UNITED NATIONS CONFERENCE ON TRADE AND DEVELOPMENT

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UNECE EG on Assessment of Climate Change Impacts and Adaptation for Inland Transport

20th session, Geneva, 22-23 April 2021

Climate Impact Assessment at Facility Level: some of the key data requirements -

UNCTAD project SIDSport-ClimateAdapt

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

Focus: key coastal transport infrastructure (8 Ports & Airports) in 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

- ***National Case Studies: Jamaica and Saint Lucia***
- ***Climate Risk and Vulnerability Assessment Framework for Caribbean Costal Transport Infrastructure***
- ***2 national and 1 regional capacity building workshops*** *– 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** (Monioudi et.al, *Regional Env. Change 2018, https://rdcu.be/Q1OY*)

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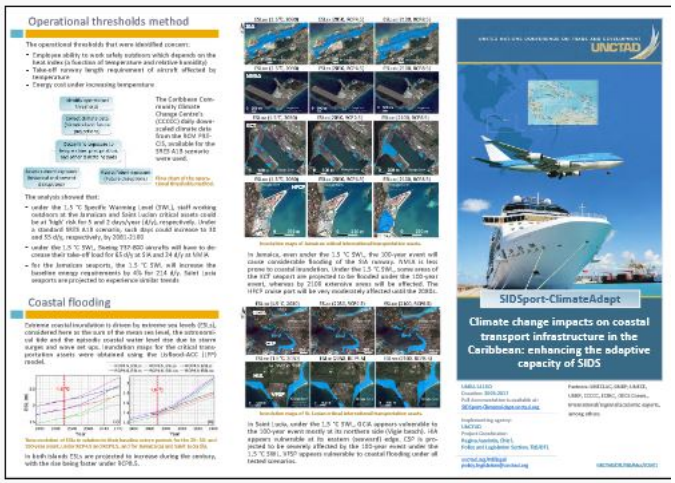
SIDSport-ClimateAdapt.unctad.org

Further information, documentation, tools and guidance materials are available on the web-platform



Key findings published:

Regional Environmental Change
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ORIGINAL ARTICLE

CrossMark

Climate change impacts on critical international transportation assets of Caribbean Small Island Developing States (SIDS): the case of Jamaica and Saint Lucia

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Facility level data requested

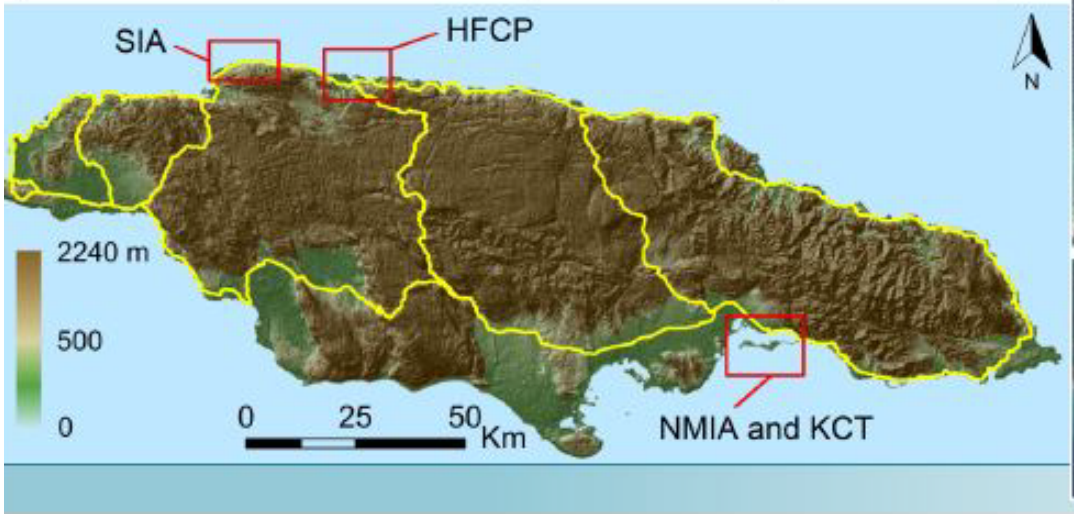
Data	Description	Priority (1 = high)
GIS Files		
Transport facility location and spatial attributes	Name, Location, Elevation, Spatial extent, replacement value, annual maintenance cost	1
Elevation	Highest-possible resolution elevation data for the country	1
Facility Information		
Facility operations data	e.g., Volume of passengers, number of enplanements and deplanements, type and volume of commodities, number of vessels, value of goods	1
Critical facility components airports	e.g., Number, location and dimensions of runways, control towers, road or rail access points and terminals in airports	1
Critical facility components ports	e.g., Number and location of wharves, warehouses, cranes, road or rail access points	1
Facility equipment information	Types of equipment are located at each facility, replacement cost of equipment	2
Facility employment statistics	Number and types of employees	3
Vessel statistics	Type and size	1
Company/tenant information	Size, number, and types of companies operating at the facility	3
Facility impact on tourism	e.g., Tourism dollars accounted for, number of visits	2
Trading partners/competition	Location and trade flows	3

