

California Maritime Tsunami Preparedness & Response Planning



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California Governor's Office of Emergency Services



**NTHMP Maritime Tsunami Hazard Workshop
August 20, 2014**

TOPICS

Hazard ID: Research & Findings

Products: Tools for Decision Makers

Response: Implementation of Tools...

2011 Tohoku Tsunami in California

- Large tidal fluctuations = 16 feet in Crescent City (largest surges at low tide)
- Strong currents/debris in harbors
- Potential dangerous tsunami conditions lasted for more than 24 hours.
- Impacts: one fatality; two dozen harbors damaged; Official = \$50M; Total ~\$100M



March 11, 2011 Tohoku Tsunami in California; video at 11AM (about 3 hours after first arrival of tsunami) within Santa Cruz Harbor

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Lessons Learned from Recent Real Tsunamis and Tsunami Scenarios

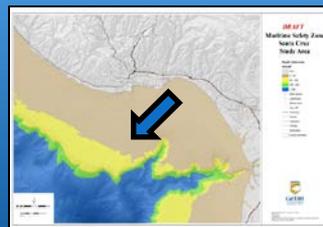
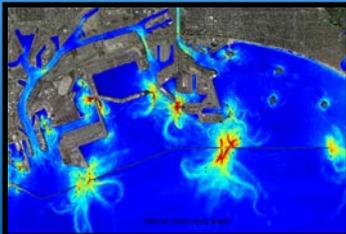
- **Evacuation Issues** – What to do in a minor “Warning”?
- **Maritime Community Issues**
 - If/When/Where to evacuate boats?
 - Educate boat owners about tsunami hazards
 - Ongoing recovery issues
 - What can be done to improve resiliency?



Boats sunk; recovery efforts in Crescent City Harbor

California Tsunami Maritime Safety Planning

1. Create in-harbor hazard maps by modeling major harbors' tsunami hazards [damaging currents]
2. Create offshore safety zone maps for use by harbors that recommend if, when, and where vessels can be repositioned or sent to sea
3. Provide statewide guidance for response planning, harbor protection, and recovery/business continuity [based on above results]



Products / Tools for Emergency Management Decision Makers

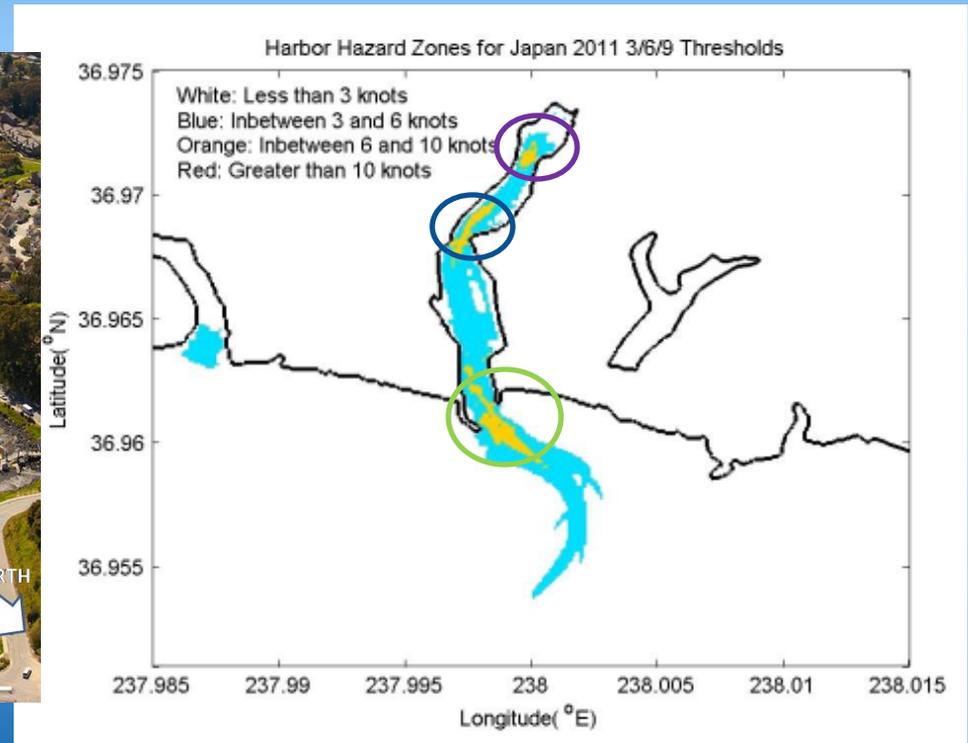
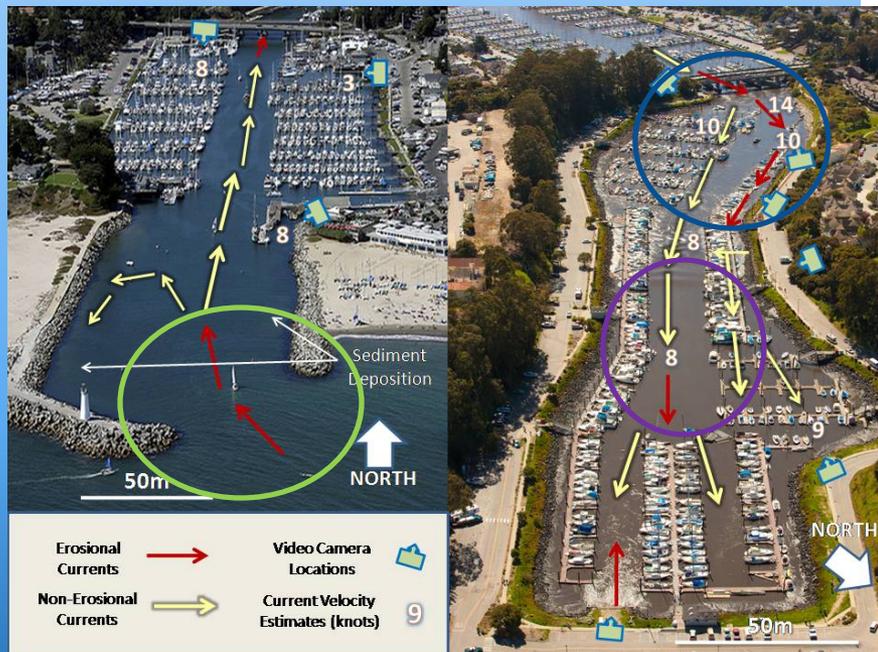
- 1. Areas of dangerous and damaging currents**
- 2. Length of time damaging currents are active**
- 3. Safe offshore depth**
4. Current velocities and relationship to damage
5. Peak-to-trough water-level fluctuations
6. Areas of Bores or amplified waves

