



International Tsunami Information Centre
A UNESCO/IOC-NOAA Joint Partnership

Pacific Tsunami Warning and Mitigation System

Dr. Laura Kong

Director

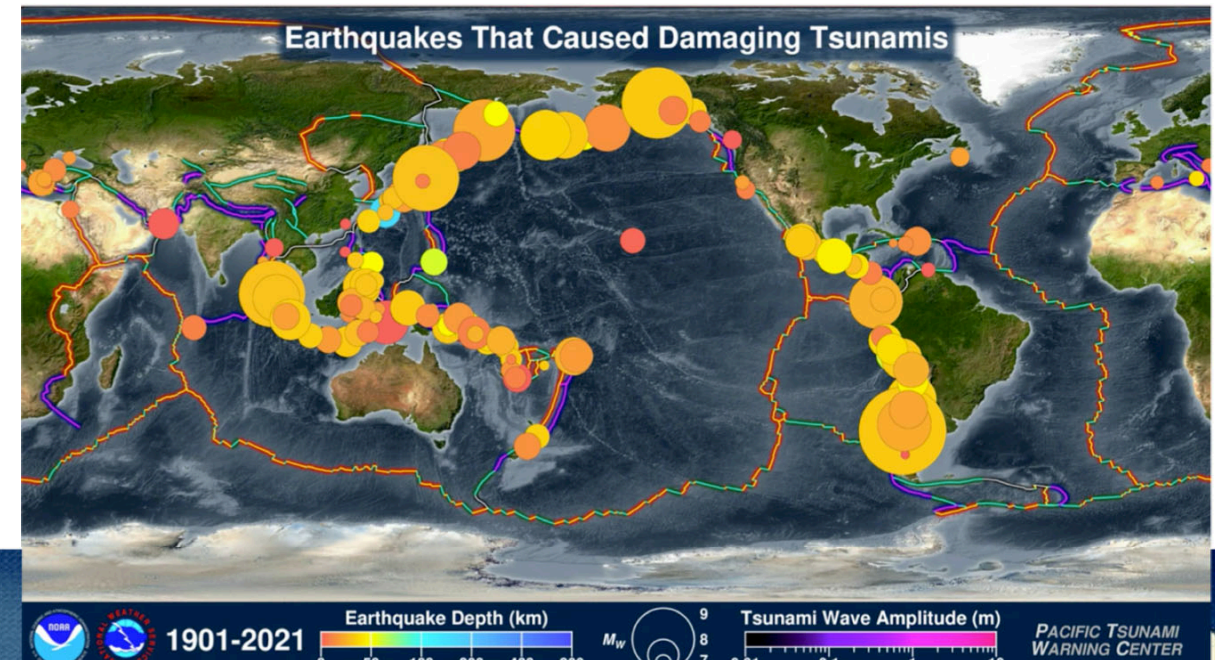
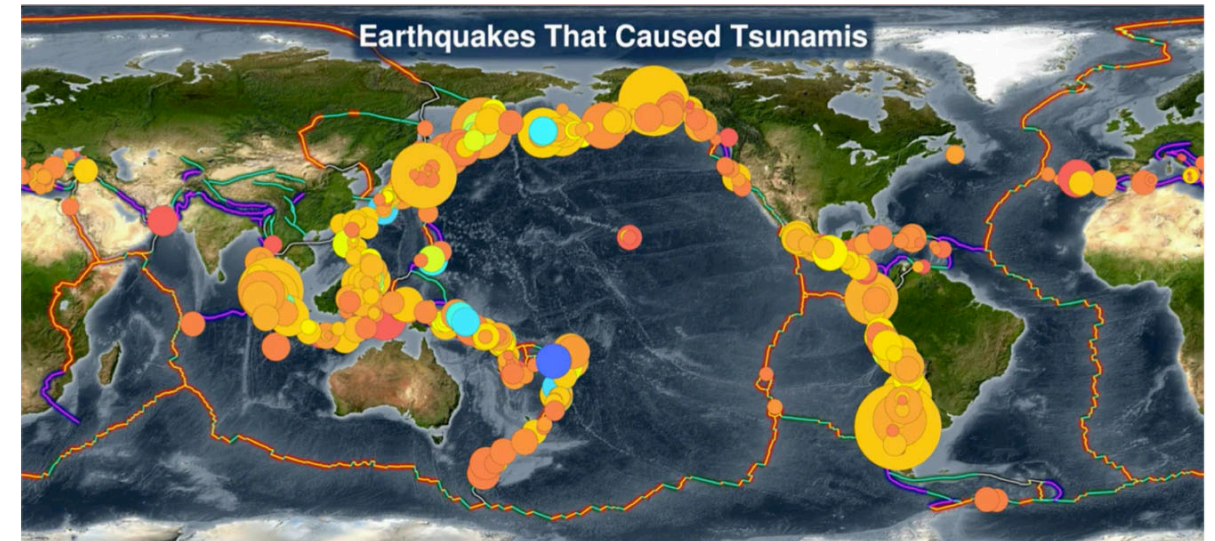
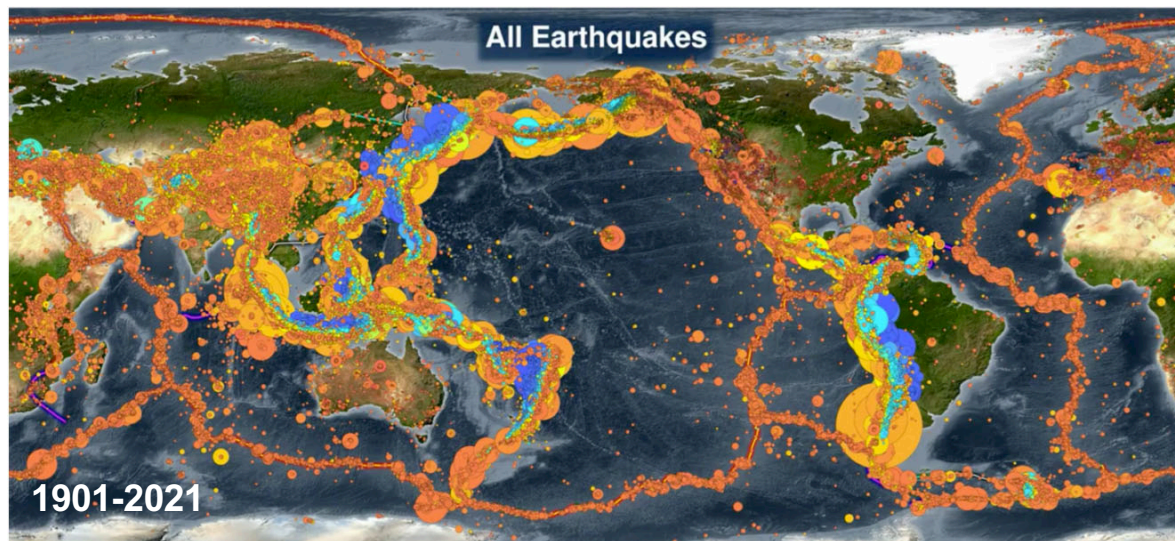
UNESCO/IOC International Tsunami Information Centre



