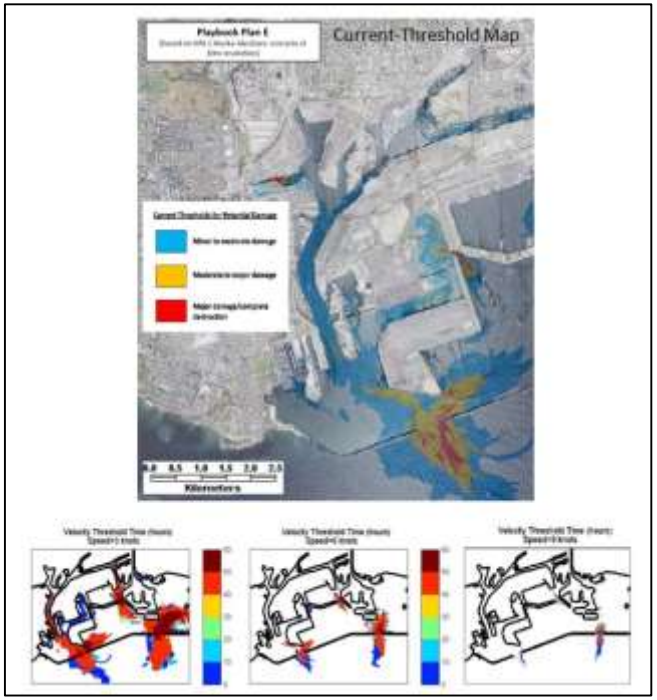
2018 update of NTHMP:
"Guidelines and Best Practices for Tsunami Hazard Analysis, Planning, and Preparedness for Maritime Communities"


Counter-rotating TCS offshore of Iwaki city, Fukushima Prefecture, Japan during the 2011 tsunami. (Photo: Reuters/Yomiyuri.)


Recovery efforts in Crescent City Harbor following the March 11, 2011 tsunami from Japan (photo credit: Rick Wilson)

Guidelines and Best Practices for Tsunami Hazard Analysis, Planning, and Preparedness for Maritime Communities

Draft initially available December 2015; updated in 2017



Purpose of Maritime Planning and Preparedness Guidelines

Intended Audience

Objective and Scope of the Guidelines are:

Part 1: Guidance for Tsunami Hazard Analysis, Modeling, and Mapping

1.1 Use of Numerical Tsunami Models and Digital Elevation Models/Grids

1.2 Maritime Tsunami Hazard Preparedness Products

- **Product 1: Identification of Areas of Past Damage and Strong Currents**
- **Product 2: Mapping Current Velocities and Relationship to Damage**
- **Product 3: Identification of Areas of Potentially Large Water Fluctuation**
- **Product 4: Identification of Areas of Potential Bores, Seiches, and Amplified Waves**
- **Product 5: Identification of Timeframe for Damaging Currents**
- **Product 6: Identification of Safe Minimum Offshore Depth**
- **Other Products**

1.3 Basic Guidance on Design of Products

*Part 2: Guidance for Tsunami Response, Preparedness, and Education

2.1 General Maritime Guidance

2.2 Harbor/Port Specific Maritime Response Guidance

- **2-level Tsunami Response Guidance**
- **Multi-level Tsunami Response Guidance (Playbooks)**

*Part 3: Guidance for Tsunami Mitigation and Recovery Planning

3.1 Mitigation Planning Strategies

3.2 Recovery Planning Strategies

Resources – Maritime References, Products, and Entities

***INCOMPLETE SECTIONS – 2019 planned completion**

Reaffirming reasons for providing consistent NTHMP Maritime Tsunami Guidance

Objectives include:

- **Risk and disaster assessment of resilience so that decision makers, responders, and community members can take informed action to reduce risk at the local, tribal, state, and federal levels. (Chapter 1)**
  - **Risk and Disaster Resilience Assessment**
- **Tsunami warning and communication procedures for the maritime community (Chapter 2)**
  - **Alert and Warning**
- **Situational awareness and common operating picture processes and coordination within your agency and outside the agency in response to a tsunami event. (Chapter 2)**
  - **Situational Assessment (SA/COP)**
- **Describing tsunami mitigation, response and recovery planning at the local, tribal, state, and federal levels. (Chapter 3)**
  - **Planning**

Recent Work

Alaska

- AK Maritime Workshop – April 2017

California

- SF Harbor Safety Committee Presentation - June 8, 2017
- Sector SF, USCG Presentation and Planning Meeting - April 4, 2018
- Humboldt Harbor Safety, Update and Presentation - Sept 26, 2018

Puerto Rico

- PR Maritime Guidance Workshop – June 26, 2017
- Guidance Produced

Washington

- WA Maritime Guidance Workshop – June 20, 2018
- The purpose of this workshop is to share and discuss tsunami maritime risk reduction best practices and activities.

