: confirmed received NWPTAC 1501 Z (forecast 1-3 m) and PTWC 1444 Z messages. Reminded Malakal ETA. Conveyed that PTWC early RIFT (unofficial from Darlin) indicate small (advisory levels). WSO to inform Palau National Emergency Committee (NEMO is lead). Also call WSO Meteorologists
1525 Z	48	NWPTAC MSG 2: M7.5, GRAPHICAL PRODUCTS, REVISED FORECAST DESTRUCTIVE LOCAL TSUNAMI NEAR THE EPICENTER, FORECAST: 0.3-1 M EAST COASTS OF PHILIPPINES, 1-3 M PALAU
1535 Z	58	PTWC MSG 2: M7.6, FORECAST, 1-3 PHILIPPINES, 0.3-1 PALAU
1557 Z	1:20	Laura to WSO Palau: Confirmed PTWC forecast is 0.3-1, so it is below Palau National Tsunami Warning Threshold (1 m). Reminded that Malakal gauge is in bay, so may be bigger (or smaller) on coasts facing Philippines. In morning they should check coastlines for any tsunami evidence (debris lines, etc)

PTWC ETA MALAKAL 1618Z

Decision 2. JMA, PTWC different => Use most conservative

If have more time (& not same), then wait

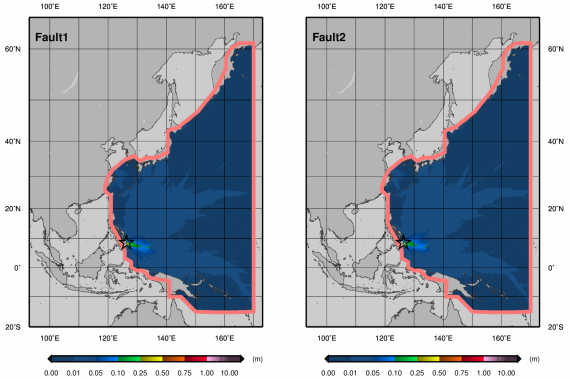
1525Z: NWPTAC Enhanced Products - forecasts

NWPTAC Deep–Ocean Tsunami Amplitude Forecast

The amplitudes shown on these maps are maximum values in meters from the undisturbed sea level to the crest.

Maps should not be used to estimate coastal tsunami amplitudes or impacts. Deep–ocean tsunami amplitudes are usually much smaller than coastal amplitudes.

Information bulletins provided by the Northwest Pacific Tsunami Advisory Center (NWPTAC) should not be construed as official warnings or evacuation notices for the areas concerned. The issuance of actual evacuation notices is the responsibility of individual local authorities.

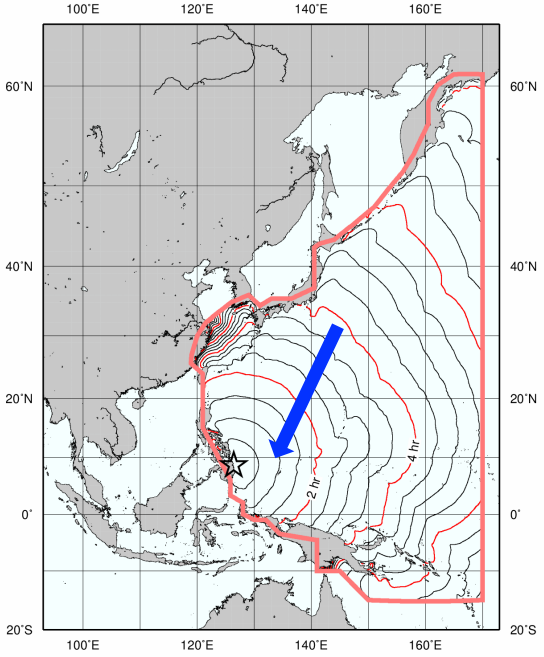


Earthquake: 02 Dec 2023 14:37:00(UTC)
Lat: 08.6°N, Lon: 126.4°E
Mw: 7.5
Earthquake Mechanism:
Fault1 Strike: 11.58°, Dip: 58.83°, Rake: 102.05°
Fault2 Strike: 169.17°, Dip: 33.20°, Rake: 70.96°
model run at: 02 Dec 2023 15:16:00(UTC)

NWPTAC Tsunami Travel Time Forecast

Actual coastal arrival times may differ from forecasts, and initial waves may not be the largest.

Information bulletins provided by the Northwest Pacific Tsunami Advisory Center (NWPTAC) should not be construed as official warnings or evacuation notices for the areas concerned. The issuance of actual evacuation notices is the responsibility of individual local authorities.