UNESCO/IOC-NOAA SHOA
International Tsunami Information Centre

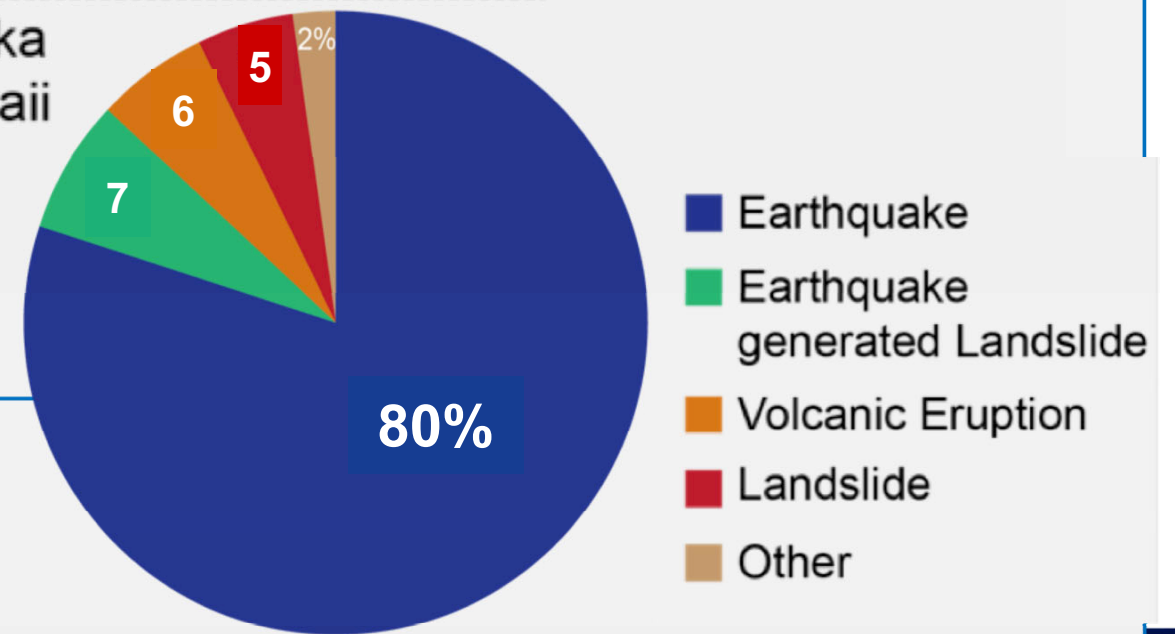
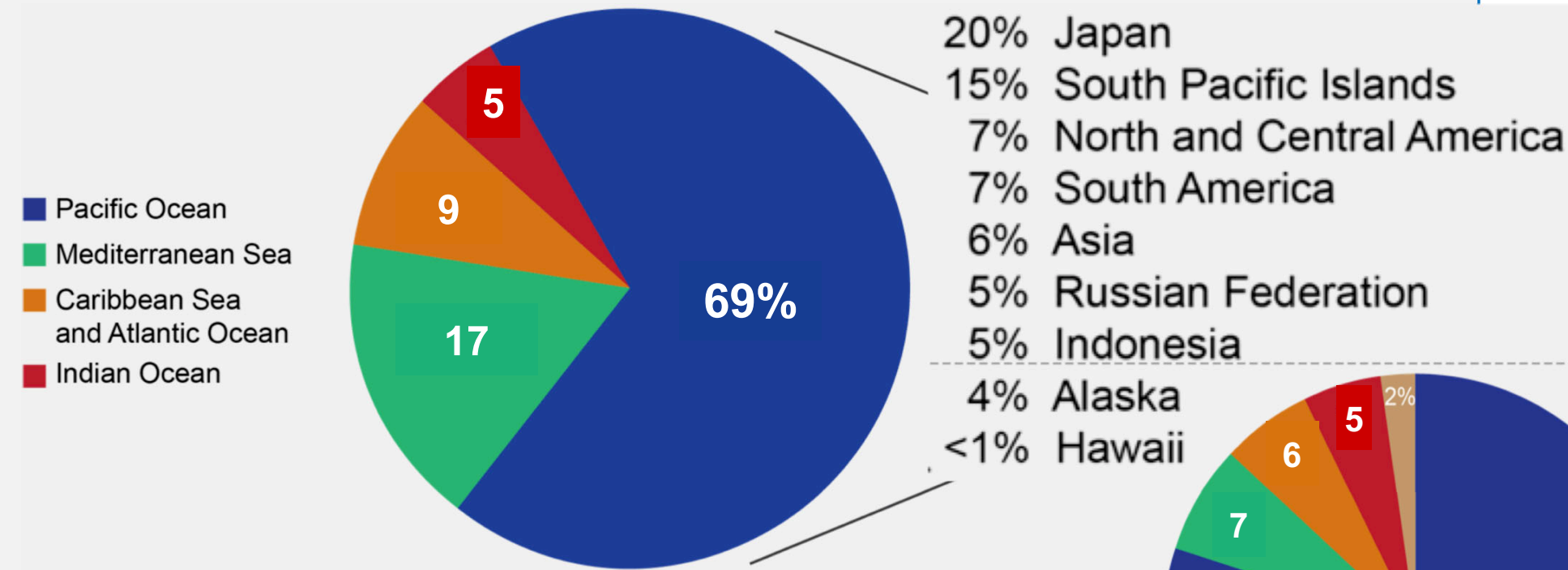


DANGEROUS EARTHQUAKES & TSUNAMIS



- ❑ 80% caused by earthquakes
- ❑ Shallow, undersea/near coast
- ❑ Magnitude 8+ ($M7+$)

DEADLY TSUNAMIS – GLOBAL (1620 B.C to A.D. 2022)

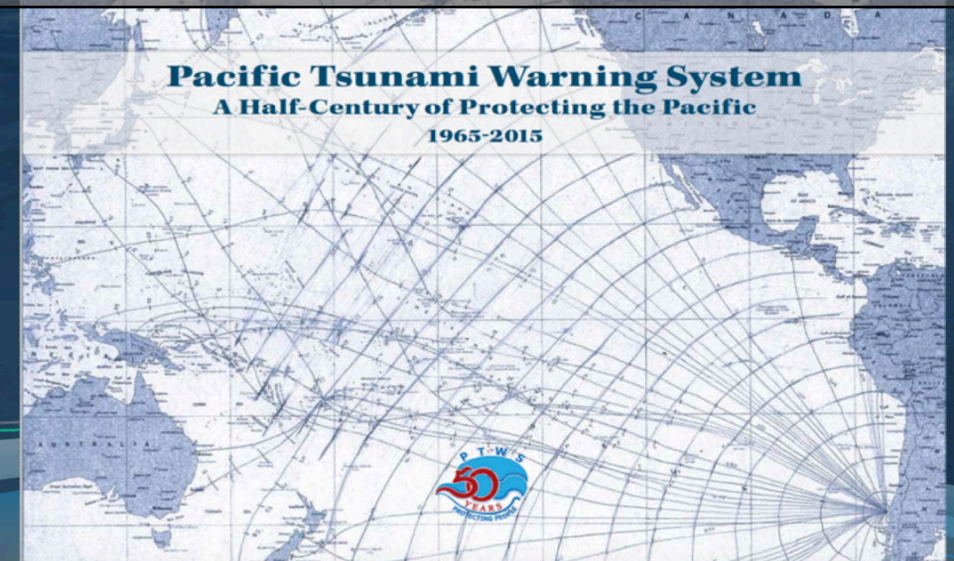
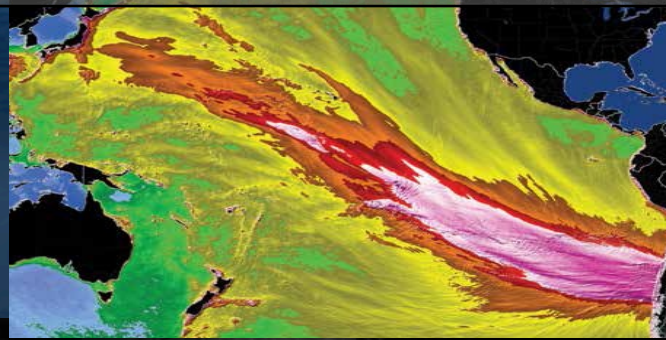


1960 Deadly Basin-wide Tsunami

1960 9.5 Mw Chile earthquake generated a tsunami that killed 2000 in Chile, then hundreds in Hawaii, Japan, and the Philippines
=> No international warning

