2017 Update on NTHMP Maritime Preparedness, Response, Mitigation, and Recovery Planning

By Rick Wilson, Kevin Richards, and Kevin Miller

1) Need for updating and improving maritime planning for tsunamis.

2) Status of addressing NTHMP Strategic Plan measures for maritime planning.

3) Update of MMS/NTHMP Maritime Guidance/Best Practices document.

4) Update on draft NTHMP Guidance to USCG for Safe Minimum Offshore Depth for Vessel Movement.

5) Status of the current benchmark workshop report.

6) Update on NTHMP partner states/territories/ commonwealths and NOAA are working on to address maritime: 1) outreach/preparedness;
   2) response planning; and
   3) mitigation and recovery planning.

March 2011: Post tsunami; Boats sunk; recovery efforts in Crescent City Harbor

Needs and Lessons Learned from Recent Tsunamis

March 2011: During tsunami in Santa Cruz Harbor

- **Inconsistent response activities, including If/When/Where to reposition vessels**
- **Educate boat owners about tsunami hazards to help them make better decisions**
- **Better collaboration between State/NOAA with maritime officials, including harbormasters, Coast Guard and Navy**
- **Ongoing mitigation and recovery issues: What can be done to improve tsunami resistance and resiliency in harbors?**
- **Guidance (State and National) for consistent response planning**

March 2011: Tsunami damage to boats and docks in Brookings Harbor, Oregon

March 2014: Rebuild in "tsunami resistant" Crescent City Harbor

NTHMP 2013-2017 Strategic Plan – Maritime Strategies and Milestones

Strategy	Sub-committee	Milestone	Status
Develop new tsunami hazard products to assist the maritime community and meet emergency management and other NTHMP customer requirements.	MMS	**Review existing demonstration projects and develop products guidelines** (including offshore safety zones, drawdown, and currents) for maritime planning by end of 2013.	Draft guidelines for mapping and modeling complete and available for use.
		Benchmark numerical tsunami models for use on maritime products to ensure NTHMP funded models meet NOAA-NTHMP standards by end of 2015.	Complete.
		Develop prototype maritime products for one community within each high tsunami hazard state/territory by the end of 2015.	Complete for most high-hazard states/territories.
		Dependent on success of the two above milestones and emergency management and other NTHMP customer requirements, **develop maritime products for 25% of threatened communities** within each high tsunami hazard state/territory by the end of 2017.	Not complete. Most partners still working towards 25% milestone.
Support tsunami outreach efforts to specific audiences such as coastal residents and businesses, media, maritime community, and tourism	MES	Support the maritime community in **developing educational resources and preparedness efforts** by end of 2017.	Work Group formed to produce guidance. Many partners actively moving forward with outreach and response planning.

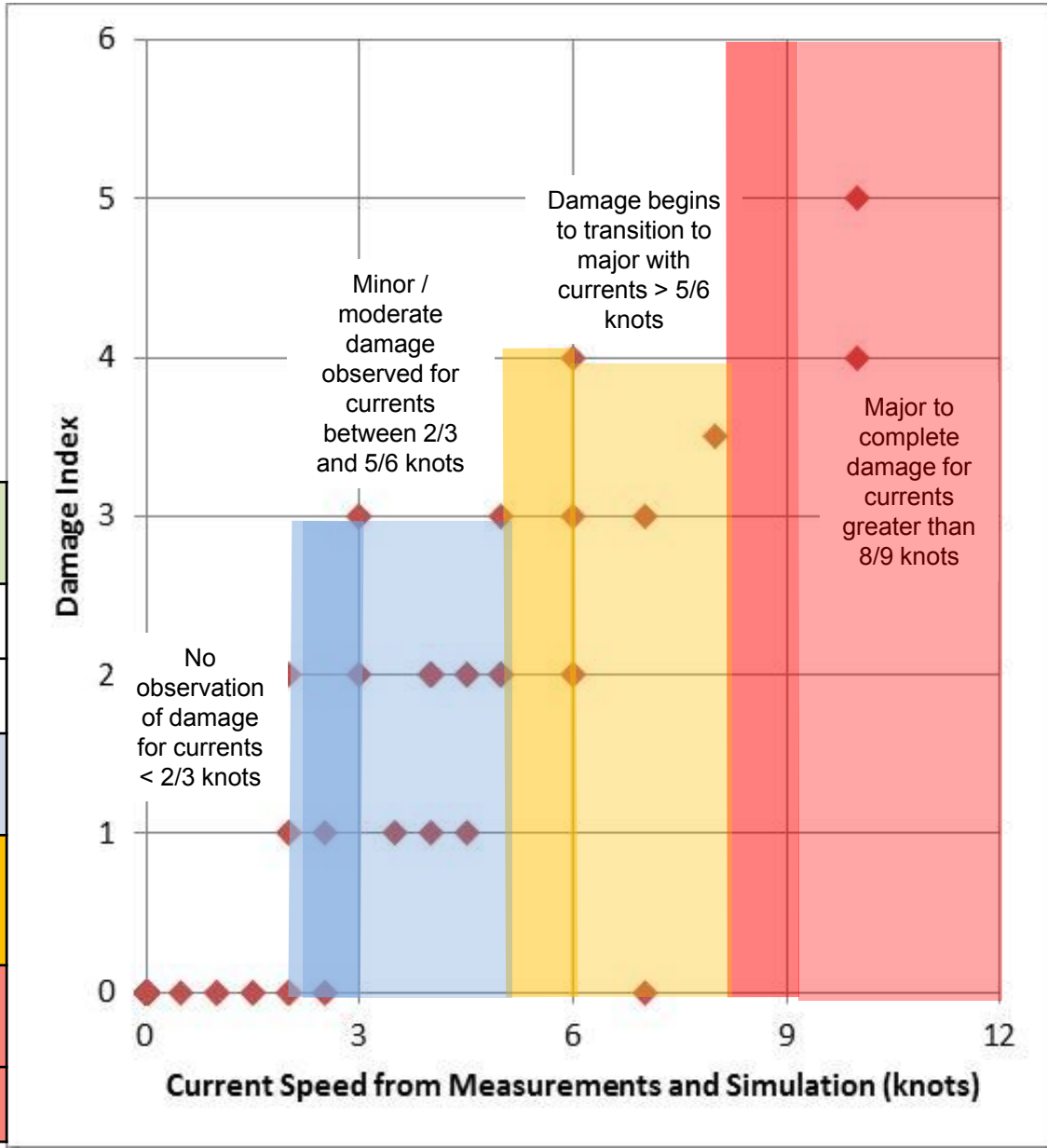
Note: Although not specific to maritime planning, other Strategic Plan Milestones recommend or include development of generic decision support tools and assistance with mitigation planning. Recovery planning is also discussed in the Strategic Plan as a need.

