

I DON'T BELIEVE IN  
GLOBAL WARMING

## climate responsive spatial adaptation - research by design on the Flemish coast

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**CcASPAR** **AMRP**  
CLIMATE CHANGE AND CHANGES IN SPATIAL STRUCTURES  
RESEARCH PROJECT



agentschap voor Innovatie  
door Wetenschap en Technologie

# the aim of the research

## AIM OF THE PROJECT

- What climate related problems do occur at the Flemish coast?
- How can we adapt the Flemish coast to (ongoing) global warming?
- Which adaptation strategies are currently in place or under development?
- Which alternatives could/should be developed?

## METHODS AND FOCUSPOINTS

- Research by design as a method for scenario explosion
- Imbedded in a large, interdisciplinary research project on climate change and changes in spatial structures within Flanders (CcASPAR, financed by IWT)



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**1. WHICH CLIMATE IMPACTS DO WE NEED TO ADAPT TO?**

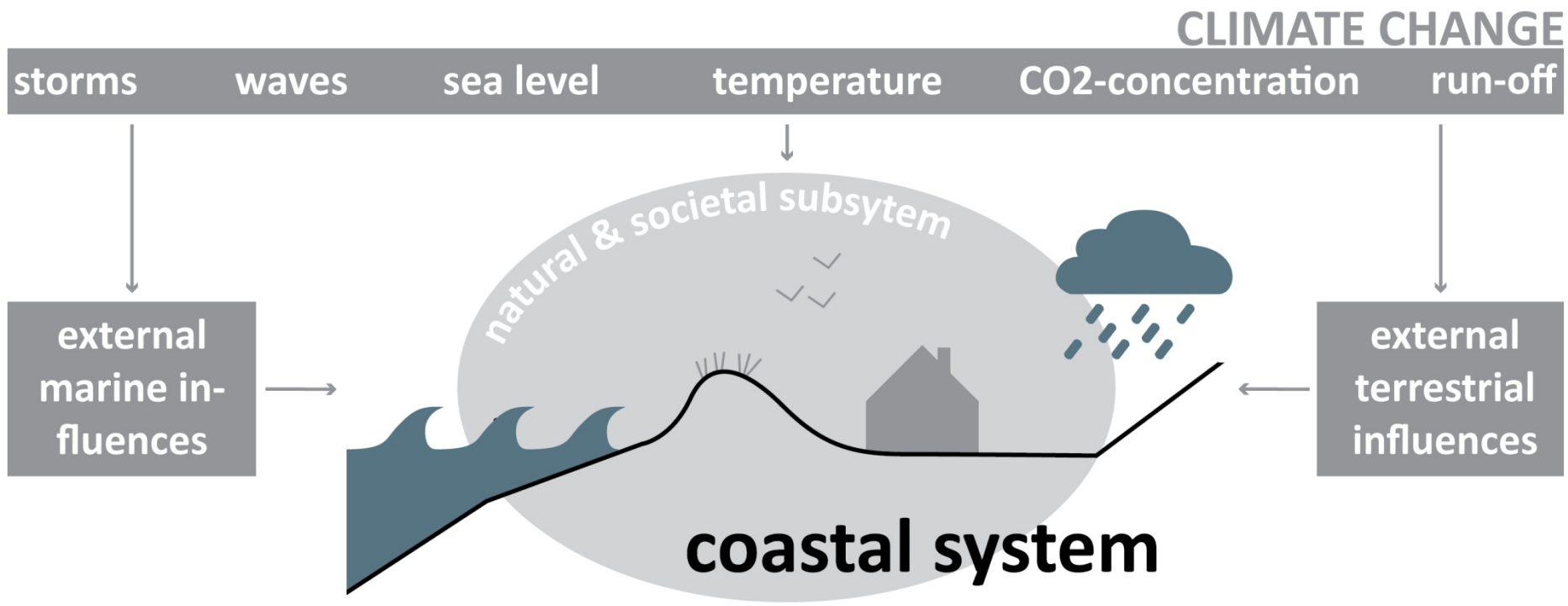


# definition of the coastal system

'Here, coastal systems area considered as the interacting low-lying areas and shallow coastal waters, including their human components. This includes adjoining coastal lowland, (...), but excludes the continental shelf and ocean margins.' (THIRD ASSEMENT REPORT, IPCC)



