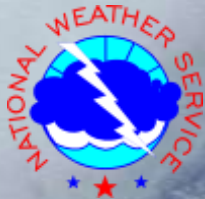


# RSMC Miami/National Hurricane Center Tropical Cyclone Risk Products, Forecasts, and Warnings



**Jamie Rhome, Deputy Director  
National Hurricane Center**

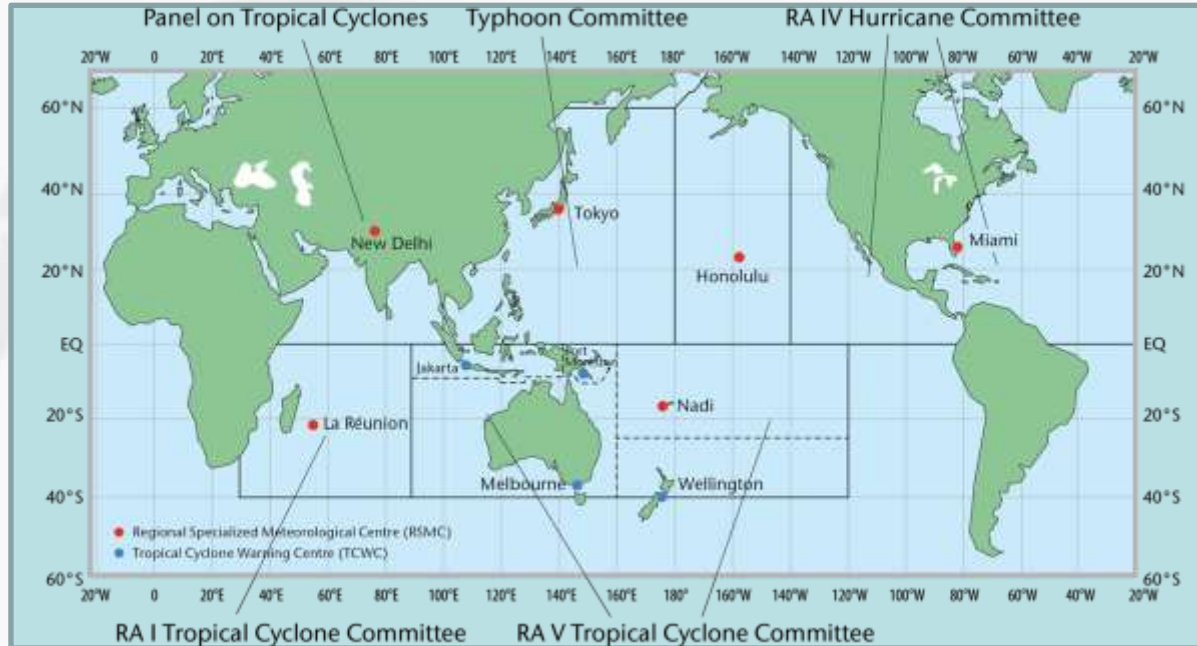




# World Meteorological Organization



## Regional Specialized Meteorological Centers (RSMC)



- **NHC is one of 7 RSMCs that produce and coordinate tropical cyclone forecasts for various ocean basins.**
- **NHC is responsible for both the Atlantic & eastern North Pacific Ocean**



# NHC's International Coordination



## World MET. ORGANIZATION - Regional Association IV Coordination



RSMC= Regional Specialized Meteorological Center

RA-IV countries include Caribbean area, Central America, Mexico, Canada, and Bermuda.