Demonstration Project Review – CA Tsunami Current Hazard Maps

- **Can we filter this information, create areas where certain levels of damage might be expected?**
- **Developed relationship between tsunami currents and damage**
  - **Based on previous observations of damage, and numerical hindcast & direct speed measurements at the damage location**

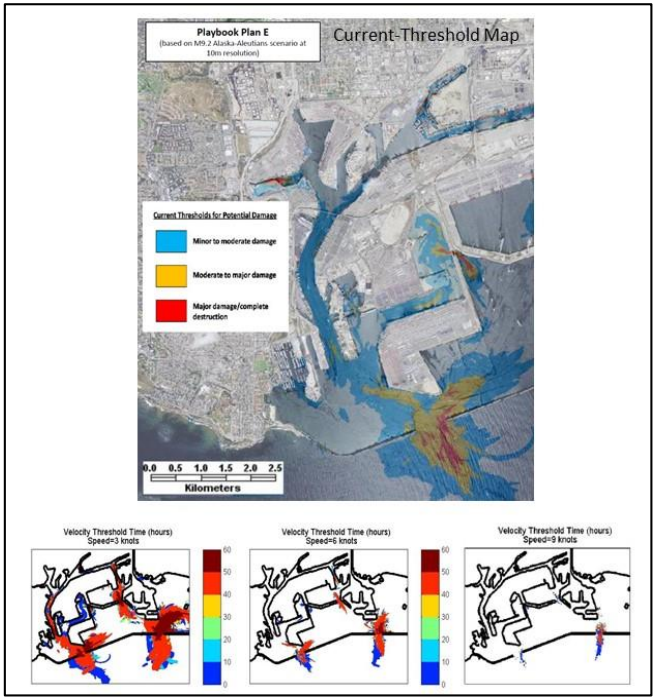
Damage Index:	Damage Type:
0	no damage
1	small buoys moved
2	1-2 docks/small boats damaged, large buoys moved
3	Moderate dock/boat damage, mid-sized vessels off moorings
4	Major dock/boat damage, large vessels off moorings
5	Complete destruction

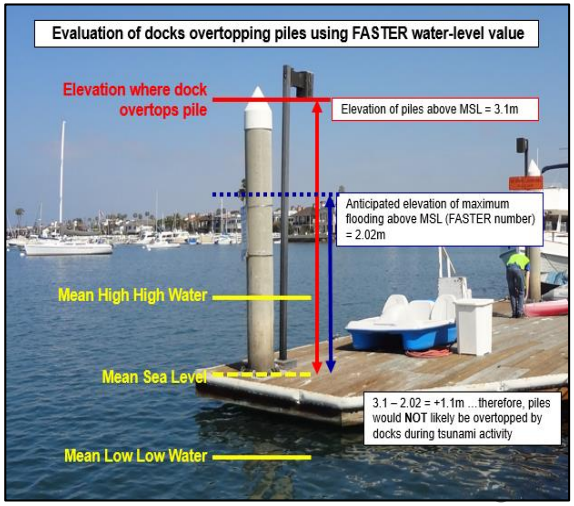
From Lynett and others (2013)



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

Draft initially available December 2015; updated in 2016





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

Example of Real-Time Recommendations from State
Multi-Level Response (Playbook) Approach

Real-time recommendation from State:

Communities/Harbors	Recommended MINIMUM Tsunami Response Playbook Plan, based on tsunami forecast amplitude (wave height)	Tsunami forecast amplitude (wave height), in METERS above existing conditions, from National Tsunami Warning Center
Port of Oakland	Response Plan B	0.5
Alameda Marinas	Response Plan A	0.5
East San Francisco	Response Plan B	0.4
North San Francisco	Response Plan B	0.7
Pillar Point Harbor	Response Plan B	0.8
Santa Cruz Harbor	Response Plan B	0.8
Moss Landing Marinas	Response Plan B	0.6
Monterey Harbor	Response Plan A	0.5
Morro Bay Marinas	Response Plan B	0.7
Santa Barbara Harbor	Response Plan A	0.5
Ventura Harbor	Response Plan A	0.5

DRAFT 03/20/2015

California Maritime Tsunami Response Playbook And Mitigation Guidance

Santa Cruz Harbor – Santa Cruz County

Maritime Tsunami Response Playbook (MTRP) No. 2015-SCruz-01

DURING AN EMERGENCY, USE THE "QUICK REFERENCE" SHEET ON THE BACK PAGE (PAGE 22).

