



# TsuInfo Alert

prepared by the Washington State Department of Natural Resources on behalf of the  
**National Tsunami Hazard Mitigation Program**  
a state/federal partnership funded through the National Oceanic and Atmospheric Administration (NOAA)

APRIL 2022

Volume 24, Number 2



## CARIBE WAVE 2022 Exercise

By Stephanie Soto and Christa von Hillebrandt-Andrade, NOAA ITIC Caribbean Office,  
and Elizabeth A. Vanacore, UNESCO/IOC ICG CARIBE WAVE Task Team Chair,  
UPRM, Dept of Geology, Puerto Rico Seismic Network

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Almost 410,000 people across the Caribbean and Adjacent Regions participated in the annual tsunami exercise, CARIBE WAVE on March 10, 2022. The main objectives were to exercise and evaluate communications and the tsunami procedures and programs, as well as promote awareness and preparedness. The exercise is one of the main activities of the UNESCO/IOC Intergovernmental Coordination Group for the Tsunami and other Coastal Hazards Warning System for the Caribbean and Adjacent Regions (CARIBE EWS). The CARIBE WAVE task team of the CARIBE EWS coordinates the exercise thru the NOAA International Tsunami Information Center Caribbean Office with the support of the Caribbean Tsunami Information Center and Pacific Tsunami Warning Center. Two hypothetical scenarios were modeled for this exercise, a tsunami generated by a magnitude 8.0 earthquake located on the Western Muertos Trough and a tsunami generated by a magnitude 8.3 earthquake located in Northern Panama. It was up to each Member State and territory to choose between the two scenarios and decide the level of official participation and activity for their country.

The Pacific Tsunami Warning Center (PTWC), the Regional Tsunami Service Provider, issued a “Dummy” message at 1400 UTC through the different warning systems to test communications with Tsunami Warning Focal Points (TWFP) and National Tsunami Warning Centers (NTWC). Different methods of communications were used to test and disseminate the message: The World Meteorological Organization (WMO), Advanced Weather Interactive Processing System (AWIPS), Aeronautical Information Replacement System (AIRS), NOAA Weather Wire, GEONETCast Americas, Fax, Email, and Social Media. According to feedback from the post-exercise survey as well as social media and web posts, the “Dummy” message was successfully received. The Central America Tsunami Advisory Center also disseminated simulated products for the Northern Panama scenario to its stakeholders.



Dr. Charles McCreery, PTWC Director, sending out tsunami products during the exercise.

According to the Tsunami Zone website (<https://www.tsunamizone.org/>), which manages the registration system, the majority of the participants were from K-12 Schools. Local governments, universities, and preparedness organizations also had a high level of participation. Social media platforms, which have become the primary source for communicating tsunami awareness, reached over 1.7 million people worldwide during the exercise.

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Prepared and published bimonthly by the Washington State Department of Natural Resources, Washington Geological Survey, on behalf of the National Tsunami Hazard Mitigation Program (NTHMP), a state/federal partnership led by the National Oceanic and Atmospheric Administration (NOAA).

This publication is free upon request and is available in print by mail and online at:

<http://www.dnr.wa.gov/programs-and-services/geology/geologic-hazards/tsunamis/tsuinfo-alert>

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**NATIONAL TSUNAMI HAZARD MITIGATION PROGRAM LIBRARY CATALOG:**

<http://d92019.eos-intl.net/D92019/OPAC/Index.aspx>

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## CARIBE WAVE 2022 Exercise

By Stephanie Soto and Christa von Hillebrandt-Andrade, NOAA ITIC Caribbean Office,  
and Elizabeth A. Vanacore, UNESCO/IOC ICG CARIBE WAVE Task Team Chair,  
UPRM, Dept of Geology, Puerto Rico Seismic Network

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The International Tsunami Information Center Caribbean Office (ITIC-CAR) used virtual meeting tools to support the exercise. It also assessed the availability of sea level data, which is important to forecast and confirm a real tsunami event. If a tsunami had occurred during the day of the exercise, data of 34 of the 64 sea-level stations in the region would have been available for event analysis. Only 2 of the Deep Ocean Assessment and Reporting of Tsunamis (DART) were operational during the exercise. A regional post-exercise "hot-wash" webinar took place on March 22 to allow the Member States and Territories to discuss and provide feedback on the exercise in an open forum. Feedback from the participating countries is being gathered through an online questionnaire to guide future actions and to continue to strengthen tsunami readiness at all levels across the region.



Tsunami evacuation drill in Mexico as part of the CARIBE WAVE 22 exercise.

CARIBE WAVE has been improving and validating tsunami preparedness since 2011, which is why tsunami exercises are crucial to maintaining readiness in case of a real tsunami event. For more information on the exercise, the Western Muertos Trough and Northern Panama scenarios, and exercise reports visit: <https://www.weather.gov/ctwp/caribewave22>.

