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Saint Lucia coastal flooding assessment

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Project aim

Carry out studies to inform the improvement of resilience of

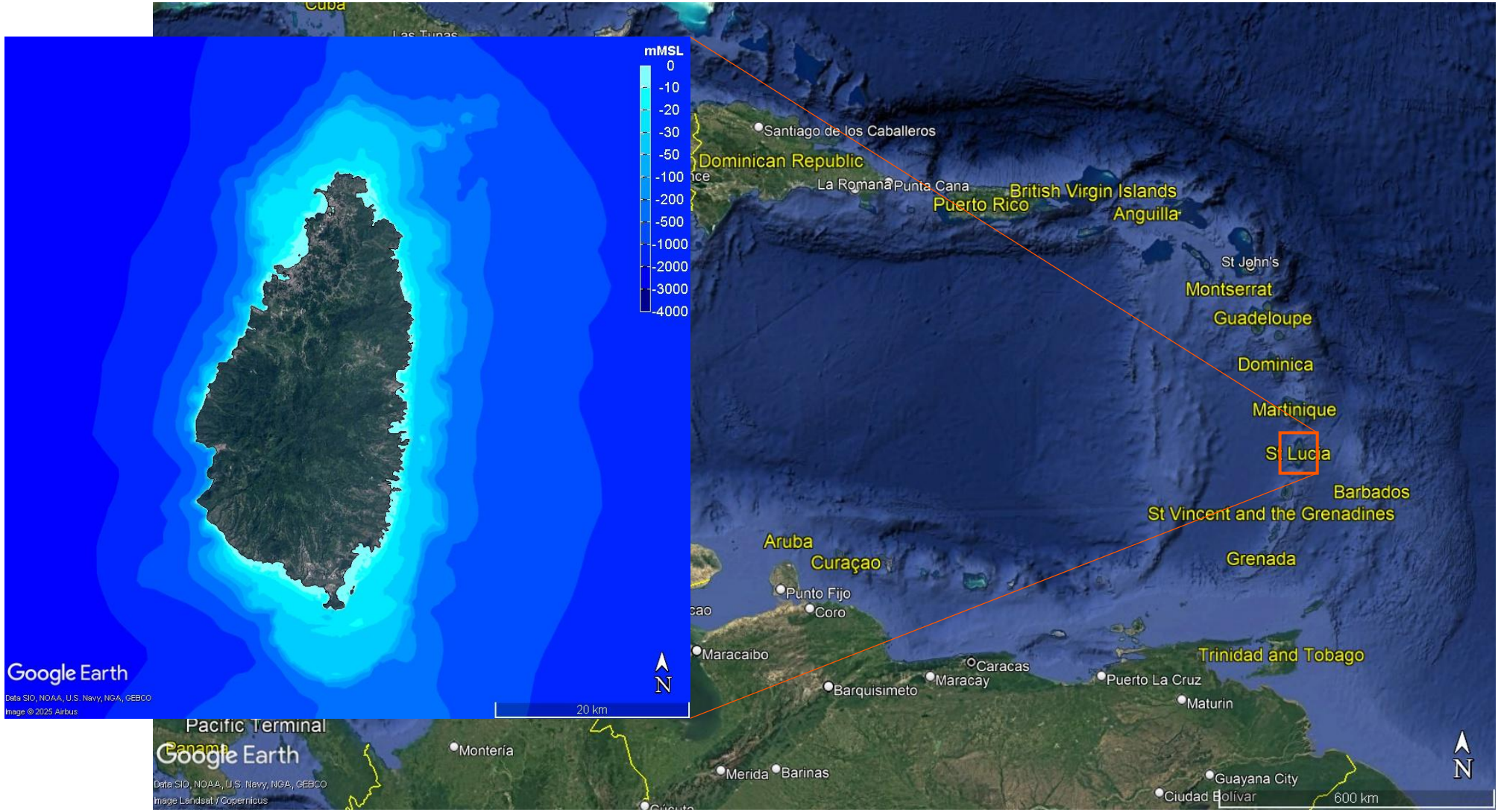
- coastal ecosystems,
- critical infrastructure and facilities,
- economic sectors, and
- coastal communities

to the combined effects of sea level rise and stronger hurricanes

→ Probabilistic assessment of coastal inundation from hurricane surge, wave set-up and wave run-up

