Climate Change Adaptation for International Transport: Preparing for the Future

16 to 17 April 2019

Climate change impacts and adaptation for transport – key issues and UNCTAD work

Presentation by

Regina Asariotis
Chief, Policy and Legislation Section
UNCTAD

This expert paper is reproduced by the UNCTAD secretariat in the form and language in which it has been received. The views expressed are those of the author and do not necessarily reflect the views of the UNCTAD.
Climate change impacts and adaptation for transport - key issues and UNCTAD work

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

UNCTAD Ad Hoc Expert Meeting on  
Climate Change Adaptation for International Transport: Preparing for the Future  
16-17 April 2019, Geneva

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 the network of closely linked international supply chains

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

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

Environmental challenges: two sides of the coin

- Effects of transport on the environment (e.g. pollution, CO2 emissions)
- Environmental impacts on 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)
- UNSG – Climate Action Summit 2019: Update of NDCs under Paris Agreement by 2020
- Since 2008, integration of CV & C considerations into UNCTAD’s work on transportation
Limiting global warming to 1.5°C above pre-industrial levels by 2100 is included as an aspirational target in 2015 Paris Agreement, Art. 2 (a) (advocated by AOSIS)

Some key messages from IPCC (2018) regarding impacts and adaptation:

- Severe impacts are expected at 1.5 degrees warming, as early as in the 2030s
- Impacts expected to be much worse at 2 degrees warming than at 1.5 degrees
- “Much of the published research on the risks of climate change for the transportation sector has been qualitative”
- For SIDS – substantial increases in the risk to critical transportation infrastructure from marine inundation at 1.5°C, as early as in the 2030s, unless further climate change adaptation is undertaken

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)
- UNSG – Climate Action Summit 2019; Review of NDCs under Paris Agreement in 2020
- Since 2008, integration of CV & C considerations into UNCTAD’s work on transportation
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]

<table>
<thead>
<tr>
<th>Year</th>
<th>Event/Project</th>
</tr>
</thead>
<tbody>
<tr>
<td>2009</td>
<td>UNCTAD Multiyear Expert Meeting: &quot;Maritime Transport and the Climate Change Challenge&quot;</td>
</tr>
<tr>
<td></td>
<td>Follow-up: UNCTAD edited multidisciplinary book: Maritime Transport and the Climate Change Challenge</td>
</tr>
<tr>
<td></td>
<td>UN-Earthscan (Routledge/Taylor&amp;Francis) (2012) 327 pp</td>
</tr>
<tr>
<td>2010</td>
<td>Joint UNECE-UNCTAD Workshop: “Climate change impacts and adaptation for international transport networks”</td>
</tr>
<tr>
<td></td>
<td>Follow-up: UNECE Group of Experts on Climate Change Impacts and Adaptation for International Transport Networks (2011-2014); mandate extended in 2015;</td>
</tr>
<tr>
<td></td>
<td>2012 International Conference - including session on SIDS</td>
</tr>
<tr>
<td></td>
<td>2013 EG Report - Climate Change Impacts and Adaptation for International Transport Networks</td>
</tr>
<tr>
<td>2011</td>
<td>UNCTAD Ad Hoc Expert Meeting: &quot;Climate Change Impacts and Adaptation: a Challenge for Global Ports&quot;</td>
</tr>
<tr>
<td>2014</td>
<td>UNCTAD Ad Hoc Expert Meeting: &quot;Addressing the Transport and Trade Logistics Challenges of the Small Island Developing States (SIDS): Samoa Conference and Beyond&quot;</td>
</tr>
<tr>
<td></td>
<td>UNCTAD Multiyear Expert Meeting: &quot;Small Island Developing States: Transport and Trade Logistics Challenges&quot;</td>
</tr>
<tr>
<td>2015-2017</td>
<td>UNCTAD DA Project, &quot;Climate change impacts on coastal transport infrastructure in the Caribbean: Enhancing the adaptive capacity of Small Island Developing States (SIDS)&quot;</td>
</tr>
</tbody>
</table>

CV & C implications for 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 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**: Transport is not (just) a ‘culprit’, it is (also) a victim
**Direct and indirect** impacts on transport infrastructure and services:

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

- affect coastal transport infrastructure, hinterland/connecting transport infrastructure, and transport throughout global network of supply-chains
  - potential for damage, disruption and delay – economic/trade related losses
- affect demand for 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

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 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**

- The 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 infrastructure and operations
## Major climate change impacts on [coastal] transport infrastructure

<table>
<thead>
<tr>
<th>Factor</th>
<th>Impacts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sea level (mean and extreme)</td>
<td>Coastal transport infrastructure (open sea ports, estuarine ports and inland waterway ports; airports; roads; railroads; bridges)</td>
</tr>
<tr>
<td>• Mean sea level changes</td>
<td>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</td>
</tr>
<tr>
<td>• Increased destructiveness of storms/storm surges</td>
<td></td>
</tr>
<tr>
<td>• Changes in the wave energy and direction</td>
<td></td>
</tr>
<tr>
<td>Precipitation</td>
<td>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</td>
</tr>
<tr>
<td>• Changes in the intensity and frequency of extremes</td>
<td></td>
</tr>
<tr>
<td>• (floods and droughts)</td>
<td></td>
</tr>
<tr>
<td>Temperature</td>
<td>Damage to infrastructure/equipment/cargo and asset lifetime reduction; higher energy consumption for cooling cargo; lower water levels and restrictions for inland navigation affects 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</td>
</tr>
<tr>
<td>• Higher mean temperatures, heat waves and droughts</td>
<td></td>
</tr>
<tr>
<td>• Increased spatio-temporal variability in temperature extremes</td>
<td></td>
</tr>
<tr>
<td>• Permafrost degradation</td>
<td>Major damage to infrastructure; coastal erosion affecting road and rail links to ports longer shipping seasons-NWP; new shorter shipping routes-NWP/less fuel costs, but higher support service costs</td>
</tr>
<tr>
<td>• Reduced arctic ice coverage</td>
<td></td>
</tr>
</tbody>
</table>

### 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) and DRR
  - 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 most significant SIDS industry, is threatened by climate-driven beach erosion / coastal inundation, as is its facilitating transport infrastructure

SIDs are vulnerable to storms


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


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) and DRR
- 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 most significant SIDS industry, is threatened by climate-driven beach erosion / coastal inundation, as is its facilitating transport infrastructure
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); 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

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

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!