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Maritime Transport and Ports: Adapting to and Mitigating the Climate Challenge

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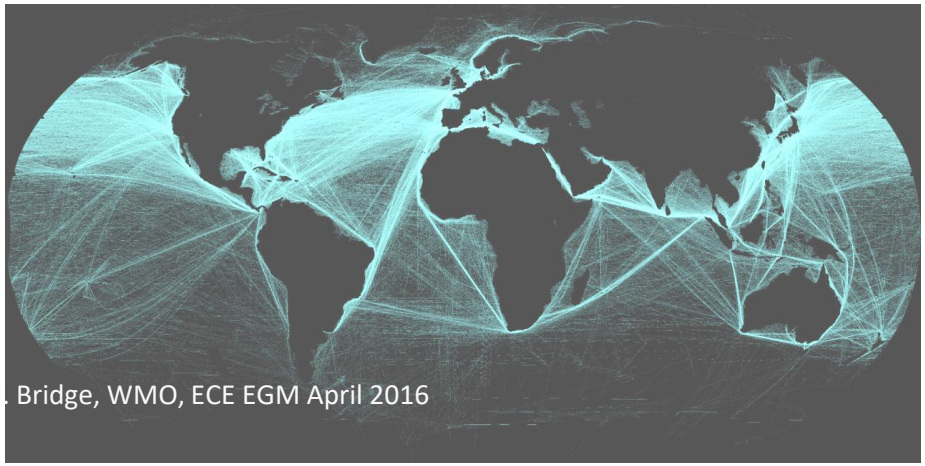
Maritime Transport: critical for global trade and development and the blue economy



Global shipping movements

Over 80% of volume (70 % of value) of world trade is carried by sea (port-port): shipping/ports are key links/nodes in the network of closely linked international supply chains – ports and port cities: gateways to global markets and the blue economy

Globalization: interconnectedness/interdependence of shipping/ports and transport across supply chains

Seaborne trade: around 60% of goods loaded and 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. Climate Variability and Change, CV&C)

Important to address these global challenges effectively, also in the light of the *2030 Sustainable Development Agenda* and *Paris Agreement 2015*

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 CV&C/impacts (IPCC SREX; AR5; 2018; 2019; 2021)

Huge potential costs associated with inaction

- *WEF (2019 and 2020) Global Risks Report*: Top 3 economic risks are extreme weather events, climate action failure, natural disasters
- *Stern Review (2006)*: 5 - 20 % of GDP, annually
- 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 (*Jevrejeva et al 2018 Environ. Res. Lett*)
- *Global Comm. on Adaptation (2019)*: Investing US$1.8 trillion over next decade in adaptation measures could produce net benefits worth more than US$7 trillion

Very serious development threat, particularly for LDCs and the SIDS

Since 2008, integration of CV & C into UNCTAD's work on transport policy and legislation

CV & C implications: 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 climate 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 - Mitigation - Decarbonization

Shipping: Key developments at IMO

Ports: IAPH/ WPSP - World Ports Initatives on Climate Change mitigation and decarbonisation of shipping (www.sustainableworldports.org) and engagement with IMO

IMO Resolution MEPC.323(74)

WPSP
WORLD PORTS SUSTAINABILITY PROGRAM
www.sustainableworldports.org

Encouraging voluntary cooperation between the port and shipping sectors to contribute to reducing GHG emissions from ships.

- Onshore Power Supply (preferably from renewable sources);
- safe and efficient bunkering of alternative low-carbon and zero-carbon fuels;
- incentives promoting sustainable low-carbon and zero-carbon shipping;
- and support for the optimization of port calls including facilitation of just-in-time arrival of ships.