(For the expanded Playbook format, use directions on page 7)

nia Maritime Tsunami Response Playbook No. 2015-SCruz-01

California Geological Survey
California Governor's Office of Emergency Services
University of Southern California
Humboldt State University
National Oceanic and Atmospheric Administration

Funded by the Federal Emergency Management Agency and the National Tsunami Hazard Mitigation Program

FEMA

APPENDIX
Quick Reference Page for Determining Real-Time Maritime Tsunami Response Activities

Step 1: Obtain basic information about the earthquake and tsunami from National Tsunami Warning Center in Alaska, regional National Weather Service office, and/or county emergency manager. **NOTE: Tsunami Alert Level may change in first couple hours after the earthquake; WATCH may be upgraded to ADVISORY or WARNING.**

Earthquake location _____
Earthquake magnitude _____
Tsunami Alert level (circle one) WATCH ADVISORY WARNING
Closest forecasted tsunami amplitude/wave height _____
Forecasted tsunami arrival time _____

Step 2: Tsunami evacuation and response will depend on the amount of time before the tsunami arrival. Four (4) hours is considered the threshold time needed for evacuation. As a quick reference, we offer the following guidance:

1) **If less than four hours before tsunami arrival, we recommend the following:**
   - ADVISORY – evacuate beaches, harbor docks, and piers
   - WARNING – evacuate entire maximum on-land evacuation zone, or follow guidance provided by local emergency manager

2) **If greater than four hours before tsunami arrival**, and your harbor has fully developed its tsunami response Playbook plans, the harbor can utilize the FORECAST AMPLITUDE from Step 1 on the table on the right to identify the appropriate response plan to use.

Reference Pages for Details in Maritime Playbook	Scenario Playbook Plan Letter	Peak Amplitude/wave height (in meters above existing conditions at harbor entrance)
	(No action)	0.2
Page 8-9	A	0.5
Page 10-11	B	0.8
Page 12-13	C	1.3
Page 14-15	D	1.5
Page 16-17	E	6

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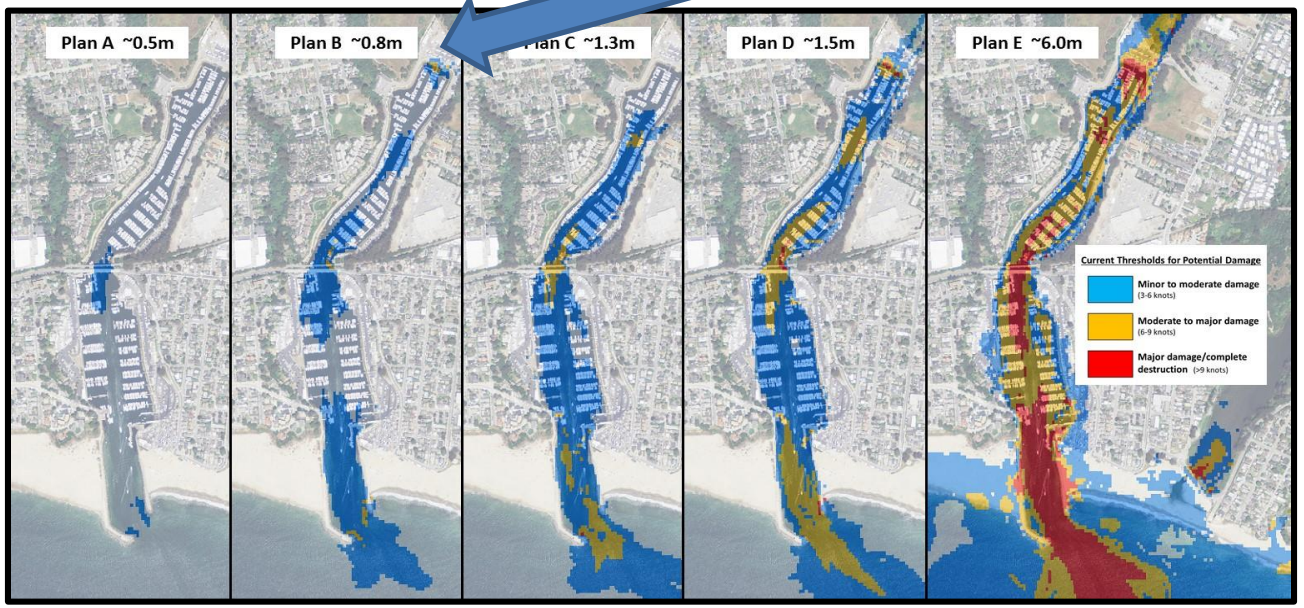
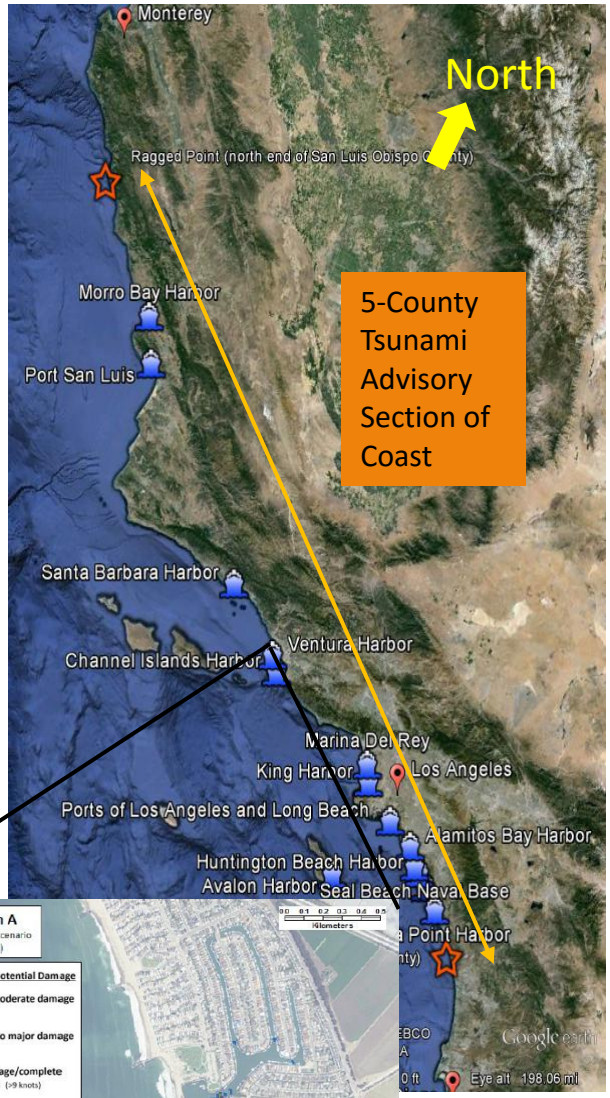


