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MEDPORTS Forum 2019

How MED ports will proactively face the environmental challenge

25 June 2019, Marseille

Climate change impacts and adaptation for ports - an overview of key issues

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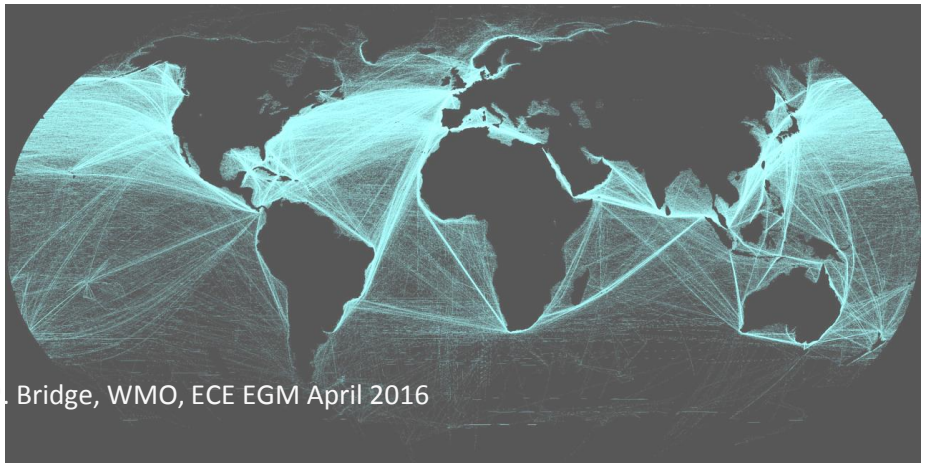
Maritime Transport: a critical facilitator of global trade and development



Global shipping movements

Over 80% of volume (70 % of value) of world merchandise trade is carried by sea (port to port): shipping and ports are key nodes in international supply chains

Globalization: interconnectedness/interdependence of shipping/ports

60% of goods loaded and 63% of goods unloaded in developing countries (UNCTAD)

Environmental challenges: two sides of the coin

- **Effects of maritime transport on the environment** (e.g. pollution, CO2 emissions)
- **Environmental impacts on maritime transport** (e.g. Climatic Variability and Change, CV&C)

Important to address these global challenges effectively, also in the light of the *Paris Agreement* and the *2030 Sustainable Development Agenda*

Relevance in the context of the 2030 Sustainable Development Agenda

2030 Agenda adopted in September 2015, effective as of 1st January 2016

Consensus by international community on a 'plan of action' involving 17 sustainable development goals with 169 targets, which are '***integrated and indivisible, global in nature and universally applicable'***

Sustainable and resilient transport among the cross-cutting issues, of relevance for achievement of progress on several of the goals and targets, e.g.

SDG 13	Take urgent action to **combat climate change and its impacts**
SDG 9	**Build resilient infrastructure**, promote inclusive and sustainable industrialization and foster innovation
SDG 14	Conserve and **sustainably use the oceans, seas and marine resources** for sustainable development
SDG 1.5	By 2030, **build the resilience of the poor and those in vulnerable situations and reduce their exposure and vulnerability to climate-related extreme events** and other economic, social and **environmental shocks and disasters**

Climate Variability and Change (CV & C)

A global challenge and "*a defining issue of our era*" (UN SG Ban Ki Moon, 2008)

- Compelling scientific evidence of increasing impacts (IPCC, 2013; 2018)

- Huge potential costs associated with inaction (5-20 % of GDP, annually; STERN, 2006)
  - WEF 2019 Global Risks Report: top 3 economic risks are extreme weather events, failure of CC mitigation and adaptation, natural disasters
  - By 2100, global flood damages due to sea-level rise (and related extreme events) might amount to up to US$ 27 trillion/year – about 2.8% of global GDP in 2100 (S Jevrejeva et al 2018 Environ. Res. Lett)

- A serious development threat, particularly for the Least Developed Countries (LDCs) and the Small Island Developing States (SIDS)

- Since 2008, integration of CV & C considerations into UNCTAD's work on transportation

UNCTAD work on climate change implications for maritime transport and relevant follow-up

2009 Follow-up	**UNCTAD Multiyear Expert Meeting: "*Maritime Transport and the Climate Change Challenge*"** UNCTAD ed. multidisciplinary book: **Maritime Transport and the Climate Change Challenge** UN-Earthscan (2012)
2010 Follow-up	**Joint UNECE-UNCTAD Workshop: "*Climate change impacts and adaptation for international transport networks*"** UNECE *Group of Experts on Climate Change Impacts and Adaptation for International Transport Networks* (2011-2014); mandate extended in 2015; 2012 International Conference - including session on SIDS 2013 EG Report - *Climate Change Impacts and Adaptation for International Transport Networks*
2011 Follow-up	**UNCTAD Ad Hoc Expert Meeting**: **"*Climate Change Impacts and Adaptation: a Challenge for Global Ports*"** Becker et. al, **A note on climate change adaptation for seaports**, Climatic Change, 2013
2014	**UNCTAD Ad Hoc Expert Meeting: "*Addressing the Transport and Trade Logistics Challenges of the Small Island Developing States (SIDS): Samoa Conference and Beyond*"** **UNCTAD Multiyear Expert Meeting: "*Small Island Developing States: Transport and Trade Logistics Challenges***
2017	**UNCTAD Port-Industry Survey on Climate Change Impacts and Adaptation**
2015-2017 Follow up	**UNCTAD DA Project *"Climate change impacts on coastal transport infrastructure in the Caribbean: Enhancing the adaptive capacity of Small Island Developing States (SIDS)"*** Monioudi et. al, Climate change impacts on critical international transportation assets of Caribbean SIDS: the case of Jamaica and Saint Lucia, Reg Environ Change 2018: 2211
2019	**UNCTAD Ad Hoc Expert Meeting: "*Climate Change Adaptation for International Transport: Preparing for the Future"***

CV & C implications for Maritime Transport

Two sides of the "coin": causes - effects

- **Mitigation**: action directed at addressing causes (long-term)

- **Adaptation**: action directed at coping with impacts (short- and long- term); requires assessment of impacts that can vary considerably by physical setting, type of forcing, sector, mode, region etc.