IAPH
International Association of Ports and Harbors

Source: A. Michail, WPSP - UNCTAD Multiyear Expert Meeting: Climate change adaptation for seaports in support of the 2030 Agenda for Sustainable Development, 27-28.10.2020

CV & C – Impacts – Adaptation and Resilience building

Climate change/extreme events likely to have *direct* and *indirect* impacts on maritime transport infrastructure, operations and services

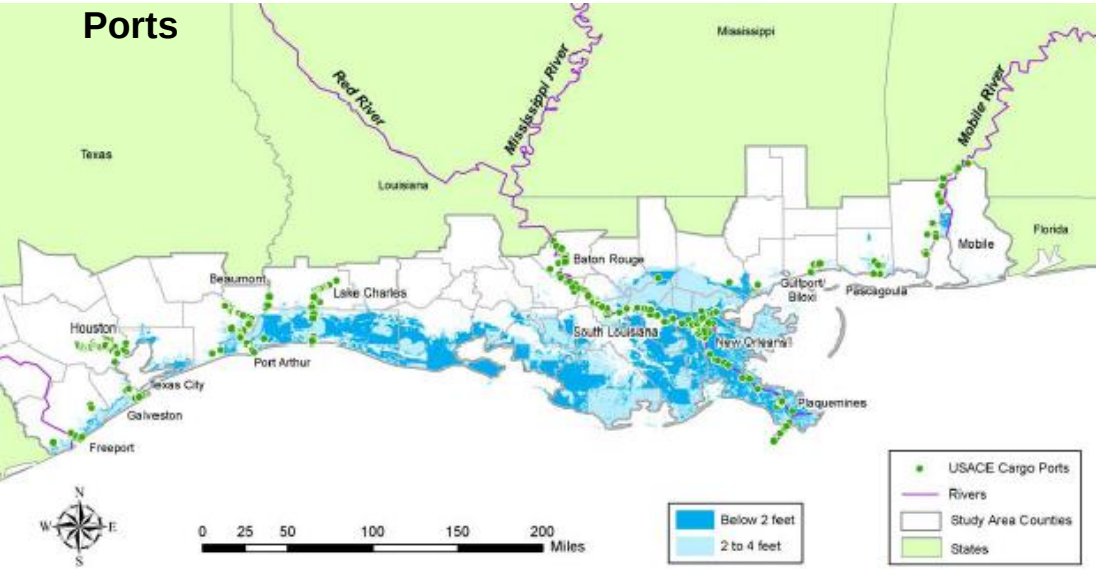
Sea-level rise, temperature-, humidity-, precipitation- changes, extreme storms and floods are likely to

- **affect ports** (infrastructure and operations) **and port cities;** hinterland transport; **and the broader global supply-chain**

  - potential for *damage, disruption and delay* – **economic/trade related losses**

- **affect demand** for transport
- **exacerbate other transport-related challenges,** including for SIDS and other vulnerable economies, including increase in energy needs and costs
- 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



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:

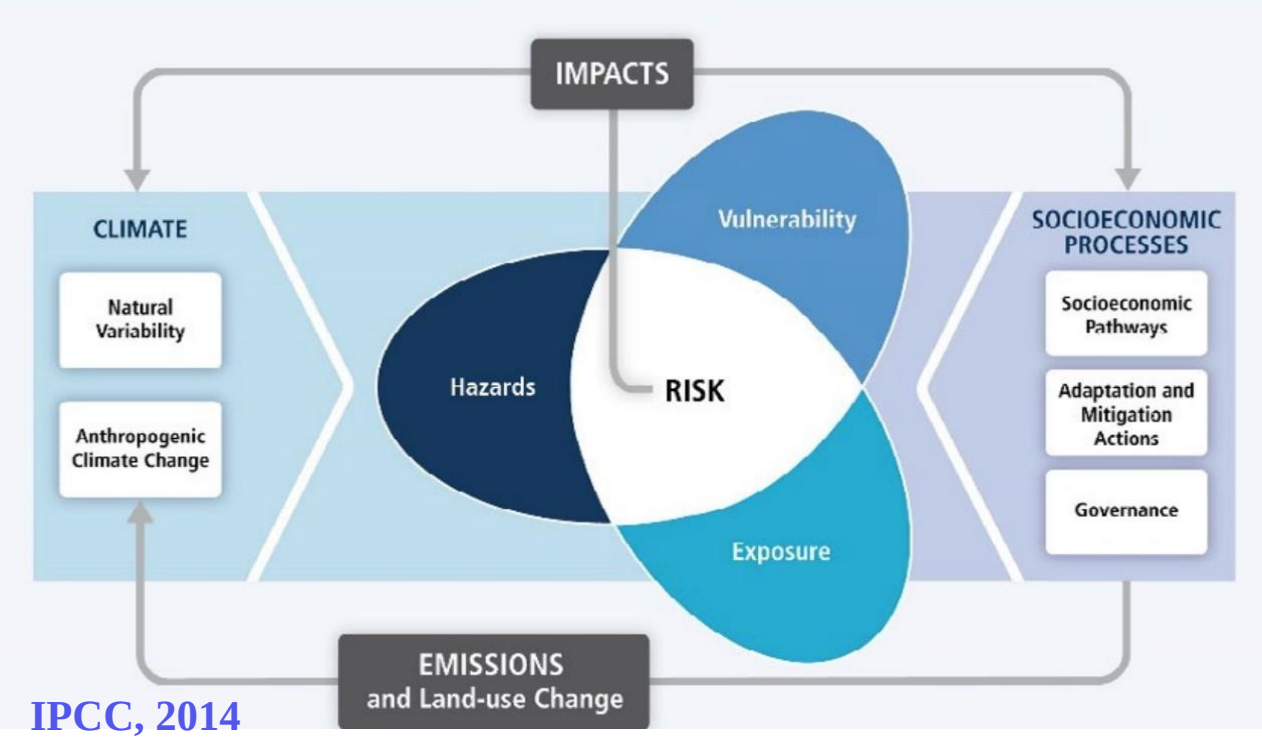
- over 70% of existing port facilities
- 3 airports
- more than 2400 miles of roads, and
- 9% of the railway lines

