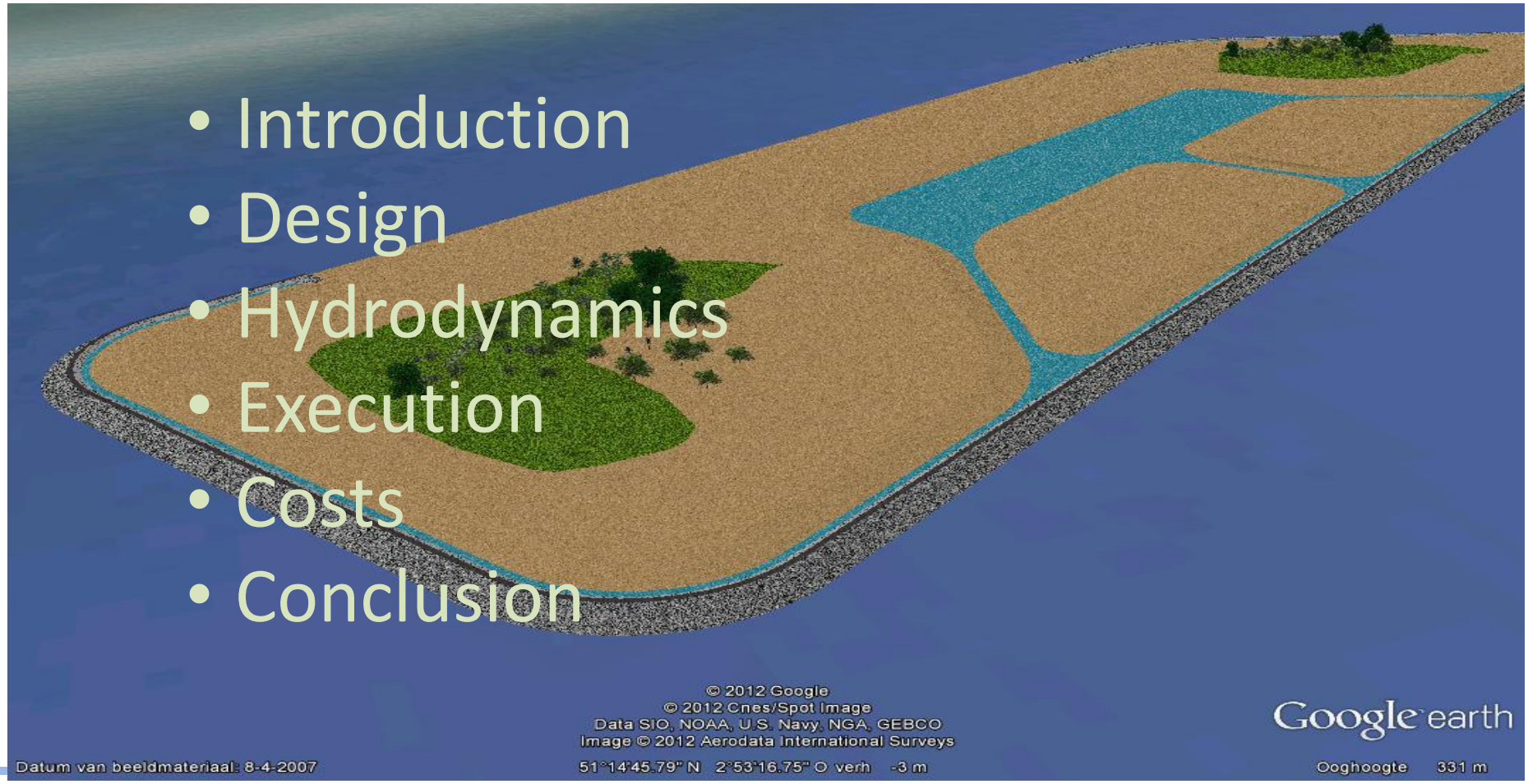
Het Stroomeiland

Merel Kroeders Jonas Coene

Contents

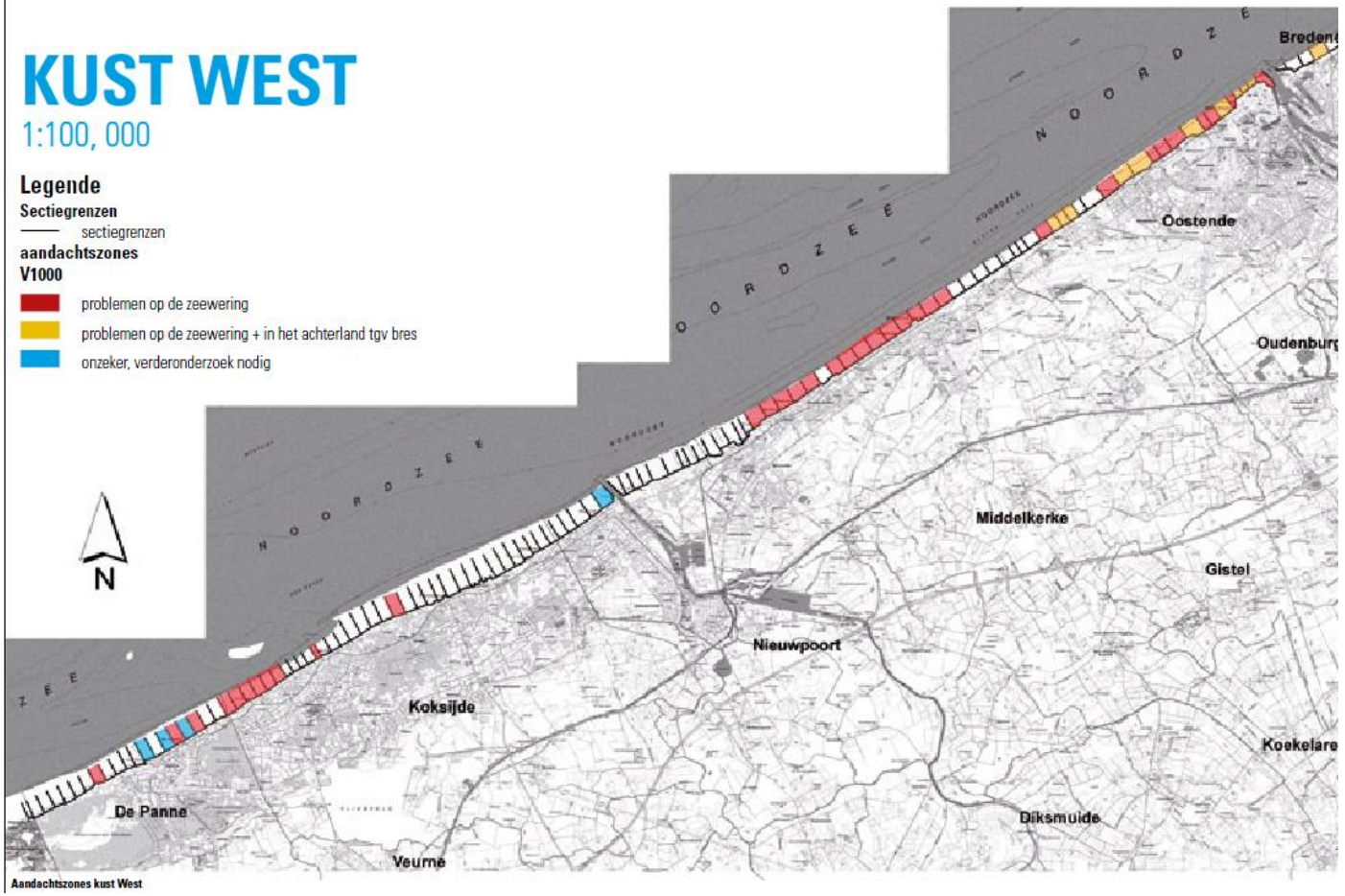


- Introduction
- Design
- Hydrodynamics
- Execution
- Costs
- Conclusion

Introduction

- Vlaamse Baaien project
- Protection of the Flemish Coast:
  - Storms
  - Rising sea level