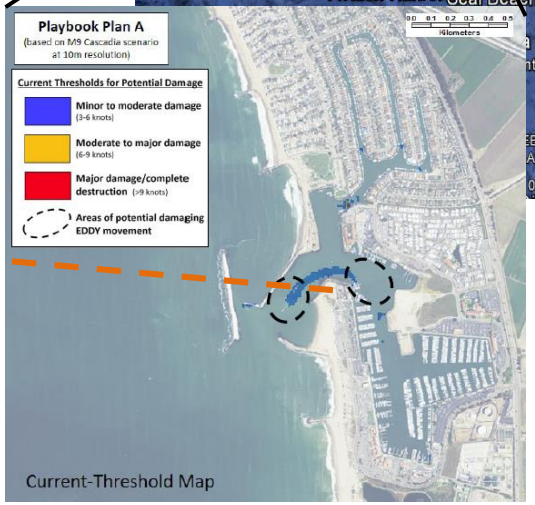
REAL-TIME USE OF PLAYBOOKS

September 16-17, 2015 Tsunami from Chilean M8.3 EQ

- 15 ports and harbors within 5 county Tsunami Advisory zone
- State recommended potential Playbook and actions in real-time
- All harbors in Advisory zone below lowest Playbook Plan (Plan A ~ 0.4-0.6m) because highest forecast wave height 0.3m
- Many harbors surveyed indicated using Maritime Response and Mitigation Playbooks during event
- Harbors monitored and controlled activity around projected areas of moderate-to-high currents

Tsunami currents entering Ventura Harbor 9-17-15; video from Dr. Pat Lynett.





Maritime Response and Mitigation Planning Products

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

California

DRAFT 06/16/2015

California Maritime Tsunami Response Playbook And Mitigation Guidance

Crescent City Harbor – Del Norte County

Maritime Tsunami Response Playbook (MTRP) No. 2015-DN-01

DURING AN EMERGENCY, USE THE "QUICK REFERENCE" SHEET ON THE BACK PAGE (PAGE 22).

(For the expanded Playbook format, use directions on page 7)

California Maritime Tsunami Response Playbook No. 2015-DN-01

California Geological Survey
California Governor's Office of Emergency Services
University of Southern California
Humboldt State University

Oregon

Maritime Guidance for Distant Source Tsunami Events

Ports of Newport and Toledo
Lincoln County, Oregon

Oregon Maritime Tsunami Response Guidance (MTRG) No. 2015-OR-01

Maritime response guidance in this document is based on anticipated effects of a **maximum-considered distant tsunami event**, scenario **AKmax** of the Oregon Department of Geology and Mineral Industries (see www.oregontsunami.org for more information on this scenario). Smaller distant source tsunamis will occur more commonly and are likely to cause significantly less damage than this maximum considered scenario. Check with local authorities for more specific guidance that may be appropriate for smaller distant tsunami events.

