

## A Note from Mike Angove, NOAA/NWS Tsunami Program Lead 2012-2023

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Greetings NTHMP Members and Extended Family! Most of you know I decided to leave Federal Service at the end of 2023. For me, that puts a wrap on a career in government of over 38 years between my military and NOAA time. I am not using the “R” word quite yet, but definitely looking forward to doing other things I’m passionate about without the day-to-day demands of a federal position. First and foremost is to get a group of eight scouts (including my son) and four adults safely to and from a 12-day Trek in the New Mexico Rockies at the BSA Philmont Scout Ranch this summer. I’ll also be volunteering with the Vienna, VA Historical Society and leading bike rides in and around some of the rich Northern Virginia historical sites. Aside from that I have volunteered to continue serving on the UN Ocean Decade Tsunami Program Scientific Committee...which means I’ll continue to be involved in many aspects of tsunami detection, forecasting and instrumentation---I just won’t be getting paid. And if you watch carefully you might see me in my little blue Toyota Yaris on an Amazon Flex delivery run!



But I would be remiss without taking a moment to express my most sincere gratitude and appreciation of all of you within the NTHMP Program. I have always maintained that as important as warning systems, instruments and advanced forecasting systems are, **mitigating** the tsunami threat is *fully half the battle*. And without all of you that “half” simply **doesn’t get done** and we *don’t have a National Capability*. Full stop.



I enjoy talking about the great achievements of the NTHMP Partners, especially with international colleagues who are looking to countries like the US for proven examples. The Vertical Evacuation capabilities brought to life in the State of Washington; the comprehensive and intuitive signage along the Oregon Coast; The pre-planned responses that make up California’s “Playbook” system; the consistent public outreach and awareness campaigns waged in Alaska and Hawaii. The relentless efforts to install alerting systems in the unforgiving deep tropics of Guam, CNMI, American Samoa, Puerto Rico, and USVI; novel, world-leading efforts to address the meteotsunami risk along the US Gulf and East Coasts. These are all *\*gold standard\** efforts and you should all take immense pride in what you have accomplished on behalf of the Nation.

So it’s farewell for now, but something tells me many of our paths will continue to cross. And if you’re ever in the Washington DC area, please let me know and I’d love hear from you. First round on me! Fair Winds and Following Seas Shipmates!

Warmest Regards,  
 Mike Angove

# TsuInfo Alert

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

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

The views expressed herein are those of the authors and not necessarily those of NOAA, the Washington Department of Natural Resources, or other sponsors of TsuInfo Alert.

## Bainbridge Island, Washington has Received TsunamiReady® Designation

By Anne LeSage, Bainbridge Island Emergency Management Coordinator

Bainbridge Island, Washington has received the TsunamiReady® designation from the National Weather Service. Bainbridge is Washington's first inner coast community to receive the designation. TsunamiReady® is a voluntary community recognition program that promotes tsunami hazard preparedness as an active collaboration among federal, state/territorial and local emergency management agencies, community leaders and the public. The main goal of the program is to improve public safety before, during and after tsunami emergencies.

Last July, the Washington Geological Survey and the Department of Natural Resources released [new modeling](#) suggesting that Bainbridge Island was at risk of a tsunami following a magnitude 7.5 earthquake on the Seattle Fault. Additionally, the incoming tsunami waves would hit Bainbridge in just a matter of minutes, leaving very little time for notification. In looking at the data, we created a set of maps that show risk by neighborhood and we have published an overall map as part of our City GIS map: [Seattle Fault Line Tsunami Overview App \(arcgis.com\)](#) (huge thanks to **Gretchen Brown, COBI GIS Specialist**, for the many hours she spent working on the maps!) Learn more about the process we went through to become TsunamiReady®: [https://www.youtube.com/watch?v=-shDsyiuW\\_E](https://www.youtube.com/watch?v=-shDsyiuW_E)

In 2024 we will use our current Map Your Neighborhood infrastructure to provide neighborhood-specific outreach to impacted areas, as well as outreach to unmapped neighborhoods in the inundation zone and to the general community. We have also added additional tsunami signs around the island, indicating areas of awareness.