In Maritime Transport:

- much of the international debate/policy action focuses on mitigation (i.e. reduction / control of GHG emissions).
- comparatively little focus on study of impacts and development of adaptation policies/actions

BUT: Maritime transport is not (just) a 'culprit', it is (also) a victim

CV & C Impacts on Maritime Transport

Direct and *indirect* impacts on maritime transport infrastructure and services:

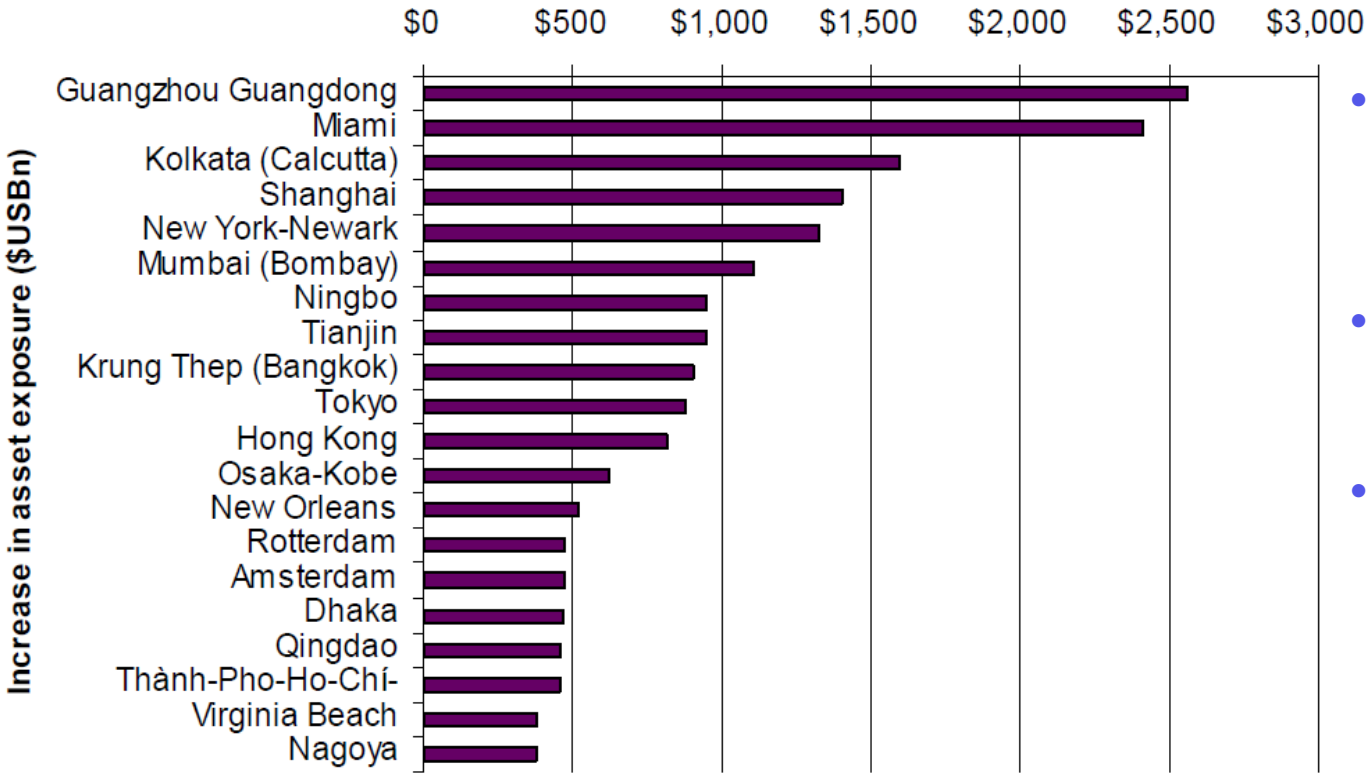
Sea-level rise, temperature-, humidity-, precipitation- changes, extreme storms and floods and other climatic factors are likely to

- affect seaports and hinterland/connecting transport infrastructure as well as the global network of supply-chains
  - potential for *damage, disruption and delay* – economic/trade related losses
- affect demand for shipping/transport
- exacerbate other transport-related challenges
- open new arctic sea-lanes due to polar ice melting

Enhanced climate resilience / adaptation for ports and other key transport infrastructure is of strategic economic importance

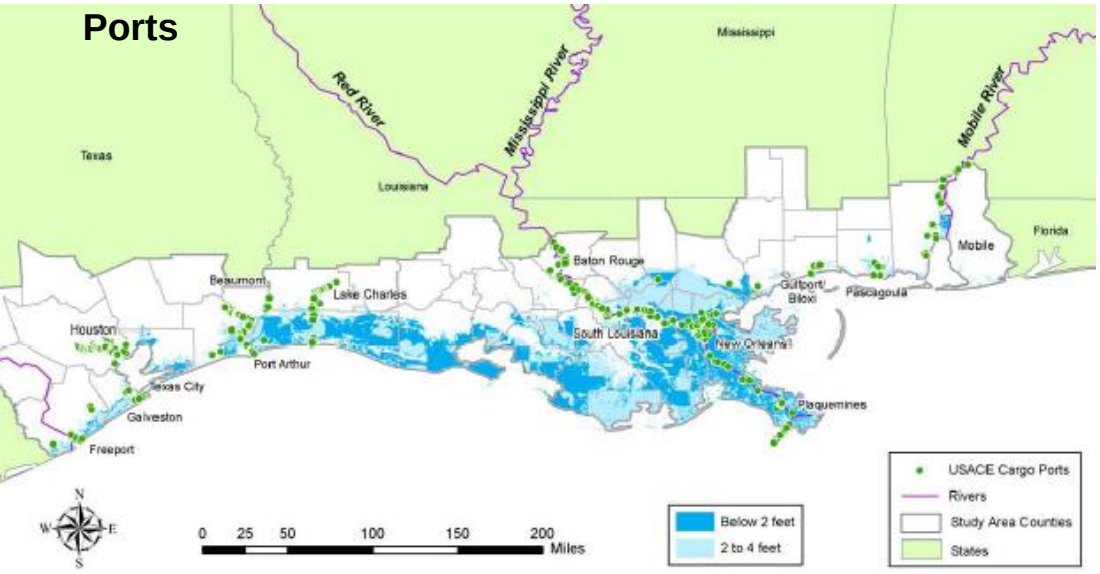
The special case of ports: Gateways to global markets:

Top 20 port cities with highest increase in exposed assets (US$ billion) by 2050



- Exposure of 136 port megacities to coastal flooding (assets) in 2005
- Assuming 0.5 m SLR by 2050 (tipping scenario)…
- Estimated asset exposure: USD 28 trillion

Allianz/WWF study (Lenton et.al, 2009) (Major tipping points in the Earth's Climate system and consequences for the insurance sector)



US Gulf Coast study (US DOT)

Flood risk at US Gulf coast under sea level rise 0-6-1.2 m.

Relative sea level rise of about 1.2 m (4 feet) could permanently inundate:

- over 70% of existing port facilities
- 3 airports
- more than 2400 miles of roads, and
- 9% of the railway lines

Temporary flooding from storms can also be devastating

Table 10. Number of seaports under inundation risk in 2030 and 2080.