Alaska

1 | DRAFT

Maritime Guidance for Distant and Local Source Tsunami Events

Kodiak and St. Paul Harbors, Alaska

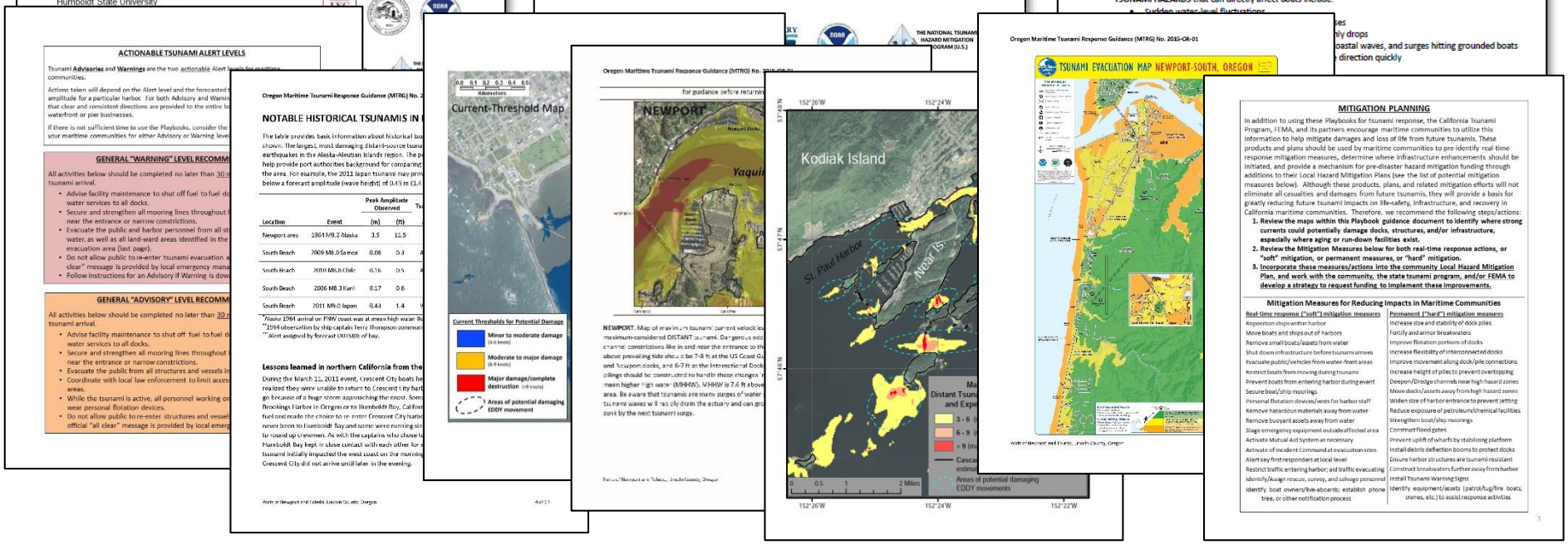
Maritime response guidance in this document follows the draft guidance developed by the National Tsunami Hazard Mitigation Program (NTHMP) is based on anticipated effects of a **maximum-considered distant and locally generated tsunami event**. Although smaller tsunamis occur more frequently, they are unlikely to cause significant damage compared with the maximum considered scenarios. Check with local authorities for more specific guidance that may be appropriate for smaller distant tsunamis.

INTRODUCTION

Tsunamis are typically triggered by earthquakes and will cause sudden water level and current changes for many hours after their first arrival. The location of the earthquake plays an important role in determining the tsunami travel time to the coastal community. Distant earthquakes far away from the Southcentral Alaska coast may produce tsunami that strike *approximately* 4 hours or more after the earthquake, whereas locally occurring earthquakes near Kodiak Island may generate waves that hit the shore within minutes. This document provides response guidance in the event of tsunamis for **SMALL CRAFT** (vessels under 300 gross tons) such as recreational sailing and motor vessels, and commercial fishing vessels. The first part of this document outlines the guidance for **DISTANT TSUNAMI**, whereas the second part is devoted to **LOCAL TSUNAMIS**.

Tsunami wave impacts are greatest in and around ocean beaches, low-lying coastal areas, and bounded water bodies such as harbors and estuaries. These areas should always be avoided during tsunamis. Any tsunami event can threaten harbors, facilities, and vessels.

TSUNAMI HAZARDS that can directly affect boats include:



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

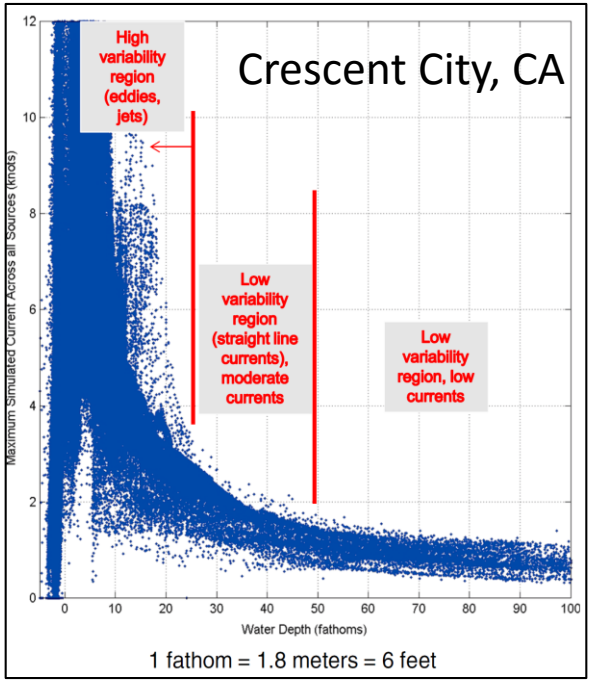
- If you are on land or tied up at the dock: Do not attempt to take your vessel offshore. Leave your boat and go to high ground on foot as soon as possible. You do not have time to save your boat in this situation and put your life at risk if you try to do so.
- If you are in deep water or very close 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.

