TsuInfo Alert

prepared by the Washington State Department of Natural Resources on behalf of the

National Tsunami Hazard Mitigation Program

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United States National Tsunami Hazard Mitigation Program Strategic Plan for 2024 - 2029

The U.S. National Tsunami Hazard Mitigation Program (NTHMP) brings together federal, state, and territory partners to mitigate the impact of tsunamis through public education, community response planning, hazard assessment, and warning coordination. This plan advances the NTHMP's mission and vision through goals and strategies that strengthen tsunami preparedness, mitigation, mapping and modeling, warning coordination, and response and recovery while considering impacts of climate change, equitably meeting the needs of all at-risk individuals in tsunami hazard zones, and protecting our maritime resources.

The NTHMP has four strategic overarching priorities, or themes:

1. Hazard and Risk Assessment
2. Education and Preparedness
3. Mitigation and Recovery
4. Alert, Warning, and Response

The themes are supported by goals and strategies, which the NTHMP will strive to meet through collaboration between partners and stakeholders. There are several cross-cutting initiatives that will be implemented in various ways within the four strategic themes:

- **Encourage national consistency of products** by sharing best practices and guidelines to promote the protection of life, property, and maritime resources;
- **Leverage continuing research and emerging technology** to ensure all NTHMP products are based on the best available science and technology, such as the increasing roles of artificial intelligence and high-performance computing in data analysis;

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WASHINGTON STATE DEPT OF NATURAL RESOURCES
WASHINGTON GEOLOGICAL SURVEY

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a state/federal partnership led by the National Oceanic and Atmospheric Administration (NOAA).
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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

United States National Tsunami Hazard Mitigation Program Strategic Plan for 2024 - 2029

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- **Incorporate evidence-based approaches from social-science research** to ensure that all NTHMP products and practices are easily understood and useable for all stakeholders;
- **Integrate equity into NTHMP efforts** by developing practices and products that meet the needs of America's underserved and vulnerable populations in tsunami-hazard zones;
- **Recognize the potential impacts of climate change** on community readiness and resilience to tsunamis, as part of NOAA's goal of a Climate Ready Nation; and
- **Promote economic development to enhance the New Blue Economy** by improving the resilience of coastal communities and economies to tsunami hazards.

Theme	Goals	Strategies
Hazard And Risk Assessment	Tsunami hazard assessments identify areas where risk-reduction planning is needed	• Identify and address gaps in tsunami source characterization and modeling • Complete inundation and evacuation maps for all U.S. coastal communities • Identify and address product requirements that support the maritime industry
	Methods to characterize and communicate societal risks to tsunamis are developed and properly applied to support risk-reduction planning	• Assess population exposure, vulnerability, and evacuation potential to tsunami • Support the development and appropriate use of tsunami loss-estimation methods and tools, such as Hazus and the National Risk Index
Tsunami Education and Preparedness	At-risk populations are informed and prepared to respond appropriately to tsunamis	• Engage public and private schools and institutions of higher learning • Develop, update, and disseminate consistent outreach materials • Conduct training and outreach events and campaigns • Evaluate tsunami outreach and incorporate findings into future efforts
	New TsunamiReady® sites are established and existing sites are maintained	• Recognize TsunamiReady® Communities • Increase number of recognized TsunamiReady® Tier 2 Communities • Increase number of designated TsunamiReady® Supporters • Determine and promote best practices for tsunami risk-reduction • Evaluate TsunamiReady® criteria and re-establish TsunamiReady® boards
	Engage and support local efforts to improve tsunami preparedness	• Conduct exercises that include tsunami scenarios to improve future response • Promote effective planning for tsunami preparedness
Mitigation and Recovery	Mitigation and recovery strategies are developed for long-term community planning	• Develop guidelines and model practices for mitigation and recovery • Develop resources and model practices for mitigation and recovery funding • Support improvements to FEMA's National Risk Index and RiskMAP • Help building code developers incorporate best available science • Incorporate non-seismic sources and long-term impacts of climate change on coastal communities into tsunami mitigation and recovery planning
	Mitigation and recovery strategies are initiated and incorporated into long-term community planning	• Implement guidelines and model practices for mitigation and recovery • Increase local stakeholder capacity for mitigation and recovery efforts
Alert, Warning, and Response	Tsunami Warning Center products are understandable, effective, and actionable	• Provide guidance to refine Tsunami Warning Center and state-level products • Provide stakeholder requirements through the WCS • Improve availability of products for underserved and vulnerable communities • Support the National Weather Service Hazard Simplification Project
	Warning forecast dissemination is effective and reliable	• Coordinate periodic system-wide communication tests and encourage authorities to participate and provide feedback • Dedicate outreach and exercise efforts for underrepresented communities • Improve local warning reception capabilities • Improve local warning dissemination capabilities
	Tsunami response is effective	• Support and provide tools to enhance community-level response planning • Align NTHMP partner alerting and response • Collaborate with USGS on testing and consistent messaging of ShakeAlert earthquake messaging and tsunami alerting
	Field data collection and communication efforts are coordinated after a tsunami	• Support and implement post-tsunami event protocols • Exercise field data collection efforts locally, regionally, and nationally