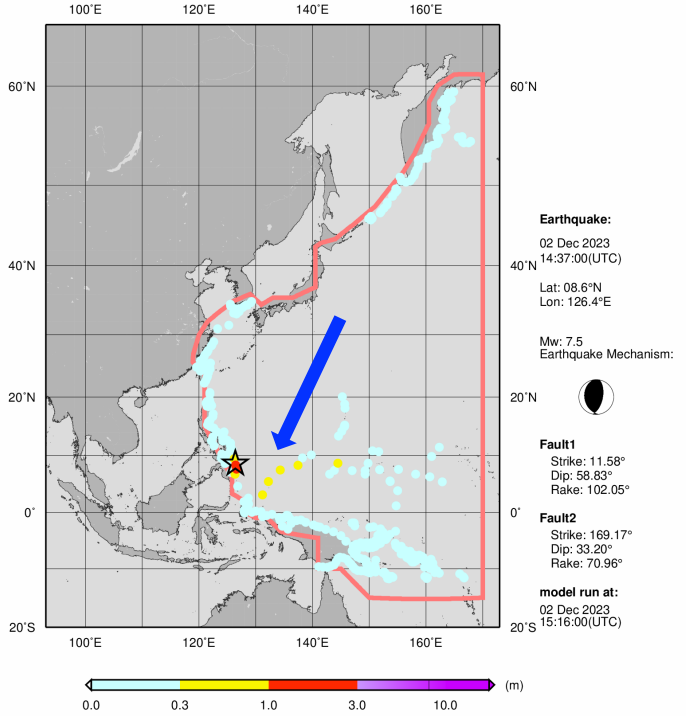


NWPTAC Coastal Tsunami Amplitude Forecast

This map shows the largest maximum coastal amplitudes of two forecasts based on a conjugate fault set obtained from CMT analysis.
Values are shown in meters from the undisturbed sea level to the crest.

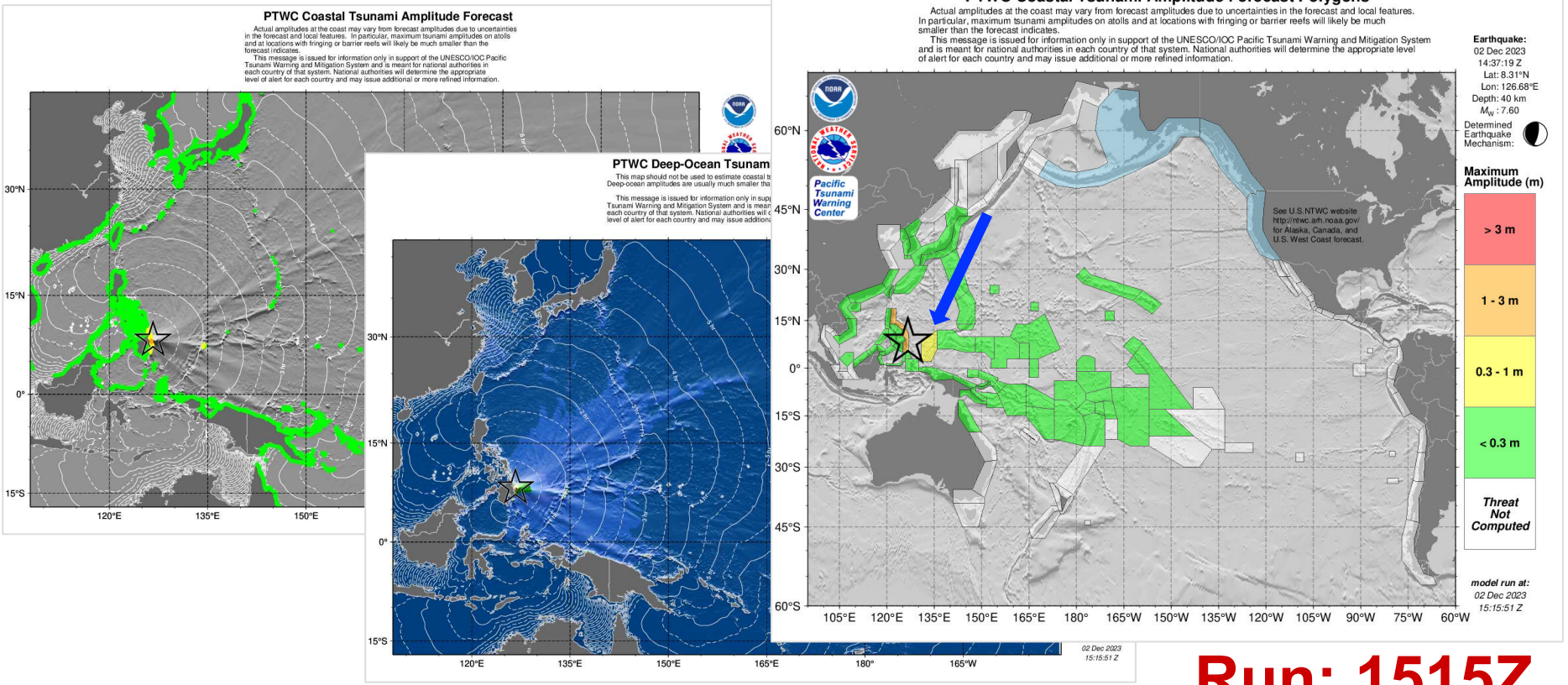
Actual coastal amplitudes at the coast may differ from forecasts due to forecasting uncertainties and local topography.

Information bulletins provided by the Northwest Pacific Tsunami Advisory Center (NWPTAC) should not be construed as official warnings or evacuation notices for the areas concerned. The issuance of actual evacuation notices is the responsibility of individual local authorities.



