

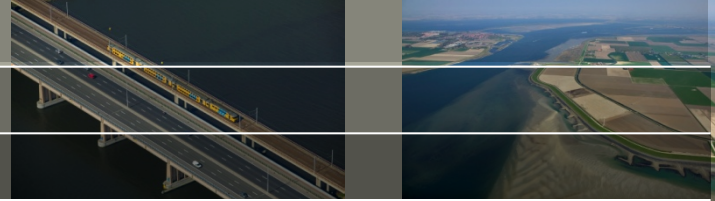


Buildings and infrastructure on coastal dunes

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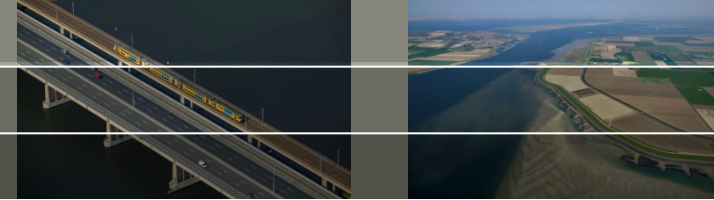
- 1) Deltares
- 2) Hoogheemraadschap Hollands Noorderkwartier
- 3) Hoogheemraadschap Rijnland
- 4) Rijkswaterstaat
- 5) Deltaprogramma

Contents of the presentation



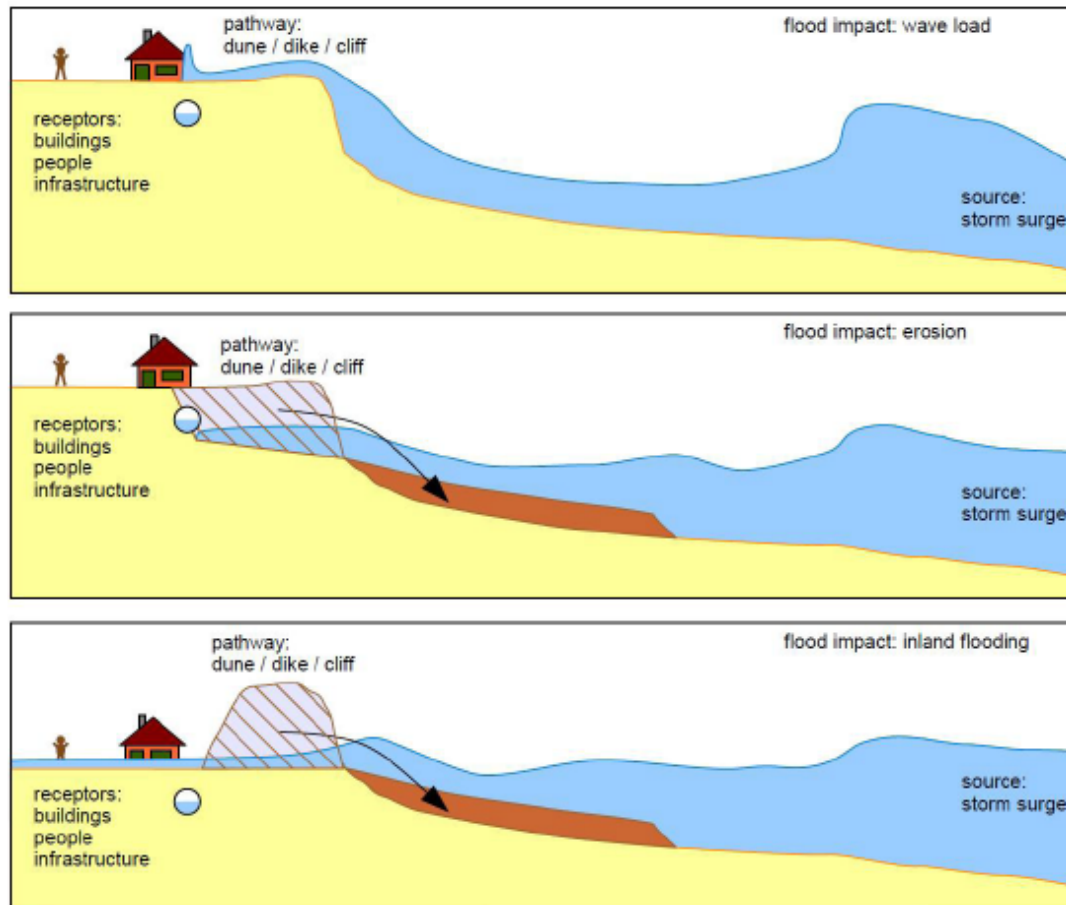
- 1) Introduction
- 2) Types of buildings and infrastructure
- 3) Storm impact on dunes with structures
- 4) Numerical models
- 5) Future plans for international co-operation