Tsunami Hazards specific to the Maritime Community

Tsunami Hazards for Harbors and Ports

There are a number of **TSUNAMI HAZARDS** that could directly affect harbors and boaters:

- **Strong and unpredictable currents**, especially where there are narrow entrances, narrow openings, and other narrow parts of harbor
- Sudden **water-level fluctuations** where docks and boats:
  - Hit bottom (grounded) as water level drops
  - Could overtop piles as water level rises
  - Buoyancy of large ships, pushed on top of docks
- **Eddies/whirlpools** causing boats to lose control
- **Tsunami bores and amplified waves** resulting in swamping of boats and damage to docks
- **Drag** on deep draught vessels causing damaging forces to the docks they are moored to
- **Debris in the water;** collision with boats, docks, and harbor buildings
- **Scour and sedimentation** can affect harbor protection measures and shipping channels, respectively
- **Dangerous tsunami conditions can last tens of hours** after first wave arrival, causing problems for inexperienced and unprepared boaters who take their boats offshore
- **Contaminated water/sediment and other environmental hazards** causing delays in recovery
- **Poor decision making** by boaters and/or port/harbor personnel

March 11, 2011 Tohoku-oki tsunami
Location: Sendai Plain, Japan - Tsunami arrives one hour after M9.0 earthquake

Strong and Unpredictable Currents, especially where there are narrow entrances, narrow openings, and other narrow parts of harbor

Strong, damaging currents produced by the 2011 Japan tsunami in Crescent City Harbor. Video from Coast Guard helicopter; image from analysis of current velocities

Sudden Water-level Fluctuations

Vessels hit bottom (grounded) as water level drops

House boats in Sausalito (2011 Japan)

Large vessels stranded by buoyancy

Large ship in Port of Sendai (2011 Japan)

Vessels and docks overtop piles as water level rises and falls

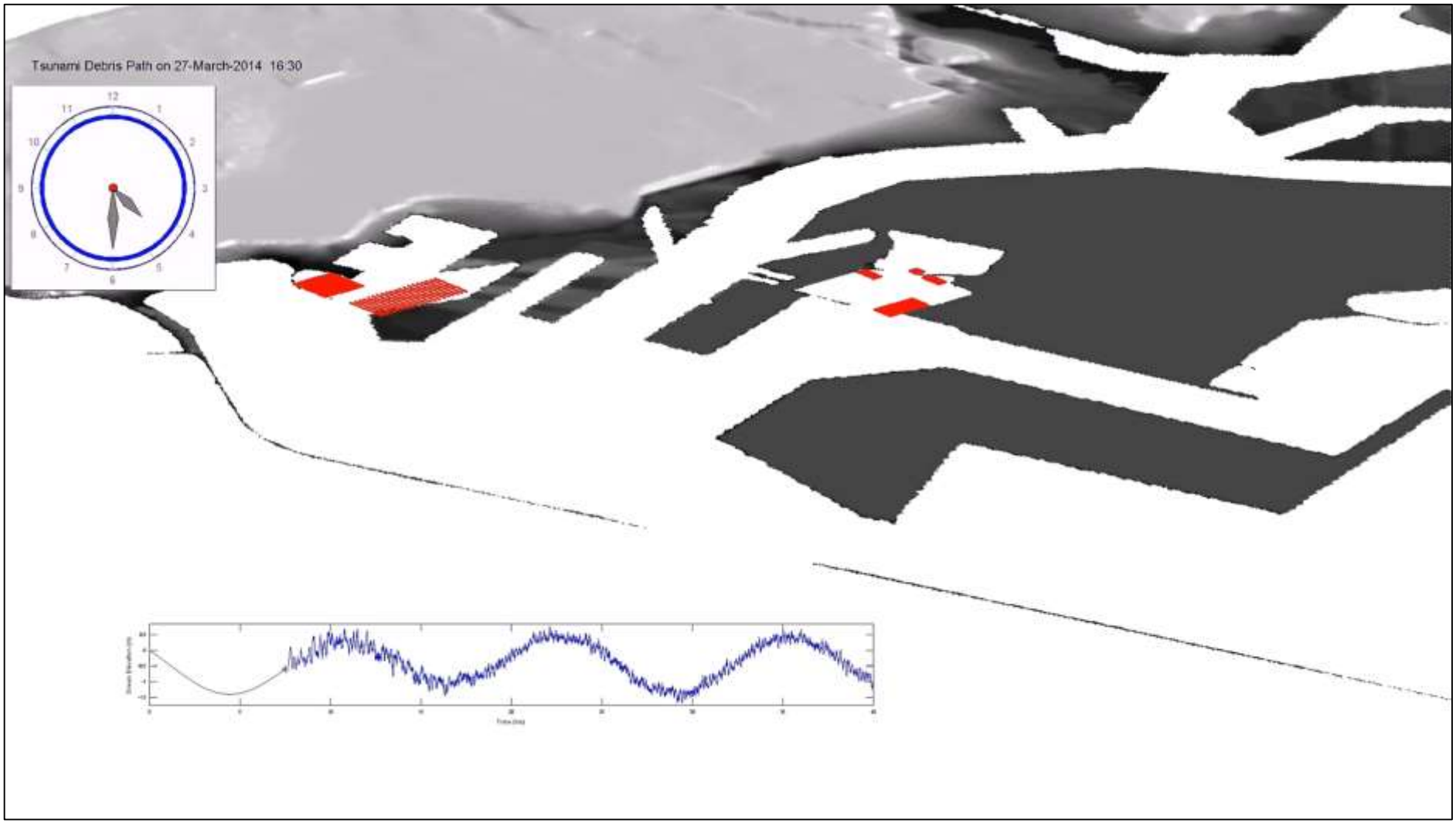
Docks at Marina Chiapas, Mexico (2016 Chiapas)