Reach out to Anne LeSage at [alesage@bainbridgewa.gov](mailto:alesage@bainbridgewa.gov) if you have any questions.

# NTHMP PARTNER NEWS

## High Ground Hike – Tsunami Preparedness Events in B.C.

By PreparedBC, Ministry of Emergency Management and Climate Readiness, British Columbia

Raising awareness about tsunami preparedness in British Columbia is an important part of the work that the PreparedBC Public Education Team carries out. To achieve this, PreparedBC is inviting coastal First Nations and other local governments in areas at risk of tsunamis to host a [High Ground Hike](#) event during Tsunami Preparedness Week. This marks the seventh year this event has taken place, and every year we have more communities participate.

In B.C., Tsunami Awareness Week takes place from April 14 – 20, 2024. B.C. is a seismically active province and its coastal areas are at risk of a tsunami. Throughout the week the PreparedBC team will be active online and in communities to encourage people to prepare by:

- Learning their tsunami notification zone
- Understanding the types of tsunami alerts
- Identifying how to get important local information
- Practicing where to go to stay safe



This year we're aiming to have at least 20 communities participate in a High Ground Hike. These are community-led events that give people an opportunity to practice reaching a tsunami-safe location. PreparedBC provides [promotional resources](#), planning support and prizes to help each community design an event that best benefits their residents.

From Stewart on the north coast to Ucluelet on Vancouver Island and White Rock on the lower mainland, each community event is different and reflects their local tsunami response plan. We are excited to see what this year's hikes look like, and we will be sharing event photos on PreparedBC's [Facebook](#), [Instagram](#) and [X](#).

Join us! Are you interested in running a similar program in your organization? We'd be happy to share our planning tips and best practices with you. Reach us by e-mail at [PreparedBC@gov.bc.ca](mailto:PreparedBC@gov.bc.ca)

Tsunami Preparedness Week and High Ground Hike events aim to make learning about tsunami preparedness a fun, engaging and a collective experience. Stay tuned for PreparedBC's updated Earthquake and Tsunami Preparedness Guide coming this March! In the meantime, explore tsunami preparedness resources at [PreparedBC.ca/tsunamis](https://www.PreparedBC.ca/tsunamis)

### About PreparedBC

PreparedBC is British Columbia's official emergency preparedness public education program serving Indigenous communities, local authorities, schools and anyone else who wants to be prepared! For all this and more, visit [www.PreparedBC.ca](https://www.PreparedBC.ca)

# NTHMP PARTNER NEWS & PBS VIDEO

## Practicing Preparedness: US Virgin Islands Plans to Participate in Caribe Wave 2024

Regina Browne, Deputy Director of Planning and Preparedness, VITEMA

The US Virgin Islands (USVI) is planning an ambitious functional emergency response exercise for Caribe Wave 2024 to test our preparedness for major disasters. Activating Emergency Operations Centers (EOCs) across three islands and conducting agency drills, the goal is to identify and resolve gaps that could impact the USVI's capacity to save lives and protect property when faced with threats like earthquakes or tsunamis.

Being prepared for catastrophic events is hugely important for the USVI. Islands have unique challenges for emergency response, including geographical isolation and limited resources. Effective coordination and continuity planning across government, private sector and communities can make the difference between successfully weathering disasters or suffering immense loss and disruption. Exercises like Caribe Wave 2024 allow the USVI to validate continuity plans across agencies and implement lessons learned to better secure the islands' future.

This month, the USVI is also launching Tsunami Ready Supporter and Champion programs to promote readiness among businesses and community organizations. By promoting awareness, planning and appropriate actions, the USVI aims to create a culture of preparedness across all sections of society. Tourism is vital to the economy as well, so ensuring hotels and attractions are ready to respond safely to warnings is a high priority.

