The Delta Works of the future

De deltawerken van de toekomst

Prof.dr.ir. Bas Jonkman
TU Delft, waterbouwkunde

1824

DER
VEREENIGDE NEDERLANDEN,
Vervaardigd naar de Nieuwste Waarnemingen
en verrijkt met alle Post en andere
Groote Wegen en de afstanden der
onderscheidene Poststations.
TE AMSTERDAM BY
MORTIER, COVENS EN ZOON.
MDCCCXXI.
NOORD
ZEE
ZUIDER
ZEE
VLIELAND
TEXEL
DRENTHE
OVERIJSSEL
GELDERLAND
NOORD
HOLLAND
ZUID
HOLLAND
UTRECHT
ZEELAND
NOORD
BRABANT
ZUID
BEVELAND
TOLE
VLAANDEREN
ZUID
BEVELAND

Overijsselse Vecht

Deventer

Photo: NU.nl

Maastricht

Photo: ANP

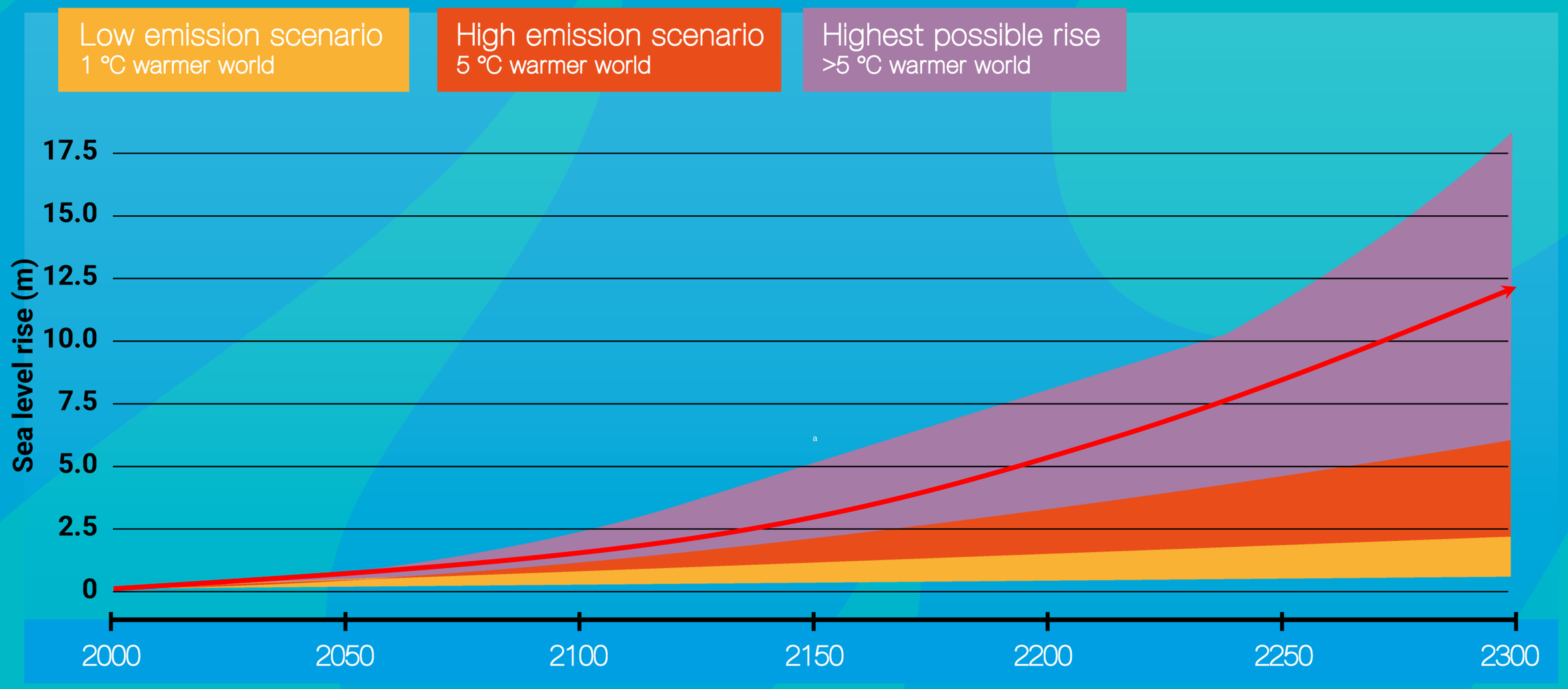
Volendam

Photo: NH Media

Pompen in aanbouw Kornwerderzand
(Rijkswaterstaat)

- Samenvallen hoogwaters
- Falen stuw Maastricht
- Ijsselmeer / Markermeer -> meer sturingsmogelijkheden?
- Veel claims en discussie: Ruimte voor de rivier, buitendijks bouwen