Link to publication:
https://nws.weather.gov/nthmp/documents/NTHMP-Strategic-Plan-2024-2029.pdf

Tsunami Sediment Transport Model Benchmarking Workshop

By Jim Kirby (University of Delaware) and Stephan Grilli (University of Rhode Island)

Strong morphological responses have been observed during recent tsunami events, with the modes of response including both significant alteration of harbors and waterways resulting from strong currents (e.g., Wilson et al., 2012), and destructive erosion to surface infrastructure and planforms during significant over-land inundation (e.g., Yamashita et al., 2016, 2022). As part of ongoing modeling work done for the National Tsunami Hazard Mitigation Program (NTHMP), hazard analyses of erodible coastal areas, such as the US East Coast (e.g., Tehranirad et al., 2017, 2021), have shown that the progressive degradation of protective coastal features (such as dunes) during tsunami events can lead to marked increase in flooding (both depth and extent), relative to predictions with model simulations carried out over fixed beds. Hence, estimating tsunami inundation hazard for such coastlines, by running models with topography/bathymetry data based on fixed-bed Digital Elevation Models (DEM), as is standard practice, may lead to significantly underestimating the level of hazard in areas that are readily subject to erosional processes.

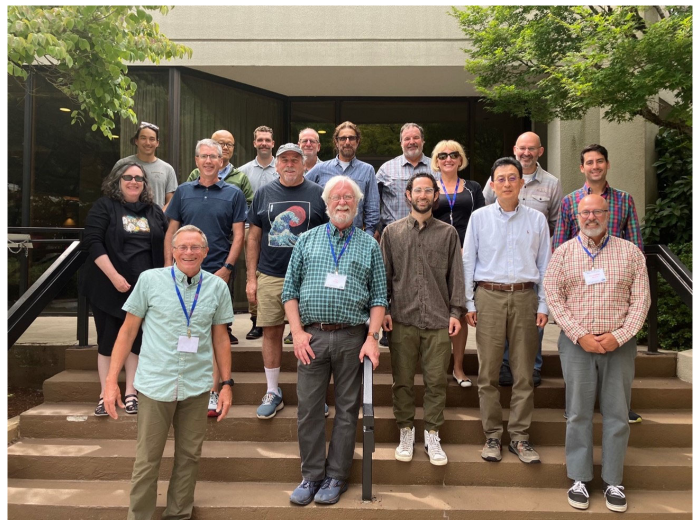

Fig. 1: Some of the workshop attendees: Front, L-R: Stephan Grilli, Jim Kirby, Alex Docimascolo, Fai Cheung, Chris Moore Second Row: Stephanie Ross, Jonathan Allan, Bruce Jaffe, Elena Suleimani, Ernesto Fernandez Back: SeanPaul LaSelle, Daisuke Sugawara, Chris Malone, Guy Gelfenbaum, Juan Horrillo, Rick Wilson, Pat Lynett.

In its FY2009 Strategic Plan, the NTHMP required that all numerical tsunami inundation models be verified as accurate and consistent through a rigorous model benchmarking workshop/process. For instance, this was completed in FY2011 for runup and inundation, but only for seismic tsunami sources and in a limited manner for idealized solid underwater landslides (Horrillo et al., 2014). Subsequent workshops examined the modeling of tsunami induced currents in FY2015 (Lynett et al., 2015) and, more extensively, the modeling of landslide-induced tsunami generation in FY2017 (Kirby et al., 2022). The results of these workshops have been used by NTHMP's Mapping and Modeling Subcommittee (MMS) to develop modeling requirements and best-practice guidances for use by the NTHMP program and other interested parties.

Due to the strong effects of tsunamis on erodible coastlines, the MMS has initiated a process for including the consideration of morphology change, occurring during tsunami events, as a component of the overall hazard analysis. As before, the first step of this process has been to organize and conduct a workshop aimed at establishing benchmark criteria for evaluating models used for the prediction of tsunami-induced morphology change. Drs. Jim Kirby (University of Delaware) and Stephan Grilli (University of Rhode Island), both MMS members, were tasked to organize this benchmarking workshop, which took place in Portland, OR, on August 4th and 5th, 2023, following the NTHMP summer meeting, with the organization benefiting from significant help from Dr. Fengyan Shi (University of Delaware). The stated goals of the workshop were: (i) to "assess the ability of existing models to simulate expected tsunami-induced morphology changes", and (ii) based on these results to "develop guidance and basic best practice requirements" to be used in future hazard mapping efforts sponsored by NTHMP.

