UNITED NATIONS CONFERENCE ON TRADE AND DEVELOPMENT
UNCTAD

# UNECE Group of Experts on Climate Change impacts and adaptation for transport networks and nodes

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# Climate change impacts and adaptation for key coastal transport infrastructure in the Caribbean


*Regina Asariotis*
*Chief, Policy and Legislation Section, TLB/DTL, UNCTAD*
*Regina.Asariotis@unctad.org*
unctad.org/ttl/legal

# Climate Variability and Change – CV & C

- A global challenge and "*defining issue of our era*" (former UN SG Ban Ki Moon)
- Compelling scientific evidence (IPCC AR5, 2013)
- Huge potential costs associated with inaction (at least 5 % of the Global GDP, annually (STERN Review 2006))
- A development threat particularly for the Least Developed Countries (LDCs) and the Small Island Developing States (SIDS)
- Since 2008, integration of climate change considerations into UNCTAD's work on transportation

  See unctad.org/ttl/legal for further information

# CV & C implications for Transport

The Climate Change debate: two sides of the "coin": causes - effects

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

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

**In (Maritime) Transport**:

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

# CV & C Impacts on Transport

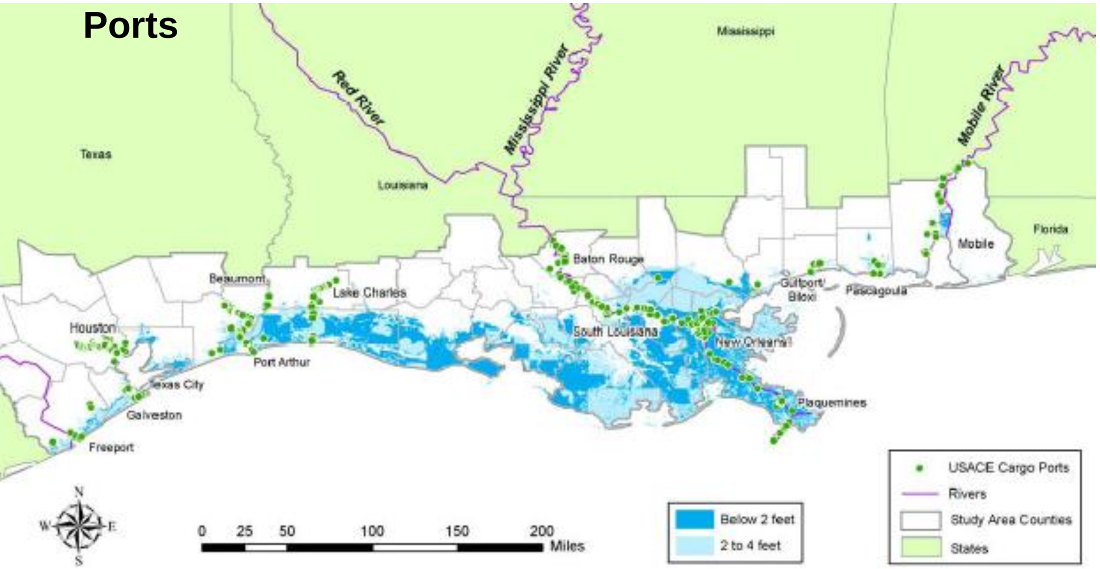
*Direct* and *indirect* impacts on transport infrastructure and services