- Elevation of sandbanks
- Construction of artificial islands

Introduction

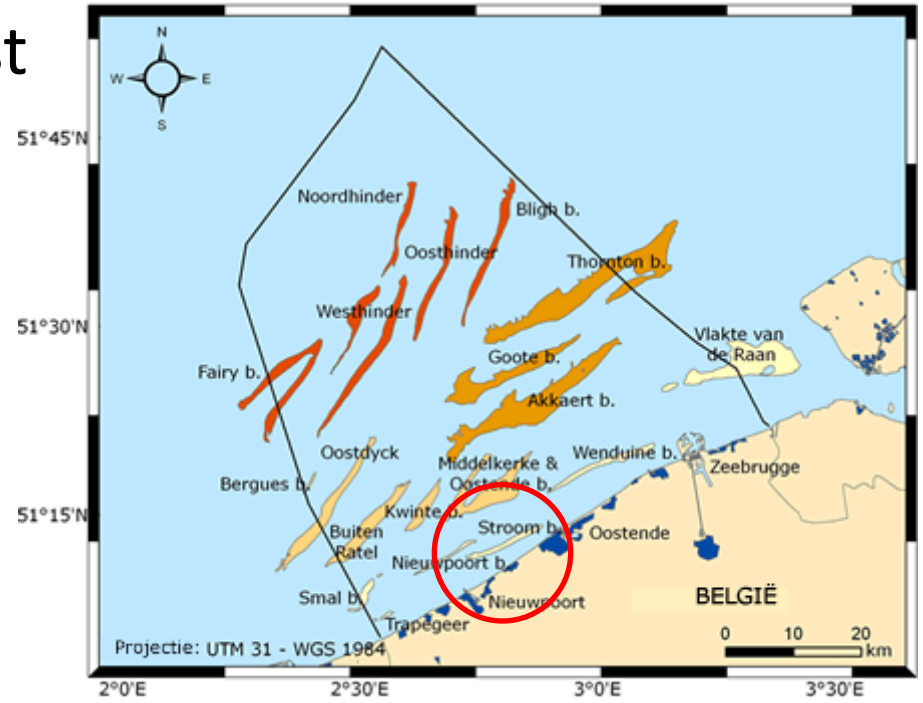


Introduction

- Problems in Ostend:
  - Very narrow beach
  - Low dikes
- Countermeasure: elevation of the Stroombank
  - Reducing wave height and peak period
  - Creating a ‘sand engine’

