

UNITED NATIONS CONFERENCE ON TRADE AND DEVELOPMENT

*5th Athens Triennial Meeting combined with the 40th  
Anniversary of the Costas Grammenos Centre for Shipping,  
Trade and Finance, Athens, 7-9 October 2024*

*Climate Change and Shipping: Decarbonisation and Adaptation*

**Climate change impacts and the need for adaptation  
– key issues and considerations for maritime transport**

**7 October 2024**

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## Seaports: critical for global trade & sustainable development but at risk of climate change

Over **80% of volume** of world trade carried by sea (port-port)

- **Ports: key nodes** in the network of closely interlinked international supply chains - gateways to global markets and the blue economy – lifelines for SIDS
- **Globalization: interconnectedness/interdependence**



**Climate change expected to have direct and indirect impacts:**

**Sea-level rise; changes in temperature, humidity, precipitation; extreme storms and floods likely to:**

- affect port infrastructure and operations; hinterland transport; and the broader global supply-chain - significant potential for **damage, disruption and delay – extensive economic/trade related losses**
- exacerbate transport-related challenges for coastal and vulnerable economies; increase energy needs and costs

**Climate change adaptation and resilience building for ports is of strategic economic importance – especially in the light of growing risks and the potential cost of inaction** (*Climate change impacts on seaports: a growing threat to sustainable trade and development*, 2021)



## Potential for damage, disruption and delay to port and shipping operations

### Huge potential costs associated with inaction:

Estimates vary

- By 2100, **damages/port disruption: up to US\$ 25.3 billion/year** (*EDF, 2022, [Act Now or Pay Later: The Costs of Climate Inaction for Ports and Shipping](#)*)
- **Losses from Vessel Incidents at Sea** (2015-2019): weather-related conditions responsible for at least **20% of approx. 400 total vessel losses** (142 crew deaths, many due to extreme weather events)
- Current annual **port-specific risk** (natural hazards): **US\$ 7.5 billion/year** (*Verschuur, et al., [2023a](#)*)
- Current annual **systemic risk** to global **maritime transport, trade and supply-chain** networks: **US\$ 81 billion/year** (global trade) / plus **US\$122 billion** (economic activity) (*Verschuur, et al.; [2023b](#)*)