Eddies/whirlpools causing boats to lose control

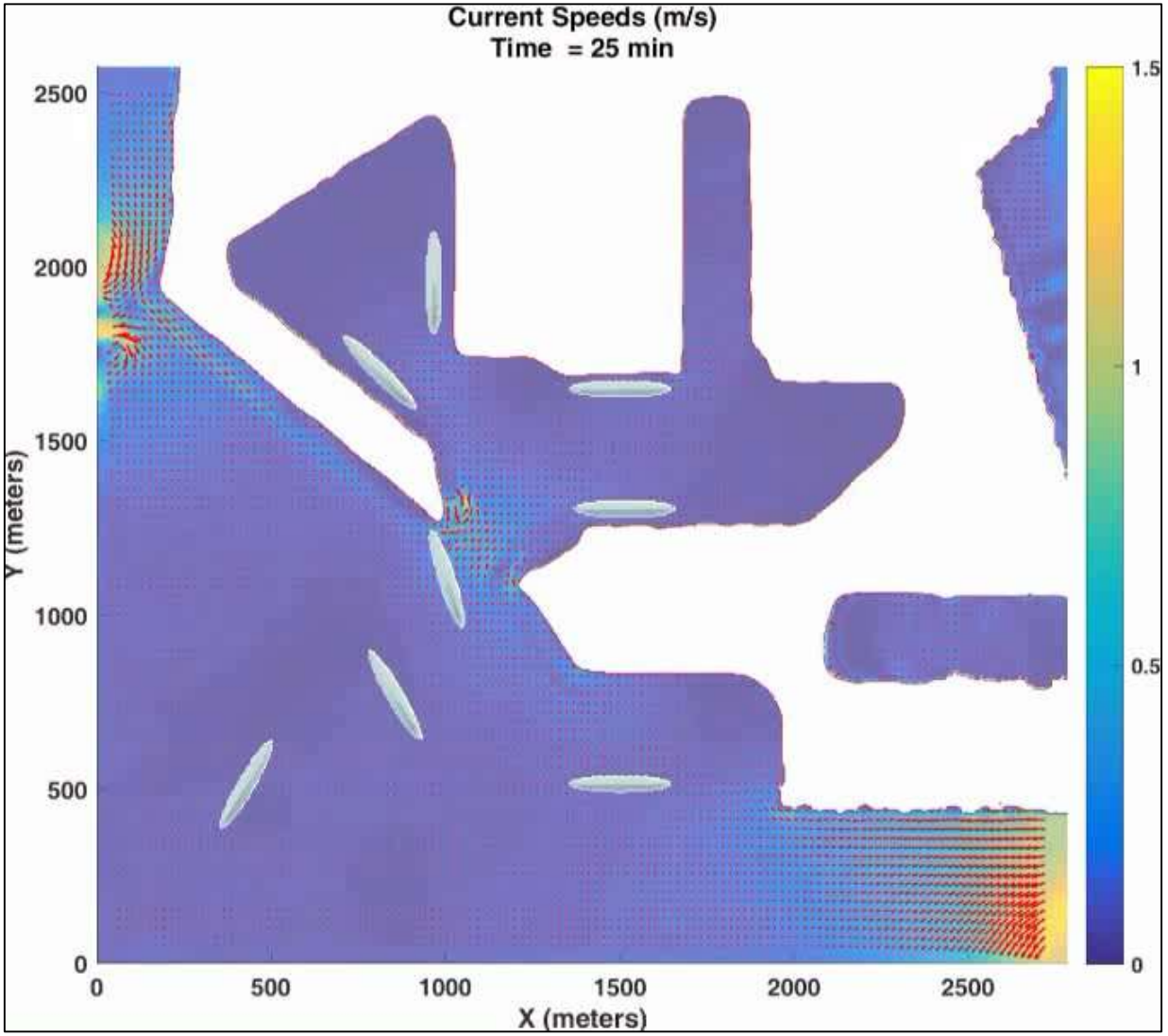
Large eddy forms in center of harbor in Japan (2011 Japan)

Debris and Sediment Movement

USC - Debris movement model for Port of Los Angeles

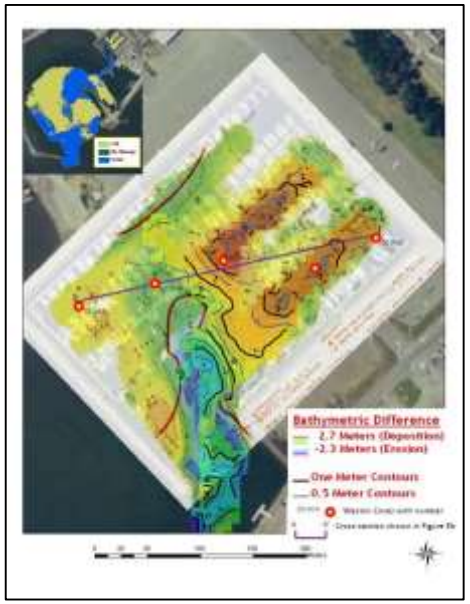


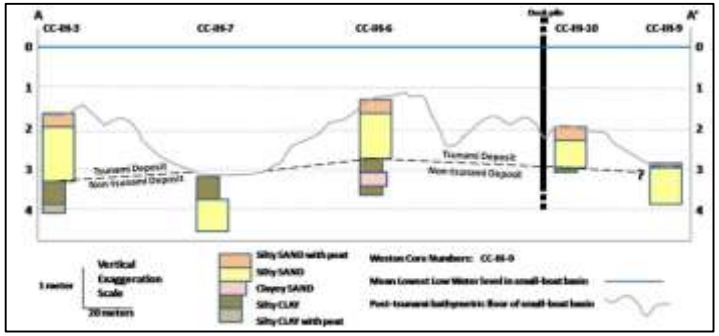
Drag on Deep Draught Vessels



USC – model showing tsunami forces on ships in Port of LA

Contamination and Other Environmental Hazards causing delays in recovery





Debris, sediment, and contaminated water/sediment in Crescent City Harbor (2011 Japan)