Sea level rise - the Netherlands

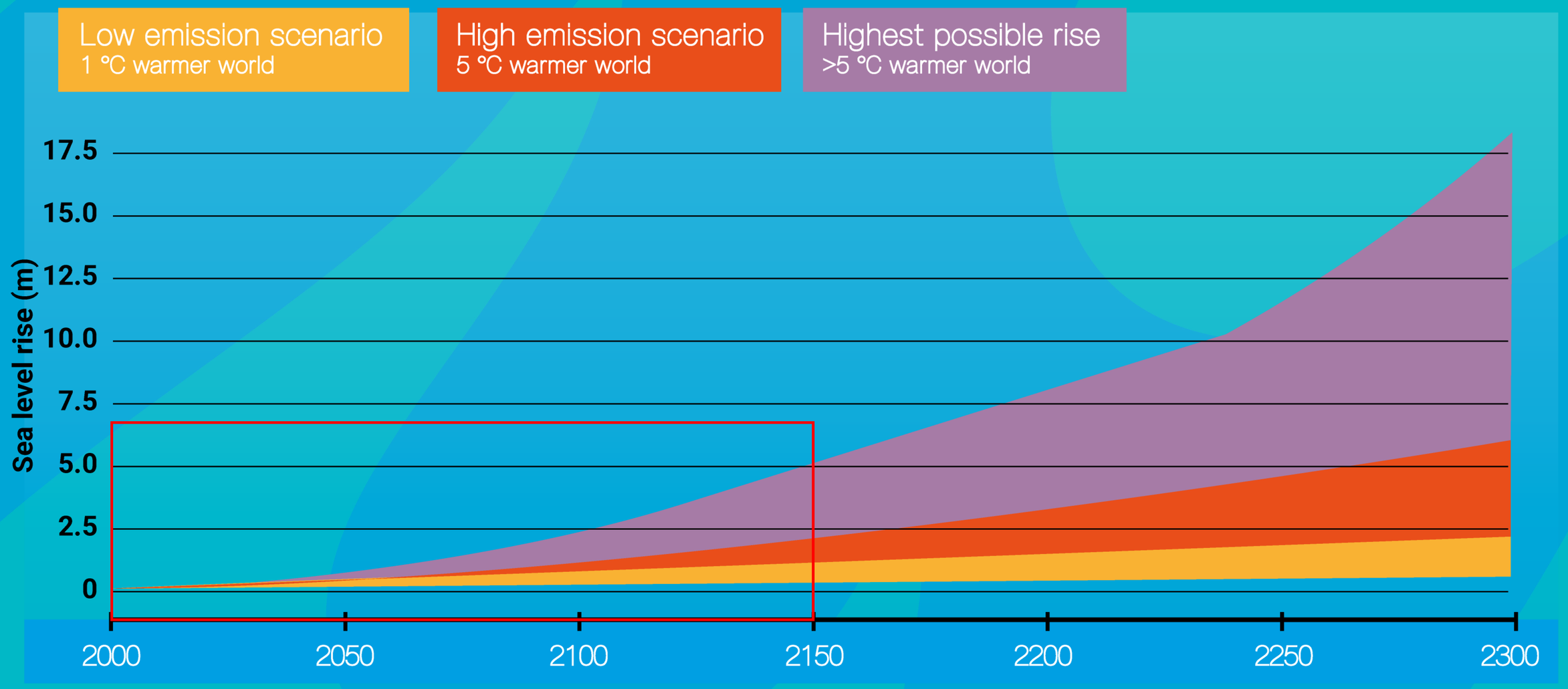


Source: KNMI

Photo: Marten van Dijl

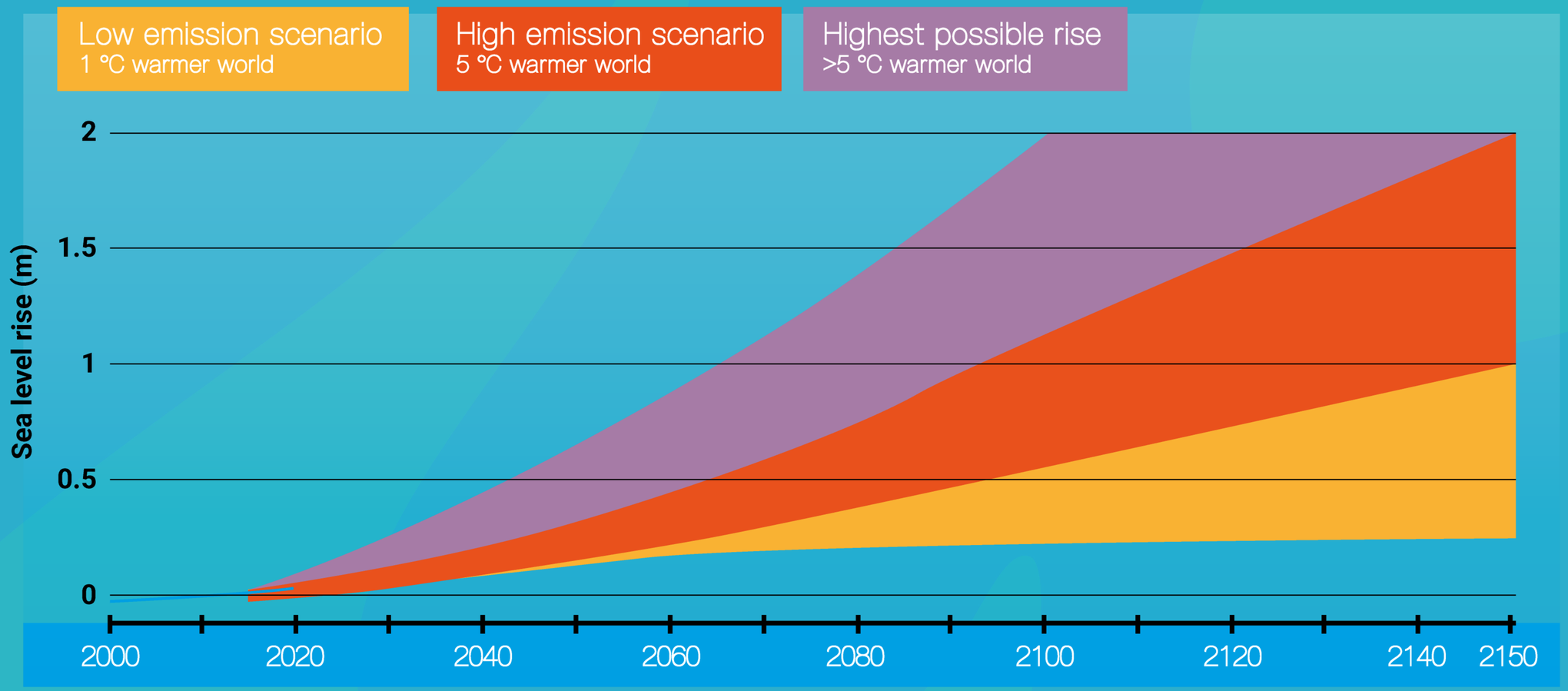
PLAN B: NL2200

Sea level rise - the Netherlands



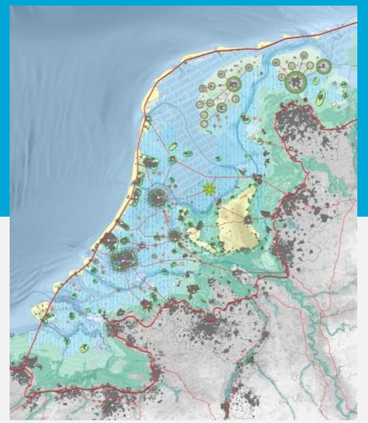
Source: KNMI

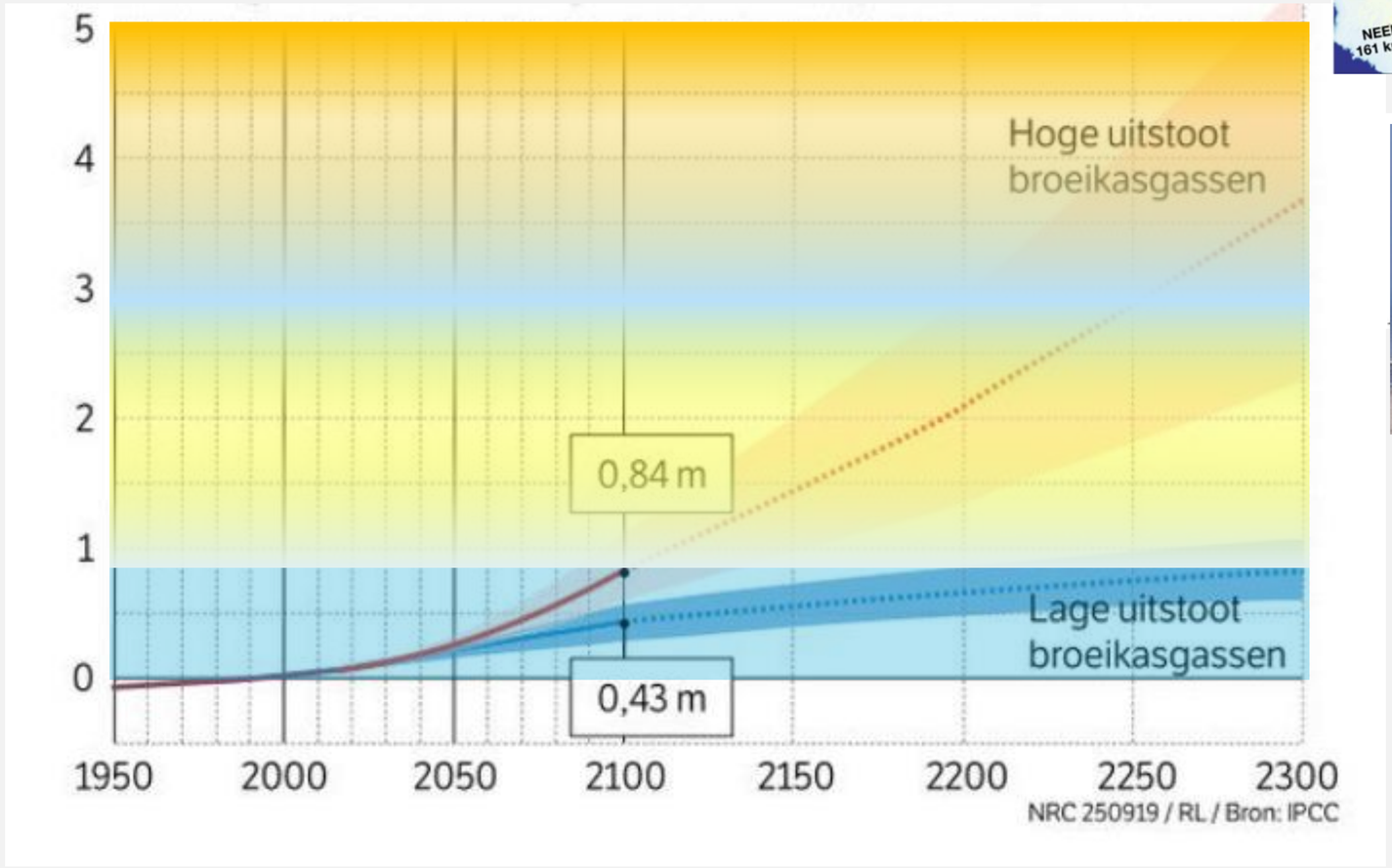
Sea level rise the Netherlands



Source: KNMI

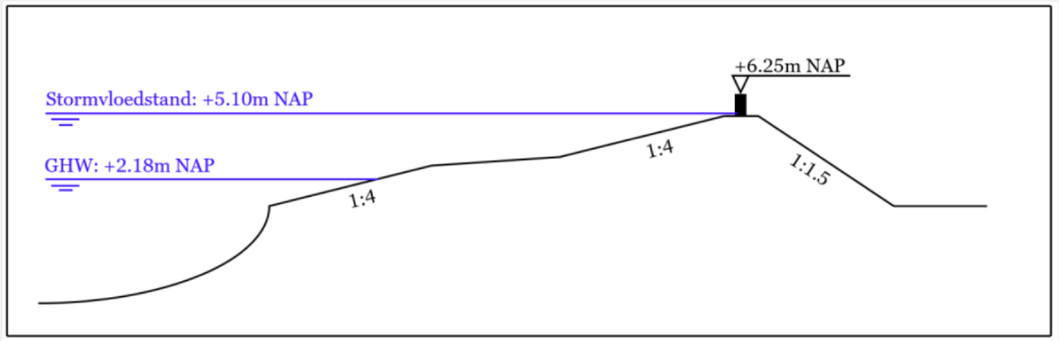
National level adaptation



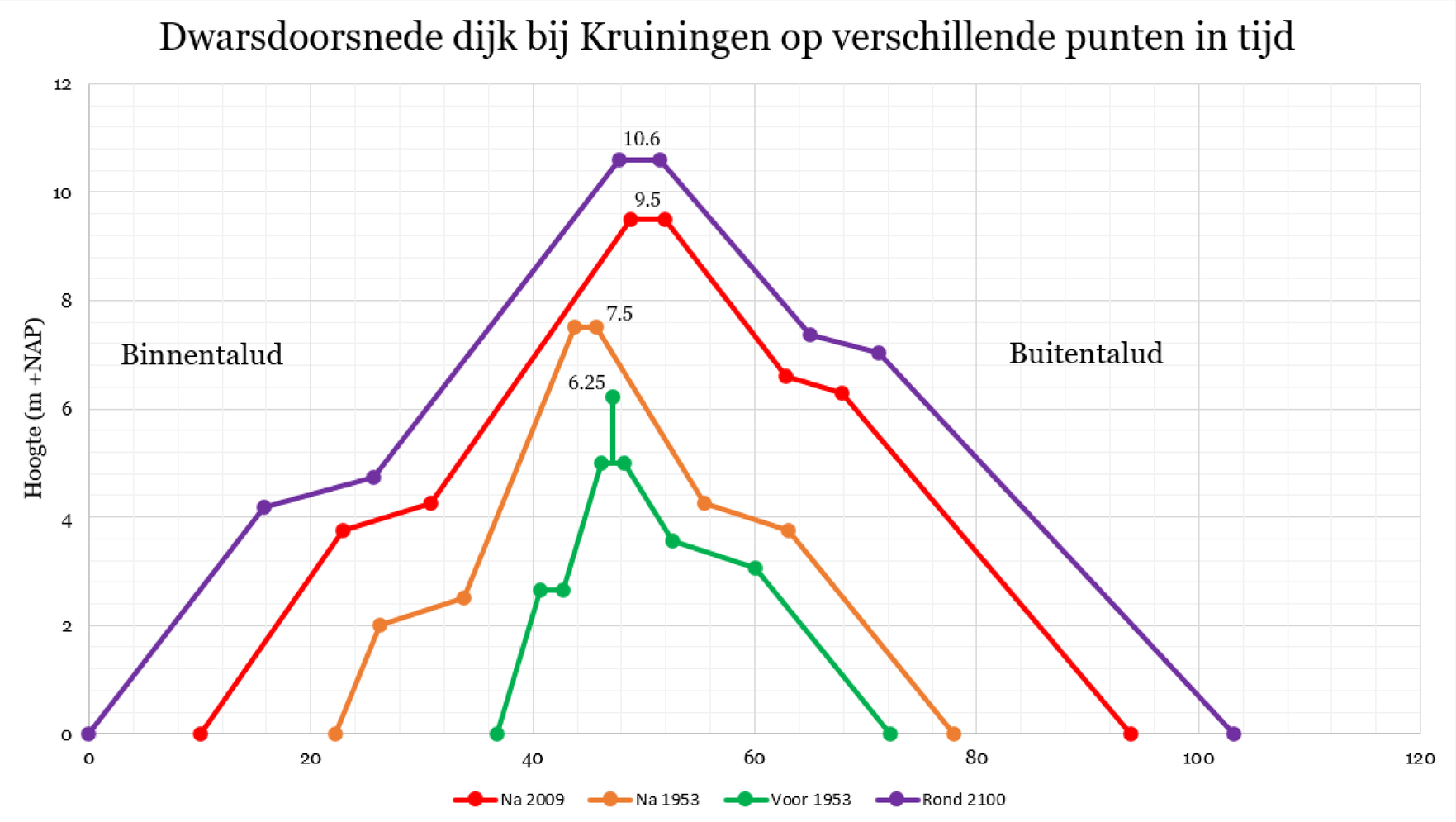


ENW, 2019

Coastal defence Kruiningen: adaptation since 1953

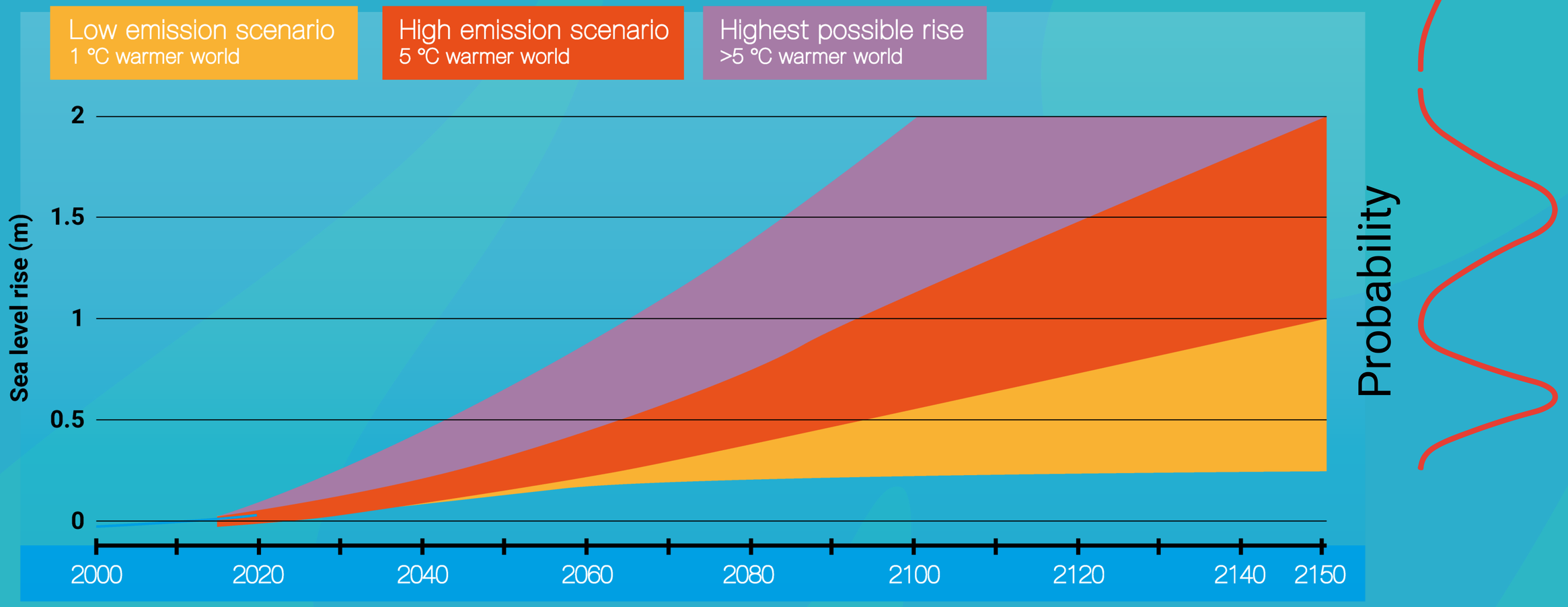


Adaptation since 1953 (2)



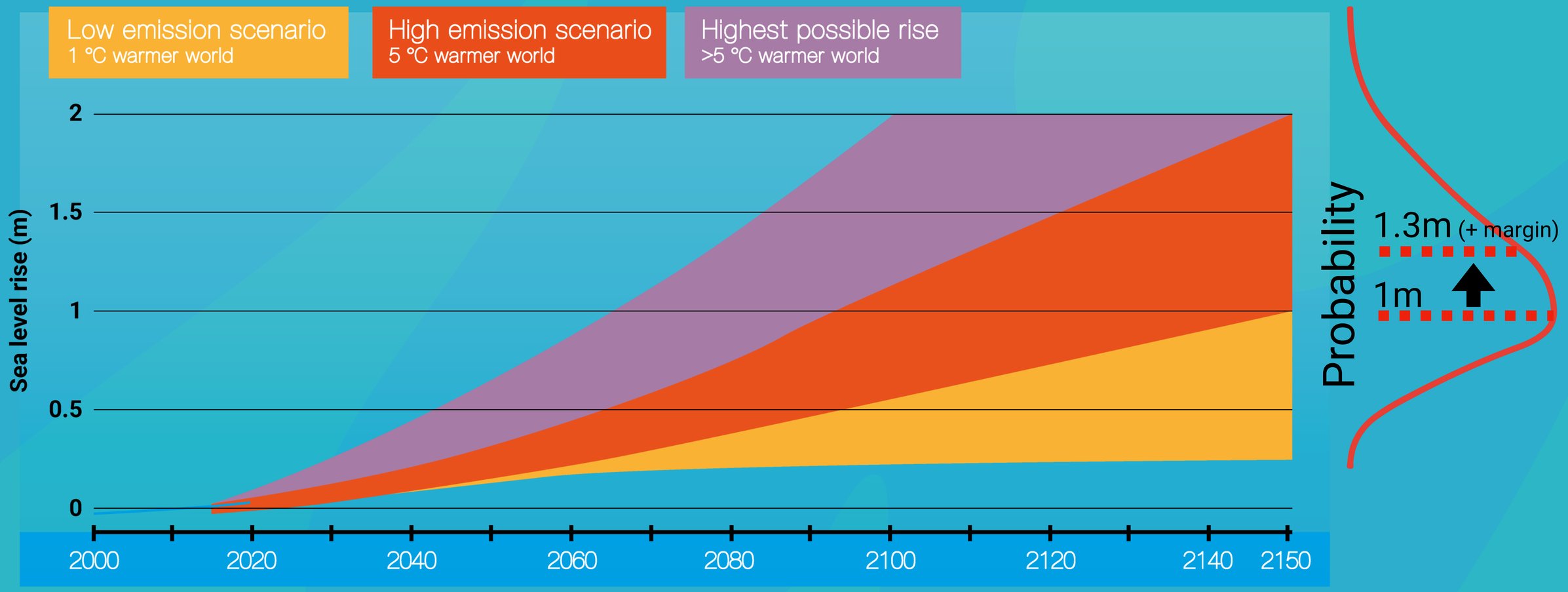
B. Langeveld TUD