Maritime Safety Products

Analysis of 2010 and 2011 tsunamis in pilot study harbors

Crescent City, Santa Cruz, Ventura, Ports of LA/Long Beach, and San Diego Bay

Video and other analyses of currents, sediment scour/deposition, areas of damage, safe areas



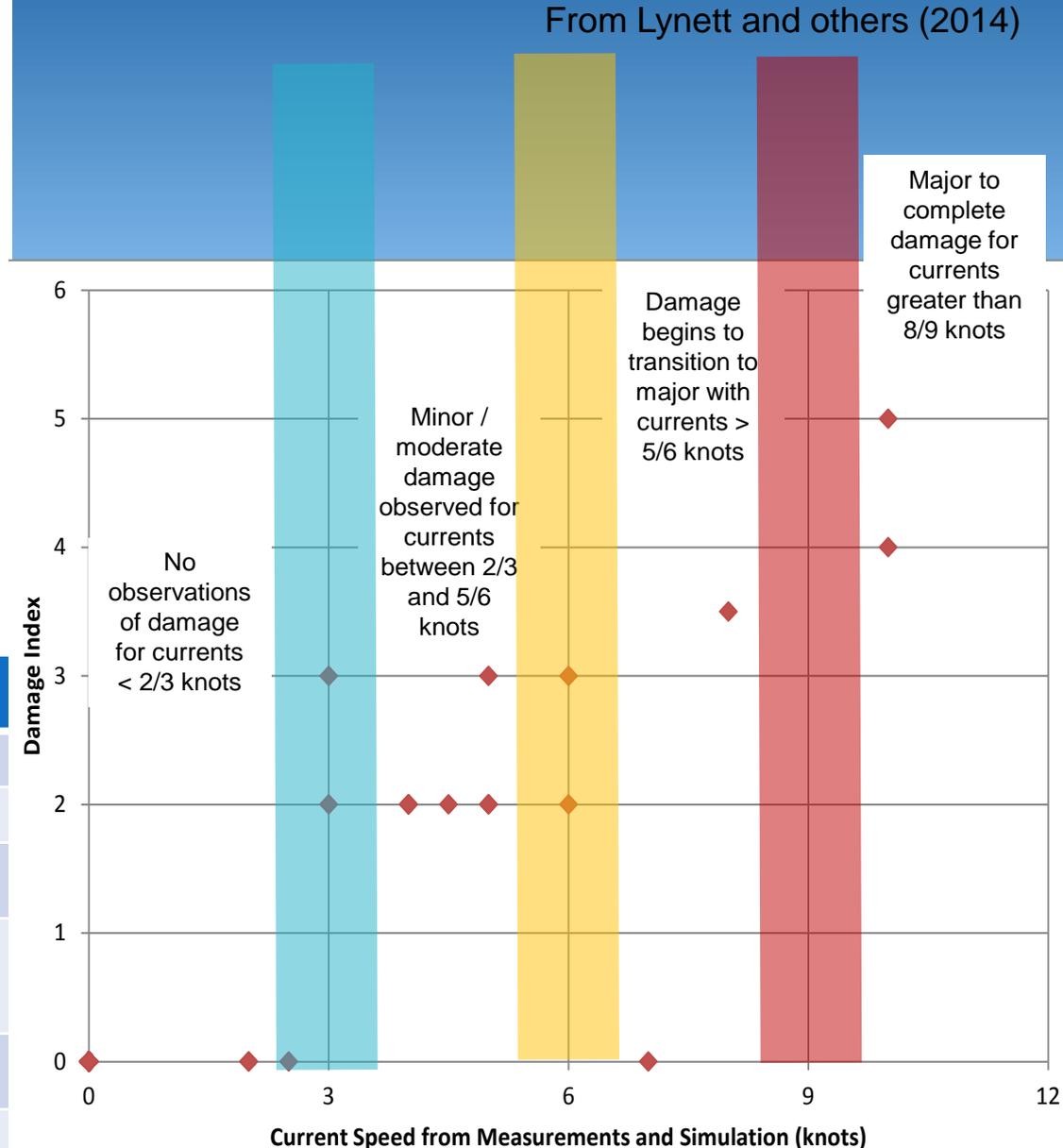
March 11, 2011 tsunami in Santa Cruz

Areas of Dangerous & Damaging Currents Within Harbors

Tsunami Current Hazard Maps

- Can we filter this information, create areas where certain levels of damage might be expected?
- Need to develop 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