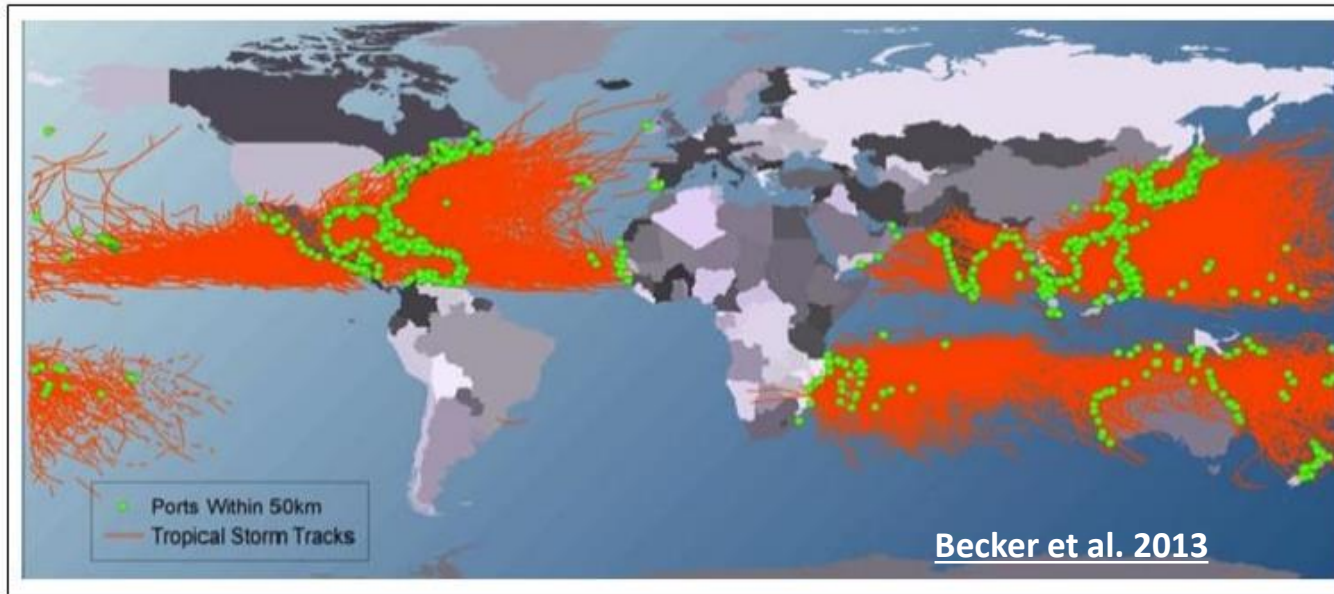
### BUT

- **Hurricanes**, e.g. **Sandy** (2012): over **US\$ 62 billion** losses (including 1 week shut-down of NY/NJ container port)
- For SIDS, a **single extreme event** can cause L&D amounting to a significant share or **multiple of GDP**
- **Typhoon Maemi** (2013): Busan port **inoperable for 91 days** (*Lam et al, 2017*)
- Potential (5- year) **typhoon losses for Shenzhen 16-berth terminal estimated at US\$0.9 billion** (*Cao and Lam, 2018*)



# Shipping and seaports are vulnerable to storms and extreme sea levels

Seaports within 50 km of tropical sea storm tracks (1960–2010)



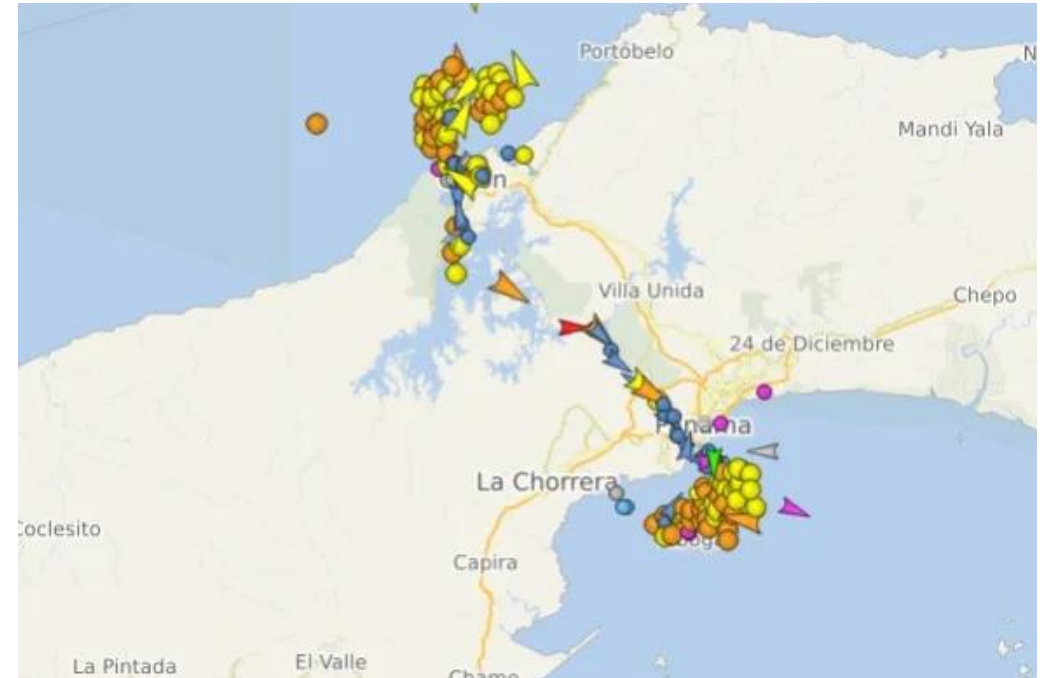
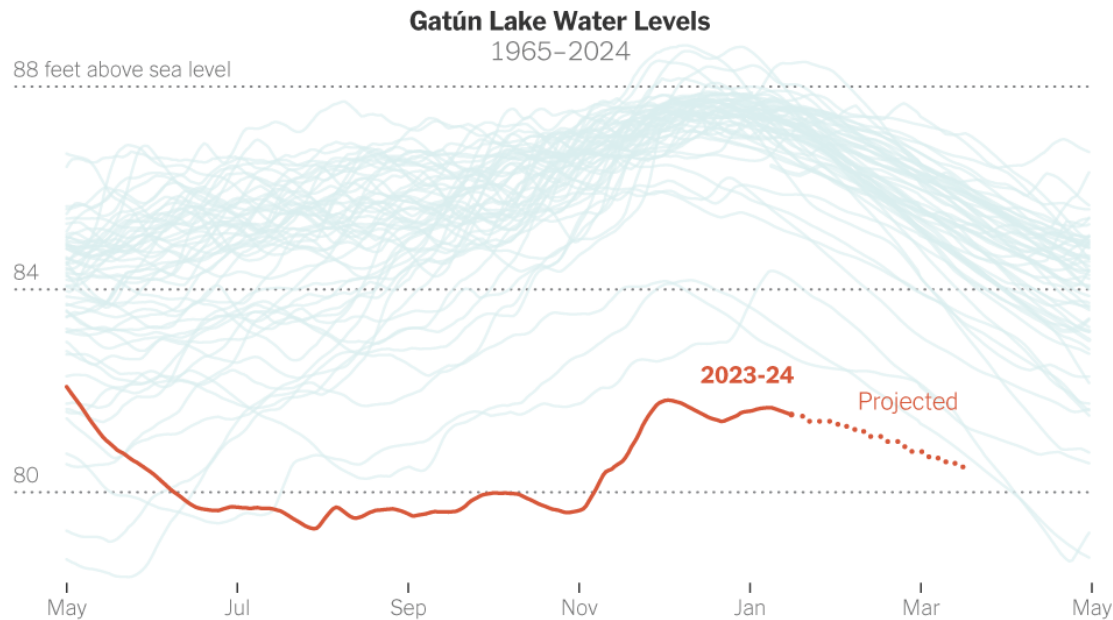
Port of Providence (RI, USA): Flood simulation