Run: 1516Z

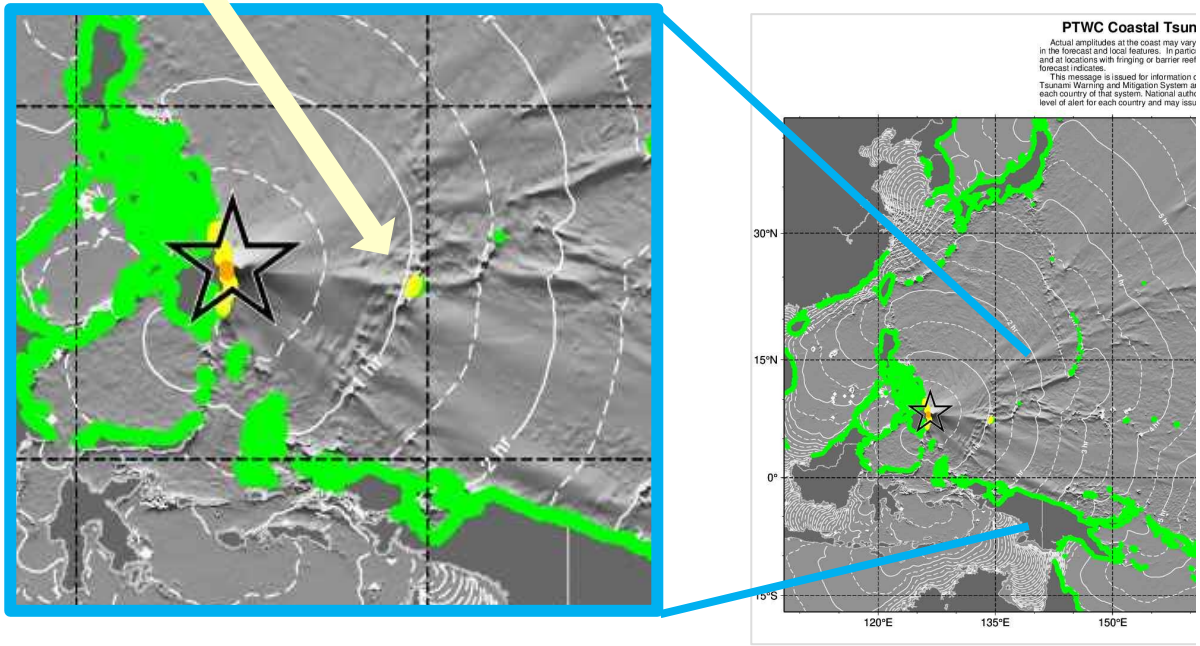
1535Z: PTWC Enhanced Products – forecasts

