# Towards sustainable sediment management and estuary functioning of the Upper Sea Scheldt based on a state of the art modelling approach


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De Vlaamse Waterweg nv

IMDC

RESEARCH INSTITUTE NATURE AND FOREST

Flanders Hydraulics

Flanders State of the Art

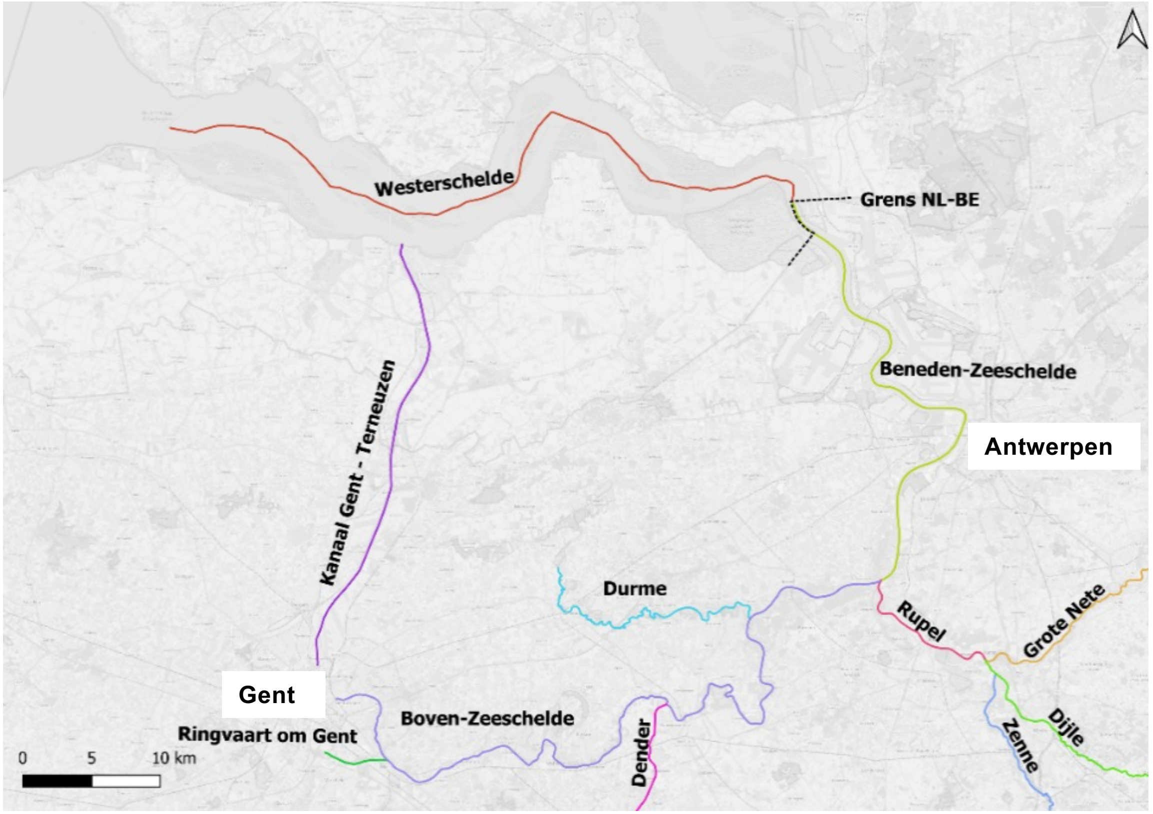
Universiteit Antwerpen

# Introduction

- Scheldt estuary : total length 160 km

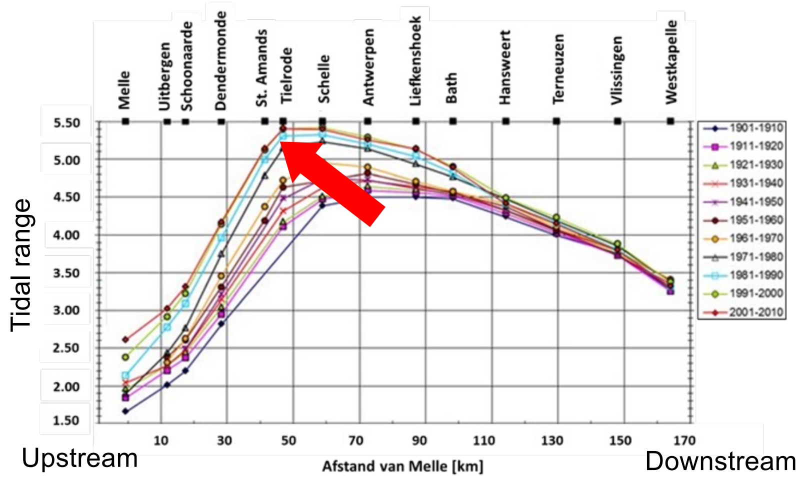
- High sediment concentration
  - Partly related with dredging and sand extraction
  - Detrimental effect on light penetration and primary production

- Since 2016 in Upper Sea Scheldt
  - Sustainable Management Plan
  - Dredging limited to navigation zones