Sea level rise - the Netherlands



Source: KNMI

Sea level rise - the Netherlands



Source: KNMI

Rotterdam

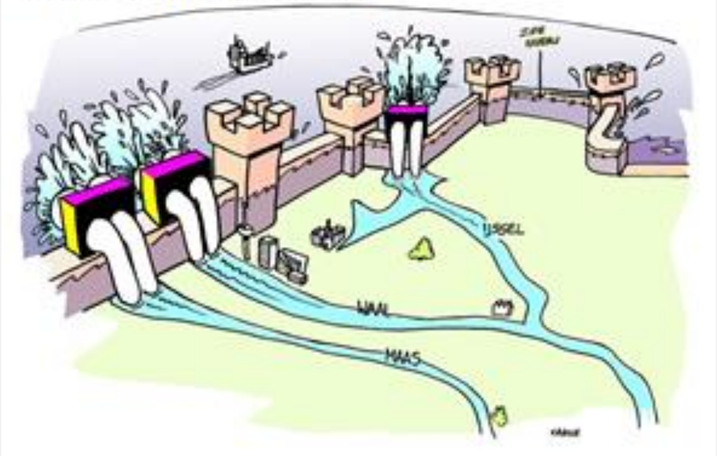
Photo: Jurjen van de Most, Rijkswaterstaat

EngD research Luc Ponsioen, TU Delft, Aveco de Bondt, Rijkswaterstaat

Rotterdam

From cartoons to regional strategies

Protection (closed)



Protection (open)

?

Seaward expansion

Accommodate

source: Deltares

Open and protected

Ties Rijcken, TU Delft, HKV & Royal Haskoning DHV

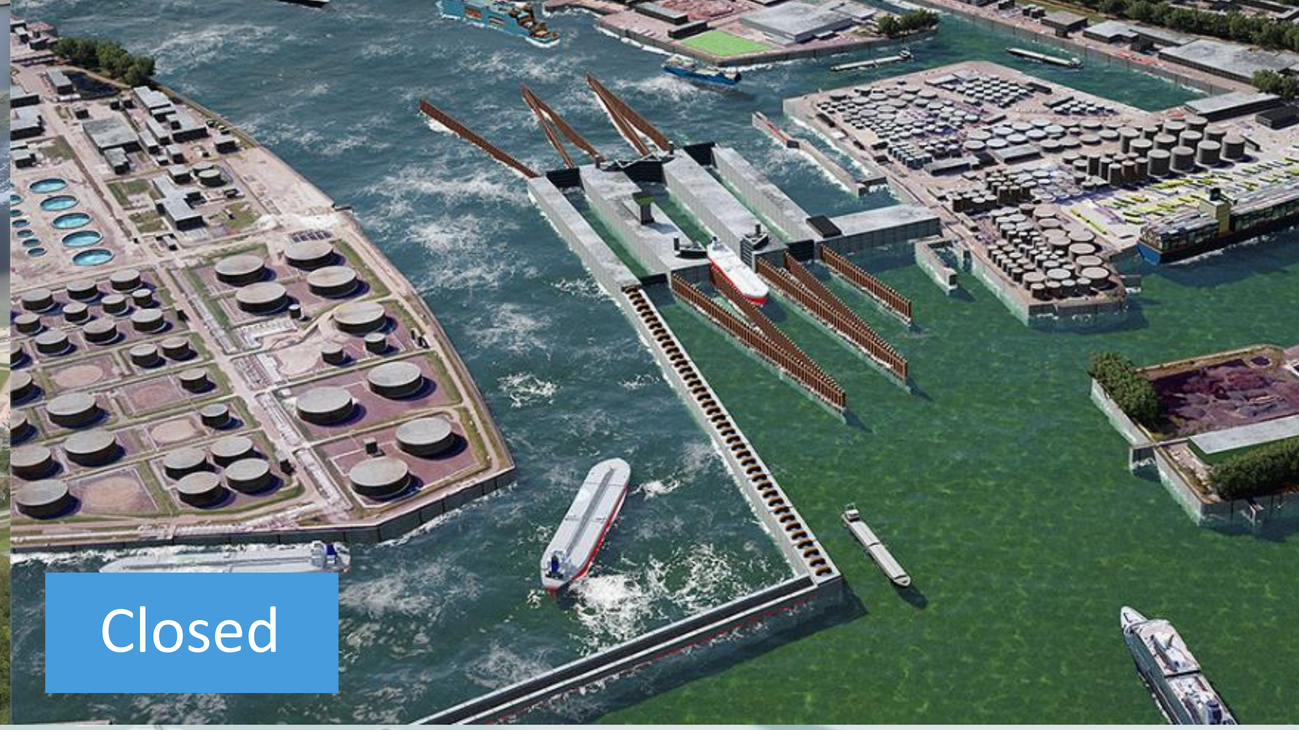
Ties Rijcken, TU Delft, HKV & Royal Haskoning DHV

Closed
Vizualism, Frédérik Ruys

Open and natural

ARK, WWF, Meyer et al.