Temporary flooding from storms can also be devastating

Port Impacts under Climate Variability and change (CV & C)

Factor/hazard changes	Impacts on Seaports
Mean sea level rise (SLR)	Permanent inundation risk making ports inoperable without port elevation/coastal protection; changes in port and key transit access (e.g. the Kiel Canal); insurance issues
Increased extreme sea levels (ESLs); changes in wave energy/direction	Increasing frequency/depth of facility flooding and damages; losses due to operational delays; breakwater instability, scouring and overtopping from storm waves; increasing protection costs; wave penetration affecting operations; navigation channel silting-higher dredging requirements; insurance issues
Precipitation: Changes in means and/or in the intensity, type and frequency of extremes causing pluvial/fluvial flooding	Infrastructure flooding and damages; poor manouvrability of locks and vessels from changes in water level and speed; poor visibility from increasing fogs
Temperature: Higher means; heat waves; changes in warm/cool days	Deterioration of paved areas; inoperable cranes; navigational equipment/cargo damages; higher energy consumption for cooling; health/safety issues for personnel/passengers
Reduced arctic snow cover and ice	New arctic shipping routes, longer seasons, lower fuel costs; reductions in snow/ice removal costs; but arctic seaports will face increasing sea storm hazards
Permafrost degradation	Ground subsidence, slope instability,drainage issues, affecting port structural integrity
Wind: Changes in frequency/intensity of exteme events	Damages to terminals and navigation equipment; problems for vessel navigation and port berthing; difficult crane operations above certain wind speeds

Port Risk under Climate Variability and change (CV & C)