- Present day
- 6 climate change scenarios to 2100

Saint Lucia


mMSL
0
-10
-20
-30
-50
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Google Earth
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Image © 2025 Airbus
20 km
N
Santiago de los Caballeros
Dominican Republic
La Romana
Punta Cana
Puerto Rico
British Virgin Islands
Anguilla
St John's
Montserrat
Guadeloupe
Dominica
Martinique
St Lucia
Barbados
St Vincent and the Grenadines
Grenada
Aruba
Curaçao
Punto Fijo
Coro
Maracaibo
Caracas
Maracay
Barquisimeto
Puerto La Cruz
Maturin
Trinidad and Tobago
Pacific Terminal
Panama
Montería
Merida
Barinas
Guayana City
Ciudad Bolívar
Google Earth
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Image Landsat / Copernicus
600 km
N

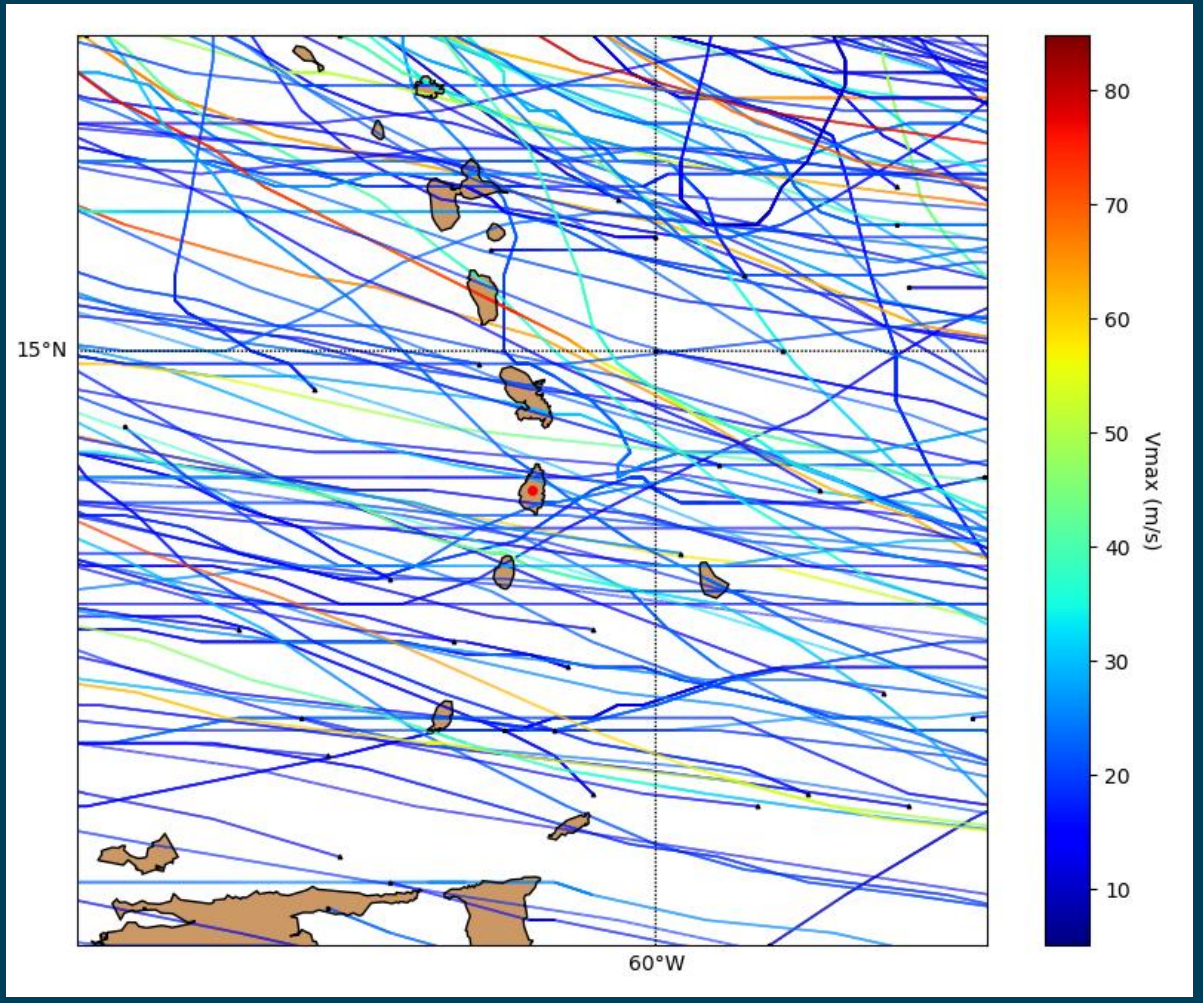
Hurricane climate

Saint Lucia is in an active hurricane zone

Hurricanes typically approach from the east/southeast