1) Introduction



Social pressure

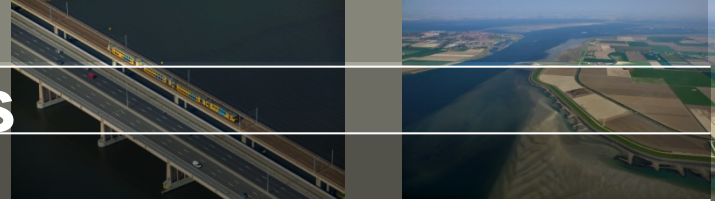
Climate change



We can expect flooding hazards more often and more catastrophic

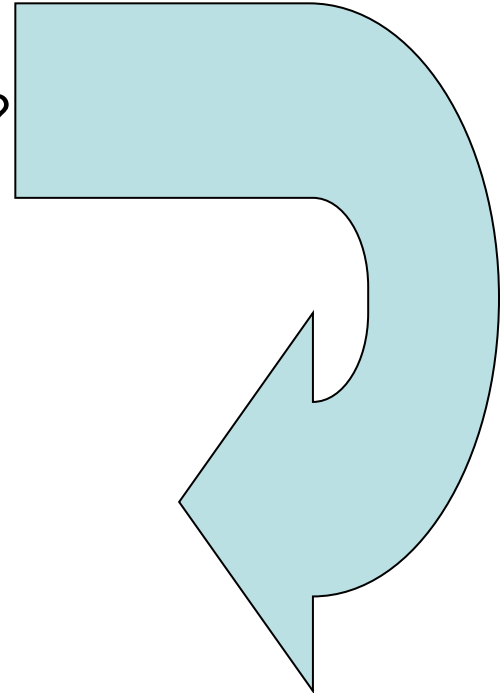
Deltares

Need for legislative guidelines



Coastal Zone Management Questions:

- What can we safely build in coastal areas?
- Where can we safely build in coastal areas?
- How can we safely build in coastal areas?



Legislative guidelines

We are not able to assess the impact of buildings and infrastructure on coastal safety

