



2015

Authored by National Tsunami
Hazard Mitigation Program
Coordinating Committee Members
January 2016

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

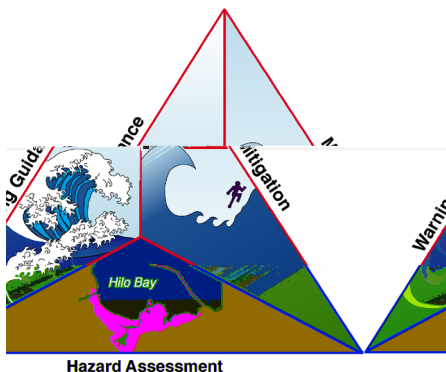


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The National Tsunami Hazard Mitigation Program (NTHMP) works to protect lives and reduce economic losses from tsunamis at the community level. The NTHMP includes the National Oceanic and Atmospheric Administration, the Federal Emergency Management Agency, the U.S. Geological Survey, and 28 U.S. states and territories. Through collaboration, coordination, and support to partner states and territories, the NTHMP focuses on three key functions: hazard assessment, warning guidance, and mitigation.

Calendar year 2015 was a busy and active year for the NTHMP. This annual report was informally produced to highlight some of the NTHMP's 2015 activities. It is a compilation of submissions from the NTHMP's three subcommittees and partner states and territories.

Input provided by the following state and territorial agencies and institutions:

- Alaska Division of Homeland Security and Emergency Management/University of Alaska Fairbanks
Alaska Earthquake Center/Alaska Division of Geological and Geophysical Surveys
- American Samoa Territorial Emergency Management Coordination
- California Governor's Office of Emergency Services/California Geological Survey
- Guam Homeland Security
- Hawaii Emergency Management Agency/University of Hawaii
- Oregon Office of Emergency Management/Oregon Department of Geology and Mineral Industries
- Puerto Rico Emergency Management Agency/University of Puerto Rico Puerto Rico Seismic Network
- Texas A&M University at Galveston (Gulf Coast)
- University of Delaware/University of Rhode Island (East Coast)
- U.S. Virgin Islands Territorial Emergency Management Agency
- Washington Emergency Management Division/Washington State Department of Natural Resources

<http://nws.weather.gov/nthmp/index.html>

National Tsunami Hazard Mitigation Program (NTHMP)

General Updates

Meetings

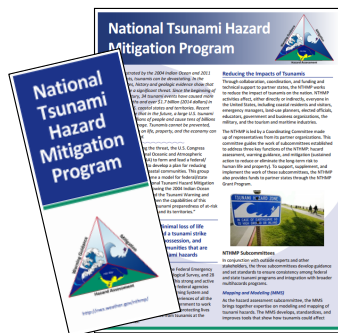
Annual Meeting

The NTHMP Annual Meeting, a preceding benchmarking workshop, and subcommittee meetings were held in Portland, Oregon, February 9–13. Eighty-three (83) people participated in these meetings throughout the week. A full accounting and reports from these meetings are available at <http://nws.weather.gov/nthmp/2015annualmeeting/index.html>.

Summer Subcommittee Meetings

The NTHMP Mitigation & Education Subcommittee (23 attendees) met July 13–15 and the Mapping and Modeling Subcommittee (19 attendees) met July 14–16. Both of these meetings were hosted in the California State Office Building in San Diego, California. A full accounting and reports from these meetings are available at <http://nws.weather.gov/nthmp/2015mesmms/index.html>.

Publications



NTHMP Fact Sheet: A two-page updated description of the NTHMP was created and published in March. The dedicated web page on the NTHMP website receives more directed visits by search engines than any other page on the website. It is available as a two-pager and a trifold brochure at http://nws.weather.gov/nthmp/about_program.html.

What Is a Meteotsunami? Fact Sheet: At the request and urging of the Mitigation & Education Subcommittee, a fact sheet describing the meteotsunami phenomenon was created, reviewed,

and published. The two-pager is available at <http://nws.weather.gov/nthmp/meteotsunamis.html>.

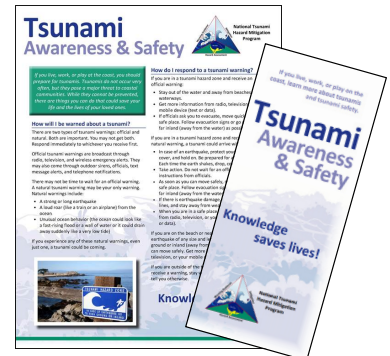


Safer U.S. Shores—NTHMP Grant Investment Activities Report FY08-FY15:

This report, culminating over two years of research on grant investments awarded to NTHMP partners during Federal Fiscal Years 2008 through 2015, was released in December. It answers frequent questions from constituents and Congress on “what have NTHMP partners done to extend tsunami preparedness, mitigation, mapping, and warning capabilities with grant funds?” It is available at <http://nws.weather.gov/nthmp/grants/iareport.html>.

Tsunami Awareness and Safety Fact Sheet: A two-page fact sheet that provides tsunami safety

information using the latest social science-based safety information was updated and released in December. This fact sheet can be imprinted with logos and contact information, printed, and distributed by anyone wishing to inform others about tsunami safety. It is available as a two-pager and a trifold brochure at <http://nws.weather.gov/nthmp/tsunamisafety.html>.





TsuInfo Alert newsletter (six issues): *TsuInfo Alert* is a bimonthly newsletter produced for the NTHMP with NTHMP grant funds by the Washington Department of Natural Resources. It describes current work by NTHMP partners, showcases interesting reports and information, and provides links to current tsunami research. Current and past issues are available for free at <http://www.dnr.wa.gov/programs-and-services/geology/geologic-hazards/tsunamis/tsuinfo-alert>.

Grants

For the Fiscal Year 2015 grant cycle (September 1, 2015–August 31, 2017), NOAA's National Weather Service awarded a total of \$5,185,757 to 11 NTHMP partners to meet critical tsunami capabilities within the scope of the NTHMP Strategic Plan. More information on the grant-funded activities is available at <http://nws.weather.gov/nthmp/2015grant/index.html>.