Occasional outlier

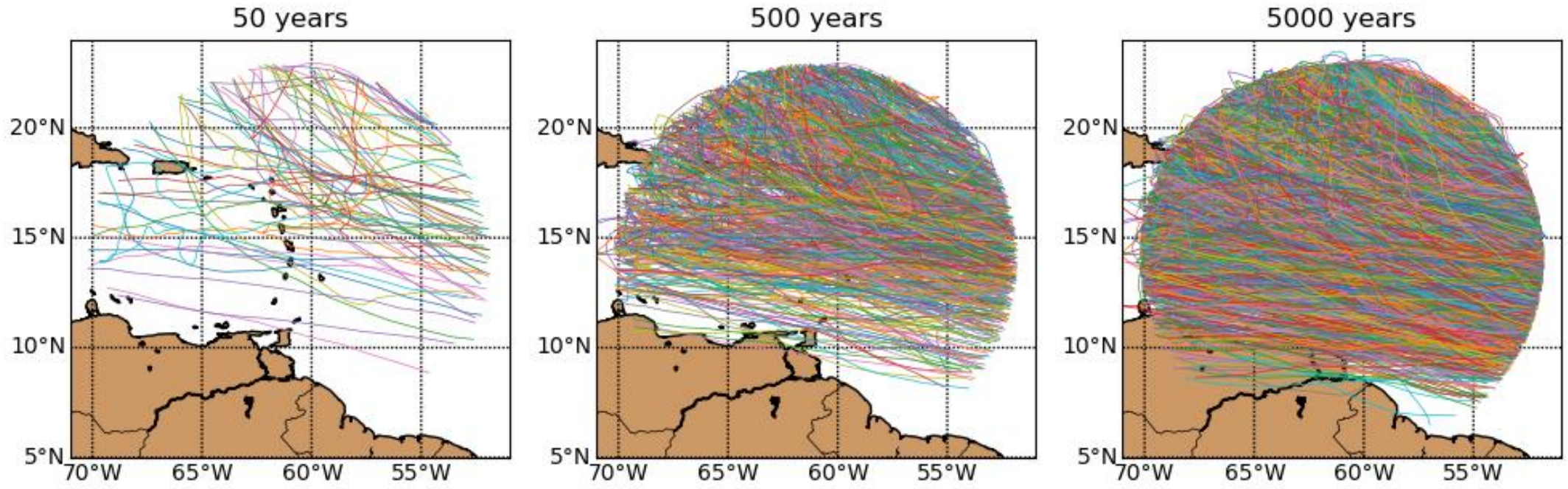
- E.g. Hurricane Lenny in 1999



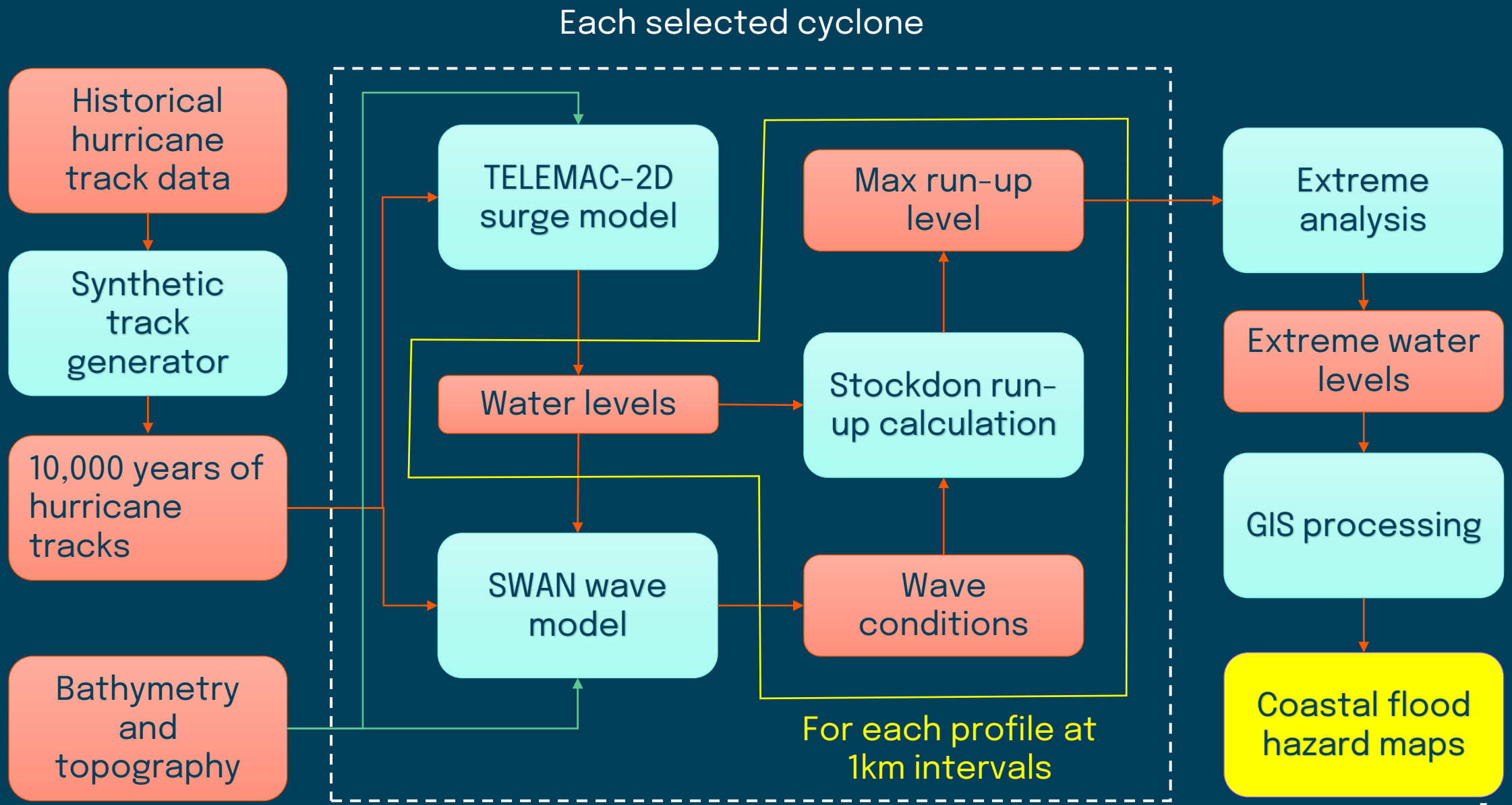
Souffriere, west coast

Aftermath of Hurricane Beryl, Souffriere, 2024

Generation of 10,000 years of hurricanes



Grey, S., Liu, Y. and Simmons, J., 2025. Hurricane surge and inundation in the Bahamas, part 2: Flood risk assessment. *Journal of Flood Risk Management*, *18*(1), p.e13022.