2011 M9 Japan scenario at
10m resolution

Current Thresholds for Potential Damage



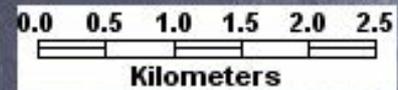
Minor to moderate damage



Moderate to major damage



Major damage/complete
destruction



M9.2 Alaska-Aleutian
scenario at 10m resolution

Current Thresholds for Potential Damage



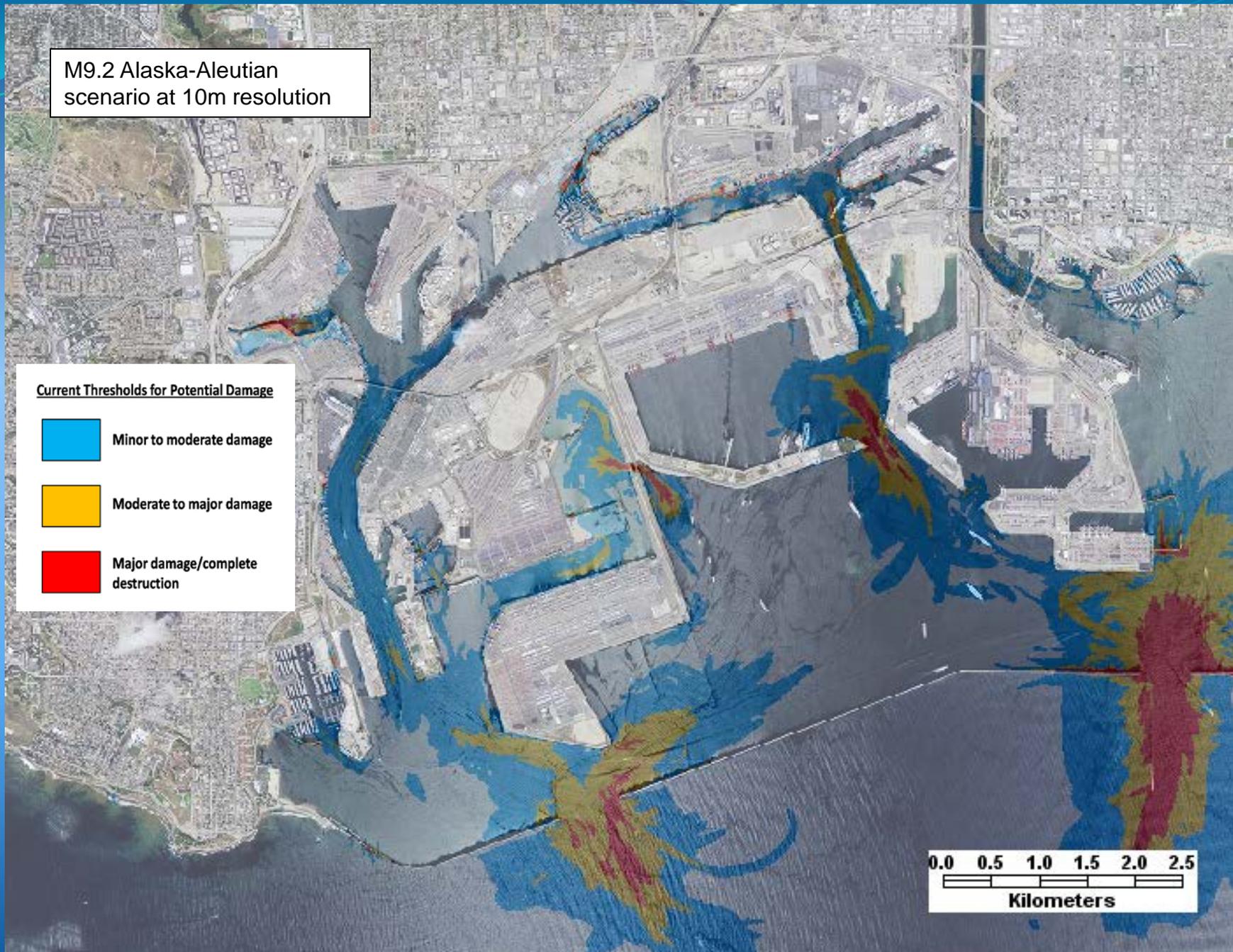
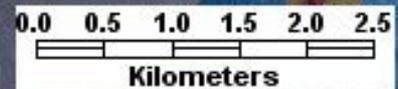
Minor to moderate damage



Moderate to major damage



Major damage/complete
destruction



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)
	(No action)	0.2
Page 8-9	A	0.5
Page 10-11	B	0.6
Page 12-13	C	0.8
Page 14-15	D	1.0
Page 16-17	E	1.2

Each of the over 70 communities in California will get a tsunami forecast value for their location and a recommendation on which associated “phase Playbook” could be followed for the response activities in real time.

The maritime community can refer to the playbook guidance document for the specific instructions to follow.



