

2013 Update

California Maritime Planning:

In-Harbor Hazard Mapping, Offshore Safety Zones,
and Guidance: Response, Mitigation, and Recovery
Planning

Rick Wilson, California Geological Survey

Kevin Miller, California Office Of Emergency Services



FEMA



Maritime planning products available starting 2013

- **In-harbor tsunami hazard maps**
- **Offshore safety zones for boats**
- **Guidance for maritime response (new brochure)**
- **Response/Recovery/Resiliency**

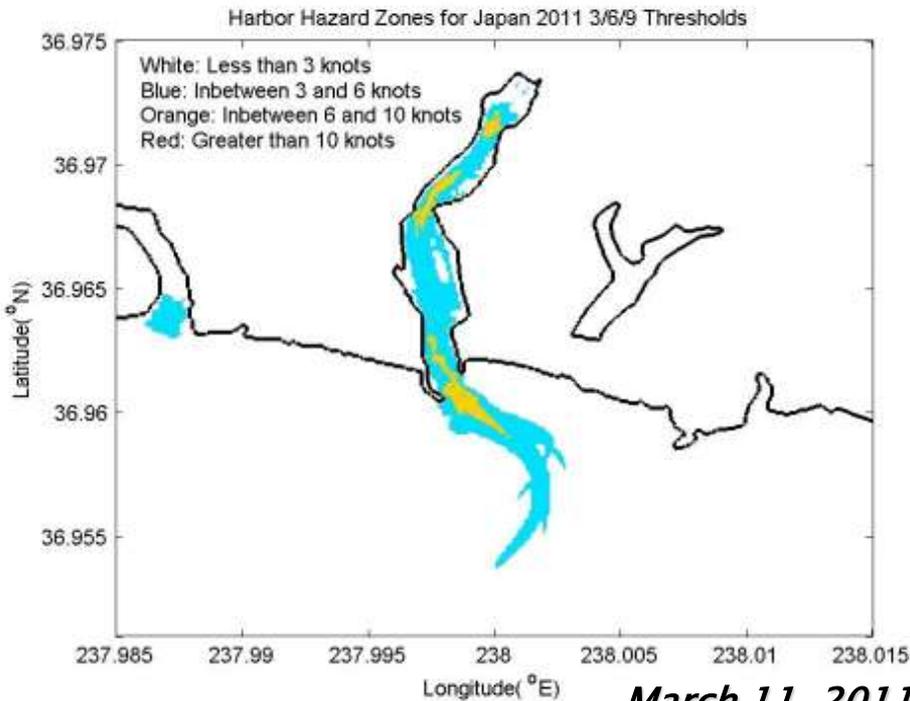


Maritime Safety Products

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



FEMA



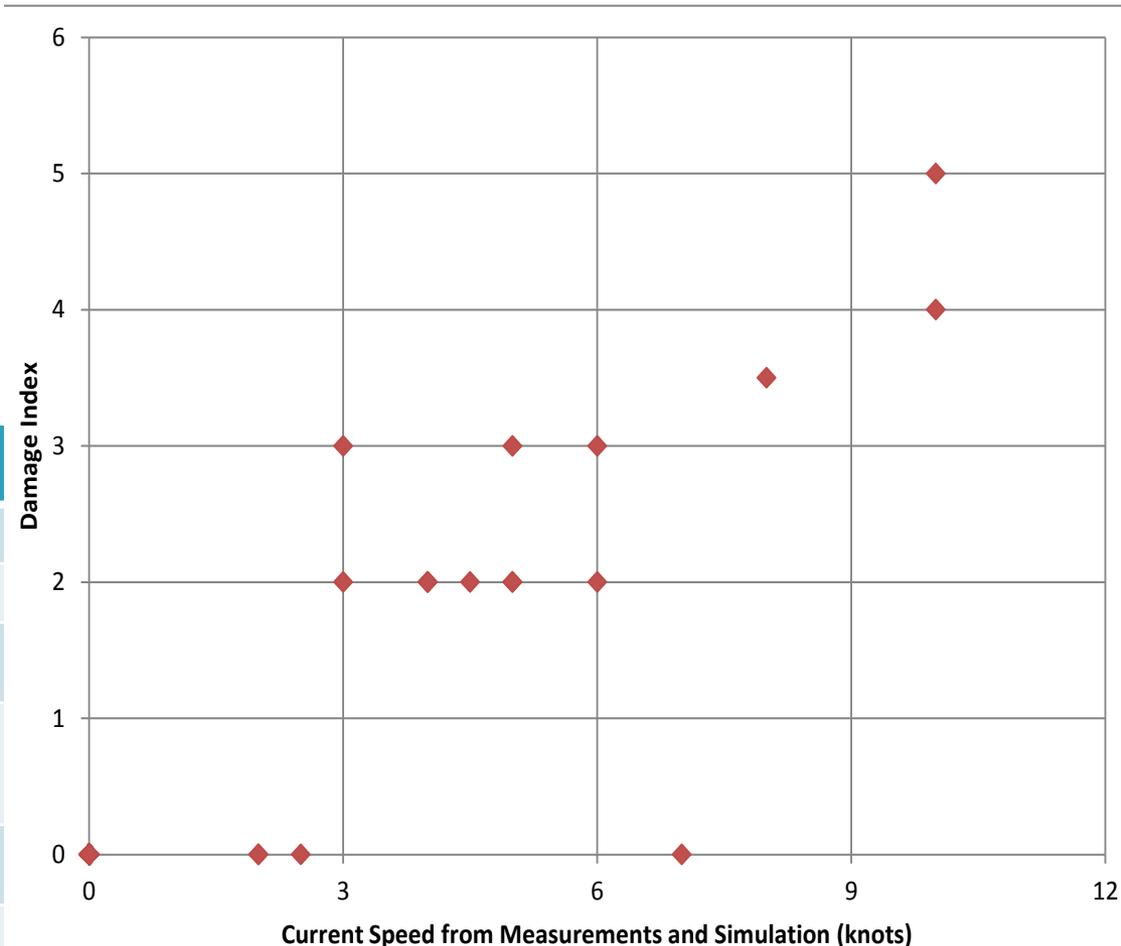
THE NATIONAL TSUNAMI HAZARD MITIGATION PROGRAM (U.S.)