IPCC, 2014

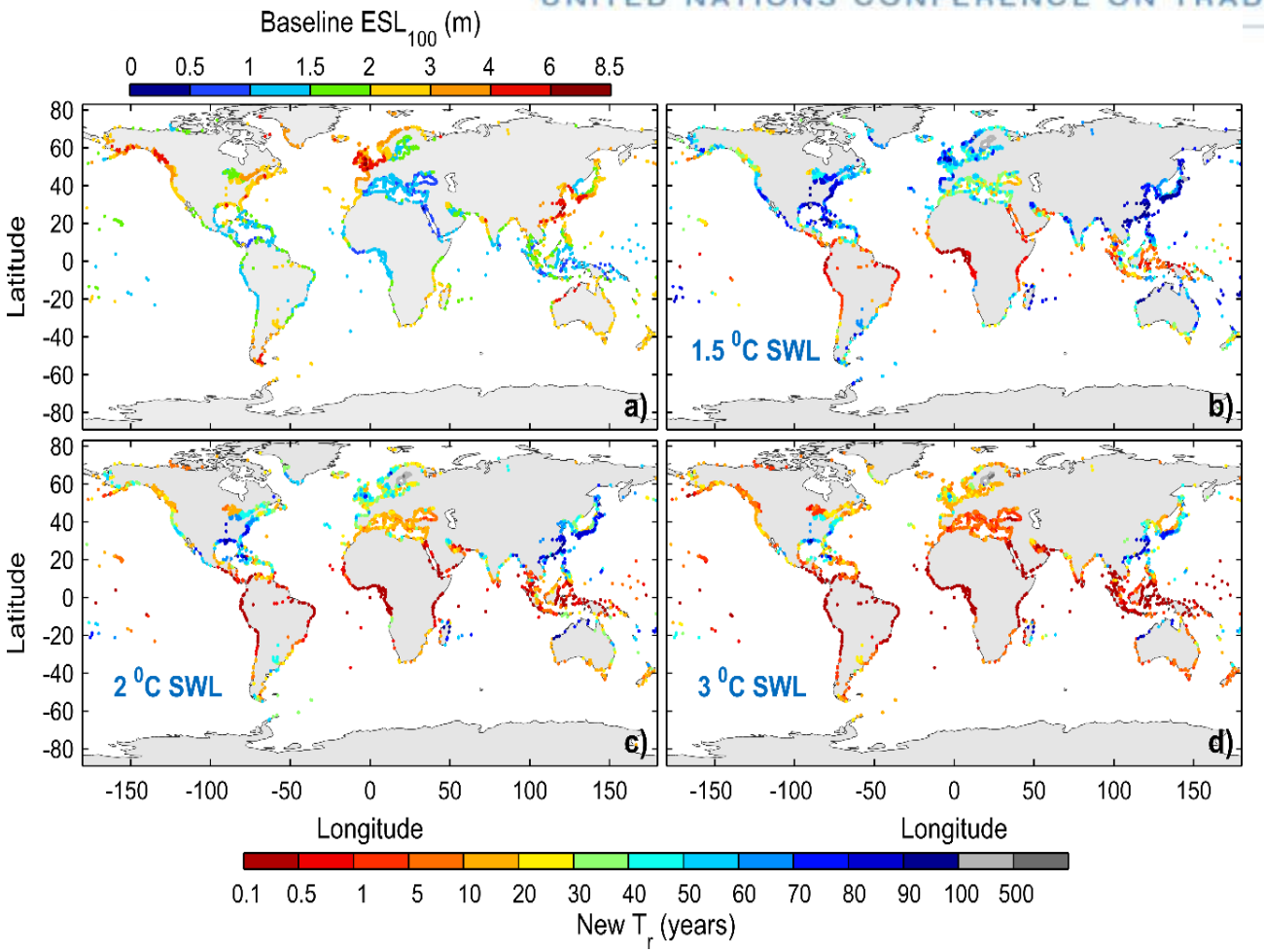
Port risk is a function of:

Climatic hazards - changing climatic factors, dependent on climate scenario/ emissions

Exposure of port infrastructure /operations to hazards

Vulnerability – depends on capacity to respond to factors that make ports prone to damages/losses from hazards, e.g. availability of technologies and materials for port defenses, elevation; human and financial resources; policy, legislation and management

Note: The IPCC risk definition differs from that of the Insurance Industry which defines risk as a function of the probability of the damaging event(s) and the magnitude of damages/losses: low probability events incurring large losses are high risks