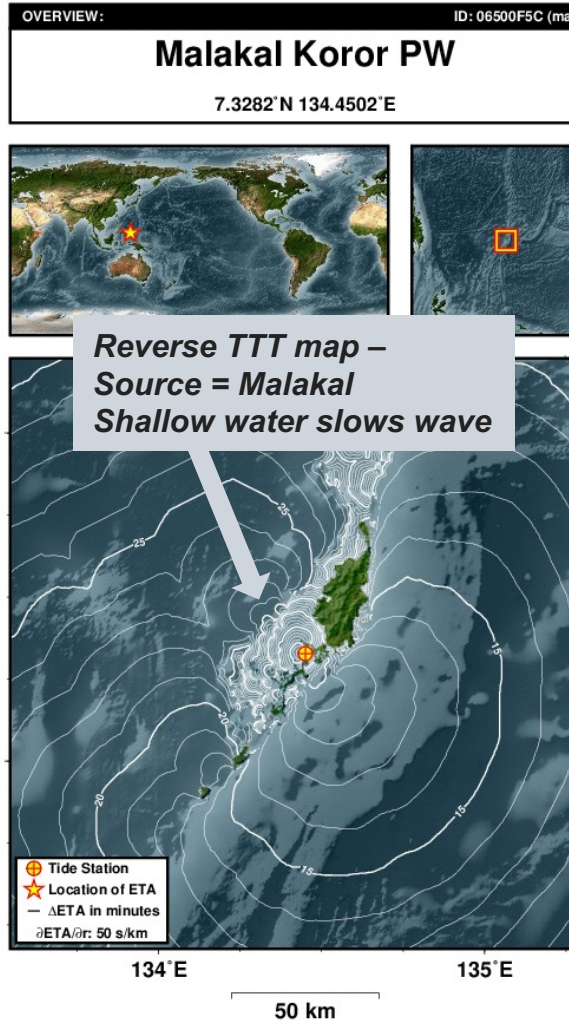


Run: 1515Z

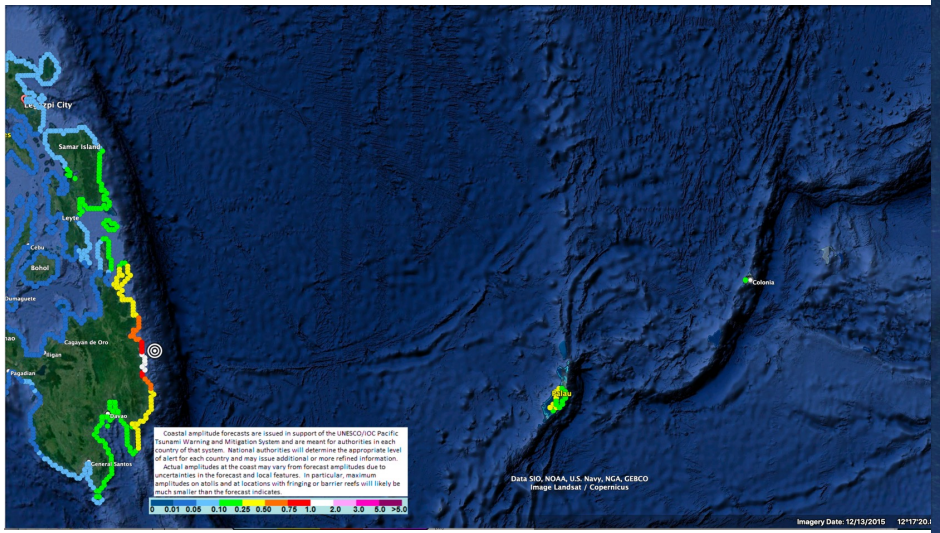
PTWC – TTT Forecasts

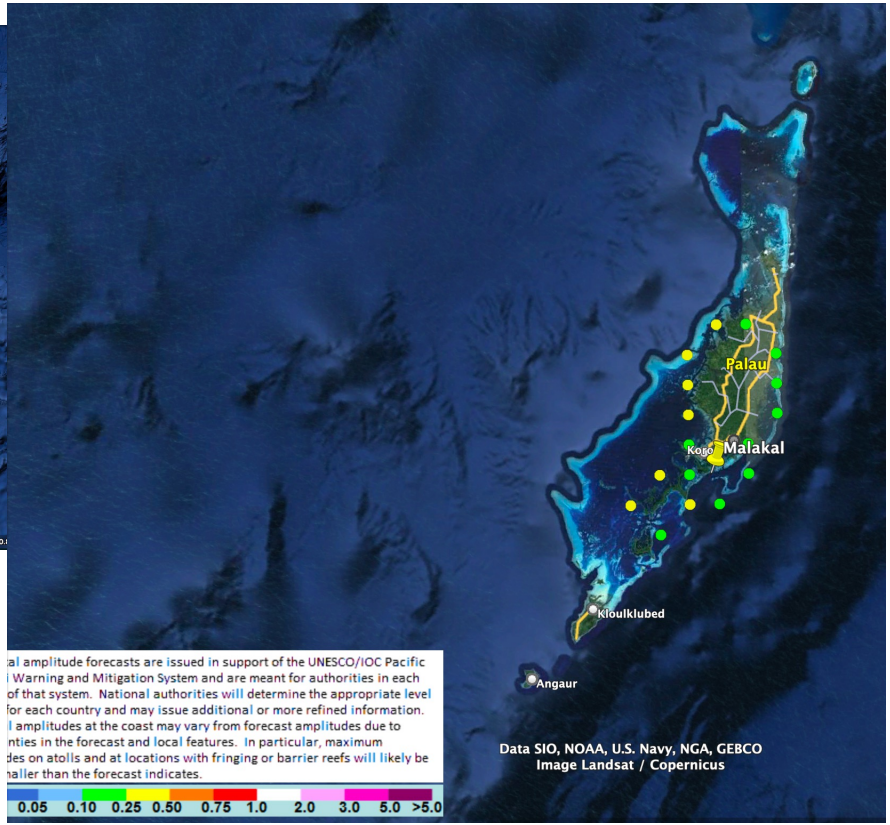
PTWC ETA CF plot: ~1 hour (1544Z)
Malakal(in bay, shallow): 1618Z, actual 1608Z