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Tsunami Sediment Transport Model Benchmarking Workshop

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Following preliminary discussions with a variety of experts, stakeholders, and tsunami modelers, the workshop identified and gathered information for three benchmarking exercises. Two benchmarks were based on field events during the 2011 Tohoku tsunami, for which observations of actual response were available: (i) Benchmark #1: Crescent City harbor, CA, where damage was mainly bathymetric (Wilson et al., 2012); and (ii) Benchmark #2: Rikuzentakata, Japan, which was extensively damaged during extreme inundation (Yamashita et al., 2016, 2022). Additionally, Benchmark #3 was based on well-controlled experiments performed in a laboratory flume, which provided a range of cases involving uniform slopes with or without superposed dune features (Yoshii et al., 2017, 2018).

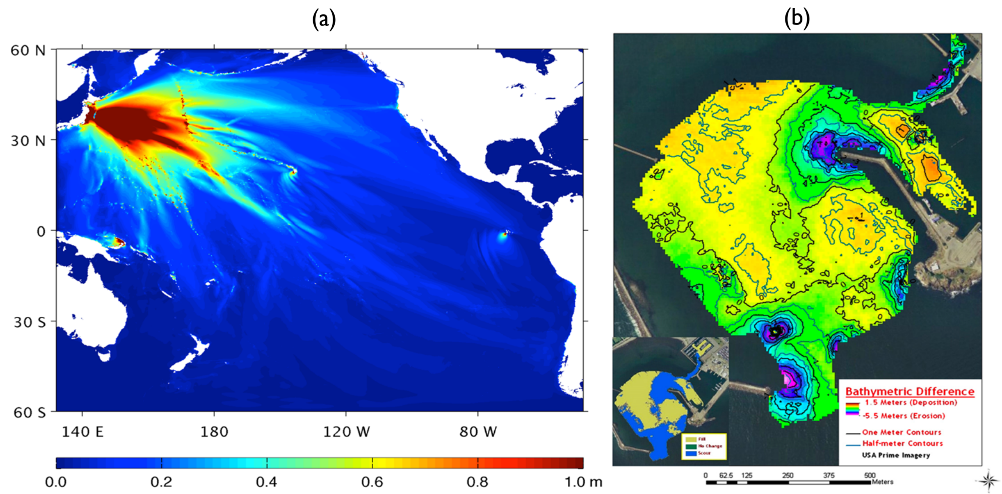

Fig. 2: Benchmark #1. (a) Maximum surface elevation simulated for the Tohoku 2011 tsunami (Grilli et al., 2013; Kirby et al., 2013). (b) Areas of scour and fill in the outer and middle portion of the Crescent City Harbor, as a result of the Tohoku 2011 event, determined by differencing multi-beam bathymetry collected by NOAA on March 16-21, 2011 and November 2008. (Wilson et al., 2012, Fig. 4).

