



Universiteit Utrecht

Enabling Delta Life

Deltares



# Can a large sand suppletion lead to a substantial increase in fresh water resources?: The Sand Motor Project

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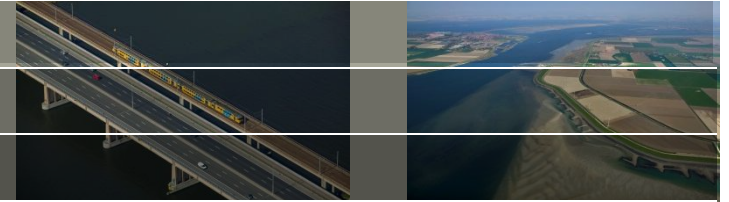
16 June 2014

Promoters:

Marc Bierkens (UU)

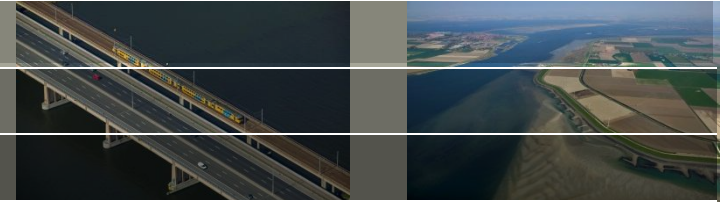
Gualbert Oude Essink (Deltares)

# Introduction

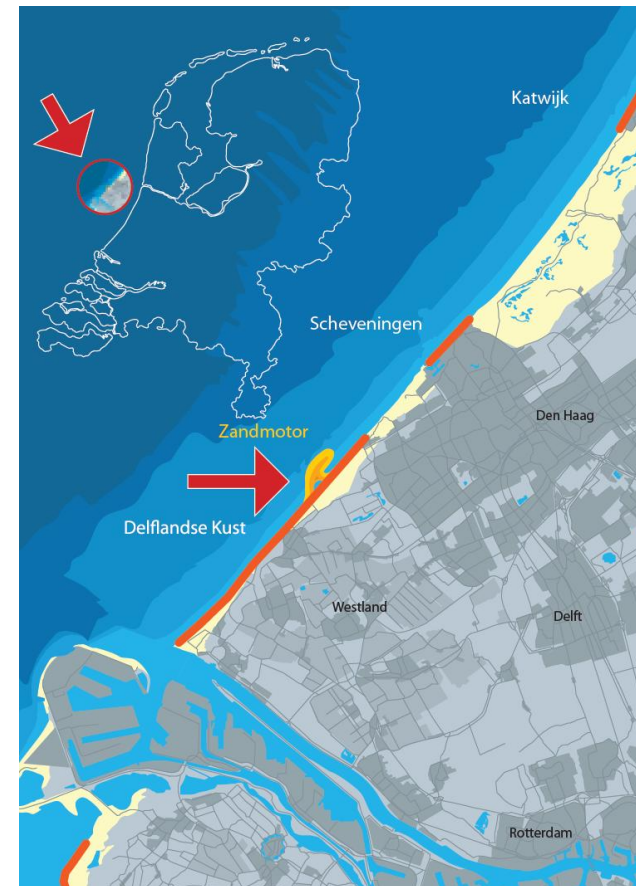


1. Introduction of The Sand Motor Project
2. Research questions
3. Methods
4. Preliminary results
5. Discussion/conclusion
6. Questions

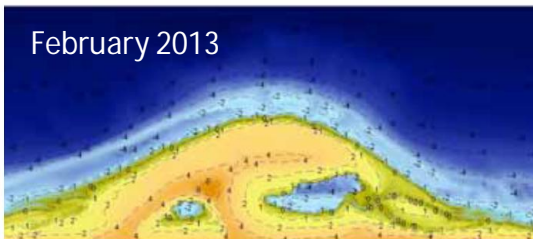
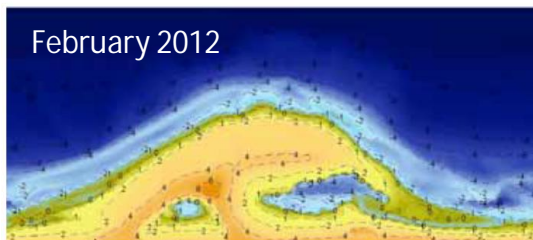
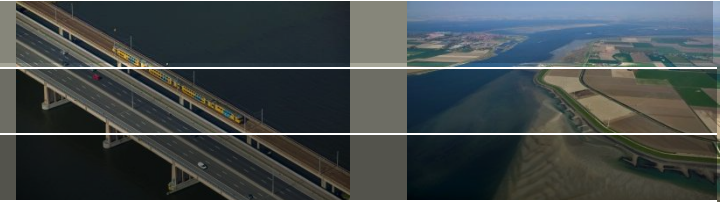
# The Sand Motor Project



- The Sand Motor:
  - Large sand nourishment of 21 Mm<sup>3</sup>
  - Located southwest of The Hague
  - Constructed in March-October 2011
- Innovative method for coastal protection
  - Traditional maintenance
  - Building with Nature
  - Opportunities recreation and nature