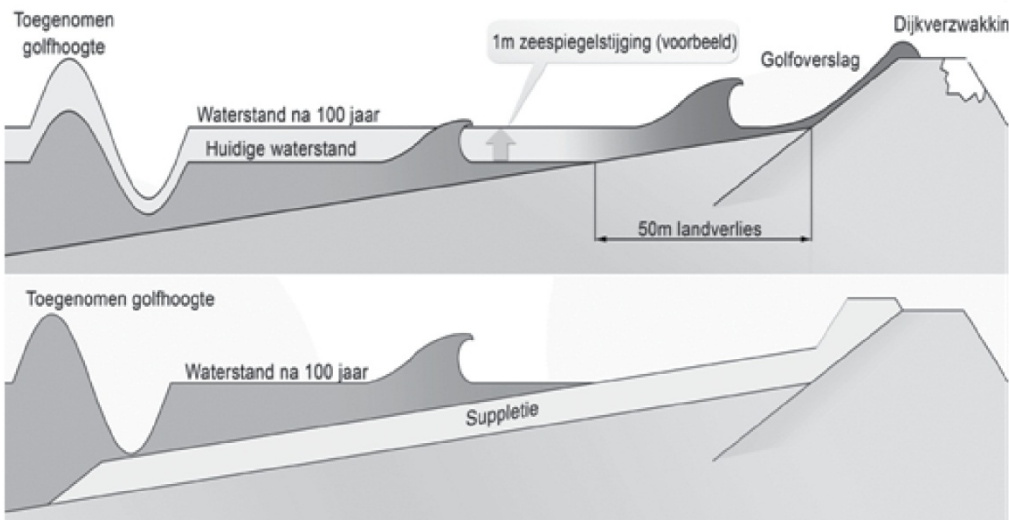
# the IPCC framework on climate change in coastal systems



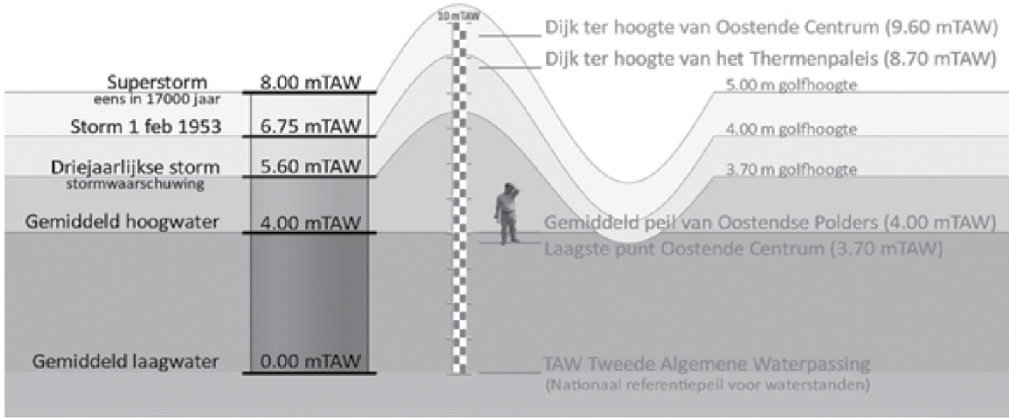
scheme of climate change in coastal systems (based upon third assesement report of the IPCC)



# external MARINE influences in the flemish coastal system



the effect of sea level rise on stormwaves (Vlaamse Baaien, 2010)



