Case Studies of Adaptation Concerns at Freight Gateways and Terminals

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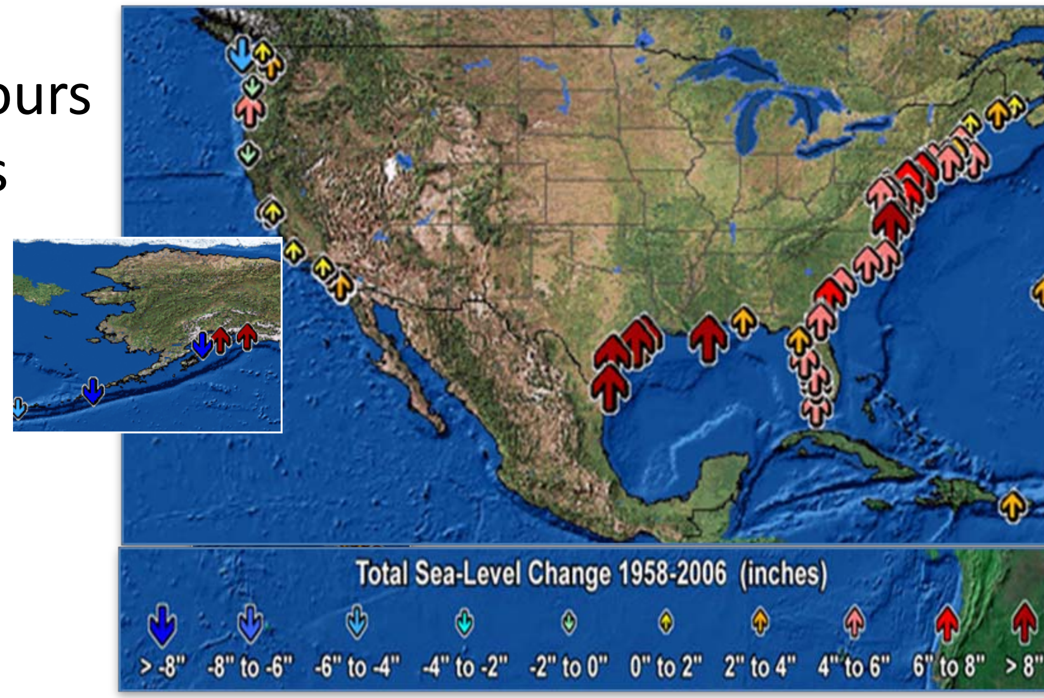
ICF International

Climate Changes are Underway in the U.S.

ICF INTERNATIONAL

- Temperature rise
- Sea-level rise
- Increase in heavy downpours
- Rapidly retreating glaciers
- Thawing permafrost
- Longer growing season
- Longer ice-free season in the ocean and on lakes and rivers
- Earlier snowmelt
- Changes in river flows

