TsuInfo Alert

prepared by the Washington State Department of Natural Resources on behalf of the
National Tsunami Hazard Mitigation Program
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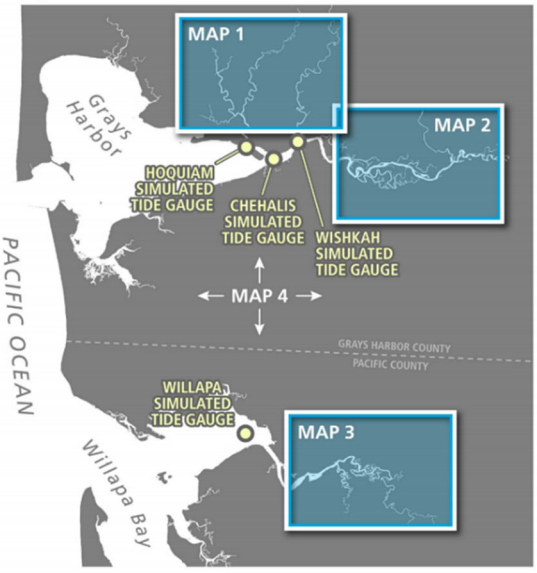
New Tsunami Hazard Maps for the Chehalis, Hoquiam, Willapa, and Wishkah Rivers in Grays Harbor and Pacific Counties, Washington, from a Large Cascadia Scenario

By Alex Dolcimascolo, Washington Geological Survey

IN THIS ISSUE:

The Washington Geological Survey has released a new publication showing tsunami model results from a large magnitude 9.0 Cascadia subduction zone megathrust earthquake scenario for the upriver stretches of the Chehalis, Hoquiam, Willapa, and Wishkah Rivers. This new modeling expands upon previous tsunami hazard mapping published in 2018 for southwest Washington that excluded these areas due to lidar unavailability. Now, with newly incorporated lidar and river depths available through NOAA hydrographic surveys, we present maximum tsunami inundation, estimated wave arrival times, and current speeds for these four major river valleys connected to Grays Harbor and Willapa Bay on Washington's outer coast.



A receding shoreline, a natural warning sign of an imminent tsunami, may not be discernable in Willapa Bay or Grays Harbor. This is due to possible coseismic subsidence impacts in addition to the proximity of this region to the earthquake source. Any impact of subsidence would also redefine the Mean High Water (MHW) shoreline following the event. This is because both the sea- and land levels would drop together, but only sea-level would recover back to the pre-earthquake level following the earthquake in the short term; this happens over a period of several hours. Conversely, it may take decades to centuries for the land level to rebound back to its pre-earthquake elevations.

Modeling results suggest that the initial tsunami signal arrives within 20 minutes in all river mouths included in this study. Water heights within these rivers then ramp up to over three feet approximately one hour after the earthquake. The tsunami travels a minimum of ~8 river miles upriver in all four modeled river valleys and flooding over roadways may isolate upstream communities, such as Aberdeen Gardens (upstream of the Wishkah River). The farthest modeled inundation extent was along the Chehalis River, traveling ~13 miles, reaching the flood plains and inundating the low-lying areas east of Montesano. Additionally, modeling within the Willapa River identifies the city of Raymond to be within the tsunami inundation zone, with