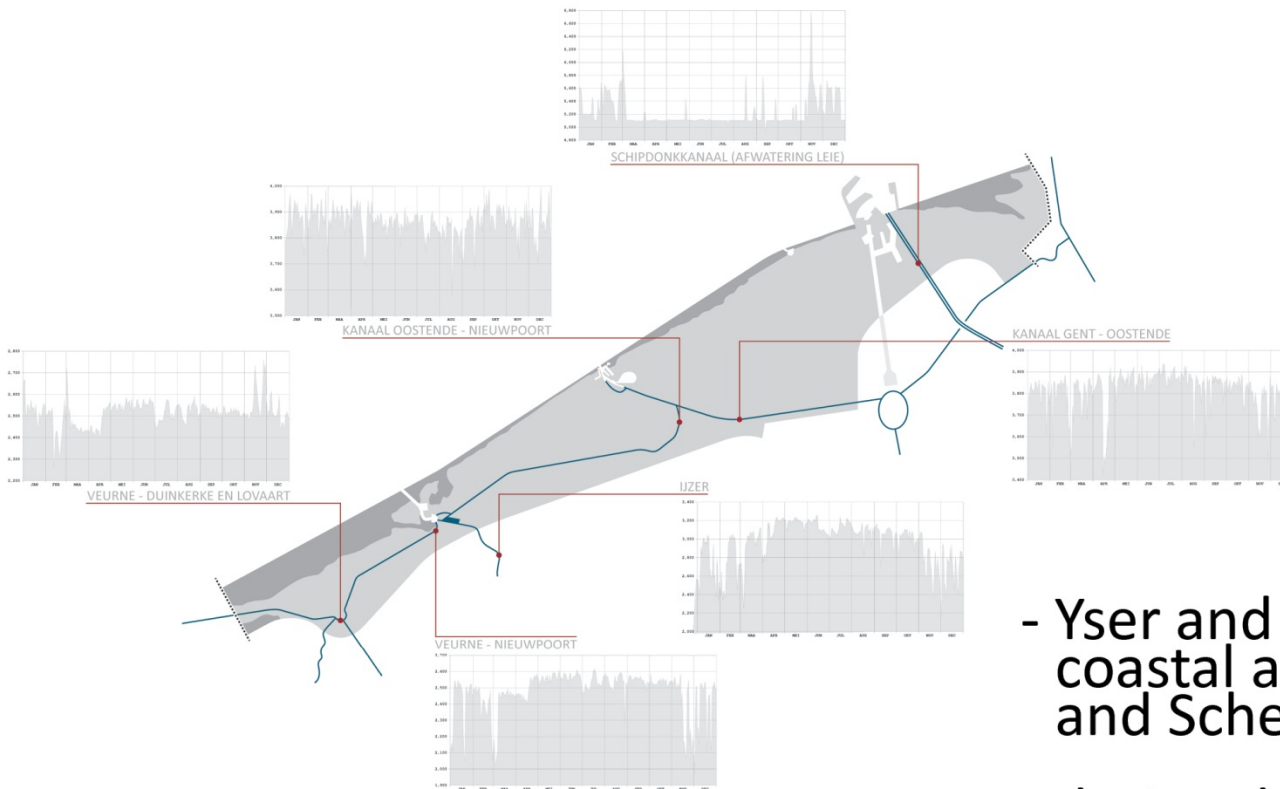
estimated sea level rise and waves (Vlaamse Baaien, 2010)

- current low tide = +/- 0mTAW
- current high tide = +/- 4mTAW
- polders = 3 to 4 mTAW
  
- permanent floods aren't really a problem / risk
  
- BUT! sea level rise causes higher waves during storms
  
- sea level rise of 1m = 4m higher waves (CLIMAR, 2011)
  
- higher waves causes storms to have more and more impact
  
- (super)storms will occur more frequently and so coastal safety needs to be updated





# external TERRESTRIAL influences in the flemish coastal system



water level in Yser and channels during 2010  
(data source: Hydrological Yearbook 2010)

- Yser and channels link the coastal area to the valley of Lys and Scheldt
- during drought little run-off, during storm peak run-off (Van Den Berghe, 2012)