# The Sand Motor Project

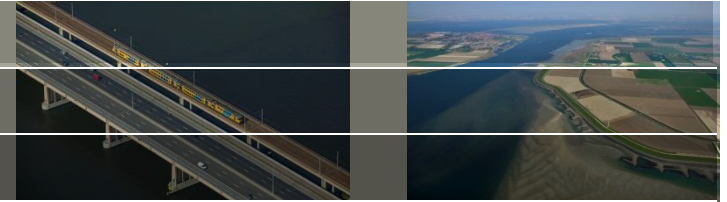


← 2 km →

- Evolution of the Sand Motor since the construction in 2011:
  - 2.5 Mm<sup>3</sup> of sand has been moved
  - 1.14 Mm<sup>3</sup> transported northward
  - 0.68 Mm<sup>3</sup> transport southward
  - 0.74 Mm<sup>3</sup> outside monitoring area (deeper water, dunes)
- Pilot project: Research by PhDs & Postdocs
  - Studying the distribution of sand
  - Ecosystem, groundwater, chemistry, recreation, swimmer safety

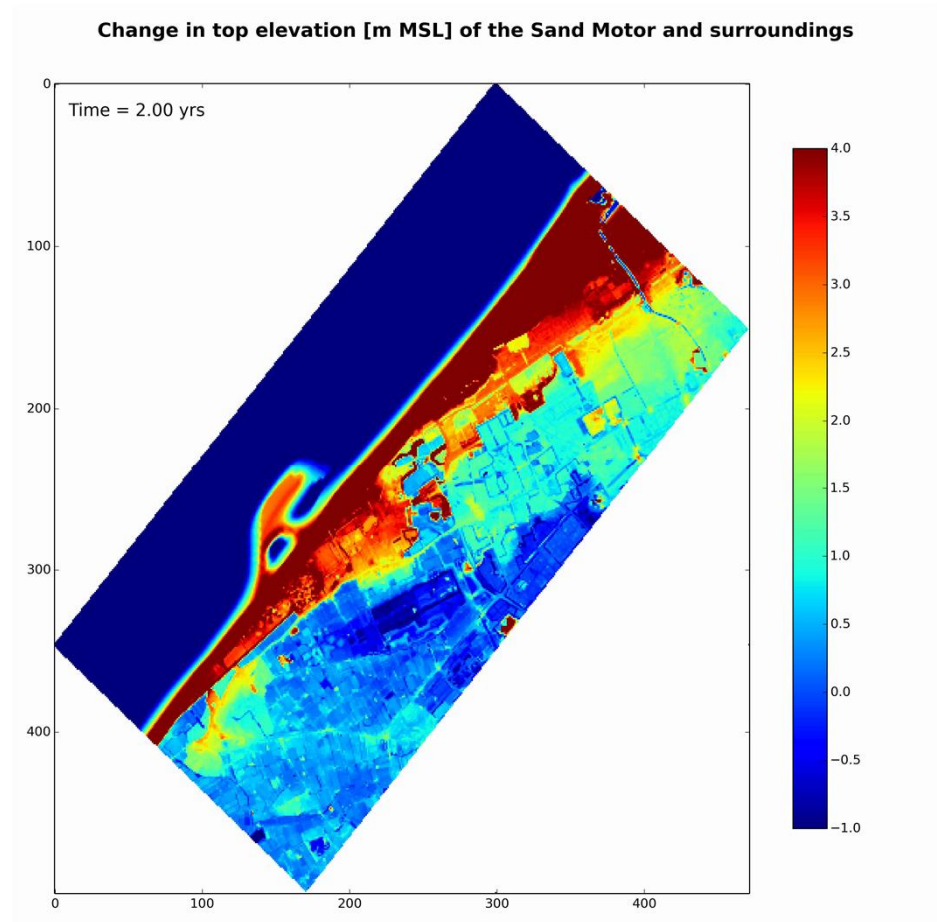


# Research

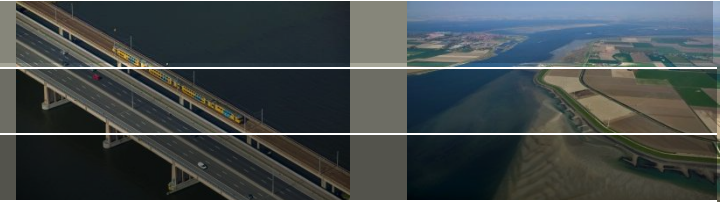


## Questions:

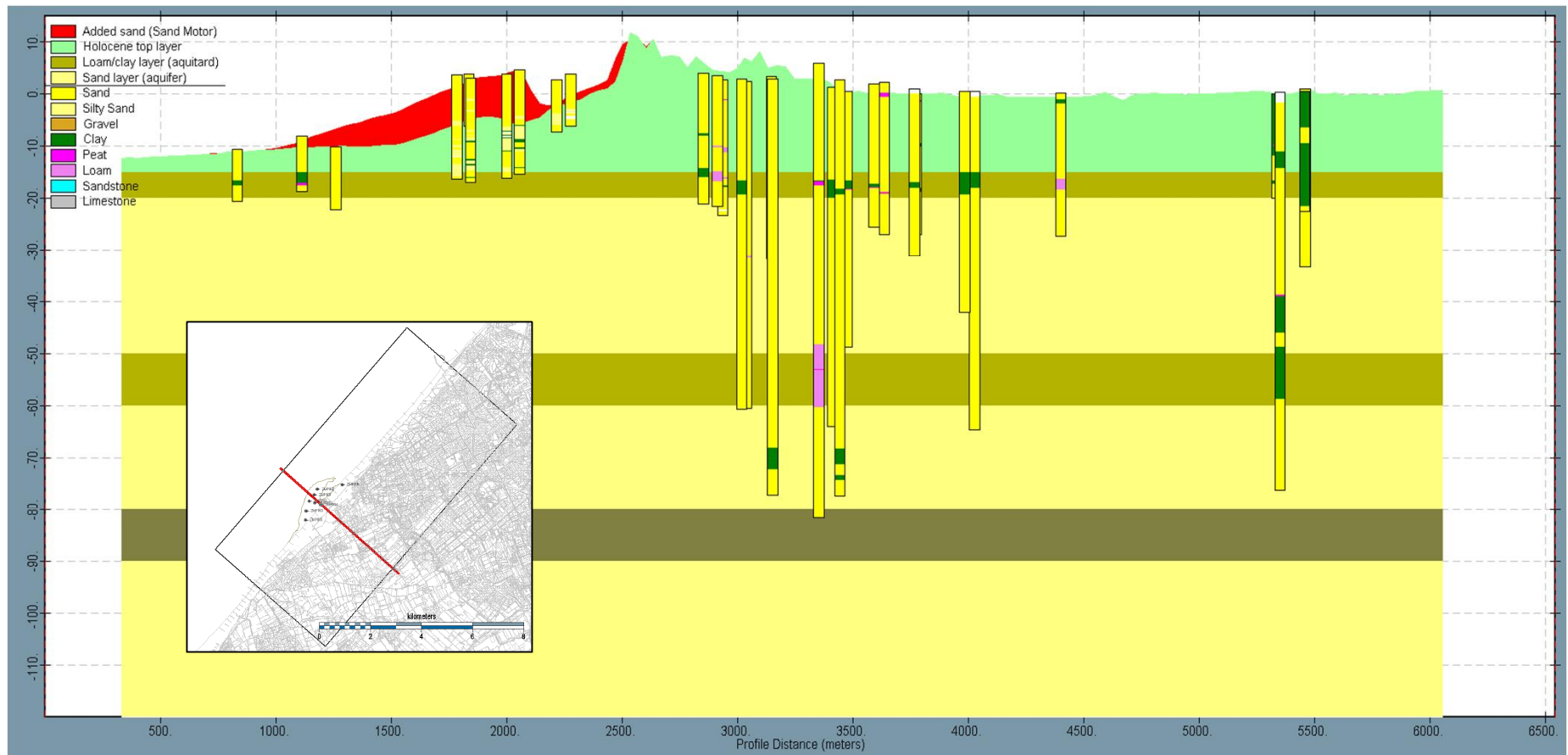
- What is the potential increase in fresh groundwater in the adjacent dune area?
- How are the fresh groundwater reserves influenced by the development of morphology?