Country Code	2030				2080			
	ind ≤1	1< *ind* ≤3	*ind* >3	Σ	*ind* ≤1	1< *ind* ≤3	*ind* >3	Σ
BE	-	-	1	**1**	1	-	1	**2**
BG	-	-	-	**0**	5	2		**7**
CY	9	-	-	**9**	11	-	-	**11**
DE	11	-	10	**21**	27	4	10	**41**
DK	12	19	5	**36**	44	40	6	**90**
EE	6	5	-	**11**	6	5	-	**11**
EL	151	14	-	**165**	155	14	-	**169**
ES	8	7	7	**22**	34	6	7	**47**
FI	8	16	-	**24**	11	19	-	**30**
FR	8	2	4	**14**	15	11	4	**30**
HR	8	4	-	**12**	26	50	1	**77**
IE	1	2	3	**6**	9	4	4	**17**
IT	40	10	1	**51**	33	19	-	**52**
LT	-	-	-	**0**	-	-	-	**0**
LV	-	-	-	**0**	-	1	-	**1**
MT	-	-	-	**0**	3		-	**3**
NL	-	-	-	**0**	1	-	1	**2**
NO	13	16	4	**33**	24	14	4	**42**
PL	5	3	-	**8**	9	6	-	**15**
PT	12	-	-	**12**	12	2	-	**14**
RO	-	1	-	**1**	-	1	-	**1**
SE	2	3	-	**5**	13	13	-	**26**
SI	-	-	-	**0**	-	-	-	**0**
UK	38	13	35	**86**	79	14	71	**164**
Total	**332**	**115**	**70**	**517**	**518**	**225**	**109**	**852**

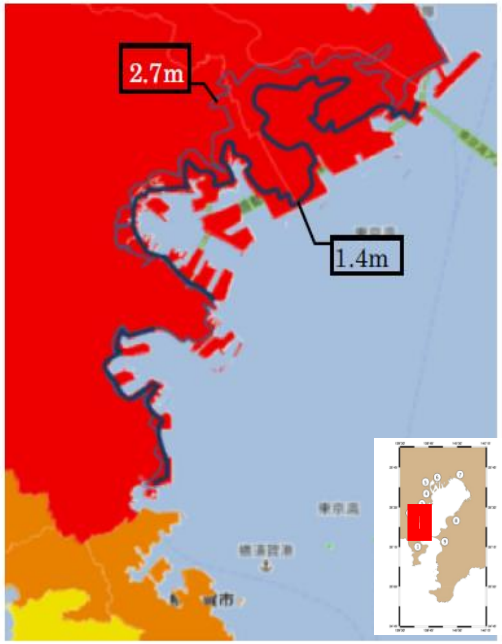
Europe:

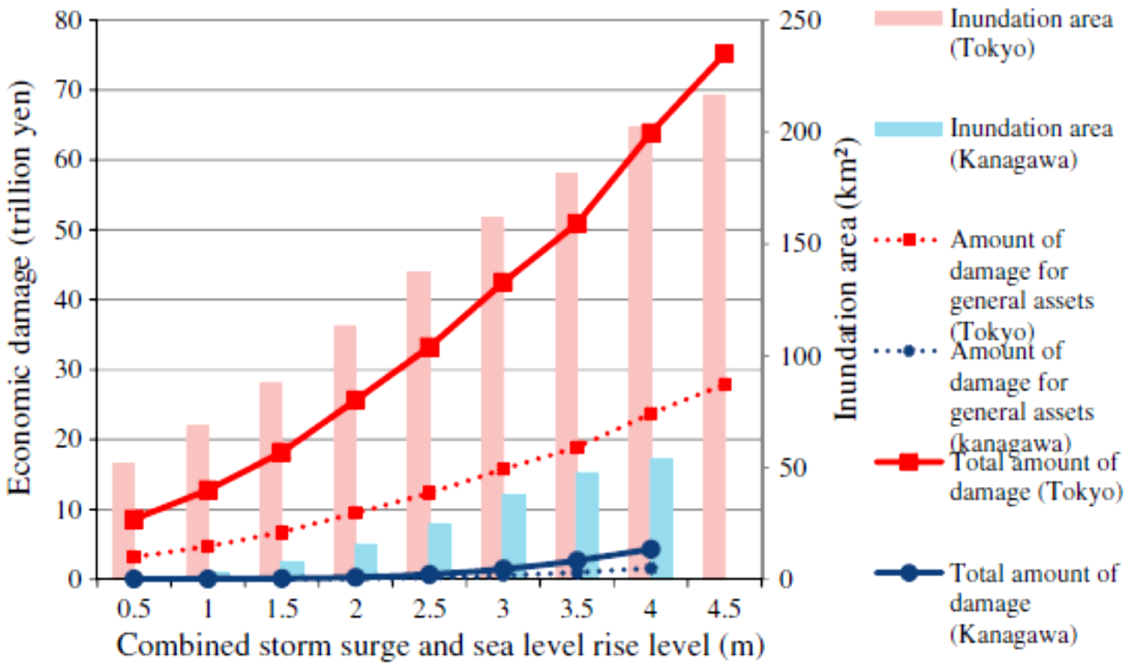
Impacts of climate change on transport: A focus on airports, seaports and inland waterways

Christodoulou and Demirel, EC-JRC 2018

- The number of ports facing the risk of inundation is expected to increase by more than 50% from 2030 to 2080
- Trend stronger in North Sea coast where over 500 ports are located with traffic accounting for up to 15% of world cargo transport
- In total 852 important ports face the risk of inundation by end of the century

Projected port city damages due to combined MSL rise and storm surge



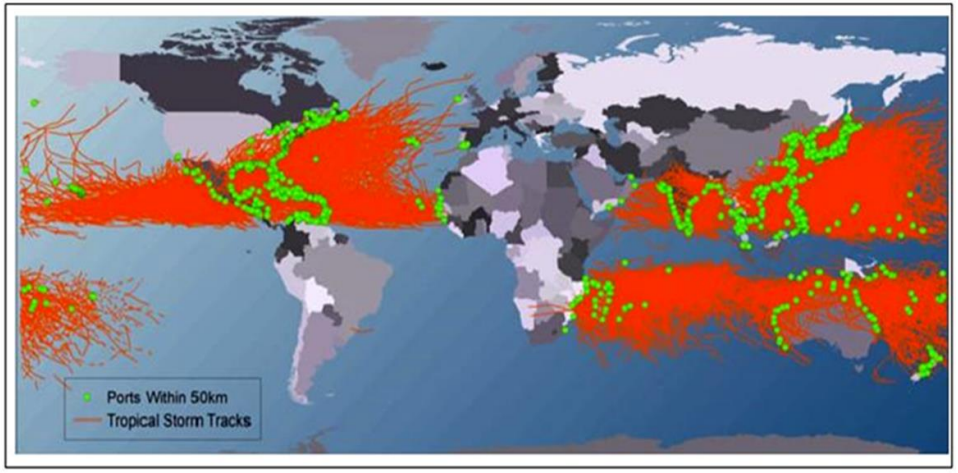


(a) Areas at flood risk in the Kanagawa area (Tokyo Bay) for the mean expected storm surge due to future storm typhoon in the year 2100 for a 0.59-m (thick blue line) and 1.9-m (thin blue line) mean sea-level-rise (MSLR) scenarios and