# International Collaboration



- **Open exchange of meteorological data among countries**
- **NHC provides forecasts and guidance on watches and warnings to 28 WMO member nations**
- **NHC hosts and teaches two 1-week training workshops on tropical cyclones for international government meteorologists**
- **NHC Director serves as Chairman of the WMO RA-IV Hurricane Committee. Annual meeting updates the Region's "Hurricane Operational Plan"**
- **U.S. conducts annual Caribbean Hurricane Awareness Tour**
- **Storm surge risk modeling and mapping**



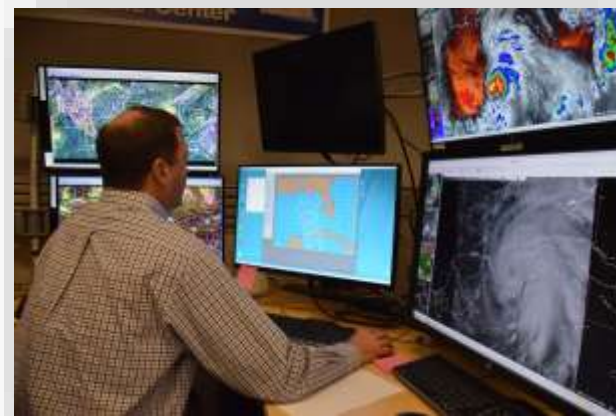




# Coordination of International Watches & Warnings



- Each country is responsible for issuing watches/warnings for their respective country or jurisdiction
  - NHC issues watches/warnings for Haiti
- NHC will recommend the placement of watches/warnings
- Coordinated with Met. Offices throughout the region
- Potential Tropical Cyclone advisories allow for the issuance of watches and warnings prior to the formation of a tropical depression



Tropical Cyclone Breakpoints - Caribbean



# Hurricane Awareness Tour



- **2020 and 2021 – Canceled due to the pandemic; limited return in 2022 - U.S. Territories**
- **Full Return in 2023 – April 17-22 – (Merida and Chetumal, Mexico, Grand Cayman, Dominican Republic, Turks & Caicos, and Puerto Rico)**
- **Opportunity to increase hurricane awareness by meeting with emergency managers, media, and general public**
- **Tour of hurricane hunter aircraft**





# Risk and Risk Perception

- Risk: the potential of gaining or losing something of value

$$\text{Risk} = \text{Probability} \times \text{Consequence} \times \text{Vulnerability}$$

- Risk perception: the subjective judgment people make about the severity and probability of a risk, which may vary from person to person

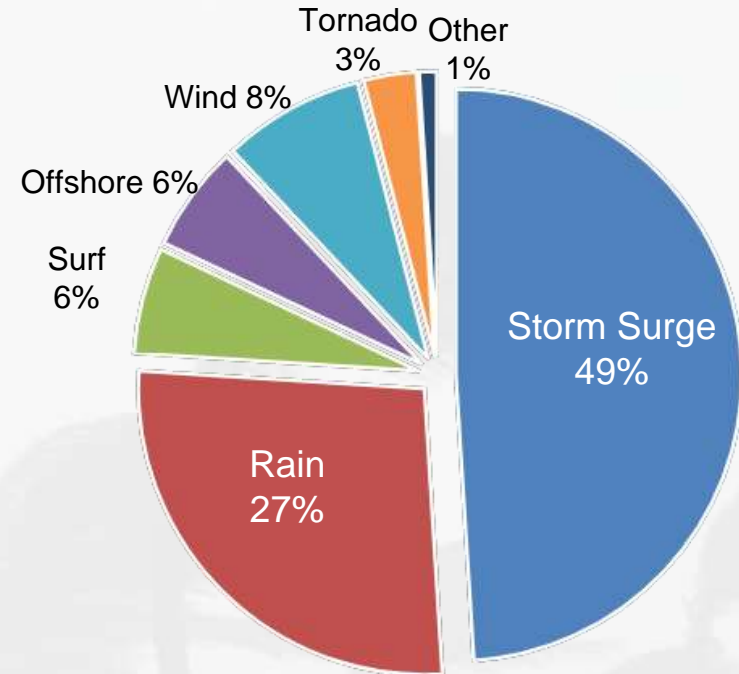
**Actual Risk  $\neq$  Perceived Risk**



# Historically (1963-2012) Vast Majority of Direct Deaths Have Been Water Related



- From 1963-2012 (Rappaport Study):
  - About 2,544 total direct fatalities
  - Water accounted for nearly 90% of direct deaths
    - Storm Surge – 49%
    - Rain – 27%
    - Surf – 6%
    - Offshore – 6%
  - Wind accounts for about 10%
    - Combination of wind and tornado