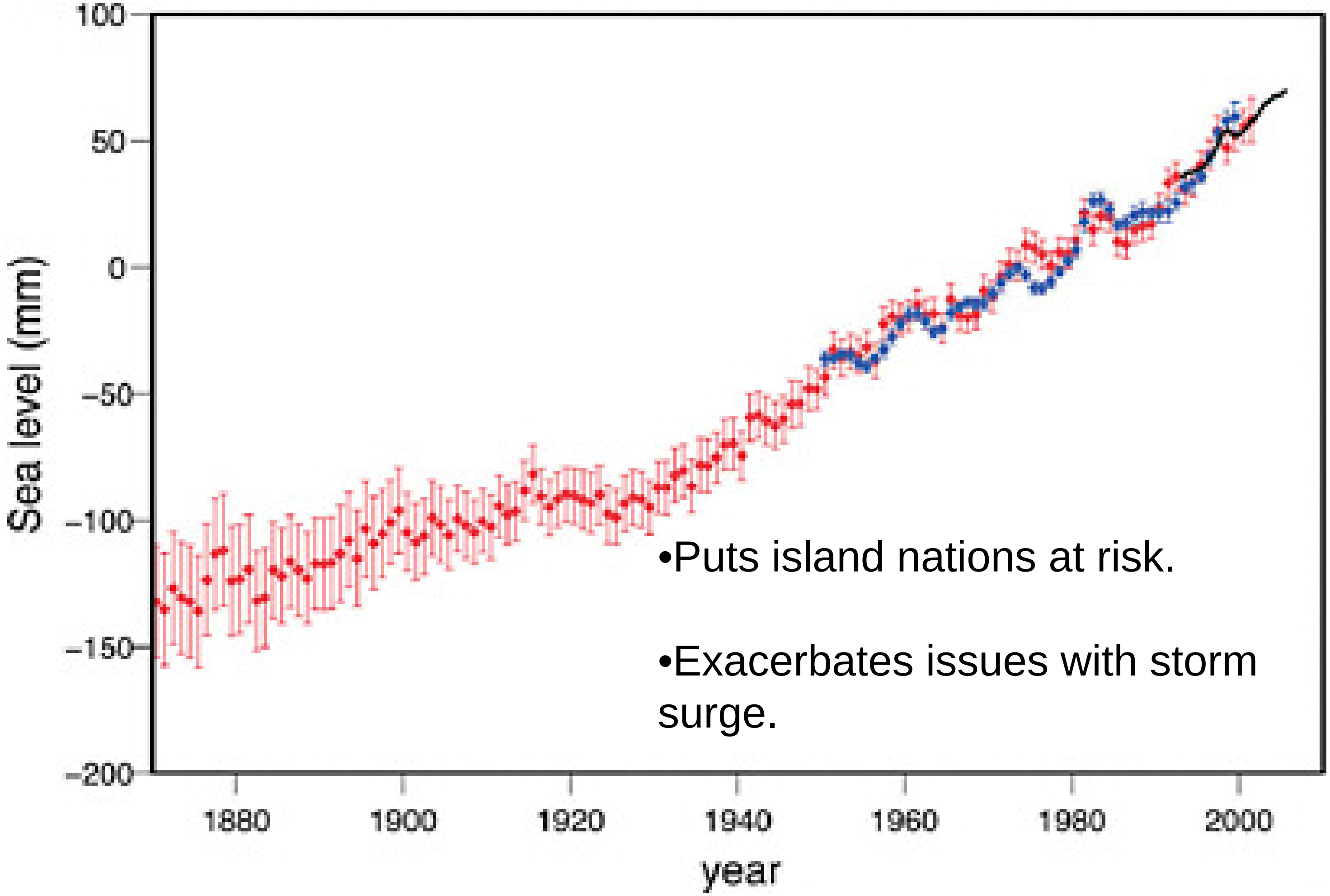
Observed U.S. Sea-Level Changes



Source: USGCRP 2009

United States Global Change Research Program

Observed Sea Level Increase

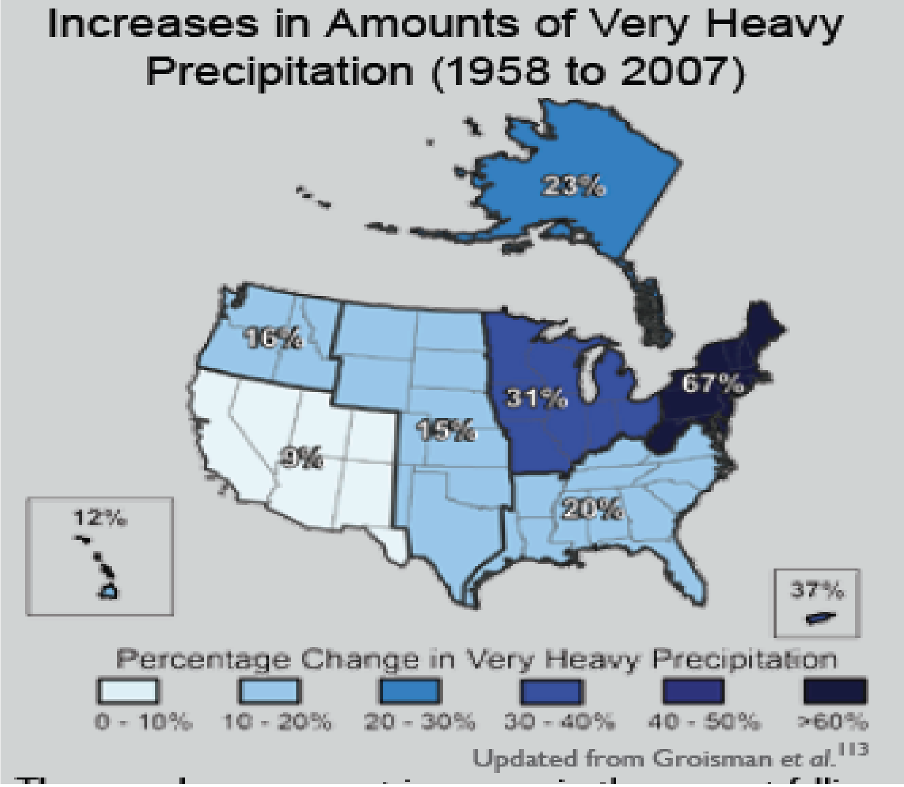


- Puts island nations at risk.
- Exacerbates issues with storm surge.

