



***UNFCCC COP 24 - UNS Side Event on SDG 9, Part II  
Sustainable Maritime Transport's Role in Supporting Global  
Trade and Development***

*5 December 2018, Katowice*

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

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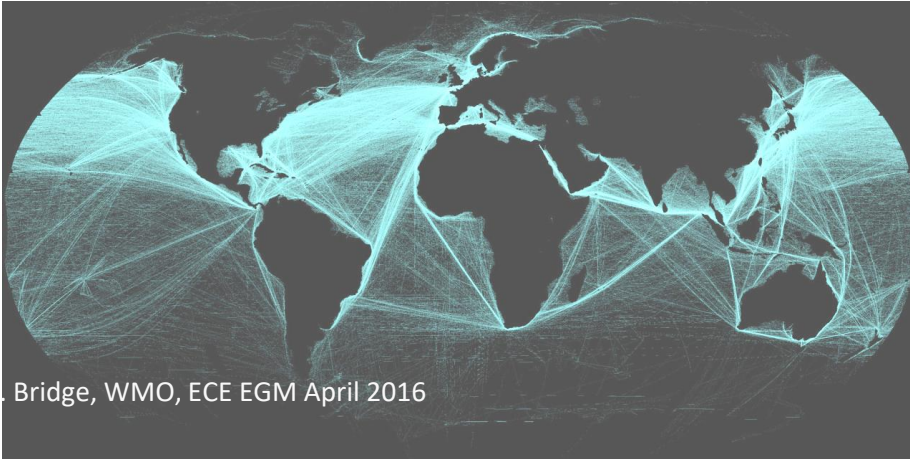
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[unctad.org/ttl/legal](http://unctad.org/ttl/legal)



## Maritime Transport: a critical facilitator of global trade and development



Bridge, WMO, ECE EGM April 2016

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



## 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 global GDP, annually (STERN Review 2006)
- 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 [Transport Policy and Legislation](#). See [unctad.org/ttl/legal](http://unctad.org/ttl/legal) for further information 
- See also [Sustainable Freight Transport and Finance Toolkit \(unctad.org/ttl\)](#)



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

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

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



## 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



## 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





Major climate change impacts on coastal transport infrastructure

Factor	Impacts
<p><b>Sea level (mean and extreme)</b></p>	<p>Coastal transport infrastructure (open sea ports, estuarine ports and inland waterway ports; airports; roads; railroads; bridges)</p>
<ul style="list-style-type: none"> <li>• Mean sea level changes</li> <li>• Increased destructiveness of storms/storm surges</li> <li>• Changes in the wave energy and direction</li> </ul>	<p>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</p>
<p><b>Precipitation</b></p>	
<ul style="list-style-type: none"> <li>• Changes in the intensity and frequency of extremes</li> <li>• (floods and droughts)</li> </ul>	<p>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</p>
<p><b>Temperature</b></p>	
<ul style="list-style-type: none"> <li>• Higher mean temperatures,</li> <li>• Heat waves and droughts</li> <li>• Increased spatio-temporal variability in temperature extremes</li> </ul>	<p>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</p>
<ul style="list-style-type: none"> <li>• Permafrost degradation</li> <li>• Reduced arctic ice coverage</li> </ul>	<p>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</p>