- How are the calculations of the fresh groundwater reserves influenced by model uncertainties?



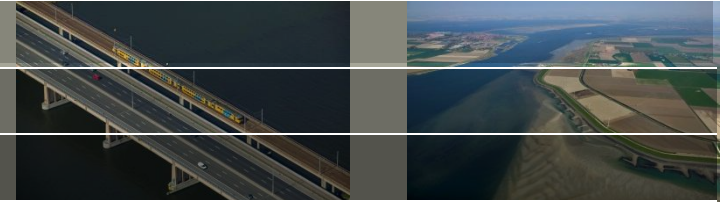
# Method: model schematization



## Transect with geohydrological schematization, including boreholes



# Method: model schematization

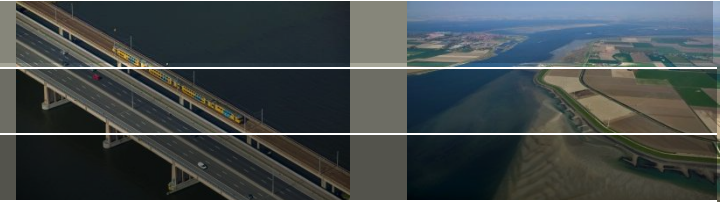


Nr	Layer	Conductivity Horizontal [m/d]	Vertical [m/d]
1	Holocene (sand/loam/clay)	10	1
2	Aquitard (loam/clay/peat)	0.1	0.01
3	Aquifer (coarse sand)	30	10
4	Aquitard (loam/clay)	1	0.1
5	Aquifer (fine sand)	10	2
6	Aquitard (loam/clay)	1	0.1
7	Aquifer (fine sand)	15	3
8	Aquifer (fine sand)	10	0.3

## Model parameters

Parameter	Value
Specific storage [-]	1e-5
Specific yield [-]	0.15
Porosity [-]	0.30
Longitudinal dispersivity [m]	2
Transverse dispersivity [m]	0.1
Diffusion Coefficient [m <sup>2</sup> /d]	6e-5