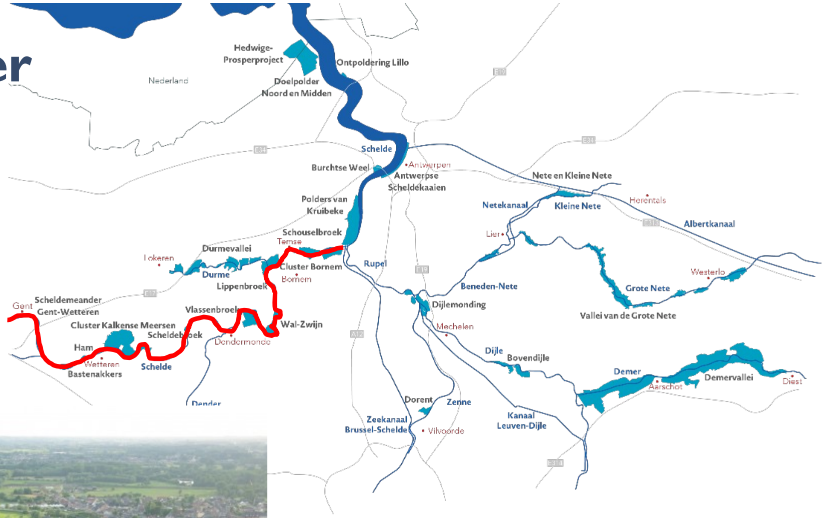


# Introduction : Challenges

- Challenges for different functions of the estuary
  - Increased suspended sediment
  - Increased tidal range (and more inland penetration)
  - Disturbance of ecological equilibrium
  - Current bathymetry does not allow larger ships
- In search of balance between all functions
- Need for an integrated approach




# Introduction :(Updated) Sigma Plan as partial answer



- 1977 : Sigma Plan
  - Focus on flood control
  - Dykes strengthening, storm surge barriers, flood control areas
- 2005 : Updated Sigma Plan
  - Include new climate change knowledge
  - Additional focus on nature
- 20? : Omega Plan : focus on sustainable and multifunctional system