# the NATURAL SUBSYSTEM at the flemish coastal system



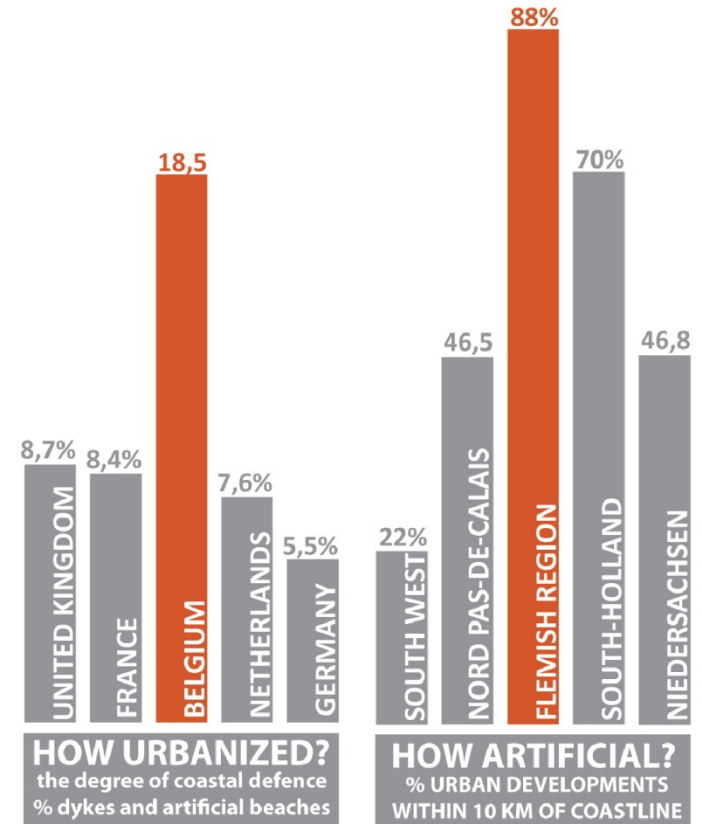
photo report of counteracting dune formation (Johan Kindt)

- erosion and sedimentation are inherent to the coastal system
- natural sand processes are however highly counteracted
- sea level rise will cause coastal erosion
- as a consequence 17 to 50% of the beach area would be lost by the year 2100
- AND what about drought, pluvial flooding, salination and urban heat island in the coastal system?...

# the SOCIETAL SUBSYSTEM at the flemish coastal system



flemish seaside resort Westende, 1992 (photo by Christian Meynen)



(graphics based upon Euroision report 2004)



## conclusion

- The challenge of climate adaptation in coastal systems is more than adapting to sea level rise.
- ‘De dreiging is niet acuut, maar de opgave is urgent.’  
‘The threat is not acute, but the challenge is urgent.’