Tsunami Current Hazard Maps

Map Generation

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

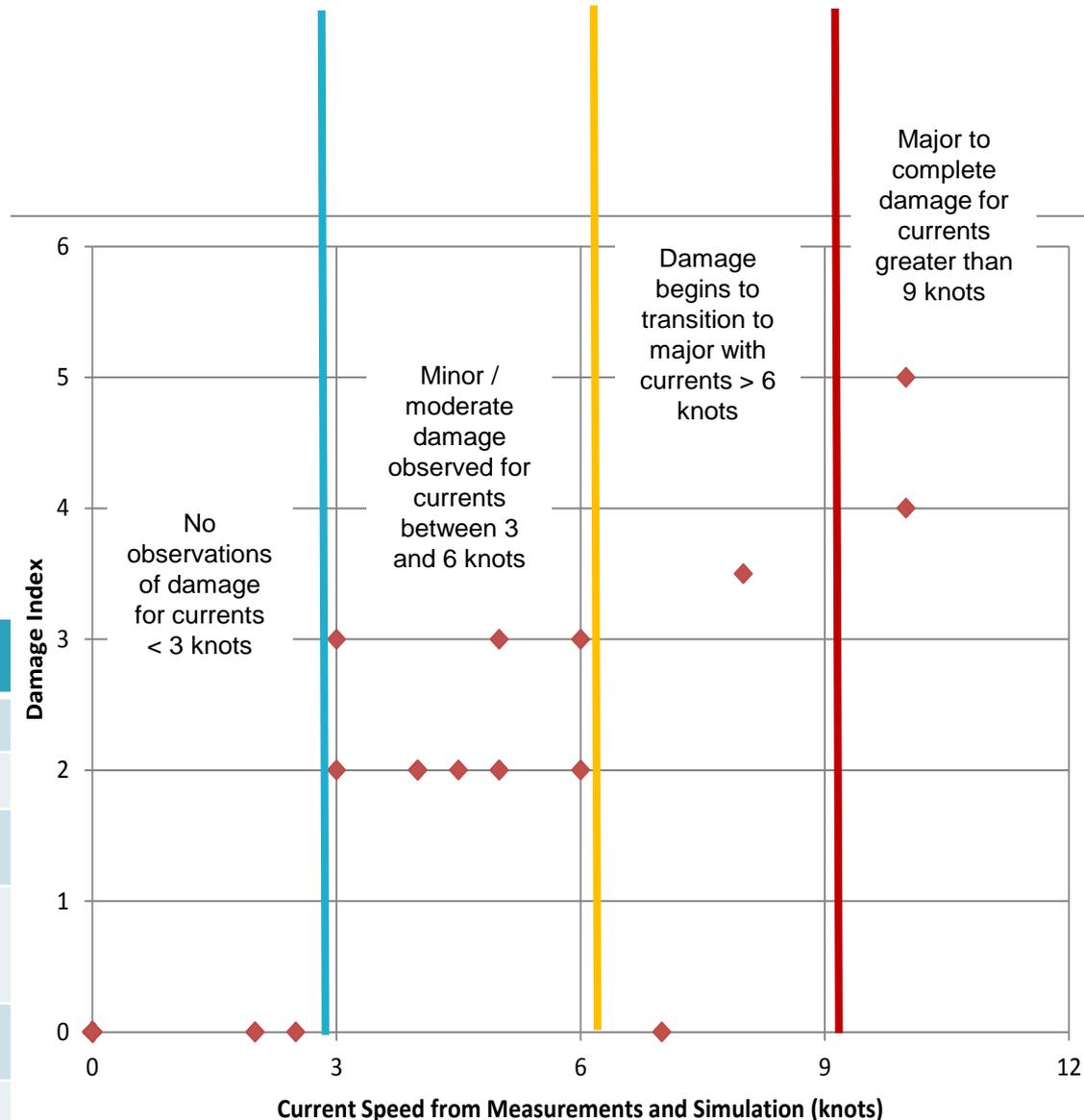


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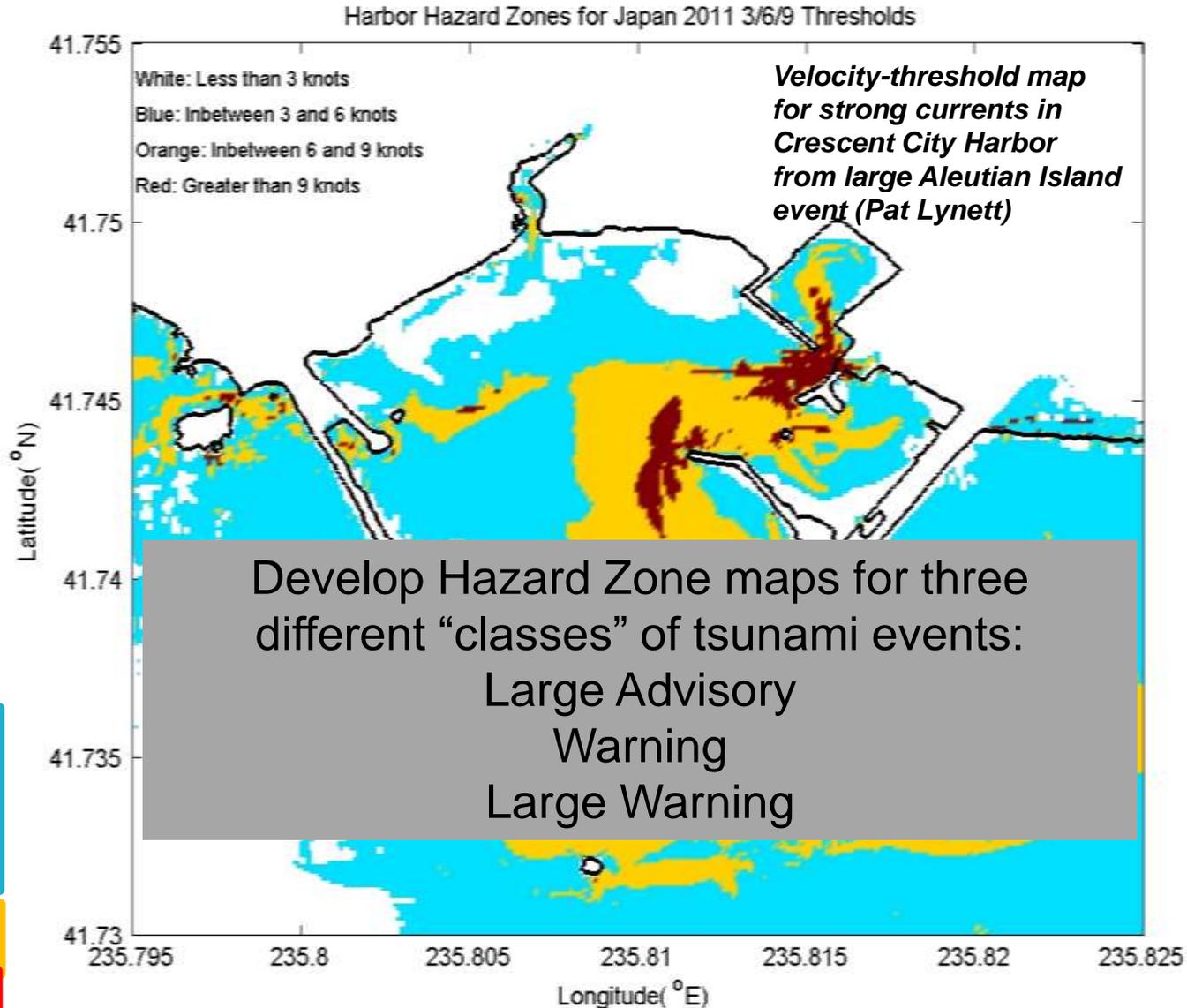
Tsunami Current Hazard Maps