Administration

The NTHMP Coordinating Committee welcomed replacement members of the NTHMP Coordinating Committee:

- Mona Barnes, Emergency Management representative for the U.S. Virgin Islands
- Ann Gravier, Emergency Management representative for Alaska
- Elinor Lutu-McMoore, Science representative for American Samoa
- Chayne Sparagowski, Emergency Management representative for the Gulf Coast

Also, Dmitry Nicolsky was appointed the State Co-Chair of the Mapping and Modeling Subcommittee.

The NTHMP was ably led by Chair Aimee Devaris, National Weather Service Alaska Region Director. Ms. Devaris left the National Weather Service at the end of November. Dr. Grant Cooper was appointed as NTHMP Chair in her place. Read more about Dr. Cooper here:

<http://nws.weather.gov/nthmp/chair.html>.

Major Actions

Production of materials is described above.

In July, the NTHMP updated its Rules of Procedure, which serve as the organization's by-laws. The updates allow for the appointment of official alternates for Coordinating Committee members and make changes to the governance of NTHMP grants. The updated Rules of Procedure are available at <http://nws.weather.gov/nthmp/documents/NTHMPRulesofProcedure.pdf>.

Also in July, the NTHMP voted unanimously to approve the revised TsunamiReady Guidelines after four years of social science research translated into workable and functional activities aligned with emergency management principles. More information about the revised guidelines is available on the TsunamiReady website at <http://www.tsunamiready.noaa.gov/>.

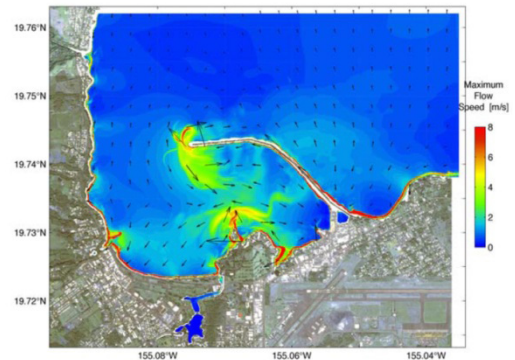


Mapping and Modeling Subcommittee (MMS)

2015 Accomplishments

- **NTHMP/MMS Modeling Benchmarking Workshop: Tsunami Currents**

To verify the accuracy/adequacy of tsunami models to produce accurate and consistent maritime and other hazard reduction products for use by NOAA and NTHMP partners to help, the MMS facilitated and organized the benchmarking “Tsunami Currents” workshop in Portland, Oregon, February 9-10, 2015. About 16 different tsunami models were presented and evaluated. The workshop summary is currently being developed. It is anticipated that the workshop will help MMS to establish the appropriate guidelines for the development of the maritime products.

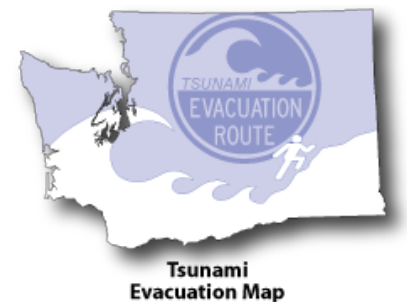


- **Development of Maritime Planning and Preparedness Guidelines**

To address the minimum requirements to develop consistent and reliable tsunami preparedness products for maritime communities the MMS have been actively working to formulate Tsunami Hazard Analysis, Modeling, and Mapping guidelines. In particular, a significant effort is applied to develop guidance for the minimum offshore safe depths for maritime vessel evacuation prior to the arrival of the tsunami. Other guidelines are pending and need to be established together with the MES and WCS.

- **Development of tsunami inundation & evacuation maps, including GIS products**

The MMS actively worked on collecting the potential tsunami inundation and evacuation maps from different states and territories. The developed dataset will help various states and federal agencies to access data in the unified and consistent way.



- **Support of the Digital Elevation Model Development via National Center For Environmental Information**

The tsunami DEMs is the cornerstone of all modeling activities, without them any development of accurate tsunami hazard assessment products would be significantly impeded. In FY15, MMS supported DEM development priorities for Kodiak Island (AK), Pensacola (FL), Orange County (CA), Regional Puerto Rico Trench (PR), while for FY16 the following list of DEMs priorities is established: Larsen Bay, Port Lions, False Pass (AK), Key Largo (FL), and Destin (FL).

- **Updates to the MMS website now include**

- The NTHMP Tsunami Inundation Model Approval Process
- A Laymen’s Tsunami Model Summary Sheet
- Organized Tsunami GIS products

- **Preparation for the NTHMP-USGS workshop in Boulder, Denver**

Mitigation and Education Subcommittee (MES)

2015 Accomplishments

- **Convened Annual Meeting in Portland, OR. Agenda included:**

- MES Return of Investment Report
- TsunamiReady Status Update
- Evacuation Guidelines Update
- FEMA Risk MAP Resilience process
- Education & Outreach Plan Activities
- Maritime Tsunami Mapping Update
- Cascadia Subduction Zone Exercise 2016
- FY15 Strategies & FY14 Achievements



- **Conducted May 27, 2015 Business Meeting**

- HAZUS for Tsunami Update
- MES Summer meeting overview
- ITIC Update 50th Anniversary of International Tsunami Warning System in the Pacific
- Post-tsunamis protocols and tsunami observer programs

- **Convened Summer Meeting in San Diego, CA. Agenda included:**

- TsunamiReady
 - › Approved 2 reps to be on National TsunamiReady Board: Alaska and Hawaii
 - › Approved Tier 1 and Tier 2 guidelines
 - › Agreed to finalize grandfathering
- Developed framework for evacuation planning options for communities and discussed among membership
- Formed Work Groups
 - › Outreach/Social Media
 - › Tsunami Awareness Safety Fact Sheet
 - › Evacuation/Inundation Maps online
 - › Maritime Planning

