

Climate Change Impacts on Ports: A Global Survey *Preliminary Results*

SEALEVELRISE2010

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Development



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Overview

2

- Why Ports
- Impacts and Vulnerabilities
- Preliminary Findings of Survey of Port Directors
- The Big Picture - Risk and Responsibility
- Next Steps

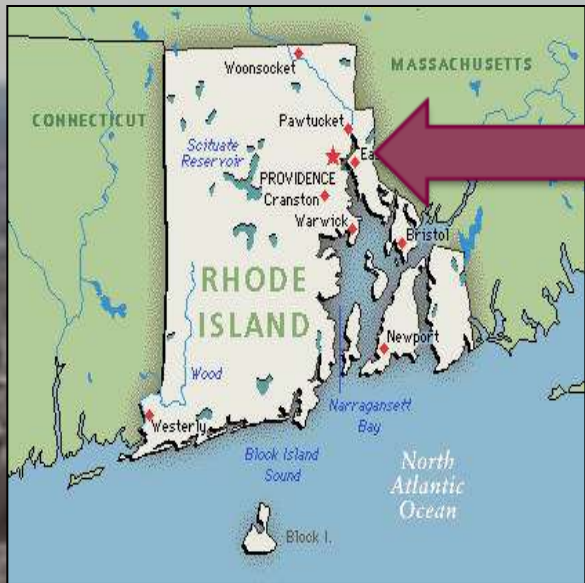


Why Ports?

3

- 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 the provide ecosystem services
 - Prone to flooding, storm surge, and SLR







PORT



Surge Height 4.5 m (MLLW) Image © 2005 MDA EarthSat © 2005 Sanborn

Google

What does an increase in extreme events mean for ports?

6

IKE

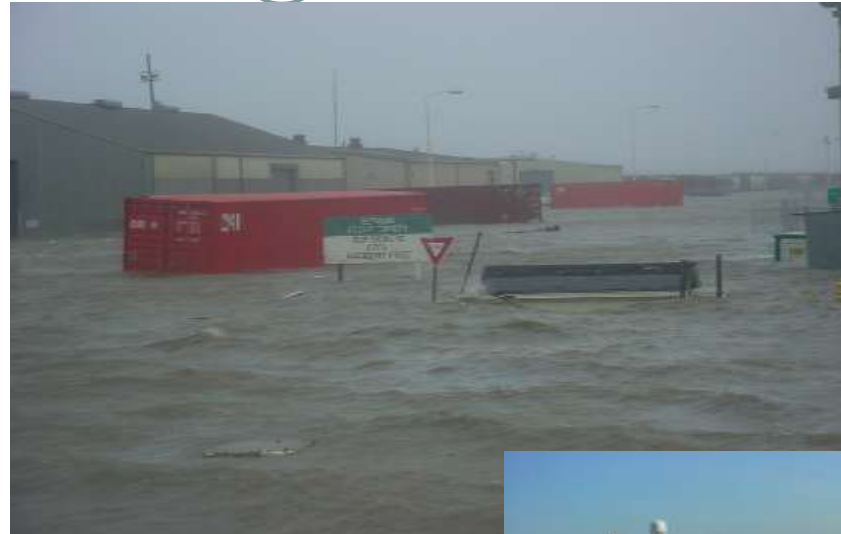
\$2.4 Billion Damage
to TX ports/waterways

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

7

- **Climate Change Impacts** – Is climate change an issue for ports?
- **Adaptation Strategies** - Are ports thinking about how they might make changes to anticipate impacts?
- **Climate Assumptions** – What impacts do ports foresee?
- **Categories** - Are certain categories of ports or port directors considering these issues more than others?



<http://www.portoflosangeles.org>

Overview of Methods

8



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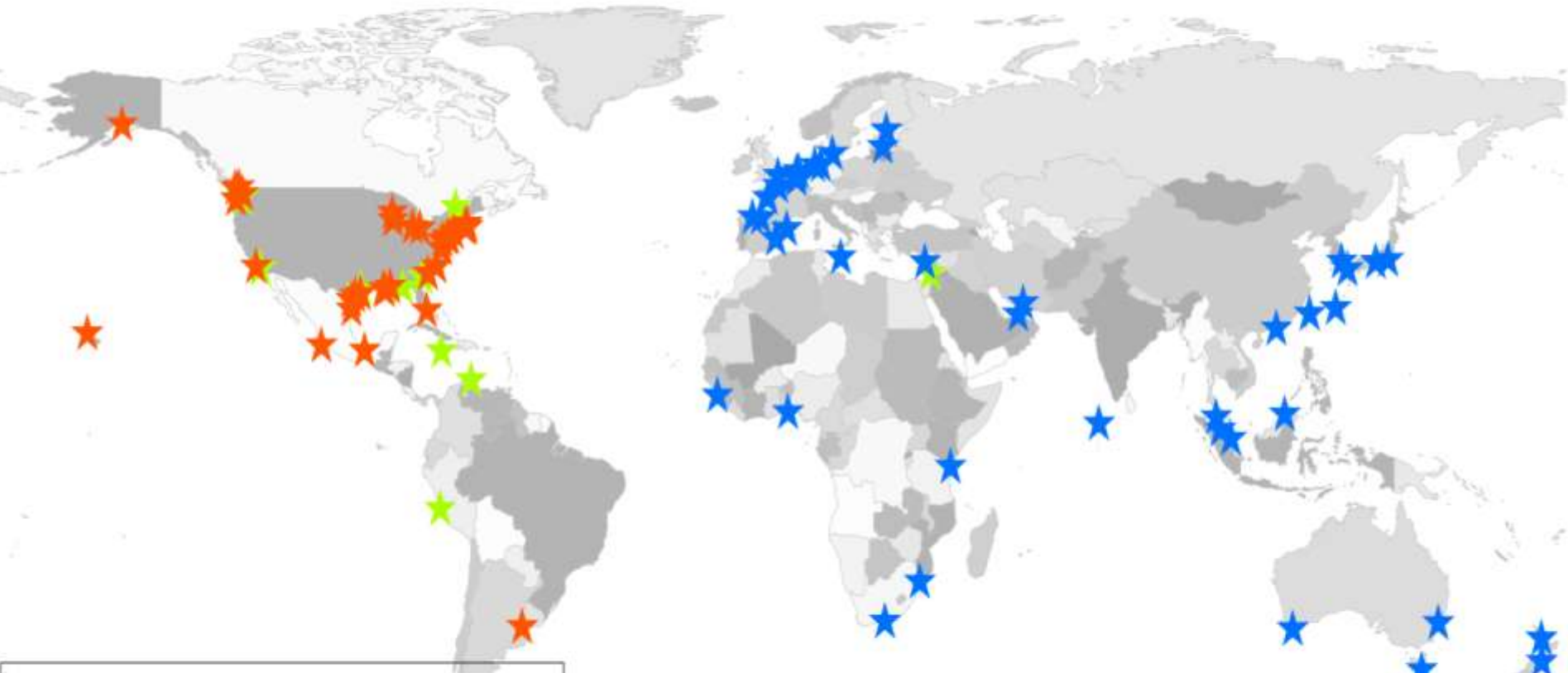


