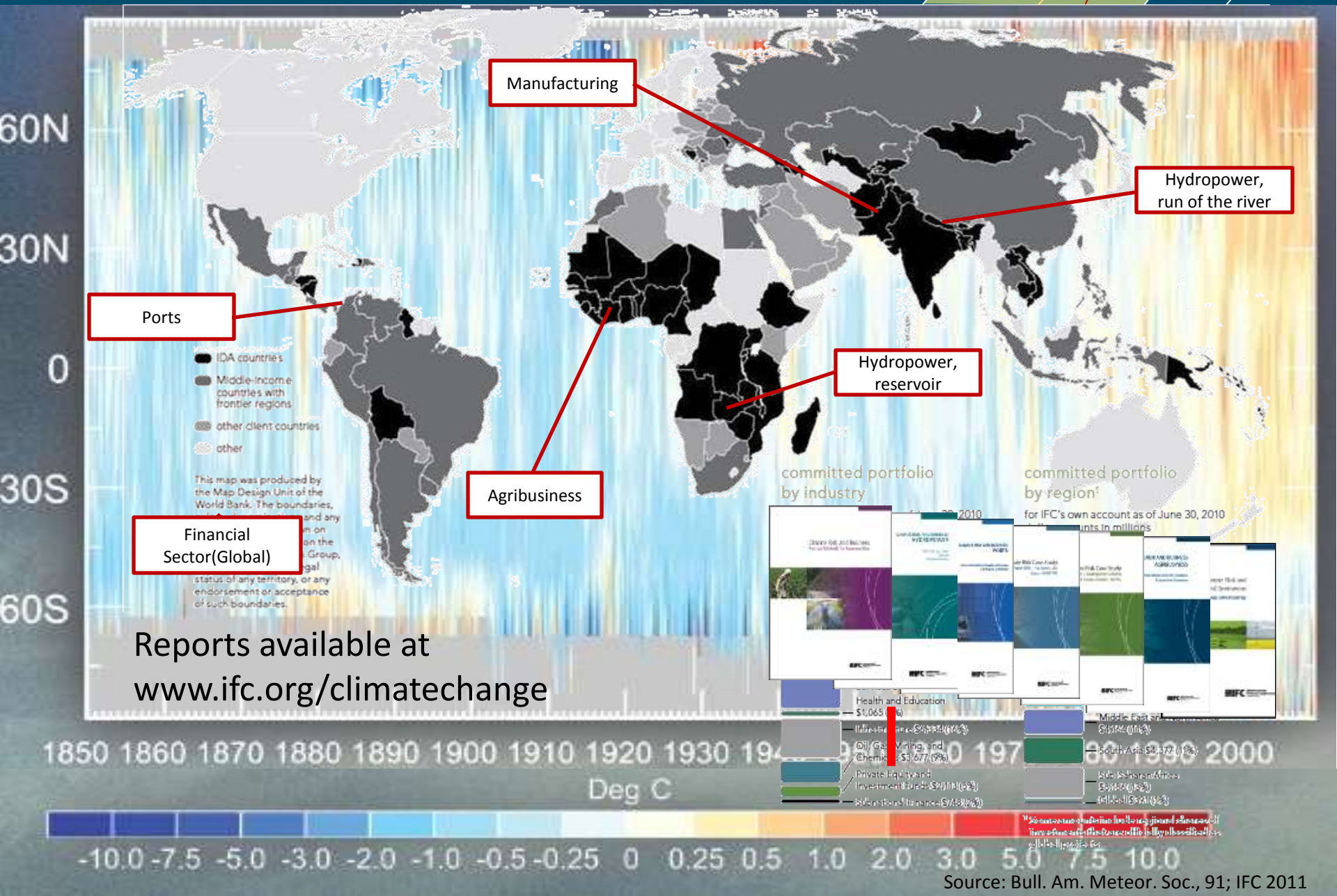
Climate Impacts and Adaptation in Ports

Pacific Ports Clean Air Collaborative Conference

Port of Los Angeles, February 22, 2012

International Finance Corporation



Reports available at
www.ifc.org/climatechange

Source: Bull. Am. Meteor. Soc., 91; IFC 2011

Climate risk and investments

Financial and Credit

- Market conditions
- Project costs
- Asset depreciation
- Efficiency and performance
- Outputs
- Loss contingencies
- Country risk

Operational

Strategic and developmental

Environmental and Social

Legal

Reputational

- Underlying cash flow values may be significantly altered; revenues and costs
- Equity: changes in valuation
- Supply and demand, futures prices
- Depreciation: financial models may overestimate useful lives of physical assets
- Change in insurance costs and availability
- Fiduciary and legal implications
- Investment institutions, regulatory focus
- Overall sustainability and development

Source: Stenek et al. 2010

Examples of recorded and extreme weather events from past 12 months

- **World's largest investor groups,** representing $21 trillion: expected steps from investee companies
  - "clear definition of board and senior management responsibilities and accountability processes for managing CC risks"
  - integration of "CC risks and opportunities into the company's business strategy"
  - definition of key metrics and "goals to address vulnerabilities to CC"

Thai floods, economic consequences: impacts on GDP, growth, jobs, port operations, shipping volumes, etc.