Poor Decision Making

March 11, 2011 Japan Tsunami in Crescent City

Fishing boat captain takes vessel out of harbor <u>during</u> tsunami

NTHMP 2018-2023 Strategic Plan

Theme 1: Hazard and Risk Assessment

Goal 1.1: Tsunami hazard assessment that supports informed decision-making

Strategy 1.1.3: Identify and address the tsunami hazard assessment and product requirements

Tsunami hazard assessment and product requirements are important to maritime communities and other NTHMP customers and stakeholders. Harbors damaged during recent tsunami events have demonstrated the need for maritime tsunami hazard assessments (Wilson and others, 2012). New hazard assessment will be evaluated and guidance will be developed for consistent products for evacuation, maritime guidance, land-use, and construction planning to help make communities more resilient to tsunami hazards. To help meet stakeholder requirements, the NTHMP will work to accomplish the following tasks:

- Complete guidance and products for community-level evacuation modeling and mapping in at-risk communities.
- Complete guidelines and develop products that address various elements (i.e. vessel size, hazard level, and harbor configuration) of the maritime community.
- Develop guidance for analysis of modeled tsunami currents/vorticity and forces on structures.
- Promote periodic review of hydrological tsunami modeling through a process to update published model benchmarks.

Theme 2: Tsunami Education and Preparedness

Goal 2.1: Inform and prepare at-risk populations to respond appropriately to tsunamis

Strategy 2.4.1: Engage stakeholders on tsunami preparedness and response

The cooperation of the coastal businesses, tourism, and maritime staff is intrinsic to proper tsunami preparedness, mitigation, and response. Active involvement of stakeholders to disseminate education products, conduct outreach, and participate in exercises is essential to build a sense of community ownership and commitment for public safety. The NTHMP will engage stakeholders at all levels to enhance all aspects of tsunami mitigation, preparedness, and response capabilities.

Theme 3: Alert, Warning and Response

Goal 4.2: Effective and reliable forecast dissemination

Strategy 4.2.1: Encourage authorities to receive and respond to Tsunami Warning Center products

The NTHMP will provide the coordination mechanism for periodic system-wide communication tests with different levels and frequencies, using the corresponding communication channels appropriate to the test level. NTHMP will encourage all coastal states and territories to participate in the annual end-to-end testing of the Tsunami Warning System (TWS). The NTHMP will update warning notification process Guidelines considering lessons learned and new message procedures (e.g., broadcast text messages).

Strategy 4.2.2: Improve local warning dissemination capabilities

The NTHMP will take actions to improve dissemination capabilities at threatened communities nationwide. This strategy is also a critical part of a community's TsunamiReady® criteria. This may include creating multiple methods for emergency communication and integrating use of forecast information into local response planning.

Strategy 4.2.3: Improve community warning point reception capabilities

Before communities can disseminate tsunami information to people at risk, they first must be able to reliably receive tsunami information from the TWCs and state operations centers. The WCS will take actions to improve warning reception capabilities at threatened communities nationwide. This strategy is also a critical part of a community's TsunamiReady recognition.