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- **Sampled IAPH/AAPA**
- **Survey Monkey**
- **Designed and Pretested with IAPH/AAPA**
- **30 Questions**
- **Distributed Summer 2009**
- **93 Usable Responses**

Climate Change Survey Respondents

IAPH and AAPA



Membership

- ★ International Association of Ports and Harbors (IAPH)
- ★ American Association of Port Authorities (AAPA)
- ★ Both

Map By Austin Becker
Stanford University, 2009

Finding 1 – The Disconnect

10

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

81%

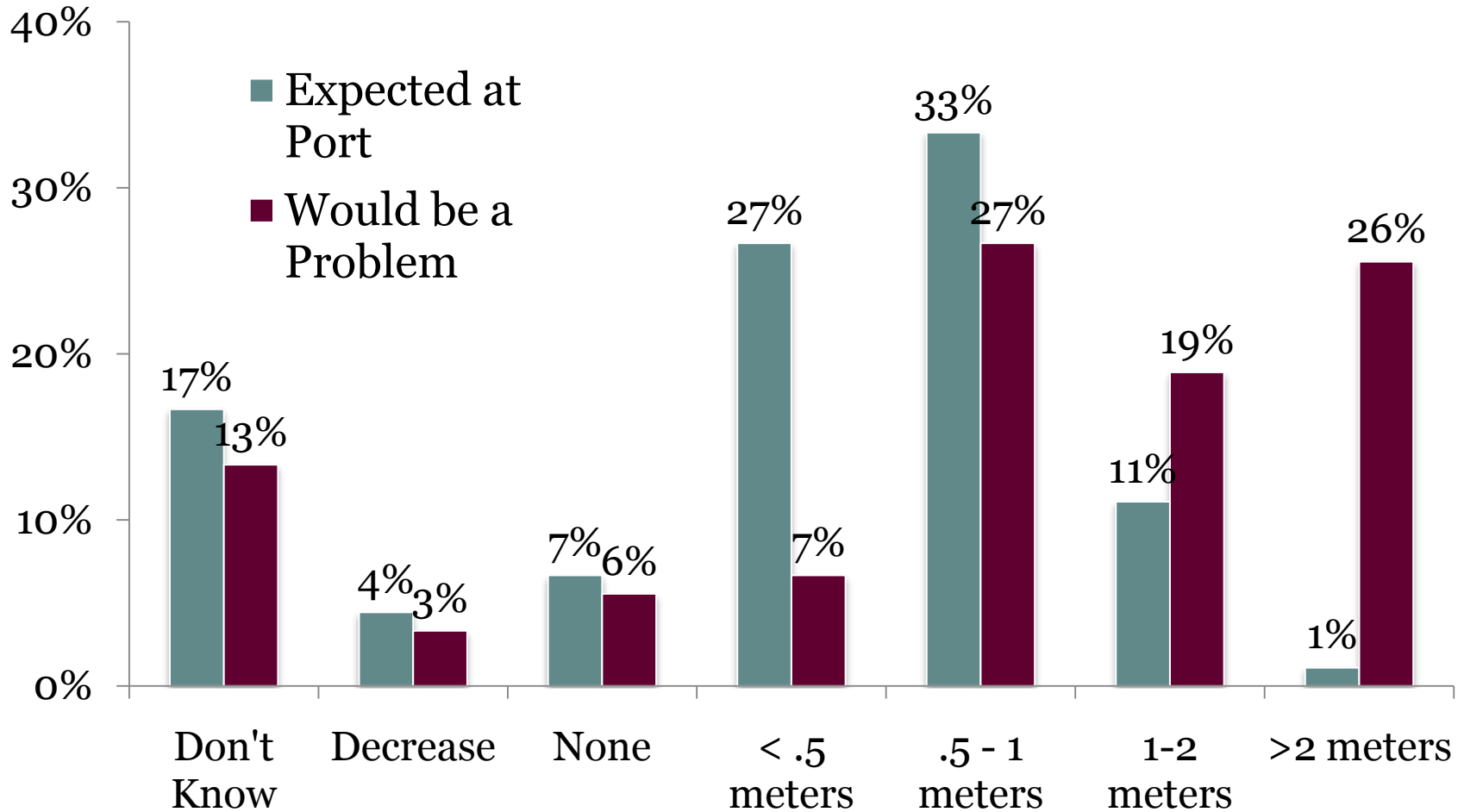
I feel sufficiently informed about how climate change will impact my port operations.