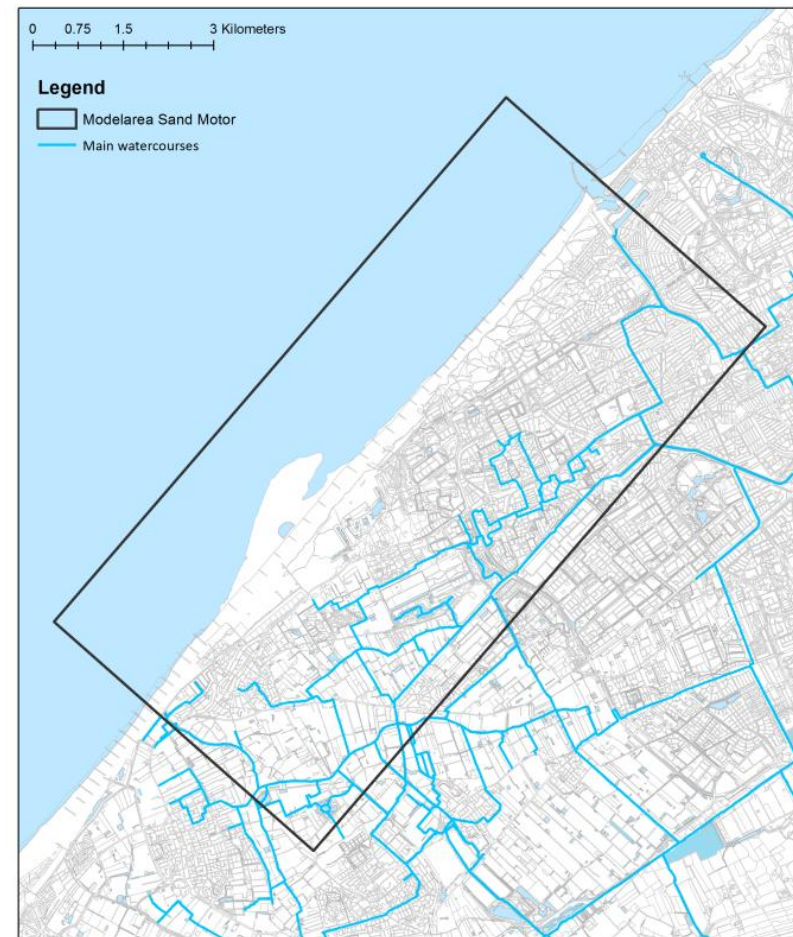
# Preliminary results calculations



Modelcode: SEAWAT version 4  
100 x 100 m gridsize, 32 model layers

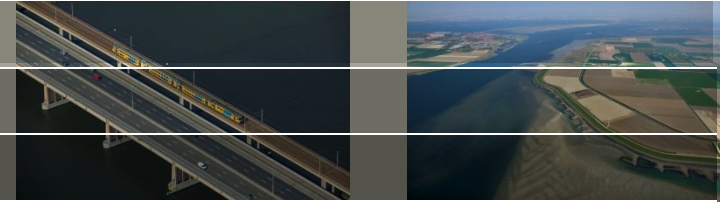
Results of model calculations:

- Initial situation  
(before creation Sand Motor)  
Calculation time: 300 years
- Scenario:
  - creation Sand Motor
  - projected morphological changes
  - period of 20 years



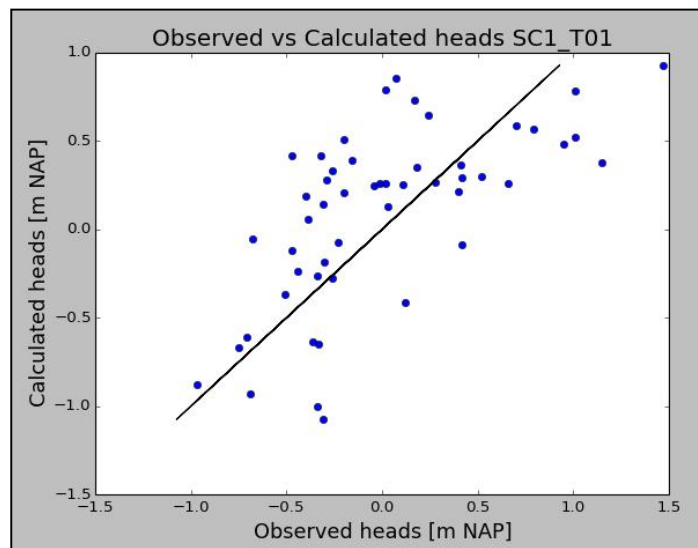


# Preliminary results: initial



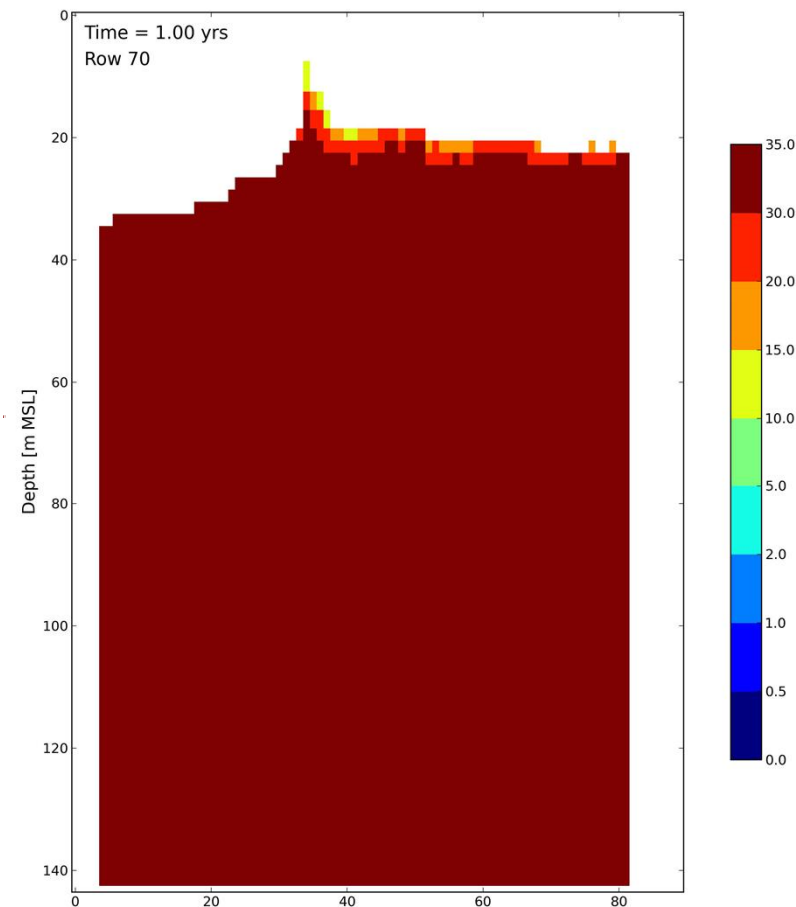
Transect  
West- East

Model calibration (heads)