Playbook Plan D (based on M9.4 North Chile Scenario)

Background Information:

Alert level = Warning

Peak Amplitude = 1.5 meters (modeled)

Peak Velocity = 9+ knots

Projected duration of strong currents (see location map below):

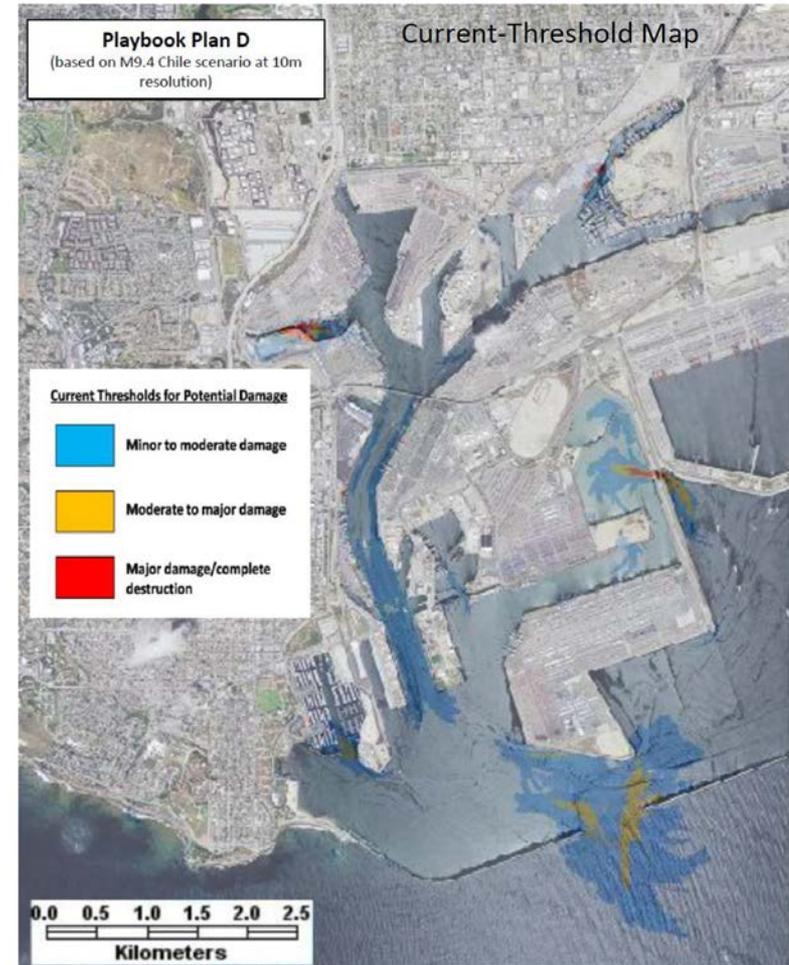
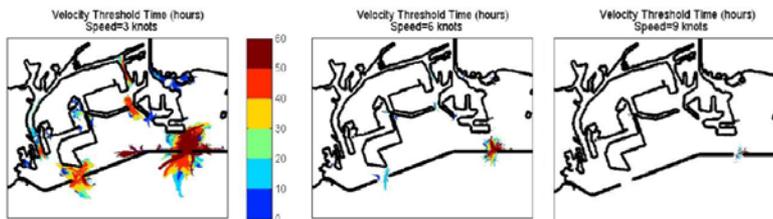
3-6 knots = 50 hrs; 6-9 knots = 10 hrs; >9 knots = 0 hrs

Specific Instructions:

- Follow general guidance for Warning-level tsunamis (Page 5)
- Strong currents and potential scour are expected in areas identified in blue and gold on the map to the right. Consider relocating vessels located within 100 meters (300 feet) of these areas.
- Specific areas where vessels should be relocated from and docks secured:
 - Vessels can be moved to non-blue areas of the port.
 - (completed with maritime community input)

Safe areas for repositioning vessels within POLA:

..... (completed with maritime community input)



Duration of Damaging Currents within Harbors

Dangerous Current Duration Maps

- Example – examine Ventura Harbor, CA
- Create Time-Threshold Map
 - Time-threshold = time interval between arrival of initial wave to a later time after which current does not exceed a given value (threshold)
- For example:
 - **8 knot threshold map**
- Allow for an estimation of how long until location is “safe”
- Useful for showing maximum possible duration of damaging tsunami effects



Offshore Safe Depth for Potential Seaward Evacuation of Ships

Offshore Safety Zones

Evacuation Considerations

Guidance needs to address appropriate groups:

- Large vessels (Military / Container)
- Mid-size vessels (Fishing Fleet)
- Small vessels (Private / Recreational)