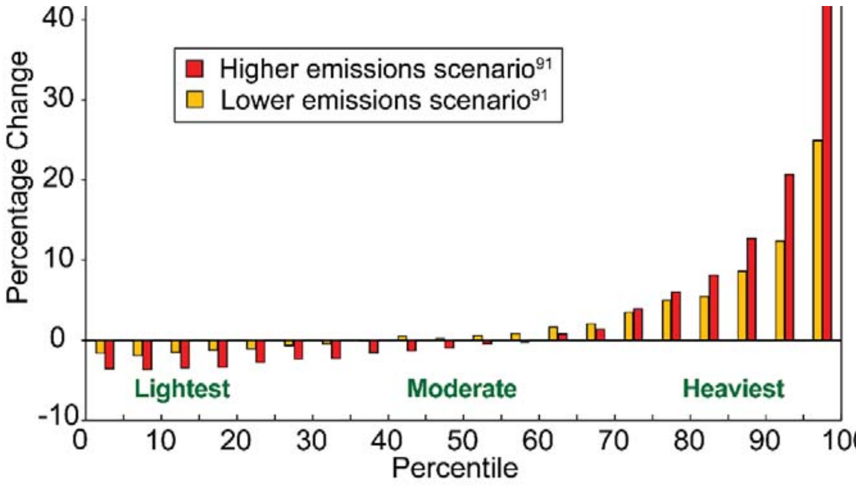
From ACC Science 2010

Floods and Droughts Have Become More Common

Increases in Very Heavy Precipitation Days, 1958-2007



Projected Change in Precipitation Intensity – 1990s vs 2090s



Source: USGCRP 2009

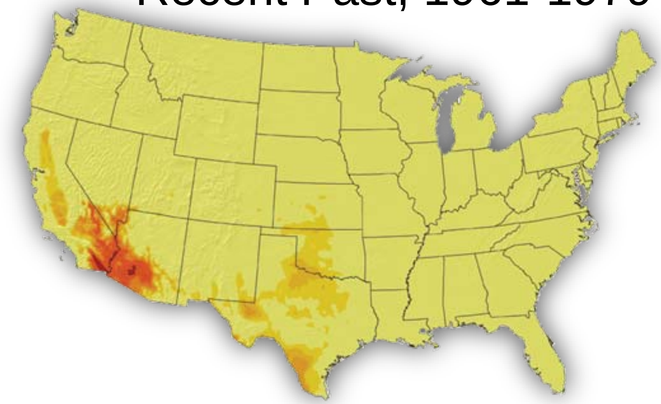
United States Global Change Research Program

Increases in Extreme Heat will Limit Some Operations and Damage Roads and Rail

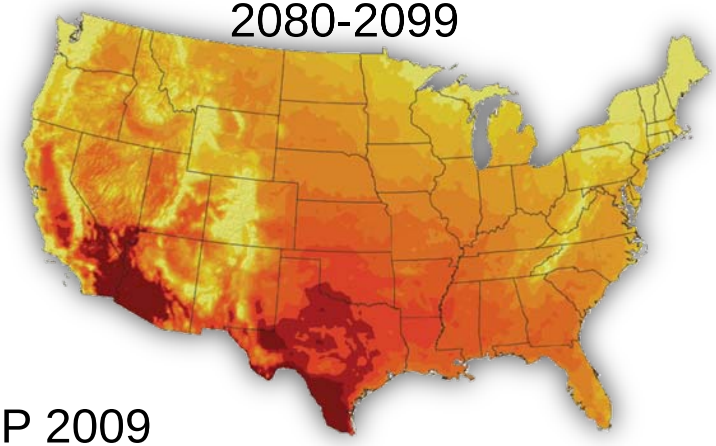
- Changes in maintenance and construction practices
- Rise in rail buckling
- Increased use of energy for refrigerated storage

Number of Days Over 100ºF

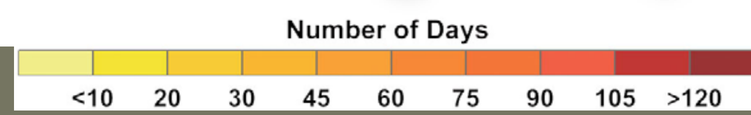
Recent Past, 1961-1979



Higher Emissions Scenario, 2080-2099



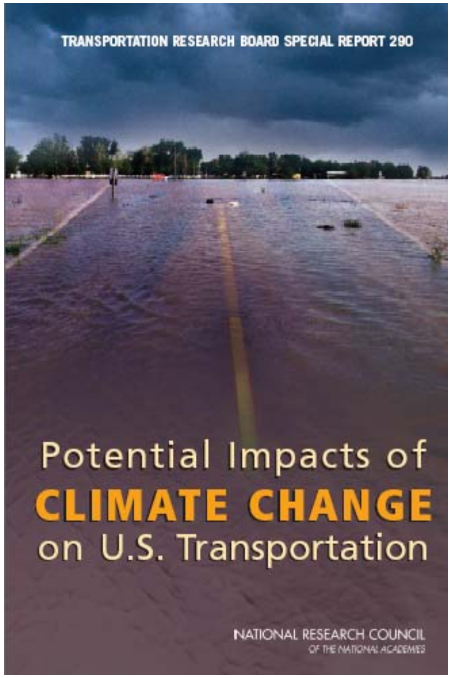
Source: USGCRP 2009



Exposure of Freight Terminals to Climate Change

TRB 290 Report

- Six of the nation's top 10 U.S. freight gateways are at risk from sea level rise
- Dry conditions could lead to low water levels, requiring additional dredging to keep shipping channels open
- Extreme weather threatens structures, power supply and supply chain
- Heat events increase need for refrigerated storage and transport



