National Tsunami Hazard Mitigation Program

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Outline

- Program Overview
- End-to-end System
- NTHMP Hazard Assessment
- Observations & Detection
- Communications
- Warnings to Forecasts
- Readiness to Resilience
NOAA Tsunami Program

Mission:  Save Lives and Protect Property

Objective:  Establish durable end-to-end forecast, warning, and mitigation systems for tsunami and related coastal hazards by strengthening:

- Hazard Assessment
- Warning Guidance
- Preparedness
- Mitigation
- Research
- International Coordination
The Threat

- Tsunamis are infrequent high impact events that can cause a considerable number of fatalities, inflict major damage and cause significant economic loss to large sections of the U.S. coastlines.

  - Since the beginning of the 20th century, tsunami events have caused more than 800 deaths and over $200 million dollars in damage to the U.S. coastal states and territories.

  - Approximately 53% of the U.S. population now live in coastal communities and are at risk for impacts from a destructive tsunami.
Integrated Risk

- **Hazard** - the probability of occurrence of a potentially damaging tsunami-related phenomenon including tsunami, earthquake, volcano, undersea landslide, or inundation within a specified period of time
- **Exposure** - the people, homes, commerce, industry, etc. that are in the tsunami inundation zones
- **Vulnerability** - the degree of loss resulting from the occurrence of the phenomenon
- **Risk** derived from hazard, exposure and vulnerability to estimate expected number of casualties, direct economic losses and indirect economic losses due to business interruption from tsunamis
• NOAA is the lead agency for providing tsunami forecasts and warnings and coordinating the National Tsunami Hazard Mitigation Program (NTHMP) with USGS, FEMA, and NSF
  - but many other federal, state, and local agencies have important roles in preparedness, response and recovery.
How Agencies Contribute

- **NOAA**
  - NWS – warnings, DART, TsunamiReady
  - NOS – bathy/topo, ocean explor., sea level, coastal service and community resilience,
  - NESDIS – hazard assessment, data and grids/DEM
  - OAR/PMEL – research, modeling and mapping

- **USGS**
  - sources, hazard assessment, bathy/topo

- **FEMA**
  - exposure, vulnerability, bathy, loss estimation models

- **NSF**
  - hazard assessment, socio-economic, modeling, generation

- **NIST**
  - building standards

- **NASA**
  - GPS,...
Strategies

• Support a Global Framework
  - *Global Earth Observing System of Systems (GEOSS)*
    • UNESCO Intergovernmental Oceanographic Commission (IOC)
    • World Meteorological Organization (WMO)
    • International Strategy for Disaster Reduction (ISDR)

• Work at Regional, National and Local levels

• Develop Capacity and Sustainability

Tsunami Sources in the world
(2180 events from 1628BC to 2005)
End-to-end System

Linking Hazard monitoring, Observations, Data, and Analysis to Early Warnings and Mitigation

End-to-End System

The U.S. Indian Ocean Tsunami Warning System (IOTWS) program will provide individual assistance to the region using an integrated, end-to-end approach. The system

will facilitate the early detection and warning of hazards, the timely communication of the message to exposed communities, and the mitigation of the approach. The system will be designed to address a variety of hazard types, including, but not limited to, tsunamis, earthquakes, and volcanic eruptions.

www.usaid.org
Unique partnership for the Core Team

- US Federal Govt. (NOAA OAR and Pacific Services Center)
- Academia (University of Rhode Island - Coastal Resources Center)
- International NGO (Asian Disaster Preparedness Center)
- Private Sector (Tetra Tech, Inc.)

- Working with numerous International agencies, organizations and NGOs to develop a sustainable program to promote Coastal Community Resiliency
Resilient coastal communities” understand coastal hazards, take deliberate and coordinated actions to reduce vulnerability, and have appropriate and practiced contingency plans to respond to disaster events.
<table>
<thead>
<tr>
<th>Region</th>
<th>Hazard based on runups</th>
<th>Hazard based on deaths &amp; damage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atlantic Coast</td>
<td>Very low to low</td>
<td>None to very low</td>
</tr>
<tr>
<td>Gulf Coast</td>
<td>None to very low</td>
<td>None to very low</td>
</tr>
<tr>
<td>Caribbean</td>
<td>High</td>
<td>Very high or severe</td>
</tr>
<tr>
<td>West Coast</td>
<td>High</td>
<td>High</td>
</tr>
<tr>
<td>Alaska</td>
<td>Very high or severe</td>
<td>Very high or severe</td>
</tr>
<tr>
<td>Hawaii</td>
<td>Very high or severe</td>
<td>Very high or severe</td>
</tr>
<tr>
<td>Western Pacific</td>
<td>Moderate</td>
<td>Low to moderate</td>
</tr>
</tbody>
</table>