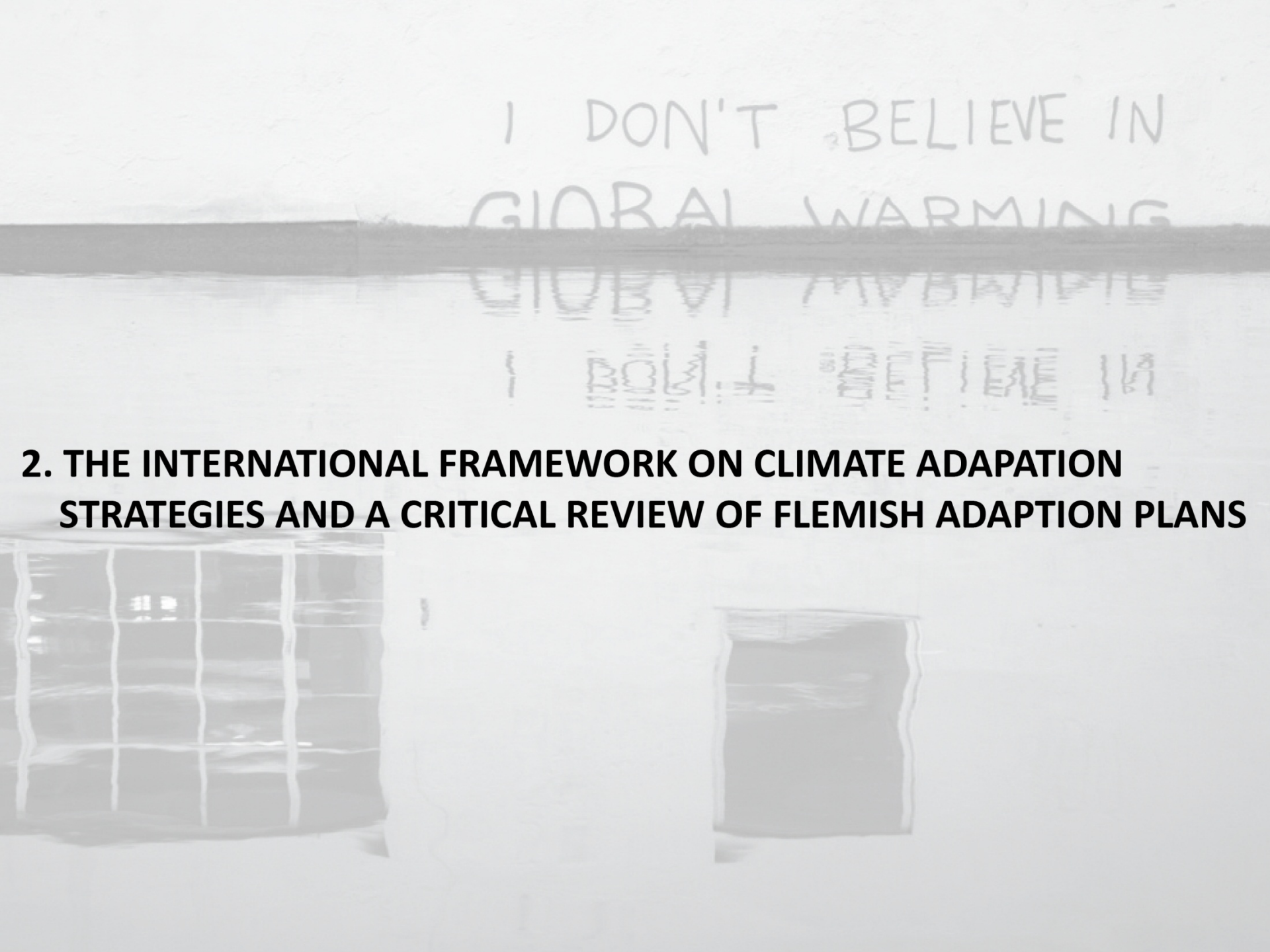
(Deltacommissie, 2008)

## why research by design for climate adaptation?

‘Sommige toekomsten kan men voorspellen, andere moet men ontwerpen.’

‘Some futures can be predicted, others must be designed.’

(Taeke de Jong, 1992)

A photograph of a building facade with graffiti that reads "I DON'T BELIEVE IN GLOBAL WARMING" and its reflection in a body of water. The text is mirrored in the water below. The background is a light, overcast sky.

I DON'T BELIEVE IN  
GLOBAL WARMING  
I DON'T BELIEVE IN  
GLOBAL WARMING

## **2. THE INTERNATIONAL FRAMEWORK ON CLIMATE ADAPATION STRATEGIES AND A CRITICAL REVIEW OF FLEMISH ADAPTION PLANS**

# sea level rise dominates the international literature...



cartoon sea level rise ([www.zmescience.com](http://www.zmescience.com))



... and also stir up the debate at the Flemish coast



cartoon sea level rise (RUIMTE, oktober 2011)



collage (info campaign BRV, 2012)