Why this matters: Port Impacts*

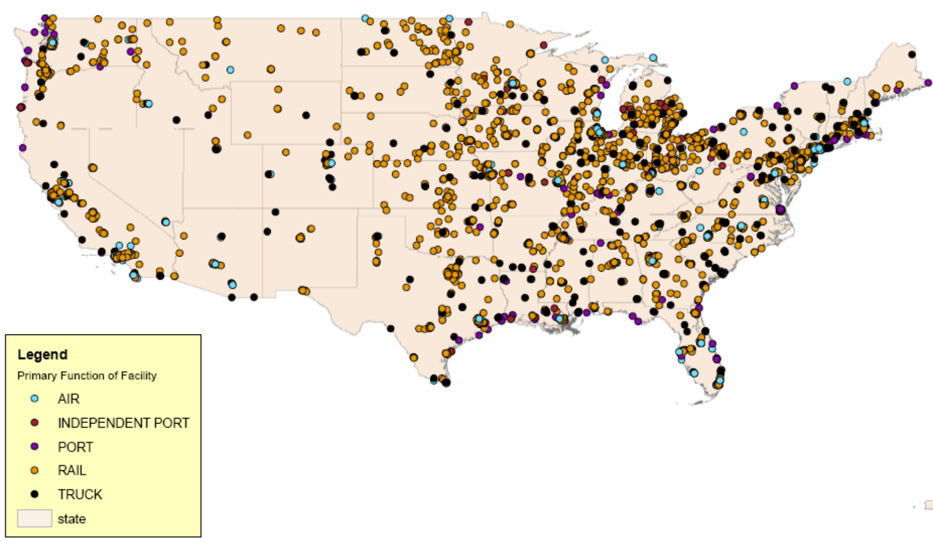
CLIMATE EFFECT	IMPACTS
More hot days	• Asphalt deterioration • Thermal expansion of bridge joints, paved surfaces • Pavement & structural design changes
Wind speeds	• More frequent sign damage • Need for stronger materials
More frequent, intense precipitation	• Increased flooding • Increased peak stream flow could affect scour rates • Standing water could affect structures adversely
Increased coastal storm intensity	• Increased storm surge and wave impacts • Decreased expected lifetime of structures • Erosion of land supporting coastal infrastructure
Sea level rise	• Permanent inundation • Erosion of road base • May amplify storm surges in some cases • Changes in port competitiveness

*Sources: "*The Gulf Coast Study, Phase 1,*" Climate Change Science Program, 2008 and *"Assessing the Need for Adaptation,"* Courtesy of Carter Atkins, 2011.

Defining Characteristics of Freight Terminals

- **U.S. Freight System**
  - Massive, multi-modal system including roads, airports, railroads, waterways, terminals, ports, and pipelines
  - In 2007, freight system moved 51 million tons worth $45 billion per day
- **Freight Terminals: Points where freight originates, terminates, or is handled**
  - Terminal Assets and Operations:
    - Facilities to accommodate ships, trucks, and trains (e.g., berths, freight yards)
    - Handling gear (depends on commodity type)
    - Significant storage space (grain silos, storage tanks, refrigerated warehouses)

U.S. Intermodal Freight Facilities



Types of Freight Terminals

- Distribution Centers (warehouse and cross-dock)
- Ports (sea and air)
- Intermodal Terminals
- Bulk/Transload Terminals
- Intermodal Logistics Centers (freight villages)
- Hub Terminals
- City Terminals

Case Study: Moorebank Intermodal Freight Terminal

- **Location:** Southwest of Sydney (Liverpool), Australia
- **Facility Type:** Intermodal terminal facility, warehouse/distribution facility, rail access (proposed)
- **Activity:** Sydney Intermodal Terminal Alliance commissioned a climate risk assessment (2011)
- **Key Climate Risks Identified:**
  - Flooding (particularly for rail corridor)
  - Bushfire
  - Heat waves
  - Hail, lightening, and wind

Figure 8: Bushfire prone land (SIMTA proposal shown in green)

- **Adaptation Recommendations**
  - Internal drainage design to take updated forecasts into account
  - Further assess flood and bushfire risk

Case Study: Moorebank Intermodal Freight Terminal

Risk Assessment Methodology

Table 9: Likelihood ratings

Rating	Recurrent risks	Single events
Almost certain	Could occur several times a year.	More likely than not – probability greater than 50%.
Likely	May arise about once per year.	As likely as not – 50/50 chance.
Moderate	May arise once in ten years.	Less likely than not but still appreciable – probability less than 50% but still quite high.
Unlikely	May arise once in ten years to 25 years.	Unlikely but not negligible – probability low but noticeably greater than zero.
Rare	Unlikely during the next 25 years.	Negligible – probability low, very close to zero.