Open and protected

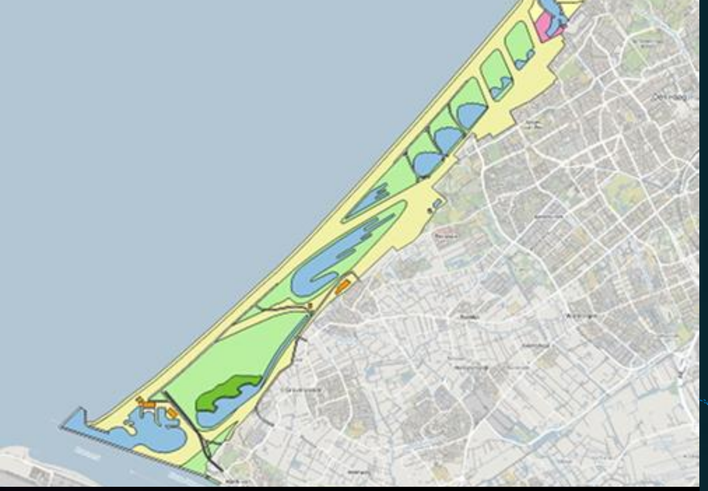

Closed

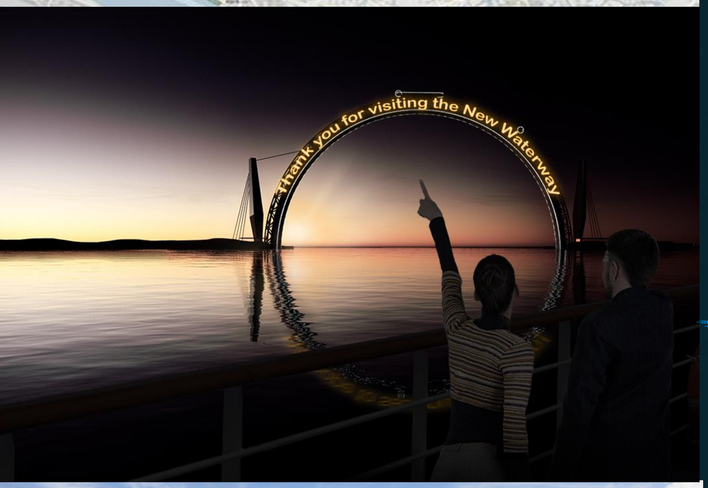
Open and natural

Defacto
urbanism

TRENDY

Samen Sterk, een concept van
TU Delft, HKV lijn in water en
Royal Haskoning DHV



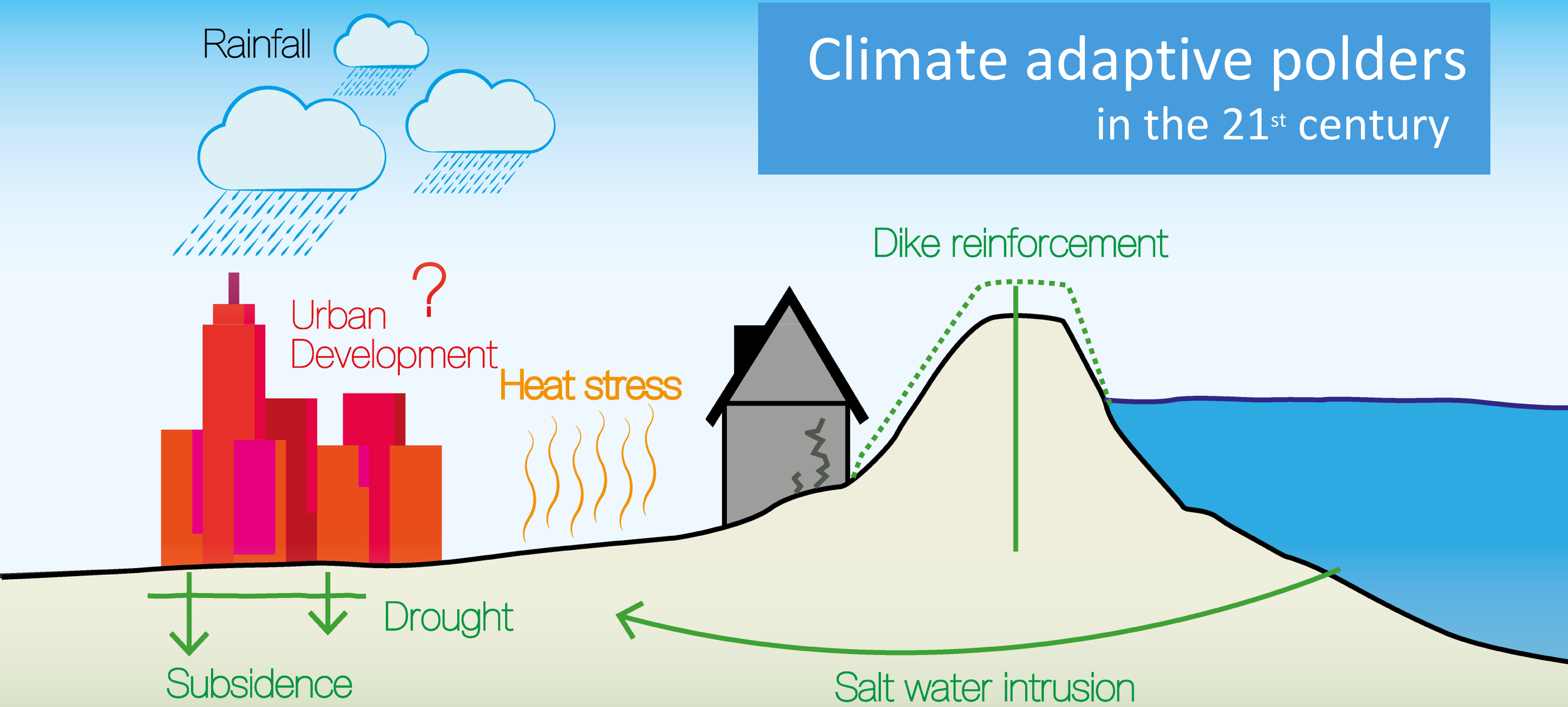


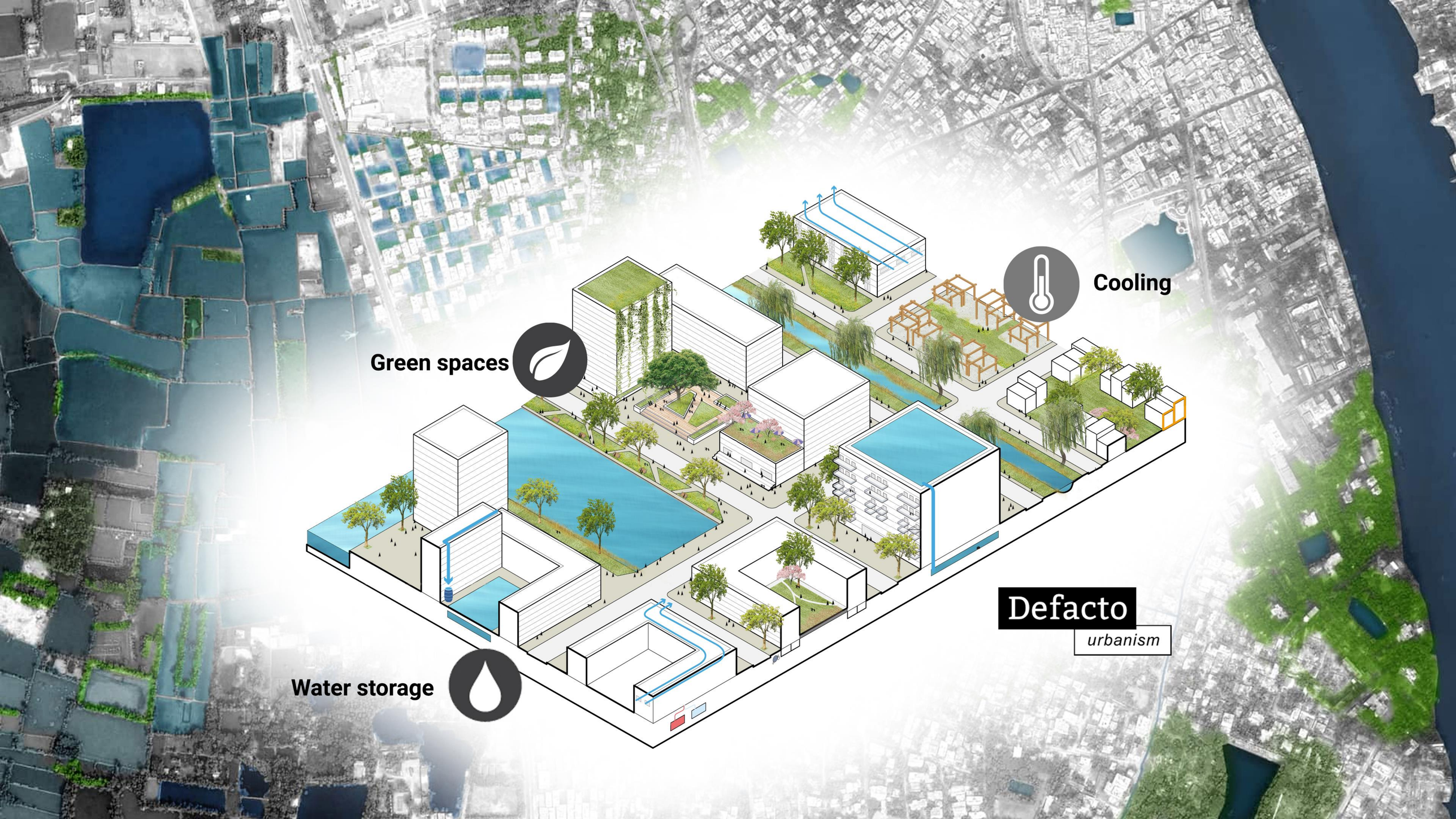
Samen Sterk - een concept van TU Delft, HKV lijn in water en Royal Haskoning DHV

Decision and construction time?