Source: NOAA, 2011-12; news agencies 2011-12; portstrategy, 2012

Observed changes

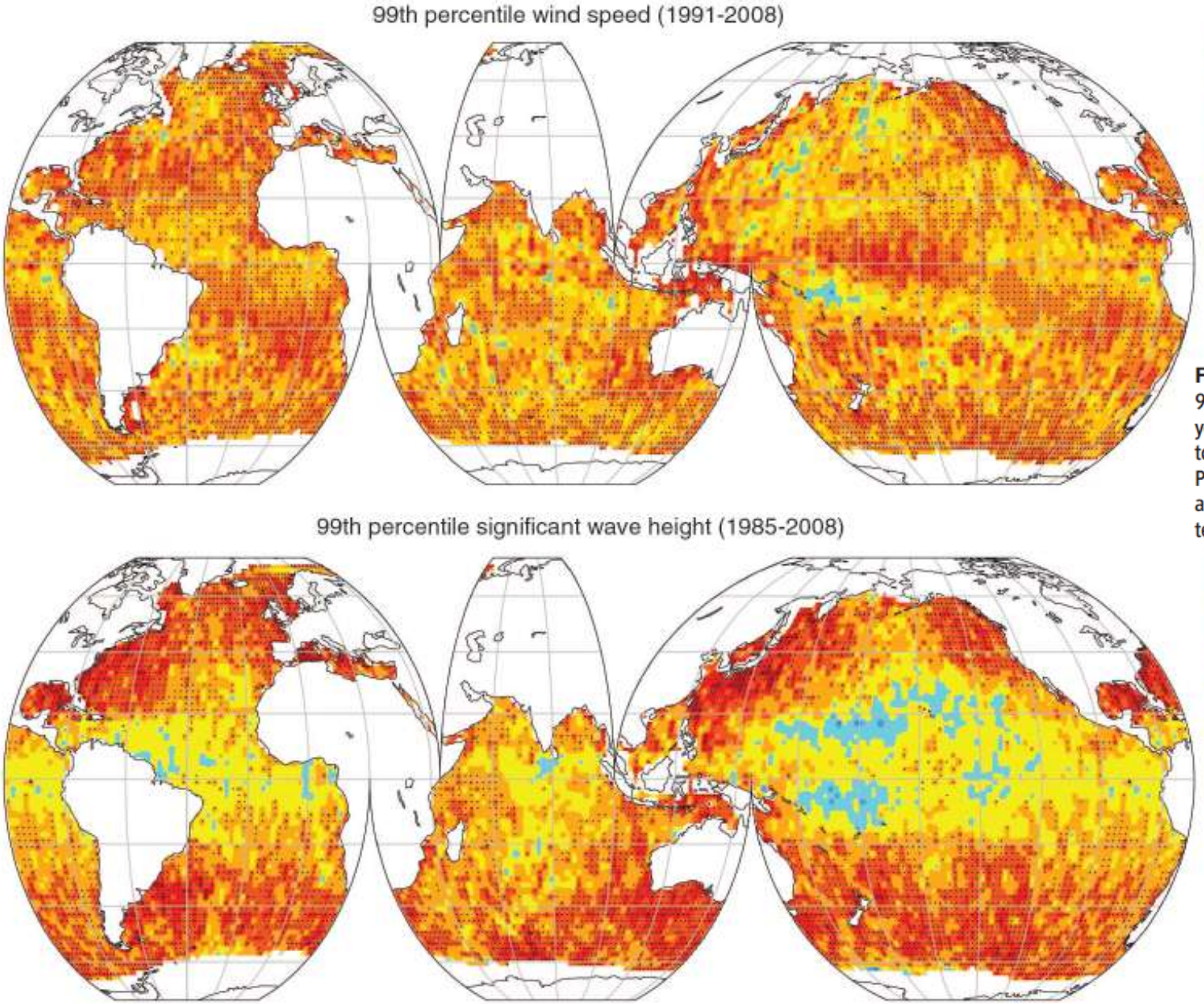
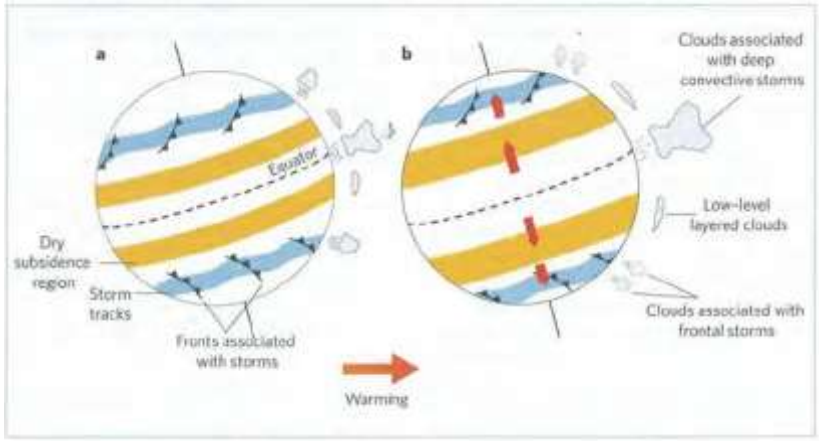


Fig. 3. Color contour plots of the 99th-percentile trend (percent per year). Wind speed is shown at the top and wave height at the bottom. Points that are statistically significant according to the Seasonal Kendall test are shown with dots.