- **Conducted December 8, 2015 Business Meeting**

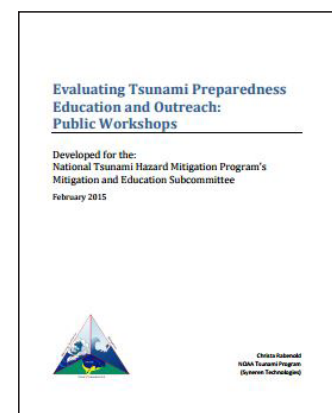
- Approved update to Terms of Reference
- Appointed representative to TsuInfo Editorial Review Board
- Reviewed 2016 Annual Meeting MES Agenda
- Reported on updates to HAZUS Tsunami Module and Vertical Evacuation P646

- **Reviewed grant reports for member states and territories**

- FY13 Progress Reports (April, November)
- FY14 Progress Reports (April, November)
- FY15 Applications (February, March)

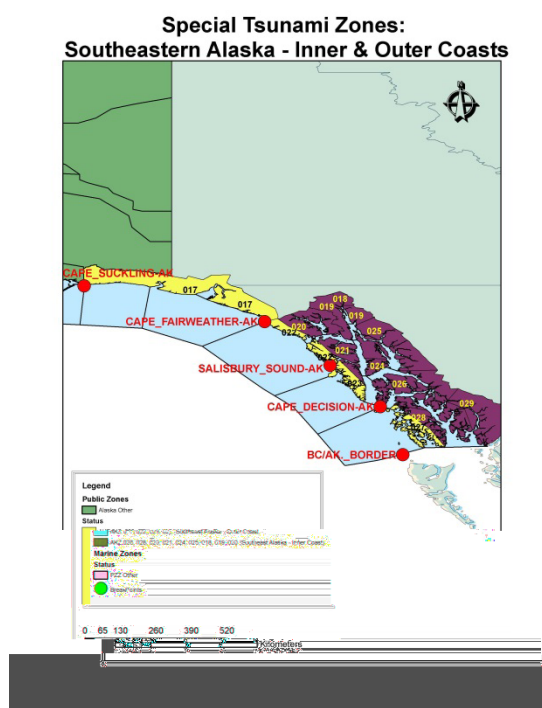
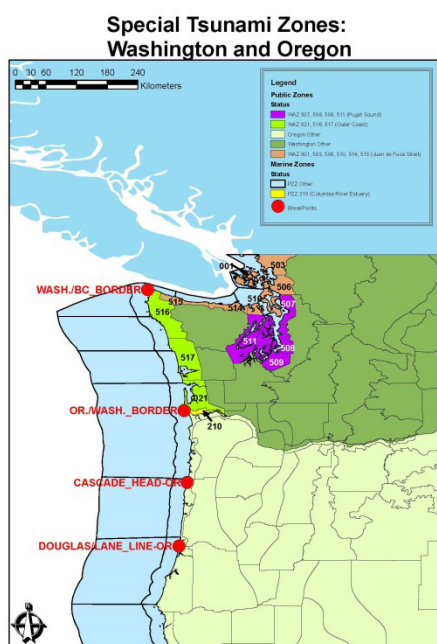
- **Produced NTHMP-wide and MES-specific publications**

- Evaluating Tsunami Preparedness Education and Outreach: Public Workshops
- NTHMP Fact Sheet
- Meteotsunami Fact Sheet
- Tsunami Awareness and Safety Fact Sheet



Warning Coordination Subcommittee (WCS) 2015 Accomplishments

- Implementation of updated NWS tsunami alert messages based on input from the NOAA Social Science study of TWC messages and the NTHMP Complex Coast Team.
 - NWS service change notice issued in October with an implementation date of November 30, 2015.
 - Fact sheet and graphics with new zones issued in mid-November.
 - Example zonation for Southeast Alaska, Washington, and Oregon shown to the right.
- NWS Weather Forecast Offices in the Western and Alaska Regions implemented Auto-Emergency Alert System (EAS) activation software to improve translation speed of TWC messages.
- Wireless Emergency Alert activation zones (polygons) have been defined for southern California to help limit the automatic cell phone activation. Work still needs to be accomplished at NWS HQ for full implementation.
- Conducted three national tsunami exercises: Pacifex, Lantex, and CaribeWave. Many constituents participated in the drills.
- Conducted several end-to-end communication tests which exercised the NOAA Weather Radio, EAS, and other local tsunami alert devices.
- Supported state partner efforts related to tsunami warning exercises, drills, communication tests, and tsunami alert reception and local dissemination.

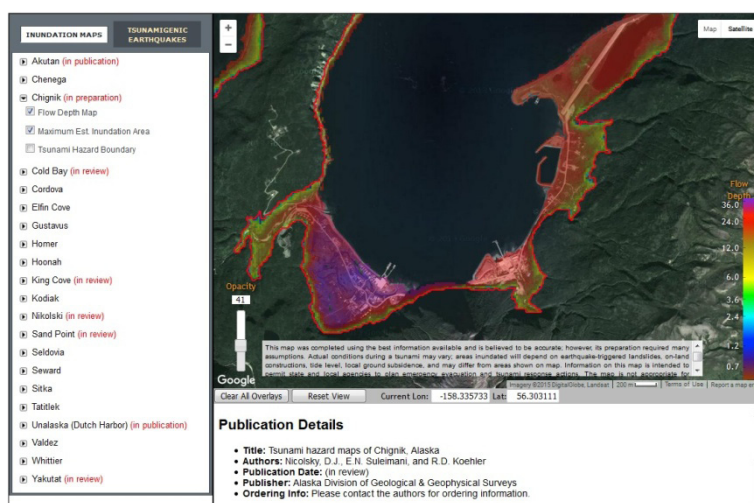


Alaska 2015 Accomplishments

Alaska experienced major destructive tsunamis in 1938, 1946, 1957, and 1964, and has over 60 communities at risk of future near- and far-field tsunamis. The Alaska tsunami hazard is essentially near-field. A near-field tsunami can reach Alaskan coastal communities within minutes after the associated earthquake. Therefore, saving lives and property depends on community preparedness, which is achieved through maps, mitigation, and education. To mitigate this risk, Alaskans need to understand tsunami hazards for their coastal communities through hazard assessment (mapping), scenario planning, mitigation tools and broad education in support of the TsunamiReady program.

