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)

JUNE 2019 Volume 21, Number 3

Update on Wireless Emergency Alerts (WEA) for Tsunami Warnings

By Rocky Lopes, Deputy Program Manager, NWS Headquarters Tsunami Program

Beginning in June 2015, the National Weather Service (NWS) enabled the option for requesting a Wireless Emergency Alert (WEA) whenever a Tsunami Warning is issued by either NWS Tsunami Warning Center for any U.S. coastal location. Since that time, there have been two instances where WEA for tsunami warnings were sent, both in Alaska.

Due to technical restrictions where FEMA's Integrated Public Alert and Warning System (IPAWS) cannot interpret NWS zones, geographic locations under Tsunami Warning have been using Federal Information Processing Standards (FIPS) codes. The FIPS standard uniquely identifies counties and county equivalents in the United States, as well as U.S. territories.

State of Alaska and NWS representatives from Alaska Region, National Tsunami Warning Center, and Headquarters collaborate on Alaska WEA polygons.

There are inherent problems with broadcasting a WEA using the FIPS geographic designation. That could present a serious potential for overwarning, particularly for people far away from the coast but in the same county (e.g. San Diego County, CA).


Colored areas show coastal zones for tsunami WEA polygons

There is a capability to refine the alerted area by defining a polygon that more closely aligns with the coastline. The trick is to ensure that the polygon covers appropriate areas where states and local NWS forecast offices wanted Tsunami Warning WEAs to be sent, but also conform to a number of other technical restrictions and constraints.

We began the process for "WEA polygons" by focusing on the West Coast of North America where tsunami risk is highest and where Tsunami Warnings have been issued most frequently.

This process involved state partners working with their NWS offices to develop polygons from the Aleutian Islands of Alaska to the Alaska border with Canada, and then pick up again from the Washington border with Canada, through Oregon to the California border with Mexico. In all, 30 polygons were developed (14 for Alaska, and 16 for WA, OR, and CA) between established NTWC tsunami breakpoints.

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WASHINGTON STATE DEPT OF NATURAL RESOURCES
WASHINGTON GEOLOGICAL SURVEY

TsuInfo Alert

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NATIONAL TSUNAMI HAZARD MITIGATION PROGRAM LIBRARY CATALOG:
http://d92019.eos-intl.net/D92019/OPAC/Index.aspx

Update on Wireless Emergency Alerts (WEA) for Tsunami Warnings

By Rocky Lopes, Deputy Program Manager, NWS Headquarters Tsunami Program

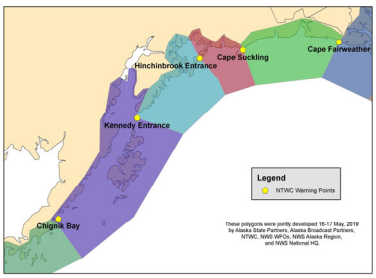
(Continued from page 1)

The polygons were reviewed by the National Tsunami Warning Center to ensure they aligned with established breakpoints as well as NWS zones, used for other alerting processes, including the Emergency Alert System.

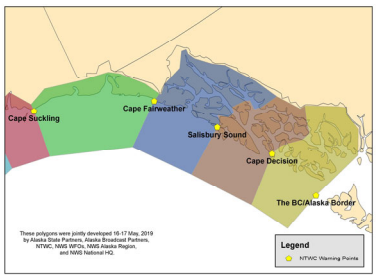
I am pleased to say that these polygons were completed and will be implemented by Fall, 2019. Should a Tsunami Warning be sent by the NTWC for any coastline in Alaska, Washington, Oregon, and/or California, a WEA should alert people within the area defined by the polygon for that state.

The process to create these polygons required lots of collaboration among all of our NTHMP partners. From the NWS Headquarters perspective, we are truly grateful and pleased with how well this worked out.

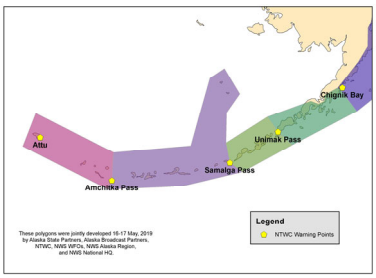
Southcentral, Alaska - Final Tsunami WEA Polygons



Southeast Alaska - Final Tsunami WEA Polygons



Aleutian Islands, Alaska - Final Tsunami WEA Polygons



What's in a Tsunami WEA?