31%

0% 20% 40% 60% 80% 100%

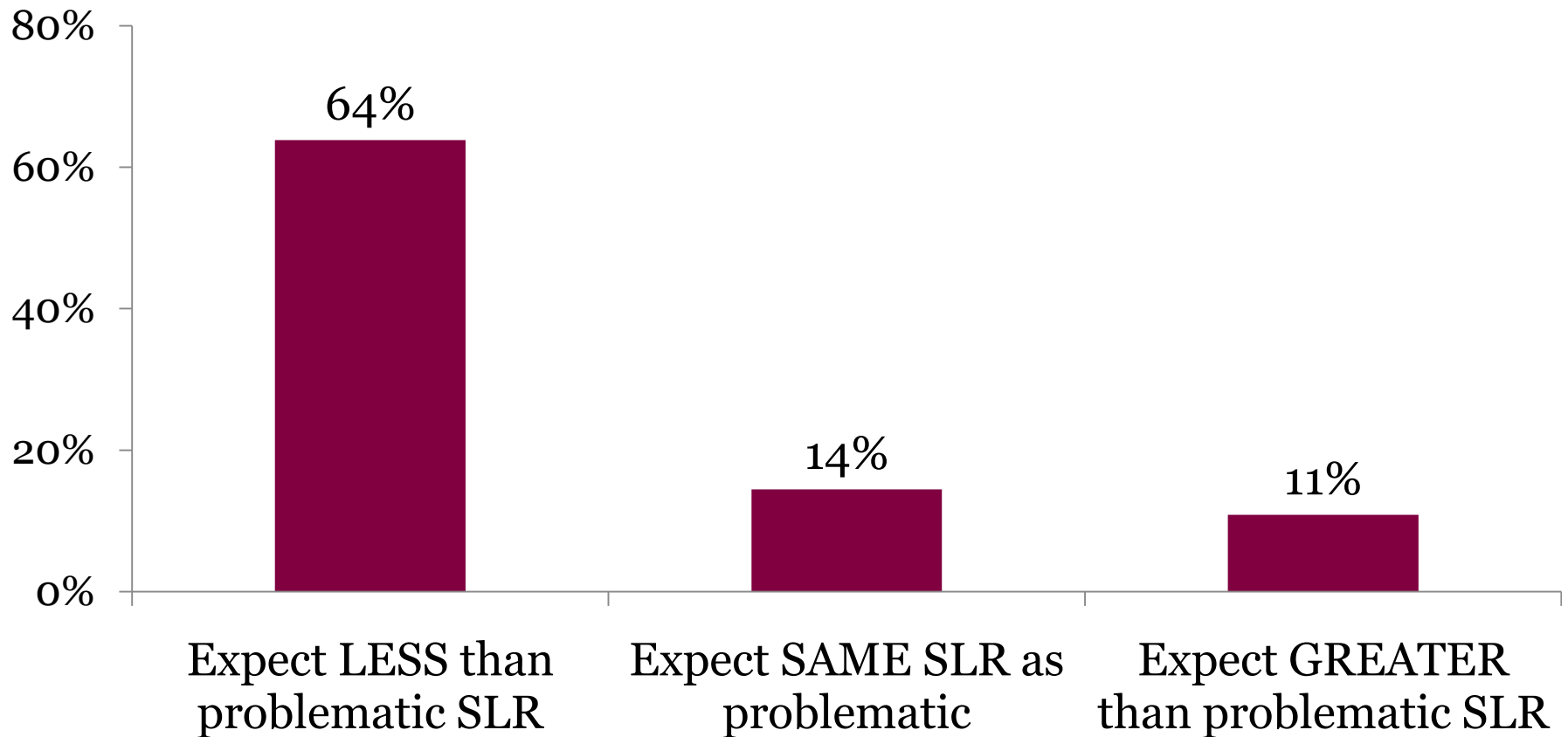
Finding 2 – Sea Level Rise

11



Expected vs. Problematic SLR for each port

12



Increased-damages
Indirect-Financial-Impacts
Impacts-on-Surrounding-Communities
Increase-in-storm-frequency
More-Ice-and-winter-storms
Project-delays
More-Intense-Storms
More-freight-on-ships-less-on-land
Downtime/Operational-Delays
Regulatory-Changes
River-Flooding
Cathodic-Protection
Changes-to-Tide-Levels
Increase-in-water-depth
Fishing-Impacts
Storm-Surge
Emissions
Facility-Elevations-too-low
Impacts-on-customers
Port-Development-Impediments
Erosion
Insurance-Coverages
Sea-Level-Rise
Air-quality
Sedimentation/Dredging
Stricter-Design-Standards
Environmental-Regulations
Wave-Impacts
Loss-of-Capacity/business
Sea-Level-Inundation
Shifts-in-Markets
Health/Performance-of-Personnel
Impacts-to-multi-modal-connections
Failure-of-Protection
Wind-Impacts
Impact-on-Coral-Reef-Barrier
Ecosystem-impacts
Decrease-in-sea-levels
Longer-ice-free-season
Change-to-Shipping-Routes
Drought
Need-for-Cold-Ironing
Storm-events
Maintenance-air-conditioning-units
Relocate-facilities
Flooding