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

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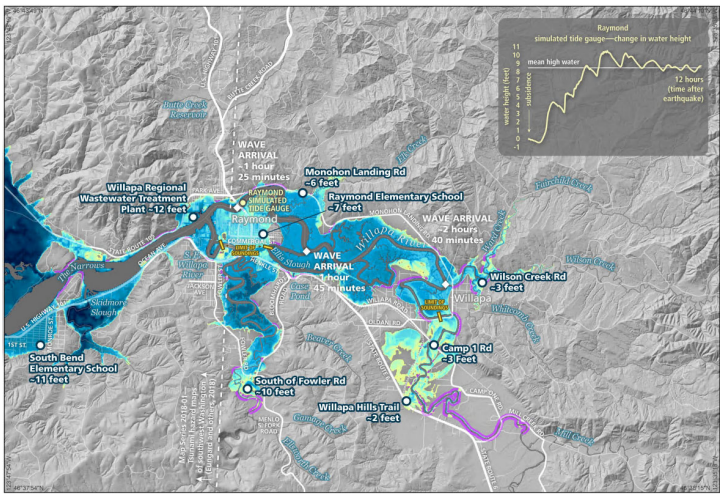
average inundation depths between 5-8 feet with exception to the high ground "island" on the eastern city limit. All results presented in this publication are for a large earthquake and tsunami, producing inundation that the next event is unlikely to exceed. We did this to encourage hazard planning for a maximum considered scenario that is a close representation to a ~2,500-year earthquake and tsunami possible for the Cascadia subduction zone. The next earthquake and tsunami will be different than the scenario presented. We recommend using this modeling as a tool to assist with emergency preparations and evacuation planning prior to a Cascadia subduction zone event or to determine locations where a tsunami vertical evacuation refuge would be appropriate.

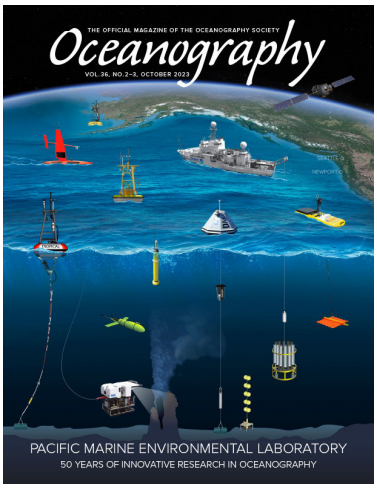


This publication is available on our tsunami hazard maps webpage and downloadable using the following hyperlink: https://fortress.wa.gov/dnr/geologydata/tsunami_hazard_maps/ger_ms2023-02_tsunami_hazard_sw_wa_rivers.pdf

Pacific Marine Environmental Laboratory: 50 Years of Innovative Research in Oceanography

Journal: Oceanography, Volume 36 | Number 2–3 | October 2023

Fifty years ago, NOAA created a new environmental research laboratory in Seattle with an initial focus on water quality in Puget Sound, and environmental studies of the Gulf of Alaska and Bering Sea.



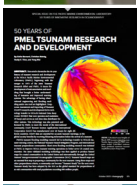
Since then, the Pacific Marine Environmental Laboratory (PMEL) has evolved into one of the world's leading ocean research institutes, specializing in observing ocean conditions from tsunamis to changes in climate and ocean chemistry with the aid of innovative instrumentation and measurement strategies often developed by the lab.

To recognize PMEL's half-century of accomplishments, the journal Oceanography has published a special issue with 29 diverse articles which highlight the laboratory's scientific work over the last five decades. The issue provides new perspectives on global and regional implications of ocean acidification and its biological impacts, the influence of El Nino-Southern Oscillation on global weather patterns, and the important role marine aerosols play in regulating climate.

"PMEL researchers and their collaborators not only have fundamentally reshaped the scientific understanding of so many aspects of our ocean, their research and explorations have sparked our imagination and fascination with the deep and all that we might learn about our planet," said NOAA Administrator and former President of The Oceanography Society Rick Spinrad, Ph.D. "Year after year, PMEL scientists continue to inspire the next generation of scientists and researchers, while providing the nation with the priceless knowledge gained by their investigations."

Discoveries made by PMEL scientists, supported by national and international research partners, have been at the forefront of a sea of knowledge about climate change and variability, extreme weather events, the effects of climate change on marine ecosystems, fisheries oceanography, global patterns and processes of heat and carbon budgets within the oceans, Arctic oceanography, and ocean-seafloor interactive processes such like hydrothermal vents.