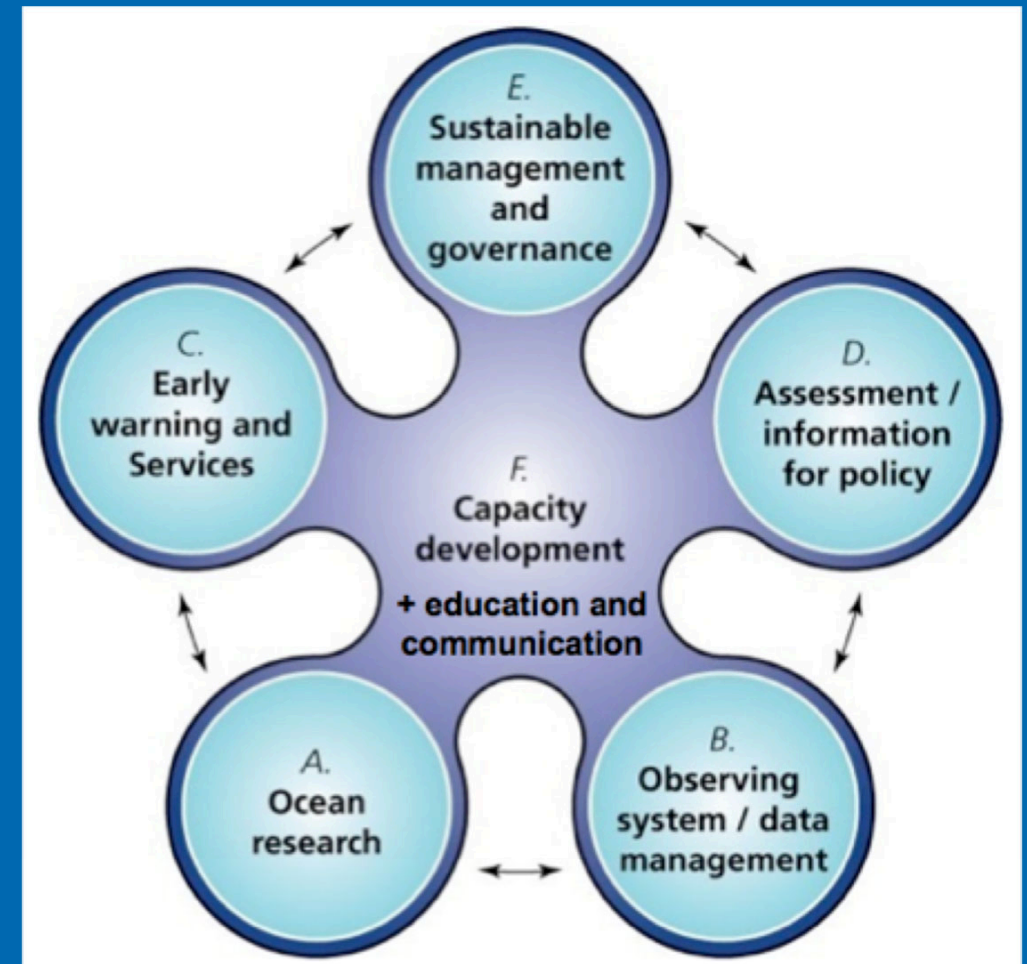
=> 1965 International Tsunami Warning System in the Pacific (ITSU) established under UNESCO / IOC (renamed PTWS in 2005)

1. PTWC (US NOAA, orig Honolulu Observatory) - PTWS 24x7 alerts
2. ITIC (IOC, NOAA hosted) – PTWS TEWS support to countries



Intergovernmental Oceanographic Commission (IOC) of UNESCO

- Only intergovernmental body of United Nations (UN) system for ocean science
- Established 1960, 150 Member States



unesco

Intergovernmental
Oceanographic
Commission

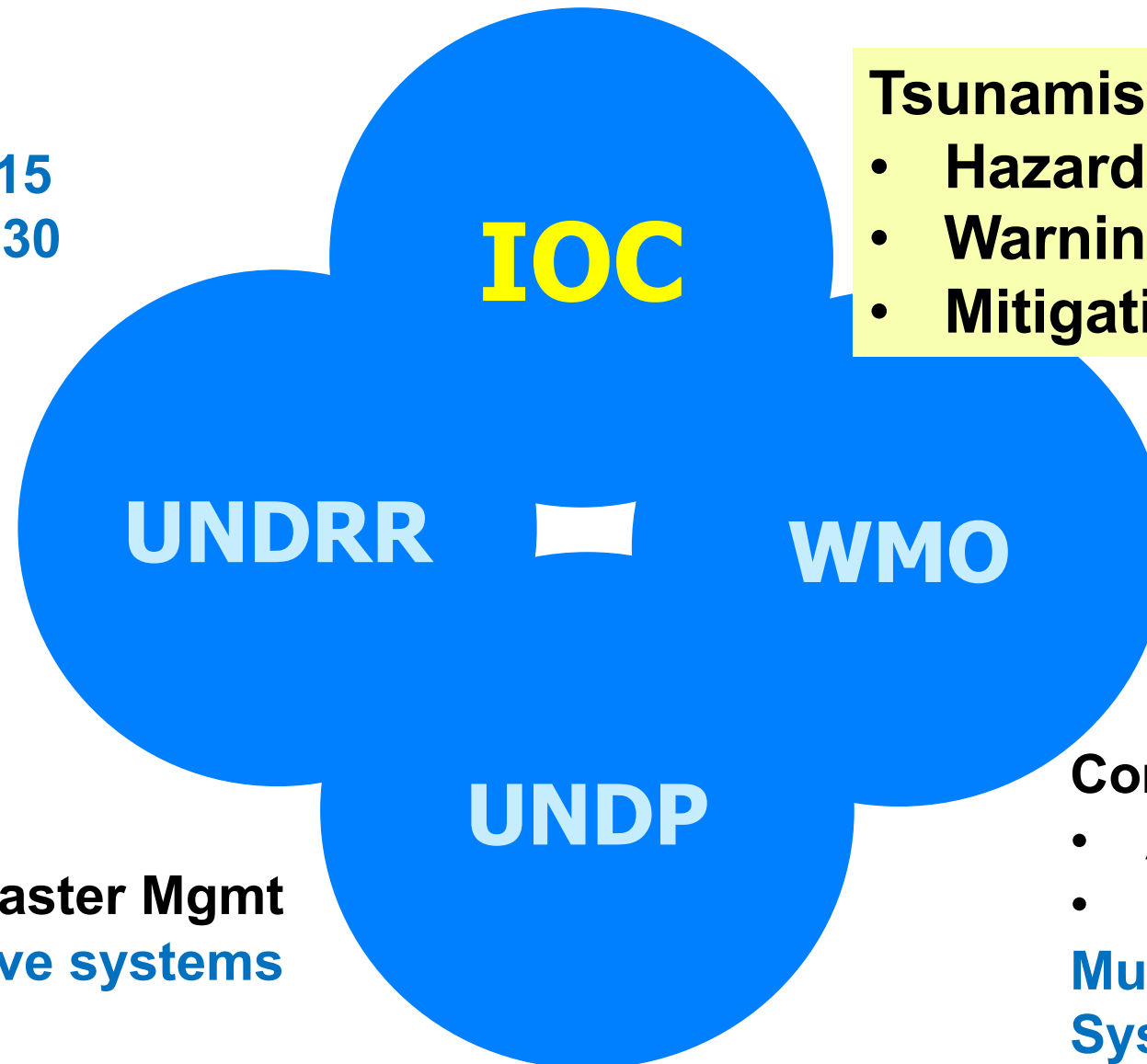
UN – Global Partnerships

DRR platforms

- Hyogo 2005-2015
- Sendai 2015-2030

Awareness

- DRR Oct 13
- WTAD Nov 5



Tsunamis:

- Hazard Risk
- Warning guidance
- Mitigation, Preparedness

Disaster Mgmt

Institutional / Legislative systems

Communication (GTS)

- Alerts
- Sea Level Data

Multi-hazard Early Warning Systems (MHEWS)

UN Global Tsunami System – How Does it Function?