Introduction

- Location:
  - 2 km of the coast
  - -3 m TAW
  - Protected area



Design

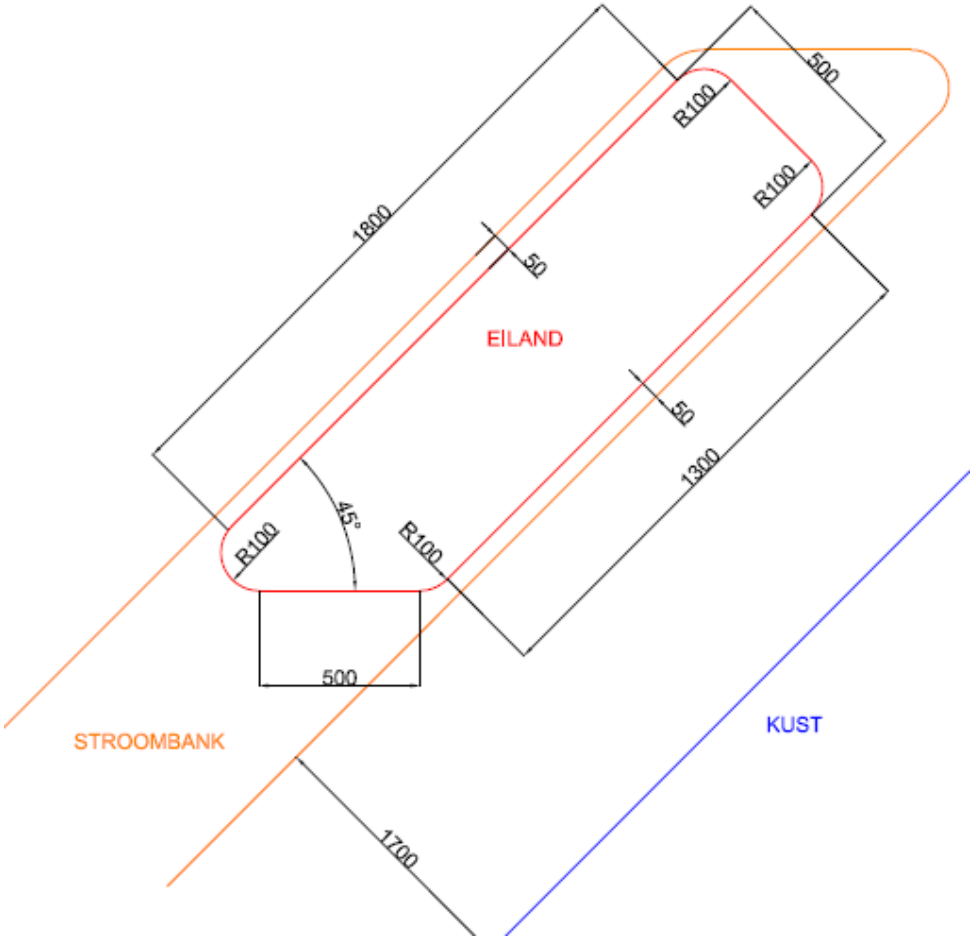
- Partial elevation of the Stroombank
- Direct protection of the most vulnerable section of Ostend
- Guiding the current to the shore
  - ‘sand engine’: beach nourishment

Design

- Dimensions
- Stability
  - Dike
  - Island
- Settlements
  - Soil investigation