(b) Simulated damages for Tokyo and Kanagawa port areas due to combined MSLR and storm surge (Hoshino et al., 2015) (*30 trillion yen approx. 285 billion US dollars*)

The special case of the SIDS

- Small (land mass, economies, population), remote & highly vulnerable to external shocks
- High exposure to natural disasters and CV&C; low adaptive capacity
- **Coastal transport infrastructure (seaports/airports): critical lifelines for external trade, food, energy, tourism (cruise-ships and air transport) and DRR**
- These assets are threatened by sea level rise and extreme events (storms)



Ports within 50 km of tropical sea storm tracks (1960–2010)

Data: Knapp et al. (2010).
(Becker et al., 2013)

- Strong nexus between transport and tourism: climate - driven beach erosion / coastal inundation threatens “Sun-Sea-Sand (3S) tourism“ and its facilitating transport infrastructure

Climate change impacts on coastal transport infrastructure in the Caribbean: Enhancing the adaptive capacity of Small Island Developing States

- Focus on key coastal transport infrastructure (i.e. airports and ports)
- Case-study approach involving 2 Caribbean SIDS (Jamaica and St Lucia) to
  - enhance the adaptive capacity at the national level (case-study countries)
  - develop a transferable methodology for assessing climate change impacts and adaptation options for coastal transport infrastructure in Caribbean SIDS
- Technical EG meeting (2016) to review, discuss and provide substantive inputs
- 2 national and 1 regional capacity building workshops in 2017 – seaports and airports authorities from 21 countries/territories, regional/international stakeholders and experts
- Web-platform - *SIDSport-ClimateAdapt.unctad.org*
- Key outcomes include *assessment of potential operational disruptions and marine inundation* risk to coastal international airports and seaports of Jamaica and Saint Lucia, under different climatic scenarios; *Innovative methodological approaches*, validated by scientific peer-review

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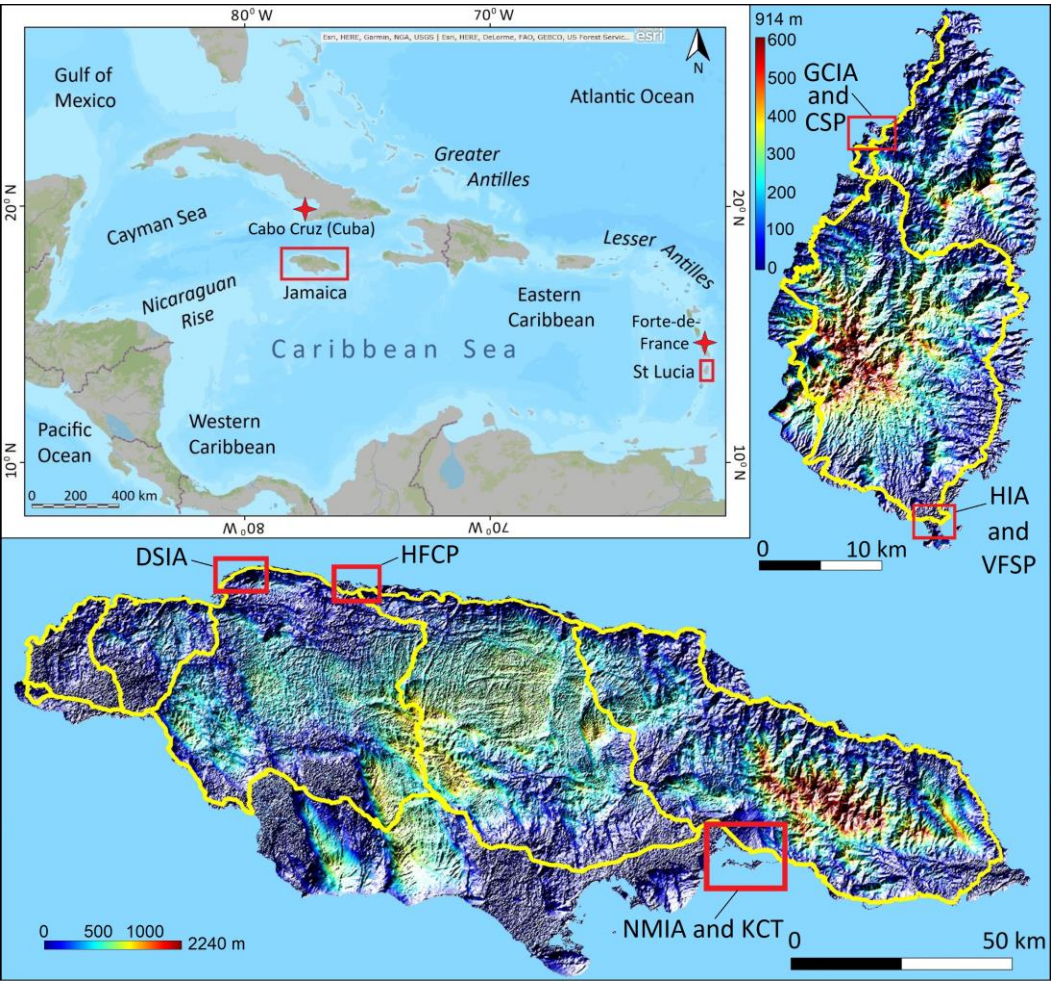
Climate change impacts on coastal transport infrastructure in the Caribbean: Enhancing the adaptive capacity of Small Island Developing States



Some findings:

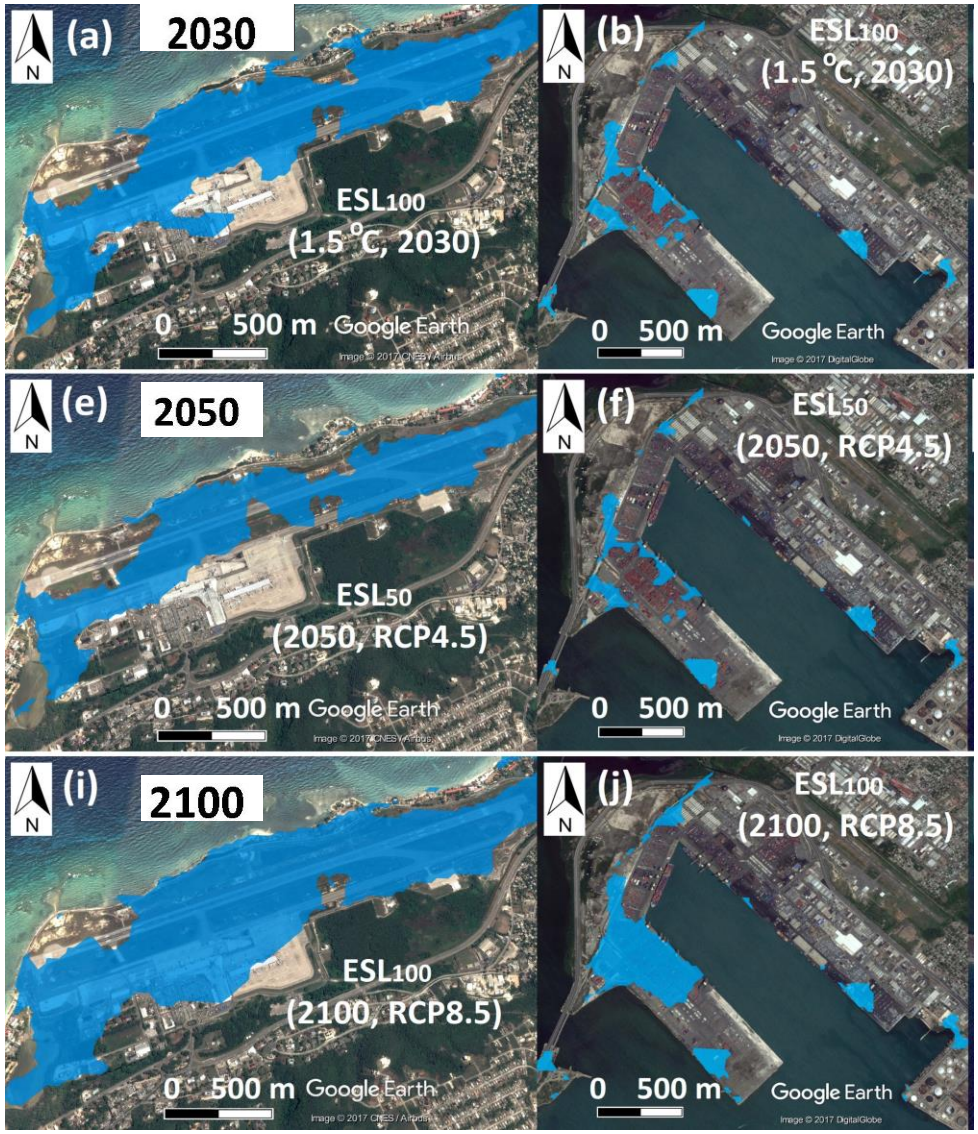
High risk of marine flooding for key assets under extreme events and different CV & C scenarios

Operational disruptions also identified, using an operational thresholds method

See also:
Monioudi, et al. Reg Environ Change (2018). **Climate change impacts on critical international transportation assets of Caribbean Small Island Developing States (SIDS): The case of Jamaica and Saint Lucia**. https://doi.org/10.1007/s10113-018-1360-4; https://rdcu.be/Q1OY

Cited in **IPCC Special Report on Global Warming of 1.5ºC** (Ch. 3)

Marine flooding projections for ports/airports under CV & C: **Jamaica**

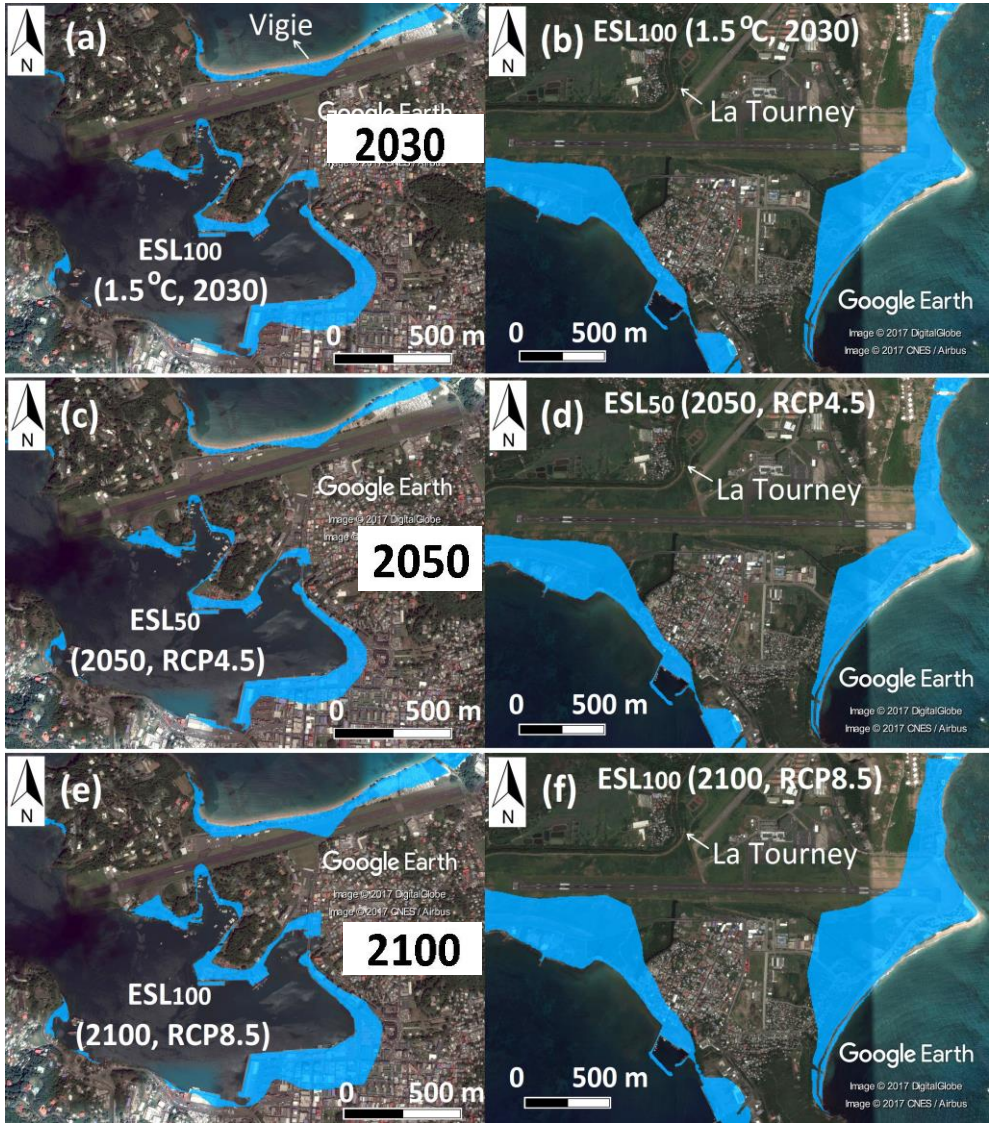


- Dynamic modeling inundation projections for coastal assets
- Different scenarios were tested
- SIA (70% of international tourist arrivals) and Kingston seaport (KFTL) appear vulnerable under all scenarios