Guidelines for building and infrastructure



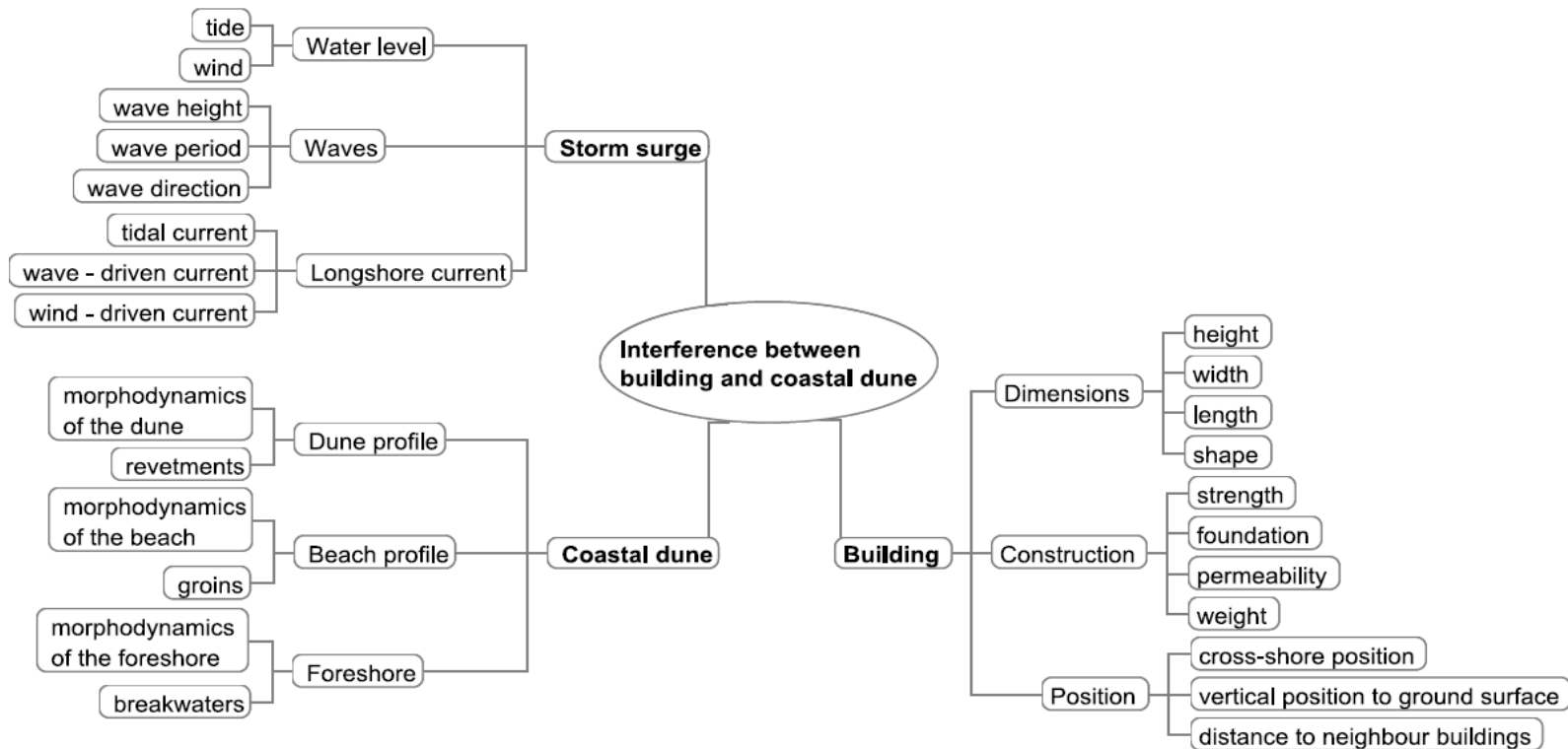
The guidelines need to take into account the local situation:

- Role of the government
- Existing legislation
- Balance between costs and benefits (financial and non-financial)
- Social flexibility

Guidelines for building and infrastructure need to be implemented locally

Assessment tools to predict the impact of flooding

Assessment tools are needed to predict what can really happen.
(see our abstract at p 77)



Guidelines for building and infrastructure need numerical models

2) Types of buildings and infrastructure

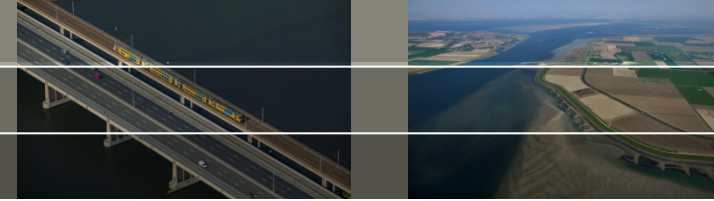


There is a large variation of building and infrastructure (structures) built on coastal dunes:

- Sea defence structures
- Residential Buildings (temporary and permanent)
- Military objects
- Windmills and navigation guidance
- Industrial objects

There is a large variation in buildings and infrastructure in coastal areas

Sea defence structures



Dune revetment



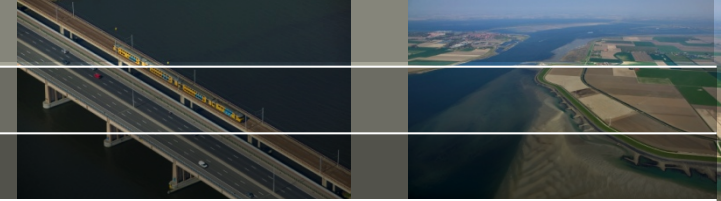
Sea dike

Residential buildings (temporary and permanent)