• Scenario planning and tsunami hazard assessment:

- High-resolution tsunami inundation modeling and mapping was accomplished for Cold Bay, Chignik Bay, Chignik Lagoon, King Cove, Yakutat and Nikolski. Tsunami hazard assessment reports for Elfin Cove, Gustavus and Hoonah were published, while products for Akutan and Unalaska were prepared and are expected to be published in 2016.
- Development of an “approximation to potential inundation zones” product was completed for communities in Kodiak, the Aleutians and Southcentral Alaska. Preliminary tsunami hazard maps for Adak, Akhiok, Atka, Chiniak, False Pass, Karluk, Larsen Bay, Old Harbor, Ouzinkie, Perryville, Port Lions, and Shemya were completed for review.



A web-page <http://maps.dggs.alaska.gov/tsunami/> publicizing tsunami hazard assessments for all tsunami hazard communities

• Mitigation and Education:

- Pedestrian evacuation travel time maps “from the tsunami hazard to safety” were completed for the communities of Chignik Bay, Homer, King Cove and Unalaska.
- Evacuation brochures were developed for the communities of Chenega and Tatitlek.
- The National Disaster Preparedness Center’s AWR-217 Tsunami Awareness course was delivered in 3 communities of Valdez, Homer and Seward. Two new Alaska instructors were trained and are available to support future course deliveries.

• TsunamiReady:

Work with the NTHMP and NOAA’s NWS Weather Forecast Offices in Alaska in promoting the TsunamiReady program.

- Craig & Ketchikan was recognized as TsunamiReady
- Tsunami signage was installed in Chenega & Tatitlek
- Tsunami siren warning system was installed in Chenega



American Samoa 2015 Accomplishments

- **TsunamiReady renewed (2015-2018)**

- **Two (2) Samoa Annual Meeting**

This meeting was developed for the Emergency Management Offices, Weather Offices, & Ozone Monitoring Offices of Independent Samoa & American Samoa to come to a mutual understanding & share data on several weather & tsunami terminologies & thresholds

- 04/20-05/01: 11th Post-Tropical Cyclone Season & 6th Disaster Management (Earthquake/Tsunami), & 2nd Ozone Monitoring Coordination Meetings
- 10/22-10/23: 12th Pre-Tropical Cyclone Season & 7th Disaster Management (Earthquake/Tsunami), & 3rd Ozone Monitoring Coordination Meetings



- **Shake Out Exercise**

- Registered the most participants since American Samoa joined the worldwide Shake Out (20,000 plus were registered out of a 60,000 plus population).
- Outreach to schools & several agencies on the Drop, Cover, & Hold On procedure as well as basic earthquake & tsunami information

- **Tsunami Preparedness Week (9/23/2015-9/30/2015)**

- Pre-exercise Meeting & Training for Tabletop Exercise
- Tsunami Tabletop Exercise
 - › Participation from key partners including PTWC & ITIC
 - › Assessed tsunami evacuation plans for each participating agency using several injects on probable local & regional tsunami events
 - › Shared tsunami inundation models including data from the 2009 tsunami & the Probable Maximum Tsunami (PMT)
 - › Described tsunami products developed by PTWC & utilized by WSO Pago Pago & ASDHS
 - › Found inconsistencies in communication between WSO Pago Pago & PTWC via Hotline & Online
- Then & Now: Tour of villages that were affected by the tsunami in 2009
- Passed out tsunami information & Shake Out flyers at the local shopping center, market place, schools, airport, & American Samoa Government (ASG) Offices
- Memorial in Leone for the 2009 tsunami & presentation of TsunamiReady Certificate



- **Tsunami Evacuation Drills**

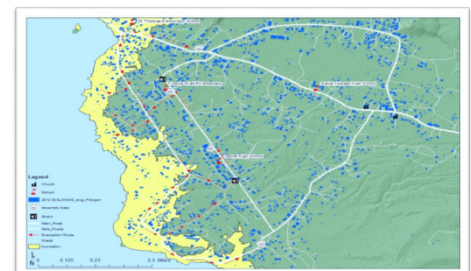
- Schools & Private Sectors (ie, Star Kist Company)

- **Erection of Tsunami Signs & Updated Tsunami Assembly Areas (to include Inundation maps) for Tutuila, Manu'a, & Aunu'u Islands**

- **Updated evacuation maps on ArcMap GIS based on new tsunami inundation model**

- **Workshop & Training**

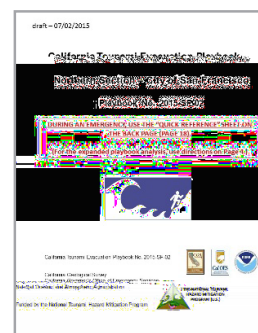
- Island Wide Outreach—Schools, villages, & churches
- Media—Educated the media on weather terminologies, climate data, & procedures put out by WSO Pago Pago, ASDHS & PTWC
- Village Mayors (Pulenu'us)
- EOC
- Different agencies (All islands)



California 2015 Accomplishments

- Tsunami Preparedness Week was observed March 22-28, 2015. The following is a selection of activities:**

- Several months of planning coordinated among state, local, and federal partners between January and March
- Call-down drill to test FASTER/Playbook statewide information exchange during response
- Tsunami Warning Communications Test (Eureka NWS Weather Forecast Office area of responsibility)
- Required Monthly Test (Monterey, Oxnard, and San Diego NWS Weather Forecast Office areas of responsibility)
- Community support for PACIFEX15 for exercises via NTWC
- Gubernatorial Proclamation
- State support of local activities
 - › County Boards of Supervisors' Proclamations
 - › Tsunami Walk/Run public evacuation drills
 - › Promotion & Registration of activities at www.TsunamiZone.org
 - › Participation in Pacific-wide exercise scenarios
 - › Test activation of sirens, TV messaging, coastal airplane flights
 - › Provision of educational materials and warning signs
 - › Workshops, presentations, and media events