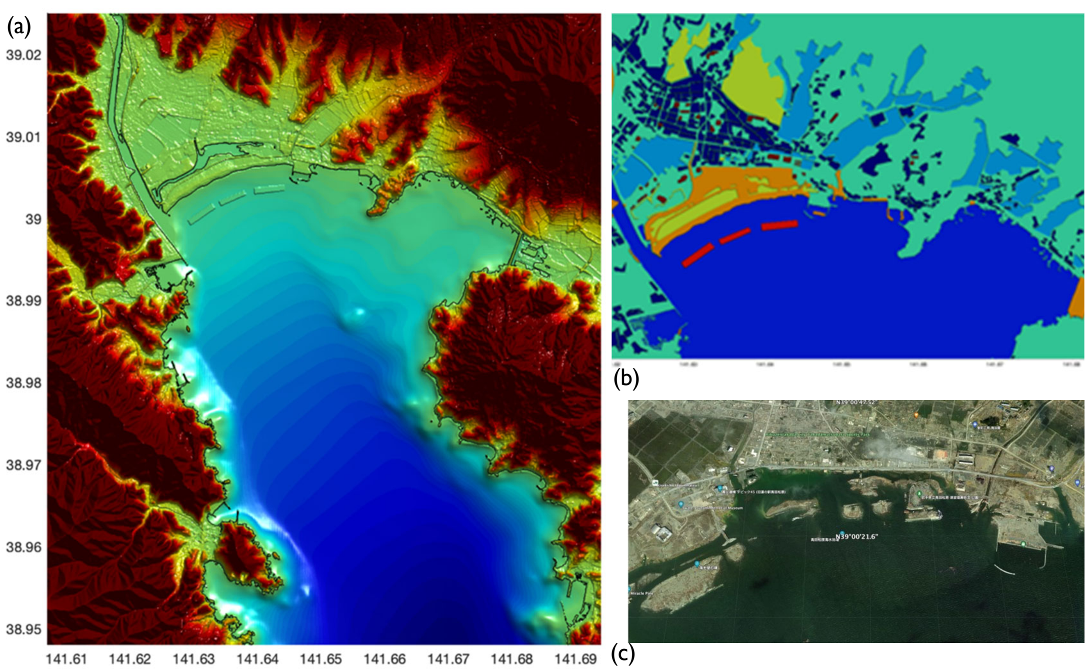

Fig. 3: Benchmark #2, Rikuzentakata, Japan: (a) Finest nested grid used (Yamashita et al., 2022, level 4). (b) Post Tohoku 2011 (4/11). (c) Northern portion of color-coded land use map used in simulations: dark blue - buildings and houses (non-erodible); medium blue - open water (erodible); light blue - arable land (non-erodible); blue/green - paved surfaces (non-erodible); yellow-green - Forest (erodible); orange - bare ground (erodible); red - submerged breakwater (non-erodible); deep red - robust buildings (non-erodible). Descriptions of varying treatments of each land-use class may be found in Yamashita et al (2016) (section 2.6).

As in earlier benchmarking workshops, a diverse group of participants were invited to attend, including geologists/ geomorphologists, some experienced in

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Tsunami Sediment Transport Model Benchmarking Workshop

By Jim Kirby (University of Delaware) and Stephan Grilli (University of Rhode Island)

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conducting tsunami hazard field survey, tsunami numerical modelers, and emergency managers with experience in response to tsunami events. Many of the participants were NTHMP investigators and many were MMS members. There was also a large group of participants from the US Geological Survey (USGS). Finally, because of the significant contribution of data from the Tohoku 2011 event, Japanese colleagues were invited, with one of them, Dr. Daisuke Sugawara, participating in the workshop and being a member of its steering committee. A list of participants and their affiliation can be found on the workshop webpages (www.udel.edu/kirby/tsunami_sediment/). On-site participants on day 1 are shown in Fig. 1. In addition to the co-chairs, Drs. Kirby and Grilli, the workshop steering committee included Drs. Bruce Jaffe (USGS), Daisuke Sugawara (Tohoku University) and Jon Allan (Oregon State University).

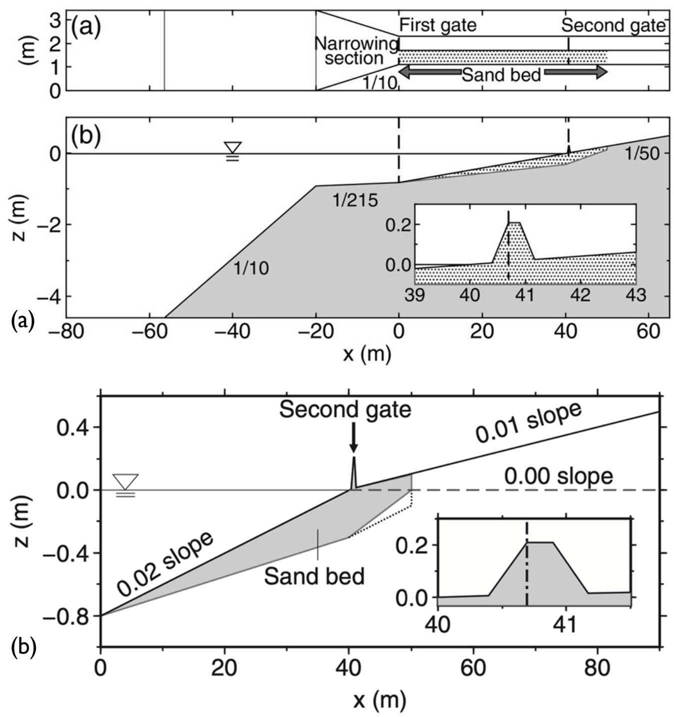

Fig. 4: Benchmark #3: Experimental configuration for cases: (a) C1 - C5 (Yoshii et al., 2017); and (b) C6 - C13 (Yoshii et al., 2018).

Set-up data for each benchmark (e.g., Figs. 2-4) was made available prior to the workshop, to allow modelers to simulate each case using their own model. At the workshop, presentations were given by the co-chairs that summarized earlier workshop activities, the Tohoku 2011 event, each benchmark problem, and introduced the workshop objectives. On both days, keynotes were given by invited experts specializing in field and/or modeling work on tsunami sediments (e.g., Rick Wilson, Guy Gelfenbaum, Daisuke Sugawara). Modelers who had run some of the benchmark problems, using their own (e.g., FUNWAVE, NEOWAVE) or available standard (e.g., Delft3D) models, each then gave a presentation comparing their simulation results to the benchmarking data and discussing discrepancies. In general, models performed better in reproducing the experimental data, but most models were able to also explain the overall features of tsunami sediment processes observed during the Tohoku 2011 event, in both the near- and far-field. In the end there was a 2 hour period set aside for an open discussion by participants on workshop results and future work and activities.