U.S. Tropical Cyclone Direct Fatalities  
1963-2012

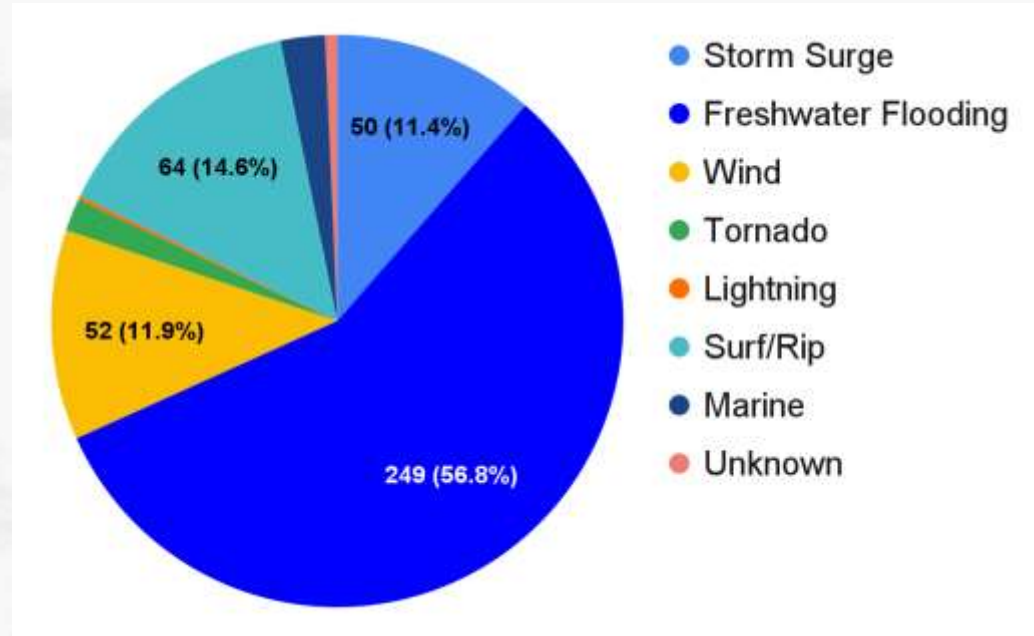




# Direct TC Fatalities – 2013-2022



- **57% (249)** due to freshwater flooding
- **15% (64)** due to surf/rip currents, many from storms well away from the U.S.
- **12% (52)** due to wind – many tree related scattered across multiple storms
- **11% (50)** due to storm surge