Update on DRAFT Guidance/Best Practices for Maritime Communities

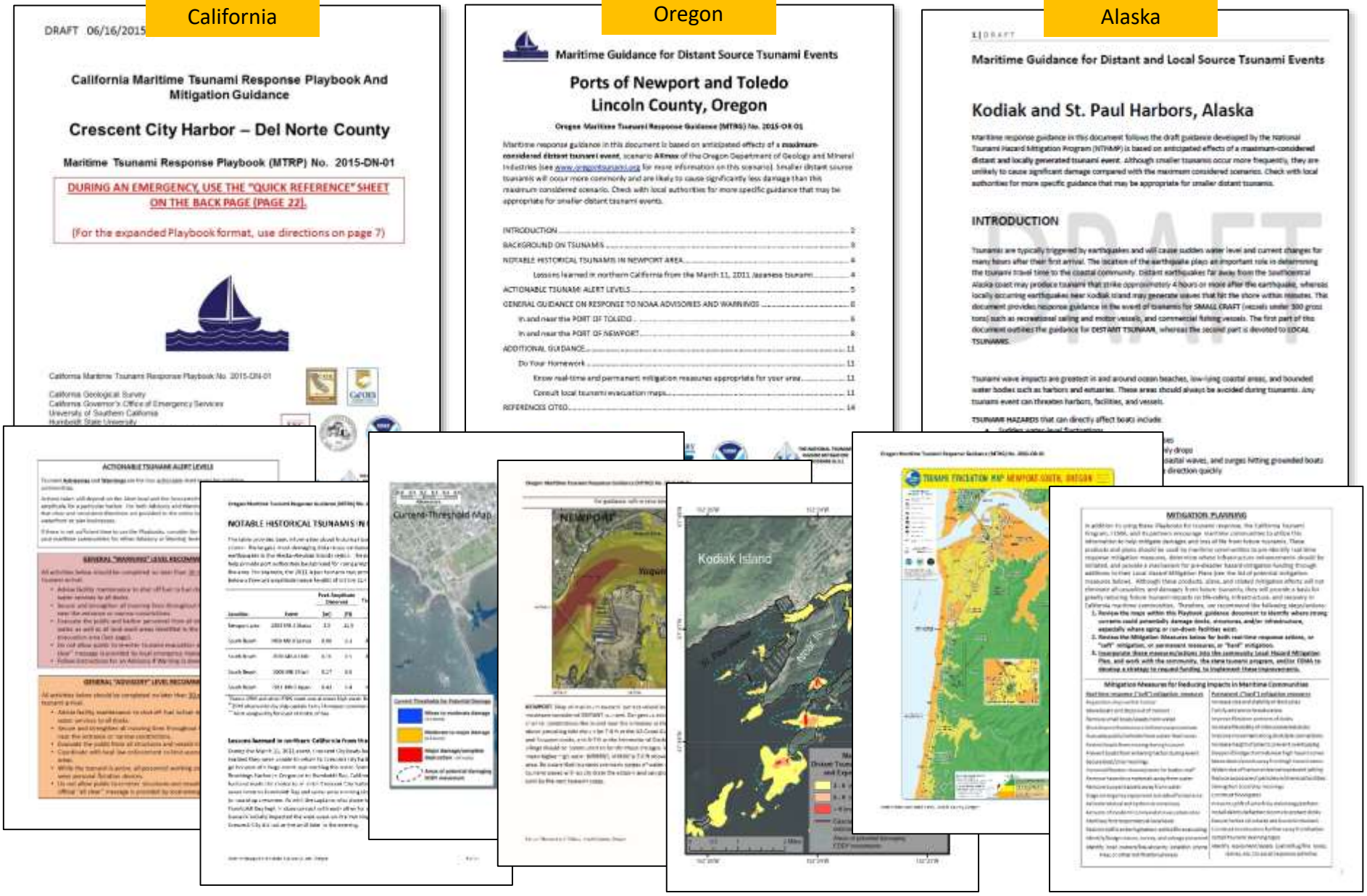
Maritime Response and Mitigation Planning Products

Working Towards More Accurate, Consistent, and Cost-Effective Products

California

Oregon

Alaska

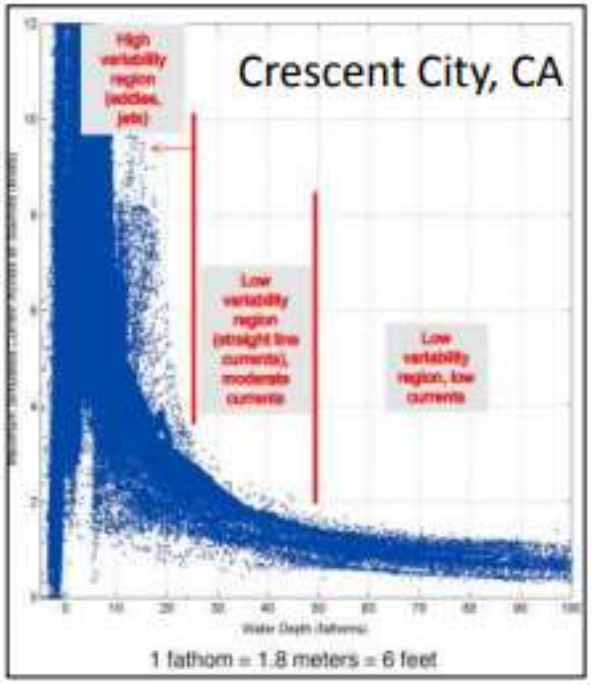


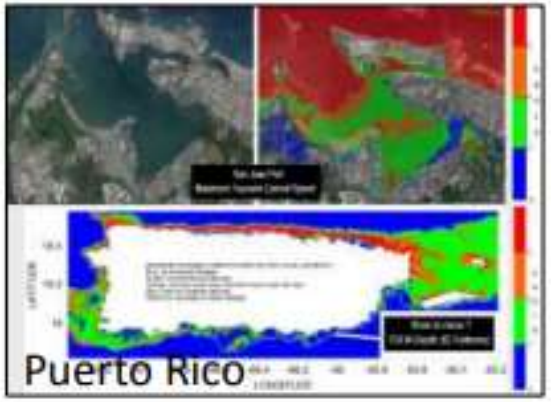
Determining Appropriate Maritime Planning and Response Guidance