Flood maps for: (a, e, i) Sangster International Airport (SIA, Montego Bay, Jamaica); (b, f, and i) Kingston Container Terminal (KFTL, Kingston, Jamaica) under the 1-100 year extreme sea level event- ESL100 (for 1.5 ° C temperature increase, 2030), 1-50 year extreme sea level event -ESL50 (2050, RCP4.5) and ESL100 (2100, RCP8.5)

Monioudi et. al. (2018)

Marine flooding projections for ports/airports under CV & C: **Saint Lucia**



All international transportation assets (airports and seaports) appear vulnerable under all scenarios

Flood maps:

(a, c, e) George Charles International Airport and Castries seaport and (b, d, f) Hewanorra International Airport and Vieux Fort seaport for the:

- *1-100 year extreme sea level event, ESL100 (1.5° C SWL, 2030),*
- *1-50 year extreme sea level event, ESL50 (2050, RCP4.5) and*
- *ESL100 (2100, RCP8.5)*

Monioudi et. al. (2018)

Major climate change impacts on [coastal] transport infrastructure

Factor	Impacts
Sea level (mean and extreme)	Coastal transport infrastructure (open sea ports, estuarine ports and inland waterway ports; airports; roads; railroads; bridges)
• Mean sea level changes • Increased destructiveness of storms/storm surges • Changes in the wave energy and direction	Damage to port and airport infrastructure/cargo from incremental and/or catastrophic inundation and wave regime changes; higher infrastructure construction/maintenance costs; sedimentation/dredging issues in port/navigation channels; effects on key transit points; increased risks for coastal road/railway links; relocation of people/businesses; insurance issues
Precipitation	
• Changes in the intensity and frequency of extremes • (floods and droughts)	Seaport, airport, and road infrastructure inundation; damage to cargo/equipment; navigation restrictions in inland waterways; network inundation and vital node damage (e.g. bridges); changes in demand
Temperature	
• Higher mean temperatures, • Heat waves and droughts • Increased spatio-temporal variability in temperature extremes	Damage to infrastructure/equipment/cargo and asset lifetime reduction ; higher energy consumption for cooling cargo; lower water levels and restrictions for inland navigation effects on estuarine ports (e.g. port of Rotterdam); reductions in snow/ice removal costs; extension of the construction season; changes in transport demand; lower aircraft payloads allowed/need for runway extension; increased health risks for staff and passengers; rail buckling and restrictions in railway operational speed; asphalt softening/rutting
• Permafrost degradation • Reduced arctic ice coverage	Major damage to infrastructure; coastal erosion affecting road and rail links to ports Longer shipping seasons-NSR; new shorter shipping routes-NWP/less fuel costs, but higher support service costs

UNCTAD Port Industry Survey on Climate Change Impacts and Adaptation

Online survey to

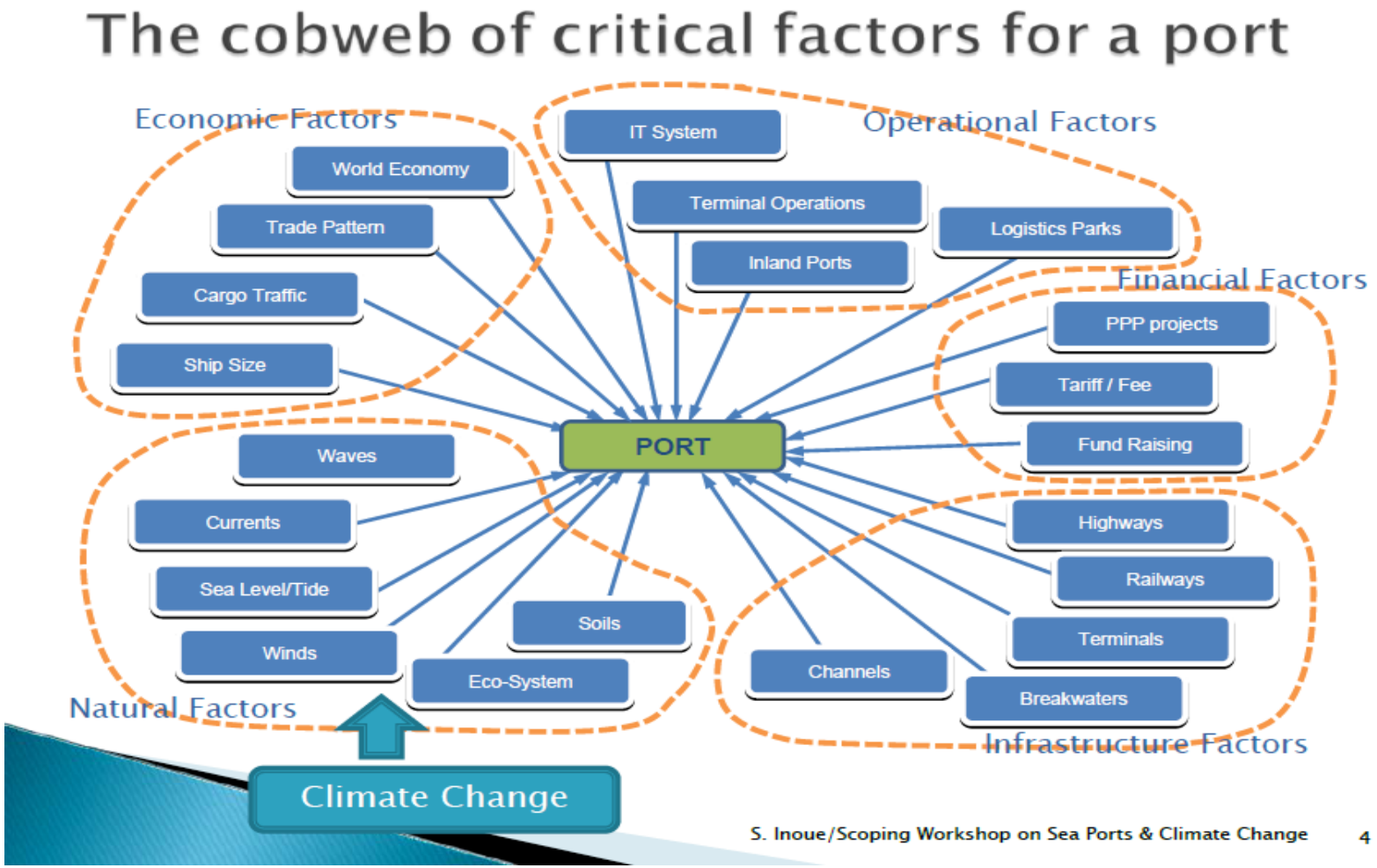
- **improve the understanding of weather and climate-related impacts on ports**
- **identify data availability and information needs; and**
- **determine current levels of resilience and preparedness among ports**