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

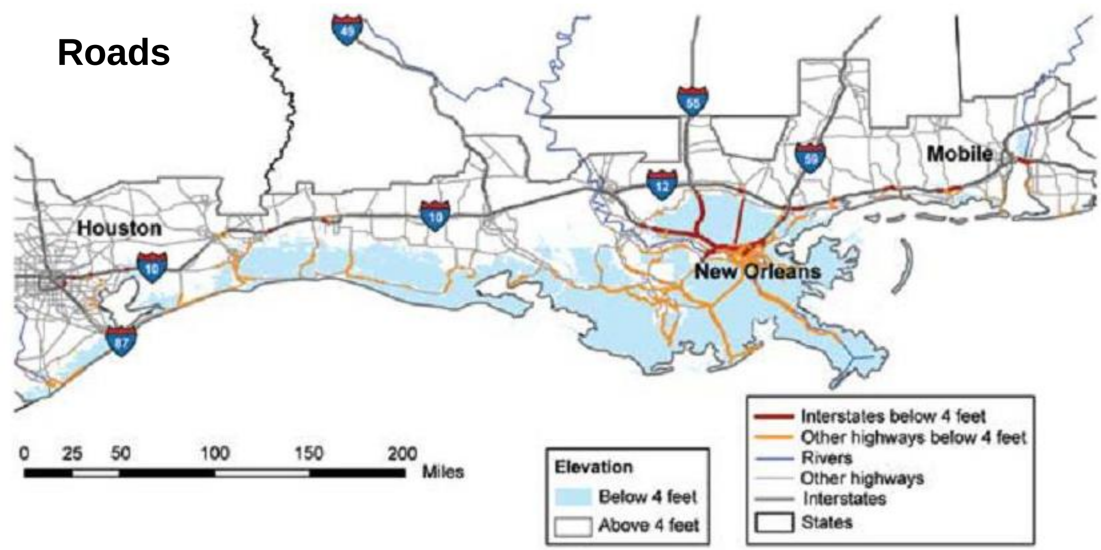
- affect seaports, airports and other coastal transport infrastructure, and may cause delay and disruption along the broader supply-chain
- affect demand for shipping/air transport
- exacerbate other transport-related challenges
- open new arctic sea-lanes due to polar ice melting

Enhanced climate resilience / climate change adaptation for transport infrastructure is key

**Ports**




**Roads**




US Gulf Coast study (US DOT)

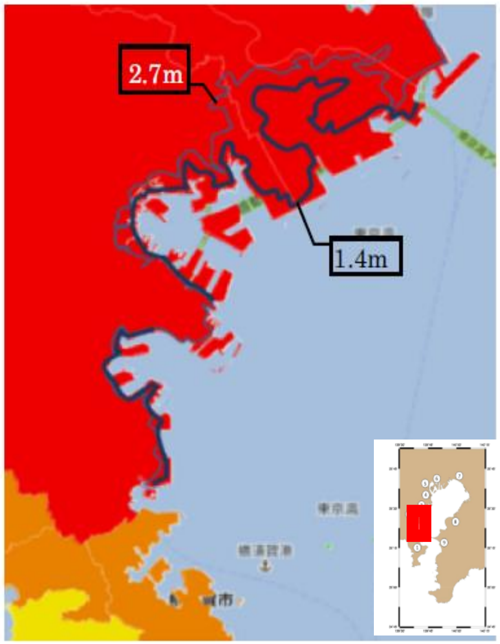
Flood risk at US Gulf coast under sea level rise 0-6-1.2 m.