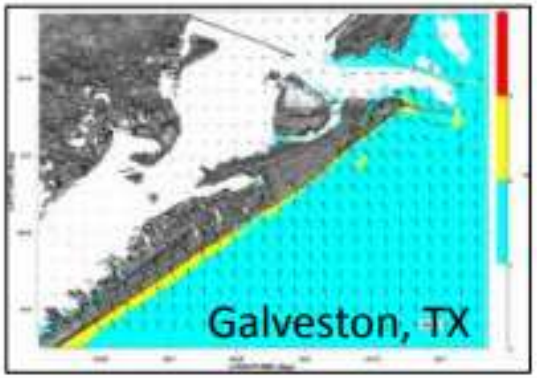
	2-Level Response Guidance	Multiple-Level Response Guidance
Type of maritime community	Small open-coast harbors or harbors within rivers or bays which have not experienced significant tsunami damage in the past	Harbors and ports which have had damage in past events, especially during both Advisory and Warning level events
Basis for response planning	Response for either Advisory level events or Warning level events, 2-levels of response	Response specific to multiple scenarios between the Advisory and small Warning level wave height range
Scenario modeling required	Minimal modeling required, velocity and flow depth for one or two maximum considered distant source scenario	More comprehensive modeling is required for a variety of distant tsunami sources with the near-shore forecast peak wave amplitude range of 0.3m to 1.5m
Relative cost*	Minor cost for modeling single maximum scenario	Moderate cost for modeling multiple scenarios
Relative accuracy	Moderate accuracy for capturing tsunami conditions	Higher accuracy by selecting response plan with more specific information about severity and location of damaging currents
Decision making and response	Simplified approach with only two choices predetermined by the tsunami alert level	Advanced approach with a number of response choices based on forecast peak wave amplitude from the Warning Center
Real-time decision making assistance from state/NWS	Assistance to select the response level is not required	Assistance to select the response level is recommended; MINIMUM scenario plan may be recommended by state or NWS IDSS

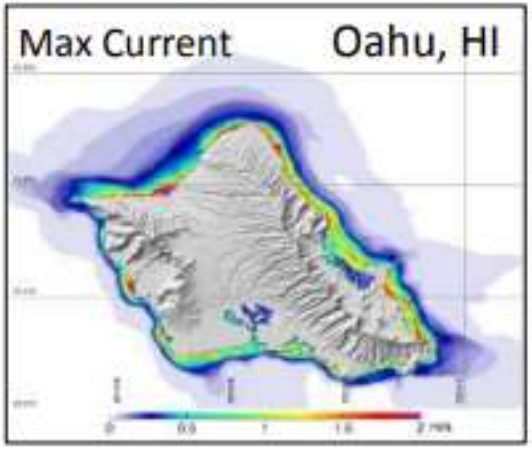
Guidance for Safe Minimum Offshore Depth for Vessel Movement

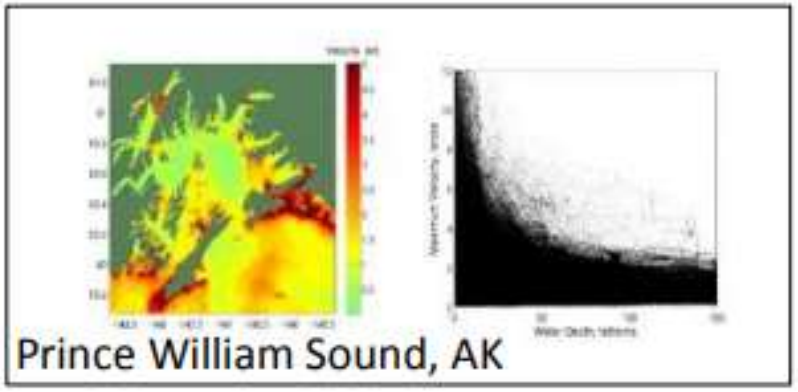
Regional evaluation of current speed vs. water depth to determine minimum offshore safe depth











Guidance for Safe Minimum Offshore Depth for Vessel Movement

Work between NTHMP States/Territories and U.S. Coast Guard

TABLE 1: Specific guidance for minimum offshore safe depths for maritime vessel evacuation prior to the arrival of tsunami.

State/Territory	Distant Source (ships in harbor)*	Local Source (ships at sea)*	Notes
California	30 fathoms	100 fathoms	Evaluated; may add potential safe areas within large bays and ports
Oregon	30 fathoms	100 fathoms	Evaluated, but is re-evaluating based on new data; also evaluating Columbia River
Alaska	30 fathoms	100 fathoms	Evaluated; ships should be at least 1/2 mile from shore for all scenarios
Washington	30 fathoms	100 fathoms	Evaluated; special conditions exist inside Puget Sound
Hawaii	50 fathoms	50 fathoms	Evaluated; implemented in Coast Guard plan in some locations
American Samoa	50 fathoms	50 fathoms	Evaluating, guidance from others
Puerto Rico	50 fathoms	100 fathoms	Evaluated
USVI	50 fathoms	100 fathoms	Evaluating; possibly follow PR
Guam	50 fathoms	100 fathoms	Coordinated with USCG Guam Sector
CNMI	50 fathoms	100 fathoms	Coordinated with USCG Guam Sector
Gulf Coast		100 fathoms	Evaluating; issues with long, shallow shelf complicate getting beyond safe depth offshore
East Coast		100 fathoms	Evaluating; issues with long, shallow shelf complicate getting beyond safe depth offshore