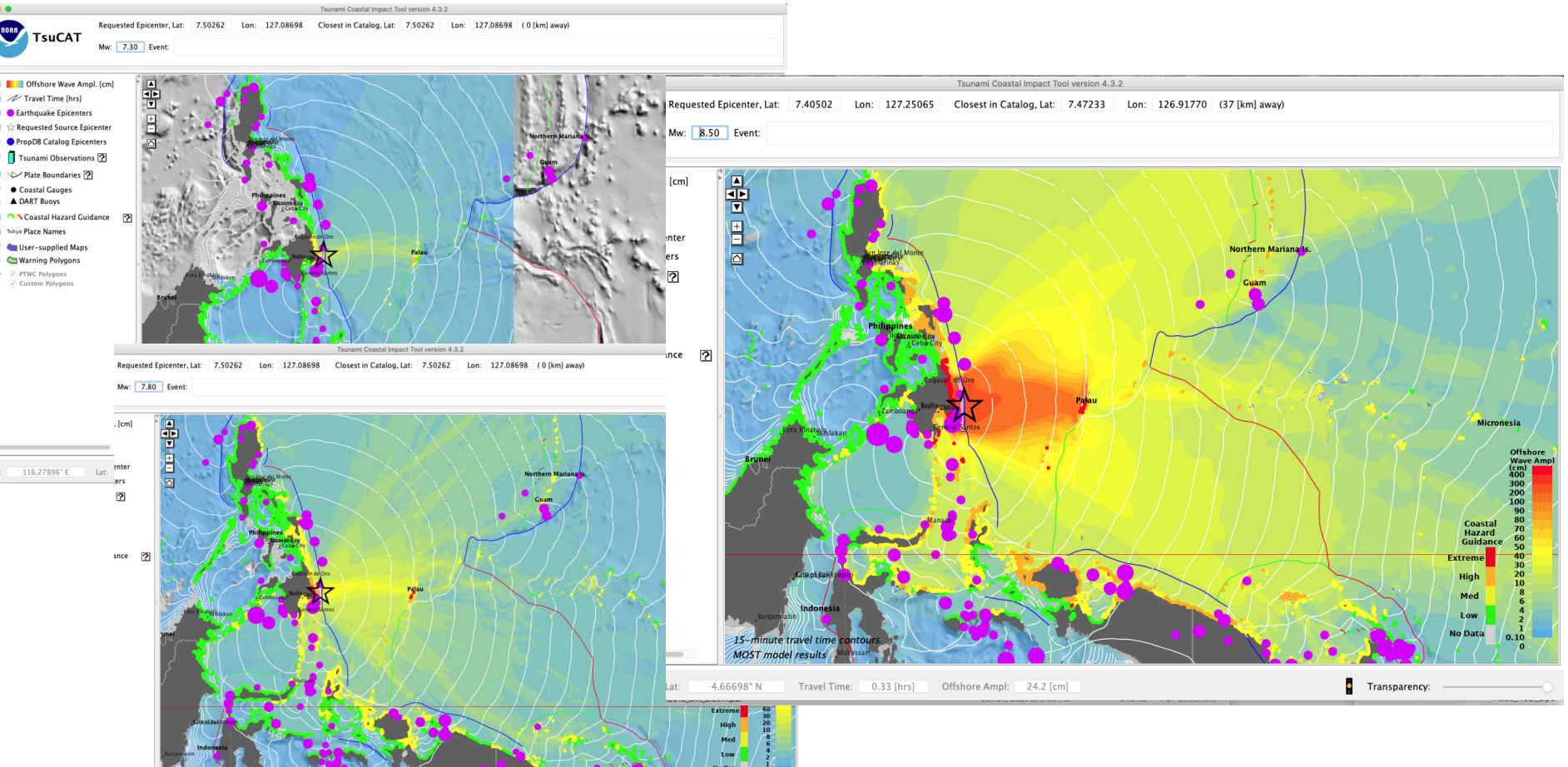
PTWC RIFT – Coastal Forecast - kmz





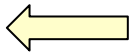
Run: 1515Z

Central Philippines, M7.3/7.5 to 8.5, TTT=1 hr



2 Dec 2023 – Detailed Timeline 3/3

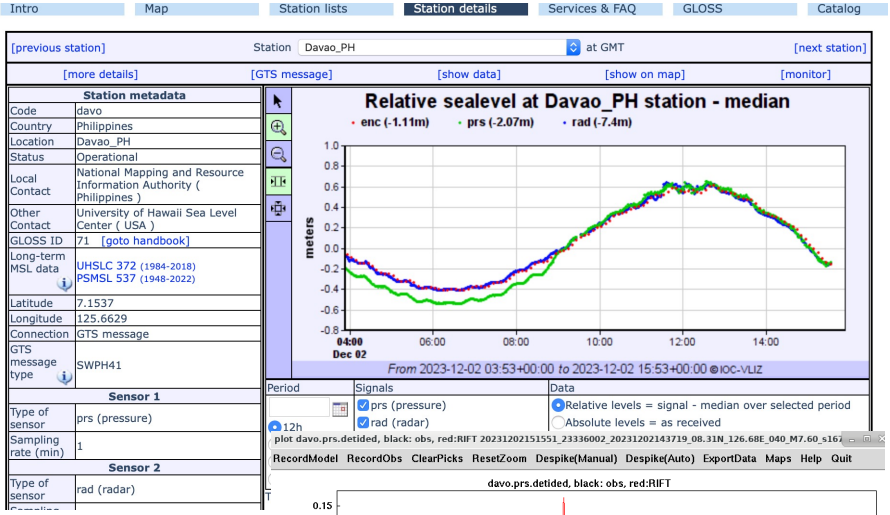
1535 Z	58	PTWC MSG 2: M7.6, FORECAST, 1-3 PHILIPPINES, 0.3-1 PALA
1557 Z	1:20	Laura to WSO Palau: Confirmed PTWC forecast is 0.3-1, so it is below Palau National Tsunami Warning Threshold (1 m). Reminded that Malakal gauge is in bay, so may be bigger (or smaller) on coasts facing Philippines. In morning they should check coastlines for any tsunami evidence (debris lines, etc)



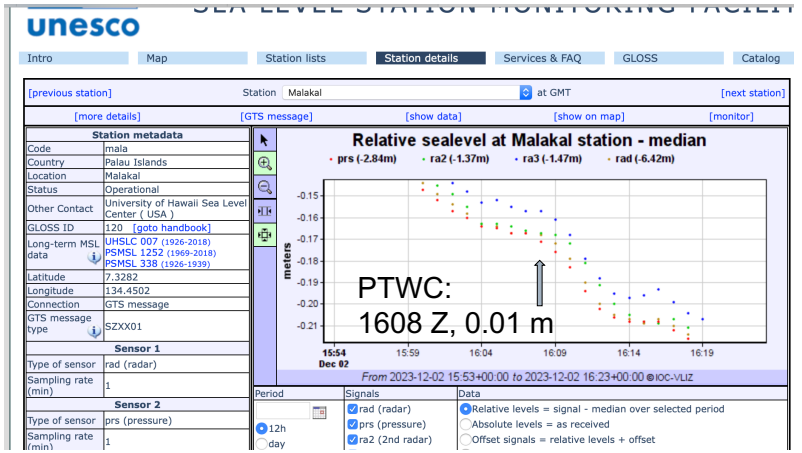
PTWC ETA MALAKAL PALAU 1618 12/02
Actual 1608