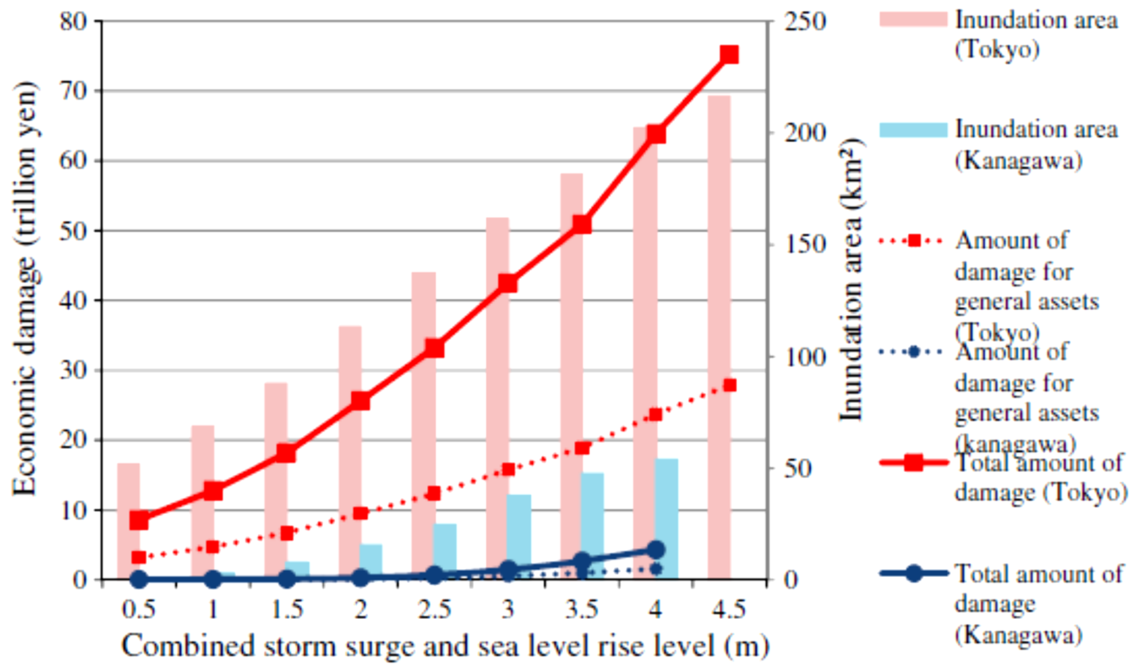
Relative sea level rise of about 1.2 m (4 feet) could permanently inundate:

- 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

# 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*)

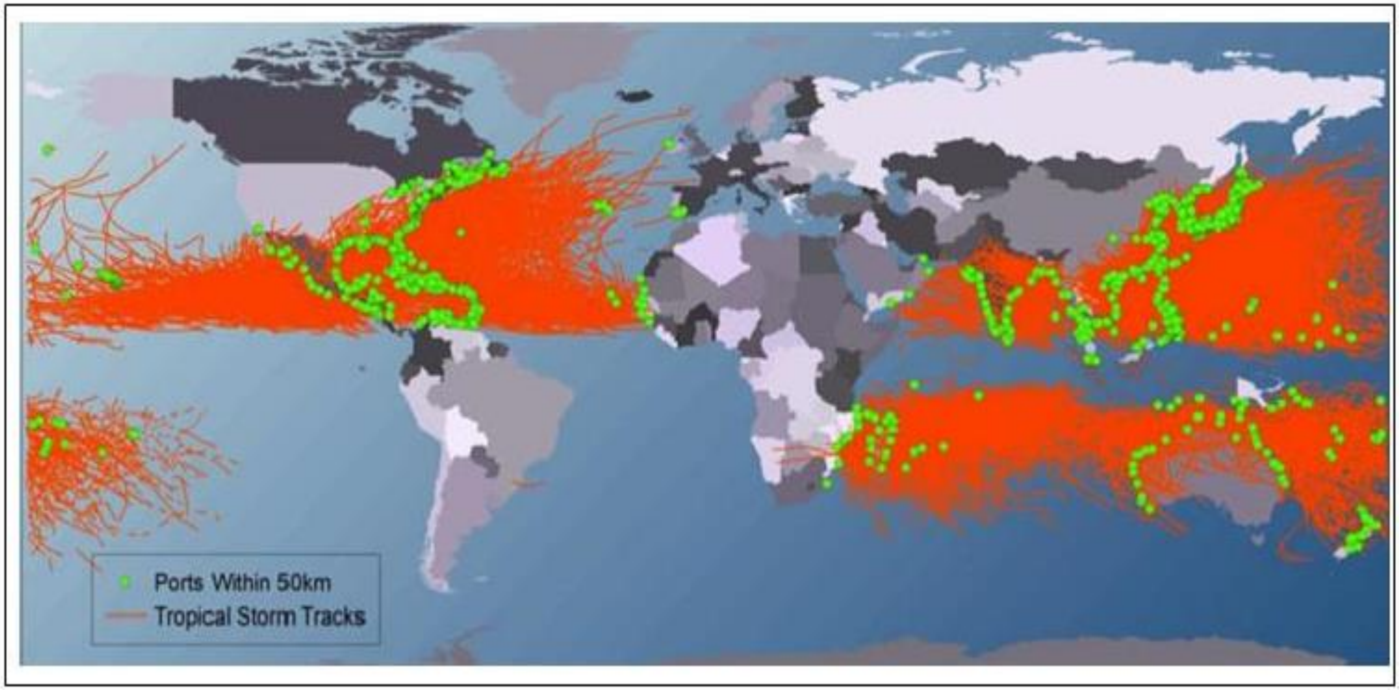
# Major climate change impacts on coastal transport infrastructure