## Droughts can also be a threat for maritime transport / global supply chains

2023: unprecedented **drought in the Panama canal area** with very severe impacts on maritime transport and supply chains



Under normal circumstances, Panama Canal handles about **3% of the world's maritime trade volumes** and **46% of containers** moving from **NE Asia to U.S. East Coast**

Record payment for auctioned slot: **\$4 million** (Nov.2023)

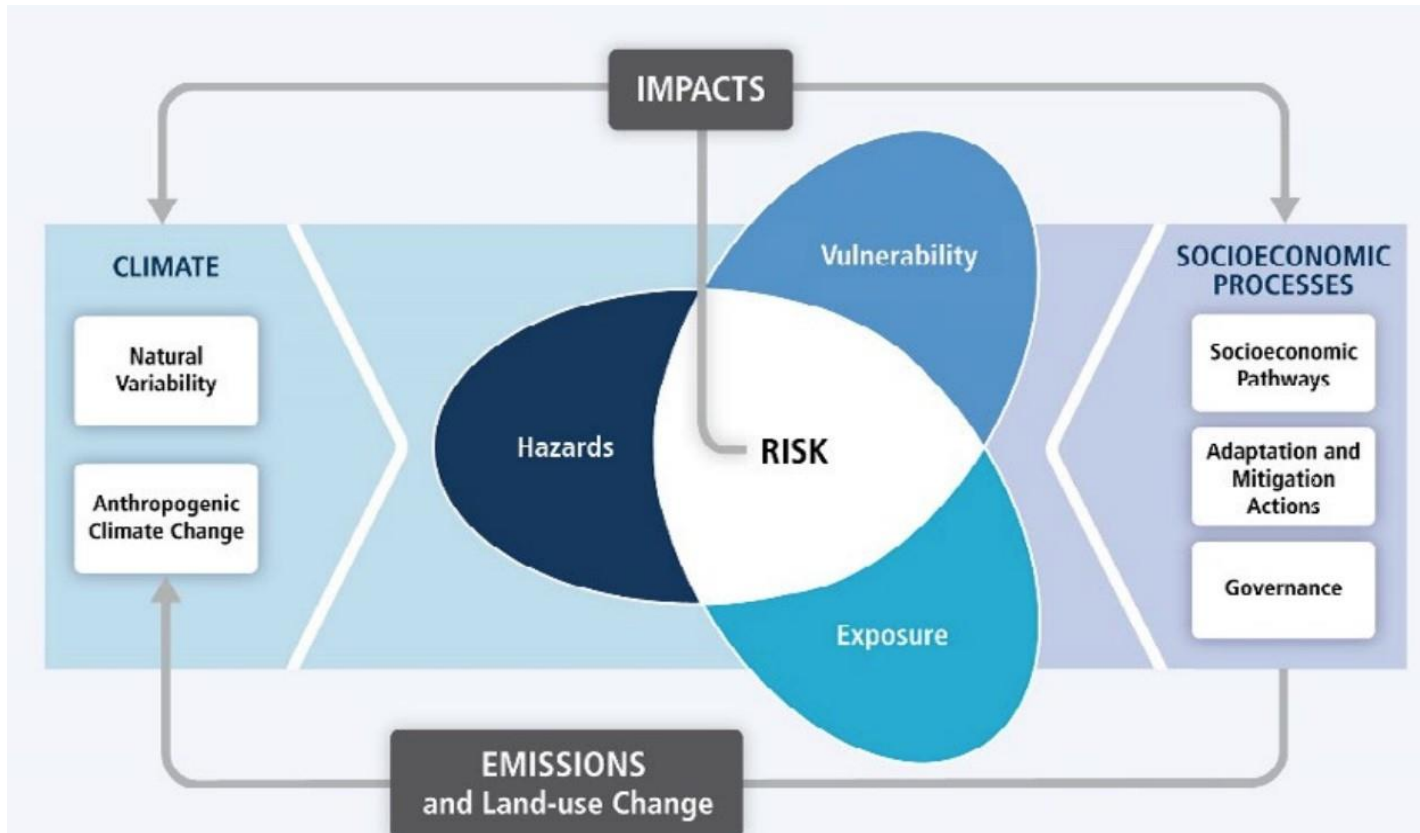


## Climate change impacts on ports

Factor/hazard changes	Impacts on Seaports
Mean sea level rise (SLR)  Increased extreme sea levels (ESLs); changes in wave energy/direction	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  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 manoeuvrability 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  Reduced arctic snow cover and ice  