# TSUNAMI PREPAREDNESS

## U.S. Virgin Islands Participation in Caribe Wave 2022

By the Virgin Islands Territorial Emergency Management Agency (VITEMA)

On March 11th at 10 am, the United States Virgin Islands participated in Caribe Wave 2022 Tsunami Warning Exercise. The exercise consisted of a live test of the territory's Emergency Alert System (EAS) and the Integrated Public Alert & Warning System (IPAWS) capabilities. The live test of the EAS and IPAWS confirmed that VITEMA would be able to deliver mass emergency notifications to U.S. Virgin Islands residents via radio, mobile devices, landline, email, and social media outlets.

According to the [www.TsunamiZone.org](http://www.TsunamiZone.org) website, more than 12,349 U.S. Virgin Islanders registered their participation in the CARIBE WAVE tsunami exercise. The participants included students throughout the territory, government agencies, and organizations. The CARIBE WAVE Tsunami Warning Exercise allowed residents to build resilience by exercising emergency communications, reviewing tsunami response procedures, and promoting tsunami preparedness throughout the territory.

VITEMA reminds the community that tsunami preparedness in the territory is a constant and ongoing process that must be continuously practiced because it is a no-notice event. "VITEMA will continue to work towards accomplishing its mission, which is to save lives and protect the property of the territory's population from threats and risks from natural and man-made hazards. We will ensure our territory remains prepared and resilient through planning, coordinating, training, and exercising." VITEMA reminds you to always Be Prepared, Stay Informed and Be Vigilant.



## California Conducts Annual Tsunami Communications Exercise During California Tsunami Preparedness Week

By Matt Palmer, California Governor's Office of Emergency Services (Cal OES), Rick Wilson, California Geological Survey (CGS), and Yvette LaDuke (Cal OES)

The California Tsunami Program (Cal OES and CGS) held a California Tsunami Communications Exercise on Wednesday, March 23, 2022. The annual communications exercise aims to test the state's ability to notify Tsunami Program partners of tsunami incidents, distribute and communicate critical incident information, and test the reception and use of the Tsunami Evacuation and Maritime Response Playbook information and recommendations. It provides an opportunity for emergency management organizations throughout the state to exercise their Operational Areas communications, review and test their tsunami response procedures, and promote overall tsunami preparedness. Regular exercising of response plans is critical to maintaining readiness for an emergency. This is particularly true for tsunamis, which are infrequent but are potentially high-impact events. Emergency Managers in all twenty coastal counties of California are encouraged to participate and to involve their cities, special districts, and port and harbor districts in the communication exercise.

This year, over 100 coastal stakeholders participated in the exercise including 18 of California's 20 coastal county emergency management agencies, U.S. Coast Guard, National Weather Service, Ports of Los Angeles and Long Beach,

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# TSUNAMI PREPAREDNESS

## California Conducts Annual Tsunami Communications Exercise During California Tsunami Preparedness Week

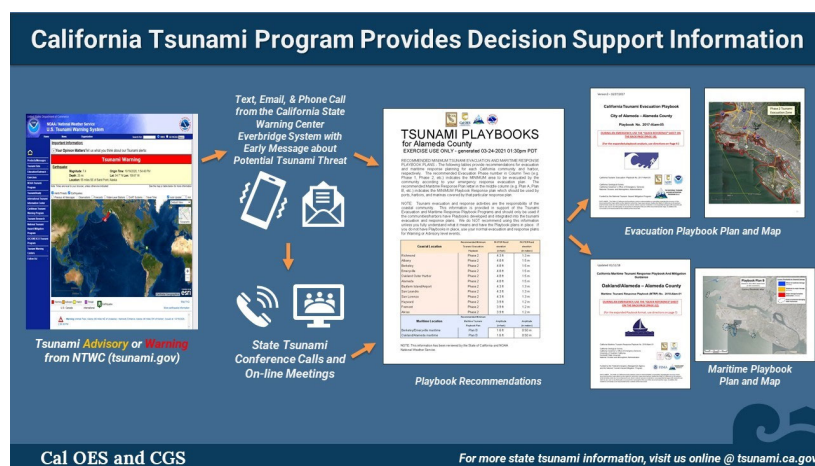
By Matt Palmer, California Governor's Office of Emergency Services (Cal OES), Rick Wilson, California Geological Survey (CGS), and Yvette LaDuke (Cal OES)

(Continued from page 3)

UC Santa Barbara, Los Angeles Unified School District, harbor/marina officials, coastal cities, the U.S. Department of Transportation, California Department of Transportation, Cal OES Duty Officers and Management, and the California State Warning Center.

Before this exercise, a handbook was developed with background information on the tsunami source scenario and the Playbook approach, which provides vital tsunami response information including estimated site-specific flood levels and corresponding evacuation recommendations for use by local officials in the tsunami response decision-making process. This handbook was provided to contacts on California's Tsunami Event Distribution List (TEDL) a week before the exercise, enabling local officials to run drills or exercises in concert with the statewide exercise.

On March 23, 2022, the exercise began with an Everbridge notification disseminated at 1318 hours to the TEDL by the California State Warning Center. This was followed by an email to the TEDL from the Cal OES Seismic Hazards Branch Duty Officer at 1335 hours to provide additional communications, information regarding the scheduled conference call, and Playbook recommendations. A Box.com website was created to share the exercise handbook, the Tsunami Playbooks, and the Playbook recommendations for the exercise scenario.