By Rocky Lopes, Deputy Program Manager, NWS Headquarters Tsunami Program

Last year, the Federal Communications Commission (FCC) issued a Report and Order that provided for expanded Wireless Emergency Alert (WEA) messages from the current 90-character to a potential for 360-character length messages. Also, the FCC's instructions allowed for WEA messages to be enabled in Spanish.

From summer 2018 through summer 2019, the National Weather Service (NWS) WEA Policy Team on which I served to represent the Tsunami Program, collaborated to review, develop, and implement the new expanded WEA messages for the eight hazards for which the NWS as a national alerting authority requests WEA activation. (More information plus actual wording of these messages is here: https://www.weather.gov/wrn/wea360).

This was a long and complex process. We were fortunate to have more than 200 stakeholders engaged to review and write revised Tsunami WEA messages, consistent with advice from social scientists. I was delighted to engage my friend and a very well-respected leader – Dr. Dennis Mileti – to review our work throughout the message development process.

While technically we could have included a URL with our expanded WEA message, we decided not to do that on advice of stakeholders who were concerned that some people could delay getting out of harm's way while fumbling with a phone looking for more information on a website. We were also concerned about responsiveness of a website's server, and other factors that social science studies revealed. For example, some studies have shown that a number of people cannot identify where they are on a map. Rendering a map on a website may cause confusion, and thus delay in moving to safety.

Where We Are Now, and Next Steps

As of the date of this article, FEMA has said that more time is required for testing, so currently if a Tsunami Warning is issued, the "short" or 90-character message in English (only) will be sent. That message is:

> NWS: TSUNAMI danger on the coast. Move to high ground or inland now.

This short, English-only alert method is known as "WEA 1.0."

When FEMA says that testing is completed and the Integrated Public Alert and Warning System (IPAWS) can display the expanded messages and messages in Spanish, then devices on 4G (or higher) networks will see:

> The National Weather Service has issued a TSUNAMI WARNING. A series of powerful waves and strong currents may impact coasts near you. You are in danger. Get away from coastal waters. Move to high ground or inland now. Keep away from the coast until local officials say it is safe to return.

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What's In a Tsunami WEA?

By Rocky Lopes, Deputy Program Manager, NWS Headquarters Tsunami Program

(Continued from page 3)

The Spanish version will be shown on devices that the user has adjusted to enable Spanish language display. The Spanish tsunami WEA will be:

> El Servicio Nacional de Meteorologia ha emitido un AVISO DE TSUNAMI. Olas y corrientes fuertes pueden afectar costas cercanas. Su vida esta en peligro. Alejarse de aguas costeras. Moverse ahora a un lugar alto o tierra adentro. Mantenerse alejado hasta que las autoridades locales indiquen que es seguro regresar.

If an area is served by a 3G network, then the short English (above) or short Spanish WEA will be displayed. The short Spanish WEA is:

> SNM: Peligro de TSUNAMI. Vaya a un lugar alto o tierra adentro ahora.

The use of expanded WEA and WEA in Spanish is known as "WEA 2.0."

On the horizon, we see what's called "device-assisted geofencing," sometimes also referred to as "device-assisted geotargeting" and "WEA 3.0."

The theory that will be applied when device-assisted geofencing is enabled is that alert originators like the NWS will significantly improve the ability to geotarget emergency messages to smartphone users in an actively hazardous location, and not send them to users outside that area. By providing the alert area coordinates to the device, the alert area can be connected to location-awareness capabilities of the device, allowing the device to determine if it is in the alert area, and therefore render the alert.

There is a lot more to be learned about how device assisted geofencing will work, what devices can support it, and what changes to configuring the alert (e.g. polygon coding, number of vertices, and other complex technical features) may be needed.

All we can say is, "stay tuned" – and always, make sure if you have a WEA-enabled device that it is set to receive these messages (that is, don't opt-out!).