Respondent port sample collectively handle more than **16 % of global seaborne trade** and can be considered as **representative**

Although **majority of respondents had been impacted by weather/climate related events**, including by extremes, the survey revealed **important gaps in terms of relevant information available to seaports of all sizes and across regions**, with implications for effective climate risk assessment and adaptation planning.

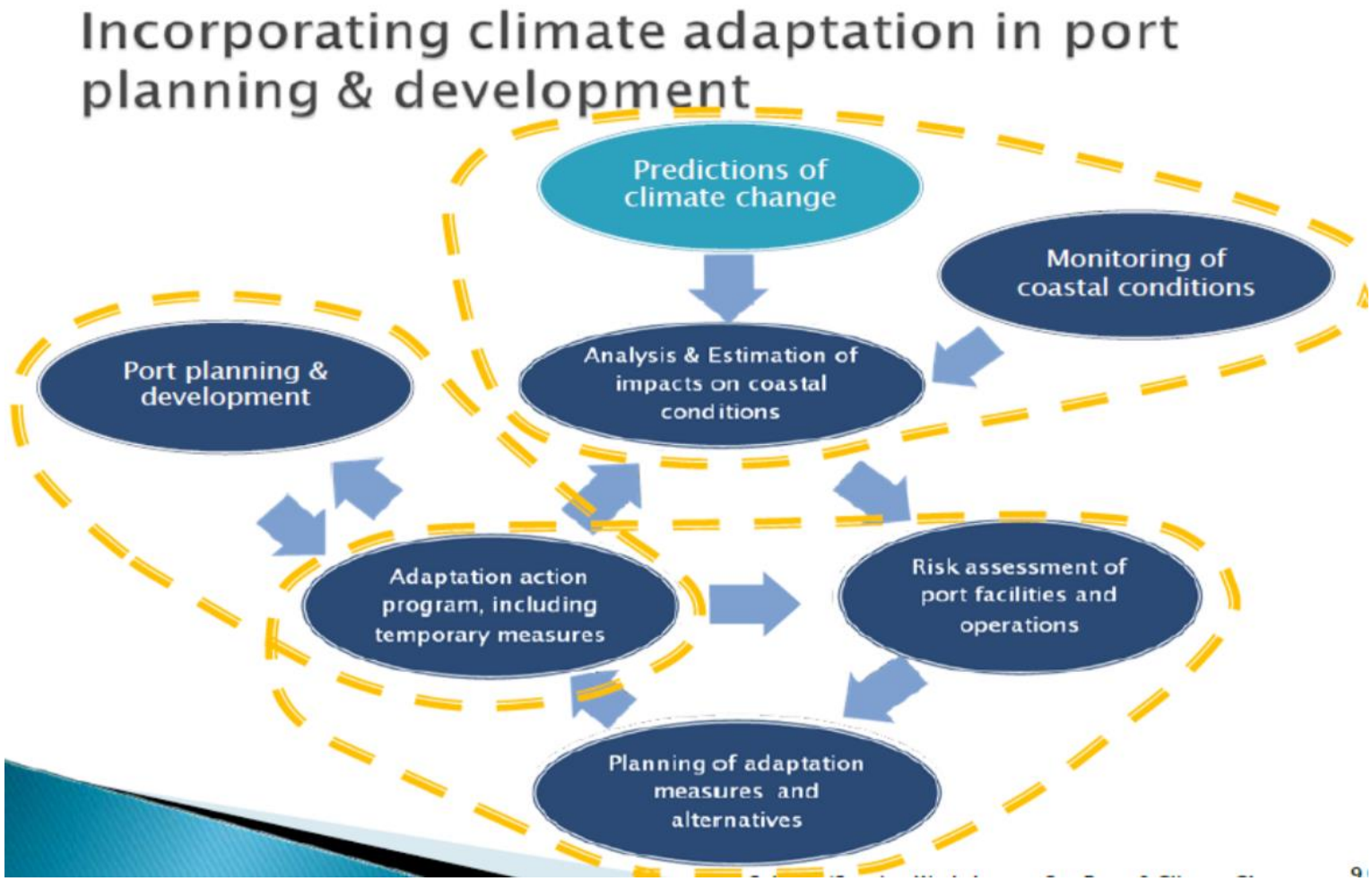
Key messages: better data/information needed; **mainstream CC considerations**; 'piggyback' climate resilience when upgrading

Port risk assessment and adaptation: A complex exercise



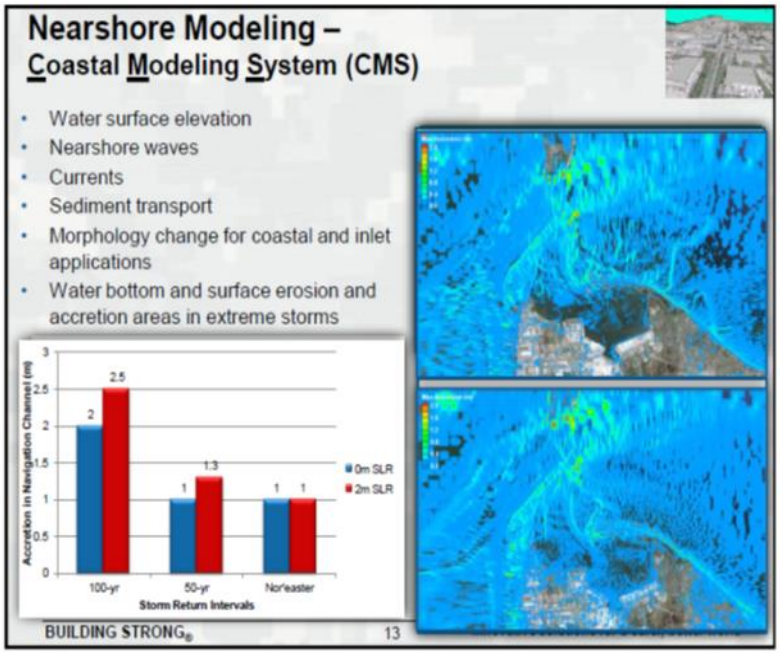
S. Inoue, Scoping workshop on Seaports and Climate Change, ECJRC March 2013