Between the territory-wide exercise and public readiness programs, Caribe Wave 2024 represents an opportunity for the USVI to upgrade coordination, enhance communications, and engage the whole community. Being prepared can save lives and livelihoods—so USVI agencies recognize this as an essential investment for securing the islands' prosperity going forward in an age of climate change and uncertainty. The lessons learned will bring USVI readiness to new heights.



## PBS Terra Video: What's the ONE THING You Can Do To Survive a Tsunami? Cascadia Subduction Zone

**Synopsis:** While tsunamis happen all over the world, really big ones are rare. But, they can be truly devastating. And what's more, the West Coast of North America is overdue for a subduction zone earthquake and tsunami that has the potential to be the biggest disaster the U.S. has ever seen. So, what is the single most important factor determining whether or not YOU survive a tsunami? Watch this episode to find out.

Weathered is a show hosted by weather expert Maiya May and produced by Balance Media that helps explain the most common natural disasters, what causes them, how they're changing, and what we can do to prepare.



Link to video: <https://www.youtube.com/watch?v=k5ldPF2VxgY>

# NTHMP PARTNER NEWS & JANUARY 2024 JAPAN EVENT

## Oregon Public Broadcasting (OPB) Think Out Loud: How Oregonians and State Agencies Are Preparing for the Next ‘Big One’

Conversation between OPB’s Dave Miller and Althea Rizzo, Geologic Hazards  
Program Coordinator at the Oregon Department of Emergency Management

Jan. 26 marks the 324th anniversary of the last Cascadia Subduction Zone earthquake. The 1700 quake caused the coastline to drop by several feet and sent a tsunami crashing into the Pacific Northwest coast. Pressure has been building in the Zone ever since, setting the region up for another potential magnitude-9.0 quake. Researchers estimate this kind of “megathrust” earthquake occurs roughly every 300-500 years. The Oregon Department of Emergency Management has been encouraging residents to prepare with initiatives like the Great Oregon Shakeout and Be 2 Weeks Ready.



Althea Rizzo is the geological hazards program coordinator at the Oregon Department of Emergency Management. Natasha Fox is the department’s inclusion, diversity, equity and accessibility (IDEA) coordinator. Susan Penrod is the superintendent of the Seaside School District, which covers the coastal communities of Seaside, Cannon Beach and Gearhart. Shawn Looney is a member of the Linnton Neighborhood Emergency Team. They all join us to offer four different perspectives on earthquake risks and preparedness.

*Link to interview and transcript:*

<https://www.opb.org/article/2024/01/25/how-oregonians-and-state-agencies-are-preparing-for-the-next-big-one/>

## A New Year’s Day Earthquake and Tsunami in Japan

**Source:** Lori Dengler for the Times-Standard, Posted January 6<sup>th</sup>, 2024

2024 got off to a deadly earthquake start. At 4:10 PM (local time in Japan) on New Year’s Day, a magnitude 7.5 earthquake struck the Noto Peninsula in Ishikawa Prefecture on the west side of Japan’s main island of Honshu. Named the 2024 Noto Peninsula earthquake by the Japanese Meteorological Agency (JMA,) it claimed 126 lives and injured 611. As I write, 211 people are still unaccounted for.

It’s human nature to look at natural disasters far away and come up with reasons why it couldn’t happen here. We can point to adobe buildings to explain the high death toll in last year’s Morocco and Afghanistan earthquakes and blame corrupt construction practices for some of the deaths in Turkey. Japan’s newer buildings meet or exceed construction standards in the U.S. and older buildings are made of wood. The mix of old and new buildings is not unlike what you would find throughout California.

*(Continues on page 6)*

# JANUARY 2024 JAPAN EVENT

## A New Year's Day Earthquake and Tsunami in Japan

Source: Lori Dengler for the Times-Standard, Posted January 6<sup>th</sup>, 2024

(Continued from page 5)

It's been less than a week since the earthquake and researchers have not been allowed into the hardest hit areas while rescue operations are still underway. Much more will be learned when scientists and engineers are able to quantify damage and detail the reasons why structures collapsed. I will be careful not to speculate too broadly.