National Guard, Emergency Management Partner with Coastal Communities for Tsunami Preparedness Workshop

By Joseph Siemandel, Washington National Guard

In the moments following a massive Cascadia Subduction Zone Earthquake, many Washingtonians could find themselves isolated, trapped or closed off from the rest of the state due to congested roadways, down trees or broken bridges. Coastal cities and towns could be the most at risk with a potential of a tsunami following a major earthquake.

See full article: https://mil.wa.gov/news/national-guard-emergency-management-partner-with-coastal-communities-for-tsunami-preparedness-workshop

2018 Accomplishments of the National Tsunami Hazard Mitigation Program: An Annual Report

By National Tsunami Hazard Mitigation Program Coordinating Committee Members

NTHMP Meetings—https://nws.weather.gov/nthmp/Minutes/minutes.html

Winter Meeting—The NTHMP Winter Meeting and subcommittee meetings were held in Seattle, Washington, January 29–February 2. Due to a government shutdown the week before this meeting, participation by federal agency partners was reduced. Forty-eight people participated in these meetings throughout the week.

NTHMP Summer Subcommittee Meetings—The NTHMP Mitigation and Education Subcommittee (18 attendees) and the Mapping and Modeling Subcommittee (15 attendees) plus three ex-officio leaders met August 2–4 in Sacramento, California.

Other Meetings

- The NTHMP Coordinating Committee met twice in person and four times by teleconference.
- The Mapping and Modeling Subcommittee met twice in person and two times by teleconference.
- The Mitigation and Education Subcommittee met twice in person and five times by teleconference.
- The Warning Coordination Subcommittee met once in person and once by teleconference.
- The NTHMP Island Caucus met twice in person.
- A three-member NTHMP Allowable Grant Activities Work Group met twice by teleconference. The purpose of this work group was to review and update the list of allowable grant activities for FY19 grant applications.
- A five-member work group met six times by teleconference to write an NTHMP Subcommittee Structure and Workload Analysis paper for discussion by the Coordinating Committee.

2018 NTHMP Publications and Resources—https://nws.weather.gov/nthmp/publications.html

- TsuInfo Alert (six issues)
- NTHMP 2018–2023 Strategic Plan
- Annual Work Plans for three Subcommittees
- Updated NTHMP Rules of Procedures and respective Subcommittees' Terms of Reference
- FEMA Community Rating System tsunami fact sheets (two)
- Tsunami Evacuation Signs web page
- Tsunami Exercises web page
- 2018 World Tsunami Awareness Day Social Media shareables

Grants—For the FY18 grant cycle (September 1, 2018–August 31, 2019), NOAA/National Weather Service (NWS) awarded $5,557,537 to 12 NTHMP partners, and $425,133 was transferred within NOAA (to the Pacific Marine Environmental Lab and the National Centers for Environmental Information) to support projects for the Mapping and Modeling Subcommittee and two state partners (Alaska and Washington) to meet critical needs within the scope of the NTHMP strategic plan. More information on FY18 NOAA/NWS grant-funded projects is available at https://nws.weather.gov/nthmp/grants/2018grants/index.html.

See full Annual Report here: https://nws.weather.gov/nthmp/documents/2018AnnualReport.pdf

TsunamiReady® Recognition Milestones

By Rocky Lopes, National TsunamiReady® Program Coordinator

As of June 25, 2019, there are 196 sites recognized as TsunamiReady®.

During the period from December 1, 2018, to June 25, 2019:

- The following sites received their first TsunamiReady® recognition:
  - King Salmon, California (added retroactively for a forgotten addition to the list)
  - Colleton County, South Carolina (previously StormReady only)
- The following site was re-recognized after temporarily losing recognition:
  - Rio Grande, Puerto Rico (This recognition was particularly hard-won, and with it, returned the "all-island" TsunamiReady recognition to Puerto Rico)
- The following sites renewed their TsunamiReady® recognition:
  - Aberdeen, WA
  - Arroyo, PR
  - Coronado, CA
  - Dana Point, CA
  - Debordieu Colony, SC
  - Half Moon Bay, CA
  - Hyde County, NC
  - Ilwaco, WA
  - Kailua, HI
  - Long Beach, WA
  - Manatí, PR
  - City of Marina, CA
  - Marine Corps Base Hawaii, HI
  - Mayagüez, PR
  - Nagubo, PR
  - Newport Beach, CA
  - North Myrtle Beach, SC
  - Ponce, PR
  - Port Angeles, WA
  - Quinault Indian Nation, WA
  - Redwood Nat. & State Park, CA
  - Rincón, PR
  - Salinas, PR
  - San Clemente, CA
  - San Francisco Airport, CA
  - Santa Barbara, CA
  - Santa Isabel, PR
  - Santa Rosa County, FL
  - Ventura County, CA
  - Yauco, PR