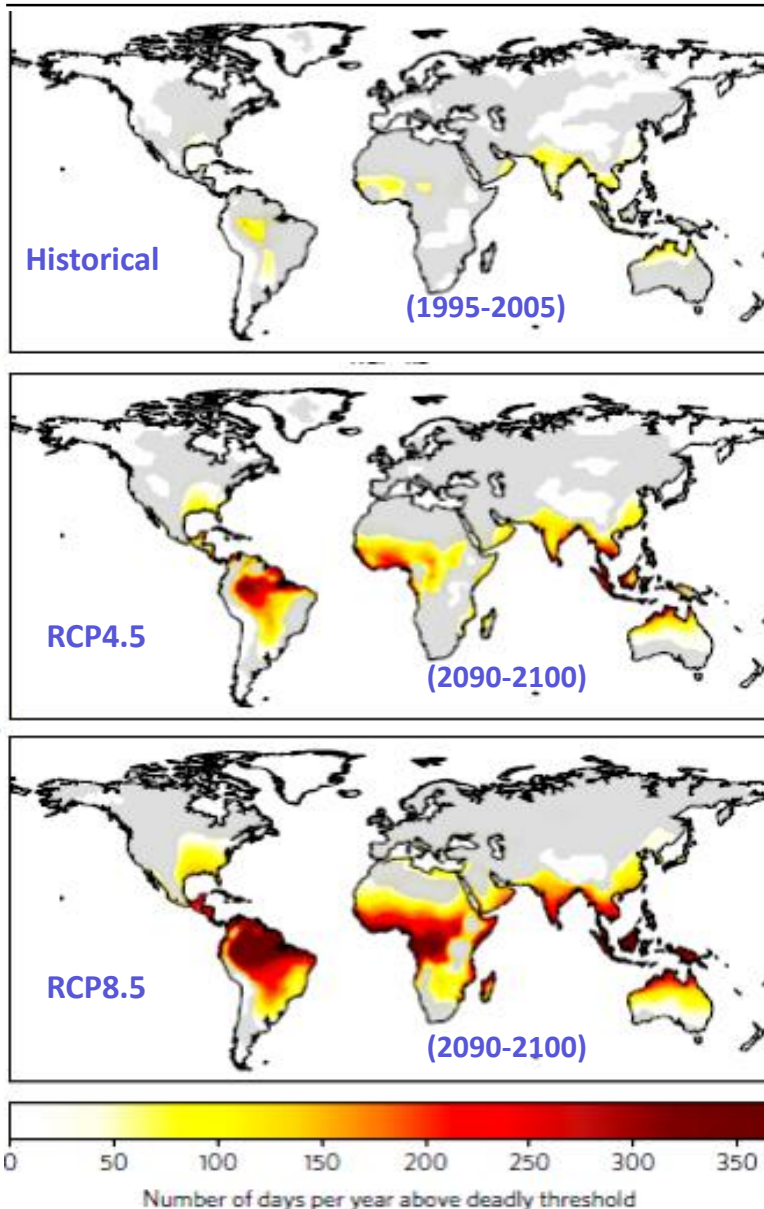


## Impacts of temperature and humidity increases

The projected temperature (and humidity) increases will affect the human thermoregulatory system and may create difficult ambient conditions for transport due to

- direct impacts on transport operations/costs and
- changes in demand

*Geographical distribution of past (1995-2005) and projected (2090 - 2100) deadly climatic conditions (from temperature and humidity increases) under a moderate (RCP4.5) and 'business as usual' (RCP8.5) emission scenario (Mora et al., 2017, Nature Climate Change)*