Finding 3 – Planning and Infrastructure Within Next 10 Years

14

Protection

Building Hurricane Barriers 6%

Building Locks 3%

Building Dikes 18%

Building New storm Protections 19%

Expansion

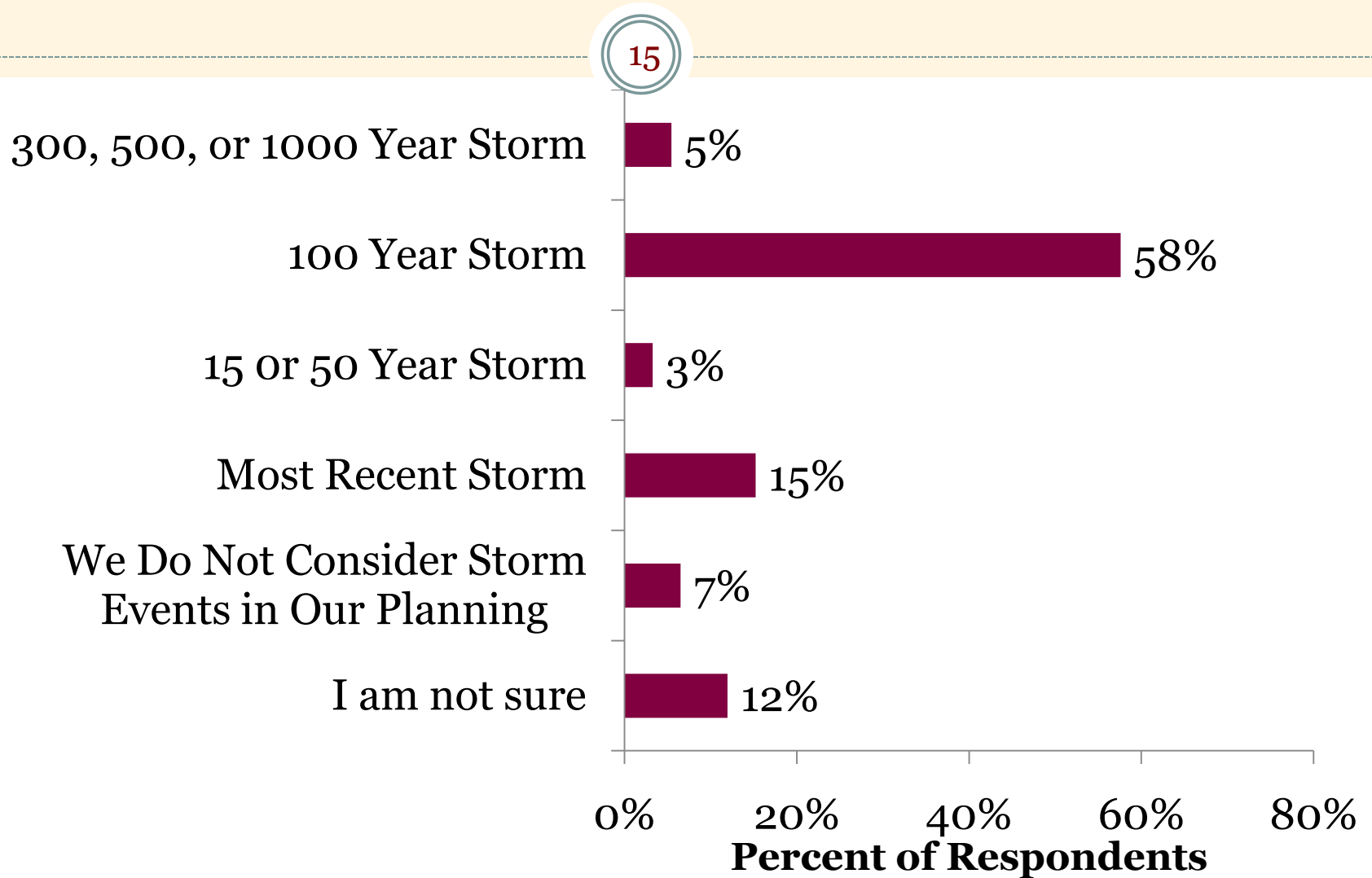