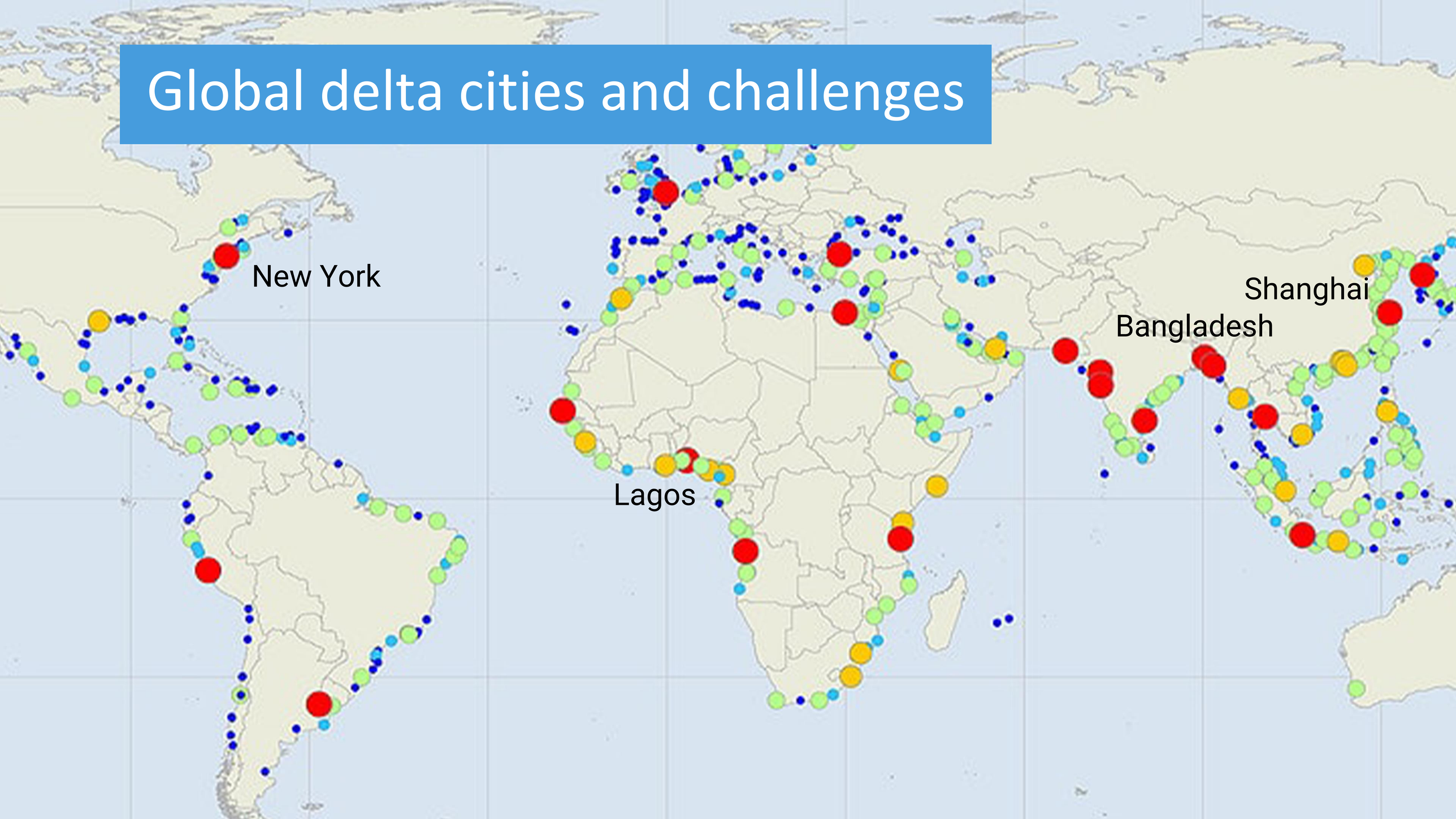
	Delta plan	New Orleans	Future delta plan?
Period	1953 – 1997	2005 – 2012	….
Duration (years)	35 - 45	7	…..
System investment	12 B€	14 B$	10’s to 100’s B€?

Climate adaptive polders
in the 21st century




Cooling
Green spaces
Water storage
Defacto
urbanism

Global delta cities and challenges



Lagos

Shanghai

New York

Bangladesh

Adaptation and flood risk reduction

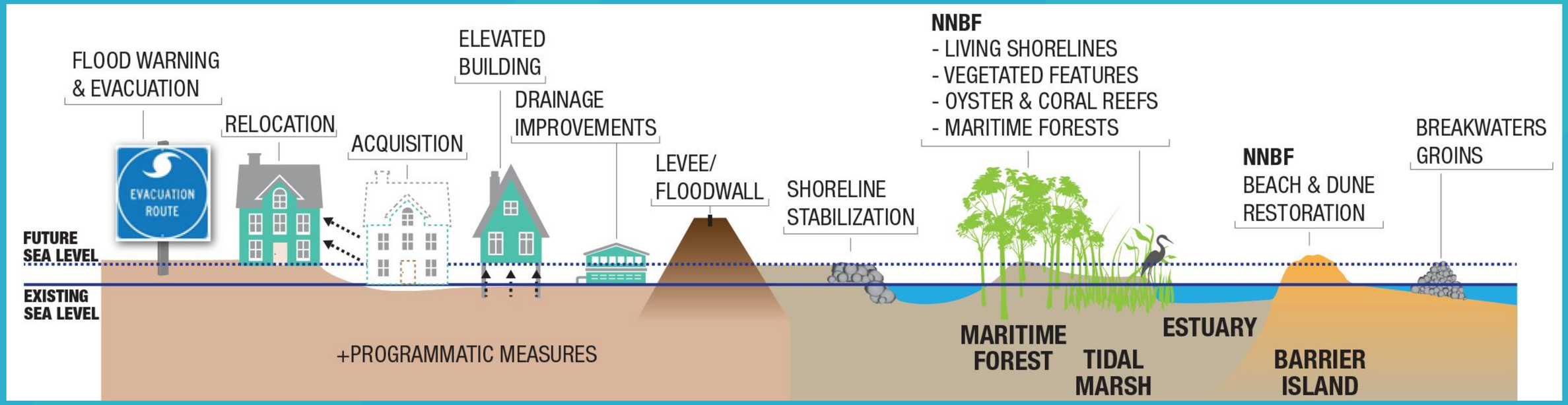
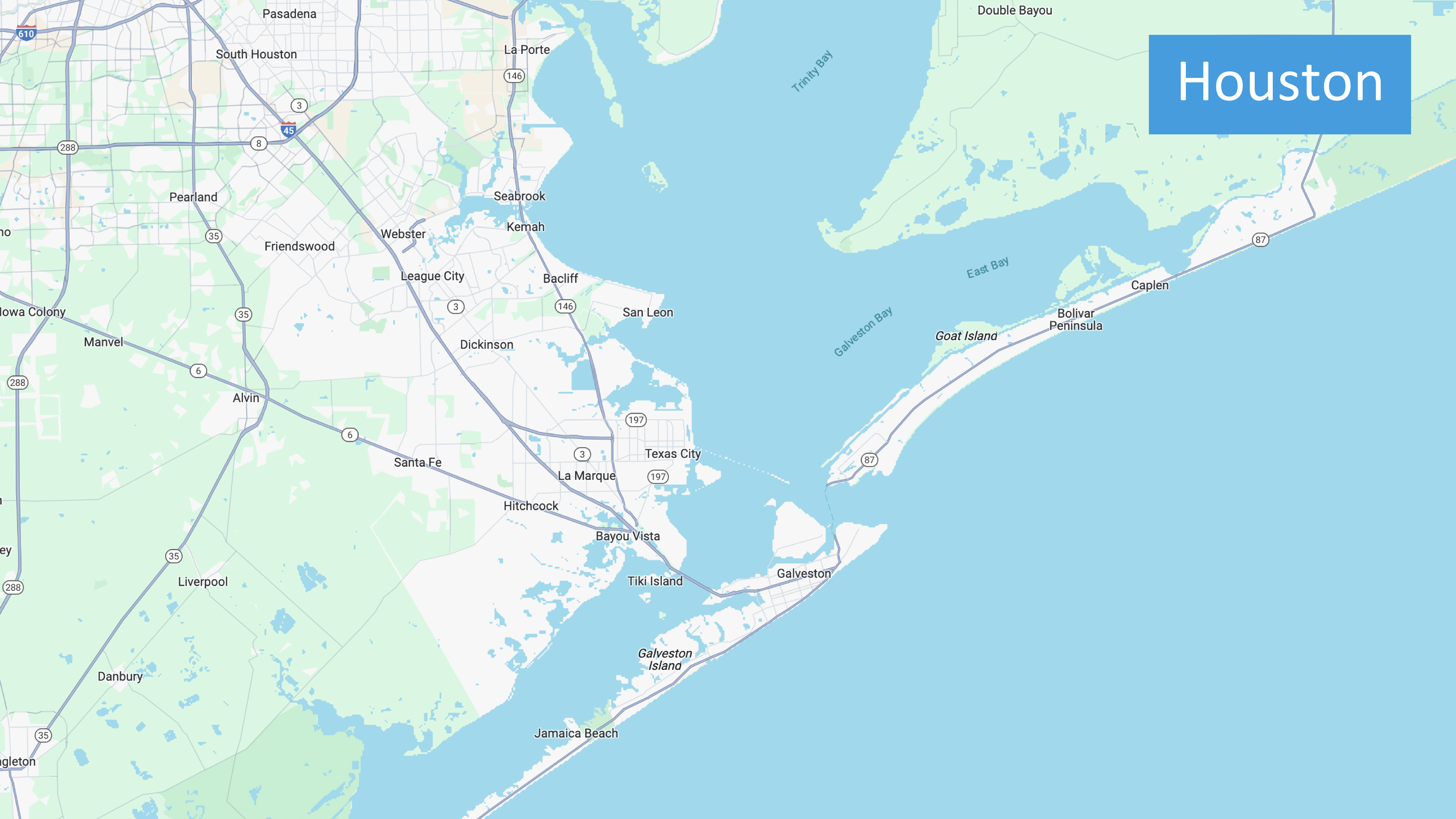