Here's a preliminary look at what is known now. The earthquake was centered on a northeast - southwest trending fault. The epicenter was on the tip of the Noto Peninsula. This 50-mile-long peninsula juts into in the Sea of Japan on the west side of Japan's most populated island of Honshu. Epicenters mark the point on the ground surface above where the rupture began. On New Year's day, that rupture started at six miles depth and grew along a fault both to the northeast and southwest. It took about 50 seconds for the rupture to propagate and when it stopped, rock along a nearly 100 miles zone had been displaced. It was a thrust earthquake, where the rock to the southeast was shoved up and over the rock to the northwest. The USGS fault analysis shows a peak slip of roughly 15 feet between the two sides.

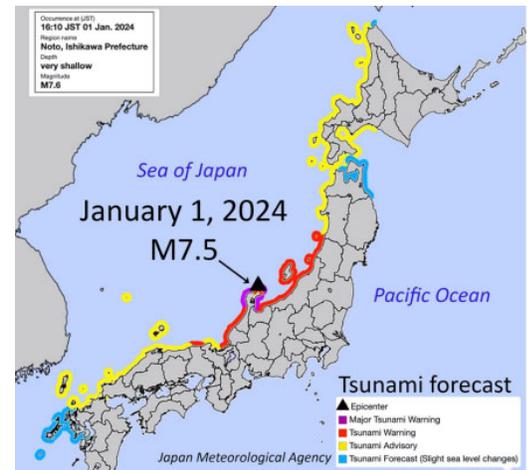


Image: Japanese Meteorological Agency tsunami map following the New Year's Day M7.5 earthquake.

Seismic waves were produced the whole time the fault was rupturing. People in Ishikawa Prefecture would have experienced nearly a minute of very strong shaking. Japan is highly instrumented, and accelerometers recorded peak values of over one g (acceleration of gravity) on the Noto Peninsula. At least two locations hit 1.5 g, similar to the peak in Rio Dell in December 2022. But there was a big difference. The strong accelerations in Japan lasted about three times as long.

These ground motions caused major damage on the Noto Peninsula and in Ishikawa. Damage and injuries were also reported in Toyama and Niigata Prefectures. The earthquake was felt throughout central Japan, by many in Tokyo about 200 miles away and in western Honshu and the Island of Shikoku 350 miles distant. Most of the damage was caused by ground shaking, exacerbated in some areas by liquefaction. Liquefaction occurs in saturated unconsolidated sediments when shaking causes the water to flow upwards and the sand grains are no longer in contact with each other. The ground behaves like a fluid while the shaking persists causing foundations to tilt and founder and riverbanks to spread. Liquefaction can occur in any saturated area, including here on the North Coast where the margins of Humboldt Bay and the Eel River basin are particularly vulnerable.

If Japan has such stringent building codes, why so many collapses? A cursory glance points to older homes built before modern codes as the main problem. Traditional Japanese buildings are made of wood, a material that resists earthquake shaking far better than brick and adobe. But in Japan, the relatively lightweight wooden framework is topped by a heavy tile roof, a construction style that evolved over centuries to resist the high winds from typhoons. Tile roofs make the

# JANUARY 2024 JAPAN EVENT

## A New Year's Day Earthquake and Tsunami in Japan

Source: Lori Dengler for the Times-Standard, Posted January 6<sup>th</sup>, 2024

*(Continued from page 6)*

buildings top heavy, and far more vulnerable to collapse in earthquakes. To compound the problem, on January 1 an additional burden of snow further increased the toppling moment, reducing the amount of force needed to knock a building over.

Thousands of homes are estimated to have been severely damaged, a number that is hard to confirm in these early days because of fire, the often-deadly secondary effect of ground shaking. Fire is a notorious problem in Japan where wood structures, stoves, and sparks can quickly become conflagrations. The deadliest earthquake in Japan's history was in 1923 where at least a third of the estimated 140,000 deaths are attributed to post earthquake firestorms.