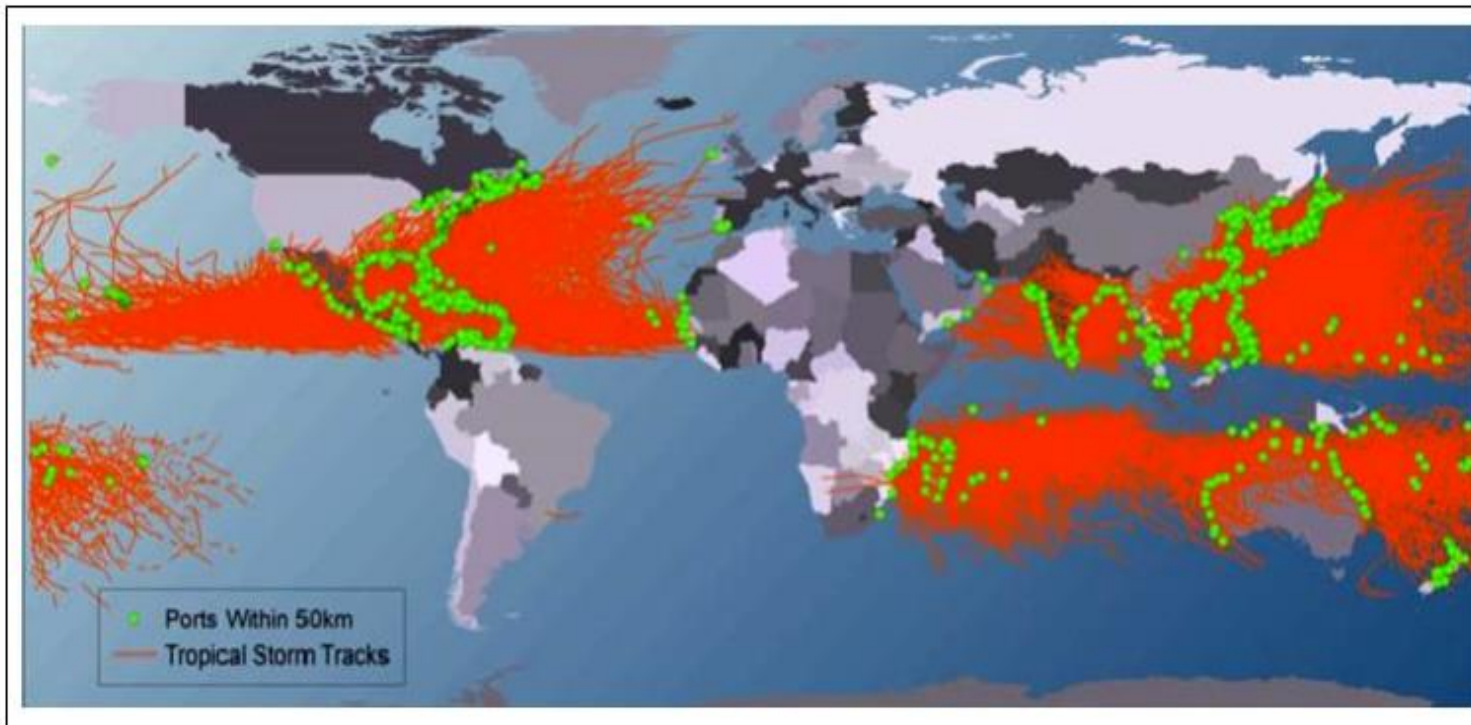


## The special case of the SIDS

- 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



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



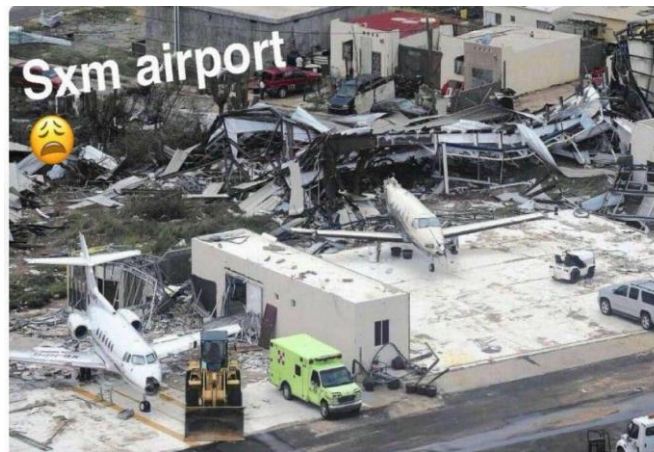




## 2017 hurricanes: impacts in the Caribbean

- Major impacts in Dominica, Dominican Republic, Guadeloupe, Montserrat, Antigua & Barbuda, Saint Kitts & Nevis, Puerto Rico, Turks & Caicos, Virgin Islands
- Most costly hurricane season on record (WMO 2018)
- Estimated losses: Dominica, US\$ 1.3 billion or 224% of GDP; BVI, about 300 % of GDP; St. Maarten: 797% of GDP (French part of island 584% of GDP) (UNISDR CRED)
- Estimated losses for Anguilla, Bahamas, BVI, St Maarten, Turks & Caicos: US\$ 5.4 billion (UNECLAC 2018)