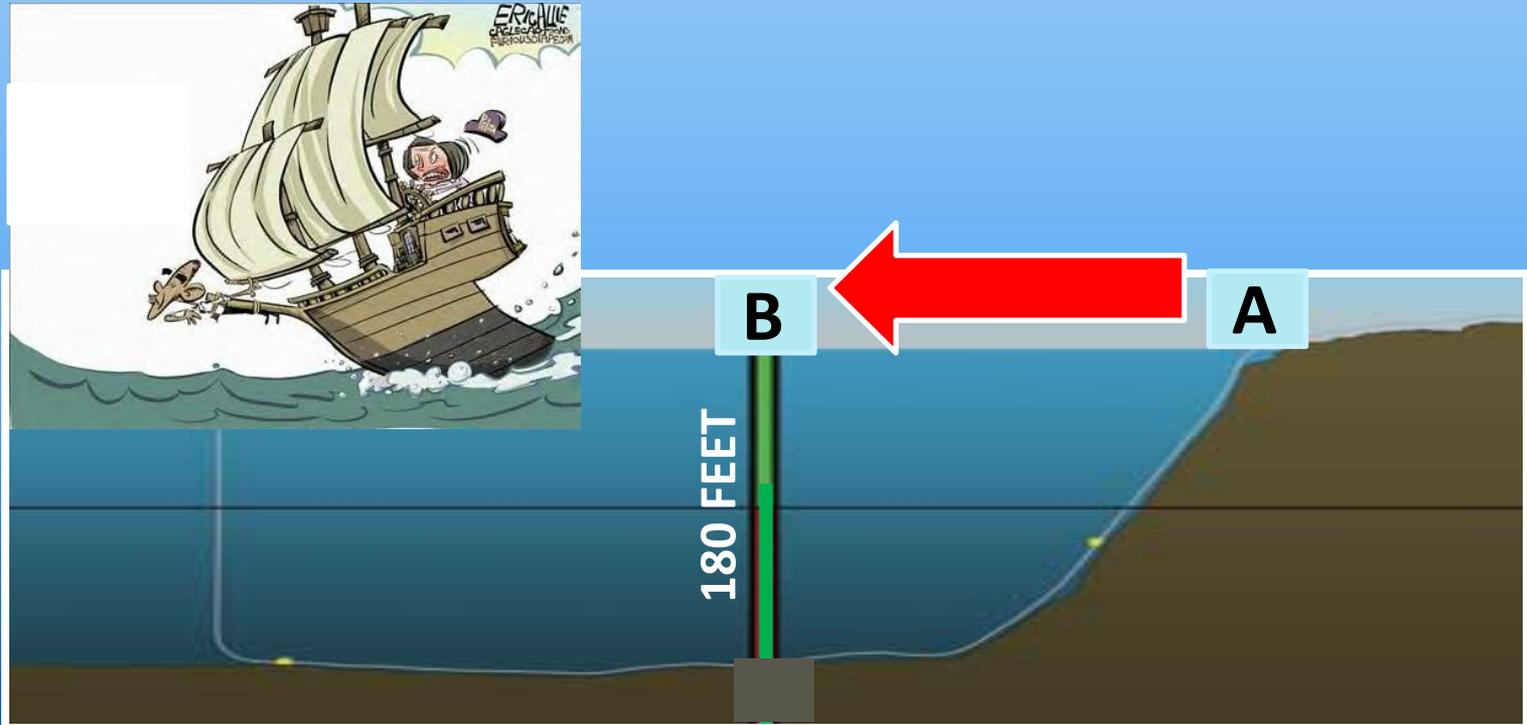
Who do you send to sea?

- Bad weather
- Enough fuel for extended periods (12-24 hours)
- Ability to get to distant ports



Decision Point

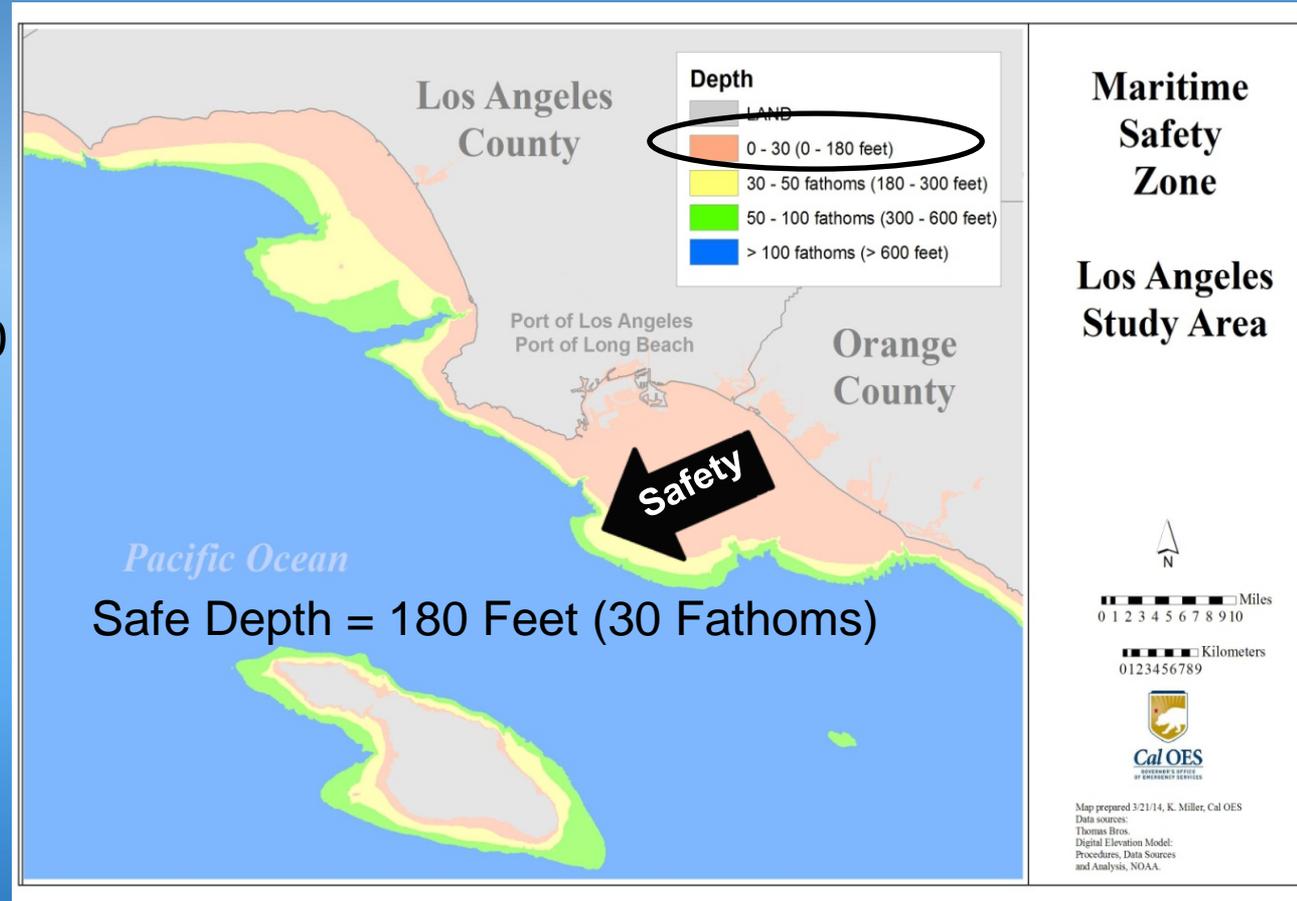
Given a tsunami Warning or Advisory, how long does it take to get from “A” (Feet on the dock) to “B” (Safe Offshore Depth)?