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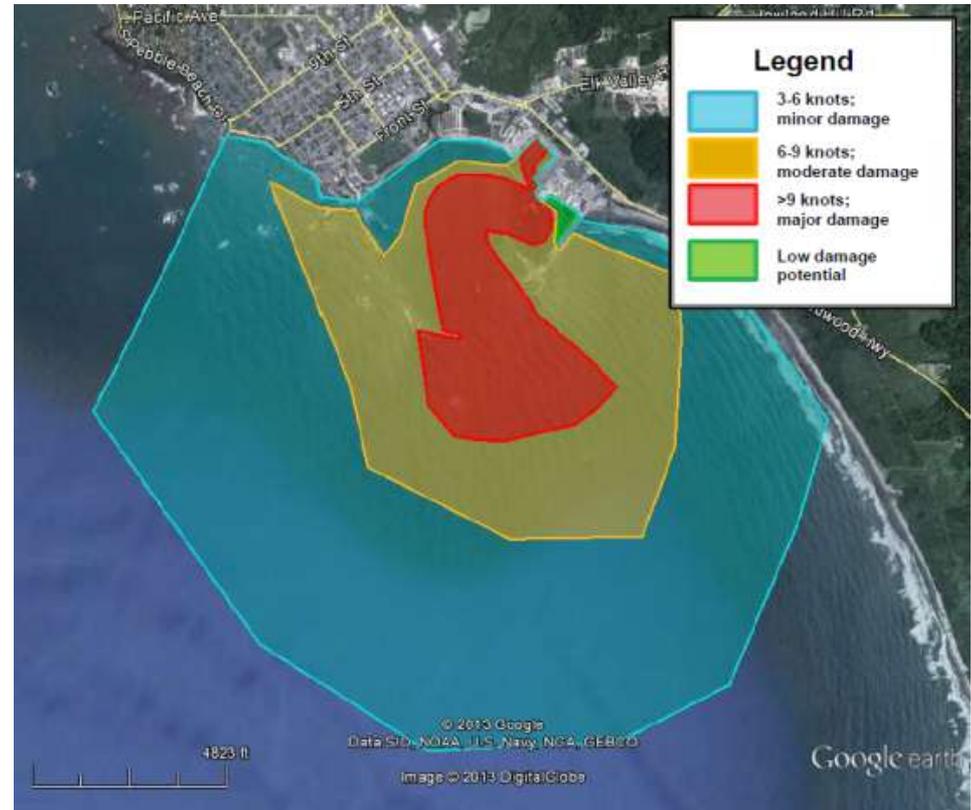


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Velocity-threshold map for strong currents in Crescent City Harbor from large Aleutian Island event (Pat Lynett)

PRELIMINARY In-Harbor Hazard Map

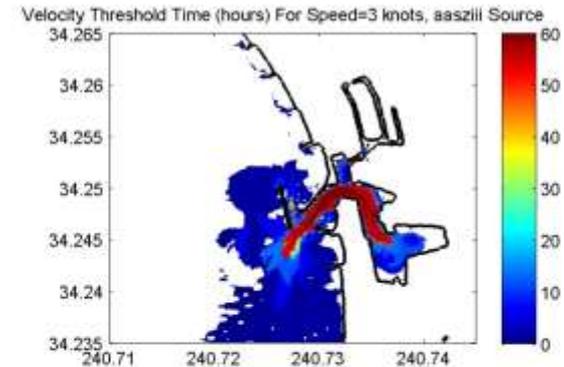


- **9+ knots** = widespread major damage to harbor structures, vessels of all sizes pulled from mooring lines
- **6-9 knots** = moderate damage, small vessels pulled off moorings
- **3-6 knots** = minor damage to docks

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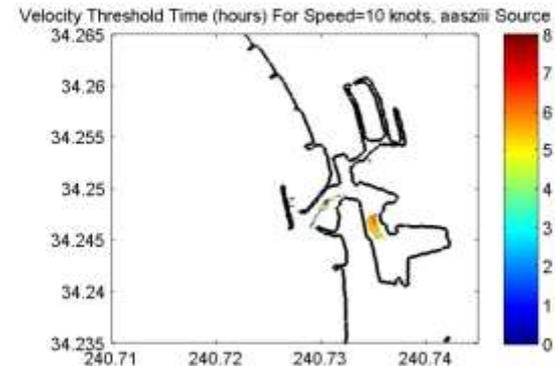
PRELIMINARY In-Harbor Hazard Map



Develop Time-Threshold maps for 3, 6, and 9 knots for three different “classes” of tsunami events:

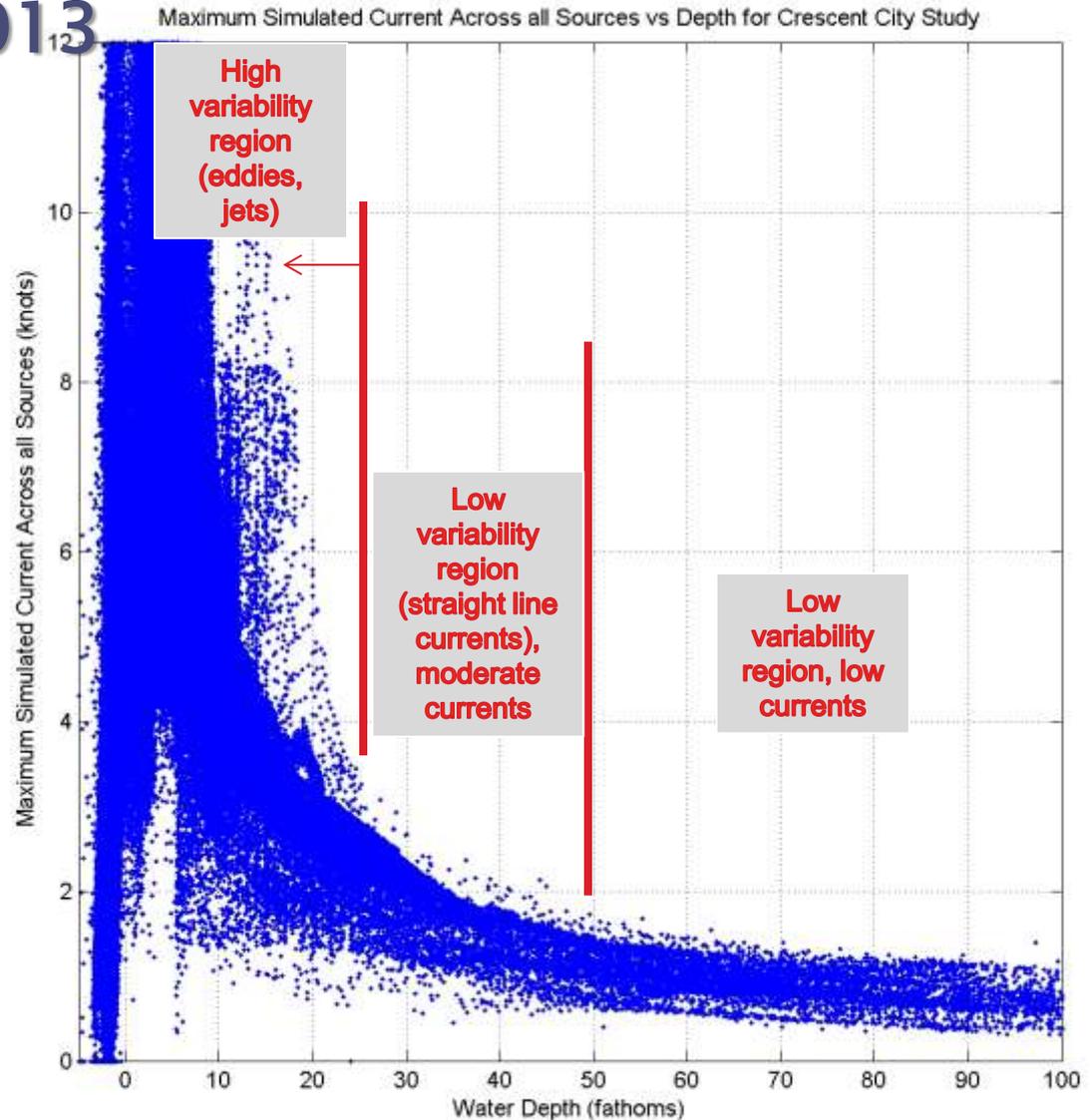
Large Advisory
Warning
Large Warning

Time-threshold map for strong currents in Ventura Harbor from