Each selected cyclone
Historical hurricane track data
Synthetic track generator
10,000 years of hurricane tracks
Bathymetry and topography
TELEMAC-2D surge model
Water levels
SWAN wave model
Max run-up level
Stockdon run-up calculation
Wave conditions
For each profile at 1km intervals
Extreme analysis
Extreme water levels
GIS processing
Coastal flood hazard maps
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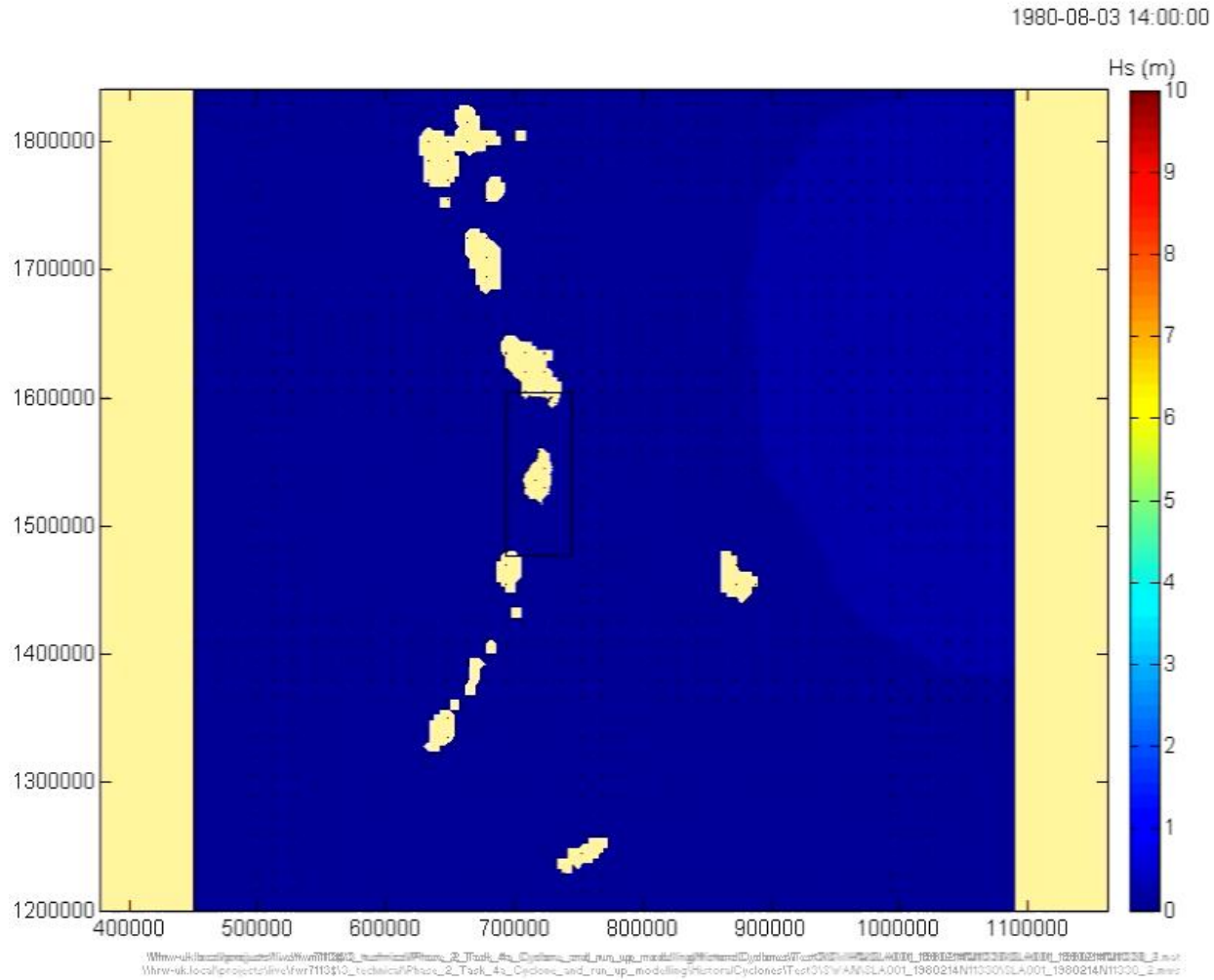
Hurricane Allen 1980 Wave model