Permafrost degradation	Deterioration of paved areas; inoperable cranes; navigational equipment/cargo damages; higher energy consumption for cooling; health/safety issues for personnel/passengers  New arctic shipping routes, longer seasons, lower fuel costs; reductions in snow/ice removal costs; but arctic seaports will face increasing sea storm hazards  Ground subsidence, slope instability, drainage issues, affecting port structural integrity
Wind: Changes in frequency/intensity of extreme events	Damages to terminals and navigation equipment; problems for vessel navigation and port berthing; difficult crane operations above certain wind speeds



## Port risk of climate change impacts



IPCC, 2014

Port risk is a function of:

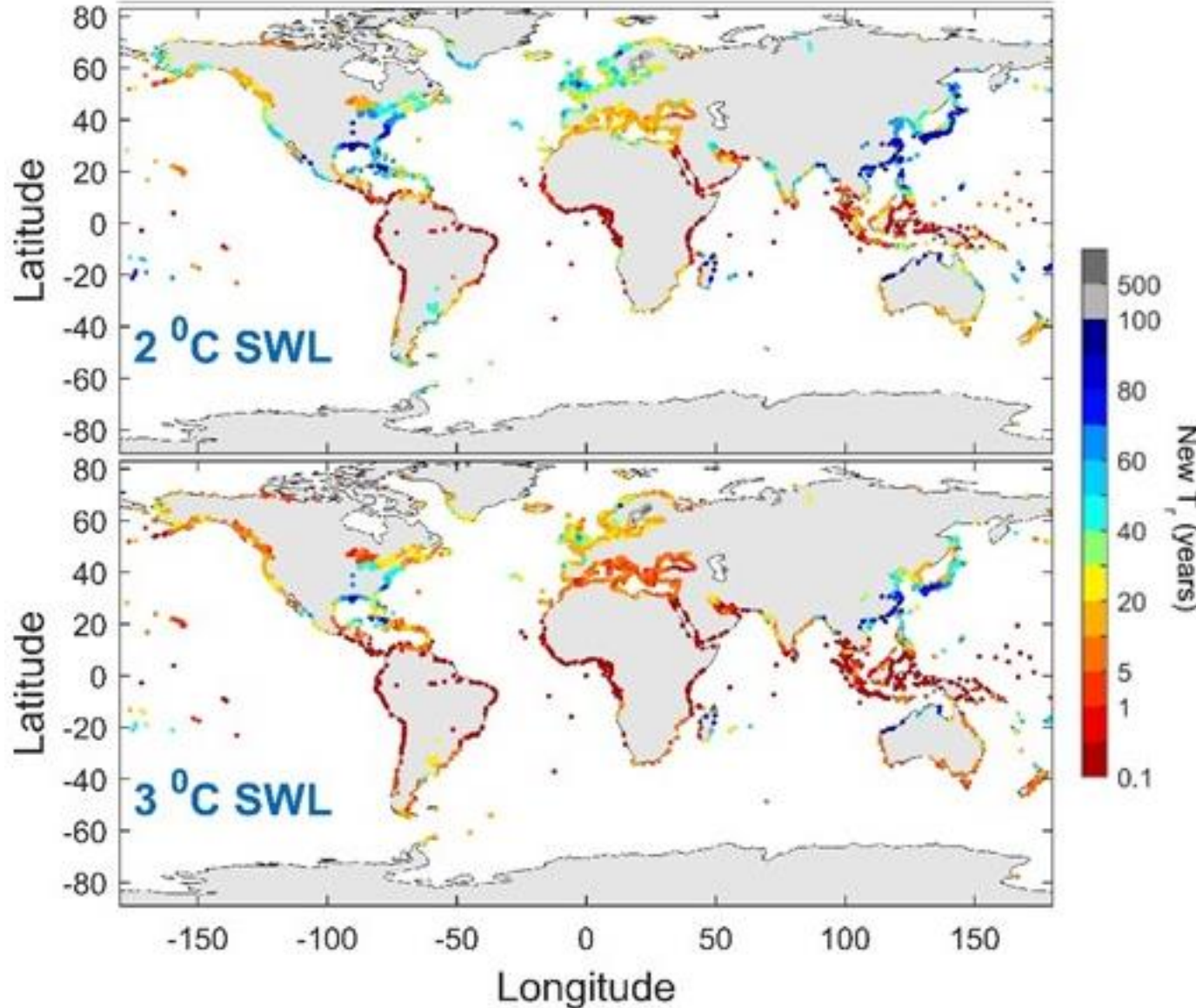
**Climatic hazards** - changing climatic factors, dependent on climate scenario/ emissions