The exercise continued with a conference call at 1400 hours with Cal OES and CGS providing a briefing, including current incident information, and a discussion of the Playbook recommendations based on the exercise scenario. The National Weather Service followed with a weather briefing and additional scenario information. Once the briefing portion of the conference call ended, a roll call was conducted of each coastal county providing them with the opportunity to brief on planned response actions based on the exercise scenario.

Following the exercise, the California Tsunami Program conducted a hot wash discussion to address the tsunami response protocols' comments and/or concerns. This exercise was critical to helping address some issues which arose during January 15, 2022, Tsunami Advisory from the Tonga volcanic eruption. During the hot wash, the Tsunami Program received important feedback from individual local partners which will help the State make improvements in the future, including moving the teleconference call to a visual web-based platform, improving the capabilities of sharing the Playbook information, and focusing on the purpose of the call, which is to provide critical incident situational awareness and ensure local reception and understanding of the Playbook information.

# TSUNAMI PREPAREDNESS

## U.S. Tsunami Warning System Needs Major Overhaul, Report Says

Current system is rife with outdated software, delayed alerts and poor communication to the public, according to expert panel

By Diana Leonard, Washington Post

The United States' tsunami system is in need of a major update, with ongoing problems that include outdated software, delayed alerts and poor communication to the public, according to a panel of tsunami experts. Its [recent report](#) sees “an urgent need for action” and advises the National Oceanic and Atmospheric Administration (NOAA) to overhaul aspects of the system to fix these and other pressing issues.

Tsunamis are a series of very long ocean waves generally caused by undersea earthquakes or other events that disrupt a significant amount of ocean water. The U.S. West Coast, Hawaii and Alaska are particularly tsunami-prone, with potential threats found around the Pacific rim. At least 30 reported tsunamis have caused at least one death or \$1 million in damage to the United States as of January 2018, [according to NOAA](#).

[\[California's tsunami vulnerability may be greater than once believed\]](#)

As recently as January, tsunami waves [reached the West Coast](#) and advisories were issued across Hawaii, Alaska, Washington, Oregon and California, prompted by the underwater explosion of the Hunga Tonga volcano that sent [shock waves around the world](#).

“Every tsunami is very tricky ... we learn something new every time,” said Rick Wilson, co-chair of the Tsunami Science and Technology Advisory Panel (TSTAP), a group of nonfederal scientists that issued the report and an arm of the NOAA Science Advisory Board. “However, we feel that these recommendations going forward will not only save lives, but potentially millions of dollars in the future for commerce and protection of the coastline from tsunami hazards.”

The 32-page report outlines several areas for improvement, but the most pressing matters involve NOAA's tsunami warning program and its two tsunami warning centers, located in Honolulu and Palmer, Alaska. Namely, the report points out “perceived gaps and inconsistencies throughout the tsunami forecast and warning process.” Some of the changes recommended are extensive and described as an “overhaul” to ensure accurate, timely and clear warnings of impending tsunami waves.

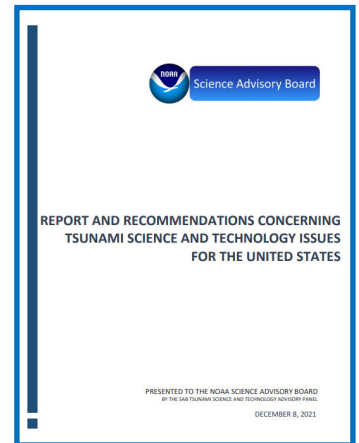
This year's report builds on a sweeping 2011 [assessment](#) by the National Academy of Sciences, which found numerous gaps in the nation's tsunami preparedness and much room for improvement, detailed in a long list of recommendations spanning nearly 200 pages.

While progress has been made on a number of fronts, many key issues remain unaddressed or have not kept pace with changing technology, or new issues have emerged.

[\[Weather Service's tornado warnings were delayed during deadly Iowa outbreak\]](#)

**'Antiquated' warning system in need of an update**

The panel looked closely at the overarching warning system: from the tsunami source to the forecast, to the messaging going out to the public.



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# TSUNAMI PREPAREDNESS

## U.S. Tsunami Warning System Needs Major Overhaul, Report Says

Current system is rife with outdated software, delayed alerts and poor communication to the public, according to expert panel

By Diana Leonard, Washington Post

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“We found that parts of [the] system that they have in place right now are somewhat antiquated and are not capable of making changes that a lot of states and communities are requesting to be changed,” said Wilson.

For example, the two tsunami warning centers in Alaska and Hawaii are relying on outdated software and methods, which limits improving the warning process — including estimating wave-generating potential from earthquakes and other sources. As new and complicated warning issues have arisen over the years, patchwork or “band-aid” fixes have been applied.

The Hunga Tonga volcanic eruption and resulting tsunami Jan. 15 in the South Pacific exposed an issue that the panel had already identified: that NOAA should improve its ability to detect and warn about tsunamis from non-earthquake sources, such as volcanic eruptions and landslides.

For example, because the system is set up to estimate tsunamis generated by earthquakes, [tsunami advisories](#) were issued for Hawaii and the U.S. West Coast relatively late, Wilson said.