National assessment

Full coastline covered

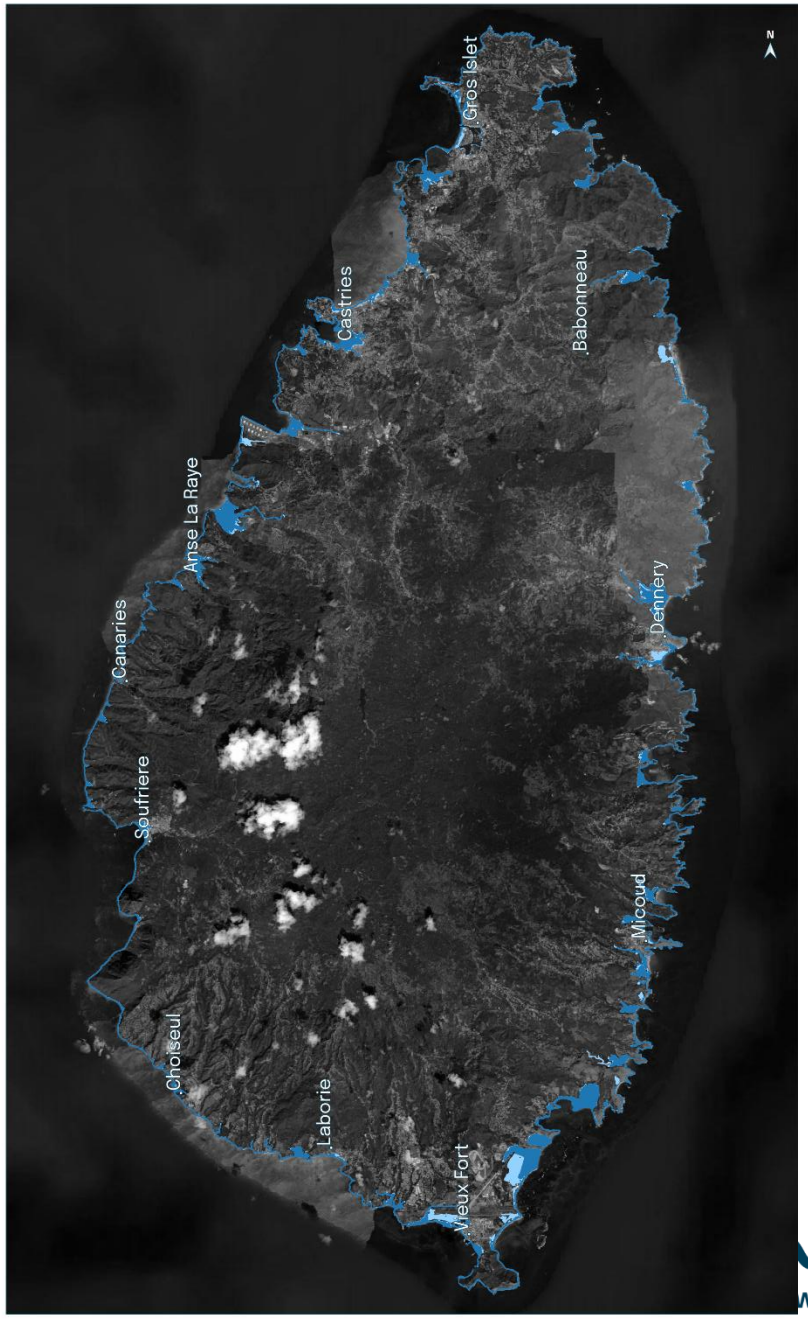
Surge is relatively small (<1.0m)

Primary cause of flooding is wave run-up

- Simplistic approach
- Beach slope based on LiDAR topography
- No allowance for shore defences