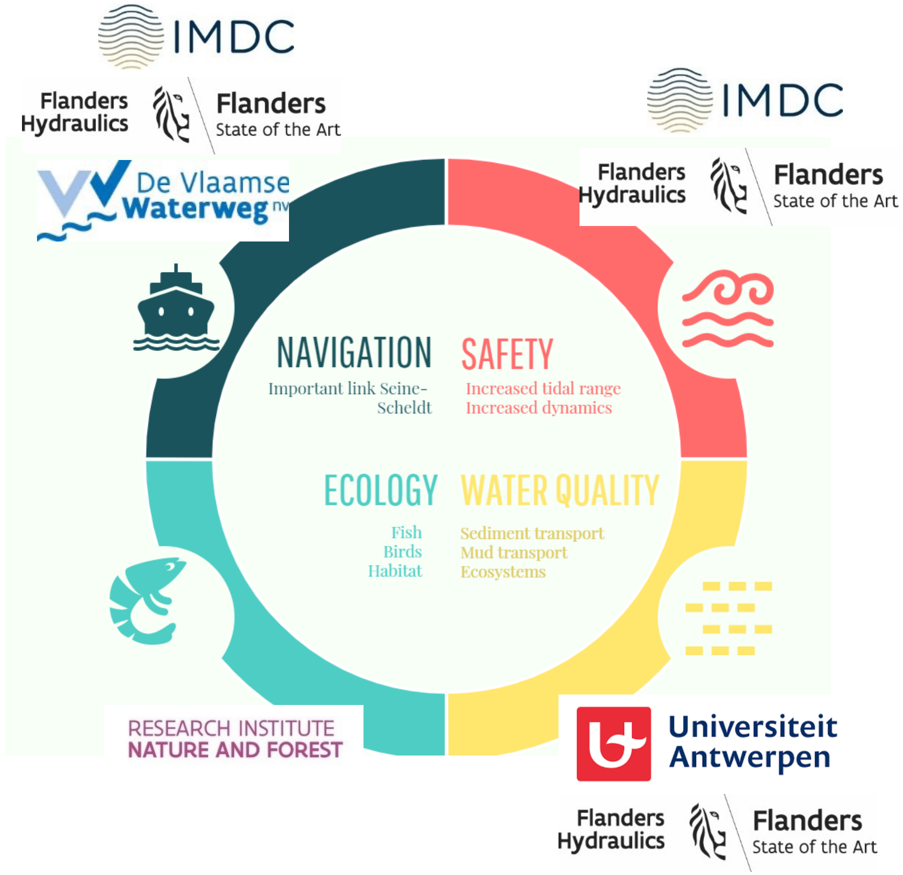
Paardeweide (source : sigmaplan.be)

Kruibeke (source : sigmaplan.be)

# Integrated Plan Upper Sea Scheldt

- Multi disciplinary team

- Three phases
  - Phase 1 : Applied scientific research
  - Phase 2 : Study of building blocks and alternatives
  - Phase 3 : Define vision for the estuary