Facility level data requested

Data	Description	Priority (1 = high)
Interdependent Infrastructure Data		
Electricity generation	Location and type	1
Potable water	source	1
Sanitation facilities		1
Inland connectivity infrastructure	e.g., Type, location, and condition of roads and rail used to access facility (in GIS, ideally)	1
Historic disruptions data		
Historical significant weather events	List of event names, descriptions, duration, and dates	1
Facility disruptions due to weather	Date and duration of closure, parts of the facility closed, type of weather event	1
Data on thresholds describing when operations are disrupted	Criteria for determining if service is stopped, description of weather sensitivity thresholds (e.g., port experiences X impacts at Y ft. of storm surge)	2
Economic implications	Facility revenue lost from disruption; damaged equipment; GDP loss	2
Repair and replacement cost	Cost of repairs and replacements (damages due to historic weather events)	1
Facility Planning Data		
Master plan for facilities	Planned port developments, market forecasting, strategic objectives	1
Annual or five-year capital program		3
Strategic business and operations plans		3

Critical assets - Jamaica

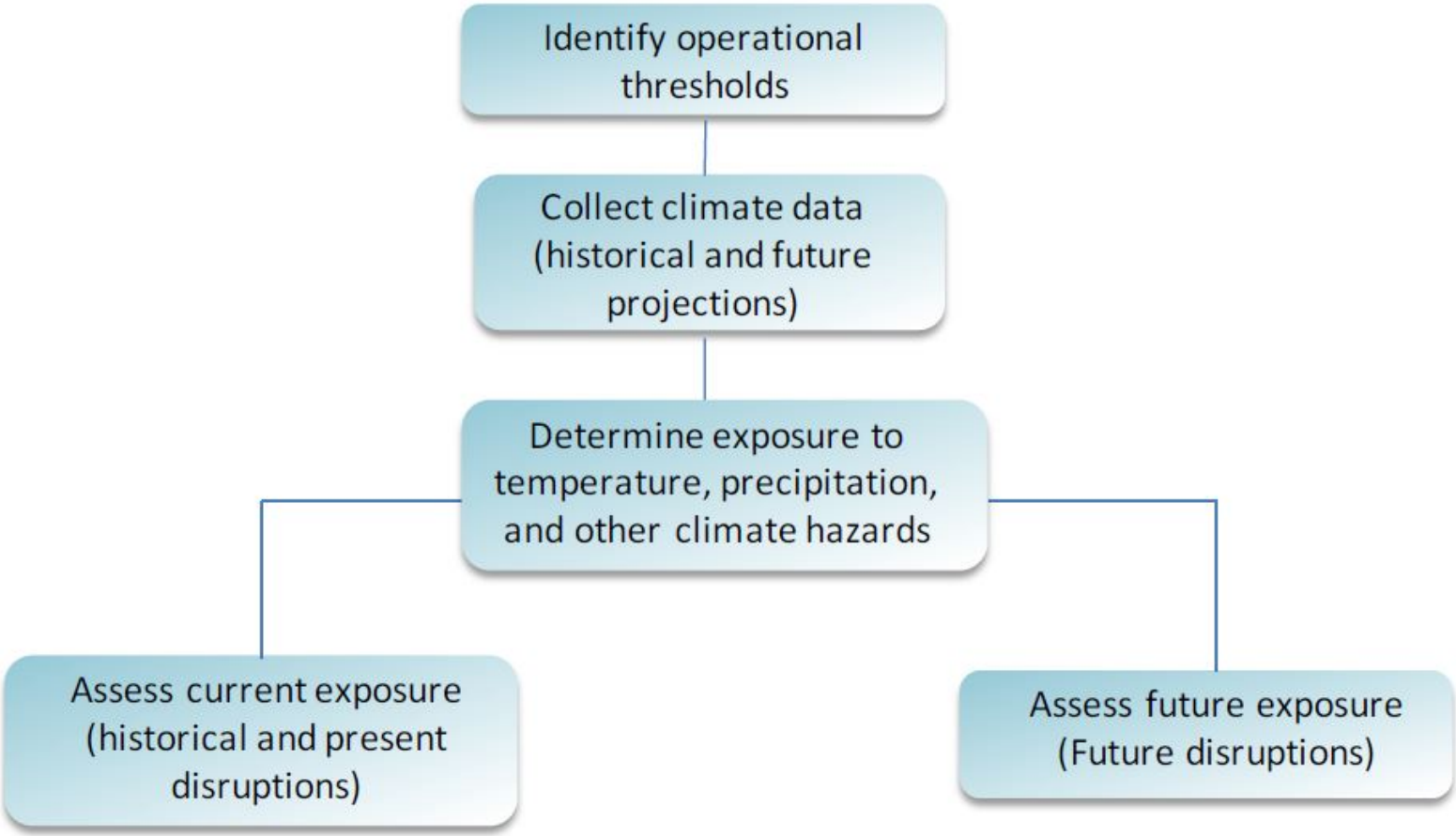
AIRPORTS	Runway length (m)	Runway width (m)	Elevation (m)	Passengers (2016)	Cargo handled (tonnes, 2016)
Sangster International Airport (SIA)	2,662.4	46	1.18-1.37	3,952,273	6,497 (2015)
Norman Manley International Airport (NMIA)	2,716	46	1.95-2.5	1,594,096	12,528