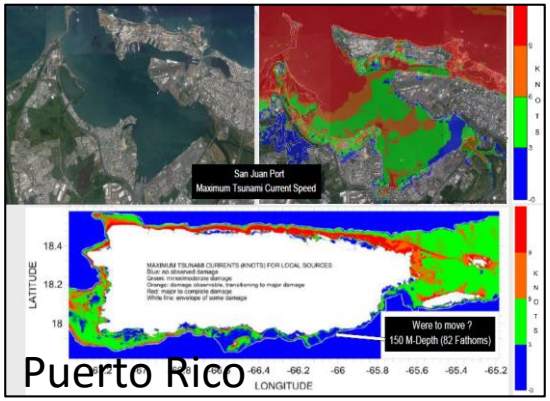
LARGE DISTANT-SOURCE TSUNAMI – Tsunami arrival at least two-hours away

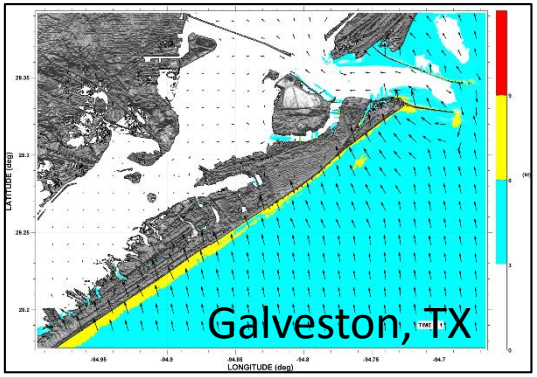
- It is NOT recommended that boaters try to take their vessels offshore before or during a tsunami. It is safer to keep your boat docked during a tsunami because most tsunamis are relatively small, and your personal safety is more important than saving your property/boat.
- On the rare occasion when 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.

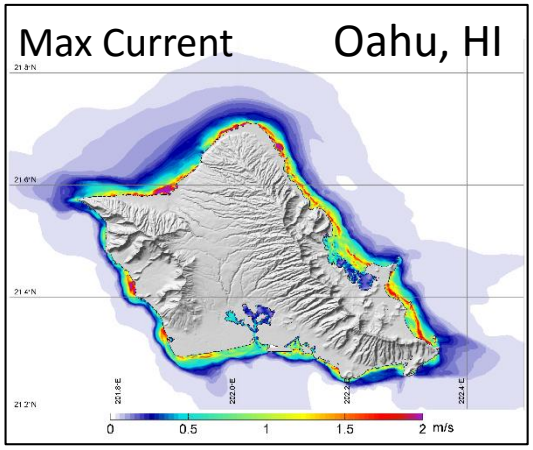
Guidance for Safe Minimum Offshore Depth for Vessel Movement

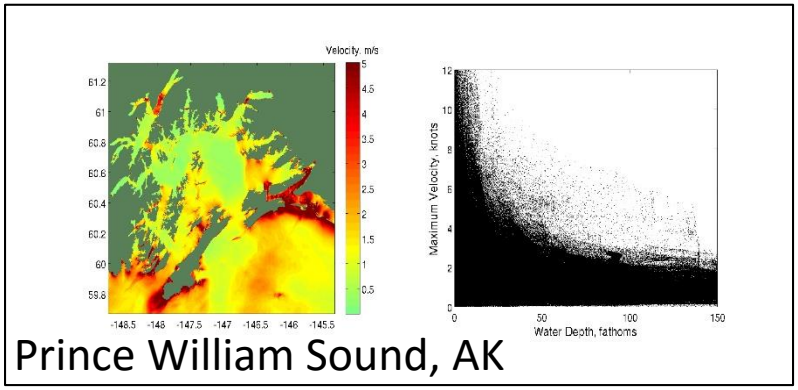
Regional evaluation of current speed vs. water depth to determine minimum offshore safe depth











Guidance for Safe Minimum Offshore Depth for Vessel Movement

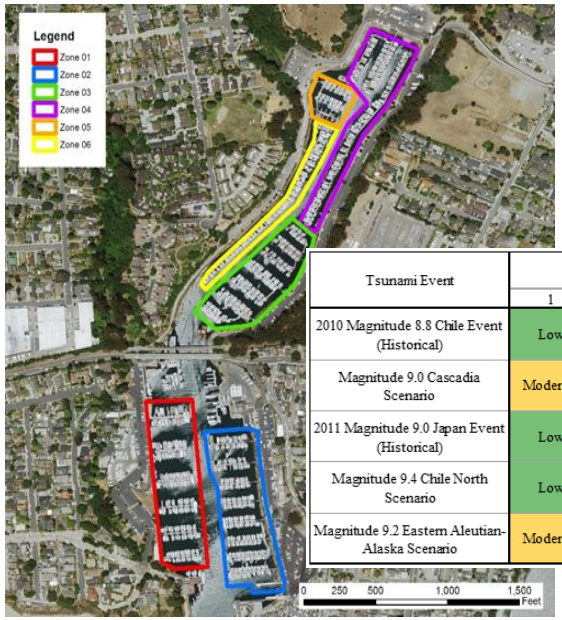
Work between NTHMP States/Territories and U.S. Coast Guard

