Climate Change Adaptation: AAPA/IAPH Member Plans and Perceptions
Overview

- Climate Change Impacts and Ports
- Survey Findings
- The Big Picture - Risk and Responsibility
- Next Steps – Case Studies
Climate Change Scenarios

- Sea levels to rise 0.6 – 2 meters by 2100
  - The world is not a bathtub!
- Doubling of Cat 4 and 5 storms
- Ocean storm tracks shifting
- Inland flooding

From Bender et al. Science 2010; 327(5964):454.
Why Ports?

- Critical infrastructure in U.S. and global economy
  - 80% of world freight moves by ship
- Highly dependent on specific locations
  - Deep water, protective harbors, multi-modal connections
- Difficult or impossible to relocate
- Highly vulnerable locations
  - Often estuaries or river deltas that provide ecosystem services
  - Prone to flooding, storm surge, and SLR
Impacts of Storms

**IKE**
$2.4$ Billion Damage to TX ports/waterways

**Katrina**
$100$ Million in Damage to 3 MS Ports

$1.7$ Billion in damage to Southern LA ports

Just eleven spills released approximately 7 million gallons of oil

*Photos from Alabama State Port Authority*
Global Ports Survey Objectives

• **Climate Change Impacts** – An issue for ports?

• **Climate Assumptions** – What impacts do ports foresee?

• **Adaptation Strategies** – What kinds of changes are ports considering with respect to climate change impacts?

• **Categories** - Are certain categories of ports or port directors considering these issues more than others?
- Sampled IAPH/AAPA
- Survey Monkey
- Designed/Pretested with IAPH/AAPA
- 30 Questions
- Distributed Summer 2009
- 93 Usable Responses
Finding 1 – Information

Impacts of climate change is something that needs to be addressed by the port community. 81%

I feel sufficiently informed about how climate change will impact my port operations. 31%

N = 93
Finding 2 – Sea Level Rise By 2100

- **Don't Know**: 17% Expected at Port, 13% Would be a problem
- **Decrease**: 4% Expected at Port, 3% Would be a problem
- **None**: 7% Expected at Port, 6% Would be a problem
- **< .5 meters**: 27% Expected at Port, 12% Would be a problem
- **.5 - 1 meters**: 33% Expected at Port, 39% Would be a problem
- **1-2 meters**: 11% Expected at Port, 58% Would be a problem
- **>2 meters**: 1% Expected at Port, 83% Would be a problem

N = 90

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Will the Sea Level Rise You Expect By 2100 Be a Problem For Your Port?

- Problem: 31%
- Not a Problem: 69%
Finding 3 – Ports Expanding

Plans for Expansion in Next 10 Years

- Building Hurricane Barriers: 6%
- Building Locks: 3%
- Building Dikes: 18%
- Building New storm Protections: 19%
- Acquiring Land: 43%
- Constructing New Quays or Berths: 78%
- Constructing New Terminals: 65%

N = 93

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Design Guidelines Used for New Infrastructure

300, 500, or 1000 Year Storm: 5%
100 Year Storm: 58%
15 or 50 Year Storm: 3%
Most Recent Storm: 15%
We Do Not Consider Storm Events in Our Planning: 7%
I am not sure: 12%

Percent of Respondents
Planning Horizons in Years

<table>
<thead>
<tr>
<th>Years</th>
<th>Respondents</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>2%</td>
</tr>
<tr>
<td>5</td>
<td>6%</td>
</tr>
<tr>
<td>10</td>
<td>6%</td>
</tr>
<tr>
<td>15</td>
<td>6%</td>
</tr>
<tr>
<td>20</td>
<td>12%</td>
</tr>
<tr>
<td>25</td>
<td>6%</td>
</tr>
<tr>
<td>50</td>
<td>5%</td>
</tr>
<tr>
<td>Other</td>
<td>6%</td>
</tr>
</tbody>
</table>

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Finding 4 – Climate Change Policies

- Has specific CC planning document
- CC funded as line item in budget
- CC addressed in port strategic plan
- Carries specific climate change insurance
- Holds staff meetings to discuss adaptation
- Has storm response plan
- Carries storm insurance
- CC part of design guidelines or standards
- Use ≥ 100 year return period

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## Port Categories and Adaptation Scores