SEAPORTS	**Berth length (m)**	**Depth (m)**	**Elevation (m)**	**Passengers**	**Cargo**
Historic Falmouth Cruise Port (HFCP)	675	11.3	2.9	752,205	-
Kingston Freeport Terminal (KCT)	2310	13	4	N/A	Domestic: 1,051,633 Transshipment: 7279722 (2015)



Critical assets – Saint Lucia

AIRPORTS	Runway length (m)	Runway width (m)	Elevation (m)	Passengers (2016)	Cargo handled (tonnes, 2016)
Hewanorra International Airport (HIA)	2,743.2	45.72	3.3	644,837	2,138
George Charles International Airport (GCIA)	1,889.76	45.72	6.1	195,859	1,079
SEAPORTS	**Berth length (m)**	**Depth (m)**	**Elevation (m)**	**Passengers**	**Cargo**
Port Castries (CSP)	940.6 (cargo +cruise)	5.5-10	1.5	677,394	480,770 tonnes (2016)
Vieux Fort Seaport (VFSP)	373	11	1.5-2.5	N/A	~46,000 TEU per year

The operational thresholds method



Future disruptions - Direct impacts

Operational thresholds method

Identifying the operational thresholds

i. Employee ability to work safely outdoors and heat index (a function of temperature and relative humidity)
ii. Take off length requirement of aircrafts and temperature
iii. Energy cost and temperature
iv. Crane operation and precipitation

Collection of Climate data

i. Raw daily climate model data from the database of the Caribbean Community Climate Change Centre (CCCCC)

Estimation of days of disruption

Trough the comparison of the operational thresholds with the climate data, the days that these thresholds would be exceeded were estimated