# focusing on SLR many adaptation strategies can be defined...

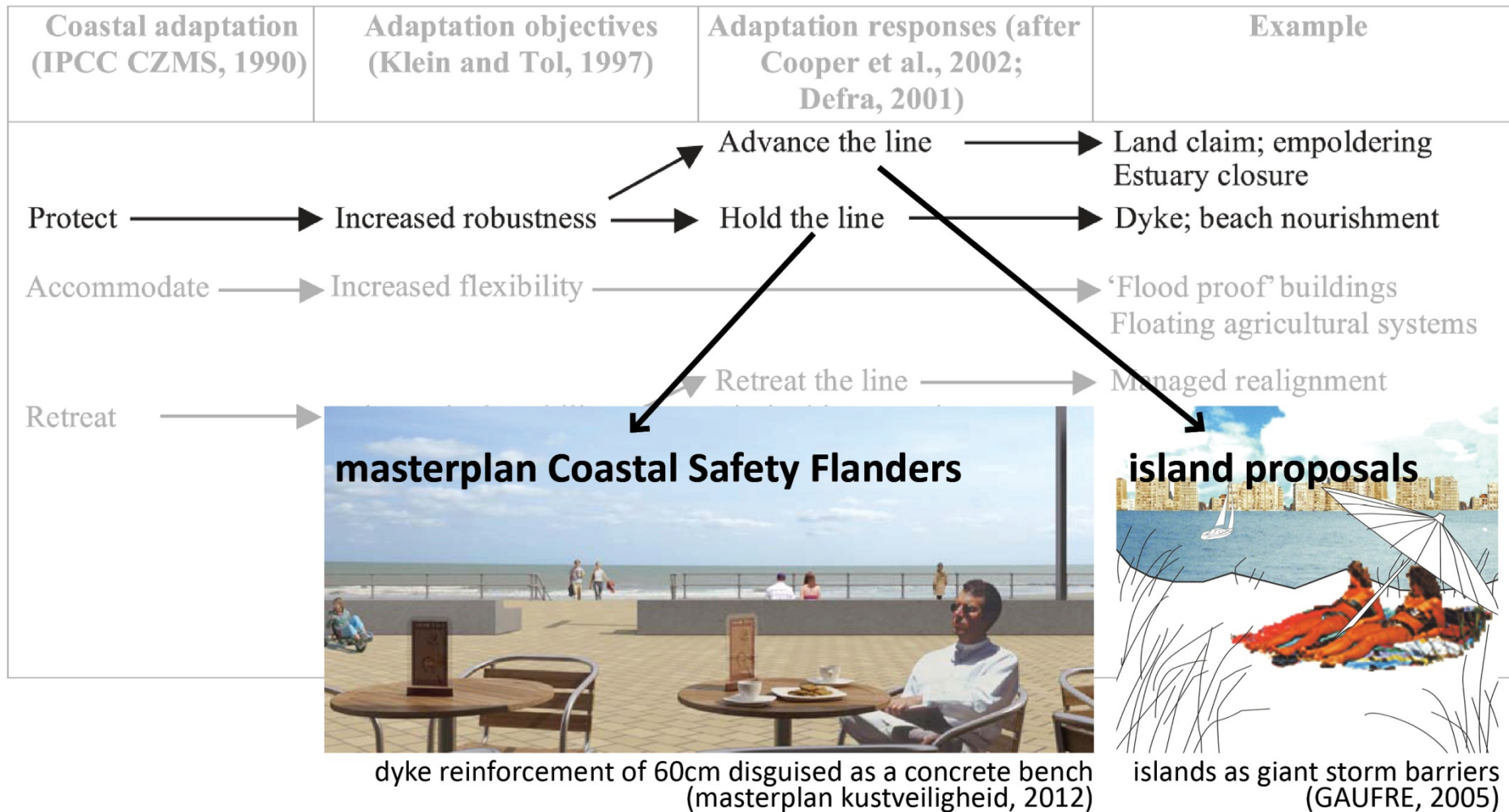
Coastal adaptation (IPCC CZMS, 1990)	Adaptation objectives (Klein and Tol, 1997)	Adaptation responses (after Cooper et al., 2002; Defra, 2001)	Example
Protect	Increased robustness	Advance the line	Land claim; empoldering Estuary closure
Accommodate	Increased flexibility	Hold the line	Dyke; beach nourishment
Retreat	Enhanced adaptability	Retreat the line	Managed realignment
		Limited intervention	Ad hoc seawall
		No intervention	Monitoring only
	Reversing maladaptive trends	Sustainable adaptation	Wetland restoration
	Improved awareness and preparedness	Community-focussed adaptation	Flood hazard mapping; flood warnings

evolution of planned coastal adaptation practices (IPCC third assesment report, 2007)





# ...but mainly PROTECT measures are in place or under development





# current strategies might get outdated on the long term



The dyke reinforcement of 60cm can be disguised as a concrete bench. ...  
(Masterplan Coastal Safety Flanders, 2012)



... but can a next dyke reinforcement be disguised?  
(modification of previous collage)