### *St Maarten airport*



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



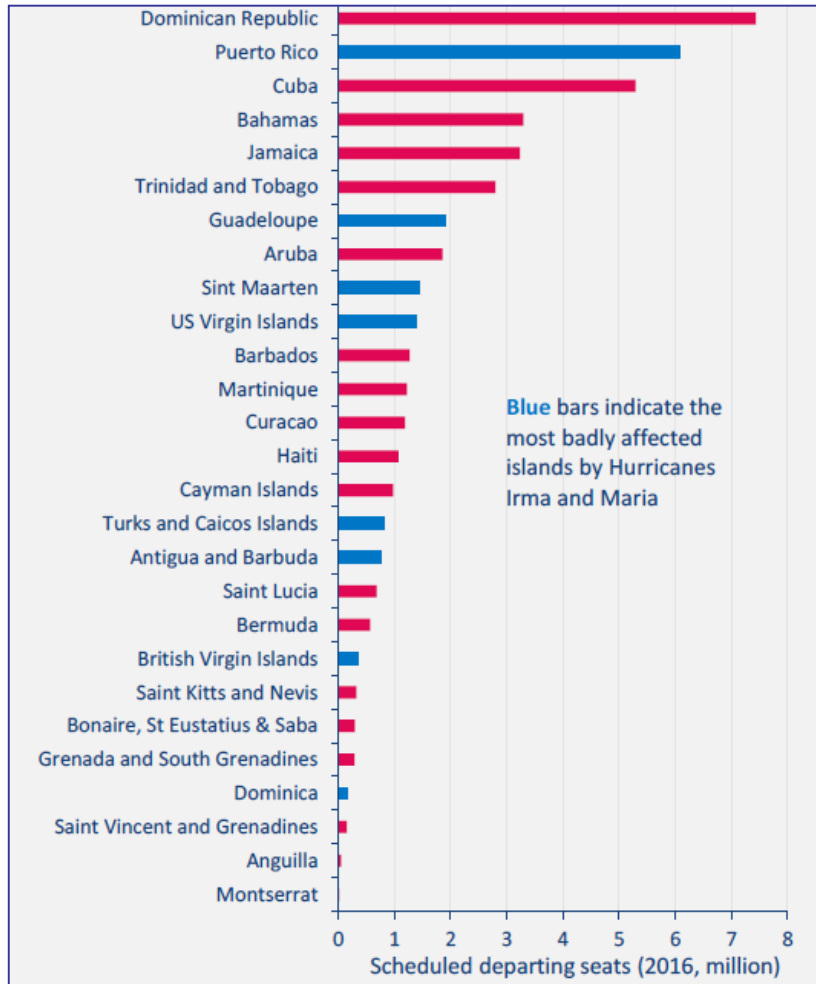


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# Caribbean: The most air-transport dependent region



Country	Travel & tourism % of GDP World Ranking, 2010)	% visitors arriving by air
Anguilla	61.0 (5)	84
Antigua & Barbuda	78.5 (1)	95
Bahamas (the)	46.5 (8)	88
Barbados	48.1 (6)	92
Belize	28.2 (17)	85
Bermuda	11.2 (65)	86
British Virgin Islands	43.7 (10)	94
Cayman Islands	23.3 (24)	67
Dominica	23.3 (23)	88
Grenada	24.4 (22)	96
Guyana	11.5 (63)	99
Haiti	7.0 (125)	n.a.
Jamaica	25.4 (20)	92
Montserrat	n.a.	99
St. Kitts & Nevis	30.5 (16)	91
St. Lucia	35.1 (13)	90
St. Vincent & the Grenadines	23.6 (23)	98
Suriname	4.6 (164)	93
Trinidad & Tobago	10.9 (66)	95