large Aleutian Island event (Pat Lynett)



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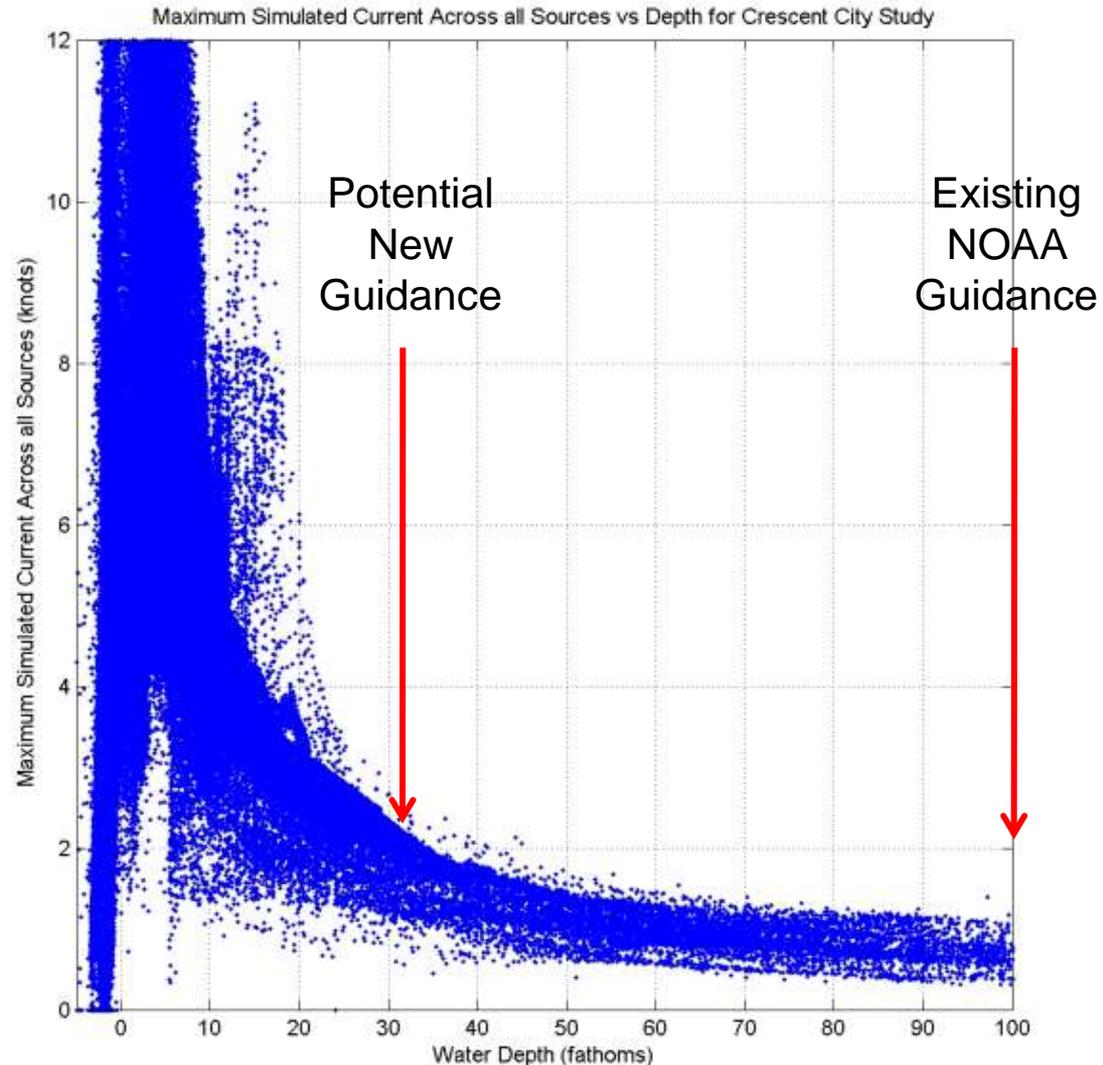