Source: Young et al. 2011

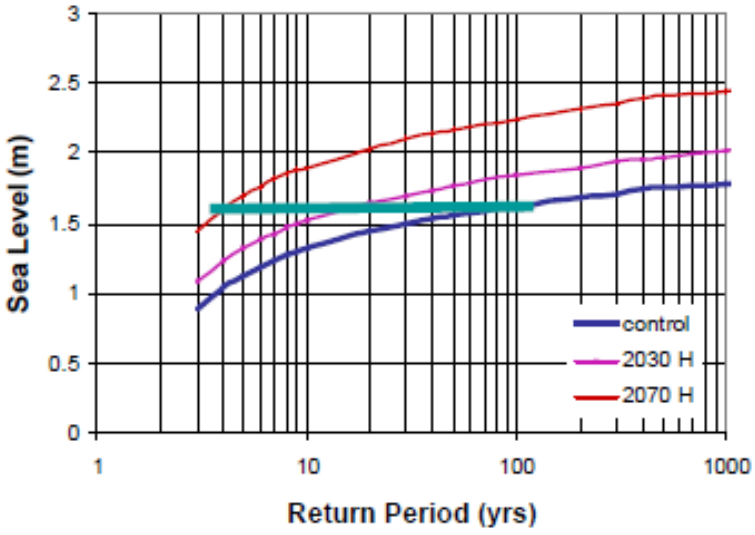
Projected changes



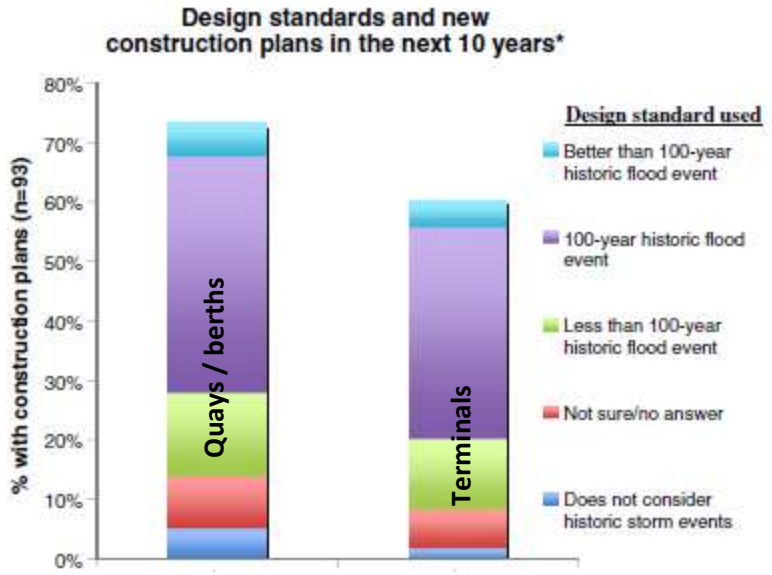
Potential changes in the position of mid-latitude storm tracks in a warming climate

MIT study (2012), storm surge floods

- 1:100 year returns (2m in NYC) may become 1:3 – 1:20
- 1:500 year return (3m in NYC) may become 1:25 – 1:240
- Manhattan sea walls – 1.5m



1:100 storm surge heights in Port Welshpool

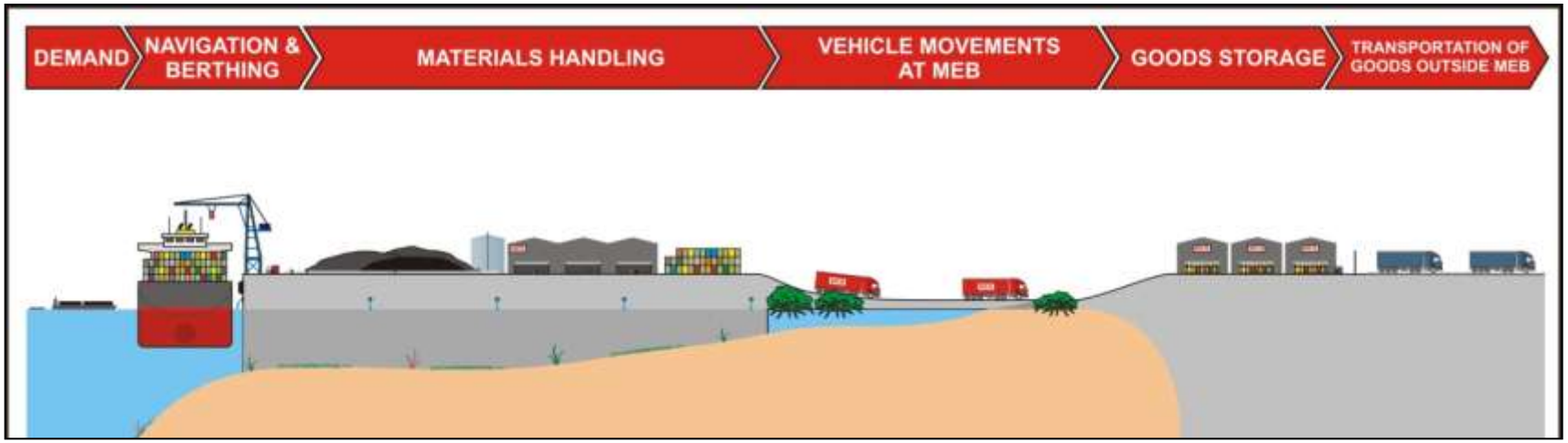


Sources: Stephens 2011, McInnes et al. 2009, Becker et al. 2011, MIT 2012

Ports sensitivity to climate change: MEB case study

- Long lifetimes of key assets, sensitive to climate
- Locations exposed to climate impacts
- Dependence on trade, shipping and inland transport which are also climatically-vulnerable
- Indirect impacts can be as important as direct