Buildings of Scheveningen with beach restaurants

Military objects (Bunkers)



Bunkers from the Atlantic Wall in Oostende

Windmills and navigation guidance

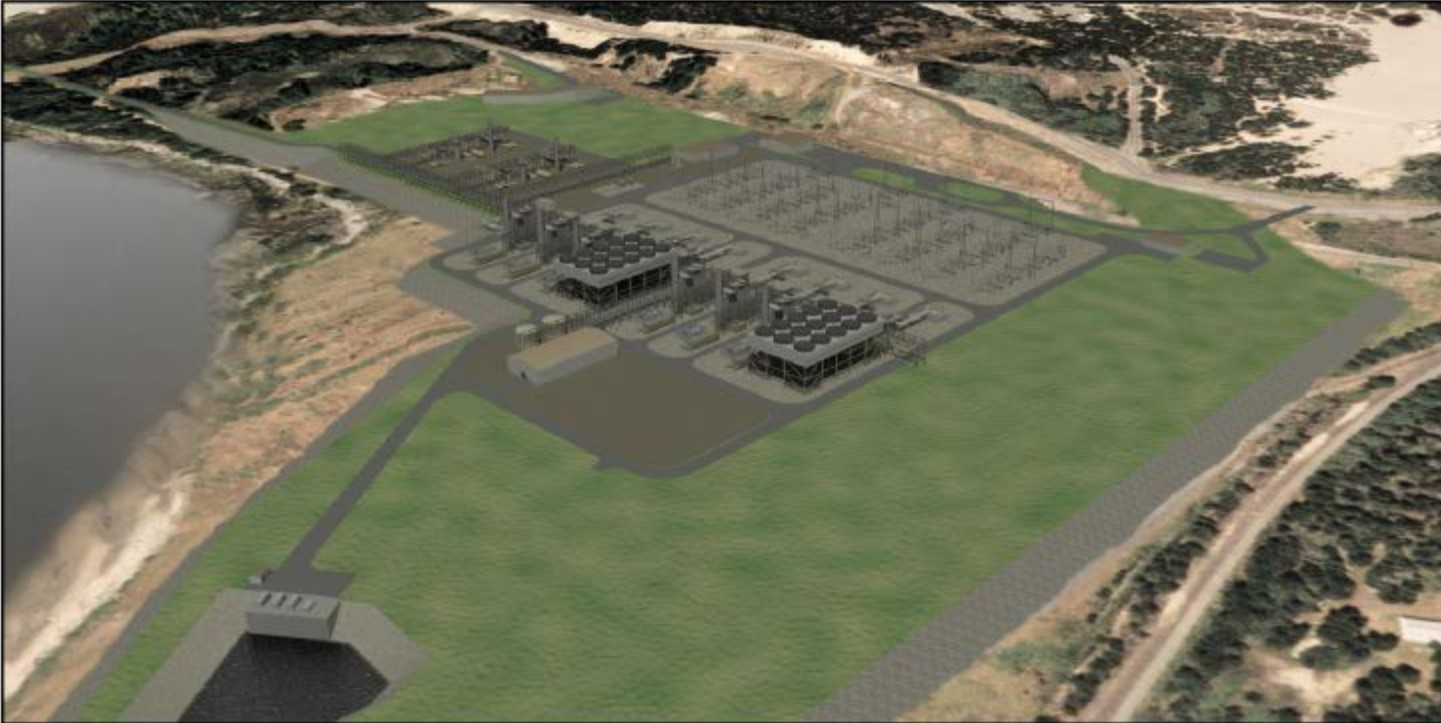


Construction of a windmill



Lighthouse

Industrial objects



Jordan Cove South Dunes Power Plant, Oregon

3) Storm impact on dunes with structures



Objects show a different type of response on dune erosion / flooding:

- Destruction of the object by flooding / wave attack
- Destruction of the object by dune erosion
- Sliding of by dune erosion
- Increase of dune erosion by structures

Also the final impact can be different

- Dune failure and loss of properties and lives
- Debris and contamination

There are various impacts of a storm surge on buildings and infrastructure

Destruction by flooding / wave attack

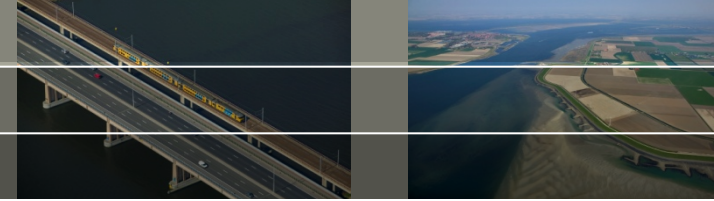


Connecticut 1954, Hurricane Carol



Hurricane Sandy

Sliding off by dune erosion



Dune erosion below bunker



Sliding off the dune



Bunker on the beach



Bunkers in the surf zone

Increase of dune erosion by structures



Dune erosion next to a swimming pole



Laboratory experiment with a dune next to a dike

Dune failure and loss of properties and lives

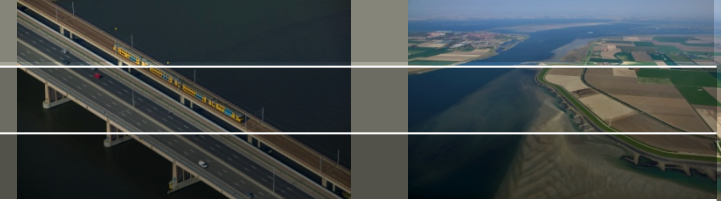


Dune breaching and flooding of the hinterland



Loss of properties and lives

Debris and Contamination

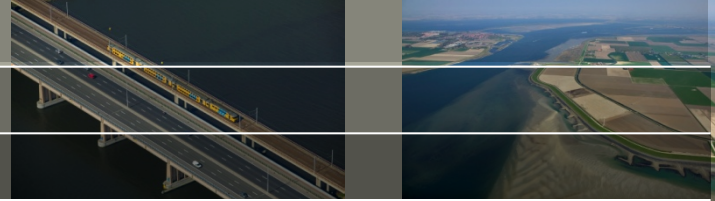


Debris



Contamination

4) Numerical models

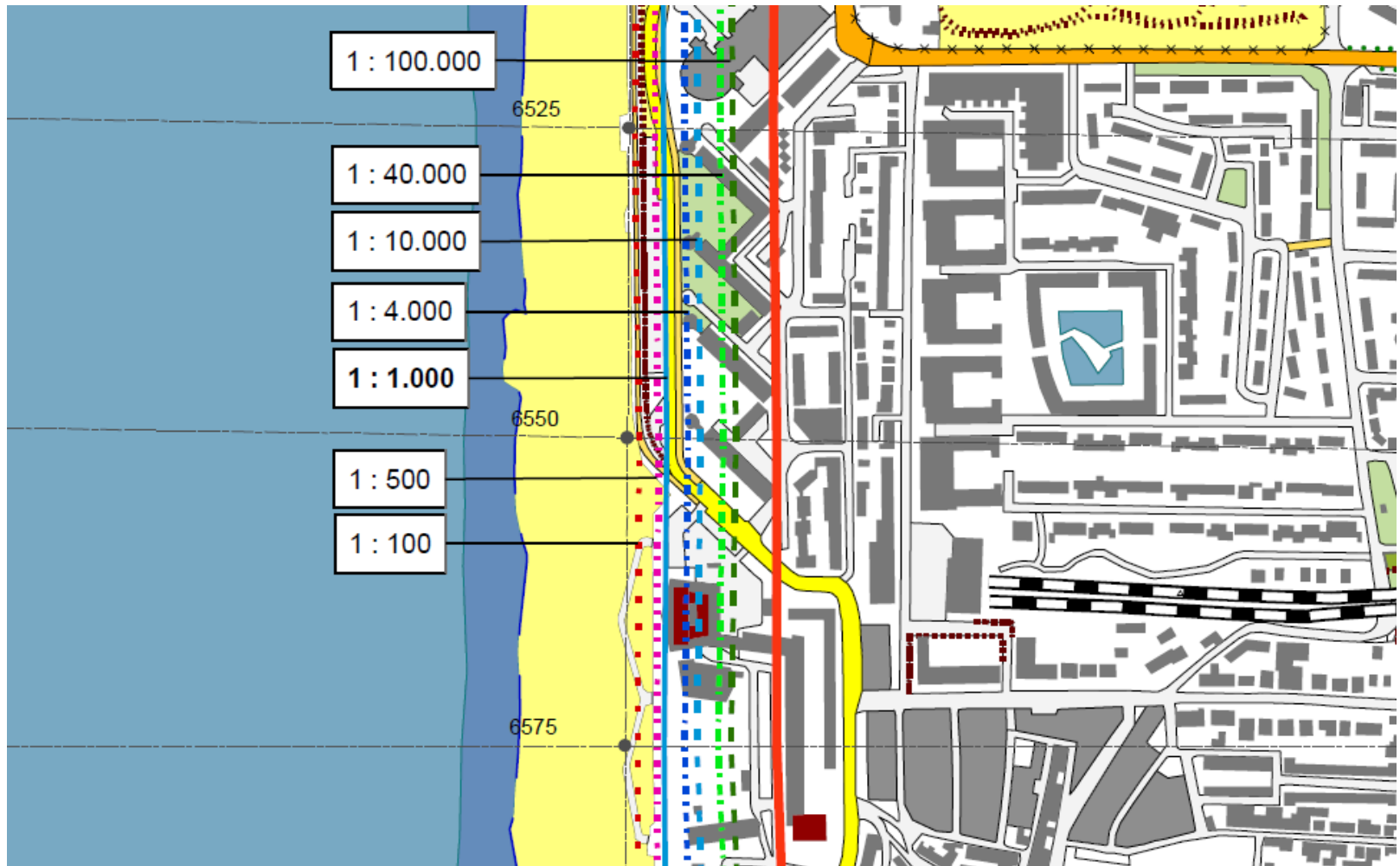


- 1) A general flood hazard map which shows the probability of flooding:
 - Numerical model
 - Statistics of storm surge level and waves
 - Altimetry / bathymetry
 - Soil characteristics

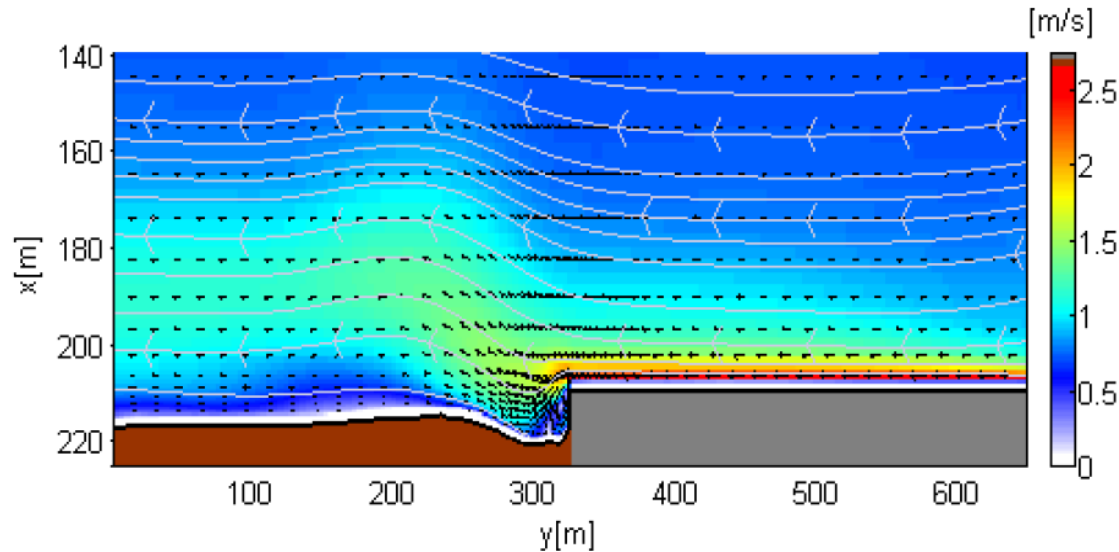
- 2) A detailed study on the impact of the storm surge on buildings and infrastructure
 - Properties of buildings and infrastructure