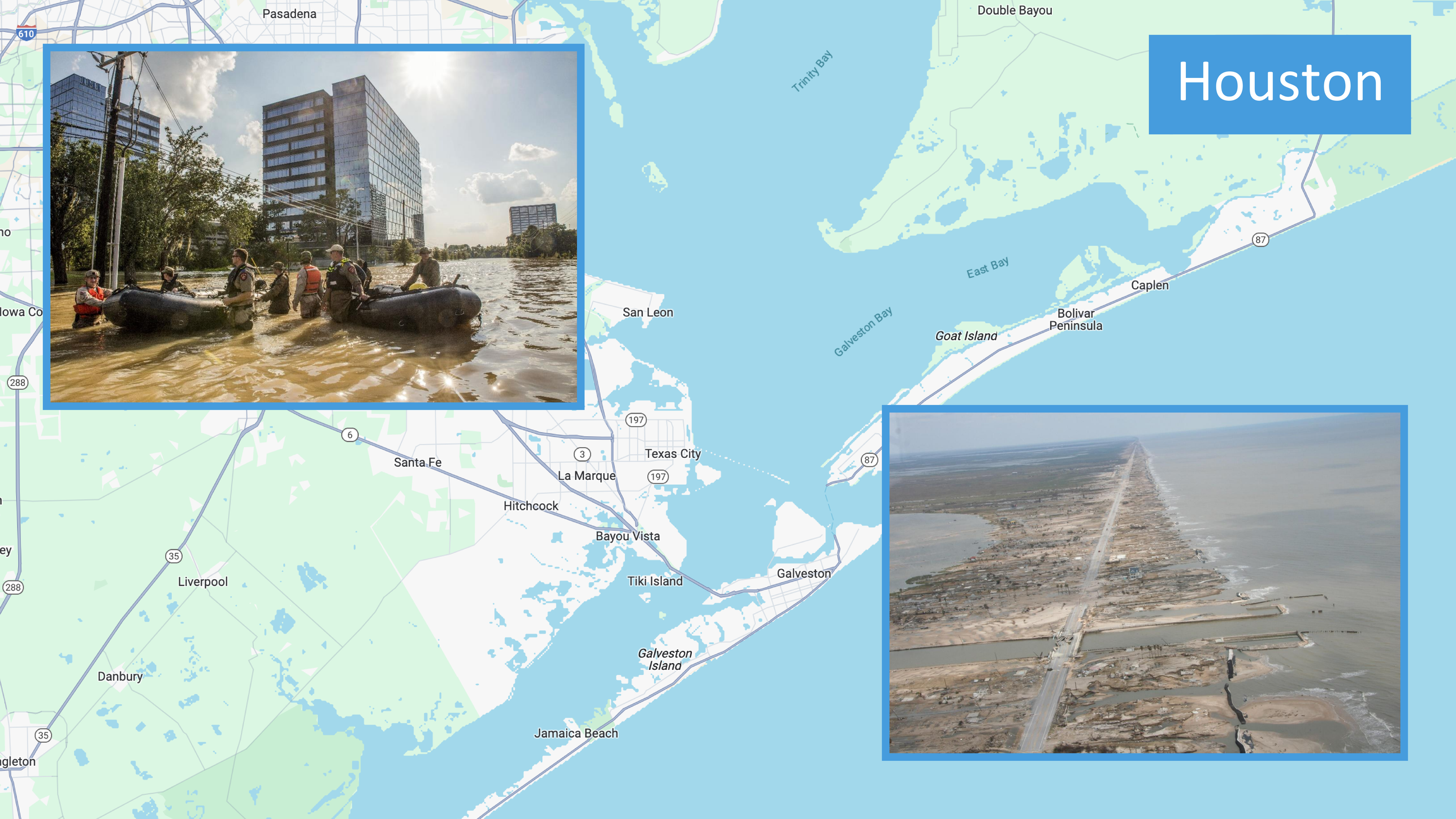
Image: USACE North Atlantic Coast Comprehensive Study

Houston


Pasadena
South Houston
La Porte
Double Bayou
Trinity Bay
Pearland
Seabrook
Kemah
Webster
Friendswood
League City
Bacliff
San Leon
Dickinson
Manvel
Alvin
Santa Fe
Texas City
La Marque
Hitchcock
Bayou Vista
Tiki Island
Galveston
Galveston Island
Jamaica Beach
Liverpool
Danbury
East Bay
Galveston Bay
Goat Island
Bolivar Peninsula
Caplen

610
South
288
Pearland
35
Iowa Colony
Manvel
6
288
35
Liverpool
288
Danbury
35
N
ton

Houston


Pasadena
610
Double Bayou
Trinity Bay
East Bay
Galveston Bay
Caplen
Bolivar Peninsula
Goat Island
87
San Leon
288
197
6
3
Texas City
Santa Fe
La Marque
Hitchcock
Bayou Vista
35
Liverpool
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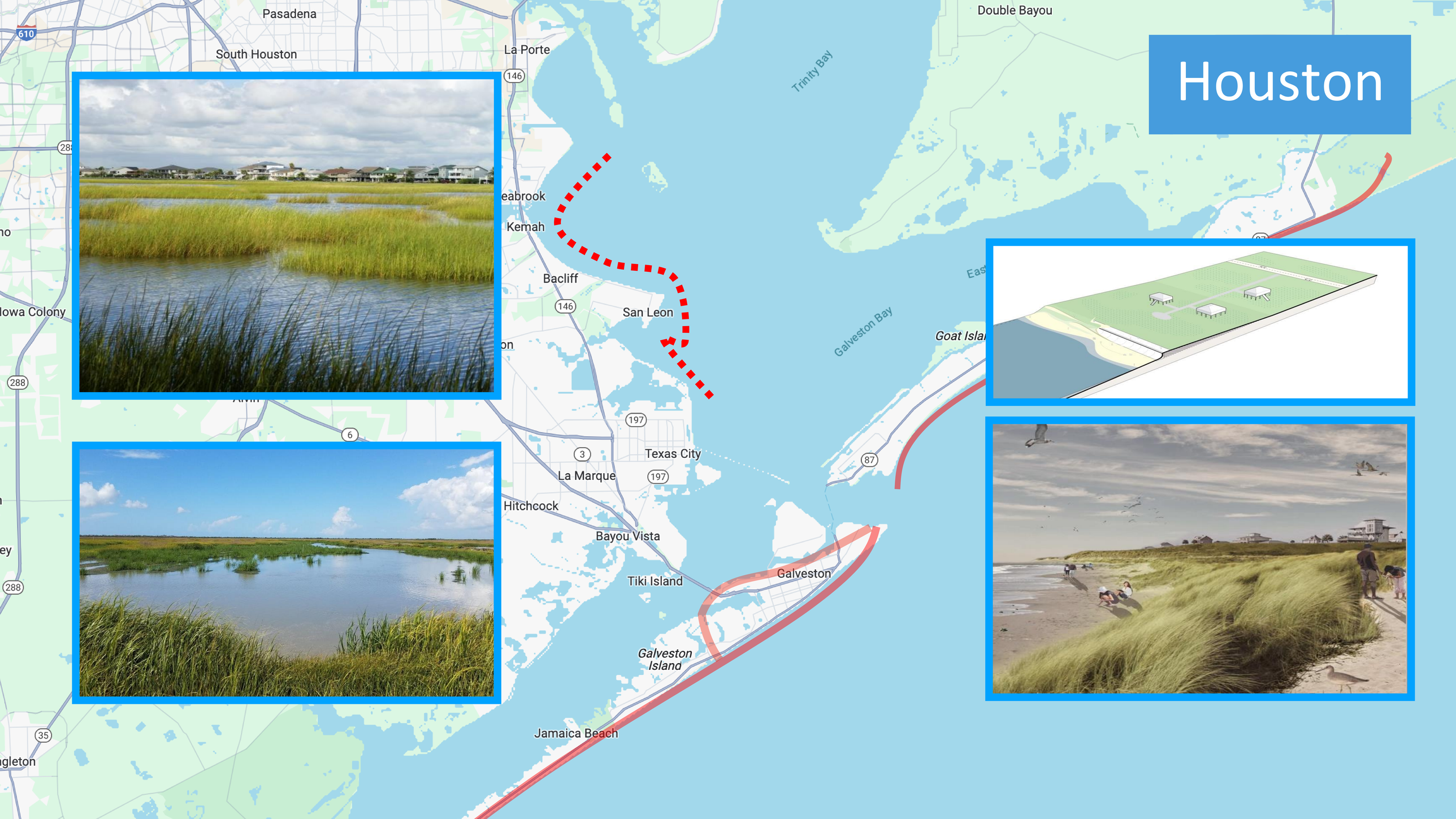
Galveston
Galveston Island
Danbury
Jamaica Beach

Houston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Jamaica Beach
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146
288
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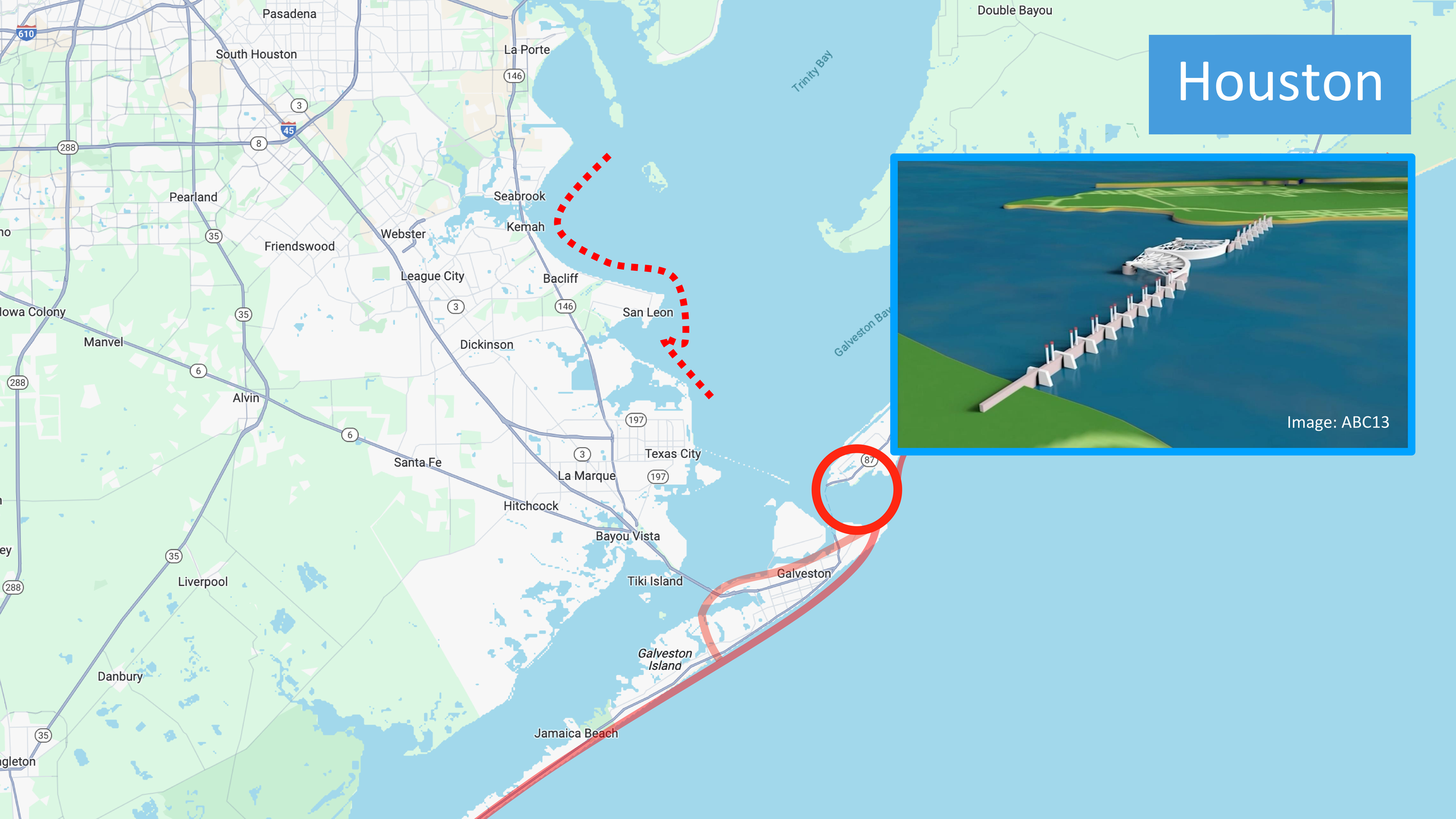
87
35