Acquiring Land 43%

Constructing New Quays or Berths 78%

Constructing New Terminals 65%

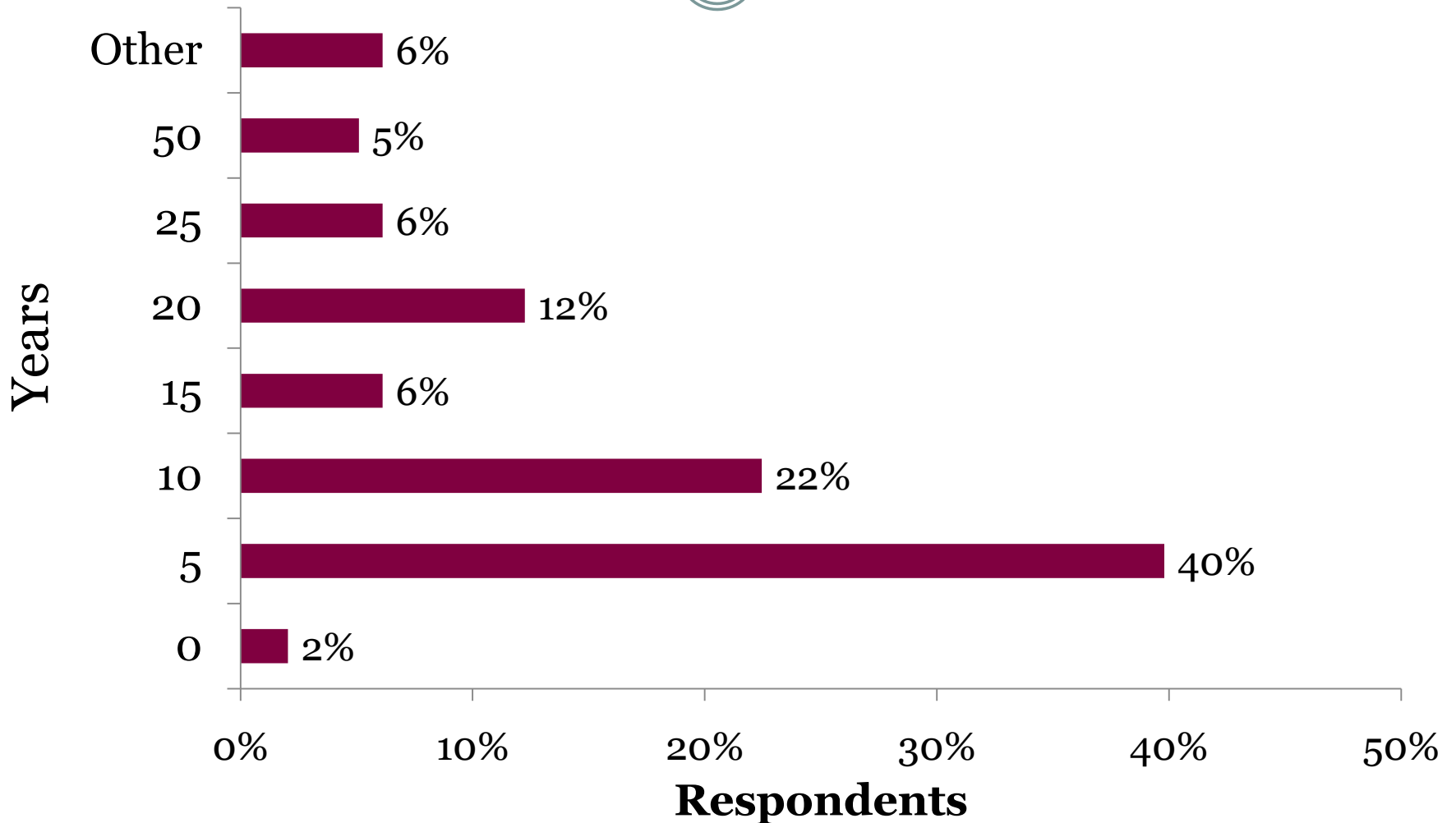
0% 20% 40% 60% 80% 100%

Design guidelines used for new infrastructure



Planning Horizons in Years