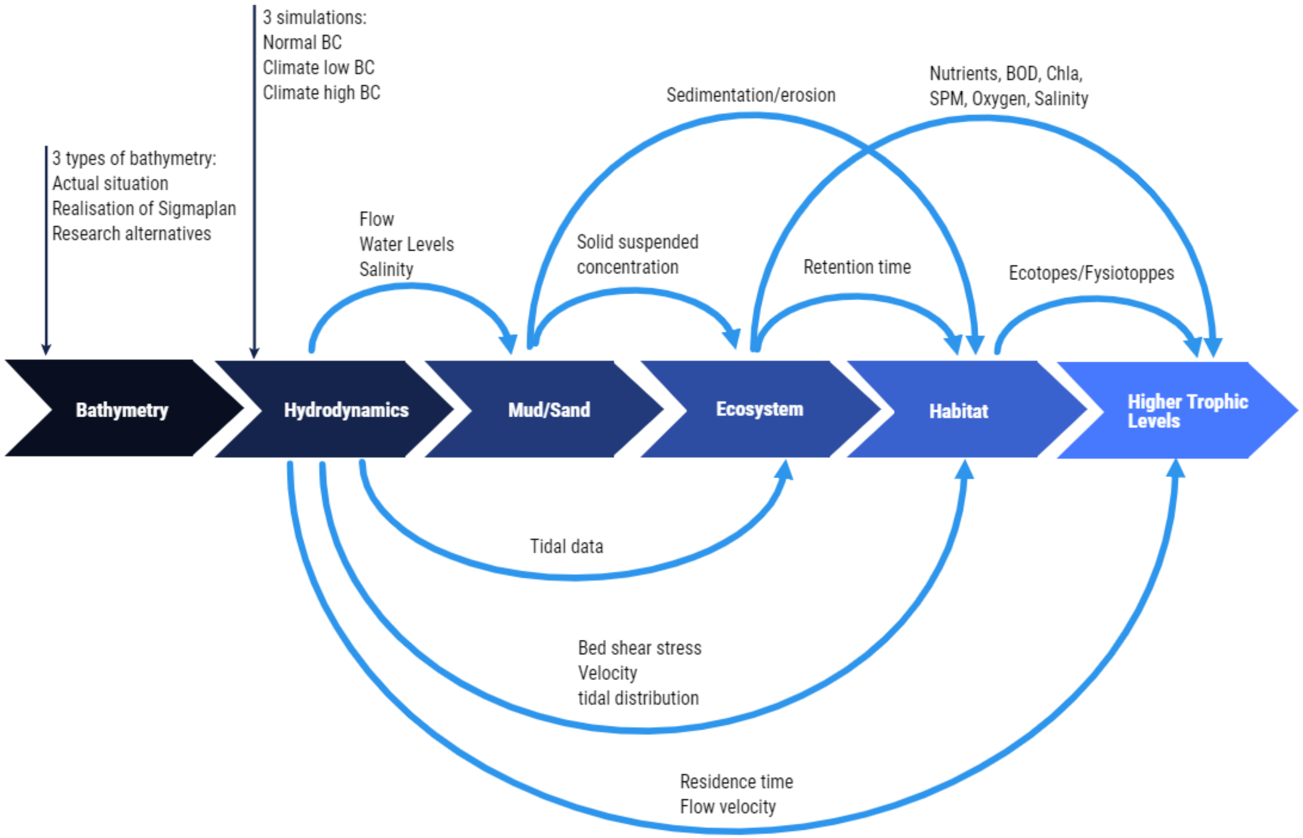
## Phase I : Applied scientific research

- Consolidation of knowledge/expertise of partners into models tailored for the Upper Sea Scheldt
- Calibration of models for the year 2013
- Realisation of Sigmaplan (by 2050) as reference for scenario calculations

| Partner | Function | Model |
|---|---|---|
| Flanders Hydraulics | Hydrodynamic | Telemac |
| | Mud transport | Sedi 3D (Telemac) |
| | Sand transport | Sisyphe (Telemac – Mascaret) |
| University of Antwerp | Ecosystem | MOSES (1D model) |
| Research Institute Nature and Forest | Habitat | GIS model |
| | Higher Trophic Levels | Statistical models (GLMM, Suitability index model) |
| IMDC/Flanders Hydraulics | Navigation | Real-time nautical simulator |

## Phase I : Applied scientific research

- Models coupled in a ‘model train’
- Bathymetry and hydrodynamics as driving factors



## Phase 2 : Study of building blocks and alternatives

- Building blocks
  - Examples: depoldering, flood channels, flood control area (FCA), FCA with control reduced tide (FCA-CRT), side channels, bottom sills
  - Investigate effects of building blocks of varying scale and location and in the estuary
  - Tools : 1-D hydrodynamic model + nautical evaluation