Houston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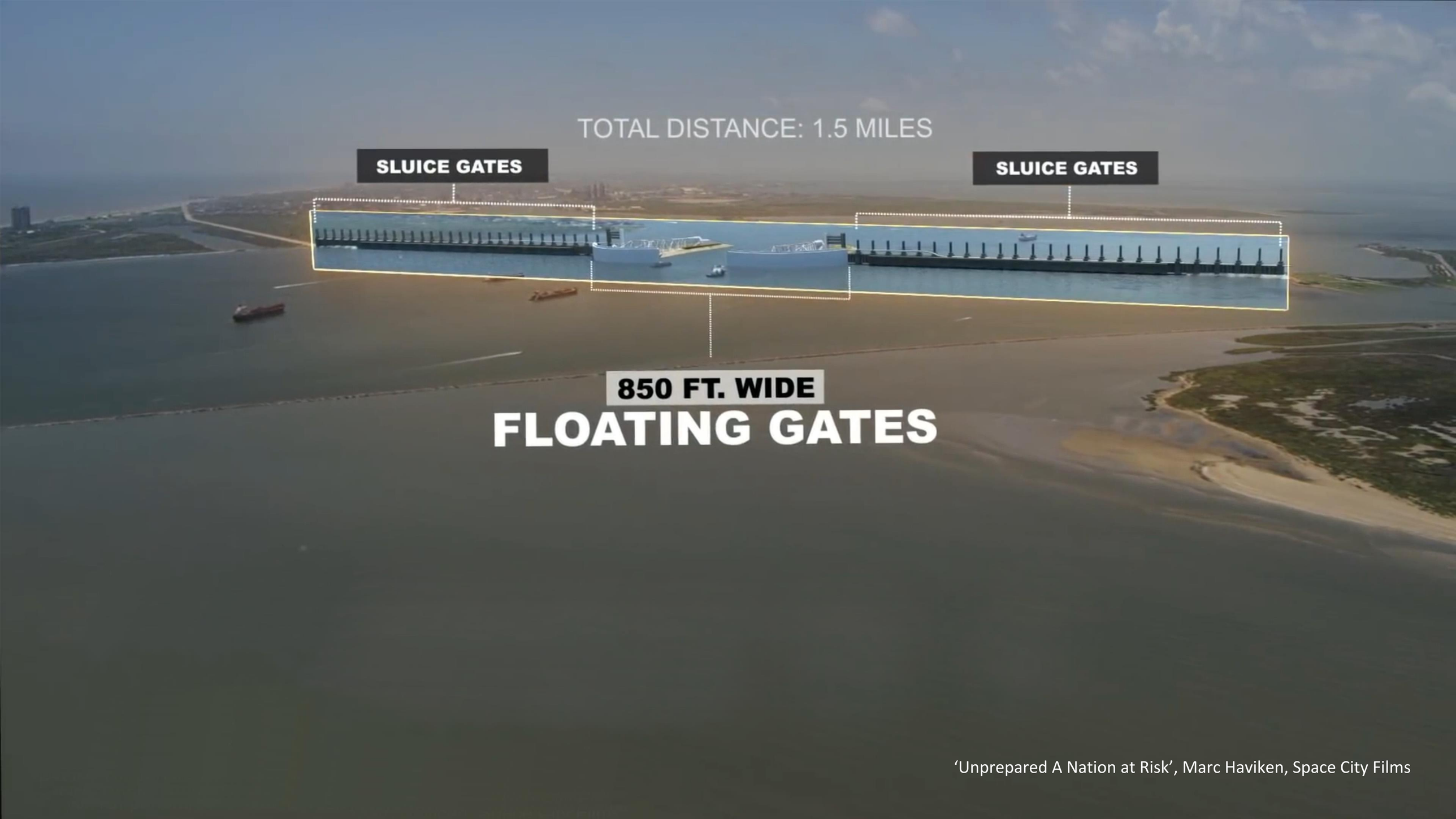
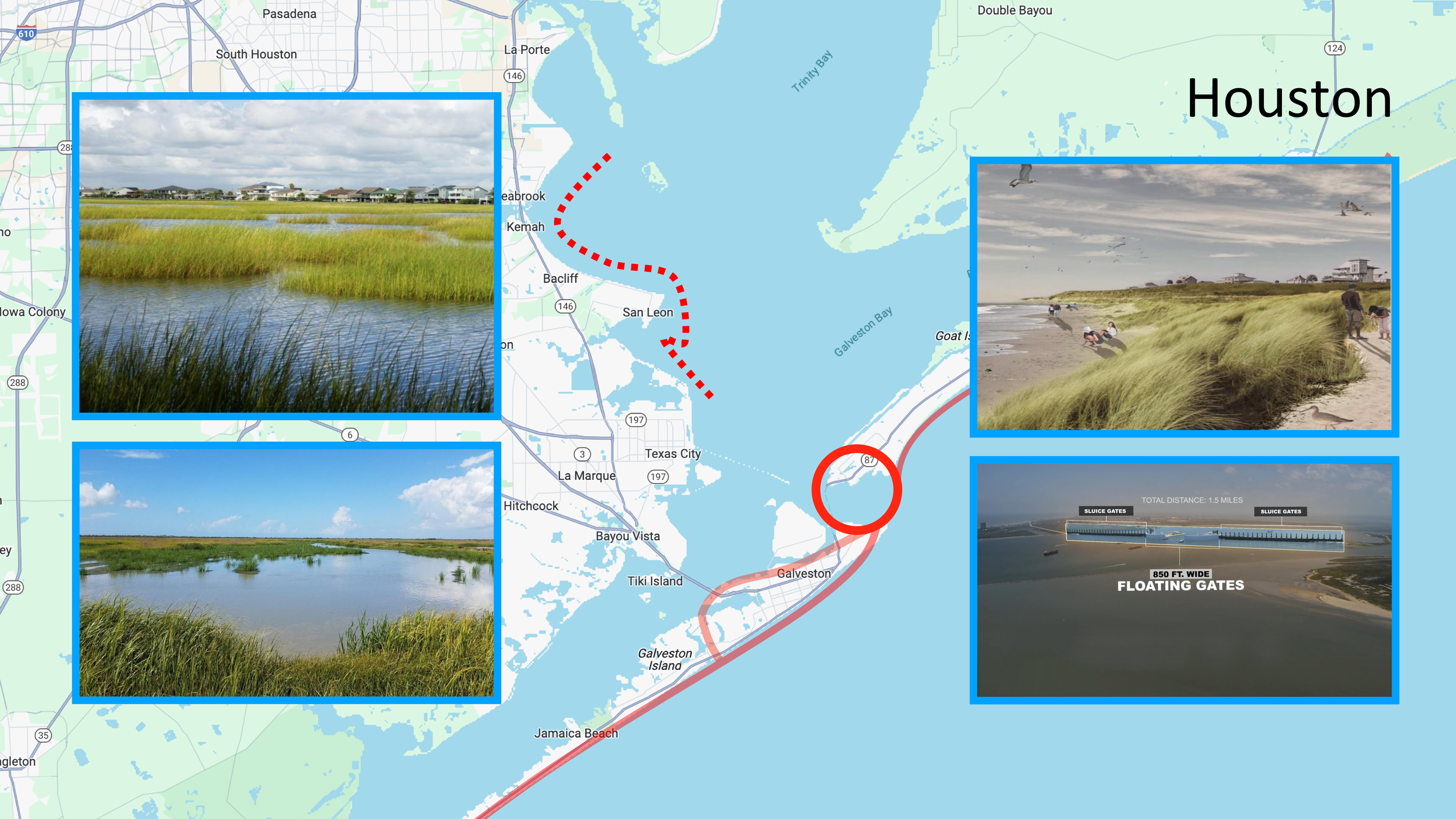
Liverpool
Galveston Island
Danbury
Jamaica Beach
Image: ABC13



‘Unprepared A Nation at Risk’, Marc Haviken, Space City Films

Houston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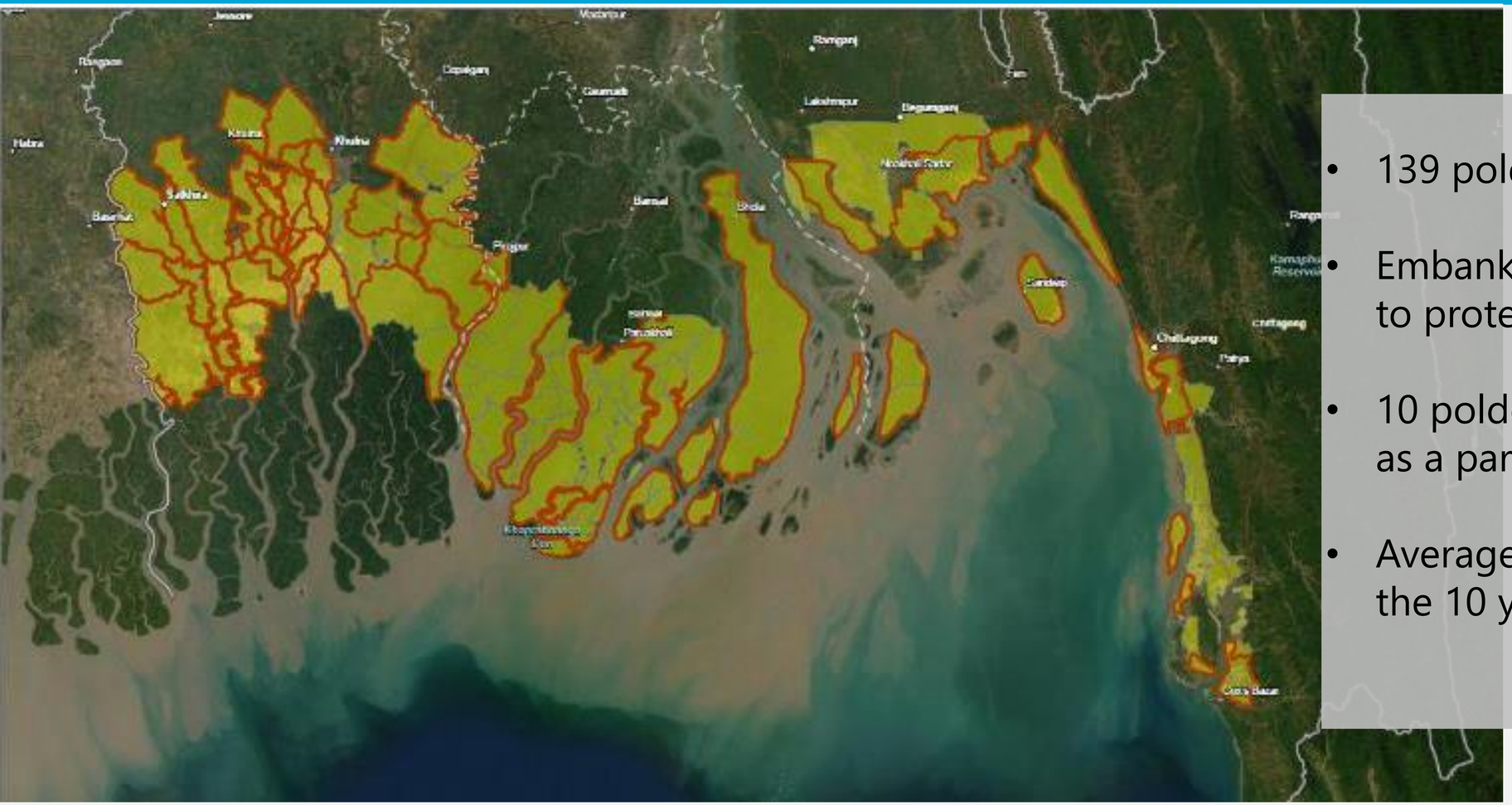
Bacliff
San Leon
Galveston Bay
Texas City
La Marque
Hitchcock
Bayou Vista
Tiki Island
Galveston
Galveston Island
Jamaica Beach
TOTAL DISTANCE: 1.5 MILES
SLUICE GATES
SLUICE GATES
850 FT. WIDE
FLOATING GATES