All global ports affected, with effects worsening as the SWL increases

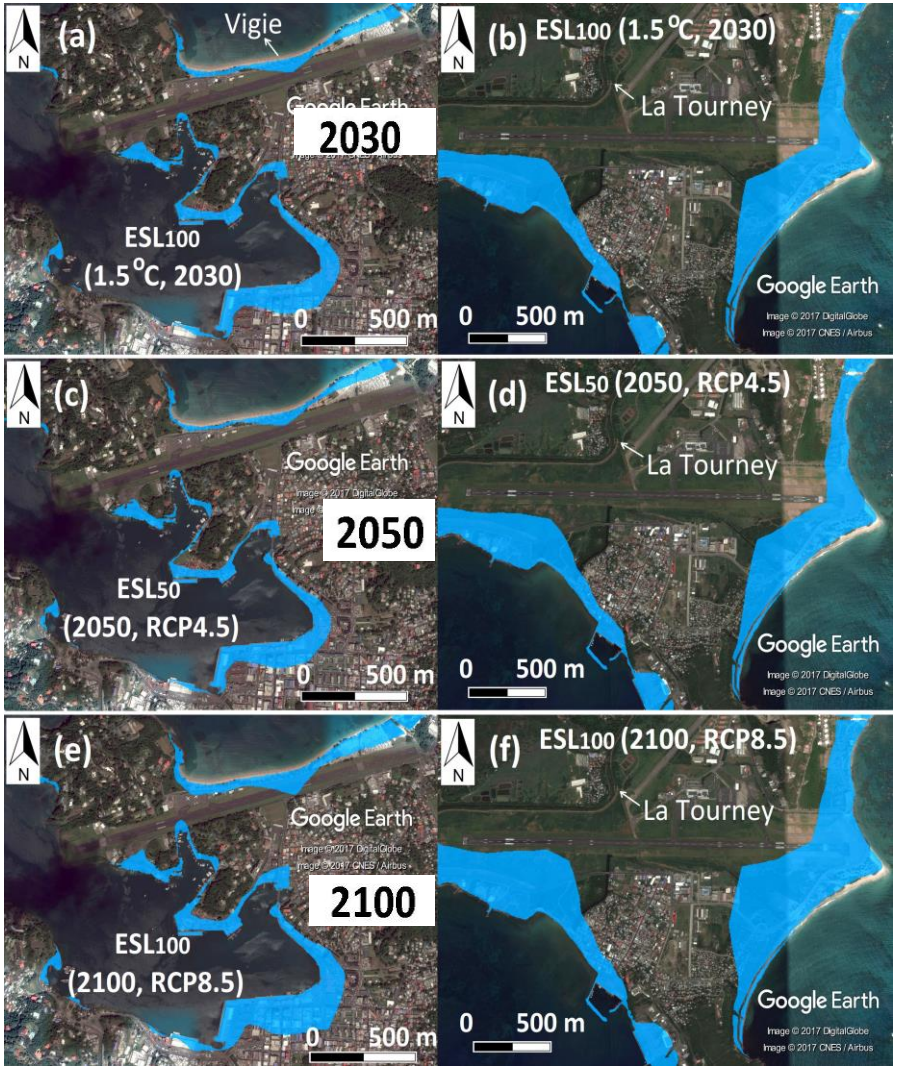
Even under SWL of 1.5 ^{0}C, the return period of the baseline 1 in 100 years ESL will decrease to every 1 to 10 years in many S. American, African, Gulf, SE Asian and Pacific ports

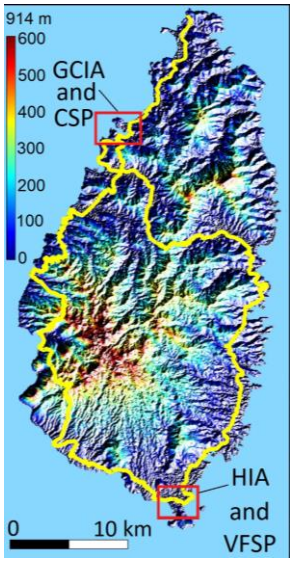
Under a SWL of 3 ^{0}C, many global ports will experience the baseline 1 in 100 years ESL several times per year

***Extreme sea level (ESL) projections for global ports (3700) under climate change**. a): Baseline (mean of the 1986-2014 period) 1-in-100 years extreme sea levels ($ESLs_{100}$) (in m, upper left scale) at major ports along the global coastline. b), c) and d): Projected changes in the return period of the baseline 1-in- 100 years extreme sea levels ($ESLs_{100}$) under Specific Warming Levels (SWLs) of 1.5, 2.0 and 3.0 C, respectively (bottom scale). Key: Tr (years), future return period; seaport location from World Port Index 2019. $ESLs_{100}$ projections for the global coastline from EC-JRC data collection; see also Vousdoukas et al. (2018). See Asariotis (2021) Climate change impacts on seaports: a growing threat to sustainable trade and development.*