There was also action on TsunamiReady Supporter sites:

- New recognitions:
  - Titi Millie Day Care, Guanica, PR
  - Tribunal Supremo de Puerto Rico, San Juan, PR
  - Hospicio San Francisco de Asis, Añasco, PR
- Renewed for an additional five years:
  - Central Oregon Coast Fire District, Waldport, OR
  - Lincoln County School District, Lincoln City, OR
  - Seal Rock Fire District, Seal Rock, OR
  - Depoe Bay Fire District, Depoe Bay, OR
  - North Lincoln Fire & Rescue District, Lincoln City, OR
  - Yachats Rural Fire District, Yachats, OR
  - Hatfield Marine Science Center, Newport, OR

Also during this period, the following previously recognized TsunamiReady® sites were not renewed for various reasons. All of these jurisdictions had been expired for more than one year.

- Belvedere, CA
- Hawaii Volcanoes National Park, HI
- Pacific Grove, CA
- Santa Cruz County, CA
- Seaside, CA
- Tiburon, CA
- Waimanalo, HI

Summary

During this reporting period, the United States added three and lost seven recognized TsunamiReady® communities or counties, reducing the net total of U.S. TsunamiReady® recognitions to 196 as of June 25, 2019.

The U.S. gained three TsunamiReady® Supporter sites and renewed seven, bringing the total of TsunamiReady® Supporters to 16.

New Tsunami Scientists Join the California Geological Survey

The California Geological Survey (CGS) has recently hired two new Engineering Geologists, Nick Graehl and Jason "Jay" Patton, in their Tsunami Unit within the Seismic Hazard Mapping Program.

Nick has significant experience in GIS applications to tsunami and earthquake hazard analyses. Over the past seven years, Nick has worked as a senior staff geologist for Lettis Consultants and GHD Inc. For Lettis, he was the lead hazard analyst for over 60 nuclear facilities in the central and eastern U.S. Nick took part in a post-event survey team responding to the 2010 Chile earthquake and tsunami and has also taken part in a statewide assessment of paleotsunami deposits as part of the USGS/CGS/Humboldt State Science Application for Risk Reduction (SAFRR) project. Nick holds a B.S. degree in Geology and a M.S. in Environmental Systems in Geology from Humboldt State. Nick's M.S. Thesis focused on Late Holocene paleoseismicity, tsunamis, and relative sea-level changes in Yaquina Bay, central Oregon.

Jay has extensive experience in marine geology and geophysics as well as tsunami hazard research and analysis. Jay has taken part in and planned numerous fault-trench paleoseismic studies, submarine seismic reflection surveys, geologic hazard investigations, and high-precision land surveys. Jay has worked as a private geologic consultant, and as an educator at Humboldt State University, College of the Redwoods, and Chemeketa Community College in Salem, Oregon. Jay and his colleagues founded Cascadia Geosciences, a non-profit group to advance the science and outreach in the southern region of the Cascadia Subduction Zone. Jay holds a B.A. degree in Anthropology and a M.S. in Geology from Humboldt State. Jay also has a PhD in Oceanography from Oregon State University, where his dissertation focused on sedimentary and geophysical investigations of subduction zone earthquakes offshore of Sumatra.

Both Nick and Jay will assist the CGS Tsunami Unit with updating tsunami inundation maps for evacuation planning, developing new probabilistic tsunami hazard analysis maps for land-use planning and construction, and working on other tsunami hazard analysis and mapping projects.