* Ships also recommended to be a minimum of ½ mile from shore or fringing reef

NTHMP Partner work on

1) Outreach/Prep
2) Response Planning
3) Mitigation & Recovery Planning

Status of NTHMP Partner Maritime Planning

NTHMP Partner	Initiated outreach/developed guidance	Use of MMS guidance; started mapping/modeling	Response product types and percent completion	Mitigation and recovery planning
Alaska	Yes; presented guide for Kodiak, and overview at Harbor Master conference; developing maritime hazard brochure	Yes; draft guide products for 3 cities and USCG Base, high-hazard areas	2-level response guides; by 2017, close to 25% of high-hazard harbors covered	Some mitigation in existing response guidance and future brochures
American Samoa	Yes; discussing maritime hazard products w/ partners	Yes; beginning stages of working w/ HI on modeling	TBD (possible Playbook-type)	Not yet
California	Yes; over 20 meetings w/ harbors/ports, USCG, and Harbor Safety Assoc.; brochure update in 2017	Yes; helping to improve MMS guidance	Multi-level (Playbook) response guides and operational; 100% coverage	W/ FEMA, creating Harbor Improvement Reports and recov. guide; NTHMP guidance?
CNMI	Yes; outreach for Boating Safety Week; sponsors NWS workshops; work closely w/ USCG on guidance	Yes; in pre-modeling stage; will start modeling in 2017	TBD	Not yet
East Coast	Not yet; landslide benchmark workshop and evacuation modeling/mapping are priorities	Not yet	TBD	Not yet
Guam	Yes; outreach for Boating Safety Week; sponsors NWS workshops; work closely w/ USCG on guidance	Yes; modeling Apra Harbor with HI; expanding in 2017	TBD	Not yet
Gulf Coast				
Hawaii				
Oregon	Yes; maritime brochure (2013) may be updated after offshore safety re-evaluation	Yes; products for Newport and Toledo (2014); 2017-Gold Beach and Port Orford; modeling Columbia R.	2-level response guides; by 2017, close to 25% of high-hazard harbors covered	Some mitigation in existing brochures and guidance, possibly OR Resilience Plan
Puerto Rico				
USVI				
Washington	Yes; briefed major maritime players; no brochure has been developed	Yes; modeled Cascadia L1; no modeling yet in Puget Sound	TBD	Not yet, though may be in WA Resilience Plan
NOAA/ PMEL				

NTHMP Tsunami Current Model Benchmark Workshop

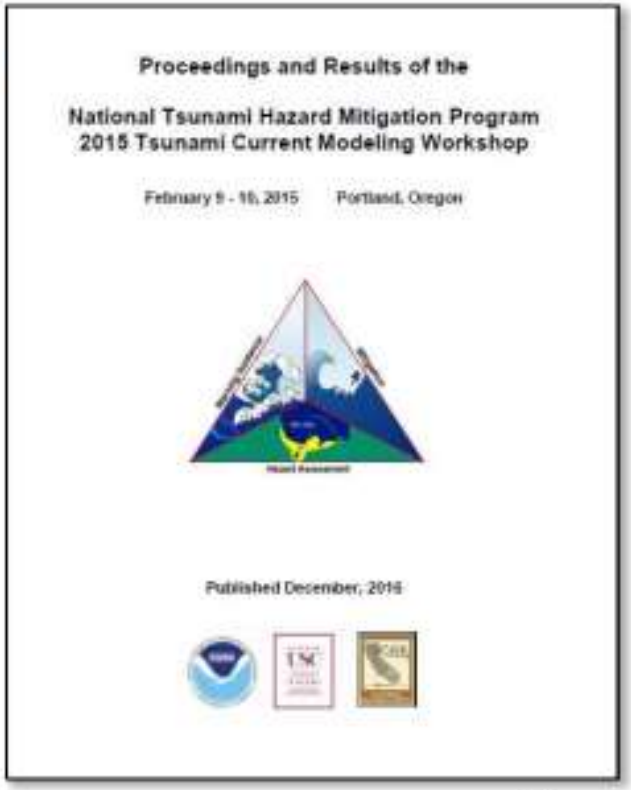
WORKSHOP: Held February 9-10, 2015 with 14 NTHMP and international models participating; five benchmarks were provided with two mandatory benchmarks to run

PURPOSE:

1. **Satisfy the requirement of the FY2013-2017 NTHMP Strategic Plan for the Mapping and Modeling Subcommittee.**
2. **Verify the accuracy/adequacy of current models for use by NOAA and NTHMP partners to help produce accurate and consistent maritime and other hazard reduction products.**

FINDINGS AND POTENTIAL OUTCOMES:

1. Models similar in their ability to identify areas of high currents, especially where jetting occurs.
2. A few models consistently captured velocities with a greater degree of accuracy than others, especially where eddy formation and migration occurred in data sets.
3. The deficiencies of the models in the areas where eddies form and are expected to migrate might be addressed by:
   - A. **Running ensemble of models** and combining the results to capture the maximum current velocities;
   - B. **Binning modeled current velocities** into numerical categories related to damage potential, to reduce the reliance on absolute accuracy of the velocities alone; and/or,
   - C. **Identifying and encircling the areas where eddies** are expected to be generated and migrate.
4. **MMS will consider results and develop guidance for modeling and mapping partners.**



NTHMP Maritime Guidance for Safe Minimum Offshore Depth for Vessel Movement

Guidance for Safe Minimum Offshore Depth for Vessel Movement
Work between NTHMP States/Territories and U.S. Coast Guard

General Recommendations for Recreational and Commercial Boaters:

***** In general, it is NOT recommended that boaters try to take vessels offshore before or during a tsunami. And, if they are offshore, they should not try to re-enter the harbor until the harbor master or port captain indicates it is safe to do so.*****