- California Tsunami Evacuation Playbooks**

- Completed draft Playbook FAQs
- Held first statewide communication test for Playbooks/FASTER approach
- Multiple counties held exercises for Playbooks/FASTER approach information
- Completed draft Playbooks for Del Norte, Los Angeles, San Francisco, and Alameda counties
- Worked with NWS-WFO Monterey to compute FASTER in real-time

- Maritime Tsunami Response and Mitigation Planning**

- Took part in national current model validation workshop and made changes to Playbook maps
- Finalized modeling for all harbors and ports, analyzing and expanding the scenarios modeled
- Completed first FAQs for Maritime Playbooks
- Held first maritime workshop for Marina Del Rey and King Harbor (Los Angeles County)
- Completed Maritime Response Playbooks for ALL 70+ at-risk harbors and ports in California

- New Inundation maps**

- Completed for previously unmapped portions of Sonoma and Mendocino Counties

- Probabilistic Tsunami Hazard Analysis (PTHA) maps**

- Conducted field work and review to finalize maps for San Diego, Orange, Los Angeles, Ventura, Humboldt, Del Norte counties

- Policy, Land-Use, and Recovery Group**

- Convened to begin to follow up on 46 policy recommendations stemming from 2013 California Tsunami Policy Work Group project and report



East Coast 2015 Accomplishments

Modeling Tsunami Inundation and Hazard for the U. S. East Coast

- Completion of draft inundation maps for targeted portions of US East Coast from Georgia to Massachusetts. Draft reports and maps are available for inspection and comment at http://www.udel.edu/kirby/nthmp_protect.html (Figure 1).
- Completed studies of effect of tidal currents on tsunami inundation in Hudson River and Chesapeake Bay near Norfolk, VA. Results show that effects can vary from site to site, indicating potential need for further study. (Figure 3)
- As part of an ongoing study of methods for providing inundation estimates for unmapped areas, we have completed a study of the effect that continental shelf geometry has on controlling the distribution of tsunami wave heights, and have shown that this control is dominant enough to make inundation fairly independent of source location. It establishes a framework for interpreting inundation in comparison to estimates from storm surge studies (Figure 2).
- As part of an effort to refine source configurations, we have completed a study of potential slide events on the Grand Bahama Banks, and are using these results in order to complete initial inundation mapping for Florida communities.
- We have started identifying and preparing benchmark cases for the landslide tsunami model validation workshop to be held in the summer of 2016. Tests will consist primarily of laboratory data sets on solid and granular slides, in both subaerial and submarine slide configurations. This work is also tied closely to ongoing NSF-supported work on model development and enhancement, aimed at improving the physical realism and numerical efficiency of slide/tsunami simulation.



Figure 1. Draft inundation map for Brooklyn, NY

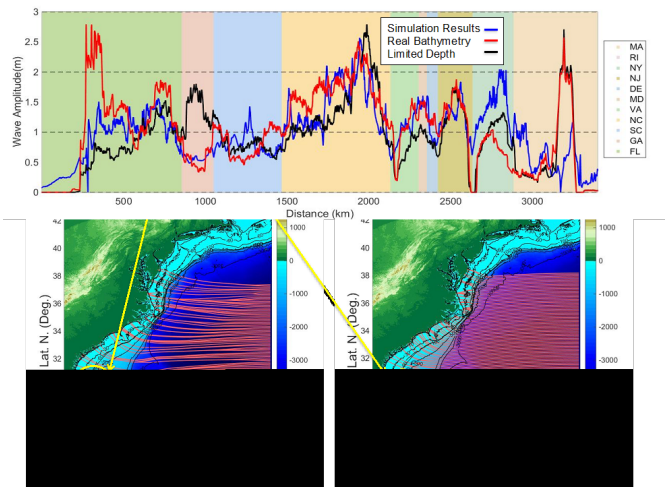


Figure 2. Comparison of model simulations and generic ray tracing estimates for wave height distribution along US East Coast

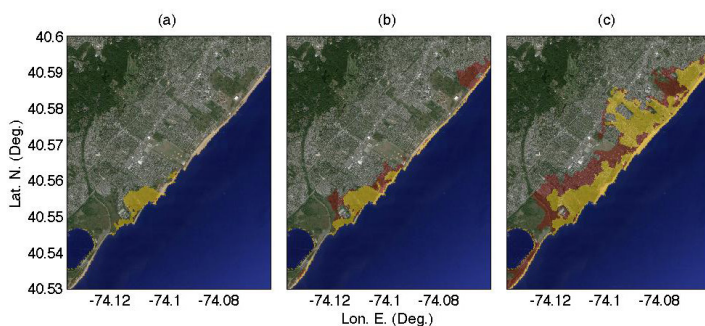


Figure 3. Comparison of inundation estimates on Staten Island for static (yellow) and dynamic (red) tsunami/tide interaction for three modeled tsunami sources

Guam 2015 Accomplishments



- Printing of Updated Tsunami Evacuation Maps
- Printing of Updated TsunamiReady Cards
- Printing of Updated Tsunami Evacuation Wheels
- Printing of Tsunami Media Tool Kit

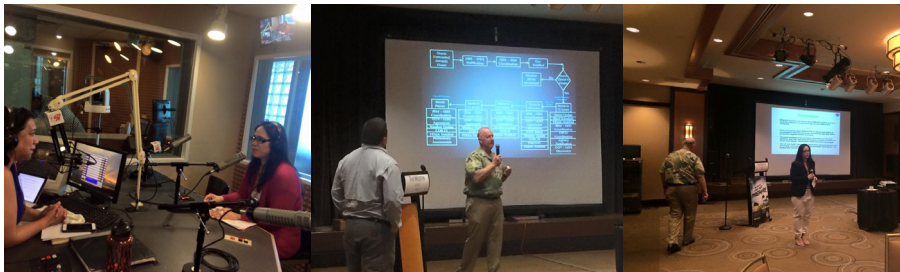
All materials distributed during 15 school presentations, 4 mall outreach events and 2 movie theater event. Also distributed to Government of Guam Agencies and Guam Hotel & Restaurant Association.