Caribbean passenger markets (2016) (IATA, 2017  
Hurricane Irma and Maria's impacts on aviation)

(UNECLAC 2011)



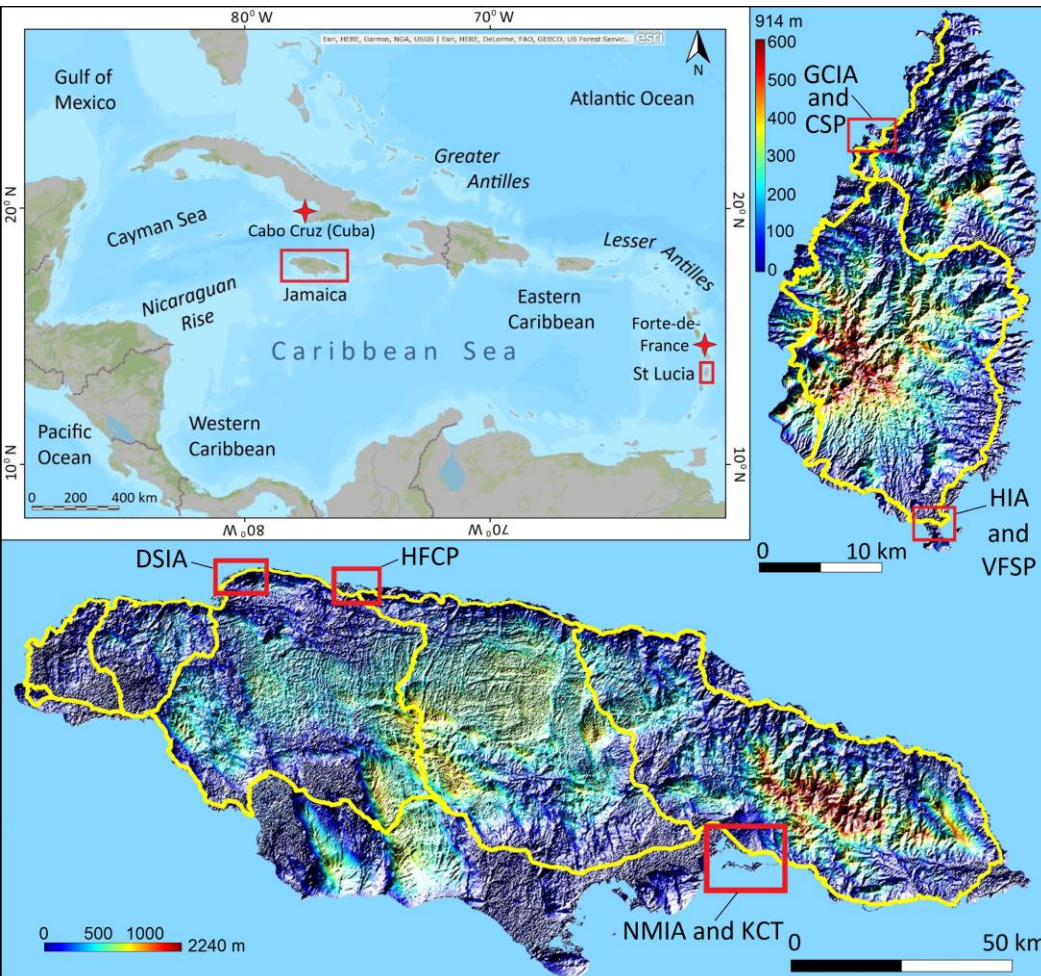


## Climate change impacts on coastal transport infrastructure in the Caribbean: Enhancing the adaptive capacity of Small Island Developing States