Table 10: Consequence ratings

Level	Structural consequence	Environmental & sustainability consequence
Insignificant	No structural damage.	Major widespread loss of environmental amenity and progressive irrecoverable environmental damage.
Minor	Localised structural damage and slight service disruption. No permanent damage.	Severe loss of environmental amenity and a danger of continuing environmental damage.
Moderate	Widespread structural damage and loss of service. Damage recoverable by maintenance and minor repair.	Isolated but significant instances of environmental damage that may be reversed.
Major	Extensive damage requiring extensive repair.	Minor instances of environmental damage that could be reversed.
Catastrophic	Permanent structural damage to property and infrastructure.	No environmental damage.

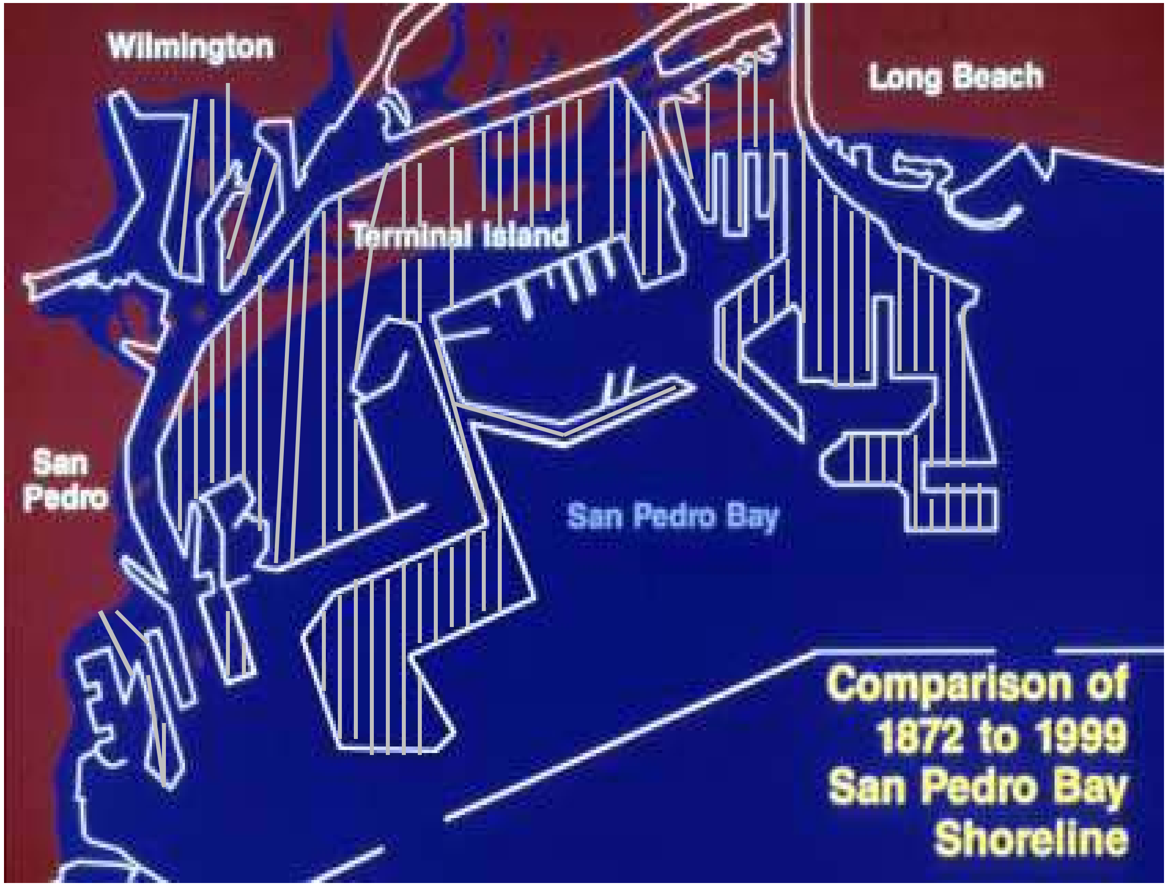
Consequence (columns) / Likelihood (rows)

Likelihood	Insignificant	Minor	Moderate	Major	Catastrophic
Almost Certain	Low	Moderate	High	Extreme	Extreme
Likely	Low	Moderate	Moderate	High	Extreme
Moderate	Low	Low	Moderate	High	Extreme
Unlikely	Low	Low	Moderate	Moderate	High
Rare	Low	Low	Low	Moderate	Moderate

Prioritised risks

Case Study: Ports of Los Angeles*

- Founded in 1907
- 69 km of waterfront
- 3,035 hectares of land and water
- 26 major cargo terminals