| 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<br>• Increased destructiveness of storms/storm surges<br>• Changes in the wave energy and direction | Damages in 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<br>• (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,<br>• Heat waves and droughts<br>• 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 |
| • Permafrost degradation<br>• Reduced arctic ice coverage | Major damages in infrastructure; coastal erosion affecting road and rail links to ports<br>Longer shipping seasons-NSR; new shorter shipping routes-NWP/less fuel costs, but higher support service costs |

# The special case of the SIDS

- Small (land mass, economies, population), remote & highly vulnerable to external shocks
- Large dependency on imports (i.e. international transport)
- Key concerns: connectivity and transport costs (accessibility and affordability)
- High transport costs (e.g. transport costs in Caribbean trade at least 30 % higher than the world average, see Pinnock and Ajagunna, 2012)
- 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)
- These assets are threatened by sea level rise and extreme events (storms)
- Strong nexus between transport and tourism: “Sun-Sea-Sand (3S) tourism“, often a very significant SIDS industry, is threatened by climate - driven coastal and beach erosion, together with its facilitating infrastructure (i.e. seaports, airports, coastal access roads)

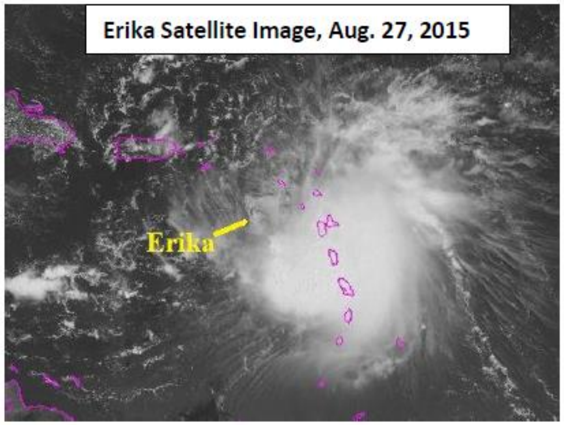
# SIDS are vulnerable to storms




Seaports within 50 km of tropical sea storm tracks (1960–2010). Port and storm data from National Geospatial-Intelligence Agency (2011) and Knapp et al. (2010). (Becker et al., 2013)

N.B. Airports in SIDS are mostly located at low coastal elevations, due to physical constraints (volcanic islands with little level land)

## Storm impacts on SIDS: Tropical storm Erika impacts on Dominica




Rainfall on 27th August: 434 mm

Transport infrastructure damages: (a) bridge and (b) airport apron

An initial assessment of impacts:

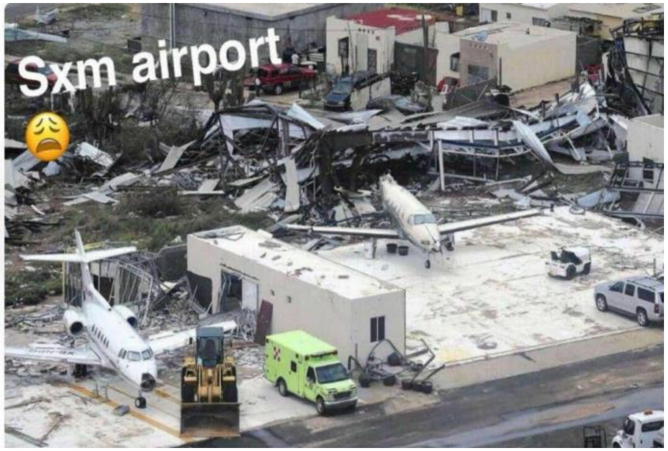
- Erika resulted in total damage/loss of EC$1.30 billion (US$483 million), (90 % of GDP)
- The majority (60 %) of damages and losses were sustained in the transport sector

(Source: Rapid Damage and Impact Assessment, Tropical Storm Erika – August 27, 2015 Report by the Government of the Commonwealth of Dominica September 25, 2015)

## Storm impacts on SIDS: Recent hurricanes 2017

- Hurricanes Irma and Maria have had major impacts on coastal transport infrastructure across the Caribbean region (Dominica, Dominican Republic, Guadeloupe, Montserrat, Antigua & Barbuda, Saint Kitts and Nevis, Puerto Rico, Turks & Caicos, Virgin Islands)
- Too recent events for detailed assessments
- Most costly hurricane season on record (WMO 2018)
- Estimated losses for Dominica: US$ 1.3 billion or 224% of GDP; estimated losses for BVI: approx. 300% of GDP
- Estimated losses for Anguilla, Bahamas, BVI, St Maarten, Turks & Caicos: US$ 5.4 billion (UNECLAC 2018)

St Maarten


**Source:** https://sxmgovernment.files.wordpress.com/2017/09/hurricane-irma-destroys-st-maarten-princess-juliana-airport-photo.jpg

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

DRR and adaptation of coastal transport infrastructure to CV & C critical for the sustainable development of SIDS

- Focus on key coastal transport infrastructure (i.e. airports and ports) in SIDS
- 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 expert group 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
- High quality substantive findings; marine inundation maps illustrate flood risk for study ports/airports, academic paper published
- Web-platform - *SIDSport-ClimateAdapt.unctad.org*

# Relevance in the context of the SDG 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 associated 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** |