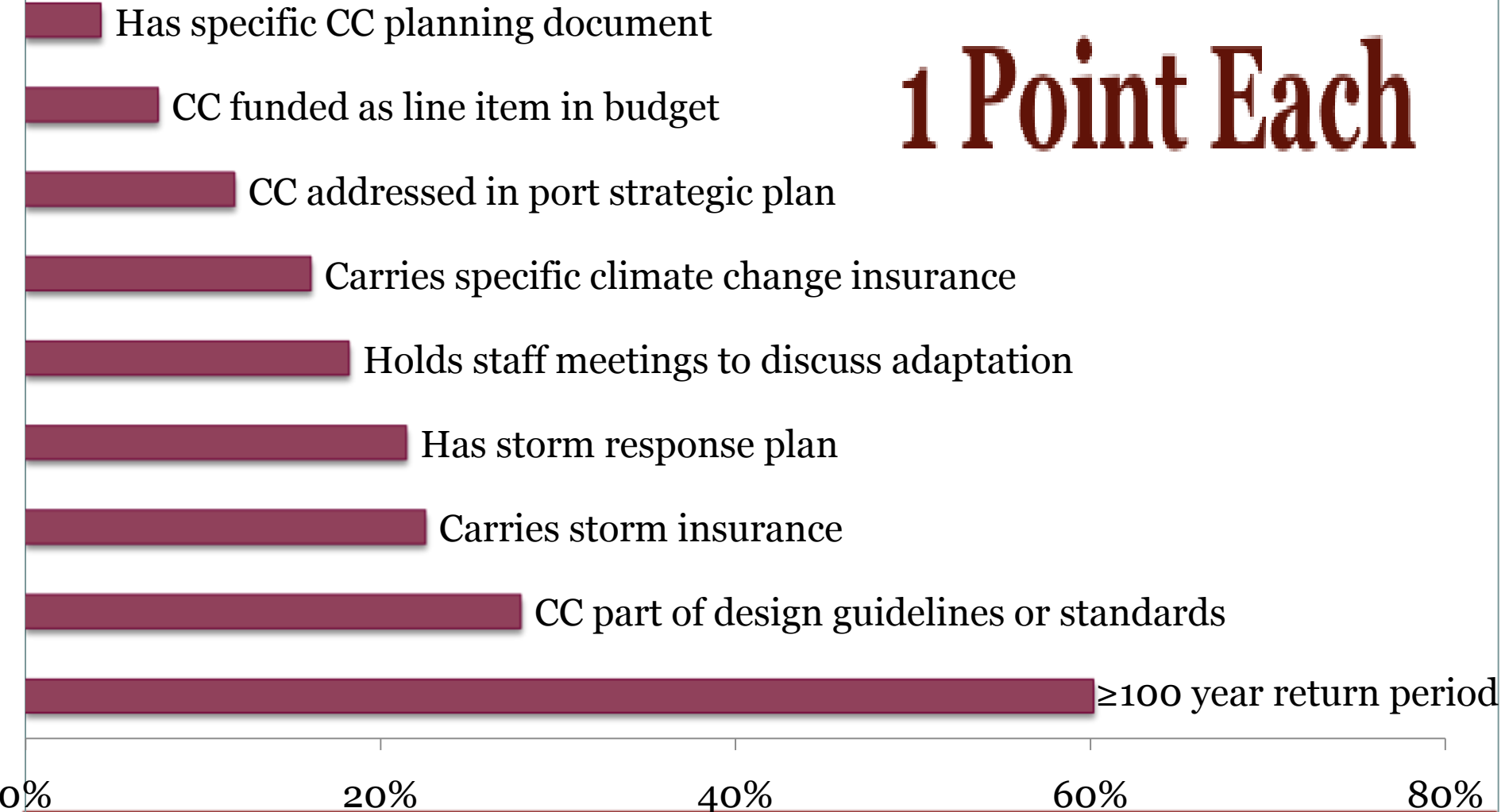
16



Finding 4 – Adaptation Scores

17

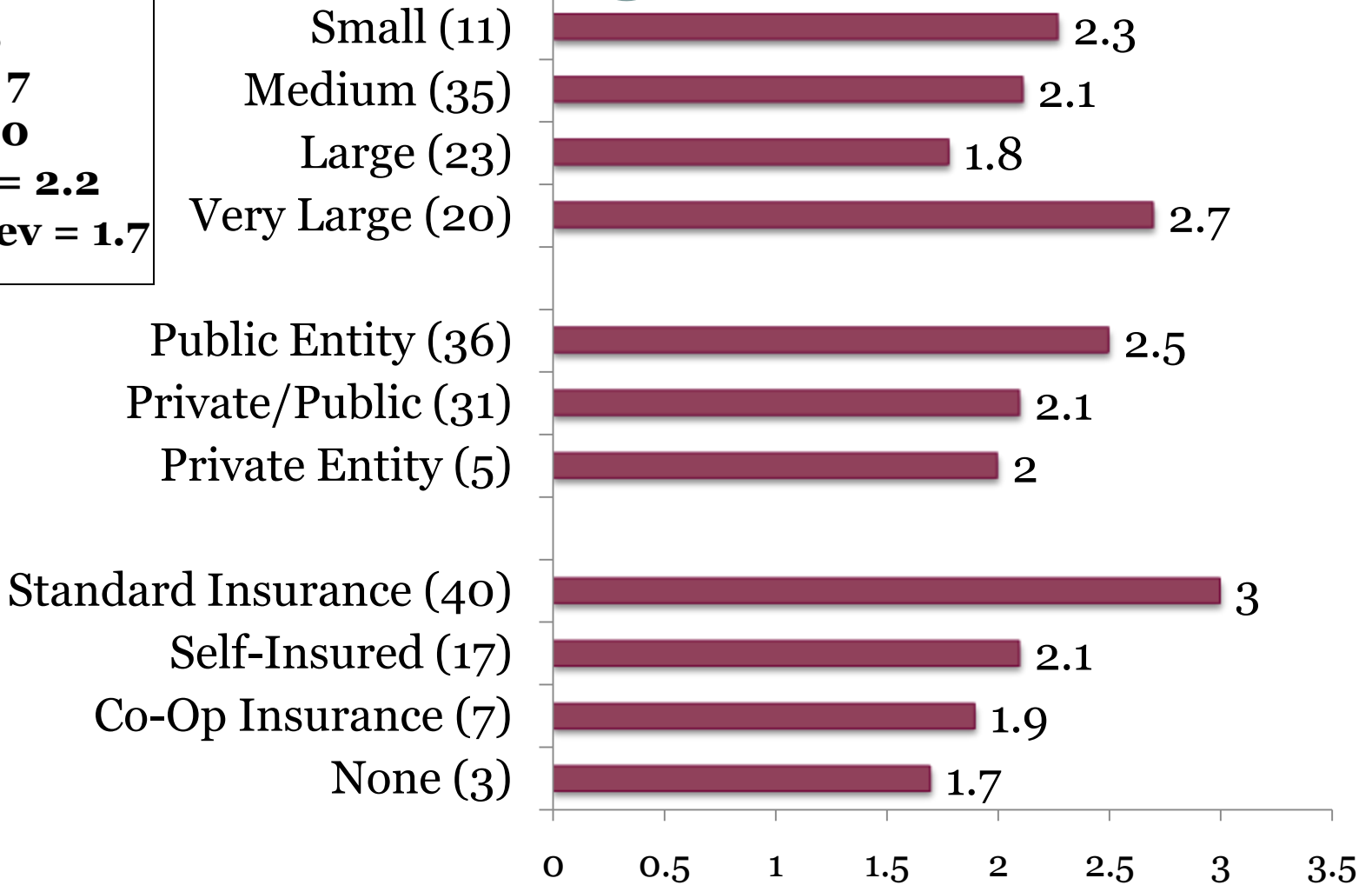
1 Point Each



Port Comparisons

18

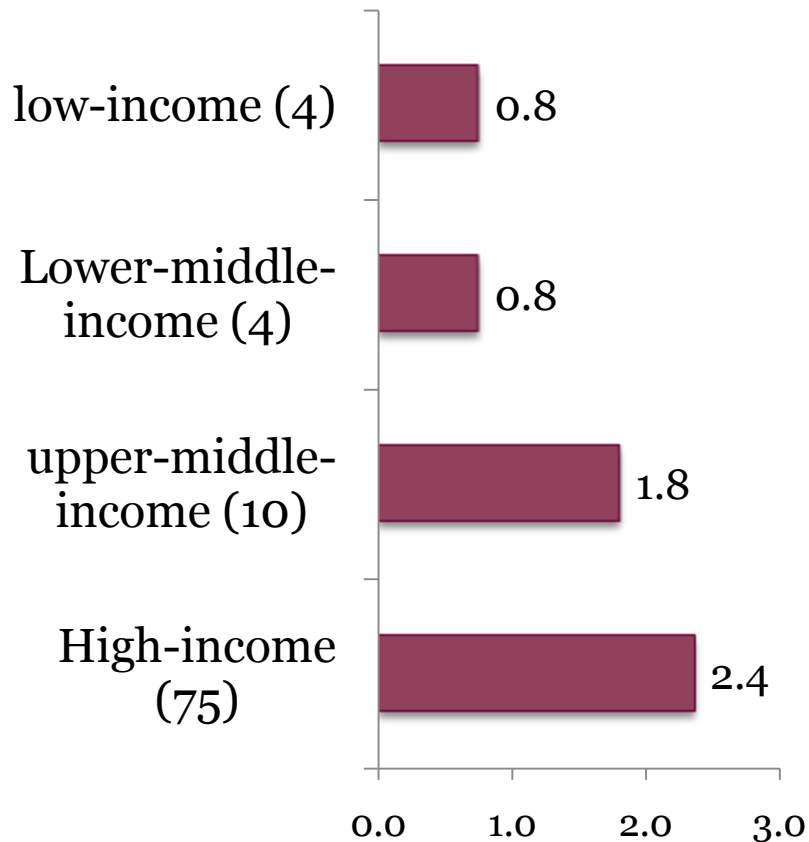
N = 93
Max = 7
Min = 0
Mean = 2.2
Std. Dev = 1.7