Days of disruptions for airports and seaports in Jamaica

Climate Stressor	Sensitivity	Threshold	Disruptions (average days/year)					
			1986-2005	2006-2030	*2030*	2031-2055	2056-2080	2081-2100
Extreme Heat	Employee ability to work safely outdoors in airports and seaports	Heat Index (NOAA) over 39.4 °C (103 °F), resulting from 30.6 °C (87.1 °F) and 80 % relative humidity presents 'high' risk	4.40	5.76	***5.00***	13.45	22.21	29.67
		Heat Index (NOAA) over 46 °C (115 °F) resulting from 32.5 °C (90.5 °F) and 80 % relative humidity presents 'very high risk'	0.05	0.12	***1.00***	1.95	4.88	10.89
	Aircraft take-off length requirements	Boeing 737-800 aircraft would not be able to take off from SIA if the temperature exceeds 33.2°C	23.70	44.92	***65.00***	84.91	138.75	183.78
		Boeing 737-800 aircraft would not be able to take off from NMIA if the temperature exceeds 34.1°C	5.35	14.64	***24.00***	44.41	99.25	146.00
	Energy costs in seaports	0.8°C warming = 4% increase if temperature exceeds 30.3°C (1986-2005 average: 29.5 °C)	145.20	177.36	***214.00***	216.73	271.46	303.44
		1.3°C warming = 6.5% increase if temperature exceeds 30.8°C	121.50	153.44	***182.00***	196.41	248.50	286.61
		3°C warming = 15% increase if temperature exceeds 32.5°C	47.25	74.92	***97.00***	117.95	168.96	214.83
Precipitation	Inhibits crane operation in seaports	Intense rainfall (e.g. > 20 mm/day)	3.70	3.60	***0.00***	4.59	4.00	3.11
		Very heavy rainfall (e.g. >50 mm/day)	0.90	0.64	***0.00***	1.45	0.92	0.89

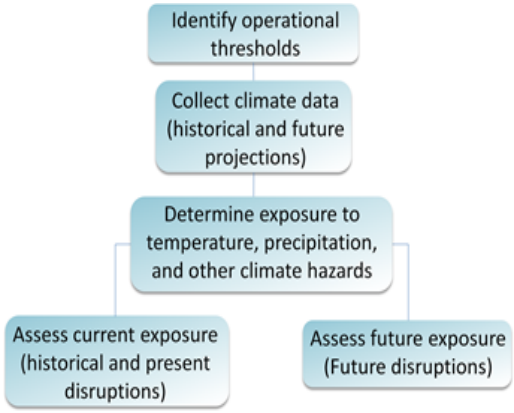
Days of disruptions for airports and seaports in Saint Lucia

Climate Stressor	Sensitivity	Threshold	Disruptions (average days/year)					
			1986-2005	2006-2030	*2030*	2031-2055	2056-2080	2081-2100
Extreme Heat	Employee ability to work safely outdoors in airports and seaports	Heat Index (NOAA) over 39.4 °C (103 °F), resulting from 30.6 °C (87.1 °F) and 80 % relative humidity presents 'high' risk	1.25	1.96	***2.00***	11.86	29.13	55.33
		Heat Index (NOAA) over 46 °C (115 °F) resulting from 32.5 °C (90.5 °F) and 80 % relative humidity presents 'very high risk'	0.00	0.00	***0.00***	0.59	2.42	9.06
	Aircraft take-off length requirements	Boeing 737-500 aircraft would not be able to take off from HIA if the temperature exceeds 31.2°C	0.55	0.96	***0.00***	10.64	31.38	69.72
	Energy costs in seaports	0.8°C = 4% increase if temperature exceeds 27.6°C (1986-2005 average: 26.8 °C)	80.55	114.32	***168.00***	225.50	322.13	355.72
		1.3°C warming = 6.5% increase if temperature exceeds 28.1°C	49.05	71.76	***113.00***	161.59	279.58	343.61
		3°C warming = 15% increase if temperature exceeds 29.8°C	5.90	9.72	***18.00***	40.32	98.54	182.78
Precipitation	Inhibits crane operation in seaports	Intense rainfall (e.g., > 20 mm/day)	48.20	44.60	***51.00***	45.55	46.88	48.00
		Very heavy rainfall (e.g. >50 mm/day)	0.45	0.72	***1.00***	1.05	0.54	0.83