[\[Hunga Tonga volcano spewed ash 36 miles high, a world record\]](#)

“Every day, year or 10 years that goes by makes it more likely that we are going to have a larger event that will really test the system,” said Corina Allen, chief hazards geologist at the Washington Geological Survey and a member of the panel.

What is needed, according to the report, is a “comprehensive, enterprisewide technology upgrade” of the warning system.

For example, the panel’s co-chair, Rocky Lopes, suggested that the centers could have their alerting capability unified under the umbrella of the National Weather Service and brought into its advanced warning platform (known as [AWIPS](#)), which is used to issue timely alerts for all weather events. In analyzing earthquake events, the panel recommended greater collaboration with the U.S. Geological Survey (USGS), which uses more up-to-date earthquake analysis software than is available at the warning centers.

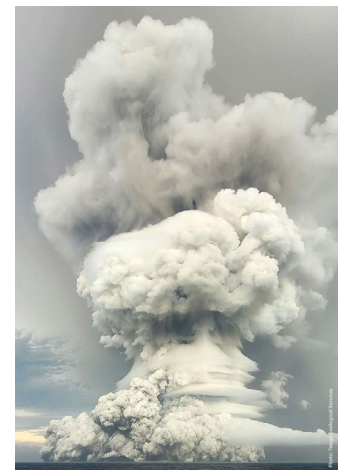
### Two warning centers, confusing messaging

NOAA’s two tsunami warning centers cover two separate regions. The National Tsunami Warning Center (NTWC) serves Alaska, Canada and the contiguous United States, while the Pacific Tsunami Warning Center (PTWC) covers the Hawaiian Islands, U.S. and British territories in the Caribbean and Pacific, and international coastlines in the Caribbean and the Pacific.

A long-standing problem is that the two centers are not coordinated and do not speak with one voice. It is also difficult for one center to step in and perform the duties of the other if one center is temporarily out of service.

“The warning centers have very capable people and really good scientists, but they operate independently,” said Lopes, a former administrator of the National Tsunami Hazard Mitigation Program.

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The plume from 14 January 2022, the day before the gigantic 15 January 2022 eruption. [Taniela Kula, Tonga Geological Services]

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As a result, they may interpret the same event differently or offer different products to their respective regions. For example, the NTWC provides estimated wave heights to Alaska and the West Coast, which states and communities have found valuable for response efforts and to better gauge tsunami hazards. The PTWC, however, does not provide this information to its service areas.

[Tsunami.gov](#), the website that serves as the official warning depot for all tsunami events, was established in 2016 and collects warning information from each center in bulletins in near real-time. But when a large earthquake happens, the nature and reach of any potential tsunami threat is far from clear.

[\[NOAA tsunami website faltered in March 2020 while Hawaii faced a potentially 'destructive' threat\]](#)

"It is not a user-friendly website," said Allen of the Washington Geological Survey. "If you are going there for the first time to try to track these bulletins, it is really confusing."

According to the report, an overall update to the Tsunami.gov website is needed, and it could provide a single national message to summarize the scope of each event. Lopes indicated that the lack of attention to Tsunami.gov is probably because of insufficient staffing, which the panel hopes NOAA will address in its response to the report.

### Earlier warnings needed for distant tsunamis

The warning centers issue initial alerts about possible tsunamis within five minutes of an earthquake, but it can take up to three hours to produce a full forecast with estimated wave heights for coastal areas farther from the wave source. That's a problem for coastal emergency managers who need to make important evacuation decisions quickly.

"What we found is that a lot of emergency managers still need about three or four hours at a minimum to pull off their evacuations and their response activities," said Wilson of Tsunami Science and Technology Advisory Panel.

On July 28, 2021, following a magnitude-8.2 earthquake off the coast of Alaska, the threat to the West Coast was listed for several hours as "being evaluated," leaving little time to initiate evacuation plans if they had been needed.

[\[Alaska earthquake sparks tsunami concerns in Hawaii and beyond\]](#)

The panel recommends that NOAA provide some estimate of likely impacts to states much earlier. It also points to newer technologies that may quickly detect tsunamis in the open ocean, such as global navigation satellite systems, which could help to speed up the warning process and may be more cost effective than the network of ocean buoys currently used.

The NOAA administrator has one year from January, when the report was received, to respond to the recommended changes. In a letter sent a day after its receipt, NOAA Administrator Rick Spinrad wrote: "Please pass my thanks on to the TSTAP for their diligence and careful attention to this important topic. We will give this report the attention and follow up that it so well deserves."

Link to original article: <https://www.washingtonpost.com/weather/2022/03/13/tsunami-warning-issues-noaa-tonga/>

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# TSUNAMI PREPAREDNESS

## UN Ocean Decade Safe Ocean Lab Highlights Transformative Actions for Tsunami Resilience

By Christa von Hillebrandt-Andrade, International Tsunami Information Center – Caribbean Office

From 5 to 7 April, 2022 the Safe Ocean Decade Laboratory for the UN Ocean Science Decade for Sustainable Development (Decade) took place with a global engagement of almost 1000 people from over 110 countries. The risk, monitoring, preparedness, governance and social equity of ocean hazards and early warning were explored. Tsunamis early warning was a trending topic over the 48 hours of the event.