□ Governance

- UNESCO/IOC through region Intergovernmental Coordination Groups (**ICGs**).
- **ICGs meet regularly** (annual, bi-annual) to coordinate and improve system. Member States represented by Tsunami National Contact (**TNC**), Tsunami Warning Focal Point (**TWFP**), National Tsunami Warning Center (**NTWC**)
- Saving lives from tsunami requires '**End-to-End**' system – people-centred
- IOC region **Tsunami Information Centres** (TIC) support Member States

□ Tsunami Alerting

- UNESCO/IOC Tsunami Service Providers (**TSPs**) **monitor 24x7**
Provide timely Tsunami Threat **advice** for region
- Based on **joint operation** of international networks connected with NTWCs
- **Each nation is responsible for** issuing **warnings** in their territory and protect its own population.
- National **warning centres** must have **strong links with emergency preparedness authorities** (national, provincial, local)



End-to-End Tsunami Warning Chain

EQ
TSU
FORECAST

TWC - Science

Intl / Natl

Country Alert System

Emergency Alert System & Mass Media

DMO / EMA – Safety

Natl / Prov / Local Govt

**TSUNAMI WARNING!
EVACUATE**

TSUNAMI HAZARD ZONE
IN CASE OF EARTHQUAKE, GO TO HIGH GROUND OR INLAND

Public

Community



Race against Time

LIVES SAVED



TSUNAMI WARNING CHAIN (M9.5 Chile)

UNESCO IOC – NOAA outreach video

Pacific Tsunami Warning & Mitigation System

Tsunami Warning!



English:
Spanish:
French:

<https://vimeo.com/124650777>
<https://vimeo.com/125109150>
<https://vimeo.com/125109148>



Pacific Tsunami Warning & Mitigation System

Tsunami Warning!

When a major undersea earthquake occurs near the coast, a destructive tsunami can result that will hit near-by coasts in minutes and also travel across entire oceans causing damage 1000s of kilometers away and up to 24 hours later. To alert far-away coasts, internationally coordinated tsunami early warning systems, such as the Pacific Tsunami Warning and Mitigation System (PTWS), have been established to quickly provide tsunami threat information to countries.

2015 marks the 50th year of the PTWS. The System was established in 1965 in response to the 1960 M9.5 earthquake off South-central Chile that generated a tsunami which crossed the Pacific killing hundreds in Hawaii, Japan, and the Philippines. The PTWS has been built up over the decades, through international cooperation and the contributions of countries and organizations under the UNESCO IOC framework.

To sustain awareness on the dangers of tsunamis, and to educate the public on how the PTWS works to disseminate alerts on approaching tsunamis, the IOC, in cooperation with Chile, has produced a 6-minute outreach video the aim of which is to broaden public and stakeholder agency knowledge of, and confidence in, tsunami alerts that save lives and reduce property damage.

This video chronicles the tsunami warning chain for a M9.5 earthquake off Northern Chile as Pacific Tsunami Warning Center (PTWC) staff quickly analyze seismic and sea level data, forecast tsunami wave heights, and disseminate their threat assessments to country National Tsunami Warning Centers around the Pacific. Woven into the fast-paced video are vignettes highlighting tsunami warning and emergency response actions by centers and communities starting immediately after the earthquake in Chile and Peru, and other receiving the PTWS alerts in Samoa and Hawaii, and in Australia, Japan, Indonesia, and the Philippines.

www.tsunamiwave.info



2004 Deadly Basin-wide Tsunami

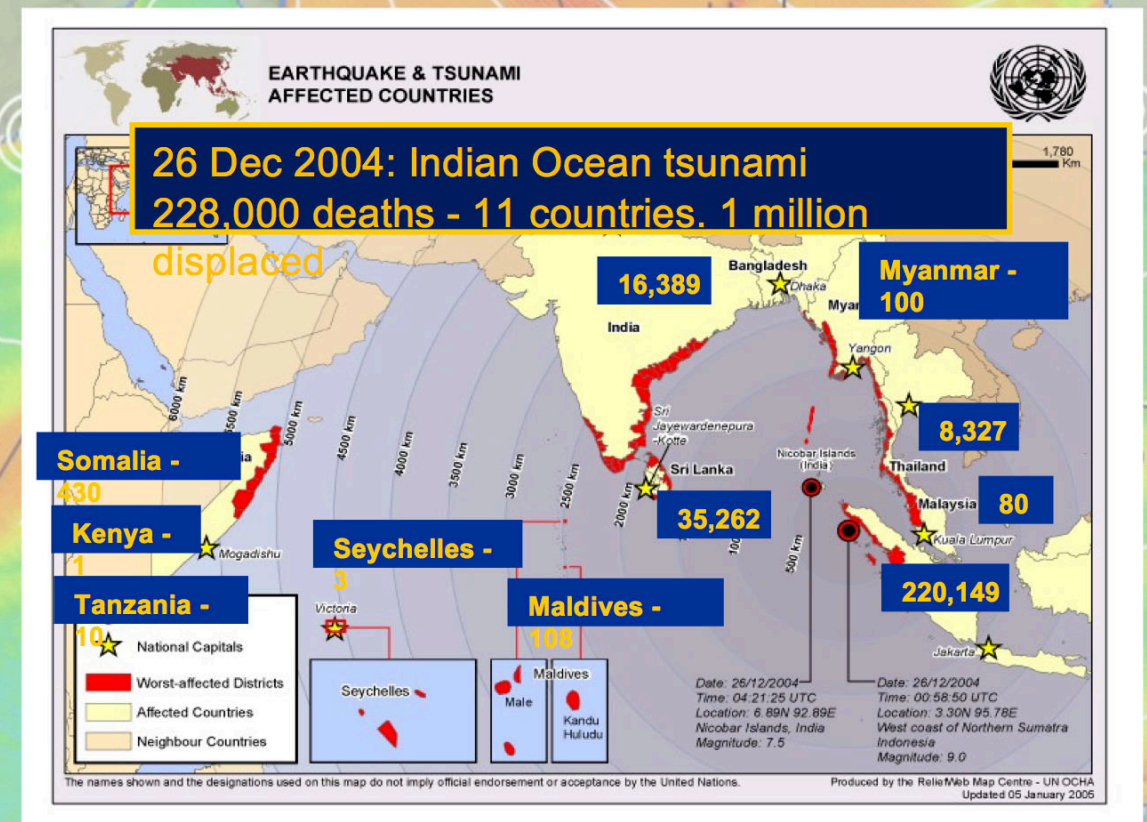


2004 9.3 Mw Indonesia earthquake generated a tsunami that killed 180,000 in Indonesia, and in total 228,000 in 11 Indian Ocean countries over 12 hours. Nearly no one knew what a tsunami was ...

=> No international warning

=> 2005 Indian Ocean, Caribbean, North Eastern Atlantic and Mediterranean Tsunami Warning and Mitigation Systems established under UNESCO / IOC