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### **3. THE VLAKTE VAN DE RAAN - ON THE LOOKOUT FOR A STRATEGIC SITE FOR ISLAND DEVELOPMENT**



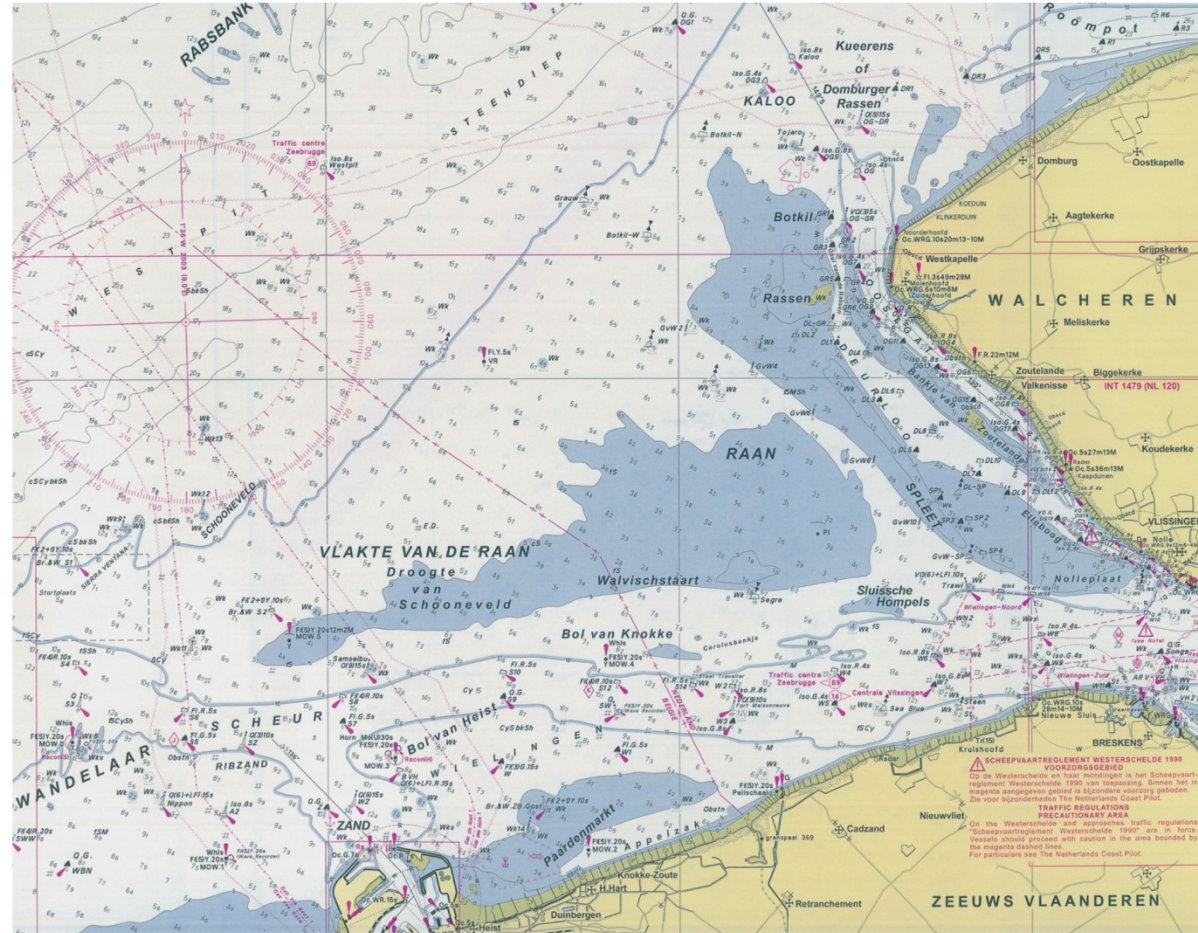




# location Vlakte van de Raan



overview sandbanks North Sea

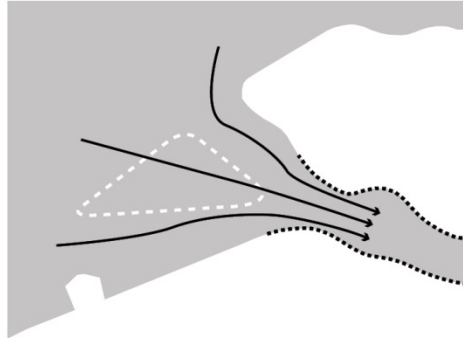


topographic map Vlakte van de Raan

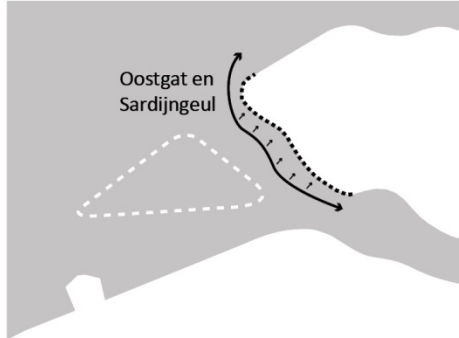
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CLIMATE CHANGE