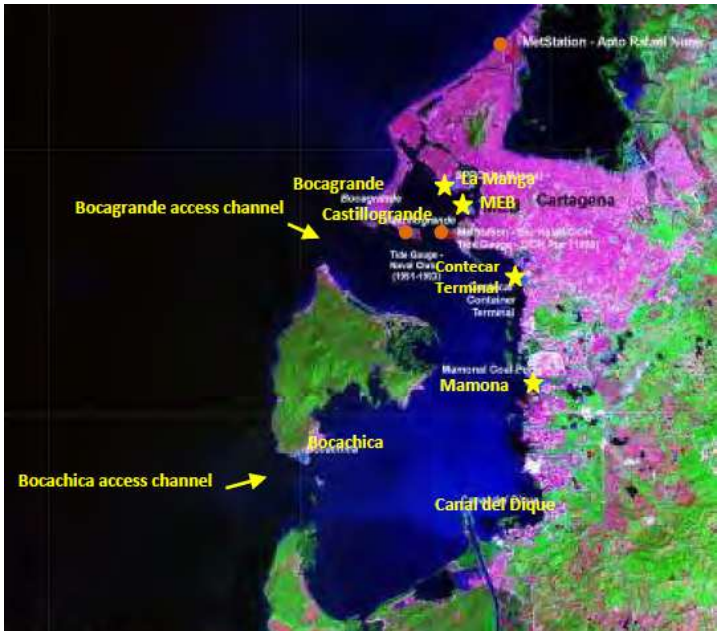
- Key risks and their materiality (financial, environmental, social)
- Adaptation options

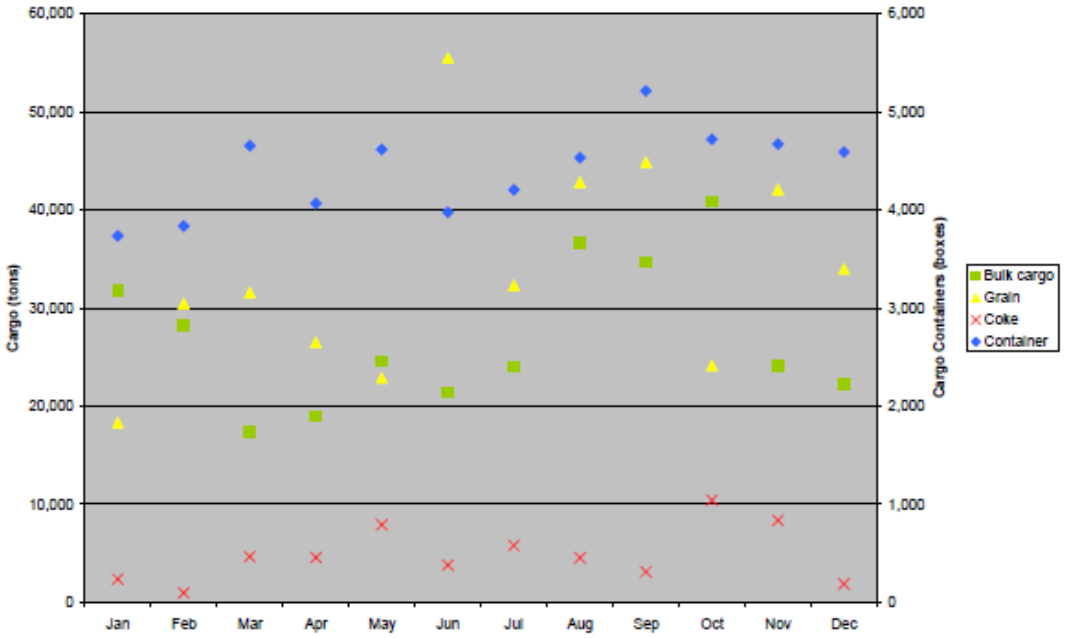


Source: Stenek et al. 2011

Port Muelles el Bosque (MEB), Cartagena, Colombia

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

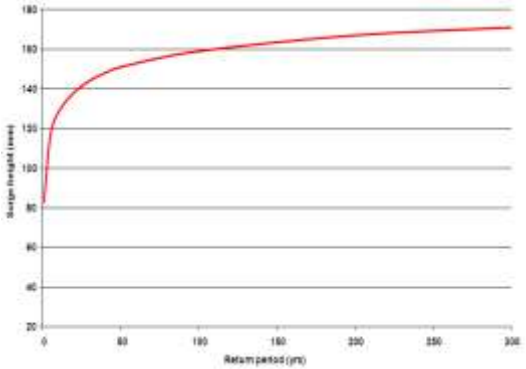




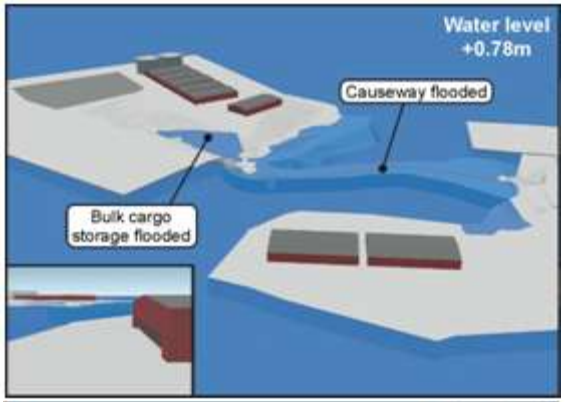
Sources: Stenek et al. 2011, IFC, MEB 2011