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**

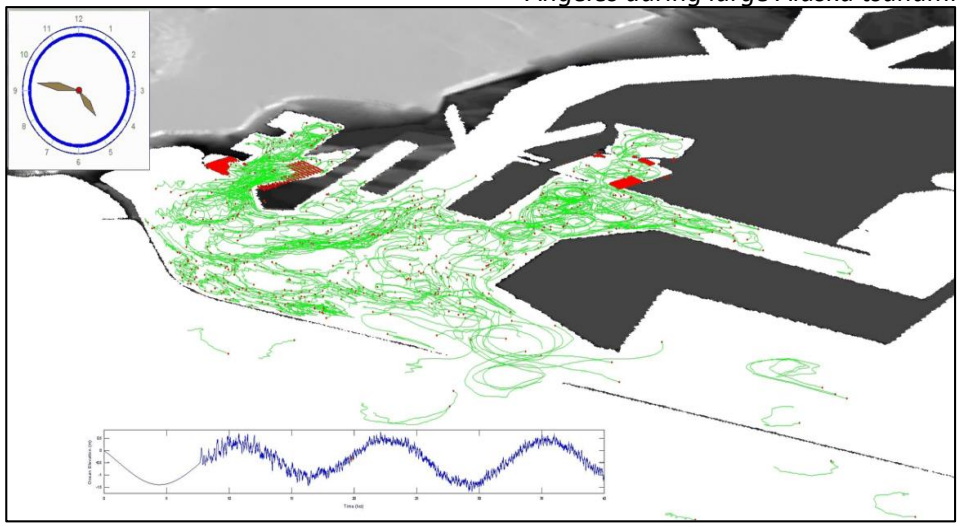
Maritime Tsunami Mitigation and Recovery Planning Work in CA with FEMA



Harbor Improvement Report for Santa Cruz – Key locations where damage may occur within harbors

Tsunami Event	Zone					
	1	2	3	4	5	6
2010 Magnitude 8.8 Chile Event (Historical)	Low	Low	Low	Low	Low	Moderate
Magnitude 9.0 Cascadia Scenario	Moderate	Moderate	Low	Moderate	Low	High
2011 Magnitude 9.0 Japan Event (Historical)	Low	Low	Moderate	Moderate	Low	Moderate
Magnitude 9.4 Chile North Scenario	Low	Moderate	Moderate	Moderate	Low	Moderate
Magnitude 9.2 Eastern Aleutian-Alaska Scenario	Moderate	Moderate	Moderate	Moderate	Moderate	High

Model of potential debris movement in Port of Los Angeles during large Alaska tsunami



Maritime Tsunami Mitigation Planning

Harbor Improvement Reports, coastal piers, and other products that integrate risk reduction methods for coastal hazards (tsunami, SLR, storm, etc.) into Local Hazard Mitigation Plans.

Maritime Tsunami Recovery Planning

Guidance for harbors, communities, and state to produce recovery plans for large local- (Cascadia) and distant-source events.

Direct Impacts (Damage):

- Vessels, docks, and harbor infrastructure damage
- Permanent land change in large local source EQ
- Debris in water and on land
- Sedimentation and scour
- Contaminants in water and sediment

Indirect Impacts (Time):

- Commercial fishing and shipping disruption
- Waterfront business disruption
- Regulatory redundancy and delays
- Limited resources and funding for recovery
- Loss of business and workforce over time

Project methods and products can form the foundation for NTHMP guidelines or standards for mitigation and recovery planning.

NTHMP Tsunami Current Model Benchmark Workshop

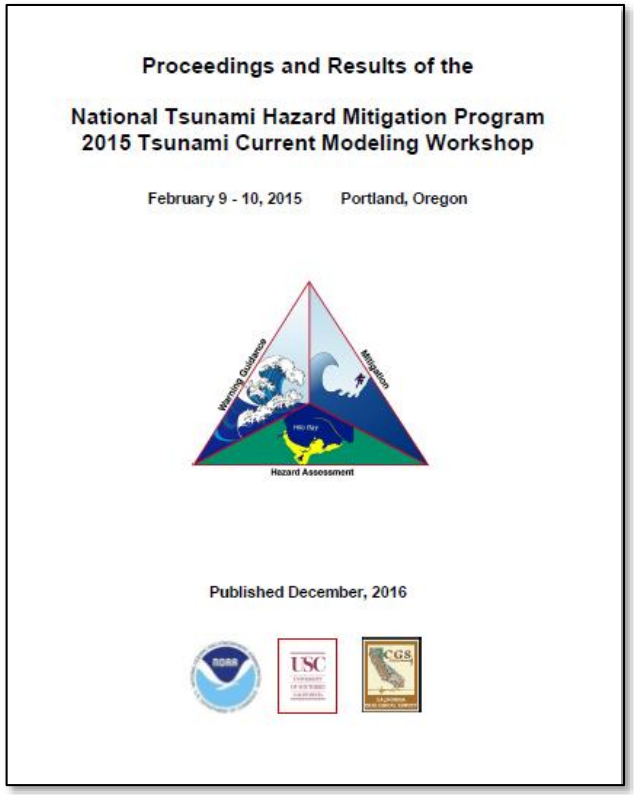
WORKSHOP: Held February 9-10, 2015 with 14 NTHMP and international models participating; five benchmarks were provided with two mandatory benchmarks to run