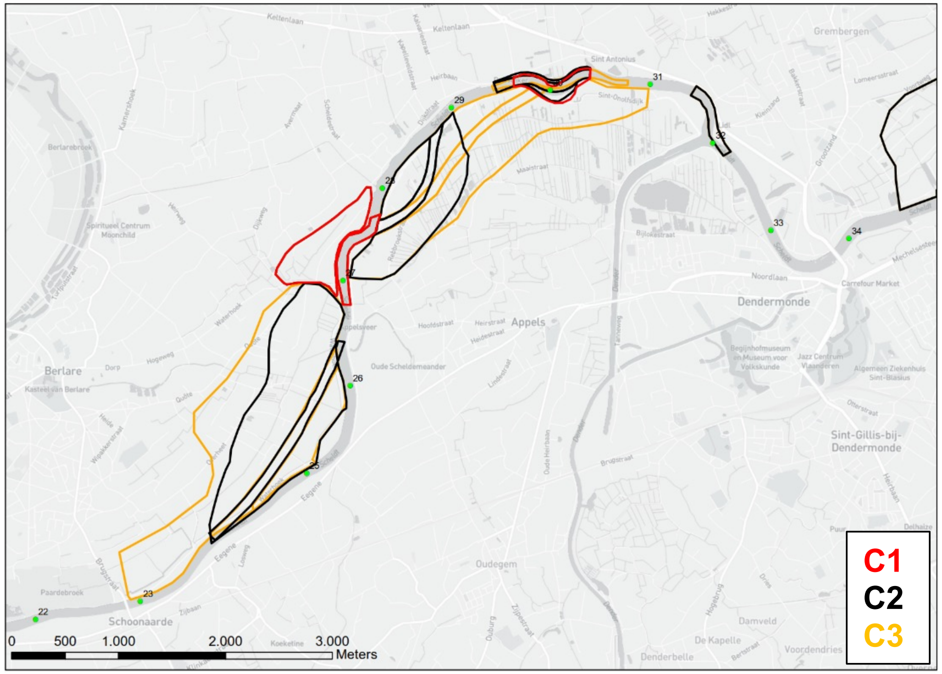
- Alternatives : combination of multiple building blocks
  - Alternatives defined keeping challenges in mind and results of building blocks
  - Study of alternative with ‘model train’ from phase 1

# Phase 2 : Alternatives

- 3 alternatives (‘C alternatives’) are defined that are in-depth modelled with the model train

- These C alternatives are derived from:
  - the knowledge gathered from the pilot projects
  - the results of research on building blocks
  - feedback from international expert group

- Definition of C-alternatives
  - C1 : minor adjustments
  - C2 : C1 + limited depolderings and bend modifications
  - C3 : C2 + larger depolderings and more extreme bend modifications