1641 Z	2:04	Laura to WSO Palau. Advised PTWC to issue final threat msg. Learned NEC decided based on NWPTAC 1-3 m forecast to sound sirens. It is not known if the sirens all worked or not. *26Feb24 MicroMgr mtg: WSO: NEC asked WSO to sound sirens but could not since new and not yet trained*
1645 Z	2:08	PTWC MSG 3: FINAL
1713 Z	2:36	NWPTAC MSG 3: M7.6,0.3-1 M EAST COASTS OF PHILIPPINES, 1-3 M PALAU. OBSERVATION: DAVAO MAXIMUM TSUNAMI WAVE 1525Z 02 DEC 0.1M
1953 Z	5:16	NWPTAC MSG 4: TOSASHIMIZU 0.2 M
2055 Z	6:18	NWPTAC MSG 5: OMAEZAKI 0.1 M

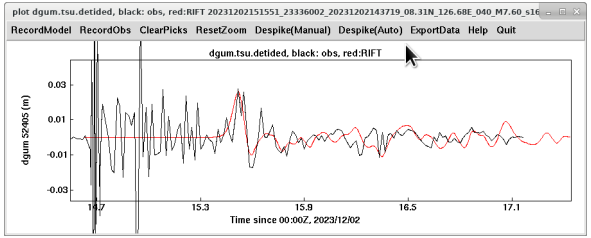
Mareograms – sea level records



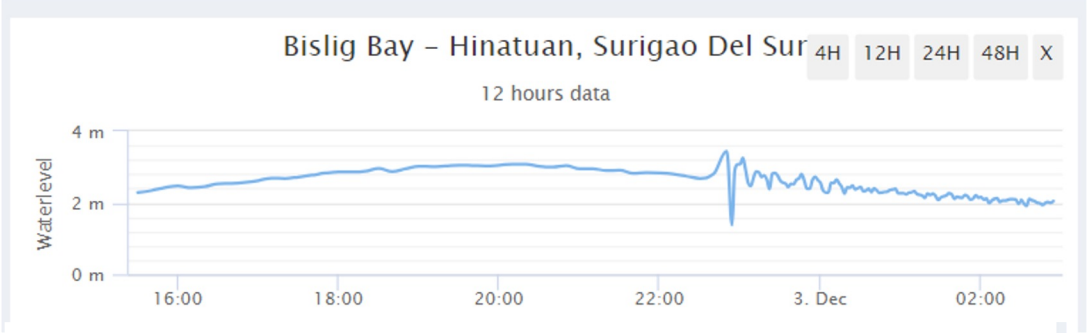
DAVO
(PTWC 0.08 m)
vs
RIFT

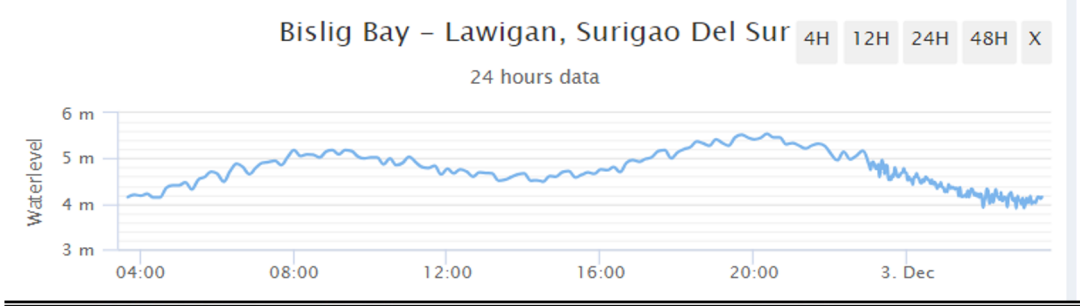


DGUM
(DART)
vs RIFT



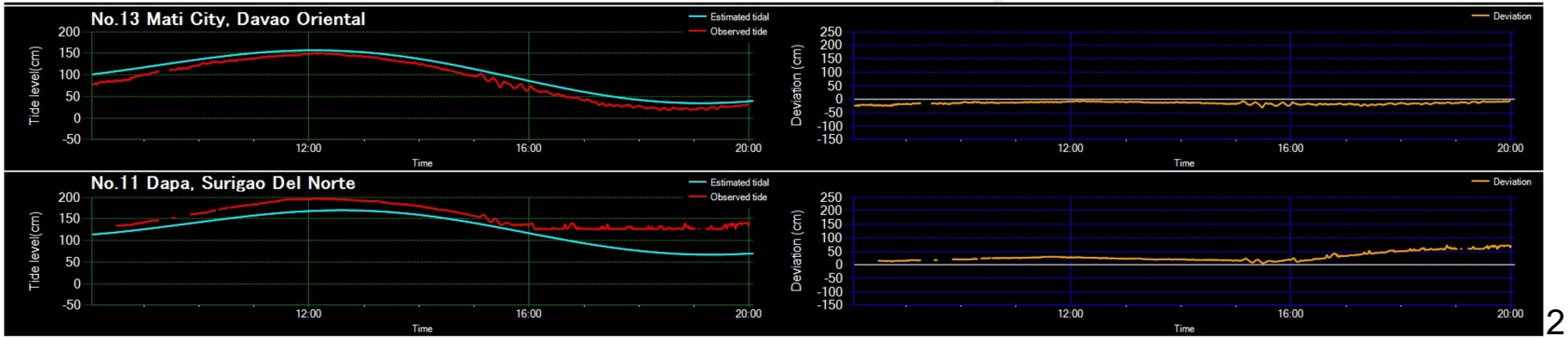
02 December 2023 Mw7.4 Offshore Surigao Del Sur Earthquake