New Tsunami Scientist at the Washington Geological Survey

Alex Dolcimascolo recently started as the Tsunami Geologist in the hazards section of the Washington Geological Survey at the Washington State Department of Natural Resources. Alex's job responsibilities include tsunami modeling for tsunami sources that affect Washington State, creating animations and evacuation maps, in addition to helping with tsunami hazard education and outreach. Alex has a research background in tsunami modeling and completed his M.S. degree at Central Washington University in Geological Sciences. Alex's thesis work focused on defining a new methodology to characterize earthquake rupture parameters of pre-instrumental tsunamigenic earthquakes. In this research, Alex compared the written and geologic tsunami record of south-central Chile against hundreds of forward modeled hypothetical tsunami simulations. Alex then used a statistical approach based on the available historic data to select possible rupture parameters for 17 historical earthquakes that were previously undocumented. In his Master's program, Alex was also a part of a field team working under Dr. Lisa Ely (CWU) and Dr. Breanyn MacInnes (CWU) that traveled to Queule, Chile with the goal of extending the paleotsunami record to a new site in south-central Chile. Alex also had the opportunity to participate as a field assistant for tsunami researchers Dr. Marco Cisternas (PUCV) and Dr. Brian Atwater (USGS) in their work in Maullín, Chile during January, 2018. Prior to his work in tsunamis, Alex received his B.S. degree in Geology at Union College (NY).

Washington State Legislature Includes Budget for 2019-2021 Tsunami Sirens for Coastal Cities

By Steven Friederich, Washington State Emergency Management Division

The Washington State Legislature has provided a big boost for tsunami sirens in the state.

For the two-year biennium starting in July, the state is contributing $928,000 to install 16 new tsunami sirens on the coast of Washington. These All-Hazard Alert Broadcast (AHAB) sirens alert residents of an impending tsunami or other disaster within a 1-mile radius. It's the first time the state of Washington has contributed to increasing the system's capacity.

Washington currently has 72 sirens along the coast with additional federal funding to add one at the Quinault Indian Nation and three in Skagit County later this year. Maximilian Dixon, the Hazards and Outreach Program Supervisor at the Washington Emergency Management Division, says the tsunami program has received more than 40 unmet siren requests from coastal emergency managers.

"The state has really stepped up to help fill a gap that would have taken many years to otherwise fulfill," Dixon said. "We still have a long way to go, but we'll be closer now to helping make Washington coasts a safer place."

Most of the sirens on the coast along with yearly sustainment costs have been paid for with funds from the National Oceanic and Atmospheric Administration/National Weather Service (NOAA/NWS) Tsunami Activities Grant. Washington's grant, which totaled almost $726,000 this year, also pays for staff time at the Washington Emergency Management Division, as well as the state's tsunami public education programs, tsunami vertical evacuation structure studies, new tsunami modeling and animations, new maps, and evacuation signs in multiple languages.

Keily Yemm, the Tsunami Program Coordinator with Washington Emergency Management Division, notes that the new two-year installation project will be broken up into two phases - half the first year and half the second year.

"Priority is being given to jurisdictions along the outer coast and Strait of Juan de Fuca, which face the highest risks, before moving on to address the needs of the Salish Sea, Puget Sound and Hood Canal," Yemm said. This is a big win for tsunami risk reduction and the Washington Emergency Management Division looks forward to working with coastal emergency managers to get these sirens installed.

Yemm says the state will continue to work with federal and state partners to secure even more funding in future years to help the coasts.

Washington State Practices Tsunami Response Communications

By Keily Yemm, Washington State Emergency Management Division

Over 180 of Washington's coastal emergency managers, state agency and federal partners practiced tsunami response communications during two tsunami communications drills held May 23rd and June 6th by the Washington State Emergency Management Division (EMD).

In partnership with the National Tsunami Warning Center (NTWC), the drills were based on an Alaska earthquake and tsunami event, generally considered Washington's maximum credible distant source tsunami hazard. This is a familiar scenario to the west coast, similar to the historic 9.2 Mw 1964 Alaska earthquake that produced a tsunami affecting the entire west coast of the United States (including Hawaii).