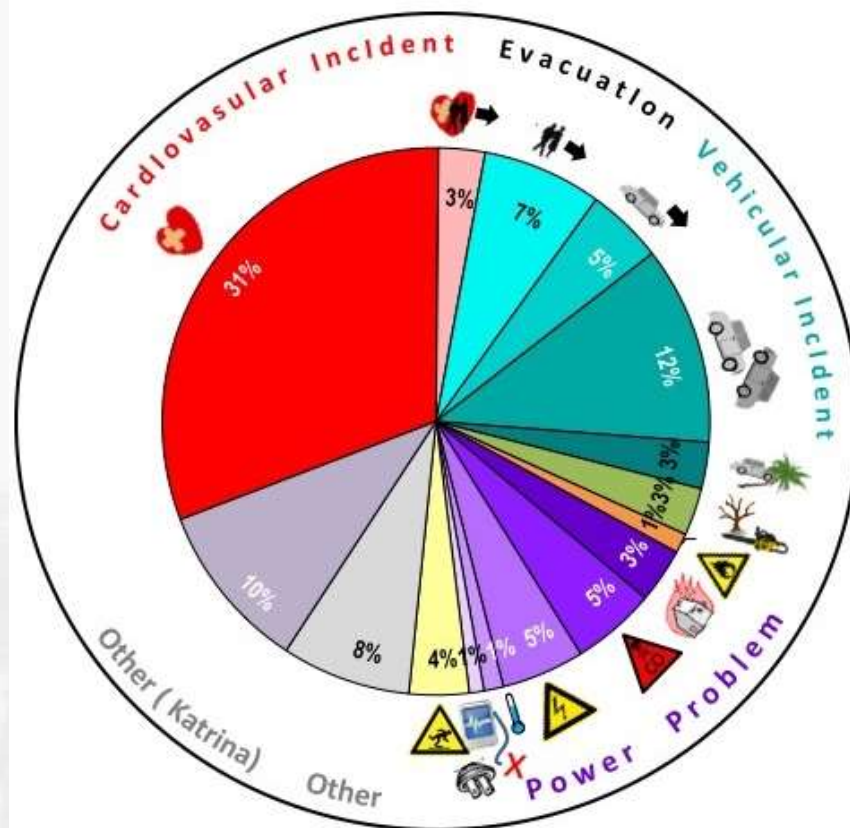


# Vulnerability of Caribbean Islands



Risk is highly modulated by structural, economic, and social vulnerabilities.

- Entire islands are exposed
- Large concentration of utility, public services (e.g., hospitals), and transportation routes in flood-prone areas
  - Lack of food, water, medicine, fuel
  - Cascading public health consequences



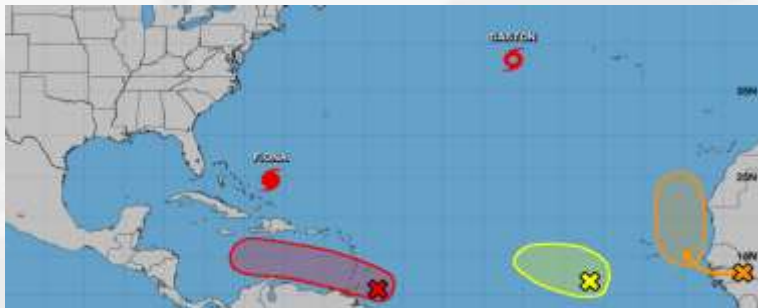