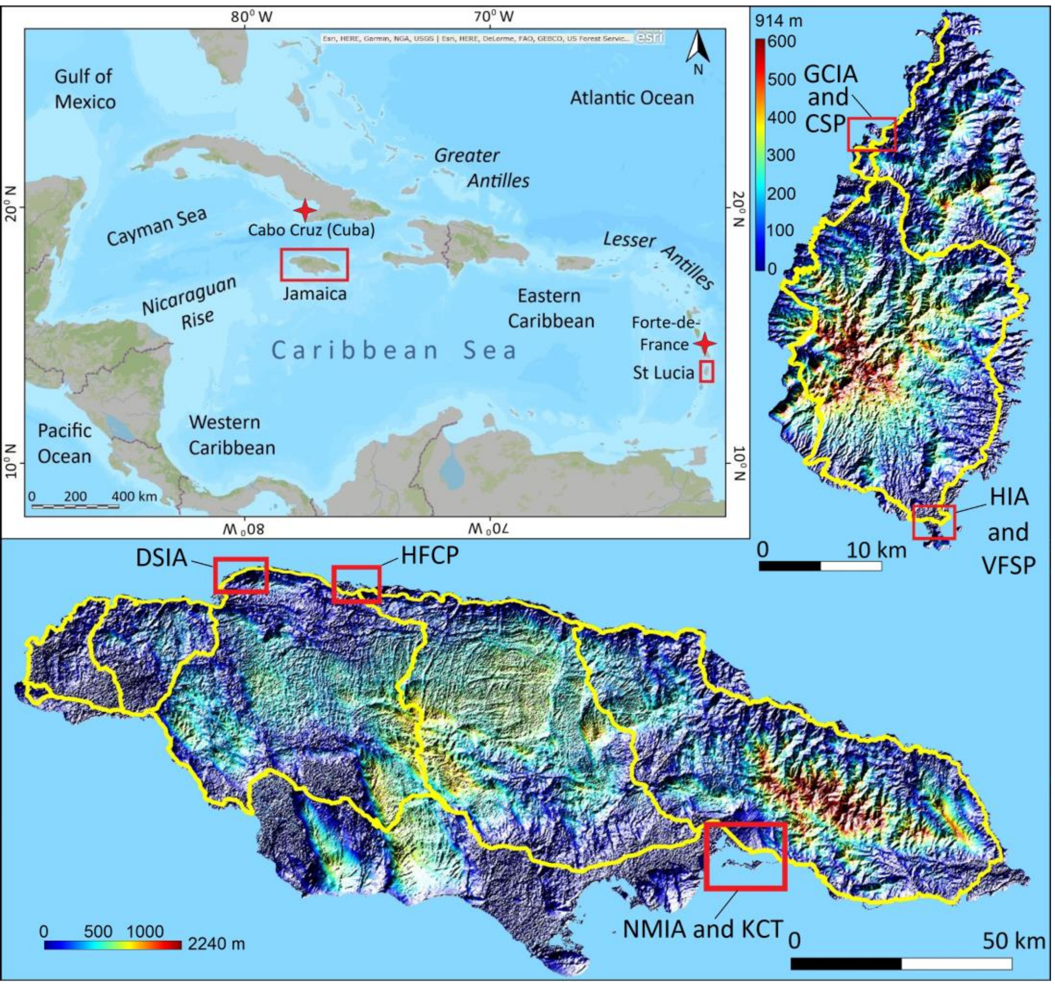
# UNCTAD project: key outcomes

Key outcomes of the project include the assessment of the potential vulnerabilities to climatic change of two Caribbean SIDS, focusing on potential operational disruptions and the marine inundation risk to coastal international airports and seaports of Jamaica and Saint Lucia under different climate scenarios.

For further details about methodology and full documentation see https://SIDSport-ClimateAdapt.unctad.org

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

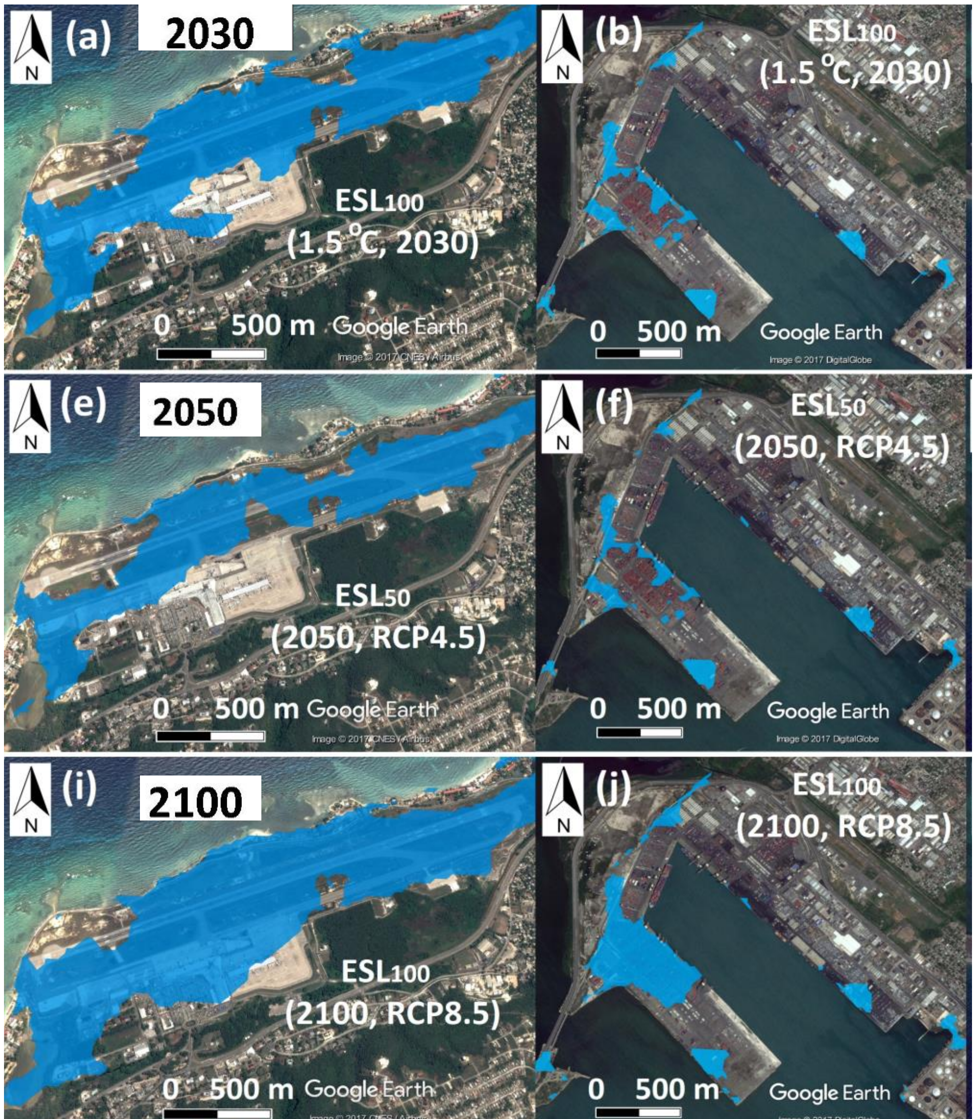
# Climate change impacts on coastal transport infrastructure in the Caribbean: Enhancing the adaptive capacity of Small Island Developing States