Offshore Safety Zones

“Rule of thumb” for safety from NOAA has been 100 fathoms (600 feet)

Findings now show 30 fathoms (180 feet) is a safe depth.

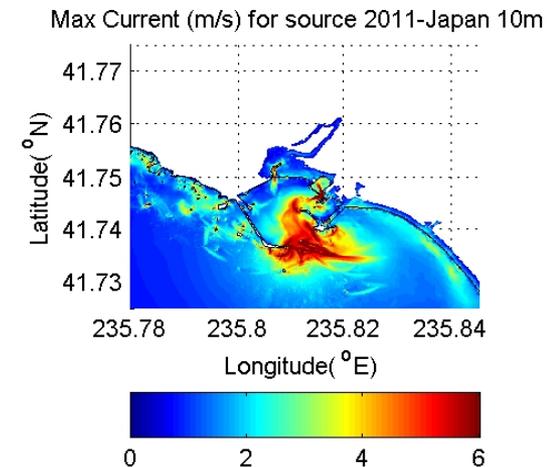
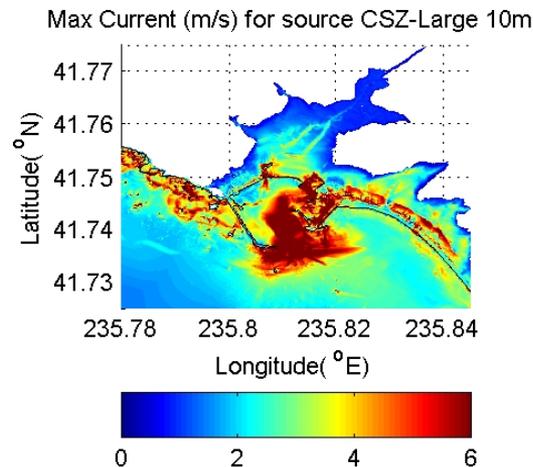
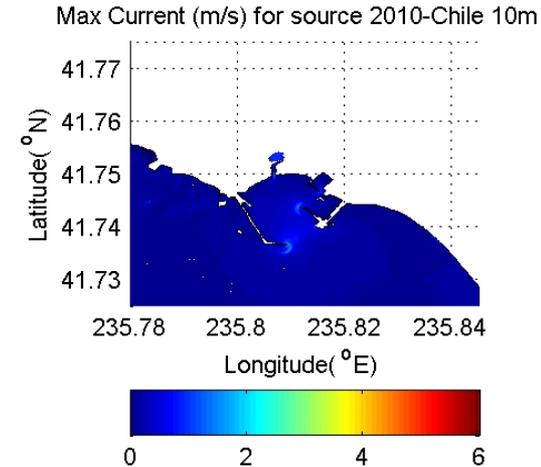
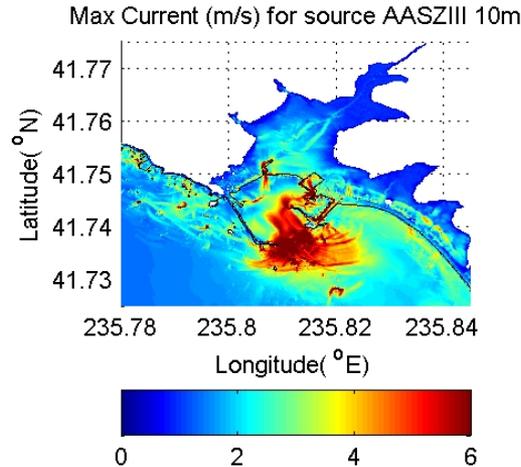