# From Deterministic to Probabilistic



## Improvements

- Track errors: 30–45% lower
- Intensity errors: 20–40% lower
- 3-day to 5-day forecasts
- Increased lead time (12 h) for hurricane watches/warnings
- Probabilistic hazard information and forecast framework



## wind



## storm surge





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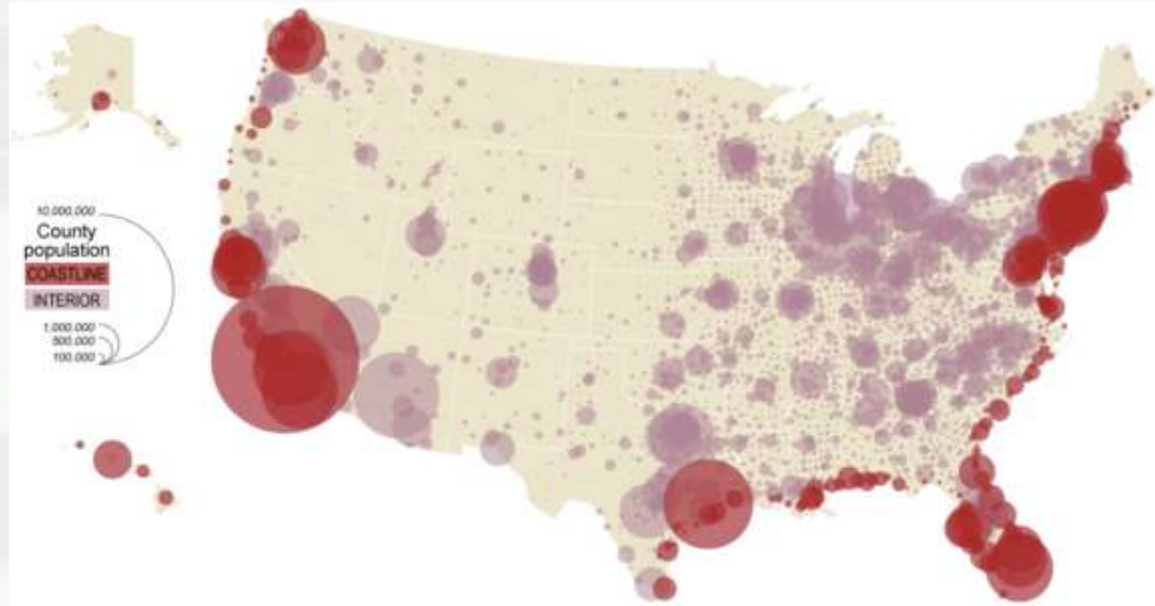
**Actual Risk  $\neq$  Perceived Risk**