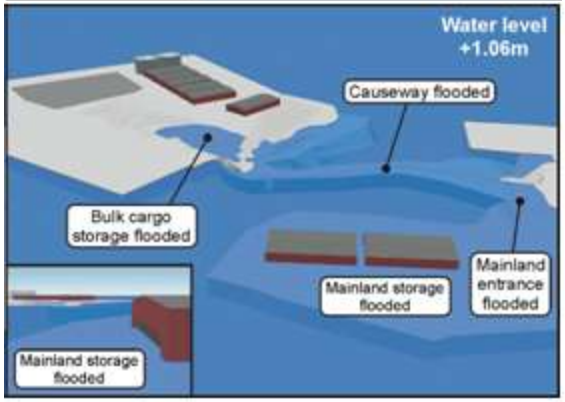
CC information, risk, impacts (internal ops, examples)

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

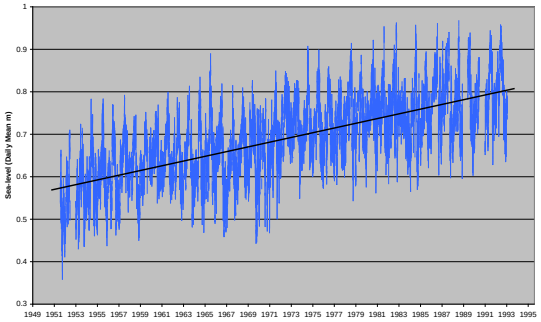


Storm surge height, 1:300 year return period

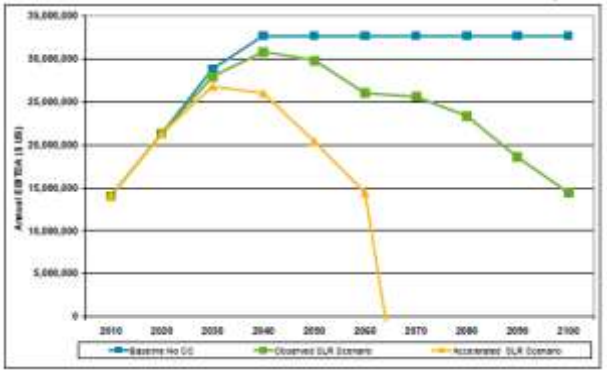




Seawater flooding, 2050, observed and accelerated SLR scenarios



Sea level, Bahía de Cartagena(1951-1993)

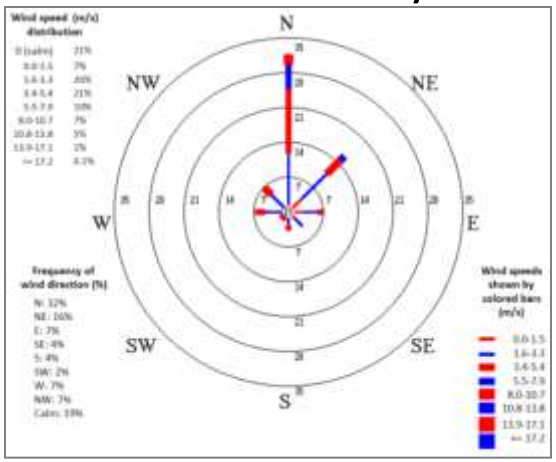


Financial analysis of the impacts

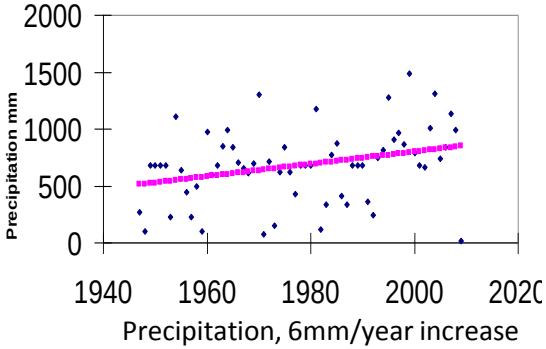
Sources: Stenek et al. 2011, Escuela Naval CIOH 2010