Island

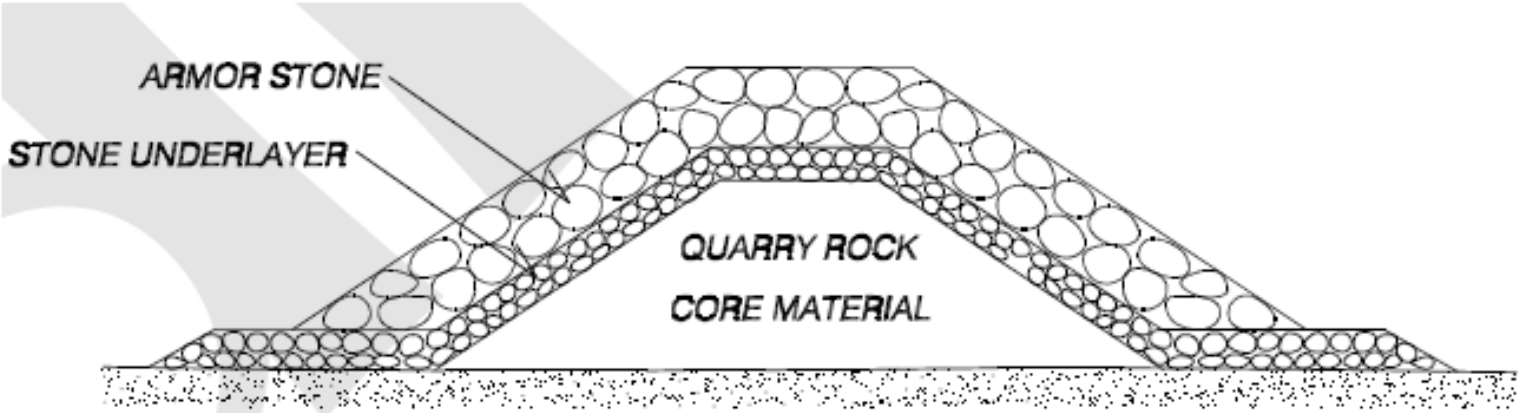
Island



Island

Dike

- Core: geobags
- Protection layer: armor stone
- Granular filter

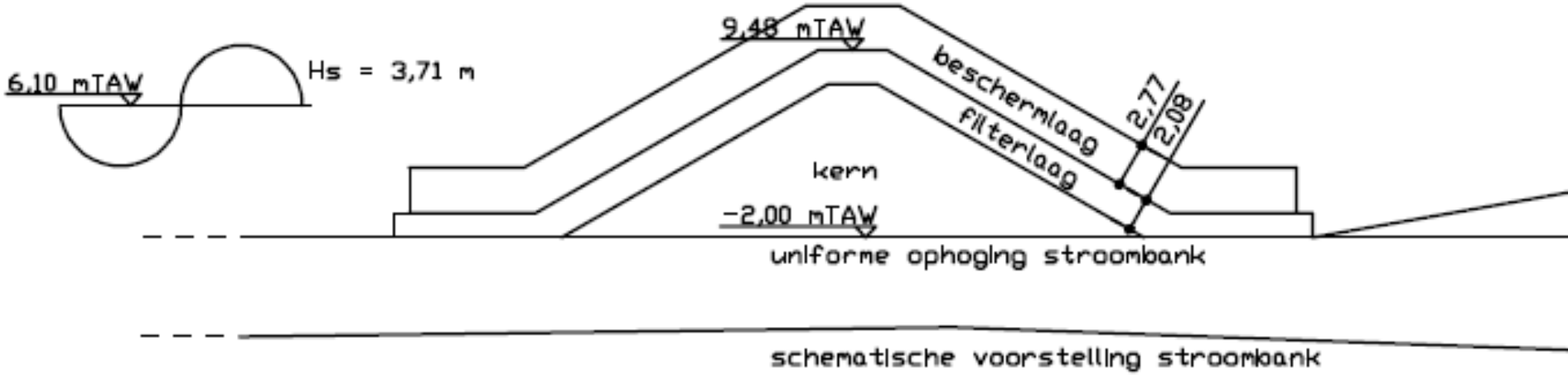


(Coastal Engineering Manual, 2003)

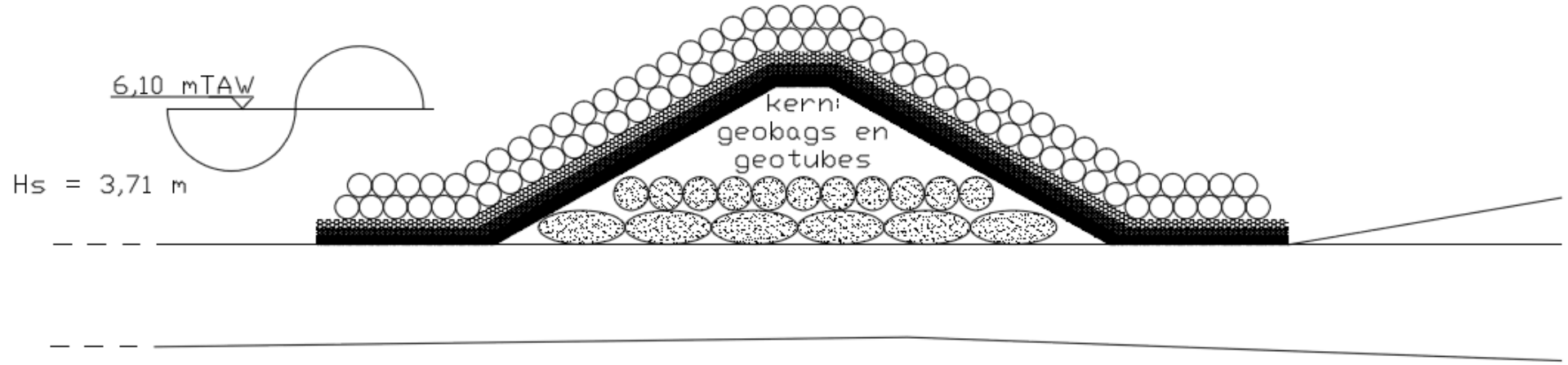
Dike

- Stability: shearing, wave action and currents
- Wave parameters 100-year storm
  - SWL = 6,10 m
  - Hs = 3,71 m
  - Ts = 7,02 s
- Overtopping accepted, q = 100 l/s/m
  - Crest and rear slope has to be protected

Dike


6,10 mTAW
Hs = 3,71 m
9,48 mTAW
beschermlaag
filterlaag
2,77
2,08
kern
-2,00 mTAW
uniforme ophoging stroombank
schematische voorstelling stroombank