# More People Along the Coast



- 40% increase in coastal population from 1970 to 2010 (34.8 million people)
- 40% of population (128 million people) live on the coast even though it is less than 10% of the land mass



Source: US Census





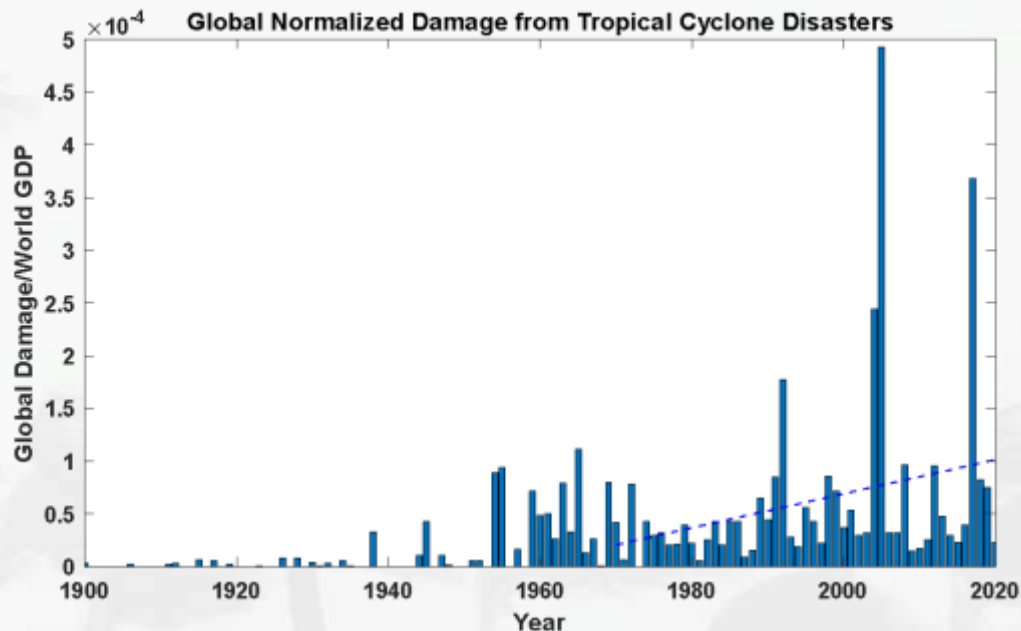
# More Infrastructure Along the Coast



**380% increase in damage from tropical cyclones since 1970**

**Population and infrastructure are dominant over hurricane changes in explaining the increase over the past century**

**High confidence that islands are already reporting losses and damages from hurricane changes**



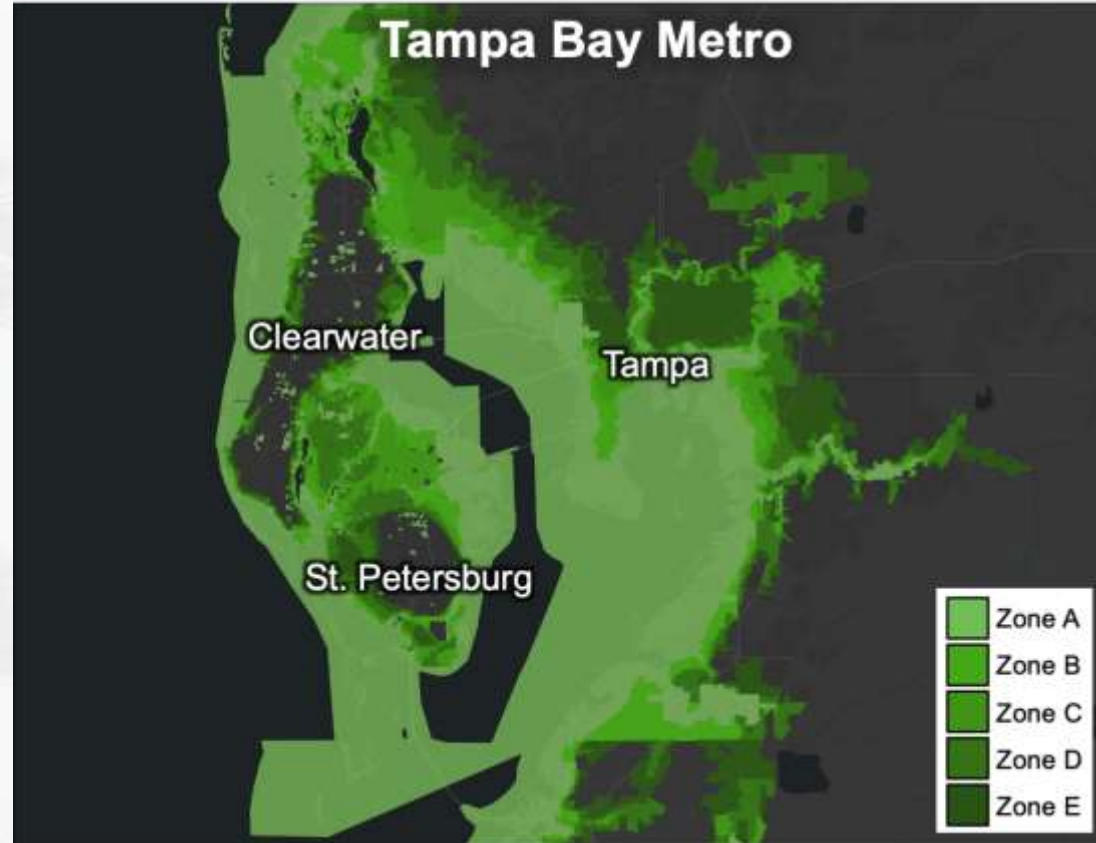
Graph Source: Kerry Emanuel  
Data Source: OFDA/CRED  
International Disaster Database



# Evacuation Decision Making



- Evacuation zones are typically constructed based on storm surge risk.