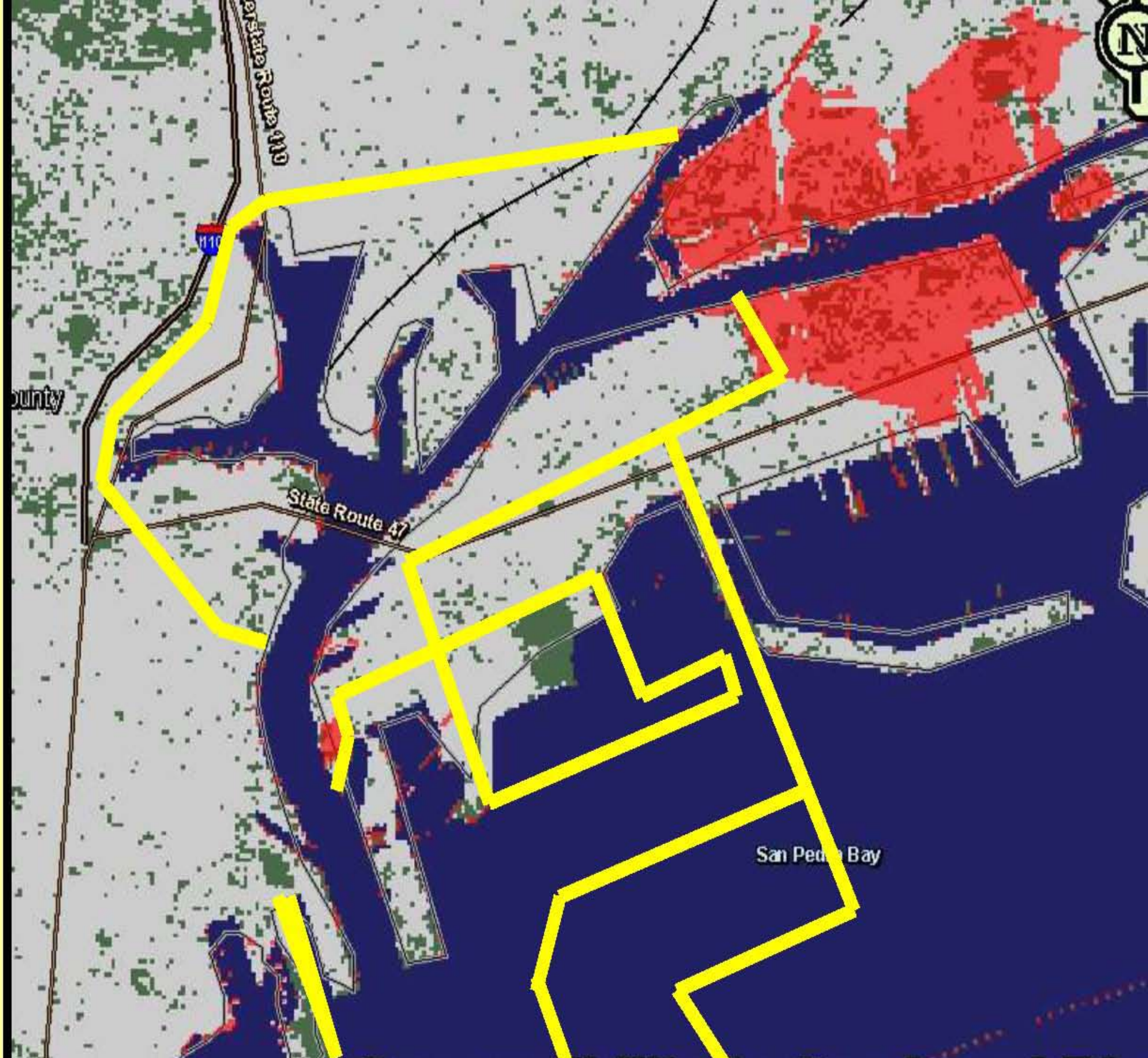


*Adapted from "*Assessing the Need for Adaptation: The Port of Los Angeles/ RAND Corporation Study,*" Courtesy of Carter Atkins, 2011.

No SLR

1 Meter SLR

SLR Affected Areas



2 Meter
SLR

SLR Affected Areas

Case Study: Felixstowe Dock and Railway

- **Location:** Port of Felixstowe, UK
- **Facility Type:**
  - Largest container port in the UK
  - Port owns and operates intermodal rail terminals in addition to port
- **Activity:**
  - Directed by the Climate Change Act of 2008 to report on the current and future predicted impacts of climate change
  - Conducted a risk assessment in collaboration with UKCIP
- **Key Climate Risks Identified**:
  - Power outages
  - Increased frequency of crane and pilot delays
  - Port closure

Case Study: Felixstowe Dock and Railway

Risk Assessment Methodology

- **Key Thresholds Identified:**
  - Wind speeds > 45mph
  - 1 day work stoppage
  - 3 day closure

Risk = **likelihood** of an impact occurring x **magnitude** of the consequences if it occurs

Likelihood	Magnitude	Consequence
1 = Negligible	1 = insignificant	20 - 25 = Very High
2 = Rare	2 = minor	15 - 20 = High
3 = Unlikely	3 = moderate	10 - 15 = Medium
4 = Possible	4 = significant	5 - 10 = Low
5 = Probable	5 = catastrophic	0 - 5 = Inconsequential

The results of the risk assessment are shown in Table 1.