Exposure - Coastal flooding projections under CV & C:

SIDSport-ClimateAdapt.unctad.org – 8 Ports and Airports in Jamaica and Saint Lucia





Exposure needs to be understood to adapt effectively

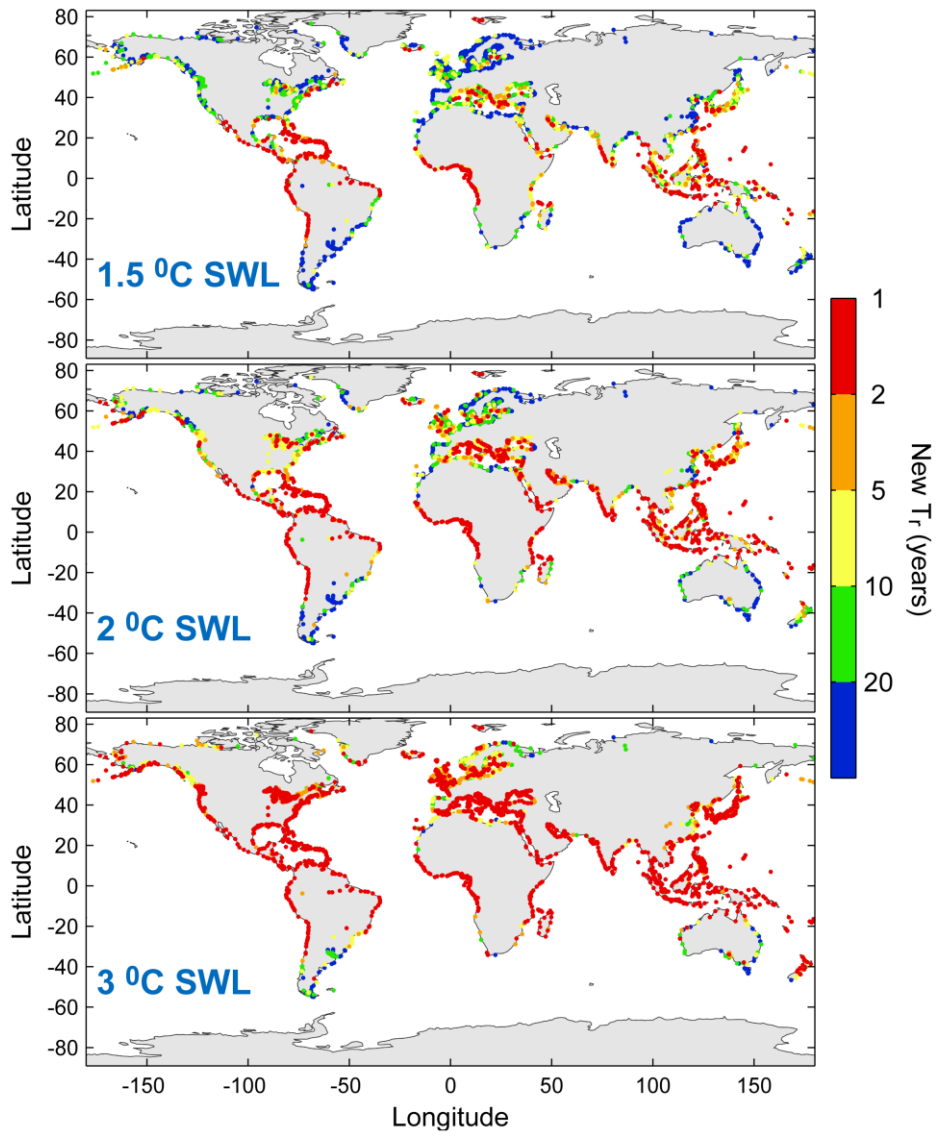
Requires risk assessment at local / facility level

All international transport assets (seaports/airports) of Saint Lucia are at high risk, under all scenarios, and from as early as 2030s