Numerical models are needed for the assessment of coastal safety

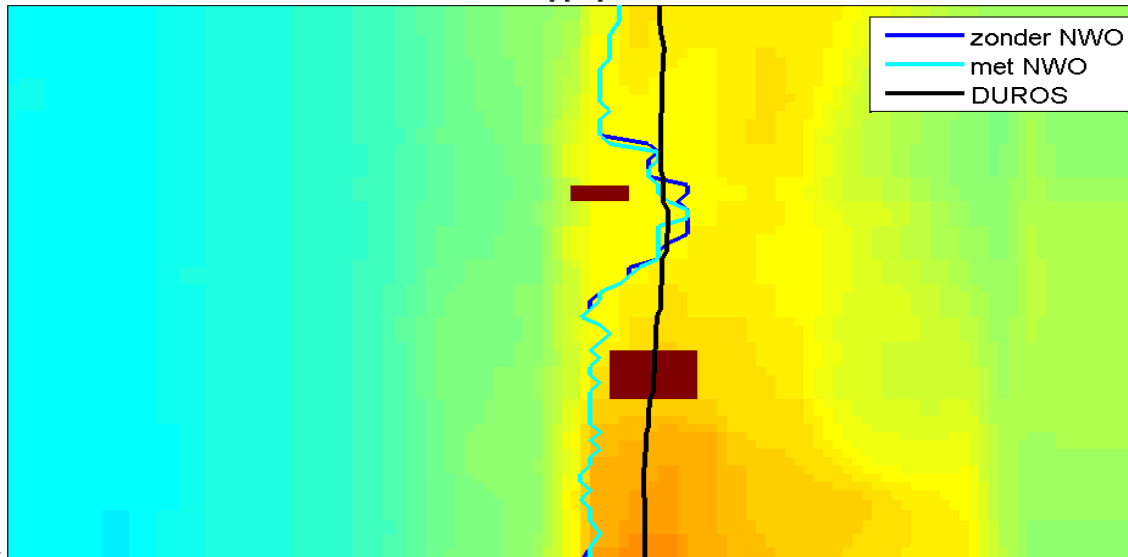
Flood hazard map



Compute the impact of hard structures

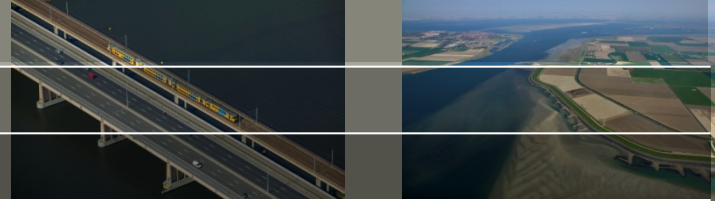


Xbeach computation of
dune erosion beside a dike



Xbeach computation of
The impact of a hard structure

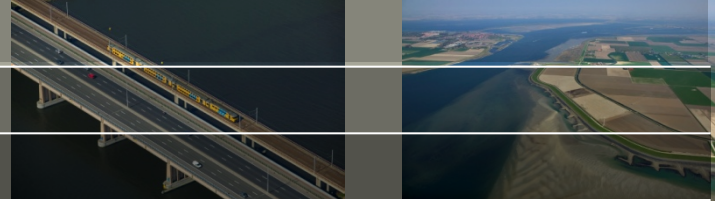
5) Future perspective



The Dutch government is in need of guidelines for buildings and infrastructure and is thinking about an international research programme:

- Sharing of present national guidelines
- Sharing of field data and lessons learnt
- Sharing of lab data
- Development of numerical models
- Development of international guidelines for buildings and infrastructure

Coastal safety benefits from international research



Thank you
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