As in earlier workshops, it was decided to provide modelers with an additional period (set to 6 months) during which they could provide either improved or additional simulation results for Benchmark problems #1-3. Based on submitted results, the workshop steering committee will prepare a report and, eventually, a peer-reviewed paper, detailing the workshop benchmark problems, simulation results, and conclusions.

A workshop website (https://www1.udel.edu/kirby/tsunami_sediment/index.html) lists general information, information about each benchmark problem, and where links to the workshop report, supplemental presentation files, benchmark data and submitted model results will eventually be accessible.

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Tsunami Sediment Transport Model Benchmarking Workshop

By Jim Kirby (University of Delaware) and Stephan Grilli (University of Rhode Island)

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Improvements to Alaskan Tsunami Sirens

By Anthony Picasso, State of Alaska's Geohazard Mitigation Coordinator

Today represents a notable milestone in strengthening the readiness of Alaskan coastal communities for potential tsunamis. As many are well aware, government funding is constrained, and as Emergency Managers, we must employ creative strategies to optimize our financial resources. Another challenge I encounter is managing the states geohazards planning efforts largely on my own. From grant writing to public outreach, travel coordination, brochure projects, and more, I'm involved in every aspect. Nevertheless, our leadership has placed their trust in me for this role, and I'm deeply committed to sustaining this program to assist fellow Alaskans!

Last month, I received news that the Kenai Peninsula Borough had secured funding for siren upgrades. This development has now enabled me, in my capacity as the Alaska Geohazard Mitigation Coordinator, to retrieve the original sirens, which are still in excellent condition. These sirens were originally purchased with National Oceanic & Atmospheric Administration (NOAA) National Tsunami Hazard Mitigation Funds.

The plan is to refurbish these sirens and begin addressing the gaps in communities that have been waiting for years to receive early warning systems. Andrew Sather, Alaska Division of Homeland Security and Emergency Management, Response Manager, assisted me in recovering the items and ensuring their safe storage. It was a lot of work and appreciated the help from Andrew.

These sirens are substantial, measuring 12 feet in length and weighing up to 1,400 pounds. Ultimately, it's a delight to collaborate with local emergency managers across the state. Brenda Ahlberg and Paul M. with Kenai Peninsula Borough are exceptional to work with, making the transition process incredibly smooth. I express our gratitude and eagerly anticipate future collaborations on upcoming projects.

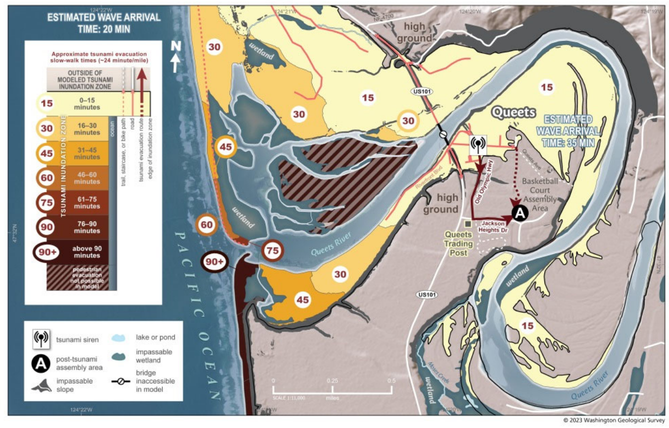
VITEMA hosts the Caribbean Office of the International Tsunami Information Center

By Regina Browne, Virgin Islands Territorial Emergency Management Agency (VITEMA)

VITEMA hosted Deputy Director Christa von Hillebrandt-Andrade, of the Caribbean Office of the International Tsunami Information Center. VITEMA was extremely excited to host Deputy Director von Hillderbrandt in the territory from August 17th to 18th for the first time since prior to the 2017 hurricanes. The trip was planned for a period of 36 hours but we were very excited to have the ability for her to travel to each of our Islands (St. Thomas, St. Croix, and St. John), and conduct meetings with the community stakeholders who were able to have engaging conversations about the new updates to the protocol manual from the Pacific Tsunami Warning Center. Copies of the protocols were also provided to each Emergency Operation Center Supervisor to share with all necessary stakeholders. There were a lot of misconceptions that the Deputy Director was able to explain very thoroughly, including those related to natural tsunami signs being the primary key indicators that a potential threat can affect the territory. The Deputy Director also participated in the monthly Emergency Management Council meetings with Governor Albert Bryan, Jr. present. Lastly, the Deputy Director along with former University of the Virgin Islands Professor Roy Watlington, who is the USVI designated local tsunami subject matter expert, were able to participate in a local radio talk show to provide answers to common questions. VITEMA hopes to have this visit conducted annually.