Dike



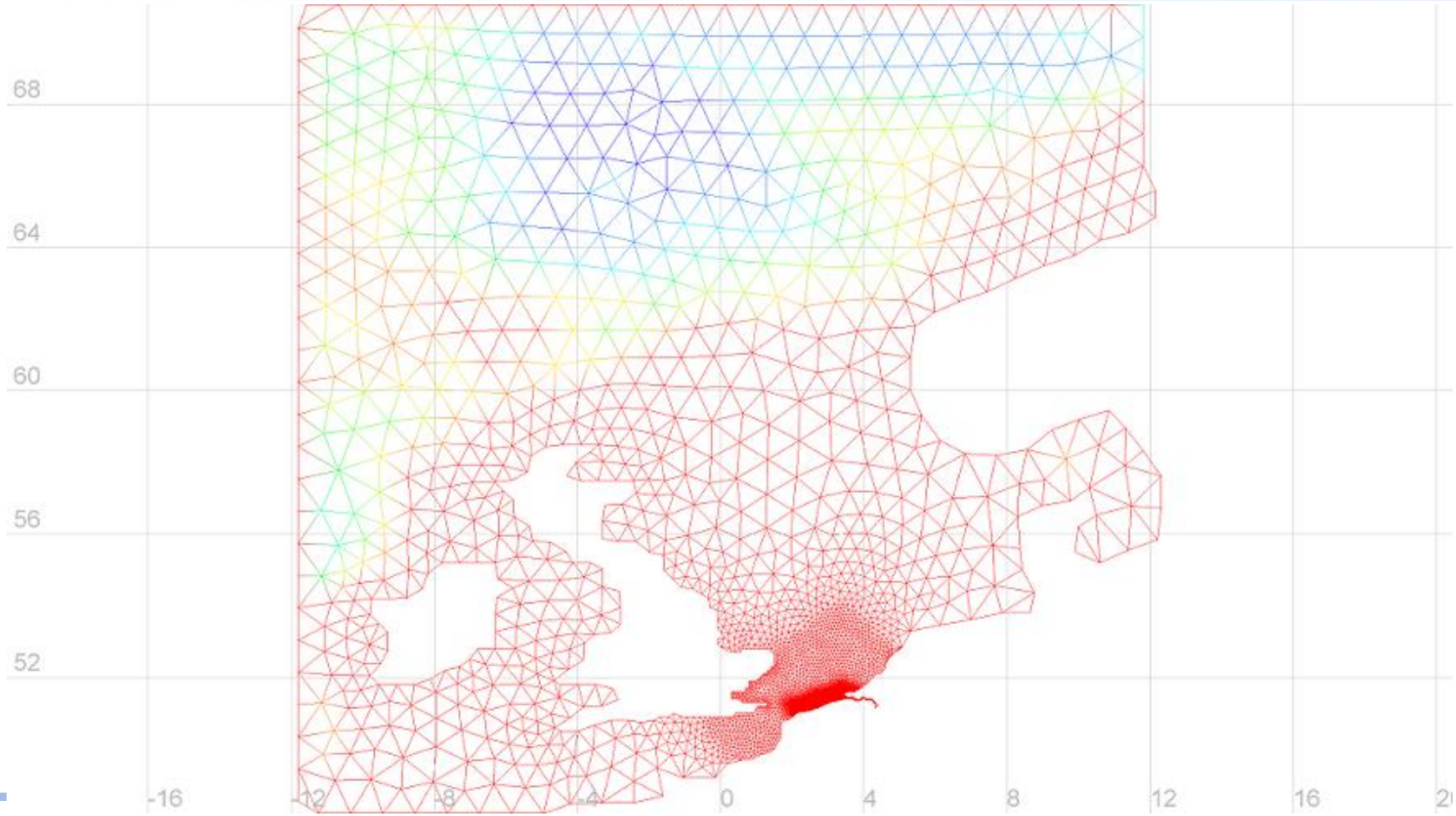
Hydrodynamics

- Modeling the hydrodynamics (Telemac)
- Modeling sediment transport (SISYPHE)
- Wave modeling (SWAN)