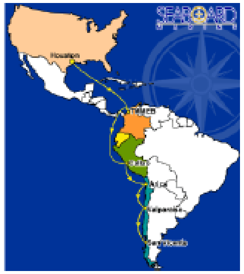
	Climate variable	Impact	Consequence of impact	Likelihood	Magnitude	Risk	Assumptions and reasoning behind risk ratings	Adaptation assumed in risk assessment	Notes
				Current / 2030's / 2060's					
1	Increased frequency of high winds or other extreme weather	Power supplies disrupted owing to off-site disruption to the network	All work would stop. Loss of Business. Reputation damage.	2 1 1	5 5 5	10 5 5	Above ground external power supplies, so susceptible to wind damage.	Autonomous adaptation (changing practise) by others assumed: more underground cables.	The greatest risk to on-site power supplies is off-site disruption. Essential services only will be maintained.
2	Increased frequency of high winds or other extreme weather	Ships break loose from moorings	Damage to ship, quay and cranes; disruption costs; insurance premiums rise.	1 1 1	2 2 2	2 2 2	Very low likelihood and therefore risk, assuming good practise is maintained.	Could be averted through good practice	


UNITED NATIONS CONFERENCE ON TRADE AND DEVELOPMENT
UNCTAD
Ad Hoc Expert Meeting on
"Climate Change Impacts and Adaptation:
A Challenge for Global Ports"
29-30 September 2011- Room XXVI, Palais des Nations, Geneva

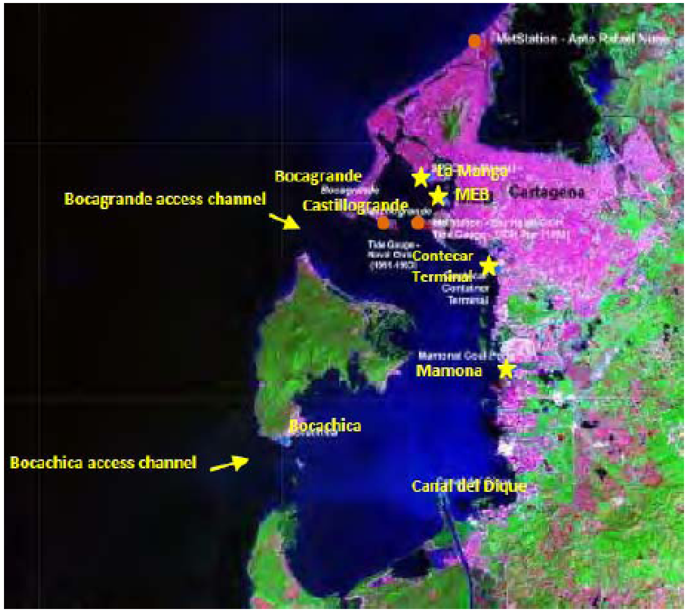
UN Conference on Trade and Development (UNCTAD)

- Meetings of “Experts”
  - September 2011
  - September 2010
  - February 2009
- Presentations on ports in:
  - Durban, South Africa
  - Hamburg, Germany
  - Mauritius
  - Caribbean
  - Tokyo
  - San Diego
  - Gulf Coast
  - Cartagena

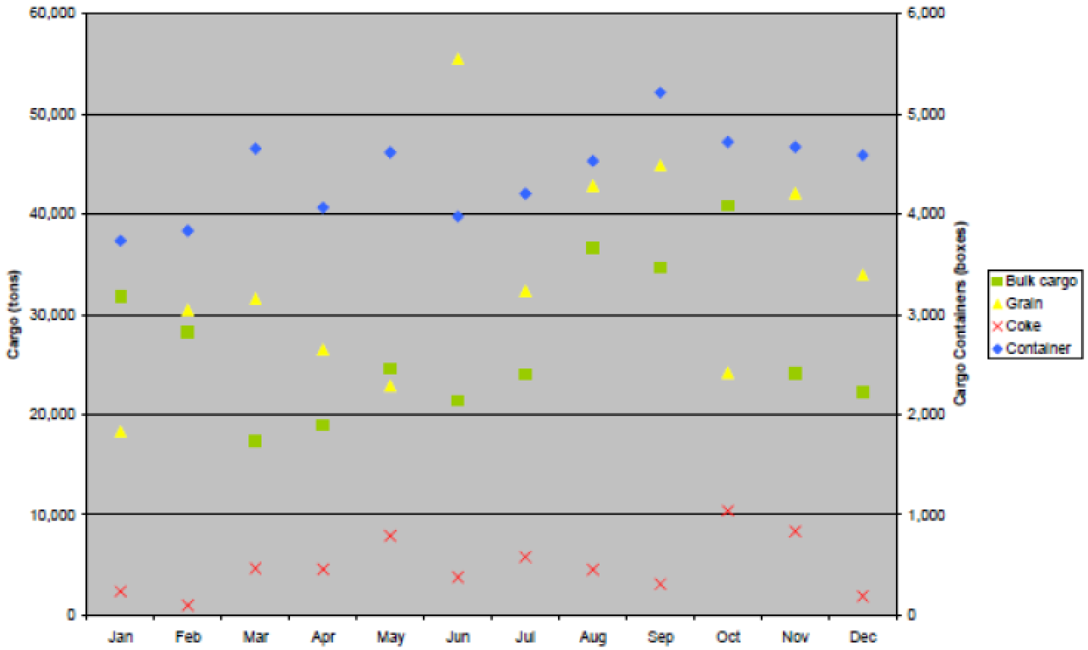
Port Muelles el Bosque (MEB), Cartagena, Colombia