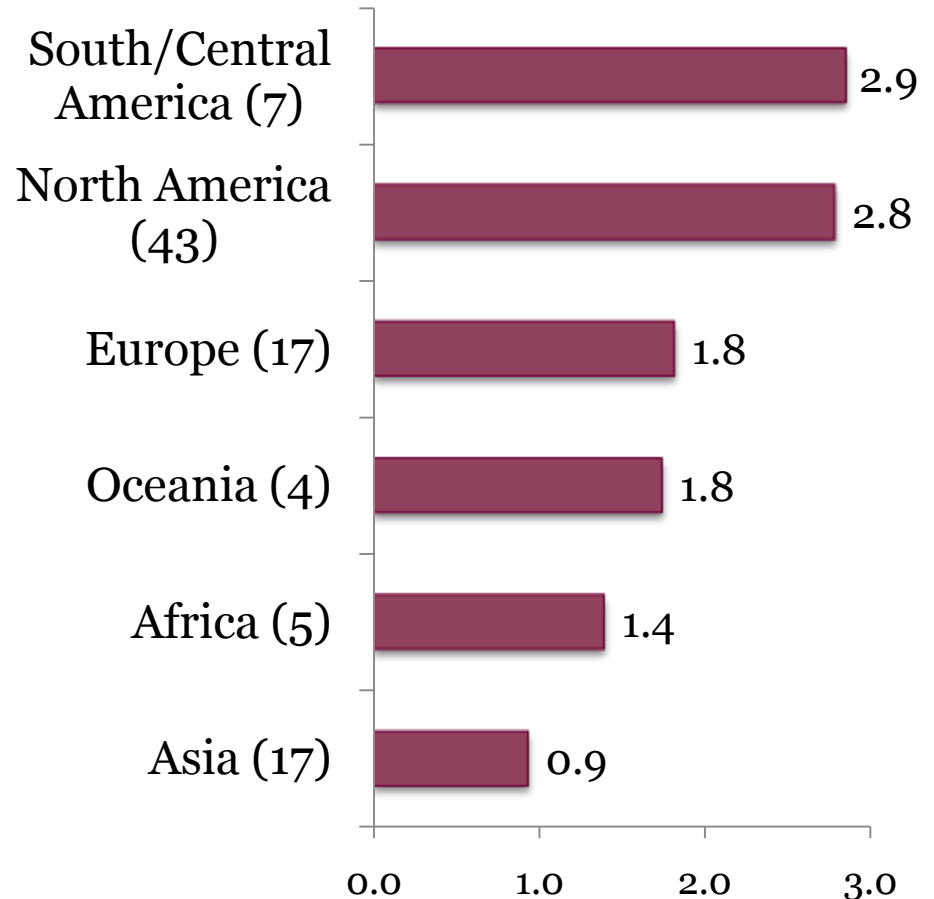
Global Comparisons

19

World Bank Income Status



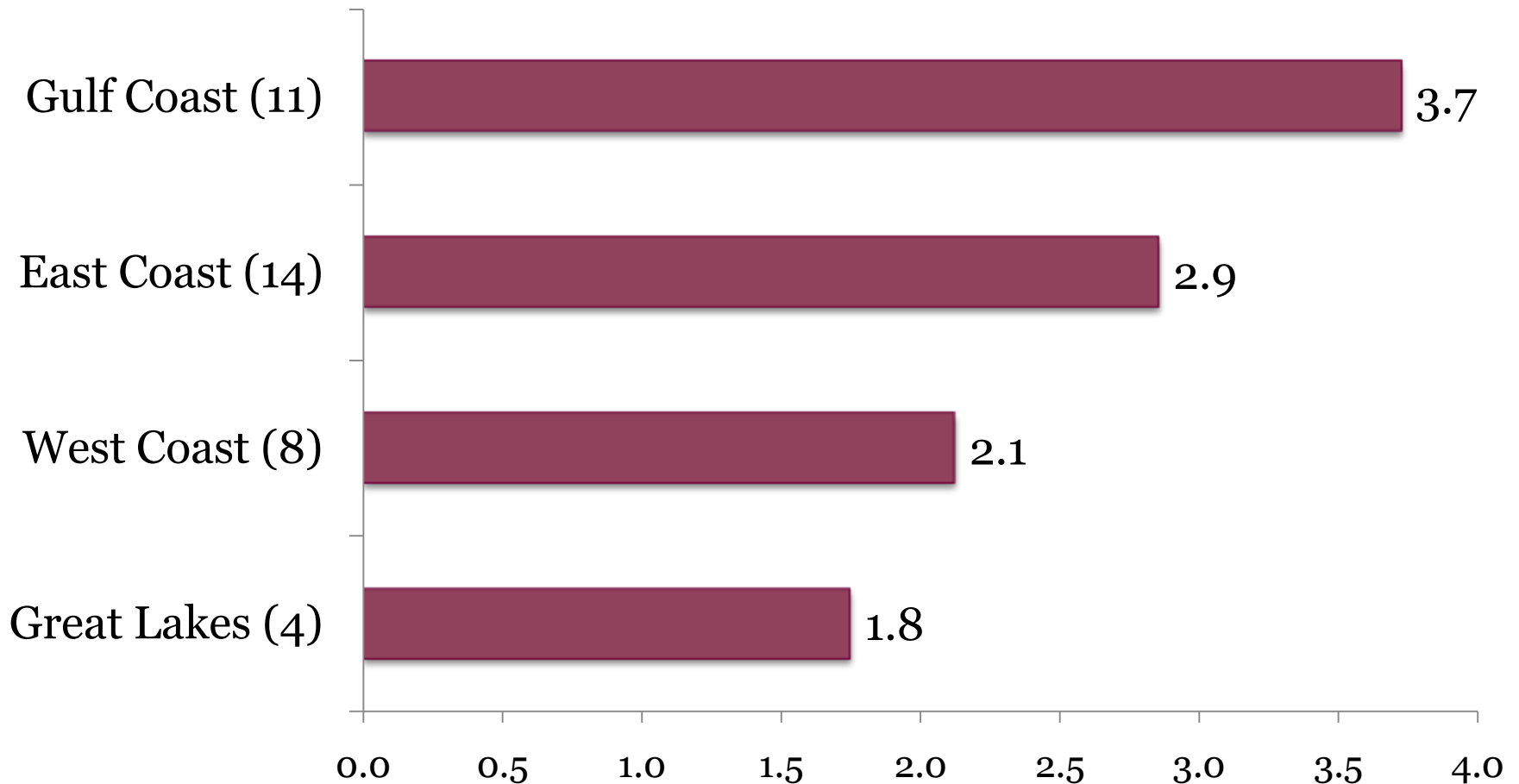
World Region



The Big Winner!