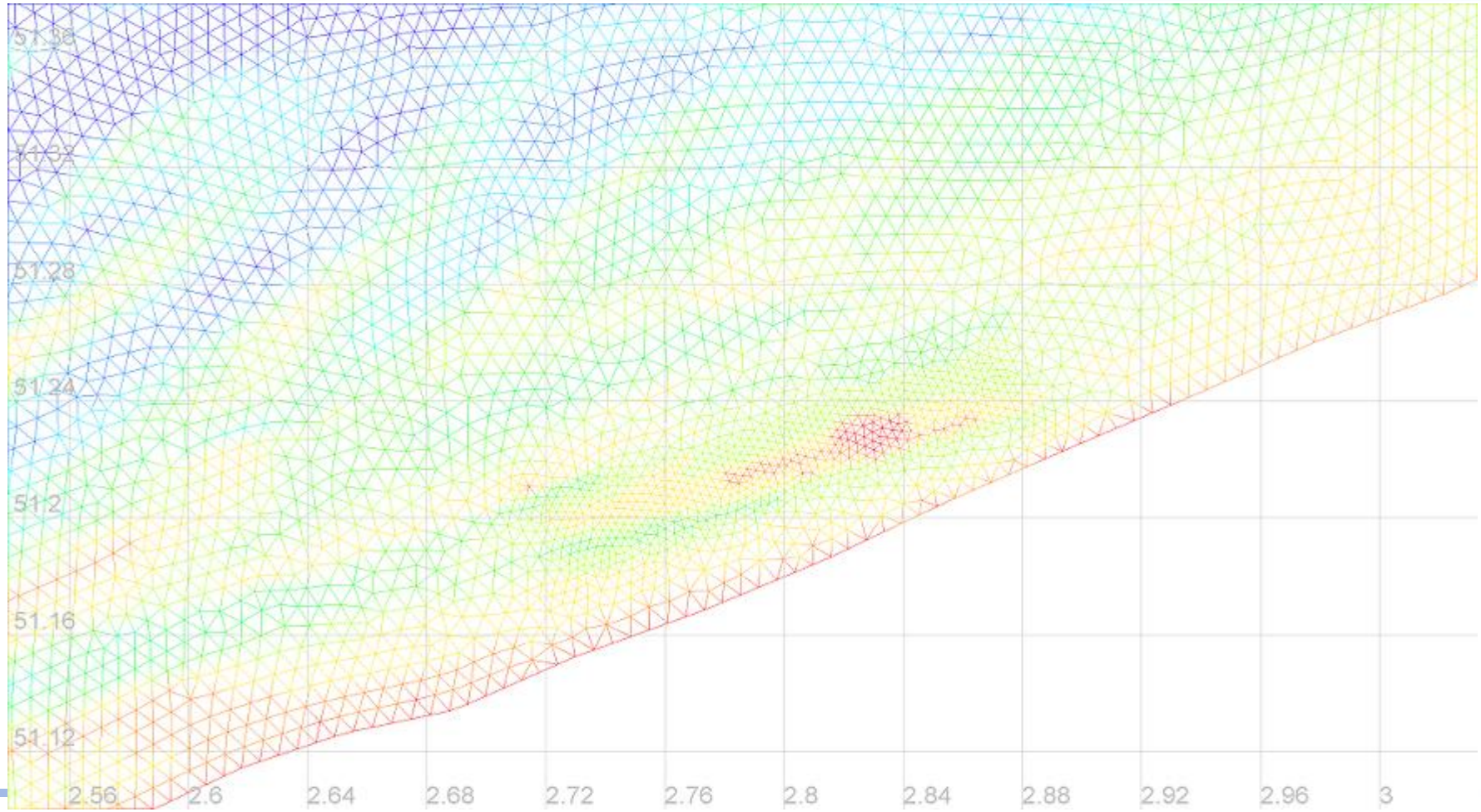
Telemac

- Area:
  - Boundaries outside North Sea
- Boundary conditions: Tides
- Bathymetry
  - Coarse outside area
  - Finer mesh in study area

Simulations Telemac



Simulations Telemac

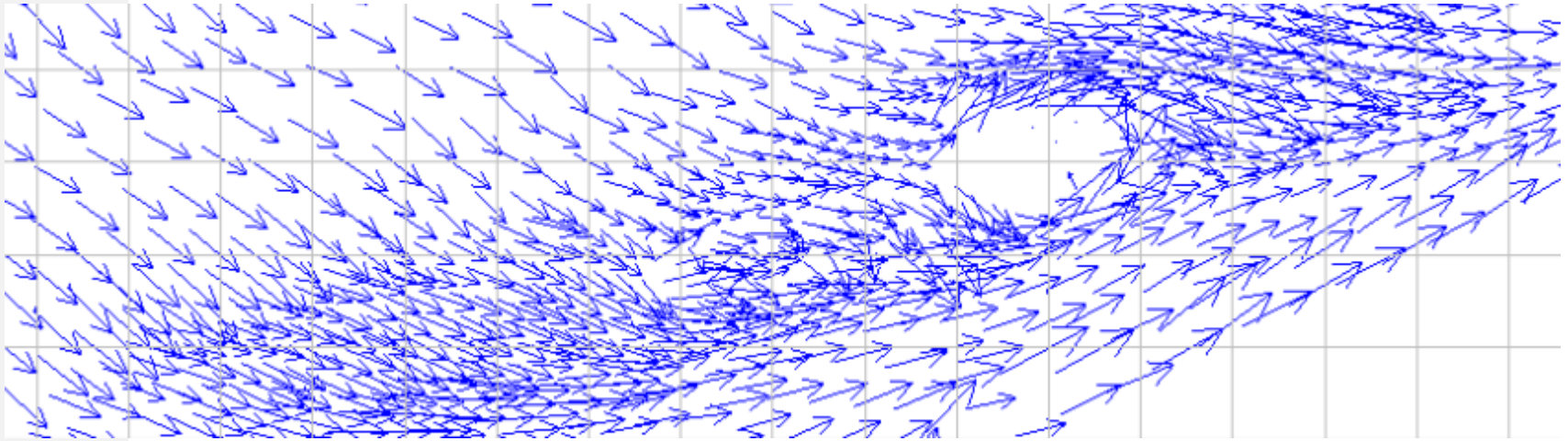


Telemac

- Solving Navier-Stokes
- Windfile
- Bodem friction
  - Chézy
- Turbulence
  - Constant viscosity
- Coriolis force
- Presence of tidal flats