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.**



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 2018	TBD	Not yet
Gulf Coast	Not yet; inundation modeling/mapping for evacuation planning is priority	Yes; pilot in Galveston Bay and extending study to other areas	TBD; needs to be defined by EM	Not yet
Hawaii	Yes; working with USCG who is taking the lead to consult and develop guidance for users	Yes; completed modeling for Honolulu Harbor and started in Barbers Point Harbor.	Mix of 2-level and multi-level approach; USCG is guiding the needs and response	HiEMA is working on separate project focusing on mitigation and recovery
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	Yes; older guidance for harbors is available; a maritime workshop to be held this summer	Yes; San Juan, Mayaguez, and Ponce studied; Fajardo and Salinas next	TBD; working to determine; cruise ships are biggest issue	Not yet
USVI	Yes; workshops held to discuss tsunami hazards in ports	Not yet; still evaluating contracts for work	TBD	Not yet
Washington	Yes; briefed major maritime players; no brochure has been developed	Yes; modeled Cascadia L1; working in Puget Sound	TBD	Not yet, though may be in WA Resilience Plan
NOAA/ PMEL	Yes; NOAA/NWS outreach/consultation with harbors/ports; outreach materials	Yes; modeling using SIFT; using 3-6-9 knot damage bins in products	Real-time SIFTView forecasts developed; TView platform for EMs	Not yet/NA

Maritime Guidance: Best Practices for Tsunami Hazard Analysis, Planning, and Preparedness

Black was completed by MMS
Green started by MMS and is being enhanced/completed by MES
BLUE will do later in 2017

Contents

MES reviewed offshore guidance portion

MES working on streamlining and improving "General Maritime Guidance"

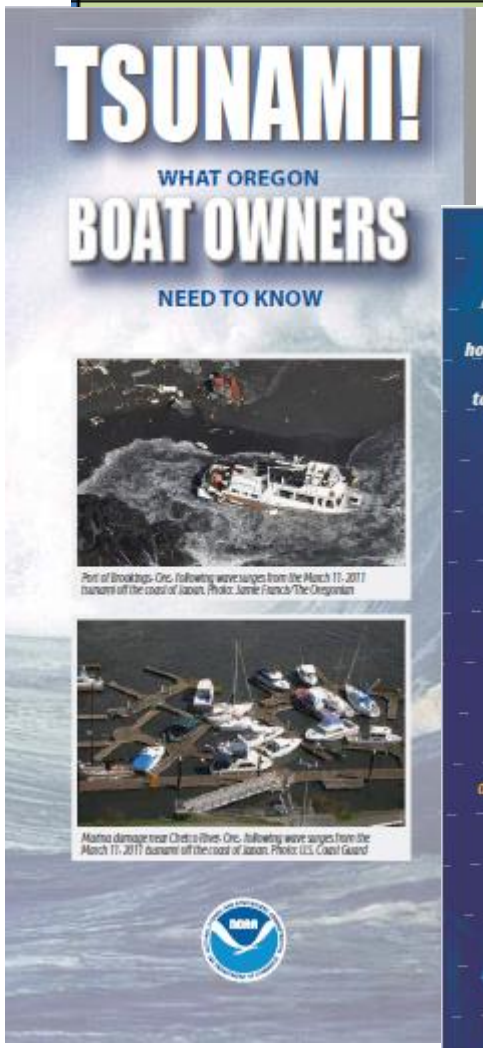
MES will develop "Preparedness and Education…" section

MES work with FEMA to develop guidance for LHMP and funding

MES may wait for mitigation and recovery work in CA to be completed

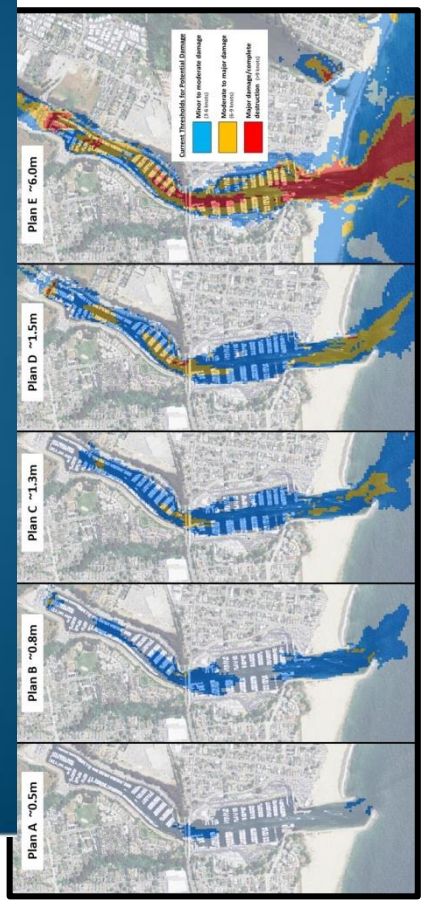
Consistent Outreach Products

2-Level Response Guidance



Warning / Advisory

Multiple-Level Response Guidance



Scenario-specific