Offshore Safety Zones

Ran simulations for a range for different sources

Here: Crescent City

- **There are a number of conditions which should be met for a depth to be given as “safe,” such as**
 - **No chance of vessel grounding,**
 - **No wave steepness, and**
 - **Readily navigable currents.**



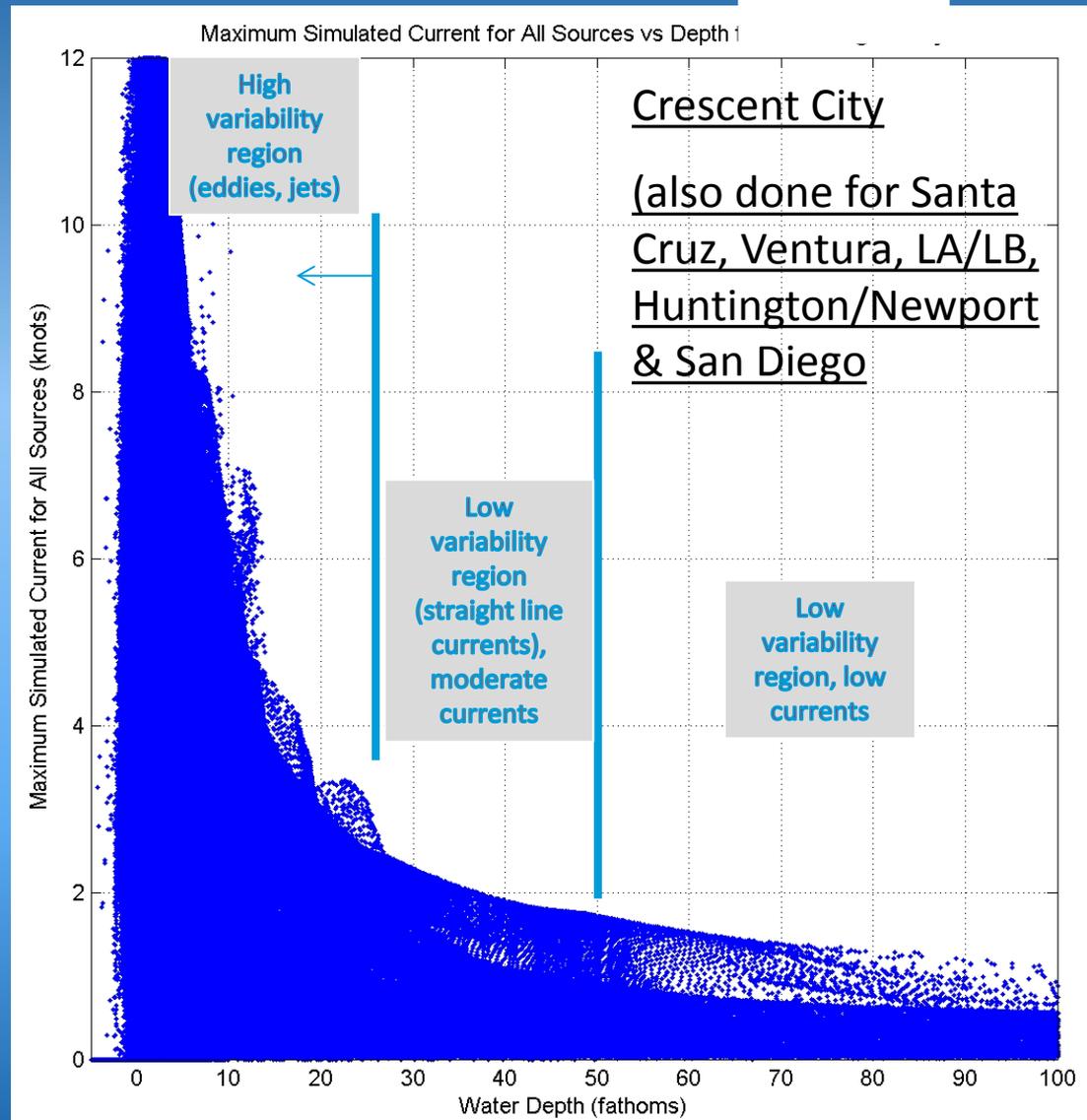
Ran simulations for a range for different sources

Create a maximum current map for each source

Plot the (max current vs. depth) for each source, as a scatter plot

Determine current variability at all depths

Develop “safe” current thresholds, taken from navigation guidelines



1 fathom = 1.8 meters = 6 feet

DRAFT Policy for Offshore Tsunami Evacuation

State of California Tsunami Steering Committee

June 2014

Our fundamental recommendation is not to evacuate vessels offshore prior to the arrival of or during any tsunami. However, if boaters decide to evacuate a harbor/port/marina in advance of a tsunami, scientific evidence indicates navigable and non-damaging conditions offshore in California can be found beyond an ocean depth of 30 fathoms, or 180 feet.

Additional comments and caveats regarding boater safety include:

1. Your personal safety from tsunamis can only be guaranteed by getting to and staying on land, above and beyond the established evacuation zone.
2. Consider whether you have enough time to reach a depth of 180 feet offshore prior to tsunami arrival.
3. Consider your navigational skill to reach distant ports (in some cases hundreds of miles away) if your home port is too damaged to return.
4. Consider your preparedness in terms of having enough fuel, food, water, and clothing to remain at sea for an extended period (24 hours – 36 hours or more).
5. The above considerations, especially preparedness, may be different (better?) for medium to large commercial and military vessels, including the fishing fleet, than for smaller, recreational, private vessels.