- **The History and Evolution of PMEL: Purposeful Research that Impacts Environmental Policy** By Michelle M. McClure, Christopher L. Sabine, Richard A. Feely, Stephen R. Hammond, Christian Meinig, Michael J. McPhaden, Phyllis J. Stabeno, and Eddie Bernard https://doi.org/10.5670/oceanog.2023.233



- **50 Years of PMEL Tsunami Research and Development** By Eddie Bernard, Christian Meinig, Vasily V. Titov, and Yong Wei https://doi.org/10.5670/oceanog.2023.208

- **Technology Transfer of PMEL Tsunami Research Protects Populations and Expands the New Blue Economy** By Vasily V. Titov, Christian Meinig, Scott Stalin, Yong Wei, Christopher Moore, and Eddie Bernard https://doi.org/10.5670/oceanog.2023.205

See full issue: https://tos.org/oceanography/issue/volume-36-issue-2-3

WORLD TSUNAMI AWARENESS DAY

UNESCO and Partners Celebrate World Tsunami Awareness Day 2023 with #GetToHighGround Campaign

By United Nations Office for Disaster Risk Reduction (November 3rd, 2023 News Release)

It has been nearly 20 years since the onset of the Indian Ocean Tsunami, which tragically impacted countless lives and communities in South and South-East Asia in late December of 2004. The figures remain sobering and instructive: wave heights across the region exceeded 30 meters, inflicting widespread coastal destruction in Bangladesh, India, Indonesia, Malaysia, Myanmar, Sri Lanka, and Thailand – as well as 12 additional countries. Total casualties exceeded 230,000 persons, many who were tragically in the direct path of the surging ocean waters.

On this year's World Tsunami Awareness Day, of 5 November, Asia's coastal and island communities can look back and take pride in having rebuilt their ways of life and regional economies, but much still needs to be done to achieve early warning services and greater preparedness.

The theme of WTAD 2023 echoes the theme of the International Day of Disaster Reduction: 'Fighting Inequality for a Resilient Future'. Activities across the world will gather the public in exploring the reciprocal relationship between tsunamis and inequality, especially in how inequality makes tsunamis more dangerous for some communities, and how the aftermath of a tsunami can drive vulnerable communities further into poverty and exacerbate inequality. WTAD 2023 activities will focus on raising awareness about the underlying *disaster risk drivers* – poverty, inequality and other factors of vulnerability – which make tsunamis more deadly for those already most at risk.

What UNESCO is doing—The Intergovernmental Oceanographic Commission (IOC) of UNESCO works to coordinate national and regional tsunami early warning services, raising global awareness about effective actions, policies and practices to reduce exposure to disaster risk. As part of the annual WTAD and its Tsunami Ready Programme, UNESCO continues to support the #GetToHighGround initiative, which offers a chance to accelerate actions on early warning systems and services for tsunamis. The concept is to engage citizens, raise awareness of tsunami and coastal risks, and tailor local actions.

As part of this effort, all parties, from governments to civil society, are encouraged to make use of the UNDRR open-access publication, World Tsunami Day #GetToHighGround Activation Toolkit, available at the WTAD website.

Background—Since 2016, advocacy around World Tsunami Awareness Day (WTAD) has called on countries, international bodies and civil society to raise tsunami awareness and share innovative approaches to risk reduction.

In 2022 UNDRR launched a new WTAD initiative, the #GetToHighGround campaign, activate citizen through participation in a drill, a run, or a walk along tsunami evacuation routes. These activities raise awareness about the importance of reducing tsunami risk, while motivating communities to prepare their own tsunami resilience. Simulation exercises (SIMEX) are good examples of preparedness activity. More on SIMEX.