The United Nations proclaimed 2021-2030 as the Decade of Ocean Science for Sustainable Development. The objective is to support efforts to gather ocean stakeholders worldwide behind a common framework that will ensure ocean science can fully support countries in creating improved conditions for sustainable development of the Ocean. A Safe Ocean is one of the decade outcomes.



Safe Ocean Laboratory Core Event venue at the EcoExploratorio: Puerto Rico Science Museum. This was the first time since the laboratories began that there was a live audience (Photo by Merry Manso).

Because of the Pandemic, the first Ocean Decade Conference could not be held in Berlin, Germany as originally planned for 2021. It was thus decided to convert this event into seven 48-hour virtual “Ocean Laboratories”, each centered on one of the Decade outcomes.

The seven virtual labs consist of three main parts: a Core Event, Satellite Activities, and a “Wrap Up”. While the Core and Wrap Up events are hosted and organized by the German Federal Ministry of Education and Research in partnership with the Intergovernmental Oceanographic Commission of UNESCO (IOC-UNESCO), the Satellite Activities are proposed and executed by other stakeholders and institutions. The Safe Ocean Lab was the fifth lab and was co-chaired by Burkard Baschek, Director of German Ocean Museum in Stralsund, Germany, and Christa von Hillebrandt-Andrade of the International Tsunami Information Center, Caribbean Office in Mayaguëz, Puerto Rico.

Given the extreme vulnerability of ocean hazards in the Caribbean and Pacific islands and small country states, the Scientific Planning group for this lab decided the focus should be on these geographic regions with the overarching theme of Environmental Justice and Right. Unlike other labs, a decision was made to “take” the Lab out of the purely virtual environment of the Berlin TV Studio. The German Ocean Museum and the EcoExploratorio: Puerto Rico Science Museum (San Juan, Puerto Rico) were used as side venues. Also, Christa, who participated from the San Juan venue, also had a live audience – another first for an Ocean Lab. The event Wrap Up session was organized by the Southern Pacific Community (SPC).

The Core Event was divided into four main sections: Preparing for the Unexpected with a focus on the Tonga Volcanic Eruption and Tsunamis, Integrated Coastal Hazard Early Warning Systems and Services in the Caribbean, an overview of Endorsed Ocean Decade Programs and Projects, and a Panel on Environmental Justice and Right. A recording of the full Core Event is available at <https://www.youtube.com/watch?v=QbdZkRfkcBM&authuser=0> and a 5 Minute Summary of Core Event: <https://www.youtube.com/watch?v=OjBGWM2Fu4s&authuser=0>.

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# TSUNAMI PREPAREDNESS

## UN Ocean Decade Safe Ocean Lab Highlights Transformative Actions for Tsunami Resilience

By Christa von Hillebrandt-Andrade, International Tsunami Information Center – Caribbean Office

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The Core Event was followed by 20 Satellite Events <https://www.oceandecade-conference.com/en/satellite-activities-a-safe-ocean.html>. Recordings of the activities are available on the website. There was a broad variety of events, which included different ocean threats and early warning components. Some of the topics covered include:

**Further Challenges for Tsunami Warnings** (2 sessions)—Knowledge on deadly tsunamis generated by non-seismic and complex sources was shared with the goal of building a pathway to also detect and warn coastal communities of these tsunamis.

**SMART Subsea Cables Contributing to a Safer Ocean**—Participants learned how an envisioned planetary observing array based on sharing the global submarine telecom network with environmental sensing can be used for earthquake and tsunami warning and climate and ocean monitoring.

**NOAA Sea Level Rise Viewer**—Explored visualization tools used to help communities identify their risks to sea level rise and the increased frequency and severity of high-tide flooding.

**Establishing a Blue Line: Jamaica Case Study for Tsunami Inundation Extent**—Presentation on the establishment of the first Blue Line in the Caribbean and how its methodology using GIS tools can integrate multiple coastal hazards in the Tropical Americas and the Caribbean.

**Importance of Multi-annual Tsunami Exercises for a Safe Ocean**—A newly published UNESCO/IOC guide on how to plan, conduct and evaluate a multi-annual tsunami exercise program providing practical advice and templates was presented and discussed.

**Disaster Risk Communication on Social Media**—Tips for routine weather & science communication on social media were provided by Ada Monzón, meteorologist, broadcaster, founder & CEO of EcoExploratorio Science Museum.

**Vaka Moana: A Sustainable & Safe Blue Pacific Ocean**—The “Vaka Moana: Safe Ocean” lab took participants on a journey to explore success stories, discuss regional challenges and opportunities to strengthening early warning systems in support of resilient coastal communities and maritime safety.

**100% of At-risk Communities Recognized as Tsunami Ready**—This satellite session offered a virtual get-together forum for local and national leaders who have gone through the Tsunami Ready recognition process, to share their experiences and work to make the ocean safer. It included presentations from Puerto Rico and Hawaii.

On April 7 the Safe Ocean Lab came to a close with the Wrap Up Session (<https://www.youtube.com/watch?v=4emigx7f7F8&authuser=0>) which was also co-hosted from the Southwest Pacific Islands. It included a panel reviewing the Core Event, reports of selected Satellite Activities, an artistic speech by Pacific Poet Amelia Rigsby, and then closing remarks.