1 fathom = 1.8 meters = 6 feet

Maritime planning products available starting 2013

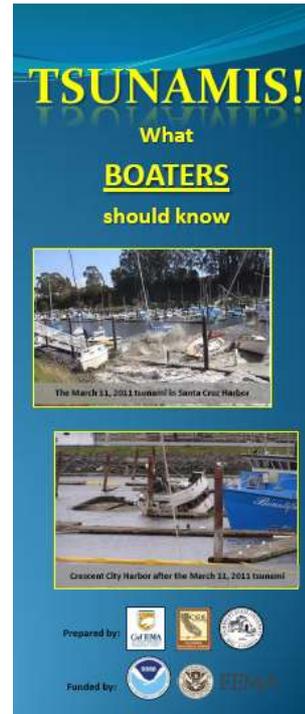
PRELIMINARY Offshore Safety Zone Analysis

- In-harbor tsunami hazard maps
- **Offshore safety zones for boats**
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Not reposition
?
Reposition ships

Crescent City	Alert level	Magnitude	Source location	Peak Amp. (m)	Tidal condition (first 5hrs)	Peak Vel. (knots)	Damage summary	Damage Index (USC)
2009	Advisory	8.0	Samoa	0.33	High		No damage	0
2012	Advisory	7.7	BC	0.46	High		No damage	0
2010	Advisory	8.8	Chile	0.64	Low		No damage	0
2006	Advisory	8.3	Kuril Isl.	0.88	Low		\$28M in damage; three docks	4
2011	Warning	9.0	Japan	2.47	Low	10	\$26M in damage; all docks	5
Modeled Scenario #1	(Warning)	(9.0)	2011 Japan at high tide	(2.47)	High	(12)		
Modeled Scenario #2	(Warning)	(9.2)	(Aleutians)	(+4m)		(+12)		

Example Maritime Response Plan "Cheat Sheet" and Mitigation Guidance

7/22/13 FIRST DRAFT - Maritime Community Tsunami Response Guidance: CRESCENT CITY HARBOR

Background information (previously filled out): Height of shortest piling above Mean Sea Level: _____

Elevation of lowest land above Mean Sea Level: _____

Areas of harbor previously damaged or potential for damaged: _____

Areas known as safe in previous events and based on modeling: _____

Distance offshore to reach 30 fathom (180 feet) depth: _____

Step 1: Obtain information about earthquake and tsunami from West Coast/Alaska Tsunami Warning Center, regional NOAA-Weather Forecast Office, and/or county emergency manager.

Earthquake location _____ Forecasted tsunami arrival time _____

Earthquake magnitude _____ Highest projected tidal height for 5 hrs after arrival _____

Tsunami Alert level _____ Ambient ocean/storm conditions for 5 hrs after arrival _____

Forecasted tsunami amplitude/wave height _____

Calculate/obtain FASTER tsunami run-up value in first 5 hours _____

Calculate/obtain FASTER tsunami run-up value at highest tide _____

Step 2: Compare information in Step 1 to forecasted tsunami height to Table 1 indicating action for securing vessels and repositioning ships away from areas of expected damage to within safe areas of harbor or offshore.