Operational thresholds method

Operational thresholds relating to:

- Take-off runway length requirement of aircraft affected by temperature
- Energy costs under increasing temperature
- Employee ability to work safely outdoors which depends on the heat index (a function of temperature and relative humidity)



Key findings:
Under the **1.5^{0}C Specific Warming Level (SWL, 2030s)**,

- Boeing 737-800 aircraft will have to decrease their **take-off load for 65 d/y at SIA and 24 d/y at NMIA**
- **the baseline energy requirements would increase by 4 % for 214 d/y** at Jamaican ports **and 168 d/y** at Saint Lucian ports
- staff working outdoors at the Jamaican and Saint Lucian ports and airports will be at **'high' risk for 5 and 2 days/year (d/y)**, respectively.
  - Depending on the climate scenario, high risk days may increase **to 30 and 55 d/y (2081-2100)**

Gathering Operational Thresholds

Generic Standards and Thresholds

Example thresholds and their impacts from a variety of vulnerability assessments and literature source.

Component	Hazard	Example Threshold	Impact
Ports			
Operations	Extreme Heat	1°C warming = 5% increase in energy costs (in one illustrative terminal)	Energy costs
Paved surfaces		Depends on asphalt pavement grade	Asphalt pavement softening
Cranes	Heavy Rain	In Manzanillo, intense rainfall > 20 mm within 24 hours reduces visibility enough to impair operations	Low visibility inhibits crane operation
Goods handling		Precipitation > 1 mm within 24 hours	Inability to handle water-sensitive goods
Operations	Flooding	Conditions that cause flooding will vary by facility.	Flooding in some locations of the port could impair operations.
Docks	Tidal Flooding	Dock elevation/quay height	Flooding
Cranes	Wind Speeds	Varies by crane type. For example, 25 m/s (56 mph, 48.6 knots) for a CONTECON SSA	Ability to operate
Navigational channel		Varies by facility. For example, at Kingston Container Terminals (KCT) in Jamaica: • Winds ≥ 18 m/s (40.3 mph, 35 knots) force operational shutdown • With winds of 12.8-18 m/s (28.8-40.3 mph, 25-35 knots), discretion is applied	Ability to berth ships (due to waves)
Airports			
Runways	Extreme Heat	Runway length requirement varies based on plane type, weight, and runway length. Rule of thumb: Runway length requirements increase by 1% for every 1°C by which the mean daily maximum temperature of the hottest month exceeds 15°C (assuming runway is at sea level) (ICAO, 2006)	Ability of aircraft to take off
Flight operations		47.7°C (118°F)	Aircraft maximum take-off operational temperature
Personnel		Heat Index* over 39.4°C (103°F) is "high" risk Heat Index* over 46°C (115°F) is "very high" risk	Reduced employee ability to work safely outdoors (need for more breaks)
Flight operations	Heavy rain	Varies by airport	May decrease runway friction to aircraft cannot take off
Flight operations	Flooding	Any flooding on the runway can impair operations. Conditions that cause flooding will vary by airport.	Inability of aircraft to land or take off
Flight operations	Sea Level Rise	Runway elevation	Flooding on the runway
Flight operations	Wind Speeds	Commercial airports: sustained winds of 20 m/s (45 mph, 39 knots) or frequent gusts of 26 m/s (58 mph, 50.4 knots) General Aviation airports: 11.2 m/s (25 mph, 21.7 knots)	Inability of aircraft to land or take off

*Heat Index is a function of temperature and relative humidity. See http://www.nws.noaa.gov/om/heat/heat_index.shtml. For a relative humidity of 70%, Heat Index would exceed 39.4°C (103°F) at 32.2°C (90°F) and would exceed 46°C (115°F) at 34°C (94°F).

Available to download

UNCTAD Regional Workshop: "Climate change impacts and adaptation for coastal transport infrastructure in the Caribbean"

Worksheet

Operational Thresholds:

Component	Hazard	Variable	Threshold	Impacts

Thank you!