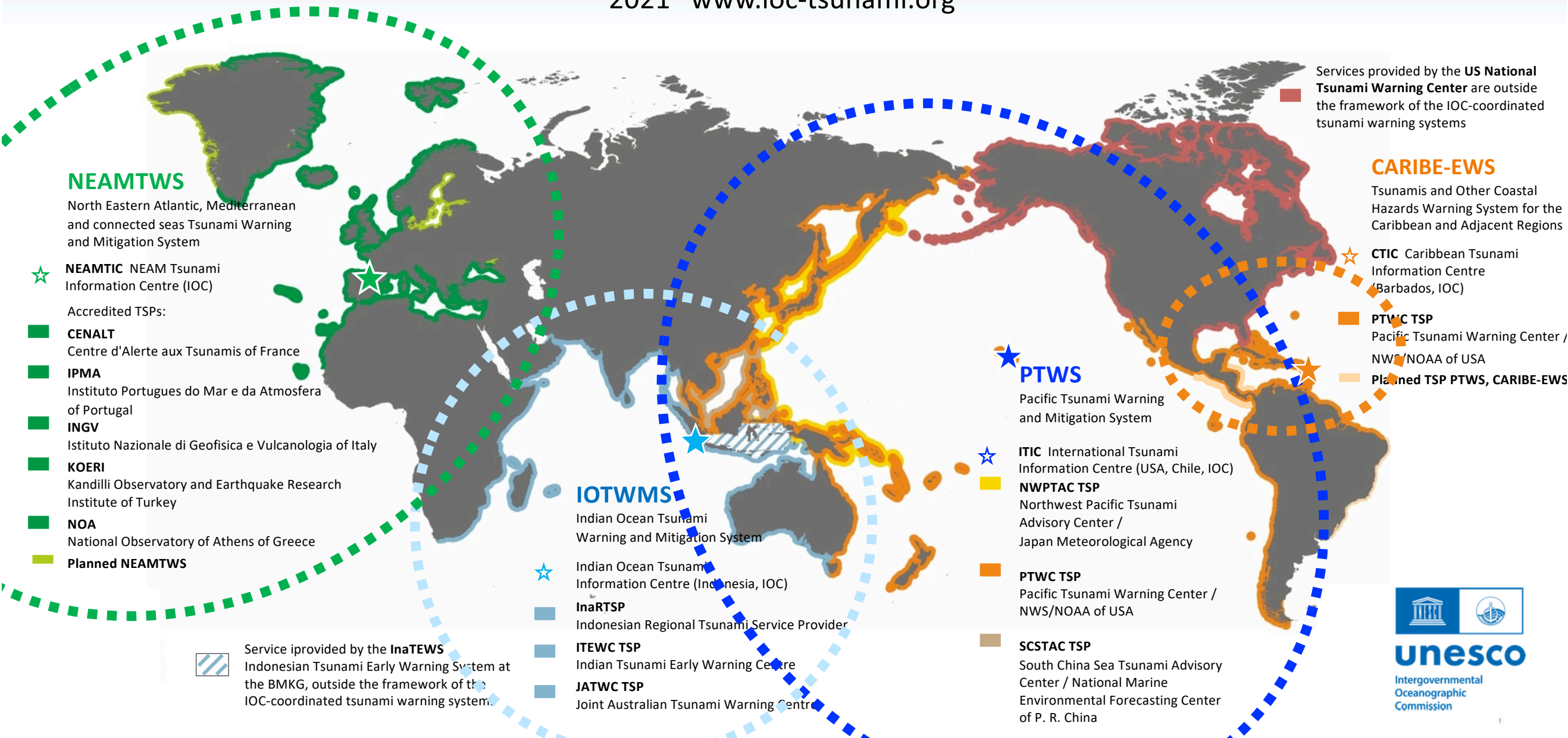
1. IOC Tsunami Service Providers - 24x7 alerts for region
2. IOC Tsunami Information Centres - TEWS support to countries



GLOBAL TSUNAMI WARNING AND MITIGATION SYSTEMS

Intergovernmental Oceanographic Commission of UNESCO

2021 www.ioc-tsunami.org



NEAMTWS

North Eastern Atlantic, Mediterranean and connected seas Tsunami Warning and Mitigation System

★ **NEAMTIC** NEAM Tsunami Information Centre (IOC)

Accredited TSPs:

- **CENALT** Centre d'Alerte aux Tsunamis of France
- **IPMA** Instituto Portugues do Mar e da Atmosfera of Portugal
- **INGV** Istituto Nazionale di Geofisica e Vulcanologia of Italy
- **KOERI** Kandilli Observatory and Earthquake Research Institute of Turkey
- **NOA** National Observatory of Athens of Greece
- **Planned NEAMTWS**

▨ Service iprovided by the **InaTEWS** Indonesian Tsunami Early Warning System at the BMKG, outside the framework of the IOC-coordinated tsunami warning system.

IOTWMS

Indian Ocean Tsunami Warning and Mitigation System

★ Indian Ocean Tsunami Information Centre (Indonesia, IOC)

- **InaRTSP** Indonesian Regional Tsunami Service Provider
- **ITEWC TSP** Indian Tsunami Early Warning Centre
- **JATWC TSP** Joint Australian Tsunami Warning Centre

PTWS

Pacific Tsunami Warning and Mitigation System

★ **ITIC** International Tsunami Information Centre (USA, Chile, IOC)

■ **NWPTAC TSP** Northwest Pacific Tsunami Advisory Center / Japan Meteorological Agency

■ **PTWC TSP** Pacific Tsunami Warning Center / NWS/NOAA of USA

■ **SCSTAC TSP** South China Sea Tsunami Advisory Center / National Marine Environmental Forecasting Center of P. R. China

Services provided by the **US National Tsunami Warning Center** are outside the framework of the IOC-coordinated tsunami warning systems

CARIBE-EWS

Tsunamis and Other Coastal Hazards Warning System for the Caribbean and Adjacent Regions

★ **CTIC** Caribbean Tsunami Information Centre (Barbados, IOC)

■ **PTWC TSP** Pacific Tsunami Warning Center / NWS/NOAA of USA

■ **Planned TSP** PTWS, CARIBE-EWS



Tsunami Alerting – Two Types of Centres

IOC Global Service - Tsunami Service Providers (TSPs)

- ❑ Provide **INFORMATION / ADVICE** on **THREAT**.
Since 2014, do not issue tsunami warnings to countries
- ❑ **Capability to detect and assess tsunami threats over a large region, covering multiple member state.**
- ❑ **Has been accepted by the Intergovernmental Coordination Group (ICG) to disseminate threat assessment to other member states.**

Tsunami Service Providers (TSPs) - PTWS

- ❑ PTWC (Pacific Tsunami Warning Center) – USA - 1965
- ❑ NWPTAC (Northwest Pacific Tsunami Advisory Center, Japan Meteorological Agency (JMA) – 2006
- ❑ SCSTAC (South China Sea Tsunami Advisory Center) – China - 2019
- ❑ CATAC (Central America Tsunami Advisory Centre) – Nicaragua – interim



PTWC Operations

Tsunami Alerting – Two Types of Centres

National Tsunami Warning Centers (NTWC)

- A center operated by a Member State that has the **authority by law or otherwise to issue tsunami warnings** for the coasts of that Member State.
- Ideally, NTWC should have some technical capability to aid decisions making.



Tonga



Peru

IOC Tsunami Information Centers



tsunamiwave.org

PTWS : ITIC
USA NOAA – IOC Partnership
1965
Chili SHOA Associate Director
1998



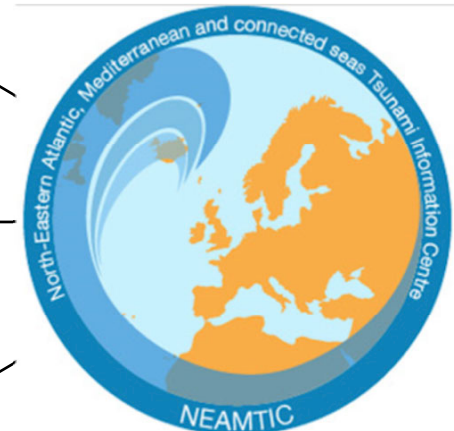
NEAMTWS
EC DG ECHO
France, Greece, Italy,
Portugal
2011-13



IOTWS
Indonesia – IOC Partnership 2012
(formerly JTIC since 2006)



CARIBE-EWS
Barbados– IOC Partnership
2015 (approved 2007)



ITIC – INTERNATIONAL IOC Mandate & Functions (1977)

- ❑ **Monitor / Recommend Improvements** to PTWS and other tsunami warning systems – communications, data networks, evaluations, dissemination
- ❑ **Assist in establishing** regional and national tsunami systems – comprehensive risk reduction
- ❑ Serve as **technology transfer** resource;
Encourage research to improve evaluations;
Conduct **trainings to build capacity**
- ❑ Serve as an information resource for **preparedness / education**; **Develop, publish, distribute materials**
- ❑ Serve as an information resource on **historical tsunamis – database, post-event surveys**