Tsunami Evacuation Walk Time Maps Published in Washington State

By Washington Geological Survey



The Washington Geological Survey has published "Tsunami Evacuation Walk Time" maps for the major population centers and tribal communities on the central Washington coast from La Push southward to Ocean City. The maps show the amount of time it would take to evacuate from within the modeled tsunami inundation zone of a magnitude 9.0 Cascadia-sourced subduction zone earthquake. The maps also shows the extent of the tsunami inundation zone, paths of tsunami evacuation routes, challenges to evacuation such as steep slopes, waterways, wetlands, and identified assembly areas and other significant or notable reference points in the communities. Colors indicate how many minutes it would take to get to safety from any given location within the inundation zone, as established from the model results from the Outer Coast and Strait area tsunami inundation and current velocity publication that came out in 2022: https://fortress.wa.gov/dnr/geologydata/tsunami_hazard_maps/ger_ms2022-01_tsunami_hazard_olympic_peninsula.zip.

These maps were developed using the U.S. Geological Survey's Pedestrian Evacuation Analyst Tool (https://www.usgs.gov/software/pedestrianevacuation-analyst-tool) for ArcGIS. Emergency managers, planners, and local officials were heavily involved in the project providing valuable local knowledge and decision making to best serve the communities represented. The walk time maps are available for download using the following links:

La Push
https://fortress.wa.gov/dnr/geologydata/tsunami_walkmaps/ger_tsunami_walkmap_la_push.pdf

Hoh Tribal Reservation
https://fortress.wa.gov/dnr/geologydata/tsunami_walkmaps/ger_tsunami_walkmap_hoh.pdf

Queets Village
https://fortress.wa.gov/dnr/geologydata/tsunami_walkmaps/ger_tsunami_walkmap_queets_village.pdf

Taholah
https://fortress.wa.gov/dnr/geologydata/tsunami_walkmaps/ger_tsunami_walkmap_taholah.pdf

Moclips
https://fortress.wa.gov/dnr/geologydata/tsunami_walkmaps/ger_tsunami_walkmap_moclips.pdf

Copalis Beach to Pacific Beach
https://fortress.wa.gov/dnr/geologydata/tsunami_walkmaps/ger_tsunami_walkmap_copalis_beach_to_pacific_beach.pdf

Ocean City to Copalis Beach
https://fortress.wa.gov/dnr/geologydata/tsunami_walkmaps/ger_tsunami_walkmap_ocean_city_to_copalis_beach.pdf

The maps are also available through an interactive map on our website:
https://www.dnr.wa.gov/programs-and-services/geology/geologic-hazards/tsunamis#tsunami-evacuation-maps

The interactive map also provides access to tsunami evacuation brochures for areas that do not have walk time maps yet.

New Tsunami Simulation Videos Published in Washington State for Central Washington Coast

By Washington Geological Survey

The Washington Geological Survey has released new videos showing simulated wave amplitude (wave peaks and troughs), inundation (extent and depth of tsunami flooding over land), and current velocity (wave speed), for communities on the central Washington coast.

Tsunamis are multi-wave events that affect coastal areas for many hours to potentially days after an earthquake happens. To show how tsunamis might affect a certain area over time we use computer models to simulate how tsunami waves might behave for a given earthquake scenario. Videos of tsunami simulations show tsunami wave behavior in a way that is difficult to convey through static images and maps. Following the public release of these videos, we have received many instances of positive correspondence from community members demonstrating increased awareness of tsunami hazards.

These new videos represent a tsunami that might occur following a Cascadia subduction zone earthquake. The next earthquake to happen on the subduction zone may cause tsunami wave action that varies from the results shown in these simulations. The videos demonstrate estimated tsunami wave arrival times following the earthquake and either detailed, localized tsunami amplitude and inundation or current velocity (wave speed) for the coastal areas along the central Washington coast from the Hoh Tribal Reservation southward to Ocean City. Each video is sped up to show the wave action of the tsunami over a period of several modeled hours in minutes.

In the videos, for areas over bodies of water, wave amplitude is shown over a range from 10 feet or lower (for wave troughs) to 10 feet or higher (for wave peaks). For areas over land, tsunami inundation is shown from a range of 0 feet to 10 feet or higher. Additionally, wave speeds are shown in nautical miles per hour (knots). One knot is about 1.2 miles per hour. These simulations use the model results from the Olympic Peninsula tsunami inundation and current velocity publication that came out in 2022: https://fortress.wa.gov/dnr/geologydata/tsunami_hazard_maps/ger_ms2022-01_tsunami_hazard_olympic_peninsula.zip.

For more detailed tsunami information in your area, refer to our tsunami hazard maps. Note that these videos are for informational purposes only and should not be used for site-specific decision-making. You can find the videos and additional information about the simulations on our tsunami webpage: https://www.dnr.wa.gov/programs-and-services/geology/geologic-hazards/tsunamis#tsunami-simulation-videos

Applying AI-Based Models to Predict Tsunamis

UNESCO News Story—October 17, 2023

How can AI-based models help predict tsunamis and their potential impacts? We interviewed Usama Kadri, Researcher of Applied Mathematics at the University of Cardiff (United Kingdom) to discuss the challenges of developing AI-based models for tsunami prediction, early warnings and preparedness, looking at the importance of collecting the right data and ensuring computational efficiency.