The next Decade Laboratory will be held 10 – 12 May 2022. The focus will be on good governance, open access to data, and information and technologies. For more information and to sign up, the link is <https://www.oceandecade-conference.com/en/an-accessible-ocean.html>. The website to follow additional Decade activities, sign up for the Stakeholder Forum, and join a Community of Practice is <https://www.oceandecade.org/>.

# TSUNAMI RESPONSE

## Alert and Response Lessons Learned from the 1/15 Tonga Tsunami

By Elyssa Tappero, WA Emergency Management Division (WA EMD)

**Everyone in emergency management knows formal exercises test the feasibility of your response procedures only up to a point.** The true trial comes when hazard strikes and those plans are launched in the real world against a real event. Until then, we can only cross our fingers and hope the event which challenges us in this way is more of a “pop quiz” and less of a “sleepless finals week crucible”. After all, small events can be excellent opportunities to discover areas of improvement in our plans – and who doesn’t love the never-ending task of reviewing and updating Standard Operating Procedures (SOPs)?

Okay, maybe updating SOPs isn’t the most exciting part of emergency management, but it’s certainly essential to our work. Before the Hunga-Tonga-Hunga-Ha’apai volcanic eruption put Washington State into a tsunami advisory on January 15th, 2022, the state’s last tsunami alert of any real consequence was a tsunami watch back in 2018. That’s a long time to go without a real-world event to test our procedures against (not that we’re complaining about the lack of tsunamis, of course!). Though we review and exercise our tsunami SOPs yearly, the Tonga tsunami still highlighted plenty of areas for improvement.

**The other thing everyone in emergency management knows is that lessons learned are most effective when you share them with others.** So here are some of the alerting and response lessons WA EMD learned during the Tonga tsunami and how we are implementing them here in Washington:

1. *Utilize your virtual meeting platform to the fullest*—WA EMD facilitated a total of 15 state/local conference calls during the Tonga tsunami. These were held via Microsoft Teams for the first time, which allowed access to features like file sharing and live chat. Thanks to feedback from our local partners, in future tsunami events we will establish a single Teams meeting for use throughout the event instead of making a new one for each conference call. By creating one Teams meeting that is open for the entire tsunami event, anyone can use the meeting space to collaborate, ask questions, and share files at any time. This will help standardize event messaging, align local response across neighboring jurisdictions, and provide a record for use during the after-action review.

2. *Work smarter, not harder, by standardizing!*—Do we need an SOP, job aid, or template for everything? Of course not. But can having one even for easy tasks save you precious seconds – or just a little precious sanity – when you’re responding to a real-world event? Absolutely. That’s why we created templates for taking notes during the National Tsunami Warning Center (NTWC) and state/local conference calls which mirror the order in which information is provided. These forms have dropdown selections and fillable fields to ensure the format of the information recorded stays consistent. We also created a script for facilitating the state/local conference call so anyone on the team can easily lead the call using the script document and the notes from the most recent NTWC call.

The image shows a screenshot of a form titled "NTWC Conference Call #1 Notes Template". The form contains several bullet points with input fields for text, dates, and dropdown menus. The items listed are: "NTWC conference call #:", "NTWC conference call start:", "Type of tsunami alert issued for WA:", "Initiating event:", "Earthquake parameters (if applicable):" (with sub-items for Magnitude, Depth, Closest geographic location, and Occurred at), "Is a tsunami confirmed?", and "Any observed tsunami waves or impacts?".

# TSUNAMI RESPONSE

## Alert and Response Lessons Learned from the 1/15 Tonga Tsunami

By Elyssa Tappero, WA Emergency Management Division (WA EMD)

(Continued from page 10)

3. *Question everything*—Documentation is vital for ensuring a smooth response, but SOPs are only as useful as they are efficient – and they can only remain efficient if they are frequently reviewed. Reviewing SOPs isn't just about correcting outdated details like contact information, it's an opportunity to improve your overall processes. To do this we sometimes need to look at them anew by questioning, well, everything. *Why do we call person A before person B? Who is part of this contact list? If step 6 takes so long, can we make it a lower priority? Do we need to do step 12 at all? Are the instructions for using this particular software still accurate?*

If something doesn't make sense, or if it seems like there's a better way to do something, don't be afraid to make improvements. WA EMD made several simple changes to our SOPs after the Tonga event which will improve initial communications to key personnel while reducing the time our duty officers must dedicate to contacting local jurisdictions individually. We also updated the procedures to include the use of new software features such as Microsoft Teams and AlertSense automated voice messages. As certain tech resources improve and others become obsolete, we need to ensure our procedures reflect these changes.

These lessons learned may seem minor in the grand scheme of things, but even the smallest becomes another tool in our arsenal during the next event. WA EMD is happy to share the templates we use; if you have similar documents or other lessons learned to share, please don't hesitate to reach out to us, too! Email [Elyssa.Tappero@mil.wa.gov](mailto:Elyssa.Tappero@mil.wa.gov).