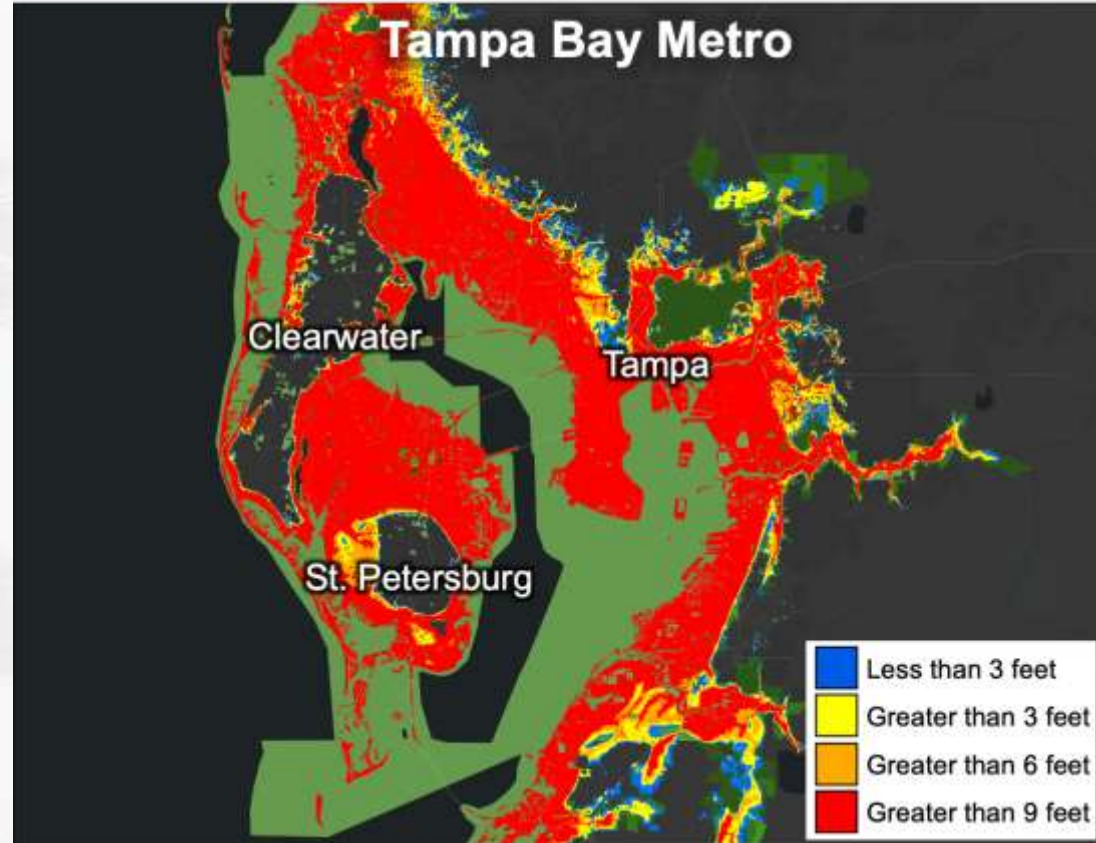




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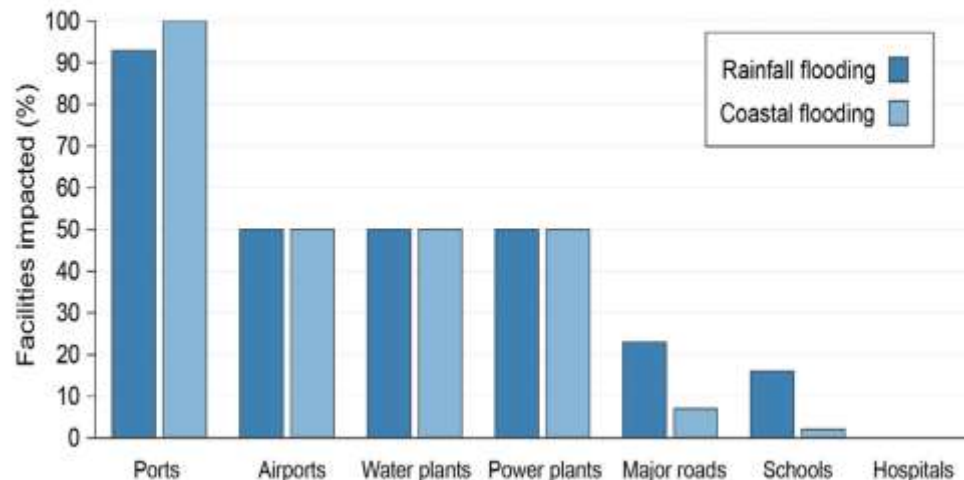
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Infrastructure at Risk of Flooding in the US Virgin Islands



Source: National Academy of Sciences





# Hurricane Vulnerability



- People with disabilities are up to 4x more likely to die in disasters (United Nations).
- For Hurricane Ian, more than 80% of storm surge victims were 60+ years old.