On January 1, a number of fires broke out involving hundreds of buildings. Suzo, a picturesque city of 13,000 was particularly hard hit. Over 5000 structures, 90% of the building stock, were destroyed. It will be difficult to determine how many were damaged in the shaking as fire consumed much of the evidence.

Suzo also received impacts from a tsunami. Within minutes of the earthquake, JMA issued a Major Tsunami Warning. Japan has a 3-tiered tsunami alerting system, Major Tsunami Warning means water heights of 9 feet or higher, a Tsunami Warning for peak water heights in the 3 foot to 9-foot range, and Tsunami Advisories when strong currents are expected to be the only threat and water heights less than 3 feet. The U.S. system only includes Warnings (greater than 3 feet) and Advisories for smaller events.

At least 60,000 people evacuated low-lying areas in the Ishikawa area, most in response to feeling the shaking. Tide gauges recorded the tsunami at 35 sites along the Sea of Japan including South Korea and Russia's Sakhalin Peninsula. The highest recording was 4 feet at Wajima, 20 miles from the epicenter. Eyewitness reports suggest heights of 9 to 14 feet on other parts of the Noto Peninsula and the first surges arriving only minutes after shaking stopped.

It is not clear how much damage was caused by the tsunami. Houses allegedly floated off foundations in Suzo and at least one person may have been swept offshore. We will know more once tsunami survey teams are able to access the area, record water height data, and interview survivors.

It is also unclear how the alerts may have affected response operations. Emergency personnel are not allowed into the expected inundation zone when a Major Tsunami Warning is in effect. There is good reason for this. Hundreds of firefighters died as they entered tsunami zones following the 2011 Great East Japan Earthquake. But this meant anyone in that zone received no assistance in the critical four hours the Warning was in place.

No areas of the Pacific were ever at any tsunami threat on January 1. The two U.S. tsunami warning centers issued 'no tsunami' statements soon after the earthquake. The earthquake source was in the Sea of Japan and tsunami hazards were restricted to coastlines around that basin.

Link to article: [https://kamome.humboldt.edu/sites/default/files/1\\_6\\_24\\_Japan%20eq.pdf](https://kamome.humboldt.edu/sites/default/files/1_6_24_Japan%20eq.pdf)

# NTHMP PARTNER NEWS & TSUNAMI RESEARCH

## USGS Powell Center Working Group on Tsunami Sources

By Marie Eble (Powell Center Work Group)

The USGS Powell Center Tsunami Sources Working Group met in Fort Collins, Colorado the week of 8 January for the sixth in a series of meetings to evaluate known and plausible sources of tsunamis. During this recent meeting, tsunamis generated by crustal faults and sources along the outer rise of Pacific Basin subduction zones were discussed and characterized. Remote and in-person expert participants from government agencies, the private sector, and from academia shared current knowledge and discussed how best to quantitatively define and weight relevant source parameters such that all probabilities would be captured within a logic tree framework. Development of the framework for Pacific crustal and outer rise sources was initiated during the meeting and is under continued development in collaboration with participants. The logic tree and resulting probabilistic tsunami hazard information gives states options to develop maps and products that reflect different hazard levels representing various average return intervals.



Remote and in-person participants in the sixth U.S. Powell Center Tsunami Sources meeting focused on crustal faults and outer rise sources.

## RESEARCH

Fuji, Kosuke; Suppasri, Anawat; Kwanchai, Pakoksung, et al, 2024, Assessing future tsunami hazards from Japan trench coupling with sea level rise impact on economic risks using an input–output table: International Journal of Disaster Risk Reduction. <https://doi.org/10.1016/j.ijdr.2024.104286>

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Putra, P. S.; Yulianto, Eko; Kongko, Widjo, et al, 2023, Geological evidence of predecessor of the 2018 Tsunami in Palu, Sulawesi, Indonesia: Natural Hazards Research, v. 3, no. 3, p. 487-493. <https://doi.org/10.1016/j.nhres.2023.04.010>