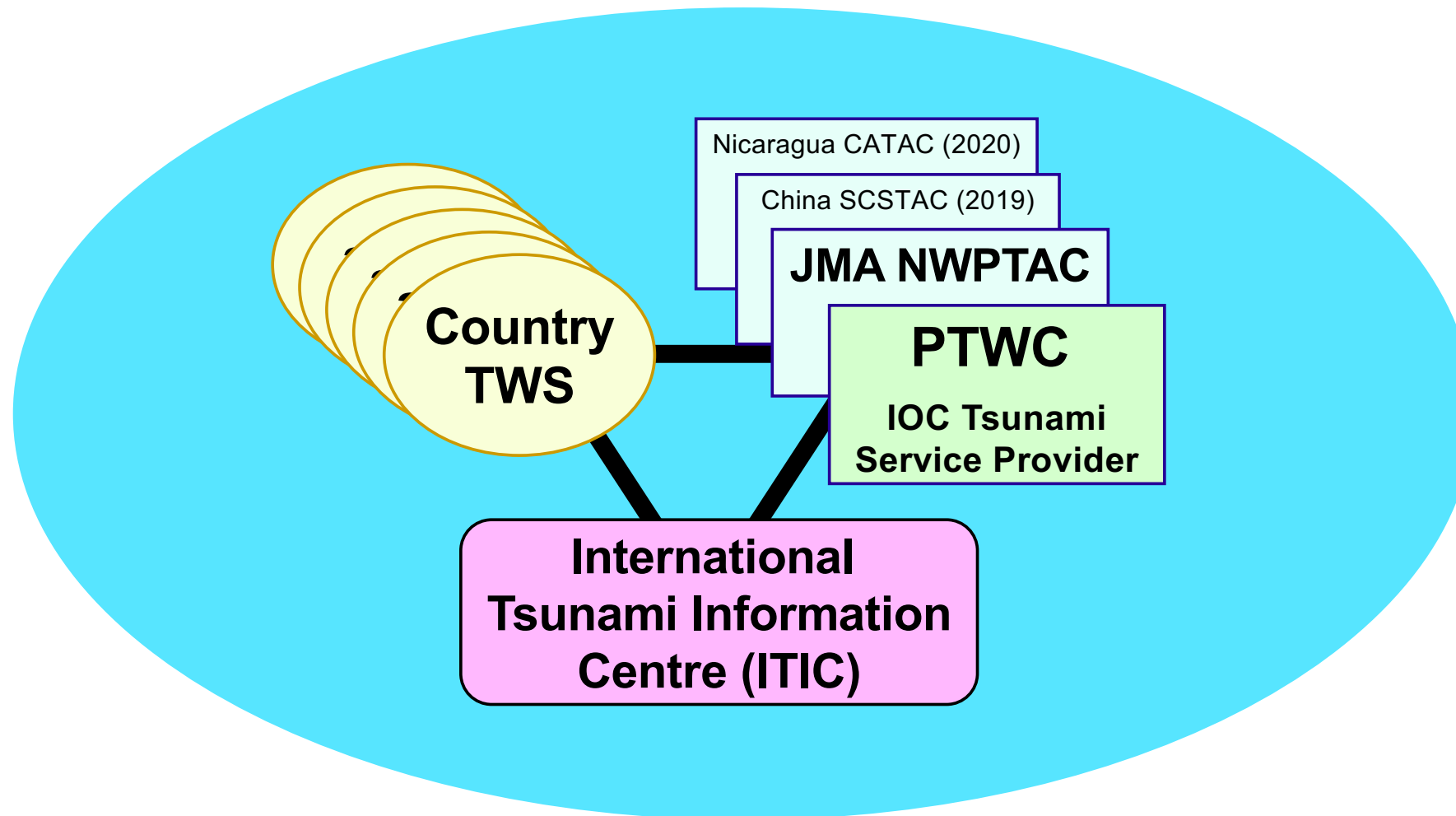


Click for
video

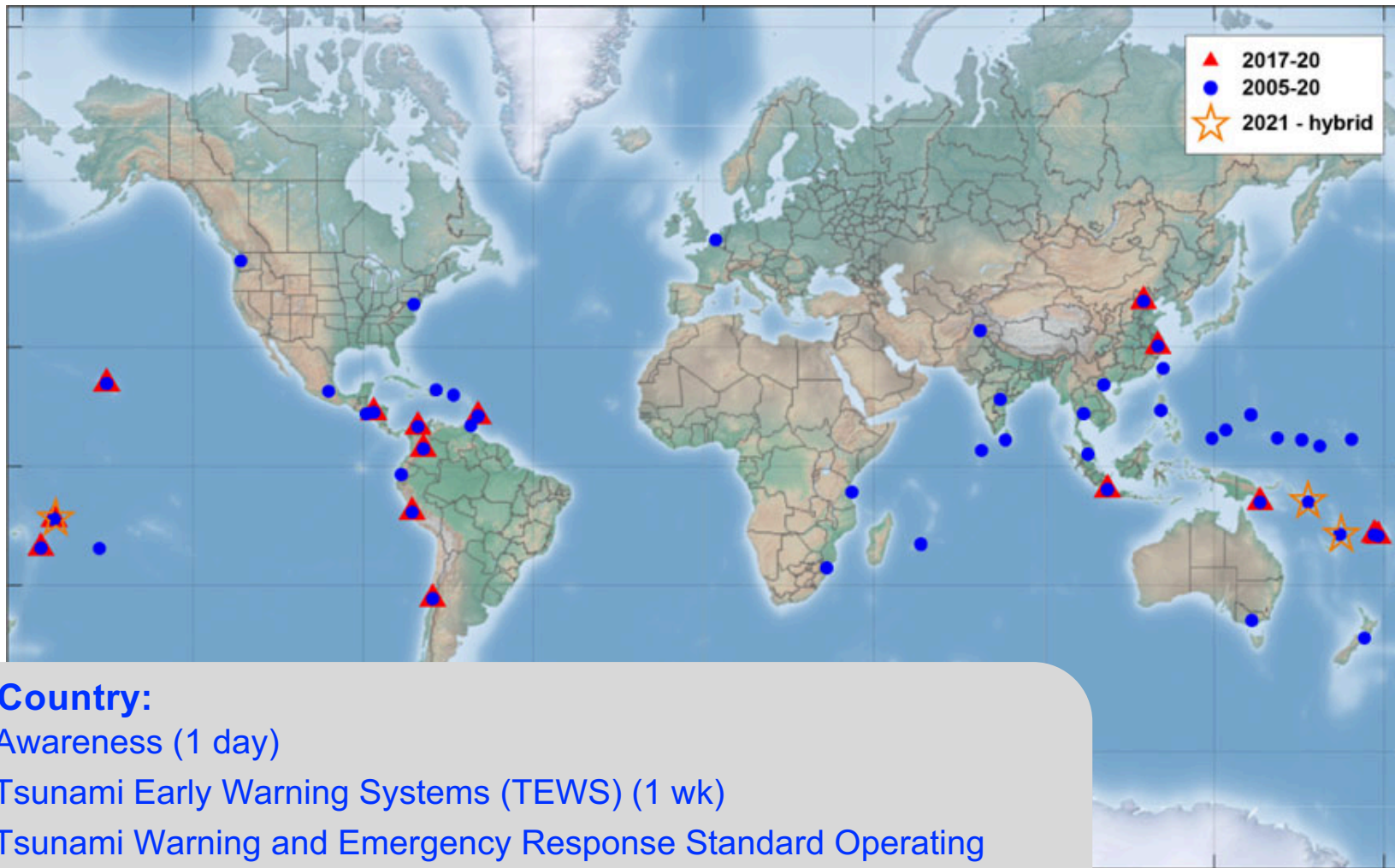
<https://vimeo.com/192771669>

PACIFIC TSUNAMI WARNING & MITIGATION SYSTEM

ICG/PTWS: FOUNDATIONAL ELEMENTS



ITIC - IOC TSUNAMI CAPACITY BUILDING (2005-2021, >130 trainings)



For example, Tonga

- In-Country -2009, 2010, 2015, 2019
- ITP-Hawaii – 2006, 2009, 2011, 2014, 2016, 2018, 2019 (14 total)