Marine flood maps:
(a, c, e) George Charles Int. Airport; Castries seaport; (b, d, f) Hewanorra Int. Airport; Vieux Fort seaport for the: 1-100 year extreme sea level event, ESL100 (1.5C SWL, 2030); 1-50 year extreme sea level event, ESL50 (2050, RCP4.5); ESL100 (2100, RCP8.5)

(Monioudi et al, 2018, Reg Env Change; IPCC 2018; IPCC SROCC 2019)

Hazard projections for global ports under CV & C: Extreme Heat



All global ports will be affected, with the effects worsening as the SWL increases

Even under a SWL of 1.5 ^{0}C, the return period of the baseline (1976-2005) 1 in 100 years extreme heat event will decrease (down to every 1 to 5 years) in most tropical/subtropical settings

Under a SWL of 3 ^{0}C, most global ports (except some ports in higher latitudes) will experience the baseline 1 in 100 years event at least every 2 years

- Important implications for energy needs/costs
- Energy efficiency/renewables/decarbonization: Important co-benefits

Projected changes in the return period baseline (mean of the period 1976-2005) 1 in a 100 years extreme heat event at about 3700 global ports*. Key: SWL (Specific Warming Level) in degrees (^{0}C) above pre-industrial times. Tr (years) = return period.*

How prepared are we?

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, information needs and levels of resilience and preparedness

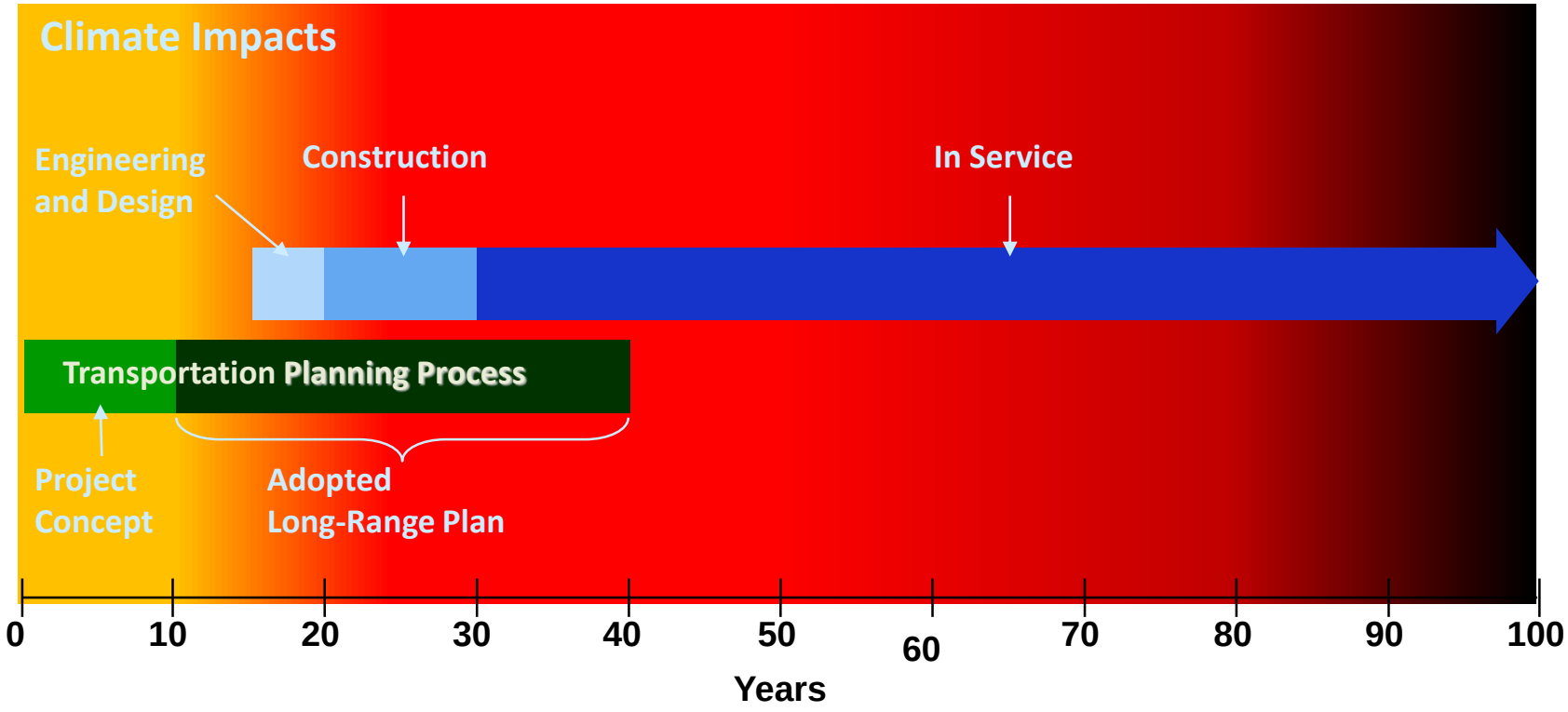
Respondent port sample collectively handle more than 16 % of global seaborne trade and can be considered as representative