During the drill, the state's Alert and Warning Center at EMD focused on receiving information from the NTWC, then quickly disseminating it to officials in the potential impact areas. State officials practiced sharing this information by using email and text alert notification systems. They also used a text alert polling feature to obtain immediate feedback from their emergency management partners. This tool, although successful in these drills, posed a challenge by forcing officials to condense as much as five pages of critical information into a 1400-character text message. Keily Yemm, Washington's tsunami program coordinator and organizer of the event explained, "As you can imagine, the NTWC is pushing out a lot of information in a short amount of time and this drill helped all participants get a feel for the message formats and the flow of information that would influence crucial decision making during a real event."

The drills also included two NTWC-led conference calls and two state-led, local-jurisdiction calls. These calls are an important part in keeping partners on the same page, providing additional information to emergency managers, and allowing for clarifying questions. Kara Gately and Chris Popham, both senior duty-scientists at the NTWC, took turns developing briefs and facilitating the NTWC call during the exercises. Chris stated "The drill was fantastic, especially the conference calls. It exercised the primary two-way communications pathway with our state partners. The drill helped us focus the content of these calls, and fielding questions on the fly was great for exercising the critical thinking that is required in these situations. Involvement in the local conference call was excellent as well. Hearing state emergency managers interact with their communities helps us see the downstream implications of our messaging."

Once the state received additional information from the NTWC, they quickly relayed it to coastal emergency managers via the local-jurisdiction calls. County, city, tribe, and port emergency managers, along with select state agency liaisons were invited to listen in and receive this information. Keily explained that it is crucial to quickly translate the information provided by the NTWC in a way that locals can clearly understand and immediately take action on. Subject matter experts from the Washington Geological Survey are close partners with EMD during these events and helped ask clarifying questions while assisting in translating the technical data received by EMD.

(Continues on page 10)

Washington State Practices Tsunami Response Communications

By Keily Yemm, Washington State Emergency Management Division

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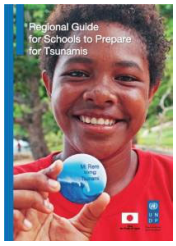
County, city, tribe, and port emergency managers had the opportunity to participate at many different levels. While some participants only had time to receive information, many more participated in conference calls and used them as an opportunity to conduct tabletop discussions on response actions. Lynn Sterbenz, emergency manager of the City of Bellingham, partnered with her county and port counterparts to strengthen operational coordination and situational awareness communication. Lynn described how the exercise "opened the door for complex communications discussions, identified areas of improvement and helped solidify roles and responsibilities." Local participants also reported being able to fully engage in the exercise effectively away from their regular office environment.

Overall, the drills were a huge success at every level. During the After-Action Review, areas of improvement were identified related to the State's emergency operations center staffing, coordination with B.C. and NWS, and inner coast forecasting/messaging. Washington State is working to incorporate lessons learned and best practices in an update to Standard Operating Procedures. In the end, although there are always items we can improve, the collective experience allows us all to be better prepared to respond during an actual tsunami event. Washington State EMD would like to extend our sincere gratitude to those that helped develop the drill and all those who participated.

Regional Guide for Schools to Prepare for Tsunamis

By United Nations Development Programme (UNDP)

The Regional Guide is intended to provide practical guidance to school administration on how to prepare for and respond to a tsunami risk. This guide is particularly relevant to schools in tsunami prone areas, although much of the procedures are applicable to flood prone or even multi-hazard areas. Whilst many guides or instructional manuals exist, this guide is based on reports from expert technical agencies, as well as lessons learned and good practices that have emerged from the practical experience under the project.



The Regional Guide has two main sections:

1. Seven Steps of School Tsunami Evacuation Drills: They are based on the technical expertise of internationally reputed agencies that UNDP partnered with for this project – the International Tsunami Information Center (ITIC), Hawaii; the IOCUNESCO Indian Ocean Tsunami Information Center (IOTIC), Indonesia; Tohoku University, Japan and the Indonesian Institute of Sciences (LIPI). They illustrate the minimum steps for an effective tsunami evacuation drill.
2. School Tsunami Preparedness: It highlights measures that schools need to have in place before to be able to carry out an effective evacuation during a tsunami. This guide also highlights the importance of context and that preparedness is an iterative process.

By adapting this guide to schools' needs, schools can improve their preparedness and enhance the safety of their students and teachers during a tsunami event.