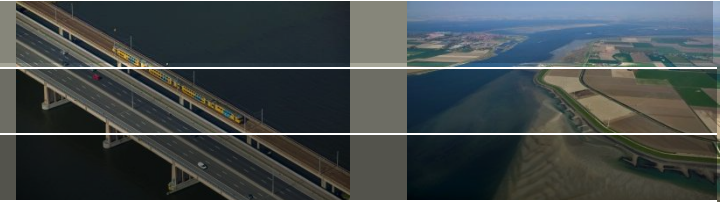


Average error = 0.1 m  
Average absolute error = 0.4 m

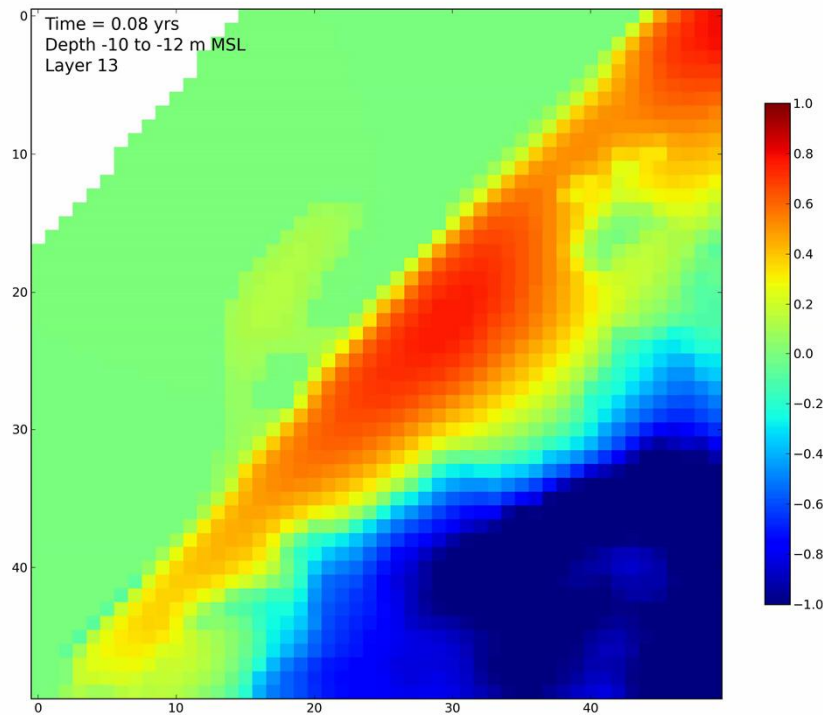
Calculated concentration [g/l] of initial situation (before creation Sandmotor)



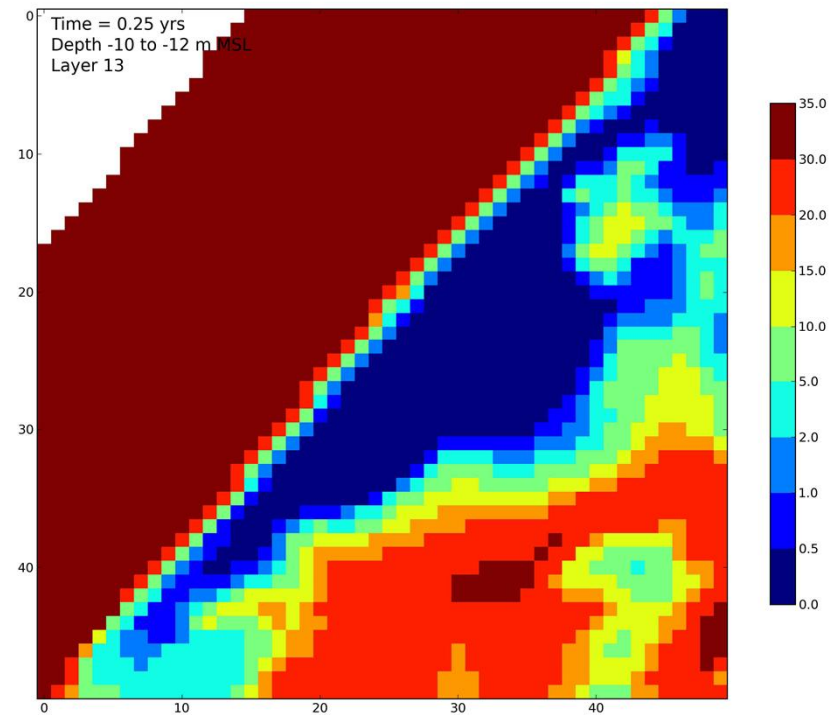
# Morphological change (20 years)



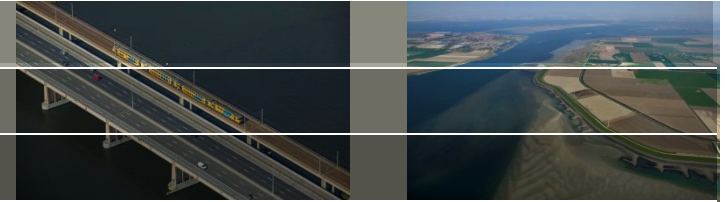
Calculated heads [m MSL] of Scenario: morphological change Sandmotor