First indication of where is most vulnerable

Recommend more detailed studies where mitigation is to be implemented



Castries flood hazard

Present day

2100 SSP2-4.5 83% quantile

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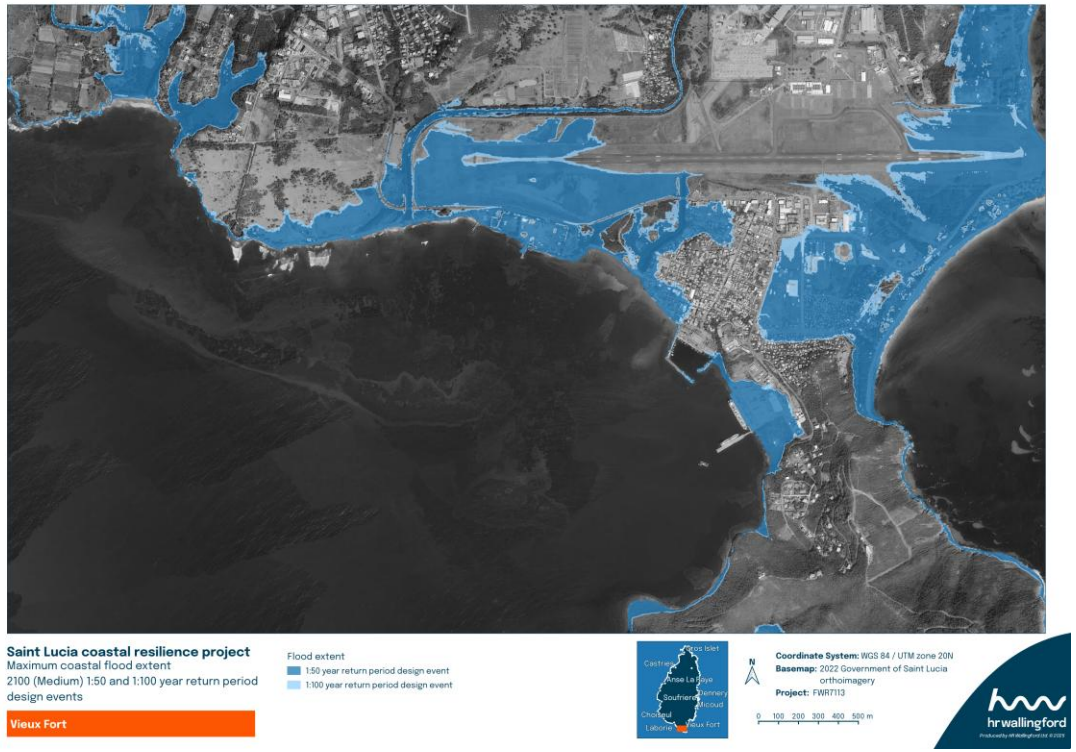
Vieux Fort

Present day

2100 SSP2-4.5 83% quantile



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Conclusions

Saint Lucia coastal flood risk study

- Probabilistic hurricane coastal flood hazard assessment
- Predicted extreme wave and water level conditions around the coast of Saint Lucia
  - Suitable for further modelling and design of coastal structures
- Produced indicative maps of coastal flooding
  - Present day
  - 6 climate change scenarios for 2050 and 2100
- Provides the Government of Saint Lucia with a decision support system to help plan for climate change and build resilience

Challenges and sources of uncertainty

Modelling challenges

- ~~Lack of good quality bathymetry and topography~~
- Limited calibration data
  - Water level data
  - No wave data
- Hurricane wind fields, generation of waves and effects of islands
- Are outlier hurricane tracks – e.g. ‘wrong way‘ Lenny – represented in climate?
- Simplistic run-up calculation

Challenges for Saint Lucia

- Risk of hurricane flooding increasing with climate change
- East coast is most exposed to Atlantic hurricanes but lower population
- West coast
  - low-lying areas with buildings and infrastructure close to shore
  - Events less severe than east coast but greater vulnerability
  - Lower certainty

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