**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

# Hazard projections for global ports under CV & C: Extreme sea level (ESL)



All global ports affected, with effects worsening with increasing SWL

- Under a **2 °C SWL (2050s)**, the return period of the **baseline 1-in-100 years ESL** will occur every **1-10 years** in many S. American, African, Gulf, SE Asian and Pacific ports
- Under a **3 °C SWL (2100?)**, many global ports will experience the **baseline 1-in-100 years ESL, several times per year**

*Projected changes in the return period of the baseline (mean of 1986-2014) 1-in-100 years ESL under CV & C for about 3700 global ports. Key: SWL (Specific Warming Level) in °C above pre-industrial times.  $T_r$  (years) return period. Seaport location from [World Port Index 2019](#).  $ESL_{100}$  projections for the global coastline from [EC-JRC data collection](#) (see also [Vousdoukas et al. \(2018\)](#)). See [Asariotis \(2021\)](#)*



## Climate change impacts and shipping - commercial law implications

Increasing climate and weather-related risks and impacts may lead to

- **delay and operational disruptions**, greater incidence of **cargo loss/damage**, heightened risks for carriage of **deck cargo**
- particular **challenges for safety of berthing, loading and discharge operations**
- **increased risks of maritime accidents, GA incidents, pollution, groundings and bunker oil spills**

**Implications for contractual performance, obligations, liability – costly disputes & litigation**

Specifics depend on type of contract (& terms and applicable law), e.g. **Charterparties:**

- **duration/number of voyages**; arrival, tender of **NOR**; **speed and consumption**; **redelivery (FTD)**
- start/duration/completion of **key operations** at the beginning/end of a voyage (**laytime and demurrage**) and their **safety**
- **safe port warranty**: loss of vessel due to **unprecedented extreme weather events** in port not attributable to charterer – **risk is on shipowner** ([The Ocean Victory UKSC \[2017\] 35](#))



## Climate change impacts and shipping - commercial law implications

- **Risk of climate-related damage, disruption and delay** to port/shipping operations and related **implications for contractual obligations** need to be better understood, **to minimize losses** and help **inform commercial contracting practice** into the future (*Asariotis, 2023; UNCTAD RMT 2024*)
- **Judicial approaches** to interpretation may **need to develop**, to take into account ‘**new normal**’ under a changing climate: *past experience no longer serves to predict future exposure and risk*
- **To avoid** potentially lengthy and **costly litigation**, commercial parties should **review their contracts** and consider including **specialist clauses** to accommodate **delay and disruption** and provide for a commercially sensible & **balanced commercial risk allocation**
- **Rather than waiting for future risks and losses to materialize** before being considered the new “normal” (ex post facto), **commercial parties—and commercial law—should be proactive** in trying to guard against these

**Commercial parties, law and contracts need to adapt**



## Key messages

- **Ports are critical facilitators of global trade and development** and vital for access to the blue economy – **maritime transport depends on well-functioning ports**
- These assets 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. **Failure to adapt is not an option and time is of the essence**
- **Need for mainstreaming** of CC consideration into port planning and operations, **high-quality risk-assessments** and development of **well-designed innovative adaptation measures**
  - *Compliance with EC technical guidance on climate-proofing already required for new EU port infrastructure and for EU funding for ports in other countries ([Asariotis et al, 2024](#))*
- **Scaling up of capacity building and (affordable) adaptation finance** vital, particularly for developing countries
- **Promoting port risk-assessment and adaptation helps mitigate future losses** (as well as related **legal disputes** and **insurance costs**) which is in everyone's interest.
- **Commercial parties, law and contracts** also **need to adapt** to a future under climate change

# Thank you