Shrivastava, M. N.; Sunil, A. S.; Maurya, A. K., et al, 2023, Tracking tsunami propagation and Island's collapse after the Hunga Tonga Hunga Ha'apai 2022 volcanic eruption from multi-space observations: Scientific Reports, v. 13, article 20109. <https://doi.org/10.1038/s41598-023-46397-1>

Xiao, Han; Spica, Z. J.; Li, Jiaxuan; Zhan, Zhongwen, 2024, Detection of Earthquake Infragravity and Tsunami Waves With Underwater Distributed Acoustic Sensing: Geophysical Research Letters, v. 51, no. 2, article e2023GL106767. <https://doi.org/10.1029/2023GL106767>

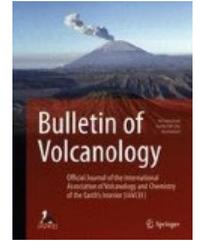


# TSUNAMI RESEARCH & EVENTS

## RESEARCH

**TITLE:** Implementation of tsunami warning procedures in the Caribbean in case of a volcano crisis: Use of a Volcano Notice for tsUnami Threat (VONUT)

**CITATION:** Clouard, V.; von Hillebrandt-Andrade, C.; McCreery, C.; Sostre Cortes, J. J., 2024  
Implementation of tsunami warning procedures in the Caribbean in case of a volcano crisis: Use of a Volcano Notice for tsUnami Threat (VONUT): *Bulletin of Volcanology*, v. 86, article 18.  
<https://doi.org/10.1007/s00445-023-01702-8>



**ABSTRACT:** While 80% of tsunamis are related to earthquakes, recent examples of the Hunga Tonga Hunga Ha’apai (2022) tsunami as well as others from the Kick’em Jenny (2015), Saint Vincent (2021), and La Palma (2021) eruptions have sparked renewed reflection on how a tsunami warning system could also handle non-seismic tsunami events. A warning system is usually based on intrinsic and automatic detection by an instrumental network. In the case of tsunamis generated by earthquakes, it is the data from seismic stations and pre-established location and magnitude criteria that trigger actions from the Tsunami Service Providers (TSP, i.e., regional centers for threat information). Realtime sea level data then help constrain forecasts and determine the end of the threat. However, tsunamis generated by volcanic events are different from those induced by earthquakes in terms of source, detection, messaging, and modeling. In the Caribbean and Adjacent Regions, the UNESCO/IOC Intergovernmental Coordination Group for Tsunami and other Coastal Hazards Warning Systems created a task team to develop tsunami procedures in the case of a volcano crisis. We present here the recent progress of the task team. A bulletin is proposed to be issued by volcano observatories to the Tsunami Service Providers in the case of a potentially tsunamigenic volcano event. Derived from a Volcano Observatory Notice for Aviation (VONA) bulletin, this proposed VONUT bulletin, (Volcano Observatory Notice for tsUnami Threat), is under construction in collaboration with Caribbean volcano observatories and the Pacific Tsunami Warning Center, the TSP for the Caribbean. It was tested during the annual tsunami exercise CARIBE WAVE 2023, which includes testing the communications between the Tsunami Service Provider and nationally designated tsunami authorities. However, much more work is required to get a full operating warning system, as volcano scenarios and subsequent tsunami waves remain highly challenging to model and scale.

## UPCOMING NTHMP & RELATED EVENTS

- ◆ March 21, 2024—CARIBE WAVE 24 Tsunami Exercise (Caribbean and Adjacent Regions)  
<http://caribewave.org>
- ◆ April 2-4, 2024—2024 Partners in Emergency Preparedness Conference (Tacoma, WA)  
<https://piepc.org/2024-conference>
- ◆ April 29-May 3, 2024—Seismological Society of America Meeting (Anchorage, AK)  
<https://meetings.seismosoc.org/>
- ◆ May 23, 2024—PACIFEX 24 Tsunami Exercise (Pacific US and Canada)  
<https://tsunami.gov/?page=exercises>
- ◆ July 26-August 1, 2024—NTHMP 2024 Summer Meeting (Pago Pago, American Samoa)  
<https://nws.weather.gov/nthmp/>



Exercise  
PACIFEX24