See full report: https://tinyurl.com/y6awwbm8

TsunamiReady Signs Inventory in Puerto Rico using Collector for ArcGIS

By Raquel Lugo-Bendezú, Roy Ruiz-Vélez, Dr. Víctor Huérfano, and Dr. Liz Vanacore, Puerto Rico Seismic Network

Puerto Rico's population is vulnerable and prone to natural events such as hurricanes, storm surges, earthquakes, and tsunamis. In 1867, referred to as the "Year of Disaster," the island suffered immensely from a Category 1 hurricane. Twenty days later, a 7.3 magnitude earthquake occurred in the Anegada Passage generating a tsunami along the northeastern and southern coasts of Puerto Rico[1]. The lack of aid and resources provoked despair among the people and a sense of helplessness[2]. Similarly, on October 11, 1918, another 7.3 magnitude earthquake struck the western coast, causing a tsunami which killed 116 people and an economic loss of $4 million dollars[3]. Consequently, it is very important to alert and educate these communities that are at risk from coastal hazards. Currently, 46 coastal municipalities in Puerto Rico are TsunamiReady®. Generating awareness and helping prepare communities for earthquakes and tsunami hazards has been one of PR-NTHMP primary goals. By mapping out evacuation routes and installing tsunami signs, communities and visitors have tools to find a safe route of tsunami hazard zones.

Puerto Rico experienced another catastrophic event on September 20, 2017 when Hurricane Maria hit, causing a major collapse of electrical grids and cellular communication systems, and heavily damaging buildings. Tsunami evacuation signs were also damaged or destroyed during the event, leaving the coastal communities vulnerable. Since access to electricity and internet was intermittent during the months following the hurricane, a full-scale inventory of the status of the signs was difficult to compile. Using smartphones and the app Collector for ArcGIS, developed by ESRI, helped solve this problem and made the process of collecting field data easier. A geodatabase was created by using domains and categories from past inventories. Location, status, and photo were collected for each sign viewed in the field. In a little over year damage assessments for 1,482 signs have been collected, but much more work is required to finish cataloguing and mitigating the damages caused by Hurricane Maria.

[1]Información Sísmica, http://redsismica.uprm.edu/Spanish/informacion/sisnotas_sig.php (accessed January 2019).
[2]Castro Rivera, A., (n.d.), La triple condena de 1867. Retrieved December 14, 2018, from https://www.proyecto1867.com/la-triple-condena-de-1867.html
[3]Reid, H.F., and Taber, S., 1919, Los terremotos de Puerto Rico de 1918, con descripción de terremotos anteriores: informe de la comisión encargada de la investigación sobre terremotos: San Juan, P.R., Negociado de Materiales, Imprenta, y Transporte.

NTHMP Annual Meeting August 19 - 23, 2019

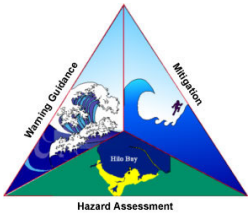
Salt Lake City, Utah

WHAT: Full NTHMP Annual Meeting has been rescheduled for August 19-23, 2019 in Salt Lake City, UT

INCLUDES: All NTHMP Subcommittees, Workshops, General Sessions

ACCOMDATIONS: Room block released; Contact hotel for available rates.

REGISTRATION: https://nws.weather.gov/nthmp/meetings/2019annualmeeting/



TSUNAMI RESEARCH & NTHMP EVENTS

NEW TSUNAMI RESEARCH ON 2018 SULAWESI, INDONESIA EARTHQUAKE AND TSUNAMI

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UPCOMING NTHMP & RELATED EVENTS

- July 8–18, 2019—IUGG 27th General Assembly (With Joint Tsunami Symposium) (Montreal, Canada) http://iugg2019montreal.com/
- August 19–August 23, 2019—NTHMP Annual Meeting (Salt Lake City, Utah) https://nws.weather.gov/nthmp/
- September 3-13, 2019—ITIC Training Programme (Honolulu, Hawaii) https://urlzs.com/PJA3a
- September 16–20, 2019—OceanOBS'19 (Honolulu, Hawaii) http://www.oceanobs19.net/
- December 9-13, 2019—AGU Fall Meeting (San Francisco, California) https://fallmeeting.agu.org