Images showing the recorded wave heights by the tsunami sea level monitoring stations for tsunami detection

Courtesy: PHIVOLCS



CISN, Tide Tool, TTT, TsuCAT

Tsunami Warning and Hazard Assessment Decision Support Tools

Notes and Highlights

ITIC-supported

Quarterly Check-in mtgs

TWTools. Tsunami Questions

Tammy Fukuji
(Laura if needed)

- **NEXT MTG**
  19 March 2024 (prev 12 Dec 2023)
  3 pm Hawaii Time

- **Send Tammy email**
  if you want to be added
  to the distribution list

When

Tuesday Mar 19, 2024 · 3pm – 4pm (Hawaii-Aleutian Standard Time)

Guests

Tammy Fukuji - NOAA Federal - organizer
Boyd Mackenzie - NOAA Affiliate
Choorang Falan - NOAA Affiliate
Dexter Sadang - NOAA Affiliate
Eden Skilling - NOAA Affiliate
Genevieve Miller - NOAA Federal
Johannes Berdon - NOAA Affiliate
Johnny Musrasrik - NOAA Affiliate
Katherine Tun - NOAA Affiliate
Kikuko Mochimaru - NOAA Affiliate
Laura Kong - NOAA Federal
Lee Jacklick - NOAA Affiliate
Marcus Aydlett - NOAA Federal
Maria Ngemaes - NOAA Affiliate
Reginald White - NOAA Affiliate
Sanchez Salle - NOAA Affiliate
Wilfred Nanpei - NOAA Affiliate

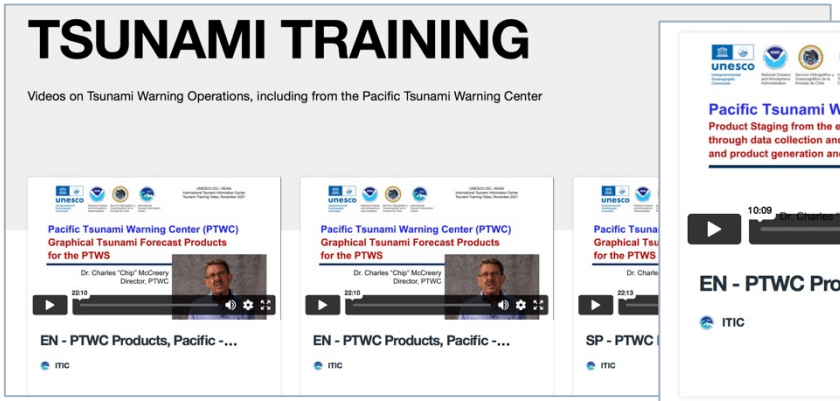
CISN – Real-time EQ Display

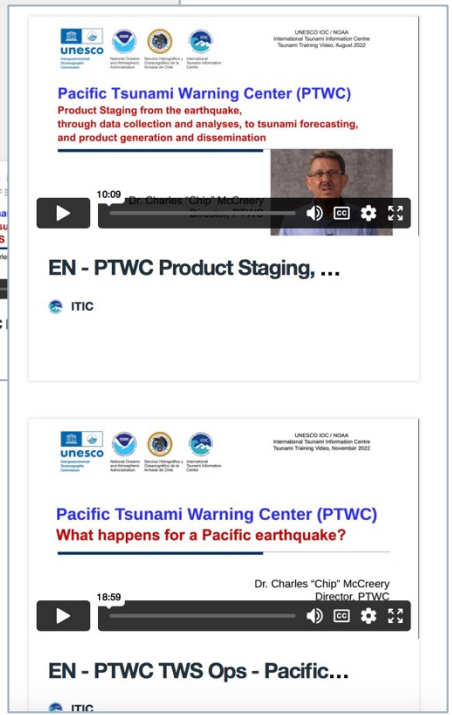
- **EQ locations display as they are received, e.g.,**
  1st CISN postings likely to be PTWC / USNTWC-determined, since they need to be fast for tsunami purposes. With time (minutes later), USGS-determined locations will supersede PTWC/USNTWC locs
  - ⇒ **EQ location is USGS location (not PTWC)**
- **Earthquake SOP (CISN):** 1. When Alarms, check for "Tsunami" button 2. Click to view Public Text msg. 3. Execute **Tsunami Event SOP**
- **Settings –** tabs to customize display, alarms, colors, etc
  - Display EQs – set to M5 (see events that USGS locates). Notes that PTWC only issues products for M6.5+
  - Alarm (visual red, audio) – set to same as Display if you want all (if M6.5, then alarms for PTWC messages)
- **ITIC help –** Tammy can login to WSO computers; update, troubleshoot