Kadri shares his visions for the future of tsunami prediction, highlighting the role of AI alongside traditional methods, and talks about his collaboration with UNESCO's Intergovernmental Oceanographic Commission (IOC/UNESCO), which has been supporting and facilitating his and other relevant research on tsunami early warning science and technology.

IOC/UNESCO: Can you briefly explain how you went about developing a tsunami prediction model based on AI? How does it differ from traditional approaches?

Usama Kadri: Traditional approaches present various challenges, advantages, and disadvantages. Existing warning systems rely on DART-buoys and seismic measurements. DART-buoys accurately measure tsunamis upon their arrival but offer limited warning time, high costs, and maintenance difficulties. Seismometers promptly detect earthquakes but struggle to provide reliable tsunami measurements, leading to false alarms or even false negatives. Numerical models require extensive processing time and are mostly used for post-processing, whereas pre-calculated probabilistic models carry a high risk of false negatives.

Our approach complements current technology by analysing sound signals recorded by underwater hydrophones. These signals travel much faster than tsunamis, carrying information of the source. We have developed two independent models: an AI model and an Analytical model. The AI model analyses streamed sound signals, determining earthquake type and magnitude to predict tsunami generation in a fraction of a second. The Analytical model evaluates the signals in real-time, inversely assessing water layer properties and calculating tsunami size globally. Combining the two models with traditional approaches increases confidence in the assessment process and enhances the overall warning system reliability.

Tsunami prediction is a complex and critical task. What are some of the main challenges you faced while developing the AI-based model, and how did you overcome them?

For the AI-based model, one major challenge is the limited amount of data available for large magnitude earthquakes. To overcome this, we used the available data and trained the AI model with a conservative approach for larger earthquakes. To enhance the accuracy of the predictions further, we are currently working on incorporating tens of thousands of historical data to be validated against known tsunamis. On the other hand, there is a need to assess the tsunami size on large coastal areas in real-time. To overcome the costly computations, we solved the mathematical problems analytically, making a breakthrough in the computation approach. For example, assessing the tsunami size on all coastlines associated with the 2004 Sumatra earthquake takes less than half a minute of signal analysis on a standard multicore station PC.

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How do you envision the future of tsunami prediction? Do you believe that AI will play a more significant role in enhancing our ability to forecast and mitigate the impact of tsunamis? If so, how?

AI models can provide more accurate and timely warnings, reducing false alarms and improving response measures, there is no doubt about that. However, training an AI model properly requires a deep understanding of the tsunami generation and propagation mechanisms which could be very challenging, and requires continuous research and analytical model development. In addition, to optimise the alarm system and minimise potential risks, we need to adapt a complementary approach that integrates AI with independent models, e.g., analytical, alongside traditional approaches. The Intergovernmental Oceanographic Commission (IOC) of UNESCO plays a key role in promoting international cooperation around tsunami early warnings and preparedness.

How do you see the role of organizations like the IOC in supporting experts like you in testing and mainstreaming AI-based tsunami prediction models?

A few years ago, I presented some initial findings about our real-time warning technology at a conference. It was there that I met Bernardo Aliaga, who leads the Tsunami Resilience Section at IOC/UNESCO. Aliaga was impressed by our technology and our global warning approach. Thanks to him, we decided to take the technology to the next level and make it fully operational. Since then, Aliaga and his colleagues at UNESCO have been incredibly supportive, and we have formed a special partnership. This partnership is important because it gives us a platform to collaborate and discuss the different stages of our technology with tsunami experts. It also facilitates access to real-time data, which would allow us to test the technology in real operational environments. Through its IOC, UNESCO has been liaising with Tsunami Warning Centres to host our latest operational software as a pilot for global real-time tsunami warning. Overall, UNESCO's role is vital in fostering cooperation, advancing technology, and promoting the use of state-of-the-art Tsunami models to enhance global tsunami preparedness and response efforts.

In addition to your research, what other initiatives or collaborations are you involved in to raise awareness about tsunami prediction and enhance public safety? How important is it to educate and engage communities in high-risk areas about the potential dangers and preparedness measures for tsunamis?

I am actively engaged in various initiatives and outreach activities to increase awareness about tsunami prediction and mitigation, with the goal of enhancing public safety. It is crucial to engage and educate the public to ensure the preparedness and safety of communities, not only in regions prone to tsunamis but also globally. The 2004 Sumatra tsunami serves as an example, where many of the victims were tourists from regions with low tsunami risk. This highlights the importance of global awareness for effective preparedness and response efforts. Higher education plays a significant role in fostering this awareness. To contribute to this cause, I am actively involved in a new initiative led by the University for Education for Sustainable Development. This initiative aims at raising awareness among our colleagues and redesigning teaching curricula to include UNESCO's Sustainable Development Goals (SDGs). By incorporating the SDGs into education, we can promote a broader understanding of the importance of tsunami preparedness and mitigation.