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UNESCO and Partners Celebrate World Tsunami Awareness Day 2023 with #GetToHighGround Campaign

By United Nations Office for Disaster Risk Reduction (November 3rd, 2023 News Release)

(Continued from page 4)

The #GetToHighGround campaign calls for a culture of tsunami and coastal hazards awareness for all people at risk. The campaign also emphasizes the importance of understanding our risk and investing in actions that both reduce risk and prepare us for future tsunami and coastal hazards.

Tsunamis are multi-dimensional hazards— Tsunamis immediately threaten human life, but they also disrupt livelihoods, industry, agriculture, gender equality, and critical services such as education and healthcare. These cascading risks can reverberate across sectors, geographies, and societies. Access to high quality, readily available information is key for supporting national mechanisms and local preparedness, and to enhancing awareness about early warning systems.

UNESCO invites all partners, including national, regional and local governments, international organizations, the UN System, non-governmental organizations, and all relevant stakeholders to contribute to building a culture of early warning and early action and to raise awareness on tsunami preparedness.

See original article: https://www.unesco.org/en/articles/unesco-and-partners-celebrate-world-tsunami-awareness-day-2023-gettohighground-campaign

World Tsunami Awareness Day and the Launch of a New Center to Better Understand Them

Source: Lori Dengler for the Times-Standard, Posted November 4, 2023

The United Nations sets aside November 5 as a day to remember tsunamis and the important role that everyone can play in reducing tsunami threats. The Japanese UN delegation proposed World Tsunami Awareness Day in 2015 in recognition of the horrors Japan experienced on March 11, 2011 but also as a reminder that all coastal areas of our planet have a tsunami threat and actions of individuals and communities can make a difference in life or death.

The date was chosen to recognize the actions of one man more than a century ago. In 1854, Goryo Hamaguchi saved his village because he knew that tsunamis follow earthquakes. A magnitude 8.4 earthquake struck Japan's Kii Peninsula in Wakayama Prefecture. Great earthquakes were infrequent and few in the village were aware of the tsunami threat. After the earthquake, Hamaguchi-sensei set fire to piled sheaves of newly harvested rice to get the attention of villagers near the coast and guide them to high ground in the darkness. The 1854 tsunami caused damage and casualties, but his actions saved many.

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World Tsunami Awareness Day and the Launch of a New Center to Better Understand Them

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(Continued from page 5)

I visited the Kii Peninsula in 2016. Four of us took the week before the 5-year commemoration of the 2011 tsunami to hike the Kumano Kodo pilgrimage trail. It is a beautiful area and has long been a sacred area in Shugendo, Shinto, and Buddhism. The terrain is rugged and small and large shrines and temples dot the way. Near the coast I could imagine the scene in 1854 with the rice sheaves safely stacked and the security of winter food in everyone's mind.

The 1854 earthquake was certainly a surprise, but it may have been even more of a shock to see the treasured rice aflame on the hillside. Villagers were likely enraged as they charged up the hill to see what happened. But when the tsunami surged over the areas where they had been only moments before, they realized the village elder had saved their lives.

Hamaguchi saved his village but at the cost of a winter's food supply. World Tsunami Day is part of a global effort to improve tsunami awareness, the safety of coastal communities, and alert residents and tourists to quickly take action to save themselves in a less painful manner.

It is a challenging proposition because deadly tsunamis are rare. Hundreds of years may elapse before they revisit a particular coastline, long after memories have faded. It is also challenging because of the many uncertainties great quakes pose. Nowhere is this more of a problem than in the Cascadia region of the Pacific Northwest. The Cascadia subduction zone extends over 650 miles from Cape Mendocino in Northern California to Vancouver Island, Canada, the only fault system believed capable of producing earthquakes as large as magnitude 9 in the lower 48 states. It's existence lay dormant to earthquake professionals who only became aware of this sleeping giant less than forty years ago.