ITIC main challenge

- Staff turnover, so continual request from Countries
- Limited resources



In Country:

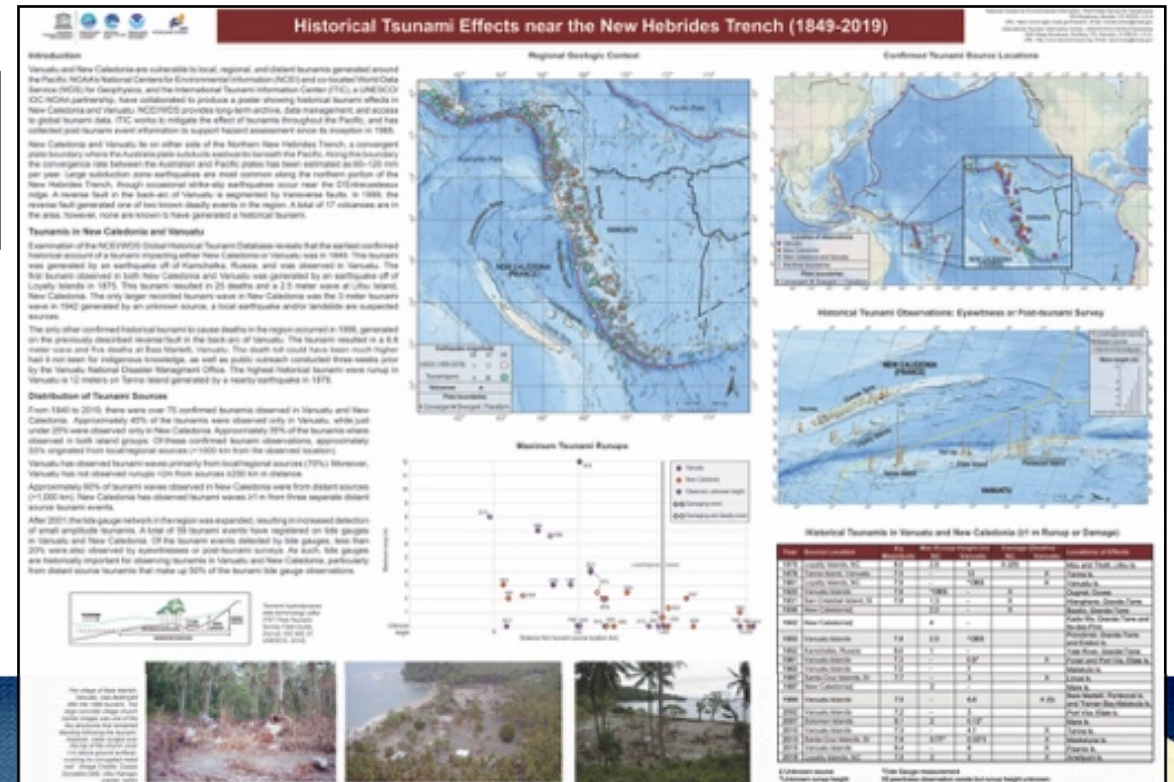
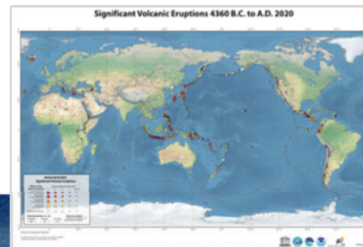
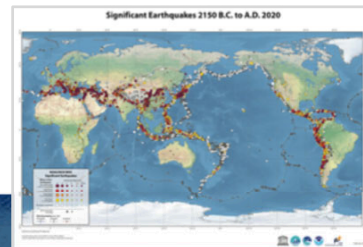
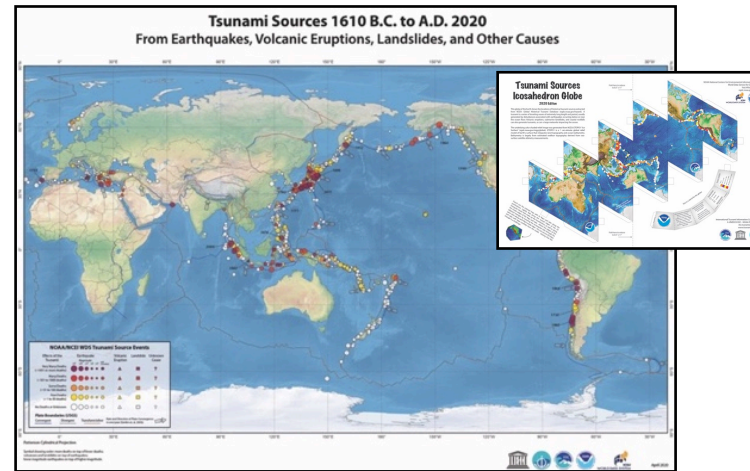
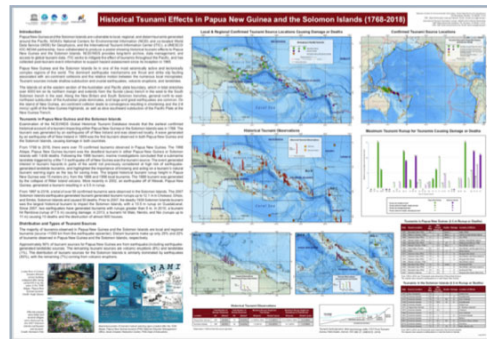
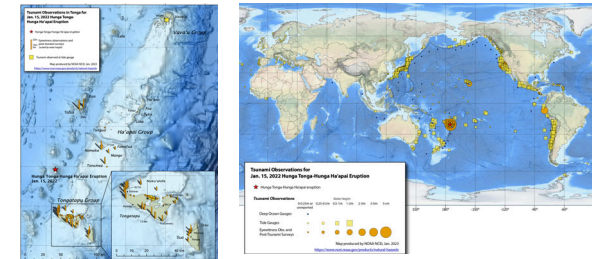
- Awareness (1 day)
- Tsunami Early Warning Systems (TEWS) (1 wk)
- Tsunami Warning and Emergency Response Standard Operating Procedures (SOPs), Tsunami Decision Support Tools (TWTtools) (1wk)
- Tsunami Evacuation Maps, Plans, Procedures (TEMPP) (5 1-wk)

At ITIC/PTWC: ITP-Hawaii (TEWS, 2-wk)



ITIC materials – Historical Tsunami Hazards

- ❑ **Global Tsunami, Earthquake, Volcanic Eruption Maps** (update 2022)
- ❑ **Regional Historical Tsunami Effects Maps**
 - Vanuatu / New Caledonia, New Hebrides (2020)
 - American Samoa /Samoa/Tonga (2017, update incl HTHH 2022)
 - Papua New Guinea/Solomons (Jun 2019)



ITIC materials - Building an Educated and Aware Public

www.tsunamiwave.org

Pacific Tsunami Warning & Mitigation System

Tsunami Warning!

IOC Wave Exercises:
Exercise Pacific Wave

PacWave

WHAT TO DO? SENSING A TSUNAMI

Tsunamis can be detected using our human senses. Recognize a tsunami's natural warning signs.

FEEL

- Big local earthquakes may cause tsunamis.
- Feel the ground shaking evenly, or for a long time?

SEE

- Tsunami may be preceded by rapid fall in sea level as the waves recede, exposing rocks, reefs, and fishes on the sea bottom.
- Tsunami often come ashore as a wall of water, and quickly flood inland.
- Do you observe disappearance of water, or oncoming wall of water?

HEAR

- Abnormal ocean activity, a wall of water, and approaching tsunami create a loud "roaring" sound similar to that of a truck at a distance.

RUN

- Don't wait for official evacuation orders.
- Immediately leave low-lying coastal areas. Move inland to higher ground.
- RUN if you see a tsunami coming!

Tsunamis on the move...

Knowledge is Safety: Tsunami Warning Signs...

TSUNAMI WAVES

Run To High Ground!

A Native American story about tsunamis and earthquakes.