## Some key findings:

High risk of marine flooding for key international transport assets under extreme events and different Climate Change scenarios

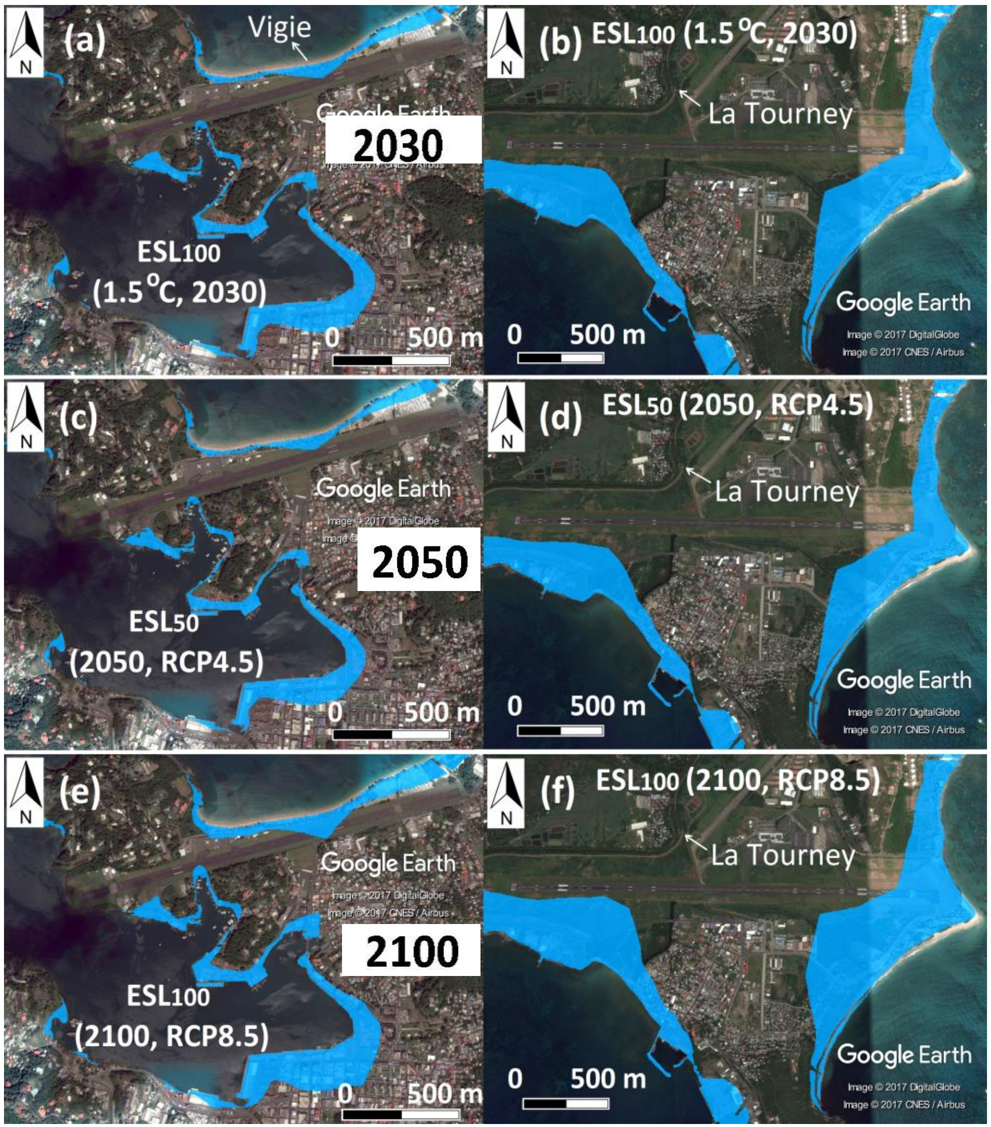
# Marine flooding projections for coastal transportation assets under CV & C: Jamaica