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

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



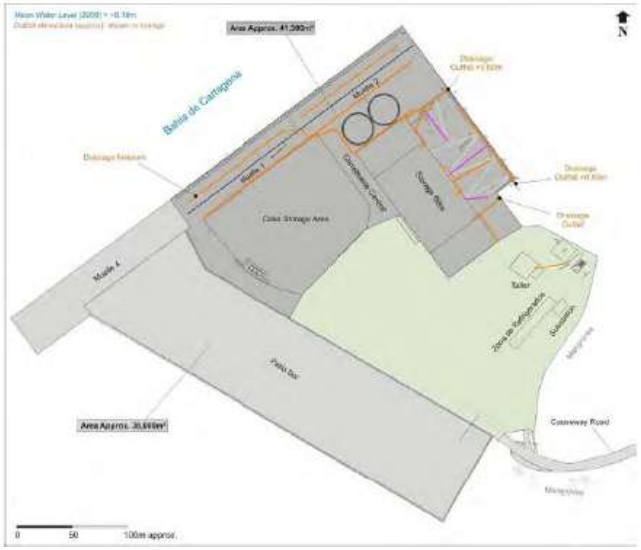
Wind rose, 19 years of data



Precipitation, 6mm/year increase

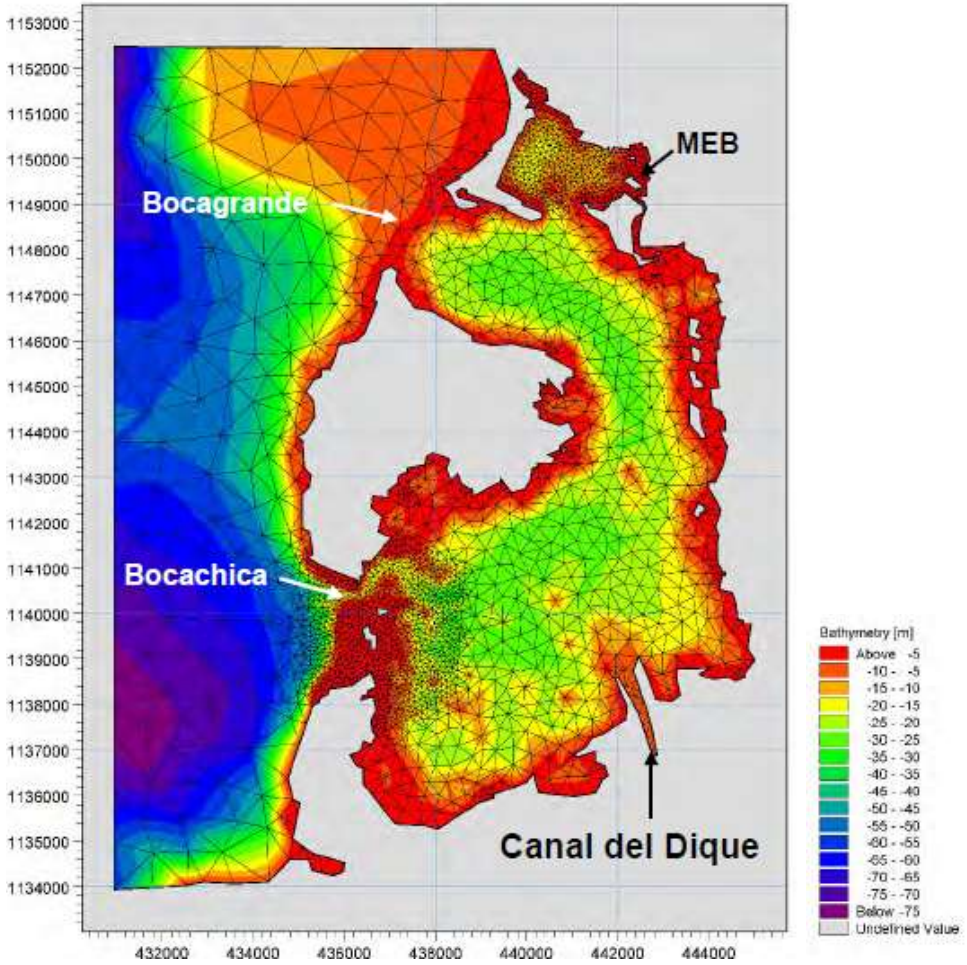
Year	2006	2007	2008	2009	Total
Pterygium		55	37		92
Cutaneous/ skin abscess	31		3	20	56
Hypertension			5	6	11
Heat stroke			2		2

Health problems potentially aggravated by climate change (days of absence)



Sources: Stenek et al. 2011, Escuela Naval CIOH 2010

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



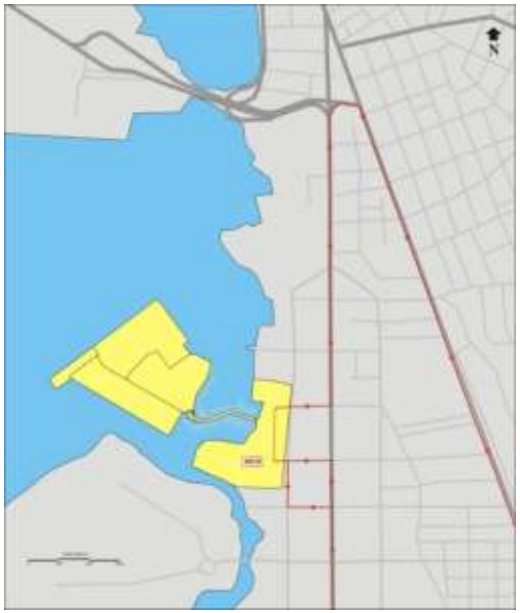
Hydrodynamic model grid of the Bay of Cartagena