Glossary covers:

- Science
- Measurement
- Instruments
- Governance

TSUNAMI GLOSSARY

2016

Technical Series 85

Surviving a Tsunami: Lessons from Chile, Hawaii, and Japan

TSUNAMI

Lessons from Chile, Hawaii, and Japan

tsunami?

TSUNAMI WARNING!

FOR HURTS!

การเตือนภัย

TSUNAMI WARNING!

TSUNAMI WARNING!

AMERICAN SAMOA

Where the First Wave Arrives in Minutes

Indonesian Lessons on Surviving Tsunamis Near Their Sources

EARTHQUAKES AND TSUNAMIS

PRE-ELEMENTARY SCHOOL

EARTHQUAKES AND TSUNAMIS

TEXT FOR ELEMENTARY SCHOOL

EARTHQUAKES AND TSUNAMIS

5th to 8th GRADE OF PREPARATORY SCHOOL

TSUNAMI Teacher

HIGH SCHOOL TEXTBOOK

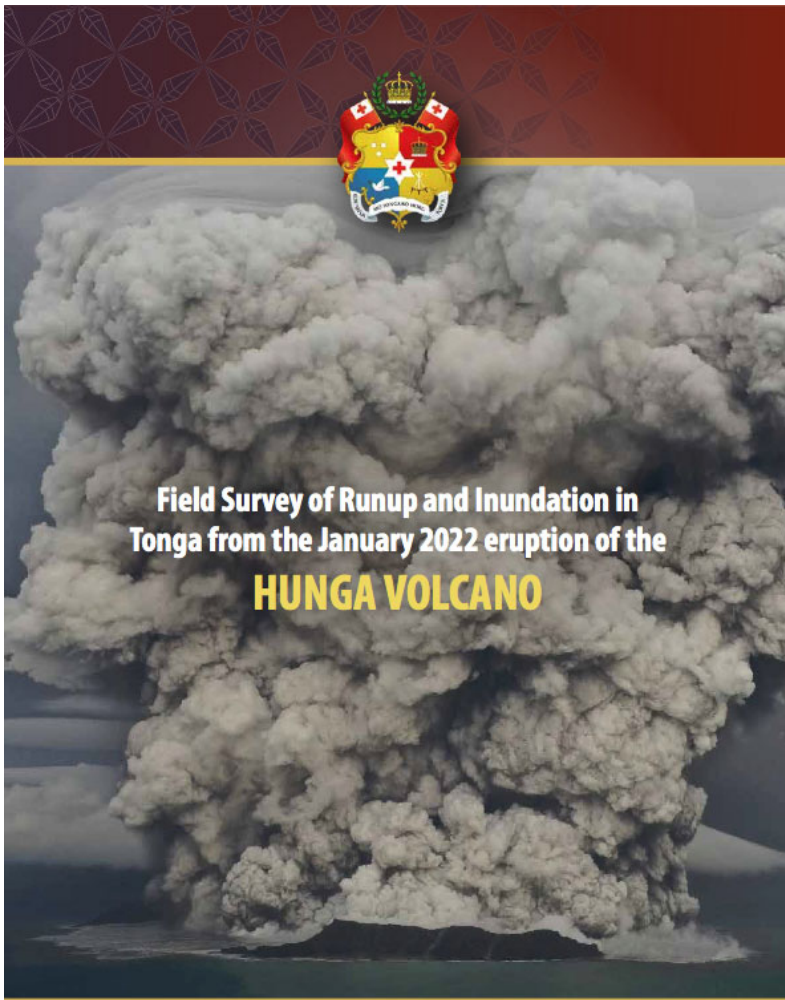


UNESCO/IOC-NOAA
International Tsunami Information Center



ITIC facilitation: Post-Event Surveys (HTHH, Tonga 15 Jan 2022)

Interim Volcano Tsunami SOPs for Pacific countries



International Tsunami Survey Team Tonga

Post-Tsunami Field Survey of the 15 January 2022 Hunga-Tonga Hunga-Ha'apai Volcanic Eruption and Tsunami

eruption rising to its climax at 5:24 pm (0424 UTC) January 15th from ~10 km north of Tongatapu. Upper plume ~120 km wide (Photo: Branko Susic)

From January 15th, 2022, at approximately 4:47 pm local time (0347 UTC), several weeks of heightened activity at the Hunga volcano (Cronin et al., 2017) 65 km northwest of Tongatapu, culminated in an 11-hour long violent eruption. During the first 45 minutes of this eruption a massive atmospheric pressure wave and a series of tsunamis were generated and observed around the world (Carvajal et al., 2022, Lynett et al., 2022). The eruption severed an undersea telecommunications cable resulting in a near-blackout in communications between Tongatapu and the world as only satellite phones and HF radio were able to work. Restoration of communications through the repair of the cable took until 22 February 2022 (5.5 weeks).

The first successful science / tsunami warning centre communications with the Tonga Meteorological Service (TMS) was 25 January, 10 days after the eruption, when the International Tsunami Information Centre (ITIC) Director was finally able to connect to TMS by satellite phone. This communication resulted in three requests from the Government of Tonga for support to repair and re-strengthen their tsunami warning and weather forecasting operations.

Due to the immediate post-disaster needs of the community and because of travel restrictions to and within Tonga caused by the ongoing COVID-19 pandemic, a comprehensive field survey of the impacts and effects of tsunami runup and inundation was not conducted in the immediate aftermath of the event. Unlike for past damaging tsunamis, no International Tsunami Survey Teams were able to deploy to work with Tongan government officials to conduct detailed surveys although local investigators. These surveys are important because they increase tsunami risk knowledge, strengthen support for community recovery, support future improvements to the Tsunami Early Warning System (TEWS) and contribute to the fundamental understanding of the tsunami phenomenon itself.

To address this need, the Government of Tonga first officially requested support from New Zealand or Australian scientists to conduct a post-tsunami survey. Given the travel restrictions, New Zealand, USA and SPC, sent in lieu surveying equipment to the Tonga Geological Services (TGS) to assist in collecting runup and inundation data.

Additionally, the ITIC requested that The Pacific Community (SPC) engage an experienced international tsunami scientist (Dr. Jose C. Borrero) to provide remote training and assistance on post-tsunami field data collection techniques and to compile the results of a series of surveys into a technical report. This report and the data collected are provided for download below.

Document	Format
Journal: Tsunami Runup and Inundation in Tonga from the	
Surviving a Tsunami -	

ITIC CARIBBEAN OFFICE (ITIC-CAR)

Quick Links

- Current Warnings
- Most Recent Tsunami

Find us on Facebook

Resources

Tsunami Ready

UNESCO IOC Tsunami Ready

Preparing communities to be ready for the next tsunami!

Tsunami Awareness Poster

Available in English, Chinese, French, Japanese, Korean, Portuguese, Singapore.

Global & Regional Hazard Maps

Tsunami Sources, Significant Earthquakes and Significant Volcanic Eruptions. Also Tsunami Sources Icosahedron Globe.

Tsunami, The Great Waves

Available in English, Spanish, French and Chinese.

Tsunami Glossary 2019

Available in English, Arabic, Spanish, French and Bahasa.

Tonga Post-Tsunami Survey

IOC, SPC, NZ, US

- Due to COVID, virtual technical assistance to Tongan agencies

HTTH Volcano Tsunami Procedures (SOP)

IOC, SPC, NZ, US

- Since March 2022 by Pacific Tsunami Warning Center (PTWC)
- Triggered by Nuku'alofa gauge or DART-NZ
- Forecast assumes HTHH source and scaled by HTHH 2022 observations



IOC ICG/PTWS STRUCTURE - WORKING GROUPS AND TASK TEAMS 2021-2023





International Tsunami Information Centre
A UNESCO/IOC-NOAA Joint Partnership

Thank You

If you need information or assistance, contact ITIC
itic@unesco.org, itic.tsunami@noaa.gov

Dr. Laura Kong

Director

UNESCO/IOC International Tsunami Information Centre



UNESCO/IOC-NOAA SHOA
International Tsunami Information Centre