- 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](https://SIDSport-ClimateAdapt.unctad.org)
- Key outcomes include *assessment of potential vulnerabilities to CV & C of two Caribbean SIDS, focusing on potential operational disruptions and marine inundation risk to coastal internat'l airports and seaports of Jamaica and Saint Lucia, under different climatic scenarios*
- Innovative methodological approaches, validated by scientific peer-review



## 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 1.5°C (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 j) 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

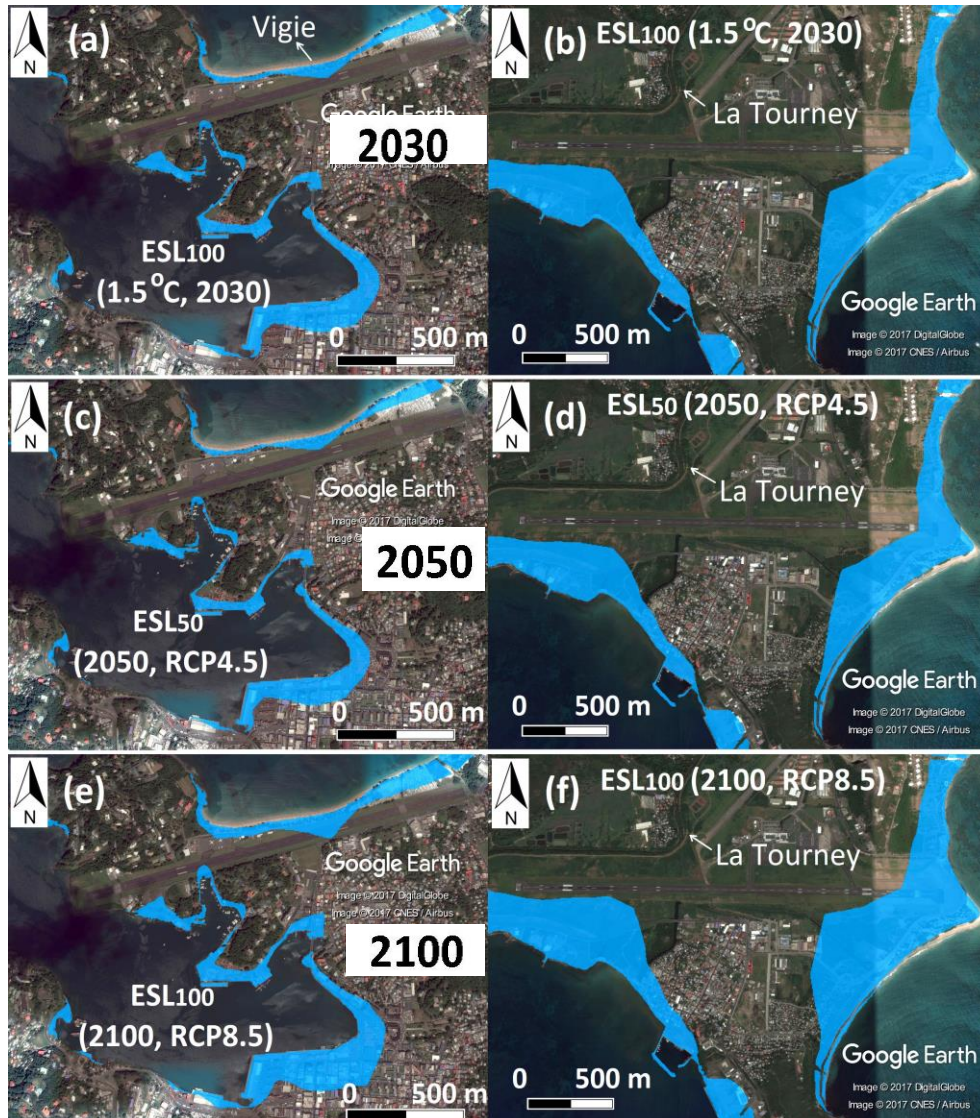
All international transportation assets (airports and seaports) appear vulnerable under all scenarios

**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)*





**Thank you!**