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In the future, I personally aspire to collaborate closely with local communities residing in high-risk areas to gain more insights into their specific challenges and needs. I plan to take part in conducting more workshops, organising awareness campaigns, and providing resources to assist these communities in understanding the significance of early warnings, developing optimised evacuation plans, and building resilient infrastructure. Through these efforts, we can empower communities to take proactive measures and protect themselves from the devastating impact of tsunamis.

As a senior lecturer and researcher, what advice would you give to aspiring scientists who are interested in working on AI-based models for natural disaster prediction? What about advice for young high school students trying to decide a field of study?

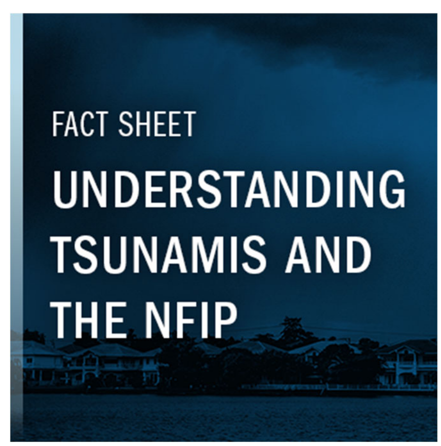
My advice for aspiring scientists interested in working on AI-based models for natural disaster prediction is to focus on interdisciplinary studies. It is important to have a strong foundation in both the scientific field you are interested in and the relevant AI techniques. Collaboration with experts from different disciplines, such as oceanography, acoustics, geology, seismology, mathematics and computer science, can provide valuable insights and expertise. For high school students, I would encourage them to explore their passion for science and consider the impact they can make in fields related to natural disaster prediction and mitigation. It's an exciting and important area that requires a lot of dedication, continuous learning, and the desire to contribute to the well-being of society.

Link to original article: https://www.unesco.org/en/articles/applying-ai-based-models-predict-tsunamis

Understanding Tsunamis and the NFIP Fact Sheet

By FEMA National Flood Insurance Program (NFIP)*

Tsunamis can be highly destructive to life and property. Use this fact sheet to learn about flood insurance coverage for tsunami damage and how the NFIP can jumpstart recovery.



Fact Sheet Includes:

- What is a Tsunami?
- Tsunami Conditions
- Does the NFIP Cover Damage Caused by Tsunamis?
- Related Resources

Link to publication: https://agents.floodsmart.gov/understanding-tsunamis

* The National Flood Insurance Program (NFIP) works to educate the public about tsunamis, including their risk of flooding, warning signs and coverage under a flood insurance policy

TSUNAMI RESEARCH & EVENTS

RESEARCH

TITLE: A Multifault Earthquake Threat for the Seattle Metropolitan Region Revealed by Mass Tree Mortality

CITATION: Black, B. A.; Pearl, J. K.; Pearson, C. L.; Pringle, P. T.; Frank, D. C.; Page, M. T.; Buckley, B. M.; Cook, E. R.; Harley, G. L.; King, K. J.; Hughes, J. F.; Reynolds, D. J.; Sherrod, B. L., 2023, A multifault earthquake threat for the Seattle metropolitan region revealed by mass tree mortality: Science Advances, v. 9, no. 39, 9 p., https://doi.org/10.1126/sciadv.adh4973.

ABSTRACT: Compound earthquakes involving simultaneous ruptures along multiple faults often define a region's upper threshold of maximum magnitude. Yet, the potential for linked faulting remains poorly understood given the infrequency of these events in the historic era. Geological records provide longer perspectives, although temporal uncertainties are too broad to clearly pinpoint single multifault events. Here, we use dendrochronological dating and a cosmogenic radiation pulse to constrain the death dates of earthquake-killed trees along two adjacent fault zones near Seattle, Washington to within a 6-month period between the 923 and 924 CE growing seasons. Our narrow constraints conclusively show linked rupturing that occurred either as a single composite earthquake of estimated magnitude 7.8 or as a closely spaced double earthquake sequence with estimated magnitudes of 7.5 and 7.3. These scenarios, which are not recognized in current hazard models, increase the maximum earthquake size needed for seismic preparedness and engineering design within the Puget Sound region of >4 million residents.

UPCOMING NTHMP & RELATED EVENTS

- November 5, 2023—World Tsunami Awareness Day
  https://tsunamiday.undrr.org/
- December 11-15, 2023—AGU Fall Meeting (San Francisco, CA)
  https://www.agu.org/fall-meeting
- March 21, 2024—CARIBE WAVE 24 Tsunami Exercise
  https://www.weather.gov/itic-car/caribewave24
- April 29-May 3, 2024—Seismological Society of America Meeting (Anchorage, AK)
  https://meetings.seismosoc.org/