20

US Region



Survey Results Summary

21

Port staff are concerned, but feel uniformed.

Ports are rapidly expanding and building new infrastructure.

Their locations put them at risk from SLR and more extreme events, but the specifics are still fuzzy.

Planning horizons, design specifications, and management should better address uncertainty and adaptation.

The Big Picture

22

- EPA
- FEMA
- Coastal Agency
- USCG
- NGO
- Insurers

Environment
Damage

- Coastal Agency
- City Planners
- Statewide Planners
- Taxpayers
- Employees

Local/Regional
Economic
Impacts

RISK

- Insurers
- Reinsurers
- Port Authorities
- Private Firms

Infrastructure
Damage and
Cleanup

- USCG
- Army Corps
- DOT
- Taxpayers

National/Global
Economic
Impacts

Perspectives

23

“...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

Future work/Next Steps

24

- Share results with ports community
- Better characterize risk and vulnerability
- Identify strategies to build resilience
- Stanford Engineering Project (SUPERSLR)



Deltaworks in the Netherlands

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CEE 129/229 Class

The Harte Research Institute

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<http://nemo.underwatershipping.com/>

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Extra Slides Below

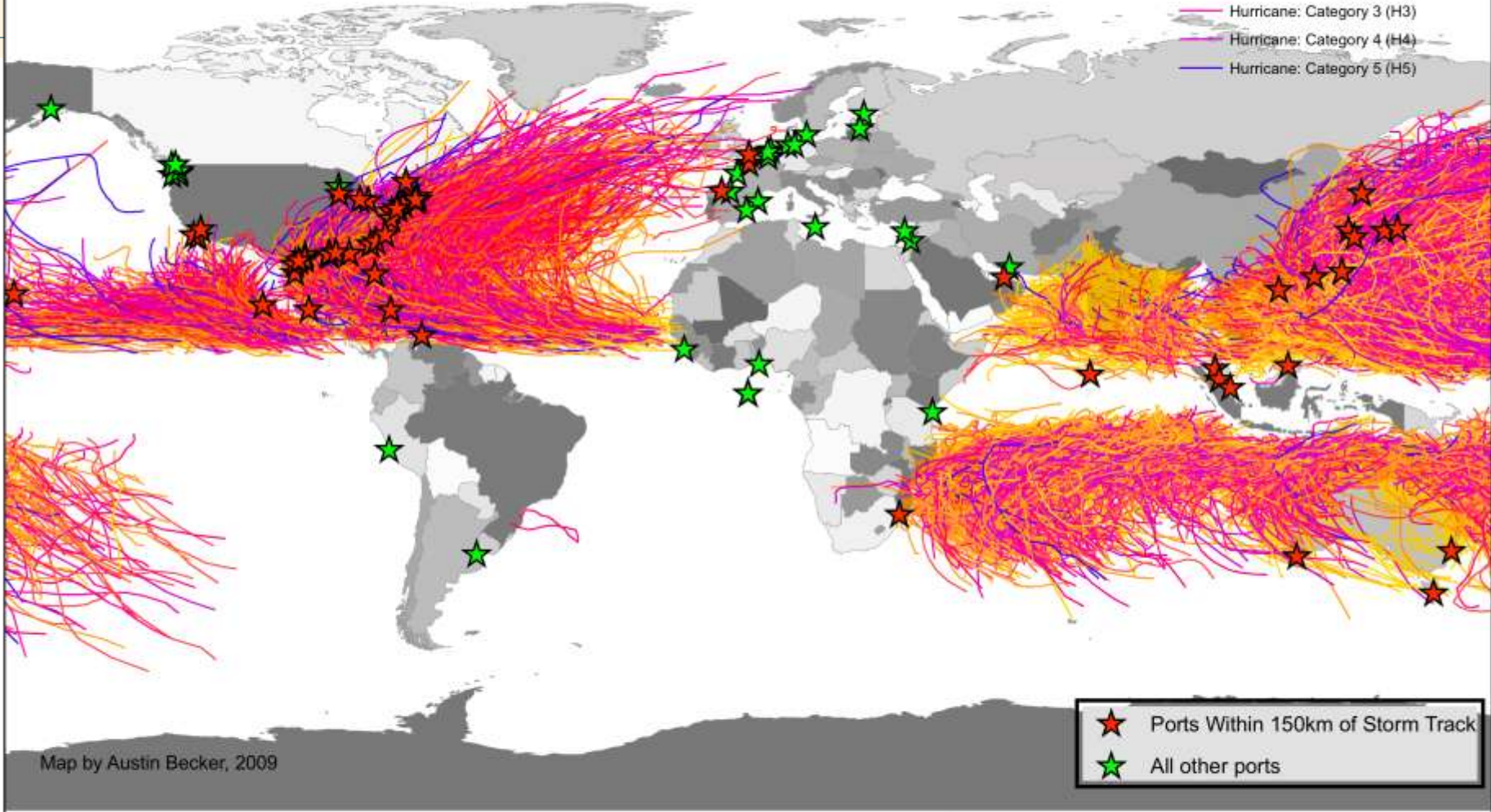
26

Ports Proximity to Historic Storm Tracks

Survey Respondents

Hurricane Tracks 1850-Present

- Tropical Depression (TD)
- Tropical Storm (TS)
- Hurricane: Category 1 (H1)
- Hurricane: Category 2 (H2)
- Hurricane: Category 3 (H3)
- Hurricane: Category 4 (H4)
- Hurricane: Category 5 (H5)



- ★ Ports Within 150km of Storm Track
- ★ All other ports

Map by Austin Becker, 2009

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AAPA American Association
of Port Authorities

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IAPH
The International Association
of Ports and Harbors

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Nov. 15, 2009
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