Sediment plumes in the Bay

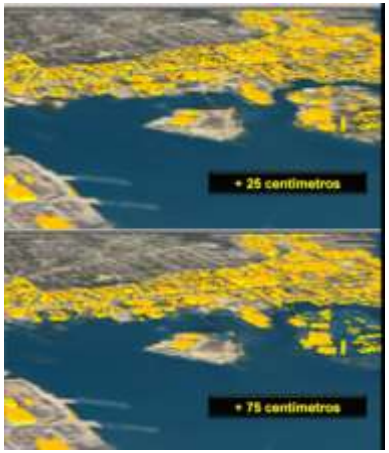
Tropical cyclone track

Sources: Stenek et al. 2011, Repestro 2005, NASA 2009

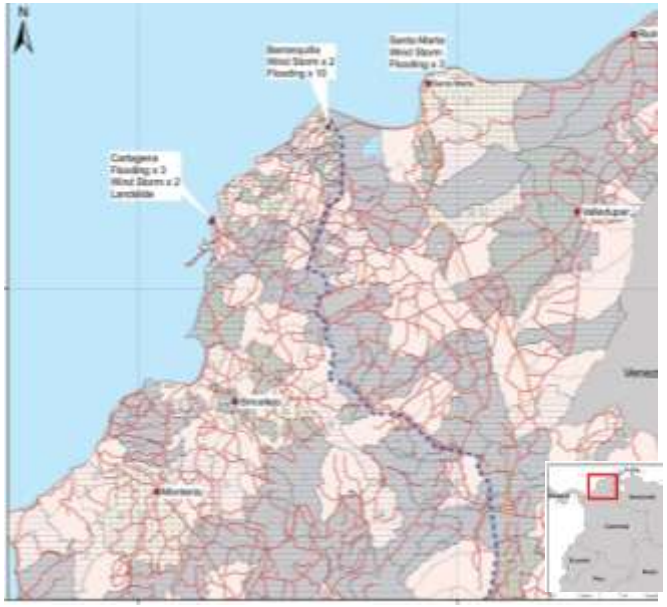
CC information, risk, impacts (external ops, examples)



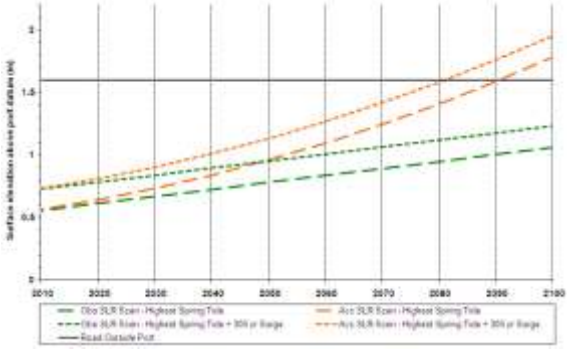
Transport routes



Effects of SLR in Cartagena



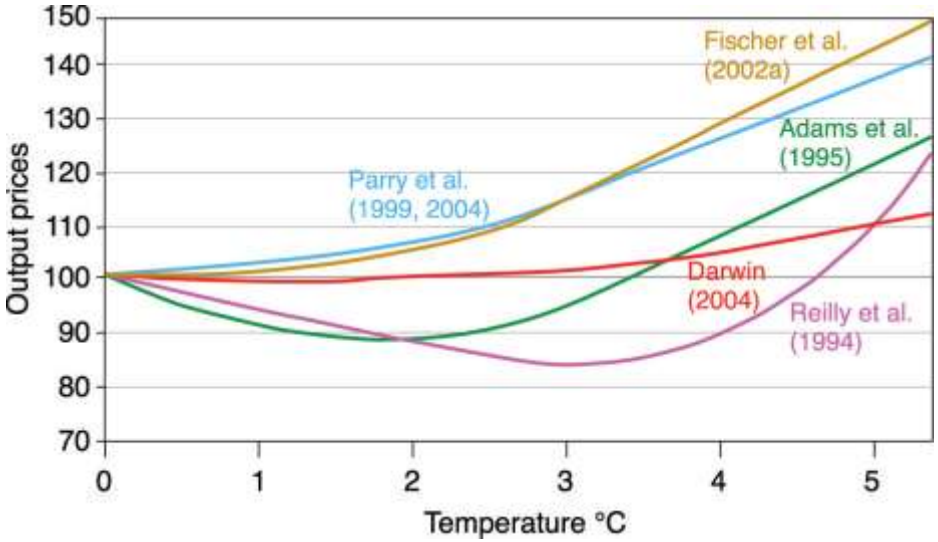
Climate related transport infrastructure hazards



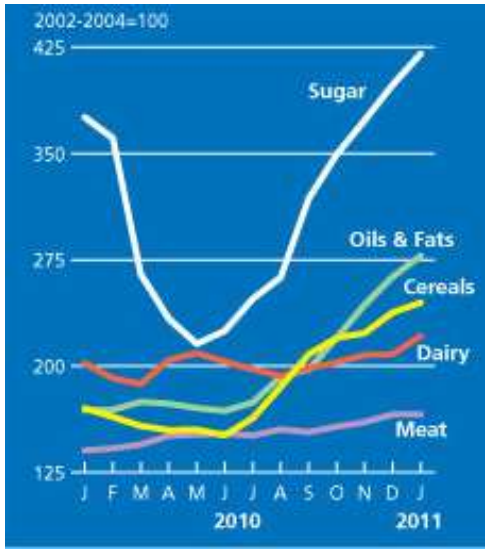
Effects of SLR (1.6m)

Sources: Stenek et al. 2011, MAVDT 2008, Alexandre et al. 2009

CC information, risk, impacts (demand, supply, examples)



Cereal prices (% of baseline) versus global mean temperature change for major modeling studies