LARGE LOCAL-SOURCE TSUNAMI – Tsunami may arrive in 10-15 minutes

- If you are on land or tied up at the dock: Do not attempt to take your vessel offshore. Leave your boat and go to high ground on foot as soon as possible. You do not have time to save your boat in this situation and put your life at risk if you try to do so.
- If you are in deep water or very close to deep water: Take your vessel further offshore beyond the "minimum offshore safe depth" outlined in the Table 1 for your U.S. state/territory/commonwealth or region. Typically, this depth is 50 to 100 fathoms (300 to 600 foot) depth, then you are safe from tsunamis.
- If you are on the water but very near shore: Use your best judgement to decide between the two options: safely beach/dock the vessel and evacuate to high ground or get to the minimum offshore safe depth. Attempting to beach the vessel could be challenging and dangerous, being dependent on wave conditions, water levels, and the presence of bars. It is easy for a boat to run aground or capsize before reaching the shore only to then be swept away by the coming tsunami. However, if you can safely beach or dock your boat and get to high ground before the tsunami, then this is your best chance. If that is not possible, head to deep water as quickly as possible.

LARGE DISTANT-SOURCE TSUNAMI – Tsunami arrival at least two-hours away

- It is NOT recommended that boaters try to take their vessels offshore before or during a tsunami. It is safer to keep your boat docked during a tsunami because most tsunamis are relatively small, and your personal safety is more important than saving your property/boat.
- On the rare occasion when a larger tsunami is expected (Warning level), the boat owner may consider taking their boat offshore considering the following criteria:
    - The SIZE of the tsunami.
    - How much TIME you have before the tsunami arrives.
    - The PREPAREDNESS of the boat and EXPERIENCE of its captain to stay offshore for extended period of time (12-24 hours), or travel to safe, undamaged harbors.
    - The WEATHER at sea could be as dangerous as the tsunami itself.
- Do not go offshore unless you are very sure that you can get beyond the recommended minimum offshore safe depth at least 30 minutes before the estimated tsunami arrival time for your coastline. Please refer to the Table 1 for the recommended minimum safe depth for your U.S. state/territory/commonwealth or region.

Next Steps – See Outline

Guidelines and Best Practices for Tsunami Hazard Analysis, Planning, and Preparedness for Maritime Communities

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~~2.3~~ Public Education Guidance/Strategies (ADDED)
2.2 Harbor/Port Specific Maritime Planning Guidance
Alert-Level Tsunami Response Guidance:
Scenario-Specific Tsunami Response Playbooks:
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3.1 Mitigation Planning Strategies
3.2 Recovery Planning Strategies
Resources – Maritime References, Products, and Entities

Recommend MES review beginning sections and verify

Recommend MES review offshore guidance document

Recommend MES streamline/ improve "General Maritime Guidance"

Recommend MES develop "Preparedness and Education…" section

Recommend MES work with FEMA to develop guidance for LHMP and funding

Recommend MES wait for mitigation/ recovery work in CA to be completed

Goal is to Complete

"Guidelines and Best Practices for Tsunami Hazard Analysis, Planning, and Preparedness for Maritime Communities

Next Steps

1. Work Group Volunteers
2. Timeline – September 1, 2018 – August 31, 2019
3. Starting Point:
   Chapter 2: Guidance for Tsunami Response, Preparedness, and Education (started – to be informed by MES 2018)
   Chapter 3: Guidance for Tsunami Mitigation and Recovery Planning (started – to be informed by MES 2018)
4. Future Homework:
   a. Each partner provide a written summary of their response planning status with regard to tsunamis and the maritime community in their state/territory
      1. Tools capability (to assess amplitudes, current speeds, drawdown, mitigation measures
      2. Strategy (mult-scenario or two-tier advisory vs. warning)
   b. Questions

Maritime Tsunami Planning "Checklist"

Information/Products available:

- Understanding maritime tsunami hazards (threats and impacts)
- Lessons learned from past events (distant and local)
- Relationship of current velocity vs. damage potential
- Guidance for analyzing in-harbor hazards
- Guidance for offshore safe depth (open ocean)
- Guidance for education-preparedness-response planning
- Partial guidance for mitigation-recovery planning
- Examples of Emergency Response Plans for preparedness and response
- Examples of Harbor Improvement Reports for mitigation (Local Hazard Mitigation Plans-LHMPs)

Maritime Tsunami Planning "Checklist"

Potential short-term information/products to be determined/produced:

- Formation of state/regional work group(s) comprised of port/harbor managers, USCG, state scientists and emergency managers
- Complete statewide assessment of wave heights and damage from past tsunamis (NOAA/NCEI historical tsunami database)
- Select several pilot harbors/ports (large and small)
- Creation of example analysis and planning products
- Determine response planning method (2-alert-level vs. multi-scenario-level)
- Develop port/harbor specific response plans
- Guidance for offshore safe depth/areas
- Develop general mitigation strategies for Local Hazard Mitigation Plans (LHMPs)
- Request additional "forecast wave height" information/points from National Tsunami Warning Center for critical locations
- Strategy for harbor inspections

Maritime Tsunami Planning "Checklist"

Potential long-term information/products to be determined/produced:

- Develop maritime Emergency Response Plans (either stand-alone or part of community ERP, Playbook example)
- Develop port/harbor inputs to city/county, approved mitigation plans for LHMPs
- Develop port/harbor recovery plans