We've learned a lot about Cascadia in the past forty years. We've nailed down the date of the last great rupture to January 26, 1700 from written accounts of the damaging tsunami it produced in Japan. Oral accounts of shaking and flooding cover the Cascadia region from the Wiyot, Yurok, and Tolowa of Northern California to the Nuu-chah-nulth peoples on Vancouver Island. Paleoseismologists have found evidence of land subsidence, tsunami inundation, and strong shaking at numerous sites in the region. Trees, submerged and killed in that earthquake confirm the Japanese accounts; their last growth rings were in the summer of 1699.

But there is so much more that we don't know. At the top of the list is how strongly will the ground shake, how large will the tsunami be, impacts in terms of building and infrastructure damage, and might there be any way of telling how soon it will come. Answering those questions requires basic science and engineering studies to define fault sources, material characteristics that determine the speed of seismic waves and features that amplify them, and fault slip that controls tsunami generation. There are a multitude of other unknowns such as what is happening offshore, and the role of smaller crustal faults and deeper buried ones.

Enter the Cascadia Region Earthquake Science Center (CRESCENT). This fall, the National Science Foundation provided funding for a regional consortium of 16 universities to establish a center to prioritize the most important questions, support studies to provide answers, and engage regional partners that will result in societal actions that will reduce impacts from the next Cascadia earthquake.

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World Tsunami Awareness Day and the Launch of a New Center to Better Understand Them

Source: Lori Dengler for the Times-Standard, Posted November 4, 2023

(Continued from page 6)

I attended the kickoff meeting of CRESCENT held the week of October 23 in Eugene, Oregon. CRESCENT is built on three basic pillars: science, developing the next generation of geoscientists, and partnerships. The roughly 150 in-person attendees spent three days in collaborative discussions about process and priorities.

Cal Poly Humboldt is one of the 16 university collaborators in CRESCENT and a number of us with Humboldt connections attended the meeting. Humboldt is a lead in the workforce development leg of CRESCENT. The geosciences have lagged behind many other STEM fields in including people from diverse backgrounds. This is limiting in several ways. Scientific advances require thinking in new ways and narrowing the workforce to a small segment of society hobbles the effort. We need researchers and credible spokespeople from every part of society to engage all at-risk communities in taking action to reduce hazards.

Over 150 earthquake and tsunami researchers and professionals at the inaugural meetng of the Cascadia Region Earthquake Science Center in Eugene, Oregon.

One of the first big efforts of the workforce leg will happen in summer 2024. Cal-Poly Humboldt is instituting a Cores to Codes summer field experience for undergraduates from underrepresented backgrounds. Students will learn techniques of paleoseismic investigations, spend time in the field coring and collecting samples and return to campus to analyze their findings. A huge ovation to Harvey Kelsey (Geology Dept.) and Nievita Bueno Watts in the Indian Natural Resources Science and Engineering Program for launching this program so quickly.

My role in CRESCENT is primarily in the partnership leg. From my perspective, the best science is of little use unless it results in risk reduction. To do this, we need to identify all of the potential users of the science and what it is they need. Some are obvious – state agencies such as the California Geological Survey, federal agencies such as the USGS, NOAA, and NASA. These groups aren't just recipients of data but will be active research participants. But we need to cast a much wider net – utilities, resilience/emergency management groups, tribes, local government, businesses, information/ media sectors, and many more.

Next year CRESCENT will be hosting a meeting for partners. The Redwood Coast Tsunami Group will be represented. I encourage anyone who thinks their organization should be at this table to contact me. Science that will actually make us safer – what a great idea! Much better than burning the rice fields.

More about CRESCENT at https://cascadiaquakes.org/.

See original article: http://www.dmes-standard.com/2023/11/04/lori-dengler-world-tsunami-awareness-day-and-launch-of-a-center-to-be%3Eer-understand-them/

Tsunami Deposits at Discovery Bay, WA

From: Cascadia CoPes Hub Quarterly Newsletter

In September, a collaborative effort between students from the University of Washington and Simon Fraser University unfolded at Discovery Bay, WA. This group collected vibracores of tsunami deposits from a salt marsh, which then underwent detailed examination at Simon Fraser University in Dr. Jessica Pilaczyk's lab, utilizing the Itrax XRF Core Scanner.

