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USGS, California Geological Survey, Cal Office of Emergency Services, and NOAA
Science Application for Risk Reduction

SAFRR’s mission: innovate and apply hazard science for the safety, security, and economic well-being of the nation

What is your science need?
SAFRR scenarios

• A large but plausible event worth planning for
• Crafted with stakeholders
• Consensus among leading experts
• Information for planning & mitigation decisions
Mw 9.1 offshore of Alaska Peninsula

Like Tohoku rupture

Between 1946 & 1964 sources

Biggest contribution to LA’s tsunami hazard
NOAA tsunami messages

11:54 AM Thu 27 Mar
M8.2, **Watch for CA**

12:00 PM Sat 29 March
(message 50):
Advisory cancelled for CA

8:02 PM Fri 28 March:
Advisory for CA

**Warning for CA**
6-21 hr duration
2-5 ft at buoys

1st wave @ Crescent City
Durations 24 hr

Amplitude ests ↑

San Francisco
San Pedro
La Jolla
Hydraulic and hydrological modeling

Waves up to 5m (15 ft) above MHHW at shore
1st wave generally not the largest
Independent models agree well
Physical damages chapter

• Buildings, ports, marinas, roads, bridges, fire...
• Describe asset, history, scenario damage, recovery, & resilience opportunities
• Lean toward cautious (optimistically low)
• Draw lessons from past tsunamis & H. Sandy
• 32 peer reviewers
  – 2+ experts per topic
  – Professionals, scholars, stakeholder experts
  – Peer review was longer than the damage chapter
Marinas and harbors

- 15% of boats sunk
- 20% of boats damaged
- 40% of docks damaged
- 20% of docks destroyed
- $700 million damage plus
  - Sediment transport
  - Hazmat
  - Fires
  - Navigational hazards

“We don't think that a large tsunami would cause docks to float off the top of pilings, we KNOW that it will happen.” -- Morro Bay Harbor Director
Ports of Los Angeles and Long Beach
Ports of Los Angeles and Long Beach

3½ hr warning
30-40 large vessels
Pilots remove 5-8 per hr
11-page dispersal plan
  – No specific triggers
  – Not exercised
Ports of Los Angeles and Long Beach

4 m/sec (8 kt)
Guam: subs pulled from pier @ 2 kt
Ports of Los Angeles and Long Beach
Ports of Los Angeles and Long Beach

Moffatt & Nichol estimate: $100 M damage
- 2,650 cars
- 1,040 TEUs
- Moorings, warehouses, equipment...
- 2-3 days downtime

Likely damage to other ports

Port Elizabeth: PANYNJ “need to stay out of the habit of only reacting to the last event.”
Population vulnerability issues at the ports
Highways and bridges

- Estimates created & reviewed with Caltrans
- $100 million, mostly CA1, US101 road scour
- Oakland-Bay Bridge Toll Plaza
Coastal homes & businesses

Wetted

• 13 counties, 1840 census blocks, 103 million sf (≈70,000 dwellings), $31B value
• 40% of property in Cal OES max inund. zone

Repair cost

• Using HAZUS (not “in” HAZUS)
• $2.6B, mostly contents
Fuel + debris = fires

- 284 in Tohoku
- Here: 17 possible releases of flammable product
- Pipe breaks, fires likely
- POLA/LB: fire boats face strong currents
### Economic bottom line: $5-10B

<table>
<thead>
<tr>
<th>Assets</th>
<th>Repair cost $M</th>
<th>Business interruption ($M)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>W/o resilience strategies</td>
</tr>
<tr>
<td>Ports of LA and LB</td>
<td>$100</td>
<td>$4,300</td>
</tr>
<tr>
<td>Fishing in Port of LA</td>
<td></td>
<td>$2</td>
</tr>
<tr>
<td>Marinas and small craft</td>
<td>$700</td>
<td>$30</td>
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<tr>
<td>Property damage</td>
<td>$2,600</td>
<td>$1,700</td>
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<tr>
<td>Roads and bridges</td>
<td>$80</td>
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<tr>
<td>Railroads</td>
<td>$2</td>
<td></td>
</tr>
<tr>
<td>Agriculture</td>
<td>$4</td>
<td></td>
</tr>
<tr>
<td>Total (rounded)</td>
<td>$3,500</td>
<td>$6,000</td>
</tr>
</tbody>
</table>

- Sediment, soil remediation, fires, other ports, and evacuation could add $1B+.
- Reconstruction will bolster the economy.
Potential environmental impacts

- Toxicants in debris
- Petroleum from refineries, terminals, & vessels
- Dry bulk (industrial borates...)
- Smoke, ash, debris from fires
- Contaminated sediments
Public policy

• Federal and state tsunami-management policy is less developed than for other hazards

• Risk awareness gaps (public & coastal sectors) may undermine disaster management in a big tsunami

• Some maritime policy priorities:
  – More detailed analyses to identify high-hazard areas & safer facility & passageways locations
  – Port dispersal planning, training & exercise
  – Review regulations to facilitate port recovery and reduce BI, e.g., dredging
Cal OES Tsunami Program

Inundation mapping
Emergency response plans
Maritime planning
Land-use planning
Stakeholder survey & interviews

4 agencies, 37 respondents:
• Found presenters well qualified, realistic scenario, well-thought-out findings
• Using SAFRR info to improve preparedness
• Understand tsunamis better, more able to plan
• Improved networking, better understand other organizations

Challenges
• Info overload, organizational confidentiality
Conclusions

• Realistic, worth planning for
• Much more severe than 2010 & 2011
• CA lucky with tides in past tsunamis
• Affects the entire CA coast: ports, marinas, communities, transit, tourism, ...
• Causes fires, hazmat, ecological damage
• Resilience strategies can make a big difference
• What are your science needs?
Learn more

- CA county emergency managers
- Workshops next 2 weeks throughout CA
- Open file report September 2013

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