Crescent City	Alert level	Magnitude	Source location	Peak Amp. (ft)	Tidal condition (first 5hrs)	Peak W/L (feet)	Damage scenario	Damage Index (ISC)
2000	Advisory	8.0	Sumatra	0.33	High	10	no damage	0
2011	Advisory	7.7	BC	0.48	High	10	NO damage	0
2010	Advisory	8.8	Chile	0.64	Low	10	NO damage	0
2000	Advisory	8.3	NZ/FI Isl.	0.88	Low	10	SCM in damage; three dunks	4
2011	Warning	9.0	Japan	2.47	Low	10	SCM in damage; all docks	5
Midland Seismic #1	Warning	8.0	2011 Japan at high tide	1.47	High	11		
Midland Seismic #2	Warning	8.3	Andaman	1.48	High	11		

Not reposition

Reposition ships

Step 3: Infrastructure considerations:

Will the tsunami overtop harbor pilings? (compare FASTER runup to lowest pile height) _____

Will the tsunami inundate dry land? (compare FASTER runup to lowest land elevation) _____



Tsunami Hazard Mitigation Activities in California Maritime Communities

Tsunami hazard mitigation activities are the focus of the California Tsunami Program, comprised of the California Geological Survey (CGS) and the California Emergency Management Agency (CalEMA), its modeling, engineering, and academic partners at the University of Southern California (USC) and Humboldt State University (HSU), and its Cooperative Technical Partners at FEMA. Nowhere is the need more apparent for initiating tsunami hazard mitigation measures than within the state's 70+ coastal maritime communities. Relatively small to moderate tolextsunami events in 2006, 2010, and 2011 caused over \$100M in total damage within at least two dozen of these maritime communities. According to the USGS-led Science Application for Risk Reduction Project (SARRP, in progress), larger tsunami events have the potential of causing tens of billions of dollars in damages and a large number of casualties in California.

With the assistance of the California Tsunami Program and state/federal funding, these maritime communities have begun implementing a number of life-safety and damage-reduction mitigation measures for tsunami hazards. These measures include non-structural mitigation efforts that include real-time (pre-tsunami) ship movement and infrastructure strengthening, and permanent mitigation measures that include wave-jetty fortification, pile reinforcement, and dock improvements. A number of other mitigation measures that may be implemented in the future include improved harbor emergency response and planning activities, repositioned/improved docks and infrastructure, increased harbor dredging, entrance channel widening, and removal of exposed petroleum/chemical facilities.

The following information offers a few examples of tsunami hazard mitigation activities, both structural and non-structural, that have been implemented in California:

Crescent City Harbor – The 2006 and 2011 tsunamis caused \$50M in damages in Crescent City Harbor. In 2011, destruction of most docks and deposition of 150,000 cubic meters of sediment in the small boat basin caused nine months to a year of delays in initiating recovery of the commercial fishing industry in Crescent City, which is vital to the community's survival. The harbor has proactively initiated several mitigation measures to reduce the direct impact of future tsunamis. Before the 2011 tsunami, harbor officials and the commercial fishing community worked with the Redwood Coast Tsunami Work Group to initiate a plan to evacuate the fishing fleet from the harbor once a tsunami warning was issued. During the 2011 tsunami, 90 percent of the sea-worthy fleet was able to evacuate the harbor, greatly reducing the potential for non-



Beach are a vital international ly basis. Although there was er historical tsunamis in 1960 rnia Tsunami Program has (FFR) Project to evaluate the at-risk facilities and large ship ss of improving their tsunami in large cargo ships and the Ports may also lead to away from narrow harbor

FEMA, and its partners are promotes mitigate damages of maps identifying in-harbor e tidal fluctuations, etc.), 2) unami), and 3) preparedness. be more resilient to tsunami nities to determine where nion for pre-disaster hazard and mitigation efforts will rtle a basis for greatly reducing ma maritime communities.

Mitigation Measures for Reducing Impacts of Tsunami Hazards in Maritime Communities

Real-time response mitigation measures

- Moving boats and ships out of harbors
- Repositioning ships within harbor
- Remove small boats/assets from water
- Shut down infrastructure before tsunami arrives
- Evacuate public/vehicles from water-front areas
- Restrict boats from moving during tsunami
- Prevent boats from entering harbor during event
- Secure boat/ship moorings
- Harbor staff donning personal flotation devices/waists
- Remove hazardous materials away from water
- Remove buoyant assets away from water
- Stage emergency equipment outside affected area
- Activate Mutual Aid System as necessary
- Activate Incident Command at evacuation sites
- Alert key first responders at local level
- Restrict traffic entering port; aid traffic evacuating
- Provide personnel to assist rescue, survey and salvage
- Identify boat owners/fly-aboards; establish phone tree, "reverse-911," or other notification process

Permanent mitigation measures

- Fortify and armor breakwaters
- Increase size and stability of dock piles
- Improve flotation portions of docks
- Increase flexibility of interconnected docks
- Improve movement along dock/pile connections
- Increase height of piles to prevent overtopping
- Deepen/Dredge channels near high hazard zones
- Move docks/assets away from high hazard zones
- Widen size of harbor entrance to prevent jettling
- Reduce exposure of petroleum/chemical facilities
- Strengthen boat/ship moorings
- Construct flood gates
- Prevent uplift of wharves by stabilizing platforms
- Debris deflection booms to protect docks
- Harbor control structures should be tsunami resistant
- Construct breakwaters further away from harbor
- Install Tsunami Warning Signs
- Purchase equipment/assets (pilot boats, tug boats, fire boats, cranes, etc.) to assist in response activities