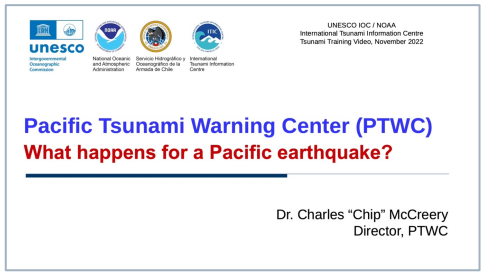
Using PTWC Enhanced Products

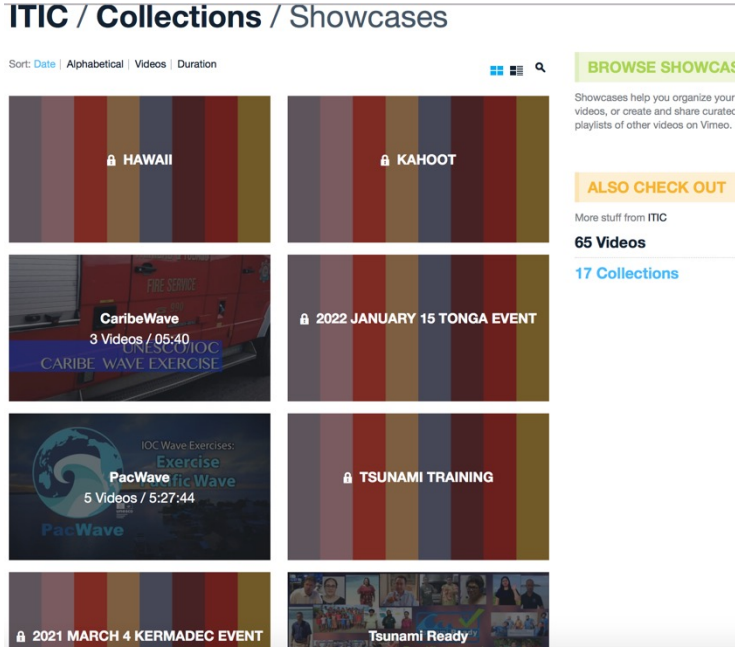
- **PTWC Public Text message –** within 5-8 min after EQ. Based only on EQ information (no forecast)
- **PTWC Enhanced Products (forecasts using RIFT) –** within 30 min after EQ. Uses actually EQ parameter to predict wave amplitude. Sent ONLY by email to TWFP (WSOs). Incl graphics maps, stats, kmz
- **PTWC Videos** – view for training refresher (see next slide)
- **Tsunami Warning Decision SOP – what to use**
  1. Use Text Message – Is it a Threat Message. If yes, is your country listed
  2. Use Polygon map for quick assessment – Is your country threatened (>1 m)
  3. Use Deep Ocean Amplitude to know directions of greatest energy (is it aimed at your country) – note amplitude scale (much smaller as deep ocean)
  4. Use Coastal Amplitude to know amplitude at coast (uses Green's Law). For atolls, this will be OVERestimate. More likely closer to Deep Ocean ampl.
  5. Use KMZ file (Google Earth) to see distr of ampl forecasts (important to look at trends not individual pts). Mouse over pt shows Coastal and Deep Ocean

ITIC Training – videos









https://vimeo.com/showcase/8956022

Password: training

Tide Tool and TTT

- **Tide Tool – PTWC uses this exact same software (you are seeing what they see at the same time!)**
- **Tide Tool –** enable real-time monitoring of sea level stations around the Pacific (or other oceans). For example, stations near you, or monitor tsunami as goes across Pacific if far source
- **Tsunami Confirmation SOP (Tide Tool) – for actual event,**
  1. Calc TTT using PTWC or USGS EQ parameters (CISN). Overlay TTT map.
  2. Bring up SL station - shows (pink line) ETA for tsunami at sta
  3. If needed, measure wave height (esp if PTWC does not report)
- **TTT – GUI entry.** Automatically produced TTT maps for input epicenter. Make these before so have for key tsunami sources.

TsuCAT

- Use for Hazard Assessment, Exercise Scenario development
- **Do NOT use for real-time prediction** (unless last resort) because the TsuCAT scenario will NOT be real event so not accurate. Good only for approximate idea of expected amplitude.
- Pre-calculated scenarios from NOAA database for sources in active subduction zones in Pacific, Indian Ocean, Caribbean. M6.5 – 9.5. Uses Green's Law for coastal forecast
- Assumes shallow source
- Can choose location (from Historic events, user-specified)
- Includes: PTWC Enhanced Products
- Includes: Exercises – can generate PTWC text and enhanced products for user-specific scenario. Use for your own exercises!

unesco
Intergovernmental
Oceanographic
Commission

MICRONESIA MANAGER'S MEETING
TSUNAMI EVENTS and TSUNAMI READY
26-27 February 2024, Hilton Guam, Tamuning, Guam, USA
Update January 2026

Thank You

Dr. Laura Kong
International Tsunami
Information Centre (ITIC)