Remember, saving your boat is not more important than saving your life!

Implementation of Tools / Findings

1. 30 fathom safe depth adopted by CA Tsunami Steering Committee
2. State policy recommendation memo in draft; going to Cal OES Director
3. Maritime Playbooks provided in 7 Counties
4. Counties can incorporate scientific findings (maps, #'s) into response planning



Maritime Response and Mitigation Product & Activity Schedule

- Maritime Response Playbooks and Offshore Safety Guidance
 - ✓ Fall 2014 – Maps and guidance for maritime communities in parts of 7 counties:
 - ❖ San Diego, Orange, Los Angeles, Ventura, Santa Cruz, Alameda, and Del Norte (+20 harbors total)
 - ✓ 2015 – Maps and guidance for all remaining harbors/ports within state (+70 total) and integration into national standards
- Maritime Mitigation and Recovery Guidance (funding pending from FEMA)
 - ✓ 2015 – Pilot studies new maps and products for integration into Local Hazard Mitigation Plans (LHMPs) for facility and infrastructure improvements
 - ✓ 2016 – 2018 – Production of maps and guidance for all maritime communities statewide

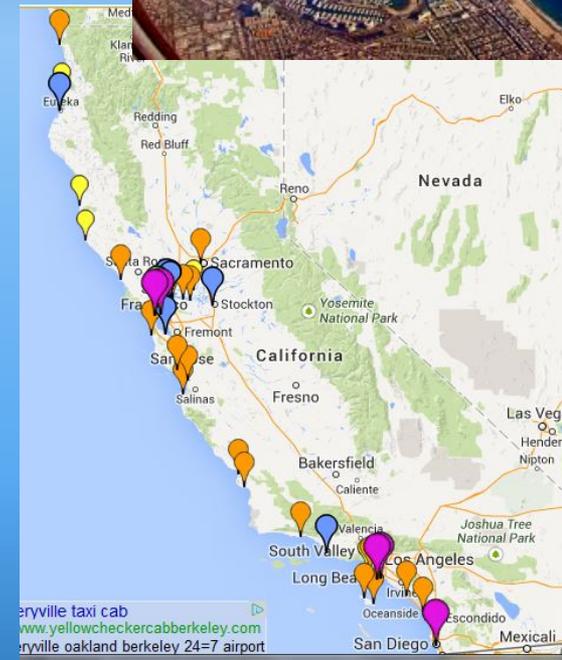
California Maritime Planning

STATEWIDE SCOPE:

- 5 Large Ports (Harbor Safety Committee mandated)
- 70 Small Harbors
- 160 Marinas

KEY PARTNERS:

- Port Authorities, Harbor District Managers
- 20 County / 100 City: Emergency Managers
- US Coast Guard, US Navy, US Border Patrol
- Federal: NOAA, USGS, FEMA
- State: CalOES, CGS, CSSC, Parks, Caltrans



How should boat owners PREPARE for tsunamis?

Prior to arrival of the March 11, 2011 tsunami along the California coast, many boat owners took their boats offshore without adequate supplies or knowledge of how long they would need to stay offshore. As a result, boaters tried to re-enter harbors too early, while dangerous tsunami conditions still existed. They put themselves and harbor personnel at risk of injury and death.

Before you plan to leave safe harbor, consider the following:

- **Talk to the harbor master** or related officials to learn about your harbor's tsunami safety protocols.
- **Sign up to receive tsunami alerts** from NOAA and emergency calls from your harbor master or community emergency services office.
- **Know weather conditions** out on the ocean.
- **Know how long it takes your boat to get to deep water.** The 100-fathom line is the NOAA recommendation.
- **Have adequate supplies** (water, shelter, food) and fuel to remain at sea for 24 hrs or more.
- **Have a family plan** for tsunamis in place so you know your family will be safe.

If you do not have these essential preparedness items covered, **DO NOT attempt to take your boat offshore.** Secure your boat to the dock and leave the dock area before the tsunami arrives.



Other resources for tsunami information in California

Information about tsunamis can come from a variety of sources, but the following sources are the most reliable:

- Harbor masters and port captains
- Local Coast Guard contact
- State and local emergency managers
- Local National Weather Service – Weather Forecast Offices

State of California Tsunami Program
(California Geological Survey website):
www.tsunami.ca.gov/

California Emergency Management Agency Earthquake and Tsunami Program:
www.calema.ca.gov/PlanningandPreparedness/Pages/Tsunami-Preparedness.aspx

NOAA tsunami website: www.tsunami.gov

NOAA – National Weather Service (NWS)

Weather Forecast Offices:

Eureka – www.weather.gov/eka/

San Francisco Bay/Monterey – www.weather.gov/mtr/

Los Angeles/Oxnard – www.weather.gov/lox/

San Diego – www.weather.gov/sdx/

Sign up for NWS alerts and updates by email:
www.weather.gov/emailupdates/index.php

Redwood Coast Tsunami Work Group/ Humboldt State University:
www.humboldt.edu/rctwg/

California Harbor Master and Port Captain Association :
www.harbormaster.org/

Marine Recreation Association:
marina.org

CA Boating Safety Officers Association:
cbsoa.org

TSUNAMIS!

What

BOATERS

should know