Telemac

- Influence island
  - Close to the island
  - Course mesh

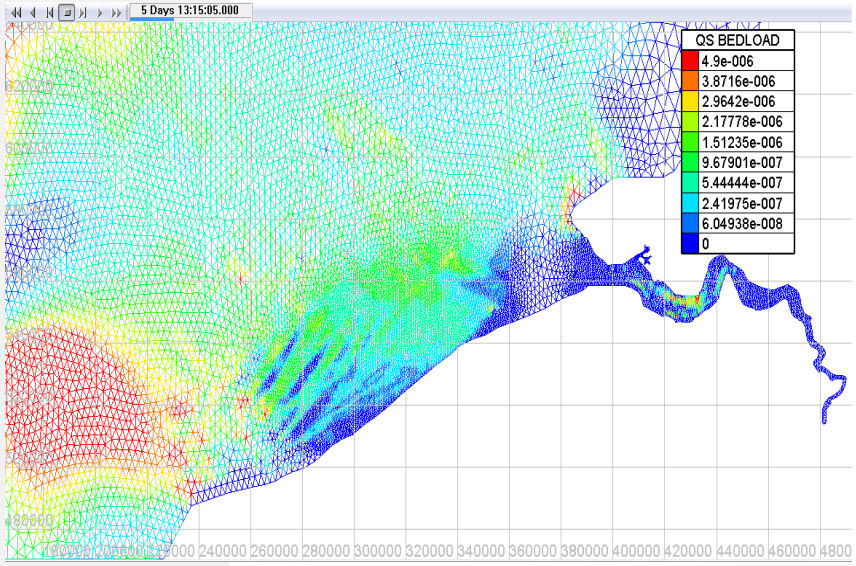


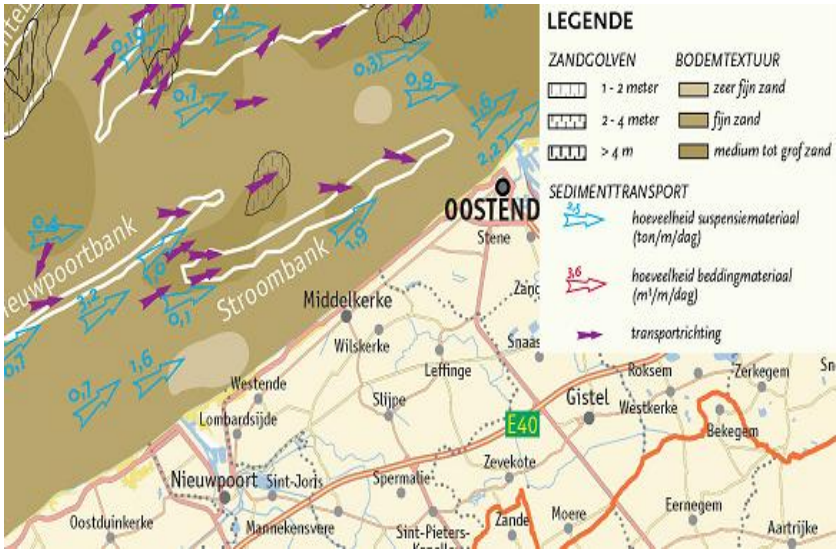
SISYPHE

- Parameters:
  - Bodom porosity (0,3)
  - Material parameters
  - Transportformula (Van Rijn)

SISYPHE

- Results sediment transport:
  - Similar to the reality
  - Course mesh





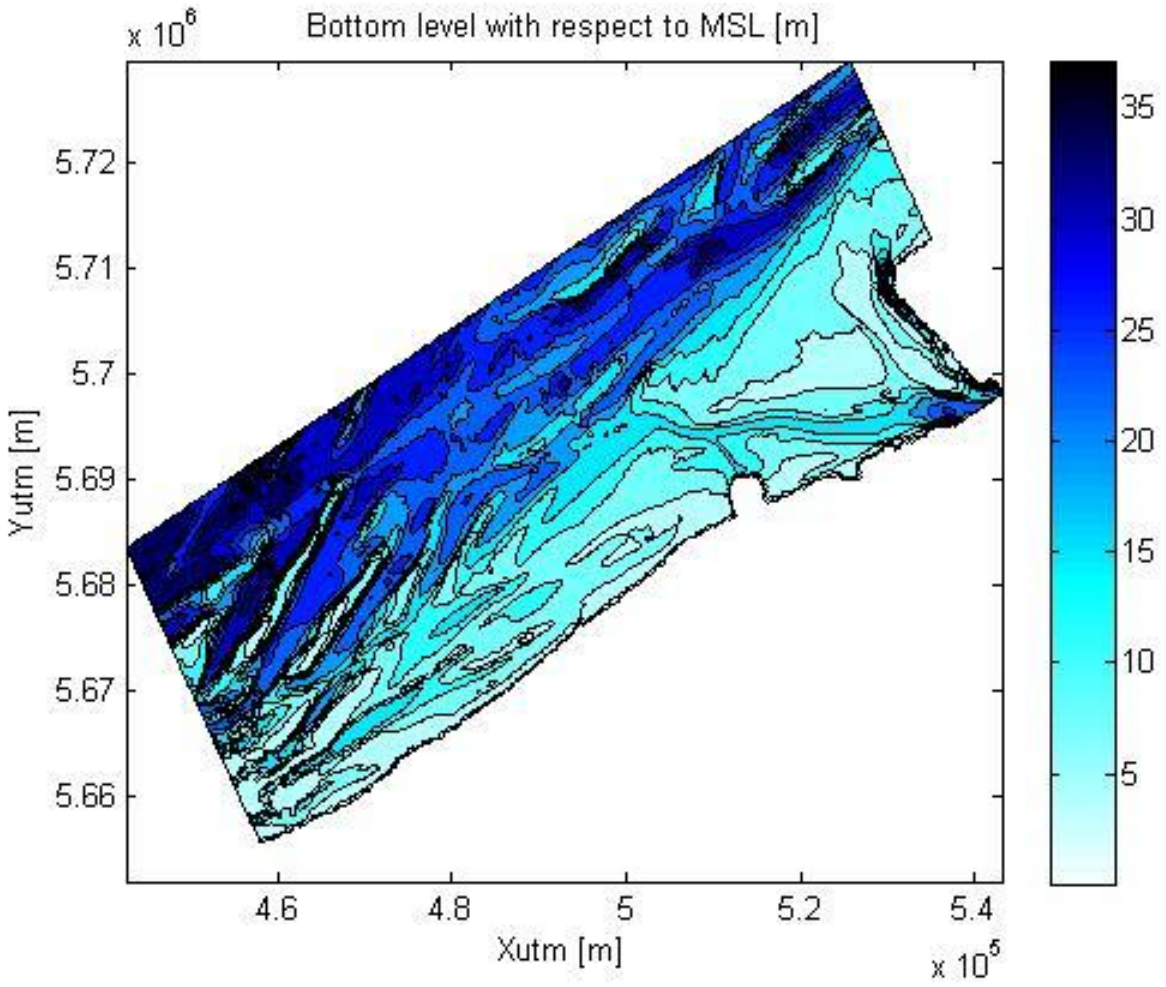
Wave modeling

- Swan
  - Suitable for wave modeling in coastal areas
  - Wave action balance equation
- 100-year storm:
  - Design island
- 1000-year storm:
  - Influence island on the coastline

Wave modeling

- Boundary conditions:
  - Marebasse Bathymetry
  - Hydraulic Boundary Conditions Flanders
    - POT-analysis based on measurement at the Flemish coast
    - Results for significant wave height, peak period, wind, water level and storm surge in deep water