Crop	Change in crop suitable area (km^2)
Sesame	1,720
Cotton*	-4,301
Rice	-23,227
Bananas*	27,270
Coffee*	-221,516
Cane sugar*	-45,680
Barley	-27,872
Coconut	10,839
Beans	-8,689
Maize	4,989
Potatoes*	-7,398
Plantain*	22,195
Sorghum	602
Tobacco*	-7,054
Wheat	-4,043
Cassava	-23,142
Cocoa*	-13,850
Yam	-13,850
Oil Palm*	-13,850
TOTAL	-346,857

Sources: IPCC 2007, Ramirez & Jarvis, 2009

Risks and adaptation options: materiality

Climate risk and adaptation checklist

The analyses undertaken for MEB in this study have shown that climate change can have material business implications for ports. Though some of the risks analyzed in this study are likely to be specific to MEB and may not apply to other ports, a number of them will be of broad relevance to the industry around the world.

The existing climate change research base often addresses port cities, rather than operational ports themselves. To help port operators and their stakeholders to identify climate-related risks and possible adaptation options, a checklist is provided below. It is based on the findings of the study on MEB and a comprehensive literature review. While it is focused on cargo ports, many of the issues it raises will be relevant to other types of port facilities.

This checklist:

- Categorizes climate impacts (risks and opportunities) according to the key operations undertaken at cargo ports (navigation, berthing, goods handling, etc.), along with other factors related to port performance, such as demand, insurance availability and environmental and social performance.
- Gives an overview of the climate-related sensitivities and thresholds of cargo ports in general, and also outlines some impacts which are specific to ports in particular environments (e.g., tropical and polar regions).
- Provides a list of adaptation measures which can be considered by port operators in response to climate change risks and opportunities. These include actions which help to build adaptive capacity (such as improved monitoring of climate impacts) as well as the implementation of physical adaptation measures (such as modifications to port infrastructure).

Notes on the checklist:

1. The climate-related sensitivities and critical thresholds for which the MEB study undertook risk assessments are highlighted in blue. For more information refer to the full study report.
2. There is not a one-to-one mapping between columns 2 and 3. For instance, for some climate-related risks, the checklist provides more than one adaptation option.

Risk areas for ports	Port sensitivities and potential climate change impacts	Adaptation options and opportunities for ports
Demand, trade levels and patterns	Supply and demand for products traded through ports is sensitive to climate change impacts on the global economy, production, commodity prices and buyers (e.g., increased temperatures may reduce crop yields, affect price and contribute to trade fluctuations)	Monitor impacts of climate change on supply and demand for traded products (e.g., on production and price of existing or potential products)
		Consider updating assumptions used in business forecasting and strategy planning
	Port import and export markets are likely to shift in response to climate-driven population movements. (Climatic changes such as increased flood and drought incidence may lead to substantial population movement over the longer term)	Over the longer term, identify opportunities for creating new or expanded port facilities in response to population movements
		Explore diversification of product lines in response to positive or negative climate change impacts on supply/demand
	Customers' perceptions of port service reliability may change in response to increased climatic disruptions	Monitor customer expectations of reliability and concerns about disruptions, and inform them of plans to address these issues
Navigation, shipping and berthing	Navigation depths in coastal ports and shipping channels are sensitive to changes in sea level	Monitor changes in sea level and review dredging plans and schedules
		Engage with those responsible for dredging to ensure changing risks are being managed appropriately
		Identify opportunities to accommodate larger ships due to sea level rise

Source: Stenek et al. 2011

Partnerships

- **IFC**
  - Acclimatise
  - WorleyParsons
  - U. of Oxford, Environmental Change Institute
  - Synergy
  - Muelles el Bosque
  - Trust Fund for Environmentally and Socially Sustainable Development (TFESSD)
  - Alcaldía de Cartagena
  - Centro de Investigación de la Caña de Azúcar de Colombia (CENICAÑA)
  - Centro de Investigaciones Oceanográficas e Hidrográficas (CIOH)
  - Centro Internacional de Agricultura Tropical (CIAT)
  - Centro Nacional de Investigaciones de Café (CENICAFE)
  - Corporación Autónoma Regional del Canal del Dique (CARDIQUE)
  - Corporación Colombiana de Investigación Agropecuaria (CORPOICA)
  - Departamento Nacional de Planeacion (DNP)
  - Departamento Nacional de Planeación (DNP)
  - Dirección General Marítima (DIMAR)
  - Exploraciones Oceánicas de Colombia (EXOCOL)
  - Federación Nacional de Cafeteros
  - Fundación Natura
  - Instituto Colombiano Agropecuario (ICA)
  - Instituto de Hidrología, Meteorología y Estudios Ambientales (IDEAM)
  - Instituto de Investigaciones Marinas y Costeras (INVEMAR)
  - Ministerio de Agricultura y Desarrollo Rural
  - Ministerio de Ambiente, Vivienda y Desarrollo Territorial
  - Puerto de Mamonal
  - Sociedad Portuaria Regional de Cartagena (SPRC)
  - Universidad de Cartagena
  - Universidad de los Andes (CIDER)
  - Universidad Nacional de Colombia

Climate risk and ports

- Priority initiatives? E.g.:
  - detailed compendium of key vulnerabilities to climate impacts (e.g. design standards, essential equipment),
  - climate information “translated” for the needs of port and shipping operations,
  - awareness about risks, opportunities, and options,
  - key partnerships

Thank you.

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www.ifc.org/climatechange