## Disaster Zone Podcast: 'Tsunami Threat in the Pacific NW'

By Eric Holdeman, Government Technology

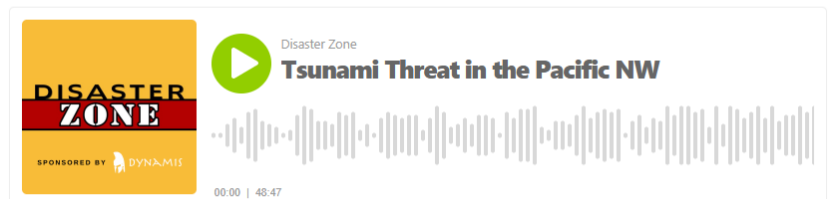
**Podcast description:** "One significant natural hazard risk that the West Coast of the United States has comes from tsunamis. The guest for this podcast is Elyssa Tappero, Outer Coast Tsunami Program Coordinator for the Washington State Emergency Management Division. In this program we review what the difference sources of tsunami waves are, and what their potential impact can be here in the Pacific Northwest. We also delve into what individuals and organizations can to be warned of

an oncoming tsunami and what mitigation measures are being used to reduce the destructive impacts of these waves. This is the website mentioned in the podcast: [mil.wa.gov/alerts](https://mil.wa.gov/alerts)."

### Disaster Zone

Tsunami Threat in the Pacific NW

MARCH 22, 2022 SEASON 3 EPISODE 12



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Link to podcast: <https://disasterzone.buzzsprout.com/1176869/10200012-tsunami-threat-in-the-pacific-nw>

# TSUNAMI RESEARCH

## Discovering Historical Tsunami Data Through Time-Lapse Animation

By Nicolas Arcos and Lindsey Wright, NOAA National Centers for Environmental Information and Cooperative Institute for Research in Environmental Sciences (CIRES), University of Colorado at Boulder

In recent years, as a result of the global pandemic and an increase in remote learning, many more requests have been received by NOAA National Centers for Environmental Information (NCEI) for basic tsunami science and data products for educational settings. In response, NCEI scientists sought to develop a tool that allows the “story” of historical tsunamis to be told in an educational setting to users new to tsunamis and tsunami data, but still allow interaction for data discoverability.

The NCEI and collocated World Data Service (WDS) for Geophysics provide data management and access to global tsunami data. [NCEI/WDS's Global Historical Tsunami Database](#) includes information on over 2500 tsunami events from 2000 B.C. to the present. The

NCEI/WDS historical tsunami data is discoverable through a public facing interface. Additionally, a REST API is available for programmatic access. A separate interactive mapping application, the [Natural Hazards Viewer](#), exists to allow geospatial searching and visualization of the NCEI/WDS databases.

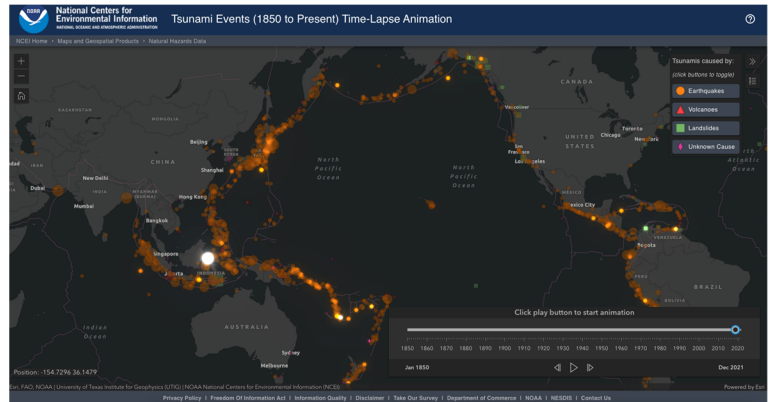


Figure 1: Screenshot of the Tsunami Events (1850 to Present) Time-Lapse Animation

NCEI developed an animated interactive map displaying global historical tsunami events since 1850. Interactive features for the animation include: (1) Clickable tsunami events to obtain more information; (2) Timeline slider to scroll to a specific date; (3) Zoomable and moveable map. The new animated web map is implemented with the ArcGIS API for JavaScript, ReactJS, and a NOAA GeoPlatform (ArcGIS Online) hosted feature layer. Utilizing Esri's cloud infrastructure to host the geospatial layer offers flexible visualization options and fast performance.



Figure 2: Teacher Guide and Tsunami Worksheet of the Tsunami Events (1850 to Present) Time-Lapse Animation.

The animation groups and displays tsunami sources into four principal and common source categories: Earthquake, Volcano, Landslide and Unknown. Also, all tsunami events with validities (ranging from “very doubtful” to “definite” tsunami) are displayed to emphasize the uncertainties involved in historical tsunami data. The animation was reviewed by partners, such as the International Tsunami Information Center, during the development process.

NCEI developed a companion [Teacher Guide](#) and Tsunami Worksheet that was reviewed by science educators from different states and their expertise, feedback, and suggestions were integrated into this resource. The Guide can be used by educators to guide student discovery. Though the guided activity is designed to supplement science lessons, data accessed with the animation tool have relevance to many academic topics (math, social science, history, etc.) and questions could be modified to use in many disciplines.