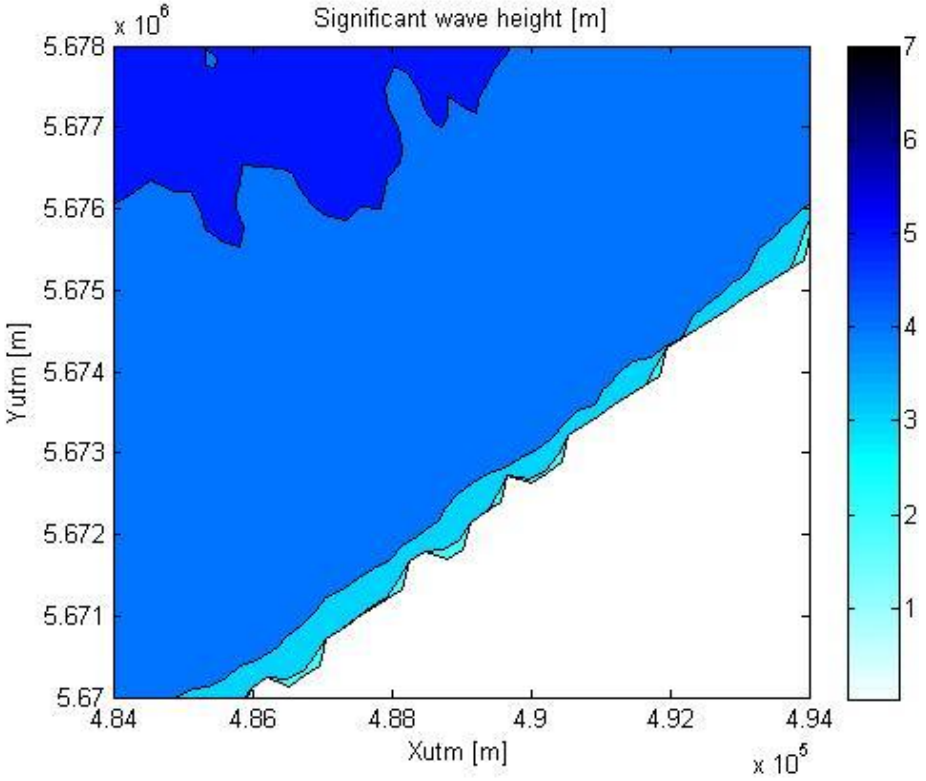
Wave modeling

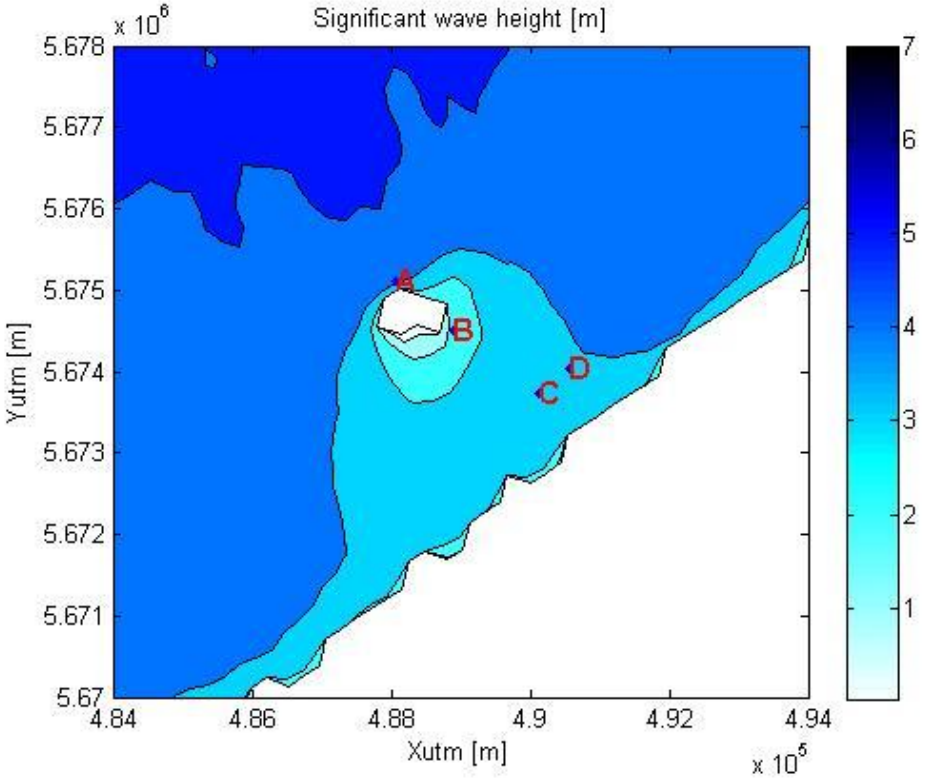


Wave modeling

- Results 1000-year storm:
  - Before and after
  - Shown for boundary conditions NNW
  - Measurement points around the island and along the coast of Ostend
  - Reduction significant wave height of 0.5m along 4km of coast

Wave modeling





Execution

- Dredge zones and sailing route
- Protection of communication cables
- Construction of the dike
  - Geobags
  - Filter and armor layer
- Elevation of the Stroombank
  - Total volume: 6.55 million m^3 sand

Costs

- Total cost: € 164 million
  - € 104 million sand
  - € 60 million armor en filter materials

Conclusion

- Installation procedure of geotubes in shallow waters has to be investigated
- Primary target reached (reduction of significant wave height)
- More research needed to be sure about the stability and sediment transport


Thank you for your attention!
Mariakerke-Bad
Oostende
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