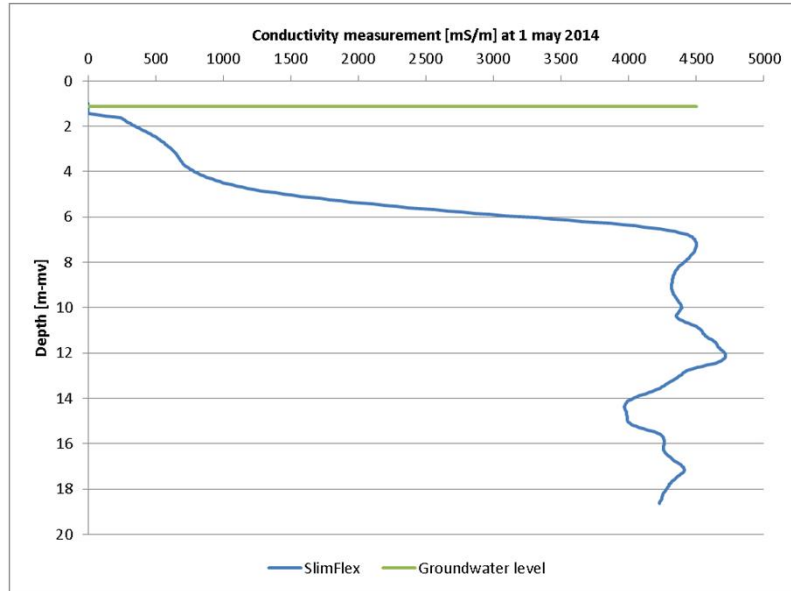
Calculated concentration [g/l] of Scenario: morphological change Sandmotor