Please visit the [Tsunami Events \(1850 to Present\) Time-Lapse Animation](#) at:

<https://www.ncei.noaa.gov/maps/tsunami-events/>

# NTHMP PARTNERS

## The Redwood Coast Tsunami Work Group Web Page and Virtual Field Trip to Commemorate the 30th Anniversary of the Cape Mendocino Earthquake

By Lori Dengler, Redwood Coast Tsunami Work Group (RCTWG)

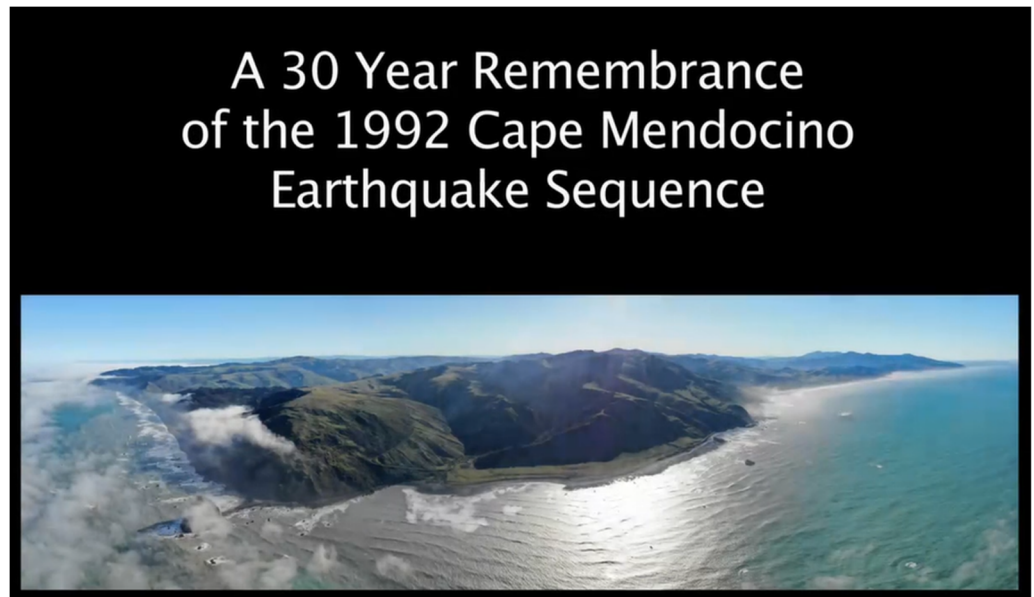
The April 25, 1992 M7.2 earthquake was the most damaging earthquake to strike California's North Coast in historical times. Causing at least \$60 million in property losses and over 400 injuries, it led to the only federal disaster declaration ever issued after an earthquake in Humboldt County. The earthquake, located near the coast just north of Petrolia, produced measurable coastal uplift along a 15-mile-long stretch of coastline and a modest tsunami that was recorded on seven tide gauges along the California and Southern Oregon coast and in Hawaii.

While not damaging, the tsunami confirmed that near-source tsunamis could occur in the Cascadia region. Washington, Oregon, and California emergency planners and scientists convinced their senators to assess the state of US tsunami preparedness, taking the first steps that would lead to the establishment of the NTHMP four years later. The

earthquake and tsunami also led to a CDMG (now California Geological Survey) earthquake planning scenario on the Gorda segment of the Cascadia subduction zone. The scenario was the first official California document to confirm not only the possibility of a magnitude 8.5 earthquake in the state, but the likelihood of a damaging tsunami following soon after.

To remember the events of 1992, the RCTWG has launched a new web page (<https://rctwg.humboldt.edu/capemendo92>) on the anniversary. The page includes remembrances of what happened and what has changed in both earthquake and tsunami planning since then. Featured is a new video field trip of the complex Mendocino triple junction area to better understand the complex geology of the Cape Mendocino area where the earthquake occurred and the role it plays in regional earthquake hazards.

The video was produced by Thomas Dunklin, an alumni of the Cal Poly Humboldt Geology Department who lives in the Petrolia area and accompanied many of the research teams who worked in the Cape Mendocino area after the earthquake. The thirteen-minute video features spectacular drone footage of the remote and rugged triple junction and includes animations of the plate interactions and earthquake activity in the region. The video project was supported by CalOES with funding from FEMA through NEHERP and donations to RCTWG from the public. Feedback appreciated ([lori.dengler@humboldt.edu](mailto:lori.dengler@humboldt.edu)).



# TSUNAMI RESEARCH & EVENTS

## RESEARCH

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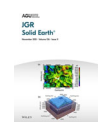
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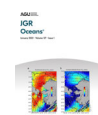
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## UPCOMING NTHMP & RELATED EVENTS

- ◆ June 13-16, 2022—Cascadia Rising Exercise Series <https://mil.wa.gov/cascadia-rising>
- ◆ July 18-22, 2022—NTHMP Summer Meeting (Palm Springs, CA) <https://nws.weather.gov/nthmp/index.html>
- ◆ September 20-26, 2022—AEG Annual Meeting (Las Vegas, NV) <https://www.aegannualmeeting.org/>
- ◆ December 12-16, 2022—AGU Fall Meeting (Chicago, IL) <https://www.agu.org/fall-meeting>