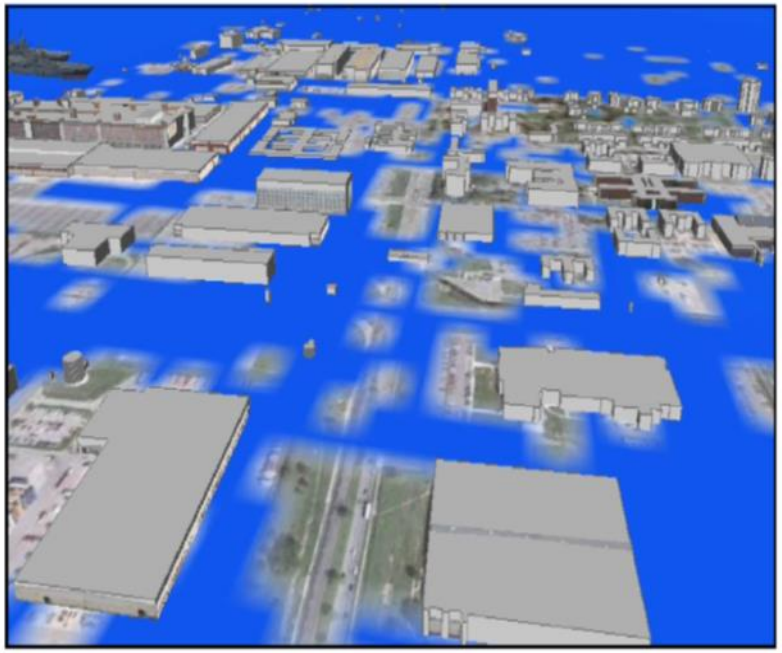
Port risk assessment and adaptation: A complex exercise



S. Inoue, Scoping workshop on Seaports and Climate Change, ECJRC March 2013

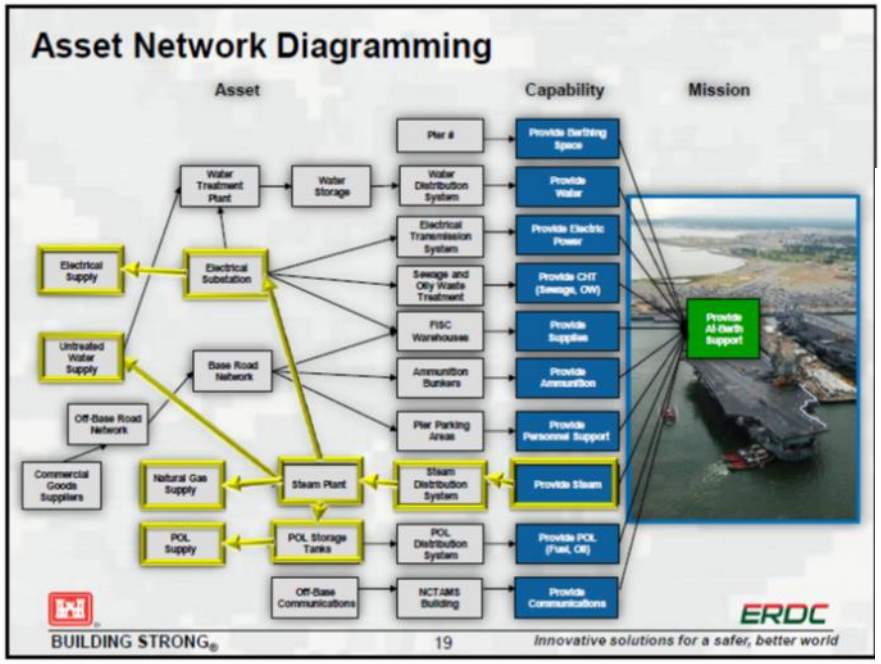
Port asset sensitivity assessment: A complex exercise

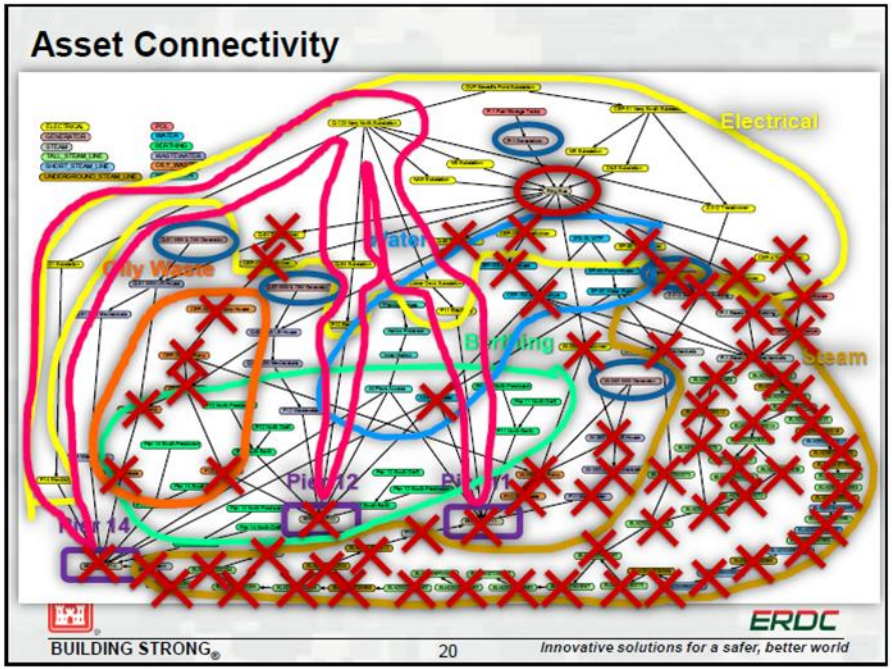




K.A. Burks-Copes, Scoping workshop on Seaports and Climate Change, ECJRC March 2013

Port asset criticality assessment: Also a complex exercise





K.A. Burks-Copes, Scoping workshop on Seaports and Climate Change, ECJRC March 2013

Recent regulatory developments

Enhanced climate resilience / adaptation for critical transport infrastructure is of strategic economic importance and is going to be key in future sustainable development

Legal / regulatory approaches will be important in the longer run; some examples already in existence, e.g.

- EU: EIA Directive 2014/52/EU of 16 April 2014, amending Directive 2011/92/EU); in force since May 2017
- California Bill (Assembly Bill No. 2800 CHAPTER 580) that modified the Public Resources Code (2016) effective Jan 2017

Thank you!