- Promote Tsunami/Earthquake Awareness through Outreach and Education
- Tsunami/Earthquake Puppet Show



- Replaced several Tsunami Evacuation Route Signs throughout the Island.



- Presented a 1-hour seminar on Earthquakes & Tsunamis for 115 U.S. Coast Guard personnel.

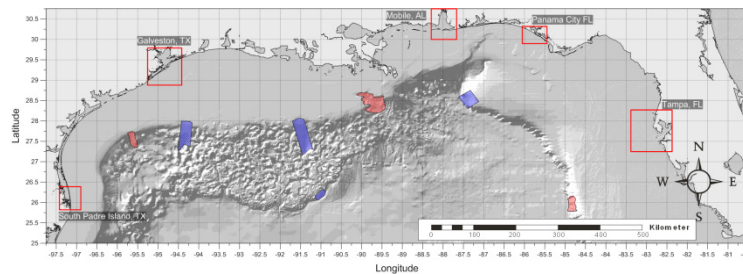
- Presented a 1-hour seminar on Earthquakes & Tsunamis for 125 U.S. Navy personnel.
- Incorporated additional graphics from the Guam Inundation Modeling study into tsunami modules.
- Coordinated Safe Distance for Boaters criteria with the USCG and assisted in developing its Comprehensive Response Plan for Guam and the CNMI.
- Provided Tsunami specific training for new management at Guam Homeland Security.
- Installation of the All Hazards Alert Warning System (Guam's Alert Notification Siren System).
- Be TsunamiReady, Guam Media Campaign on radio, television and movie theaters and outdoor billboards.
- Government of Guam EOC Workshop on Domestic Tsunami Products with PTWC and NWS-Guam.

Gulf of Mexico 2015 Accomplishments

Since FY08, the National Tsunami Hazard Mitigation Program (NTHMP) has provided grants to the Gulf of Mexico (GOM) states (through Texas A&M University at Galveston (TAMUG)) to identify the tsunami hazard to the Gulf Coast and mitigate its impact. Based on evidence of massive ancient landslides and continued emptying of sediments into the GOM mainly from the Mississippi River, a massive underwater landslide in the GOM is considered a potential hazard, although the probability of such an event is quite low.

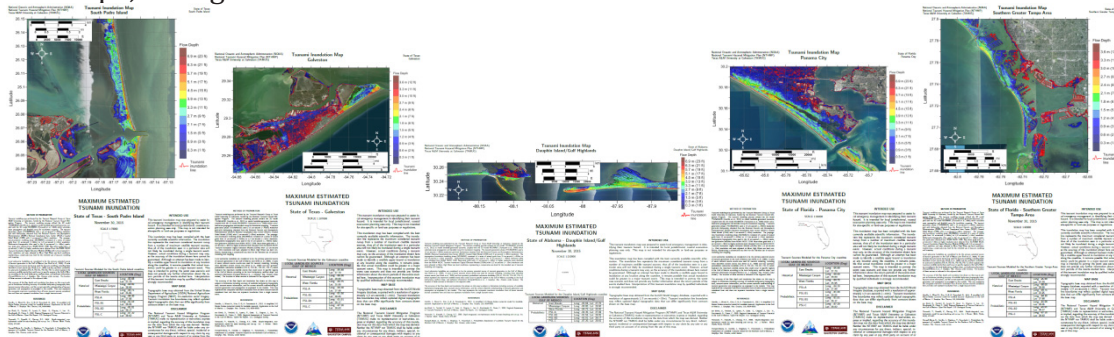
During the calendar year of 2015 the GOM group has:

- Developed 4 landslide tsunami sources using a novel probabilistic approach. These sources, along with 3 identified historical sources, increase the number of potential tsunami scenarios within the GOM to 7, covering most of the northern GOM basin:



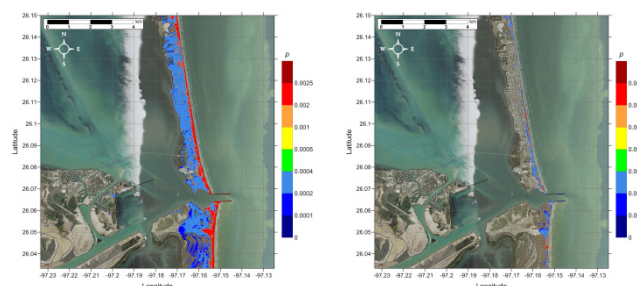
Northern GOM domain and bathymetry used to obtain detailed tsunami runup and inundation extent at five selected Gulf Coast communities. Hatched red regions: historical submarine landslides (3); hatched blue regions: probabilistic submarine landslides (4). Red rectangles along coastline indicate regions where tsunami inundation maps have been developed.

- Developed maps of tsunami inundation (flow depth) for five communities along the GOM coast, including South Padre Island, TX; Galveston, TX; greater Mobile, AL region; Panama City, FL; and greater Tampa, FL region:



Tsunami inundation maps for South Padre Island, TX; Galveston, TX; Mobile, AL region; Panama City, FL; and Tampa, FL region.

- Executed a pilot study to determine the annual exceedance rates above certain tsunami inundation threshold levels for South Padre Island, TX:



Probability of tsunami inundation exceeding 2m (~6.6ft) and 4m (~13.1ft), respectively, in South Padre Island, TX.