# Morphological change (20 years)

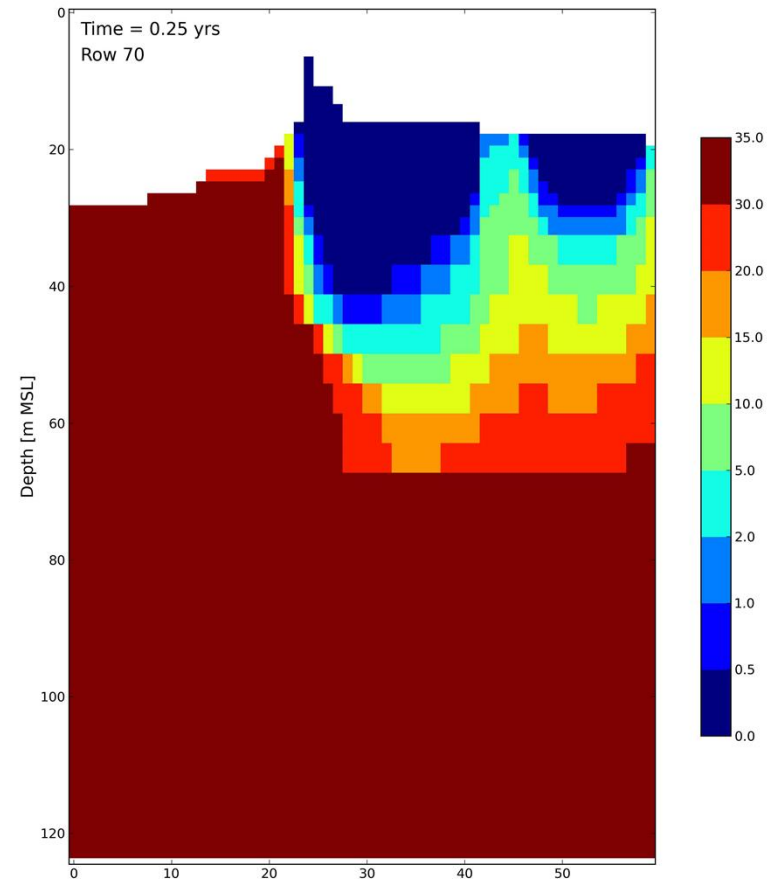


## Transect West- East

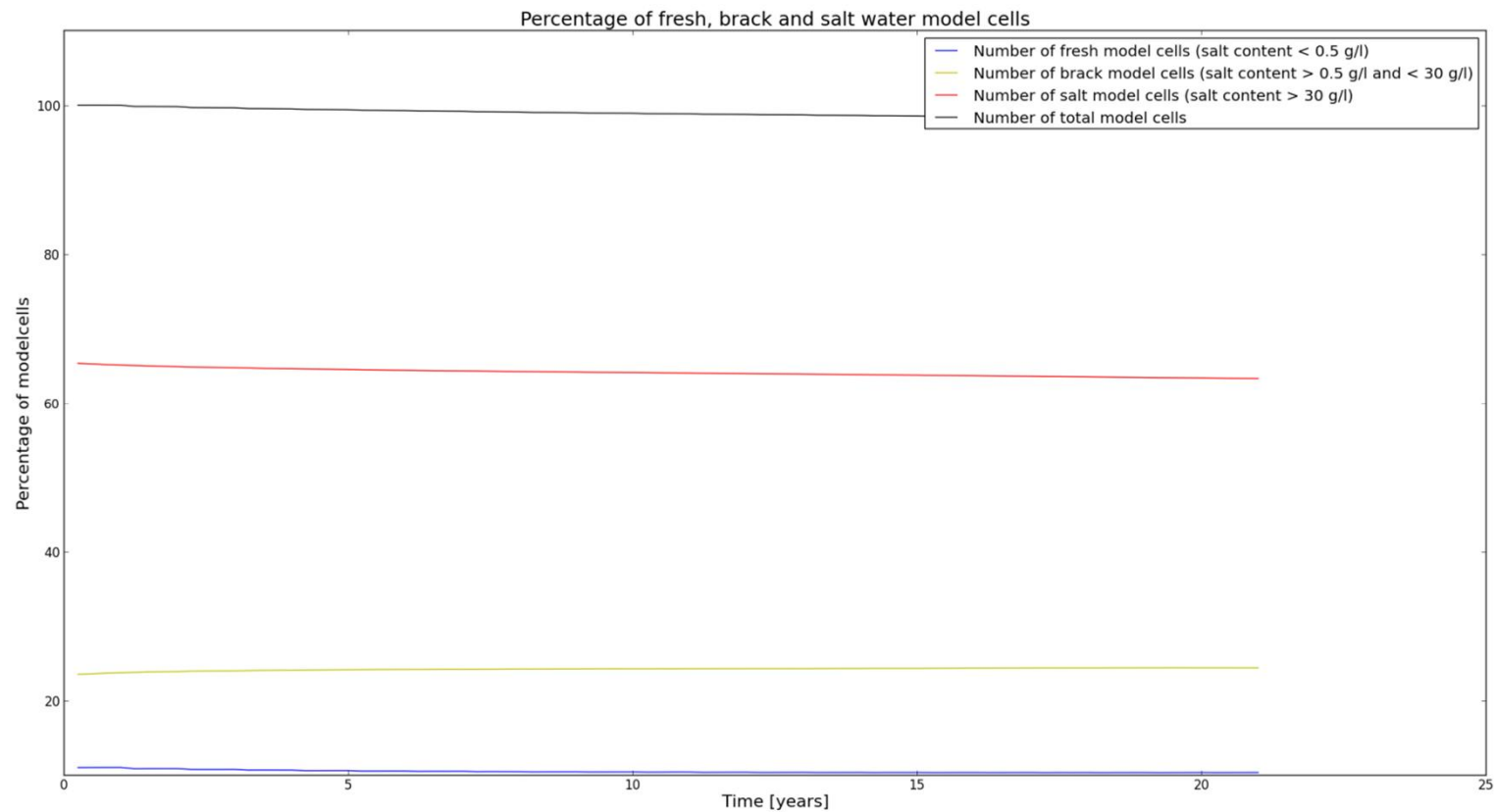
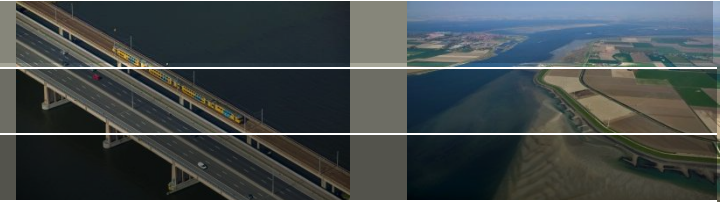


Measurement of conductivity in monitoring well on the center of the Sand Motor, approx. 3 years after creation Sand Motor

Calculated concentration [g/l] of Scenario: morphological change Sandmotor



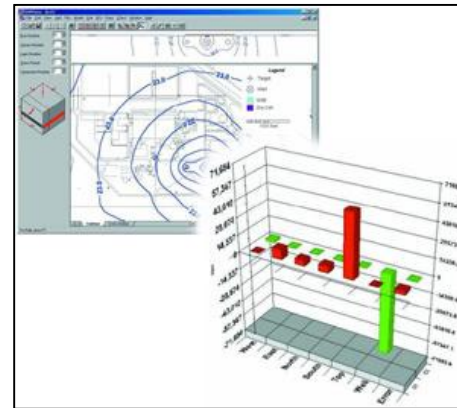
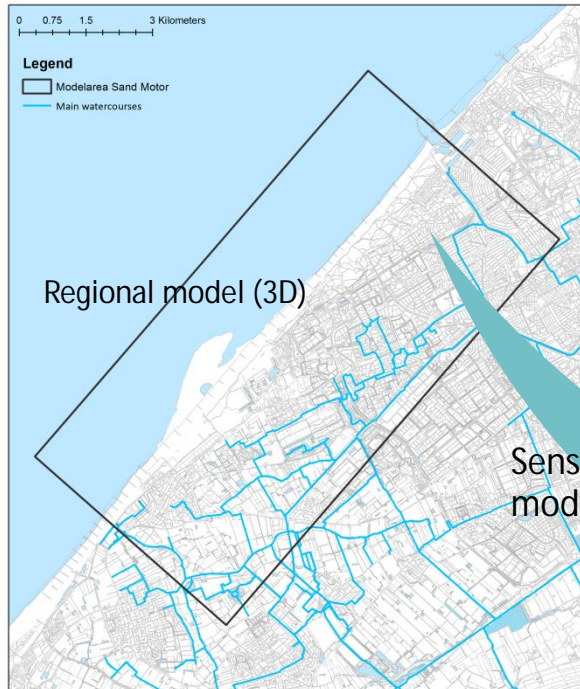
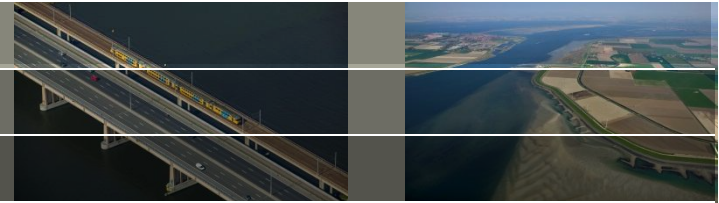
# Preliminary results