- The majority of respondents had been impacted by weather/climate related events, including by extremes;
- The survey revealed important gaps in information available to seaports of all sizes and across regions with implications for effective climate risk assessment/adaptation

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

Other surveys related to transport provided similar results (e.g UNECE, 2013; NaviCC 2020)

Transportation Infrastructure: Timeframes vs. Climate Impacts



Source: Savonis, 2011

Key messages

- **Seaports are critical facilitators of global trade and development and vital for access to the blue economy**
- Seaports (and port cities) are at considerable **risk of climate change impacts**, which **is growing**
- Significant economic **costs of inaction and threat to sustainable development** prospects of the most vulnerable, including SIDS
- Much is at stake - **Failure to adapt is not an option and time is of the essence**
- In the light of projections & infrastructure lifespans, **accelerated action is critical**
- Key challenges: technical, capacity & finance, governance/policy & legislation
- Energy efficiency/renewables/decarbonization: Important co-benefits
- Adaptation strategies need to be underpinned by **strong legal, regulatory and policy frameworks**; as well as standards (eg ISO 14090), guidance (eg PIANC), methodological tools (eg UNCTAD)

COVID-19 pandemic - a cautionary tale

Wide-ranging socio-economic impacts of the COVID-19 pandemic

- illustrate effect of disruptions to transportation/supply-chains, with extensive economic costs and broader trade-related implications

- underline the critical importance of risk-assessment, preparedness and resilience

Climate change adaptation for global ports and other key transport infrastructure remains a major and increasingly urgent challenge - in light of high/growing risks: see Climate change impacts on seaports: a growing threat to sustainable trade and development

- Note e.g. research by Swiss Re reported in the Guardian, 7 June 2021: Climate crisis to shrink G7 economies twice as much as Covid-19, says research - G7 countries will lose $5tn a year by 2050 if temperatures rise by 2.6C

Lessons learnt should provide impetus for climate risk/vulnerability assessments of critical transport infrastructure and foster early long-term planning, essential to enhancing resiliency and 'building back better'

Many thanks!

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UNCTAD PLS: climate change implications for maritime transport

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* 2013 EG Report - *Climate Change Impacts and Adaptation for International Transport Networks* 2020 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 SIDS: Samoa Conference and Beyond*"** **UNCTAD Multiyear Expert Meeting: "*Small Island Developing States: Transport and Trade Logistics Challenges***
2017-18	**UNCTAD Port-Industry Survey on Climate Change Impacts and Adaptation**
2015-2017 Follow up	**UNCTAD DA Project - SIDSport-ClimateAdapt.unctad.org *"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
2019-2020	**UNCTAD Ad Hoc Expert Meeting: "*Climate Change Adaptation for International Transport: Preparing for the Future"*** **UNCTAD – UNEP *"Climate-resilient transport infrastructure for sustainable trade, tourism and development in SIDS"*** *Climate Change Impacts and Adaptation for Coastal Transport Infrastructure: A Compilation of Policies and Practices* **UNCTAD Multiyear Expert Meeting***: "Climate Change Adaptation for Seaports in Support of the 2030 Agenda"*