Hawaii 2015 Accomplishments

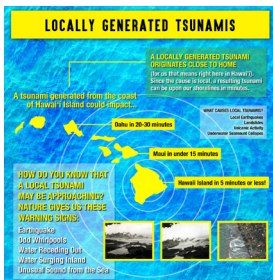
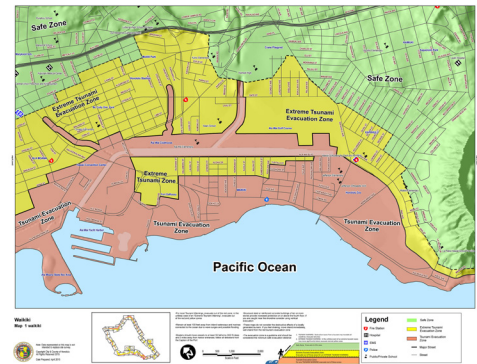
Hawaii Emergency Management Agency (HI-EMA) worked diligently to support local efforts to enhance tsunami awareness and preparedness throughout the state in 2015.



HI-EMA proudly supported the community of Waimanalo on Oahu's Windward coast as the National Oceanic and Atmospheric Administration (NOAA) recognized them for earning their TsunamiReady community designation in May. The community had to demonstrate that it had: a 24-hour warning point and emergency operations center (at the City & County and State); multiple ways to receive severe weather warnings

and forecasts along with multiple methods for alerting the public; a system to monitor local weather conditions; held community seminars to promote readiness; and, developed a formal hazardous weather plan.

In July, HI-EMA collaborated with the Honolulu City & County Department of Emergency Management (DEM) to unveil the newly created Extreme Tsunami Evacuation Zone maps for the island of Oahu. The maps add a second zone to previously existing maps that show evacuation zones should a magnitude-9.0 or larger earthquake occur in the Aleutian Islands, generating a destructive tsunami on a path toward Hawaii. The maps enable both residents and visitors to develop or adjust disaster plans, learn about potential hazards in Hawaii, and increase disaster preparedness.



The Pacific Tsunami Museum, located on Hawaii Island, unveiled its brand new Tsunami Safety Wall exhibit in August with the assistance and support of HI-EMA. In addition to illustrating the differences between locally generated and distant tsunamis, the wall also shows visitors to the museum how to prepare before a tsunami approaches, take action once a tsunami warning is issued, and stay informed and calm after a tsunami strikes (Pictured is an example of one of the panels displayed along the wall).

In October, HI-EMA spearheaded a campaign to promote the Great Hawaii ShakeOut annual earthquake drill. In Hawaii, earthquakes can cause locally generated tsunamis, which is one of our state's greatest natural threats. In a partnership with the State Department of Education, all students practiced the proper "Drop, Cover and Hold On" technique to protect themselves from the effects of an earthquake. Schools located within a Tsunami Evacuation Zone followed the earthquake drill with a campus wide evacuation to their designated safety zones. More than 244,000 people participated in the drill statewide.



Oregon 2015 Accomplishments

- **Tsunami Evacuation Wayfinding:** To maximize survivability in a tsunami, it is imperative that escape routes are clearly marked no matter the time or conditions. Oregon's Office of Emergency Management (OEM) and the Portland Urban Architecture Research Laboratory collaborated to seek new and innovative approaches for marking routes to high ground. A two phase report, "Up and Out" was produced (http://www.oregon.gov/OMD/OEM/Pages/plans_train/tsunamis.aspx#Tsunami_Evacuation_Wayfinding) and is now being used as a framework for establishing wayfinding signage in communities on the Oregon coast.

- **Tsunami Evacuation Wayfinding signage:** Three communities received funding to install new tsunami evacuation signage to improve existing routes. Nearly one hundred new signs were installed in Clatsop County, Rockaway Beach and the city of Bandon. The photo depicts a "You are Here" tsunami evacuation sign installed in Bandon, on the southern Oregon coast. The sign indicates your current location, nearest evacuation routes, and distance to safety.



- **"Entering" and "Leaving Tsunami Hazard Zone" signs:** installed in a number of populated parts of the Oregon coast Highway 101 are being relocated to match FY 2009-2012 tsunami inundation modelling of the entire Oregon coast. Oregon's Department of Geology and Mineral Industries (DOGAMI) and the Oregon Department of Transportation (ODOT) are partnering on this effort and, in Phase 1, will see the installation of over 100 new signs on the northern Oregon coast. Initial efforts have sought to identify the new sign locations, and meet with ODOT regional staff to develop a plan for sign installation. ODOT will begin relocating and installing new signs early in 2016.
- **"Beat the Wave:"** DOGAMI released new "Beat the Wave" (BTW) modeling and evacuation route analysis for the communities of Seaside and Gearhart (<http://www.oregongeology.org/pubs/ofr/p-O-15-02.htm>). The report and maps will be a standard for evacuation route modeling and mapping for other Oregon coastal cities. These maps are critical for evaluating mitigation options such as evacuation route improvement, the establishment of wayfinding signage, land use planning actions, and vertical evacuation structures. A standardized, non-technical version of the Seaside/Gearhart map is nearly complete, and work is underway on BTW maps for Warrenton, Cannon Beach and Rockaway Beach.



- **Maritime guidance:** DOGAMI released port-specific maritime response guidance for distant source tsunami events for the Ports of Newport and Toledo. (see http://www.oregongeology.org/pubs/mtrg/MTRG-2015-OR-01_Newport-Toledo.pdf)
- **Modeling current velocities and eddies:** DOGAMI staff worked with the Virginia Institute of Marine Science to benchmark SCHISM (Semi-implicit Cross-scale Hydroscience Integrated System Model) as part of the Mapping and Modeling subcommittee efforts to benchmark tsunami models for modeling tsunami currents and eddies in ports and harbors.