Cartagena: 12% of Colombia's international trade
MEB: 1% of Colombia's international trade (in tonnage)

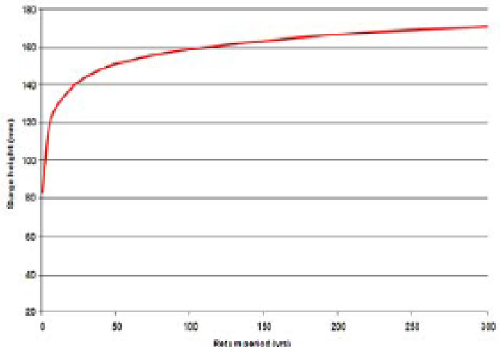


Source: IFC, MEB 2011

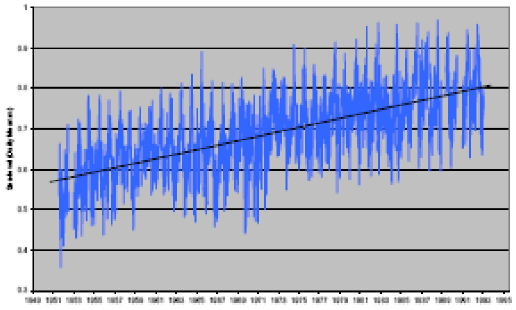


CC information, risk, impacts (internal ops, examples)

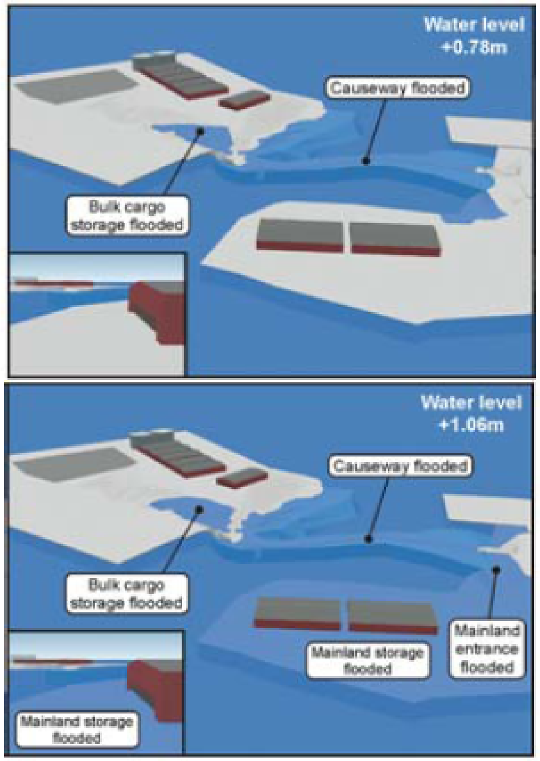
- Vehicle movement
- Goods handling and storage
- Drainage
- Health and safety



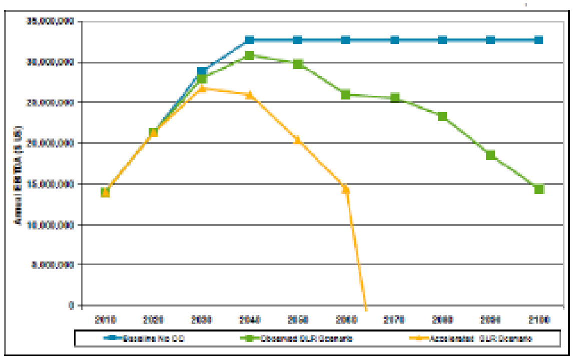
Storm surge height, 1:300 year return period



Sea level, Bahía de Cartagena(1951-1993)



Seawater flooding, 2050, observed and accelerated SLR scenarios



Financial analysis of the impacts

Thank you!