Map showing total number of tsunami events, and total number of events causing runup heights from 0m to greater than 3 m for states and territories in the Pacific Ocean.
Awareness and Assessment Tools

• NOAA/CSC and PSC are developing a manual/guidebook for developing Hazard Awareness and Assessment Tools – ArcIMS template or Open Source version

• Working with FEMA to promote the use of similar tools to all communities throughout the US

• Working with USAID, United Nations International Strategy for Disaster Reduction, and others to promote the use of similar tools throughout the world
• Probabilistic Tsunami Hazard Assessment—
  – Seaside, Oregon Tsunami Pilot Study—Modernization of FEMA Flood Hazard Maps

FEMA, USGS, and NOAA, in collaboration with the University of Southern California, Middle East Technical University, Portland State University, Horning Geoscience, Northwest Hydraulics Consultants the Oregon Department of Geological and Mineral Industries
Vulnerability or degree of loss resulting from the occurrence of tsunamis due to exposure and fragility

- Seaside, Oregon Tsunami Pilot Study—Modernization of FEMA Flood Hazard Maps

Data provided with FEMA’s HAZUS loss estimation software and Clatsop County, Oregon, tax assessment data were used as input to the model.
Assessment - Key Elements

- **Collection, analysis and quality assurance** of all data related to U.S. tsunami events
- **Assessment of frequency, severity and uncertainty** of tsunami sources
- **Acquisition, quality assurance**, and archive of bathymetric and near-shore topographic data
- Development of **tsunami inundation forecast tools**
- **Inundation mapping and modeling** of all U.S. coastal areas
While the National Oceanic and Atmospheric Administration (NOAA) has the technology to detect the formation of a tsunami and issue warnings fairly quickly, the states lack comprehensive information regarding potential human, structural, and economic impacts that could result from a tsunami wave.
Hazard Loss Estimation

- **Risk assessment, planning and analysis tool to**
  - **Identify** and characterize hazards,
  - **Inventory** assets and evaluate vulnerable areas
  - **Assess** readiness and preparedness
  - **Estimate** exposure and losses from specific events
  - **Organize** resource allocations
  - **Plan** mitigation options
  - **Estimate** recovery
HAZUS

- Analysis tool for estimating direct and induced damage, and direct and indirect losses

- Implemented through
  - GIS Technology
  - Nationwide databases
  - Standardized methodologies

For more information http://www.fema.gov/plan/prevent/hazus
• For many parts of coastal Alaska, California, Hawaii, Oregon and Washington - as well as Puerto Rico and the U.S. Virgin Islands - **reliable assessments of potential tsunami impacts have not yet been completed.**

• **Limited progress on the creation of inundation maps** that show the extent of coastal flooding for these regions,

• **Lack of standardized computer software for estimating the likely human, structural, and economic damages from tsunamis**
GAO Recommendations

- **Loss Estimation:** Create standardized tsunami loss estimation software – NOAA, FEMA and USGS

- **Outreach and Education:** Raise public awareness, through school and community programs, of how to respond to tsunami warnings – Federal, State and Local governments and others

- **Evacuation Plans:** Improve evacuation routes – Local Governments

- **Communications:** Build emergency communications infrastructure that would be protected from potential tsunami damage. – Local Government

- **Strategic Plans:** Create a long-range strategic plan and define specific performance measures so that the success of the National Tsunami Hazard Mitigation Program (NTHMP) can be assessed - NOAA
Observation and Detection

- **DART Stations**
  - DART = *Deep Ocean Assessment and Reporting of Tsunamis*
  - 32 Pacific and 7 Atlantic/Caribbean

- **Sea Level Stations**
  - Upgrade 33 Pacific Data Collection Platforms to real time
  - Install 16 new stations

- **Seismic Network**
  - Expand and upgrade seismic network in HI
  - USGS expanding 9 stations Caribbean
Communications

Acronyms
NWS - National Weather Service
EOC - Emergency Operations Center
EMWIN - Emergency Managers
Weather Information Network
GTS - Global Telecommunications System
FOS - Family of Services
Warning Guidance

Tsunami Warning Center Operations
- Expanded to 24x7 staffing and broader areas of responsibility

- WC/ATWC = West Coast/Alaska Tsunami Warning Center
  serving continental US, Canada, PR and USVI

- PTWC = Pacific Tsunami Warning Center serving HI and all
  Pacific and Caribbean basin, and interim to Indian Ocean

- Warning
  - The highest level of tsunami alert.
- Watch
- Advisory
- Information Bulletin
- Information Message
Warning Guidance
From Warnings to Forecasts

Dynamic 4D Inundation Models and Maps
- site-specific forecasts simulate tsunami generation, propagation and inundation impact for at risk communities

Graphical Products

SI FT (Short-term Inundation Forecasting for Tsunamis)
Inundation Grids

- **High resolution digital elevation models** (DEM)
  - Combined bathymetric-topographic data, DEMs are part of the tsunami forecast system SIFT
  - Used by NOAA with the Method of Splitting Tsunami (MOST) model to simulate tsunami generation, propagation, and inundation.