Small decline in amount of fresh and salt cells, small increase amount of brack cells



# Future: Work in progress



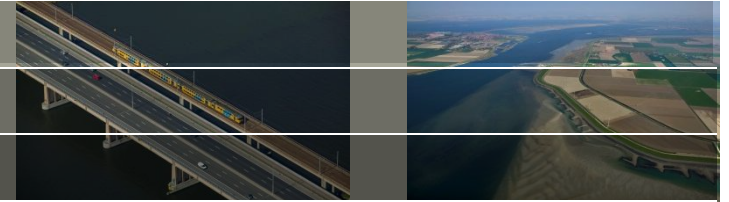
Uncertainties morphology and climate change

Transient calculations scenario(s)

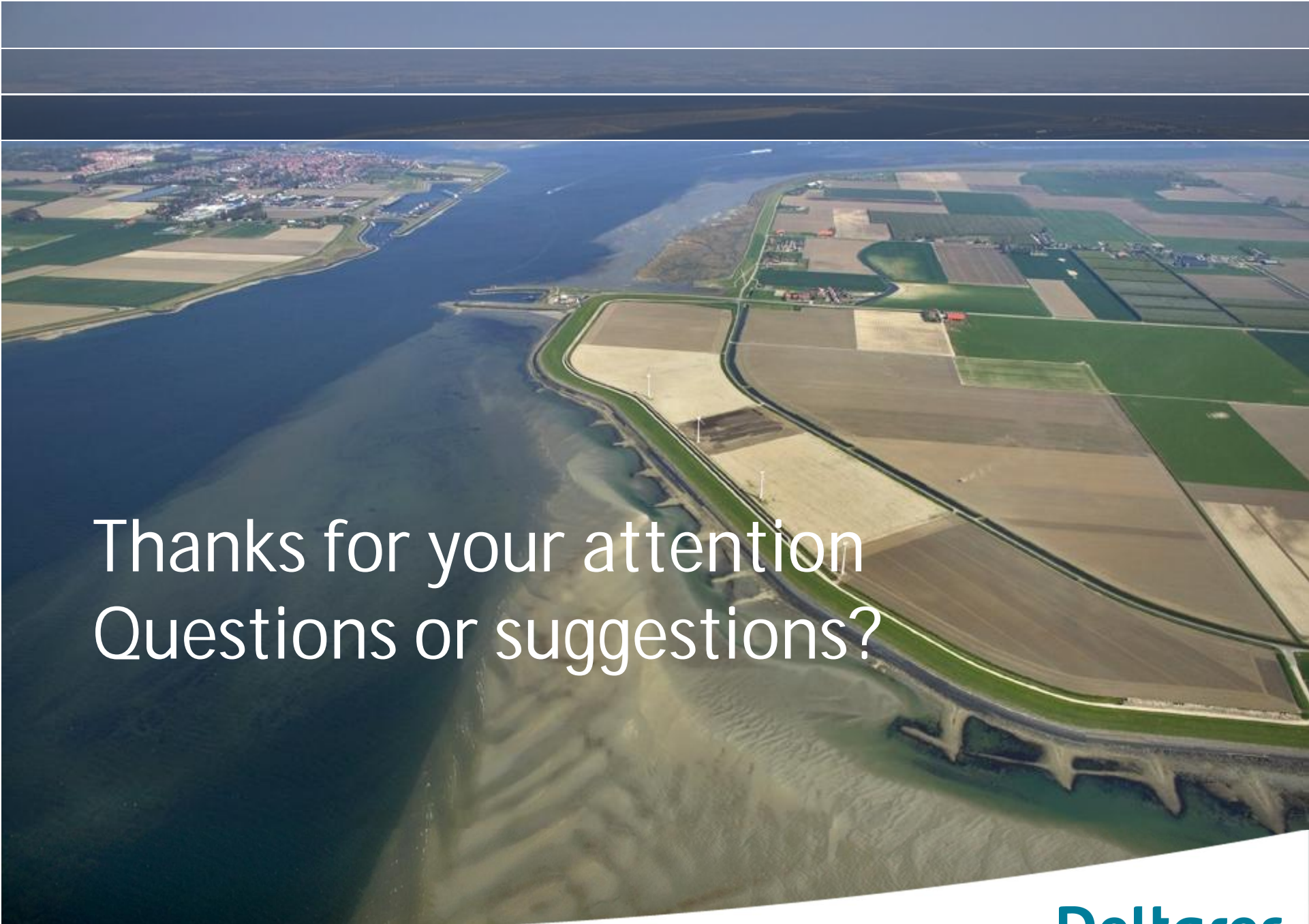
Change in fresh water quantity



# Conclusion



- Future steps
  - Detailed calculations (finer grid size)
  - More sensitivity analysis and further calibration
  - More scenario calculations (climate change, etc.)
  
- Conclusion
  - Preliminary results show negligible change in fresh water quantity

An aerial photograph showing a coastal region. On the left, a large body of water (likely a bay or estuary) is visible. A town with numerous buildings is situated on a peninsula or along the coast. To the right, there are extensive agricultural fields, some green and some brown, separated by roads and ditches. A prominent feature is a long, narrow strip of land or a dike that runs parallel to the water, with several small structures or wind turbines along its length. The overall scene depicts a mix of urban, agricultural, and coastal environments.

Thanks for your attention  
Questions or suggestions?

**Deltares**