<table>
<thead>
<tr>
<th>Category (# of ports)</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Small (11)</td>
<td>2.3</td>
</tr>
<tr>
<td>Medium (35)</td>
<td>2.1</td>
</tr>
<tr>
<td>Large (23)</td>
<td>1.8</td>
</tr>
<tr>
<td>Very Large (20)</td>
<td>2.7</td>
</tr>
<tr>
<td>Public Entity (36)</td>
<td>2.5</td>
</tr>
<tr>
<td>Private/Public (31)</td>
<td>2.1</td>
</tr>
<tr>
<td>Private Entity (5)</td>
<td>2.0</td>
</tr>
<tr>
<td>Standard Insurance (40)</td>
<td>3.0</td>
</tr>
<tr>
<td>Self-Insured (17)</td>
<td>2.1</td>
</tr>
<tr>
<td>Co-Op Insurance (7)</td>
<td>1.9</td>
</tr>
<tr>
<td>None (3)</td>
<td>1.7</td>
</tr>
</tbody>
</table>

N = 93  
Max = 7  
Min = 0  
Mean = 2.2  
Std. Dev = 1.7  

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### Global Comparisons

**World Bank Income Status**

- **low-income (4)**: Score 0.8
- **Lower-middle-income (4)**: Score 0.8
- **upper-middle-income (10)**: Score 1.8
- **High-income (75)**: Score 2.4

**World Region**

- **South/Central America (7)**: Score 2.9
- **North America (43)**: Score 2.8
- **Europe (17)**: Score 1.8
- **Oceania (4)**: Score 1.8
- **Africa (5)**: Score 1.4
- **Asia (17)**: Score 0.9

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Gulf Coast Ports Scored Highest

<table>
<thead>
<tr>
<th>US Region</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gulf Coast (11)</td>
<td>3.7</td>
</tr>
<tr>
<td>East Coast (14)</td>
<td>2.9</td>
</tr>
<tr>
<td>West Coast (8)</td>
<td>2.1</td>
</tr>
<tr>
<td>Great Lakes (4)</td>
<td>1.8</td>
</tr>
</tbody>
</table>
Survey Results Summary

- Port staff concerned, but feel uninformed.
- Ports rapidly expanding and building new infrastructure.
- U.S. Gulf Coast ports tend to have more climate policies already in place.
- Planning horizons, design specifications, and management need to incorporate uncertainty and adaptation.
Risk and Responsibility

Climate Change Impacts

- Environment
- Local/Regional Economic
- National/Global Economic

- EPA
- FEMA
- Coastal Agency
- USCG
- NGO
- Insurers
- Engineers
- AAPA
- Insurers
- Reinsurers
- Port Authorities
- Private Firms
- Engineers
- City Planners
- Statewide Planners
- Taxpayers
- Employees
- Coastal Agency
- Army Corps
- DOT
- Taxpayers

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Next Steps: Look to the Past to Plan for the Future

- Looking for case-study ports to further this research
- Continue to work with AAPA/IAPH

- How have hurricanes changed port planning, technology, and policy?
- How do port stakeholders define resilience?
- How do port stakeholders work independently and in aggregate to create more resilient ports?
The Survey Respondents
Meredith Martino, AAPA
Satoshi Inoue, IAPH
Meg Caldwell, Center for Ocean Solutions
Pam Matson, School of Earth Sciences
Mike Mastrandrea, IPCC/Woods Institute
CEE 129/229 Class

Contact Austin Becker
austinb@stanford.edu
www.seaports2100.org
Extra Slides Below
Well-Functioning Ports for the Future

• Maintain or grow the regional economy
• Are good ecosystem stewards
• Are profitable
Perspectives

“...most ports do not appear to be thinking about, let alone actively preparing to address, the effects of climate change.”

*US Environmental Protection Agency, 2009*

“The insurance industry is moving from being a passive climate change sufferer that has to sustain some very expensive consequences to becoming a proactive shaper of the future.”

*Geneva Association, 2009*

“Ports should effectively prepare for the impacts of climate change to ensure their role as the indispensable nodal points of global logistic systems.”

*Resolution of the IAPH, Genoa, Italy May 2009*
Ports Proximity to Historic Storm Tracks

Survey Respondents

Map by Austin Becker, 2009

By Austin Becker
Stanford University
Nov. 15, 2009
austinb@stanford.edu
RI Emergency Management Agency

Structures Insured Against Losses

City Zoning

US Army Corps

P&W Railroad

Private Terminal Operator

RI Dept. of Transportation

City Owned Land

State Jurisdiction over Coastal Lands

Estuary

US Coast Guard
Future Work/Next Steps

Case Studies

- What makes a resilient port?
- How have past storms led to long-term changes in port planning?
- How do ports work with government to

www.seaports2100.org

http://www.portoflosangeles.org