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

*Inundation maps for: (a, e, i) Sangster International Airport (SIA, Montego Bay, Jamaica); (b, f, and i) of Kingston Container Terminal (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)*

# Marine flooding projections for coastal transportation assets under CV & C: Saint Lucia




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

*Flooding of (a, c, e) George Charles International Airport and Castries seaport and (b, d, f) Hewanorra International Airport and Vieux Fort seaport 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).*

Thank you!

# UNCTAD's work on climate change impacts and adaptation for coastal transport infrastructure and follow-up

(see further http://unctad.org/en/Pages/DTL/TTL/Legal/Climate-Change-and-Maritime-Transport.aspx)

| | |
|---|---|
| **2009**<br><br>Follow-up | **UNCTAD Multiyear Expert Meeting: "*Maritime Transport and the Climate Change Challenge*"**<br><br>UNCTAD edited multidisciplinary book: **Maritime Transport and the Climate Change Challenge**<br>UN-Earthscan (Routledge/Taylor&Francis) (2012) 327 pp |
| **2010**<br><br>Follow-up | **Joint UNECE-UNCTAD Workshop:**<br>**"*Climate change impacts and adaptation for international transport networks*"**<br>UNECE *Group of Experts on Climate Change Impacts and Adaptation for International Transport Networks* (2011-2014); mandate extended in 2015;<br>2012 International Conference - including session on SIDS<br>2013 EG Report - *Climate Change Impacts and Adaptation for International Transport Networks* |
| **2011**<br><br>Follow-up | **UNCTAD Ad Hoc Expert Meeting**: **"*Climate Change Impacts and Adaptation: a Challenge for Global Ports*"**<br>Academic paper co-published by Experts (2013)<br>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"**<br><br>**UNCTAD Multiyear Expert Meeting: "*Small Island Developing States: Transport and Trade Logistics Challenges*** |
| **2017** | **UNCTAD Port-Industry Survey on Climate Variability and Change** |
| **2015-2017** | **UNCTAD DA Project *"Climate change impacts on coastal transport infrastructure in the Caribbean: Enhancing the adaptive capacity of Small Island Developing States (SIDS)"*** |