* NOAA, USGS, USACE, FEMA, and other federal, state, and local government agencies, academic institutions, and private companies.
Mitigation

• National Tsunami Hazard Mitigation Program (NTHMP)
  - NOAA, USGS, NSF, FEMA
  - 28 States, Commonwealths, & Territories
    • Mapping and evacuation planning
    • Outreach and education
23 Ocean/ Gulf States, 5 Commonwealths & Territories

Atlantic Ocean states (14):
- Maine
- New Hampshire
- Massachusetts
- Rhode Island
- Connecticut
- New Jersey
- New York
- Delaware
- Maryland
- Virginia
- North Carolina
- South Carolina
- Georgia
- Florida

Pacific Ocean states (5):
- California
- Oregon
- Washington
- Alaska
- Hawaii

Gulf of Mexico states (5):
- Florida
- Alabama
- Mississippi
- Louisiana
- Texas

Commonwealths (2):
- Puerto Rico
- Northern Mariana Islands

Territories (3):
- US Virgin Islands
- American Samoa
- Guam
NTHMP Status

• Through FY06 NTHMP-funded members (OR, WA, CA, HI, AK, PR, and USVI) are completing the following tasks (varies by state):
  – Maintaining Tsunami Evacuation signs
  – Working to resolve issues from the June 14, 2005 tsunami warning
  – Conducting tsunami workshops
  – Participated in *Pacific Peril 2006*
  – Continued development of educational material to convey tsunami issues to businesses, schools and residents
  – Develop tsunami inundation and evacuation models
NTHMP Mitigation Plans

• **Promote tsunami resilient communities**
  - Development of model mitigation measures and encourage communities to adopt construction, critical facilities relocation or protection, evacuation guidance, and land-use planning practices to reduce the impact of future tsunamis

• **Increase outreach to all tsunami communities**
  - Include all demographics of the at-risk population, to raise awareness, improve community preparedness, and encourage the development of tsunami response plans
Extending HAZUS

• **Development of a Tsunami Risk Assessment Model within HAZUS**
  
  - Utilize existing flood grid analysis and earthquake source modeling capabilities, and an inventory system for importing and managing national data on demographics and the numbers, types and locations of buildings, and essential facilities
  
  - Evaluate tsunami impact using either the NOAA models, e.g. MOST (Model of Splitting Tsunami), other numerical models, or existing tsunami hazard and risk maps that have been produced
Preparedness and Response

• Why does America need TsunamiReady?
  - Detection and warnings alone are not sufficient to meet the mission
  - Preparedness and response must be learned, practiced, and owned locally
  - Continuous education and outreach to requires partnerships
  - Achievements should be recognized!

www.stormready.noaa.gov/tsunamiready
TsunamiReady Status

30 communities

As of: September 1, 2006

Region       FY01   FY02   FY03   FY04     FY05     FY06
Eastern          0          0          0          0          0          1 (2)*
Southern         0          0          0          0          1          2 (2)*
Western          1          4          0          2          6          3 (3)*
Alaska           0          1          2          1          0          0 (2)*
Pacific          1          0          0          1          3          1 (1)*
Totals           2          5          2          4          10         7 (10)*

* Numbers in parentheses are planned
Preparedness and Response

• Challenges in getting America TsunamiReady
  – Establishing and maintaining a sense of urgency
  – Creating and leveraging partnerships
  – Developing socially and culturally relevant plans
  – Communicating and educating
  – Empowering local stakeholders for broad-based action
  – Scientifically based and continuously improved
  – Availability of data and information, e.g. inundation maps
  – Building capacity toward community resilience
Preparedness and Response

- NOAA NWS efforts to overcome these challenges...
  - Increase coordination
  - Bolstering education and outreach
  - Optimize resources
  - Leverage other resources
  - Enhance private sector partnerships
Program Status Sept 06

• DART deployment
  19 of 39 (39% complete)

• Facilities expansion
  Complete

• Warning operations expansion
  24x7 staffing complete at both WC/ATWC and PTWC

• Seismic Network upgrade
  4 of 8 in HI & AK (50% complete)

• Sea live (tide station) expansion
  14 of 16 new and 30 of 33 upgrades (90% complete)

• TsunamiReady
  30 TsunamiReady communities

• Forecast Mapping/Modeling
  15 of 26 (58%) full operations;
  15 of 75 (20%); Ongoing

• Long Term Archive
  Ongoing: 200 Gb new data added,
  530 Gb new to add
For Further Information

http://www.tsunami.noaa.gov/
www.tsunami.gov

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