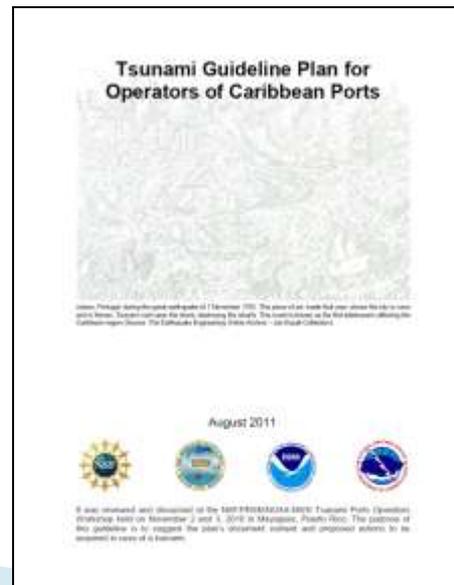
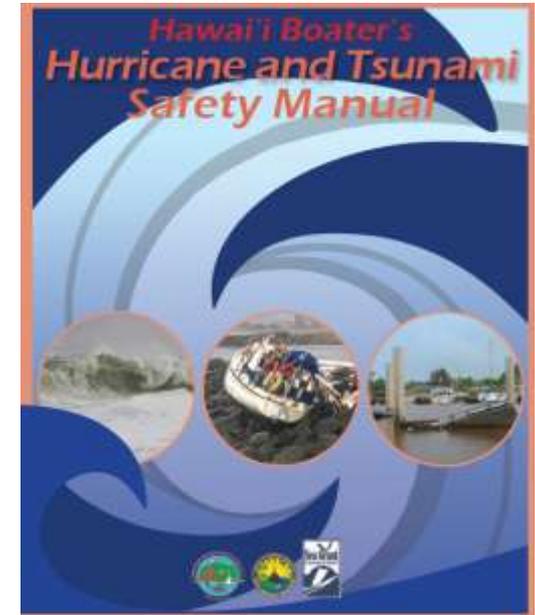
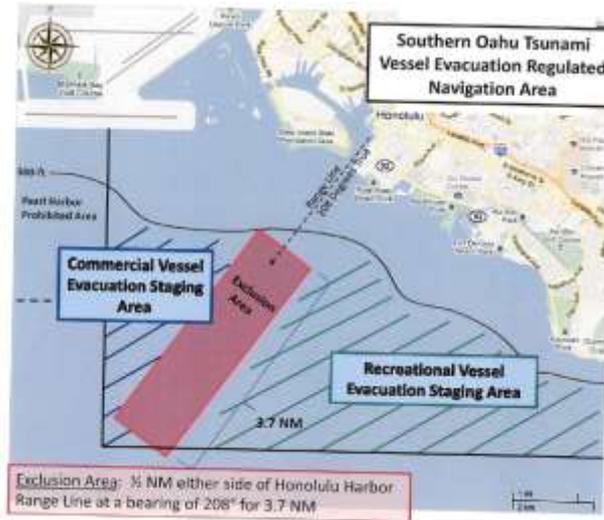
Maritime Work Update/Schedule

- ▶ Completion of video evaluation (HSU; Admire and Dengler), modeling (USC; Lynett and Borrero), and evaluation in pilot study areas
- ▶ Held meetings with Crescent City and Ventura harbors
- ▶ Plan meetings with Santa Cruz Harbor and San Diego Bay entities, and follow through meetings with Port of LA and Port of LB, all over next couple months
- ▶ Feedback leading to creation of:
 - ▶ Hazard maps (in-harbor and offshore) for FEMA RiskMAP interface
 - ▶ Playbooks (hazard maps and guidance) on various scenarios for planning
 - ▶ One-page guidance (“Cheat-sheet”) for real-time response activities
 - ▶ Guidance for mitigation and recovery activities (Martin Eskijian, retired CSLC)
- ▶ Pilot projects completed this summer
- ▶ Production for rest of the state from fall 2013 to summer 2015

Maritime Work by Others

Should NTHMP Guidance be developed?

- ▶ Hawaii plan
- ▶ Puerto Rico plan
- ▶ Oregon plan
- ▶ NOAA/PMEL (forecast)
- ▶ Others?



Maritime Work Summary

- ▶ Ready for implementation or still demonstration project?
 - ▶ Offshore and guidance being implemented
 - ▶ NEEDS: 1) In-harbor work and response cheat-sheet and mitigation work needs feedback from NTHMP; 2) Models for currents needs benchmarking; and 3) all products need standardization (guidance for production and use)
- ▶ Importance to NTHMP: HIGH, based on 1) historical damage and life safety issues; 2) high value of coastal assets; and 3) discussed in Strategic Plan