The scans generated by the Itrax XRF Core Scanner yielded high-resolution elemental and textural information for the ten distinct tsunami deposits spanning a 3,000-year record. The resulting data not only serves as valuable material for radiocarbon dating but also lays the groundwork for further in-depth analyses. This concerted effort is a significant stride toward enhancing our understanding of the historical occurrences of tsunamis originating from Cascadia earthquakes and other tsunami sources within the Salish Sea region.

Access full newsletter: https://drive.google.com/file/d/1PZIwKEJRlq1ZFwRwonk7kFwB6pRn5Jgs/view

RESEARCH

Bullard, G.K.; Mulligan, R.P.; Take, W.A., 2023, Landslide tsunamis: exploring momentum transfer to waves generated by a range of materials with different mobility impacting water: Landslides, v. 20, p. 2619-2633. https://doi.org/10.1007/s10346-023-02126-3

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Fritts, Rachel, 2023, The First Slow-Slip Events Seen off Southern Costa Rica: Eos, 23 October 2023. https://eos.org/research-spotlights/the-first-slow-slip-events-seen-off-southern-costa-rica

Karstens, J.; Crutchley, G.J.; Hansteen, T.H.; et al., 2023, Cascading events during the 1650 tsunamigenic eruption of Kolumbo volcano: Nature Communications, v. 14, article 6606. https://doi.org/10.1038/s41467-023-42261-y

Sepúlveda, Ignacio; Carvajal, Matías; Agnew, D.C., 2023, Global Winds Shape Planetary-Scale Lamb Waves: Geophysical Research Letters, v. 50, no. 19, article e2023GL106097. https://doi.org/10.1029/2023GL106097

TSUNAMI RESEARCH & EVENTS

RESEARCH

TITLE: Meteotsunamis characterization for Gulf of Mexico using meteotsunami rose charts

CITATION: Jose, Alwin; Cheng, Wei; Horrillo, J.J., 2023, Meteotsunamis characterization for Gulf of Mexico using meteotsunami rose charts: Natural Hazards, https://doi.org/10.1007/s11069-023-06316-z.

ABSTRACT: In recent years, there has been an increase in awareness and research on meteotsunamis (MT) caused by atmospheric disturbances (AD), such as widespread and long-lived cold fronts, squalls, and storms. In this work, an AD model that was developed previously has been used along with depth-integrated Navier Stokes equations to conduct 34,560 numerical experiments in the Gulf of Mexico using High-Performance Computing. The data generated is visualized with a newly developed characterization tool—the meteotsunami rose chart, described in detail. For a given location, MT rose charts provide a detailed relationship between the expected maximum MT amplitude and the AD's path, direction, and forward speed. Another new tool, the severe MT rose charts, complements these by summarizing the case scenarios with an amplitude of more than 0.3 m. An interactive online implementation has also been introduced. A sensitivity study conducted on the various constant parameters associated with it gives an idea of the factors to account for when using MT rose charts. The newly developed visualization tools are used to study the meteotsunami hazard for Clearwater Beach, FL; some critical scenarios were identified, and observations were made. These tools were then applied to 7 other places along the Gulf of Mexico to draw some broad conclusions on how the bathymetry of the region relates to severe MT hazard scenarios. It was observed that relatively slower-moving ADs produce the most severe MTs along coasts with broad continental shelves. In comparison, narrower continental shelves cause the most severe MTs for fast-moving ADs.

UPCOMING NTHMP & RELATED EVENTS

- March 21, 2024—CARIBE WAVE 24 Tsunami Exercise
  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/
- July 26-August 1, 2024—NTHMP 2024 Summer Meeting (Pago Pago, American Samoa)
  https://nws.weather.gov/nthmp/