Coastal Resilience in Bangladesh

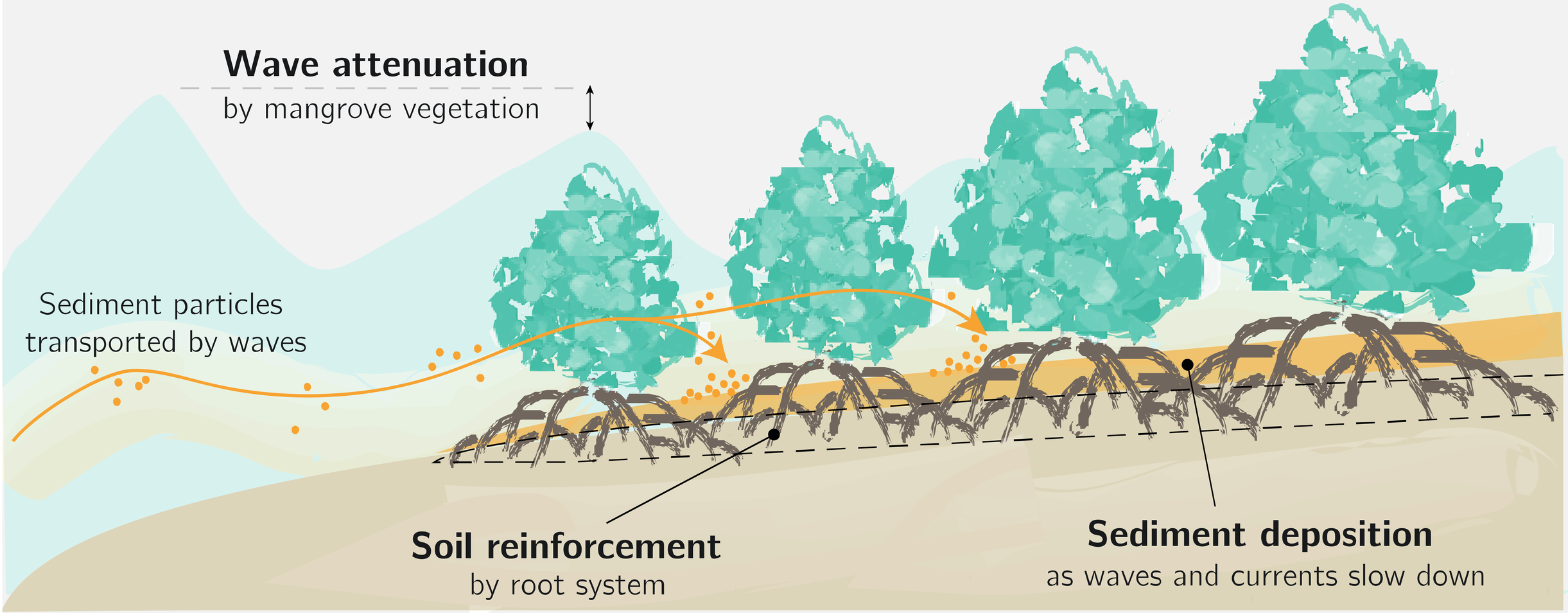


- 139 polders in the coastal zone
- Embankment system mostly to protect from coastal surge
- 10 polders upgraded to 25 year safety as a part of the CEIP-1 project
- Average current elevation estimated at the 10 year safety level

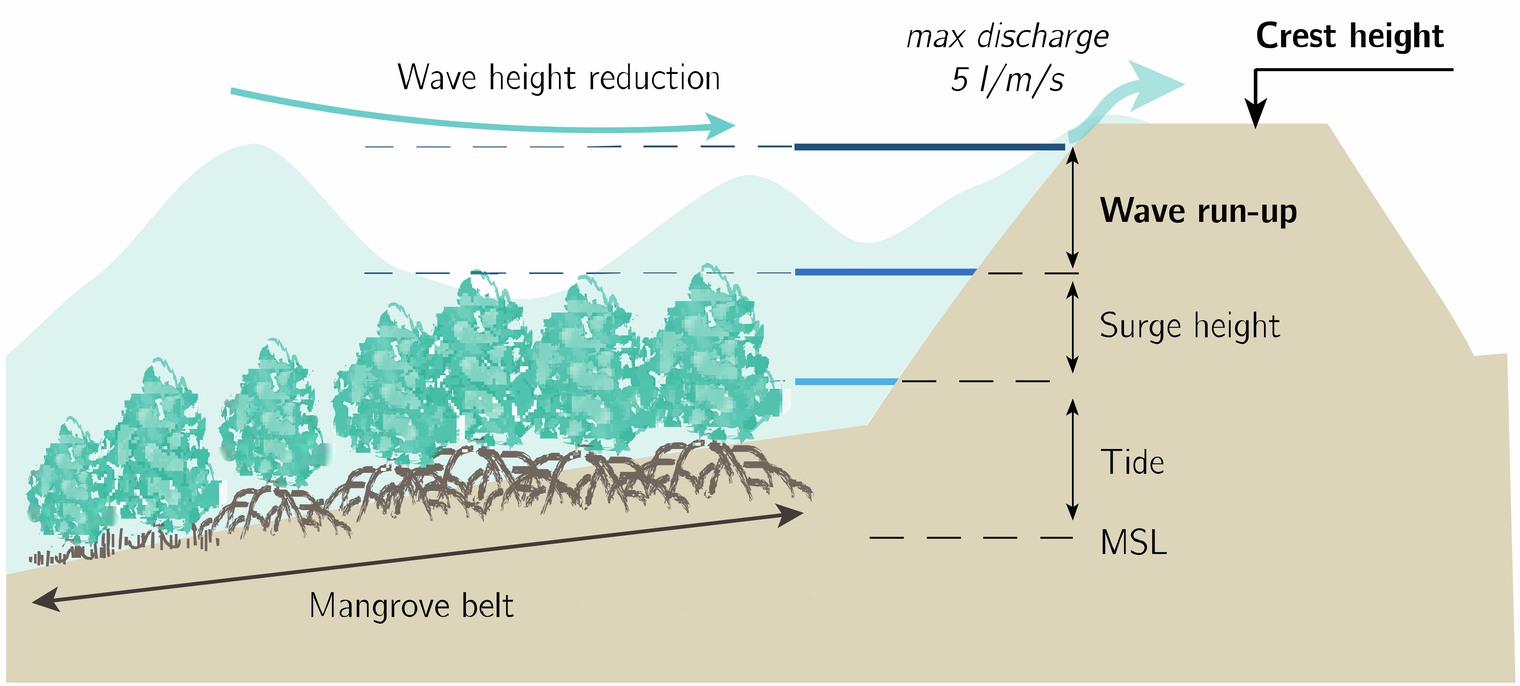
Bangladesh coastal adaptation

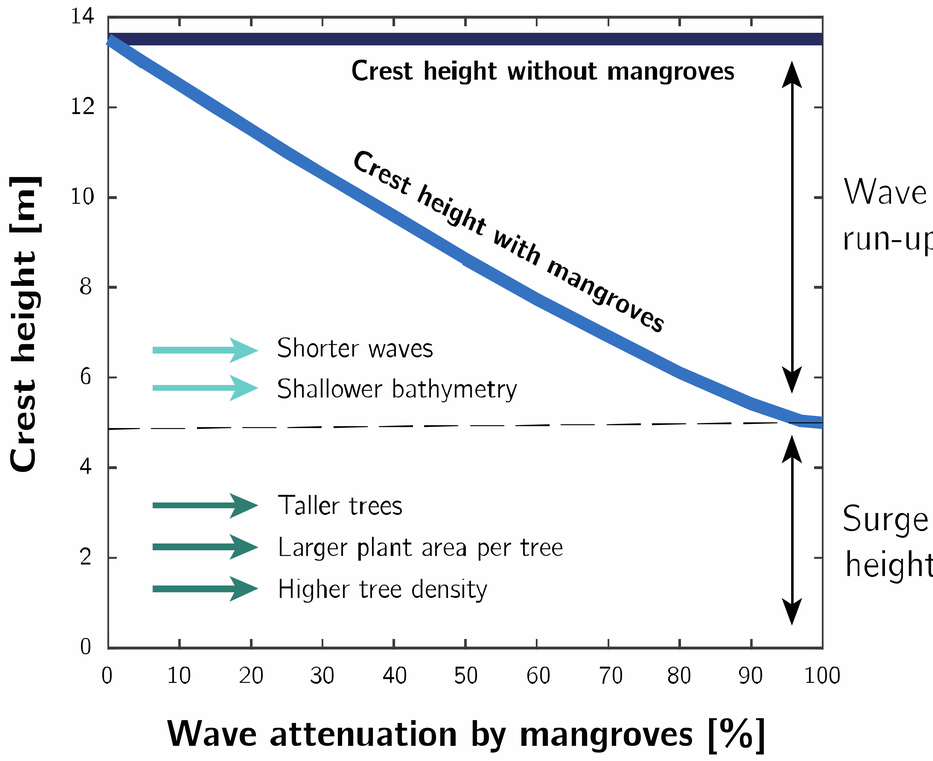
- Dike reinforcement techniques
- Rapid risk assessment and inundation modelling
- Forecasting of adaptation costs
  - 4 – 10 B$ to adapt Bangladesh coastline to 100 year protection level
  - ~0.15% GDP on annual basis

Mangroves and coastal protection



Mangroves and coastal protection (2)





A nation that lives builds its future

Een volk dat leeft bouwt aan zijn toekomst

Closure:

- Adaptation: yes, we can
- Uncertainties in sea level rise
- Start now with realistic regional strategies