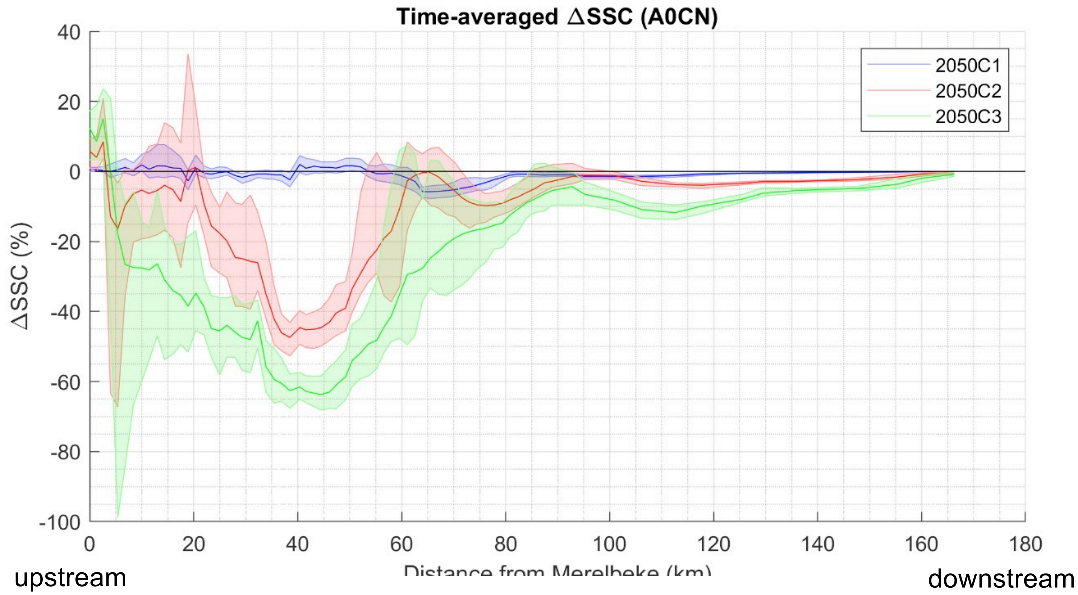


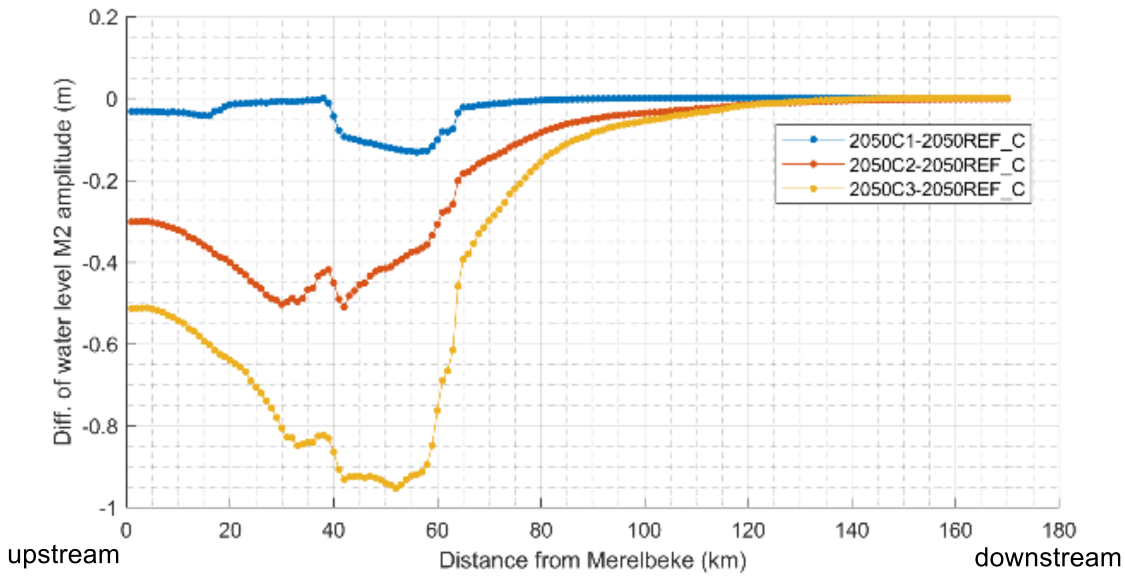
## Phase 2 : Results of alternatives

- Size of measures relates with impact :

  C1 < C2 < C3

- Depolderings considered as a effective way to tackle challenges :
  - Tidal range
  - Sink for sediment
    - Light climate
    - Primary production
  - Additional intertidal area (birds)
  - No impact on navigation (signalisation needed)
  - Safety level Sigma plan maintained



## Discussion

- Investigated C alternatives
  - Theoretical approach with multiple large scale measures
  - Practice : more gradual realization/implementation
    - Also considered beneficial with respect to development of habitat
    - Allows to monitor effectiveness of measures

- Depolderings
  - Model results are promising but should be confirmed by a (large scale) pilot study

- Next steps : Formulate vision for sustainable and balanced multifunctional system

## Conclusion

- On the long term, hydrodynamic and morphologic changes that also have an impact on the ecosystem functioning can be expected in the Scheldt estuary. While actions to tackle this have already been proposed in the Updated Sigma Plan, there is a need for additional actions in the Sea Scheldt to assure the functioning of the system.

- The possible additional measures are researched in the ‘Integrated Plan Upper Sea Scheldt’:
  - Development of a state of the art modelling tool to describe all key parameters in the estuary
  - Use of the modelling to tool to investigate alternatives
  - Results indicate a strong desired effect of depolderings on all functions in the estuary

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