Puerto Rico 2015 Accomplishments

Puerto Rico has been struck by 2 destructive tsunamis generated by local earthquakes in the past 150 years and tsunami modeling indicates that its entire coastline is threatened by this natural hazard. The overall goal of this project is to improve the readiness and to maintain the level of preparation for tsunamis in Puerto Rico. In the past year the accomplishments of Puerto Rico include but are not limited as follows:

- **Workshops and Training:**

- Four training workshops were held to train emergency personnel on TWC messages and tsunami response plans.
- Two conferences were organized to teach PR Tourist Company personnel (lifeguard organization) about tsunamis and response plans.
- A workshop was held for TsunamiReady communities press representatives as part of the Tsunami Media Kit sub task.
- A tsunami response training exercise was conducted in a resort as part of the Tsunami Exercise Lantex/Caribe Wave (Figure 1).



Figure 1. PREMA Director explaining tsunami to kids as part of the Lantex exercise

- **Maps and Modeling:**

- A pilot pedestrian analysis was compiled for the city of Mayaguez located in western Puerto Rico. The subsequent results were validated and are being used to improve the vulnerability profiles.
- A map with the tsunami elevation profiles, including the evacuation polygon, was compiled and is available online.
- An estimation of a modeled water depth was provided to help the maritime community.

- **Education and Outreach:**

- Close to ten thousand citizens were impacted, through conferences, open houses, meetings, workshops and trainings, more than one hundred news interviews were held.
- Several tsunami related materials were distributed, including fliers (22,000), coloring and cartoon booklets (3,800), safety rules card (5,100), media kits (60) and pencils (2000)
- More than One hundred thousand people were registered to participate in the tsunami Lantex/Caribe Wave.

- **TsunamiReady:**

- Fifteen TsunamiReady communities renewed their recognition status.
- Six thousands evacuation maps were distributed to the exposed population.
- Five EMWIN systems were upgraded and one hundred NOAA radios distributed.
- One hundred percent of participation of the Tsunami Focal Points in the NTWC monthly test.
- Eighty five Tsunami signs were installed including 18 poster size ones (Figure 2).
- A tsunami response plan template for hotels was created.



Figure 2. Tsunami signs installed at very visited beaches

U.S. Virgin Islands 2015 Accomplishments

The Virgin Islands Territorial Emergency Management Agency (VITEMA) held the first-ever **Tsunami Evacuation Drills** during National Tsunami Preparedness Week. For the first time public and private sector entities participated in a Caribbean region tsunami response exercise by testing their notification protocols and evacuation procedures including; the departments of Education, Finance, Labor, Human Services, the 31st Legislature of the Virgin Islands, the Supreme Court of the Virgin Islands, the Superior Court of the Virgin Islands, the Frederiksted Health Center, the American Red Cross of the Virgin Islands, West Indian



Co., Banco Popular of the Virgin Islands, First Bank, Crown Bay Marina, and Tropical Shipping. The Department of Education safely evacuated more than 2,000 students, teachers and school staff in five drills, which included crossing major roadways to reach designated safe zones.

In 2015, the Agency hired a **Tsunami Coordinator** to manage the US Virgin Islands Tsunami Readiness Program. In recent years, VITEMA has accelerated its effort to raise awareness and prepare the Territory for this no-notice event. These efforts allowed the Territory to achieve Tsunami-Ready status in 2014. A dedicated Tsunami Coordinator is instrumental in ensuring VITEMA continues its public education and outreach, to address high density high-risk coastal areas, to maximize tsunami grant funding and close gaps in planning for a tsunami incident.

During 2015, VITEMA began the work to establish the **Tsunami Maritime Preparedness Task Force** which will allow tsunami incident planning to encompass potential damage to the USVI's ports and harbors. Observations, research and protocols are needed to improve preparedness of the maritime community for the eventual tsunami. VITEMA obtained NTHMP grant funding to begin modeling and research to advance maritime community preparedness for the unpredictable impacts of tsunamis.

This year, VITEMA expanded its Tsunami Readiness Program to include **Water Island**, the fourth island to become part of the US Virgin Islands. The island, just off of St. Thomas, is inhabited by approximately 200 residents. Tsunami hazard zone and evacuation route signs were installed along the northern coast of the island. In 2016, VITEMA will install additional signs and tsunami warning sirens on the island as well as continue its education and outreach to island residents.

Finally, VITEMA continued the installation of evacuation route signs in coastal communities throughout the Territory and completed much-needed maintenance of 10 tsunami warning sirens. VITEMA's 2015 tsunami readiness activities culminated with a tsunami tabletop which saw representation from both the public and private sectors.

Washington 2015 Accomplishments

- New informational brochures, Tsunami 101 and Resource Guides were printed and distributed during various public forums and workshops hosted along the Pacific Coast of Washington: 2 forums in Grays Harbor County, 3 forums and 3 workshops in Pacific County, 3 workshops in Clallam County, 1 workshop at the Partners in Preparedness Conference in Pierce County, and 1 workshop at the North Beach School District in Seattle
- Spanish-speaking community forum was held in Aberdeen, Washington.
- Spanish outreach items were developed, printed, and distributed:
 - Spanish Tsunami 101 brochure (Figures 4-5)
 - Spanish AHAB Siren Informational Flyer (Figure 2)
 - Spanish highway evacuation signs (Figure 3)
 - Spanish Out-of-Area Contact Cards
- Upgraded tsunami sirens (Figure 1) to increase redundancy by providing Pacific County and the Shoalwater Bay Indian Tribe of the Shoalwater Bay Indian Reservation the ability to activate the tsunami sirens wirelessly.
- Pedestrian evacuation drills were held along the Pacific Coast of Washington in the spring of 2015 and in conjunction with the ShakeOut Drill held October 15, 2015.
- The *Tsunami Info Alert* newsletter was published and distributed throughout the year.



Figure 1. Willapa Bay Grange siren – facing south



Figure 2. Spanish AHAB Siren informational flyer

Figure 4. Spanish Tsunami 101 informational brochure (Front)



Figure 5. Spanish Tsunami 101 informational brochure (Back)



Figure 3. Spanish interpretive sign: "Caution Tsunami Zone/In case of Earthquake run to high ground"