# the Vlakte van de Raan as strategic spot

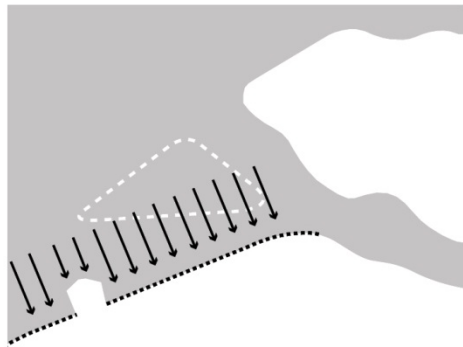
## climate impacts



tide in the Westerscheldt

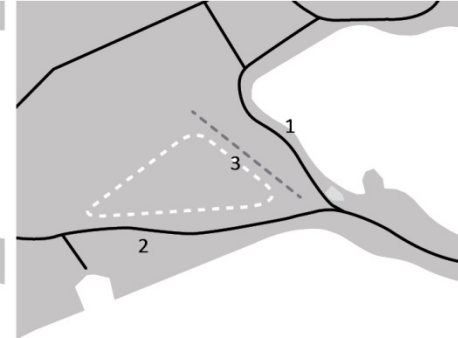


coastal erosion Walcheren

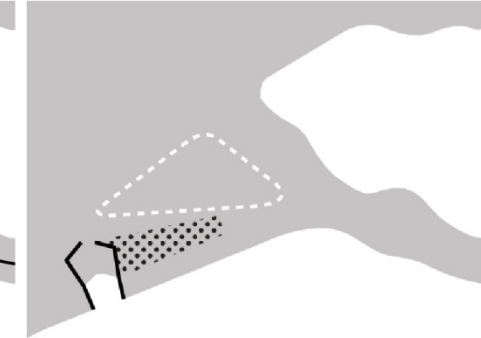


coastal protection

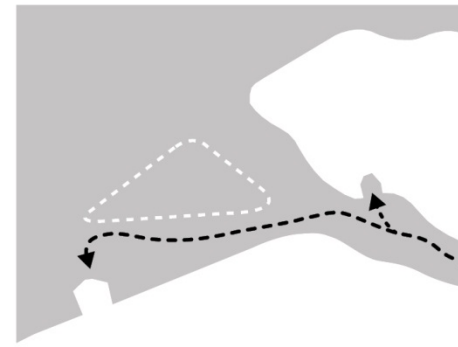
## socio-economic development



sea lanes Westerscheldt



port of Zeebrugge



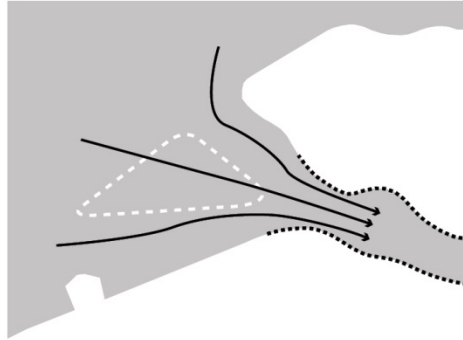
estuary shipping



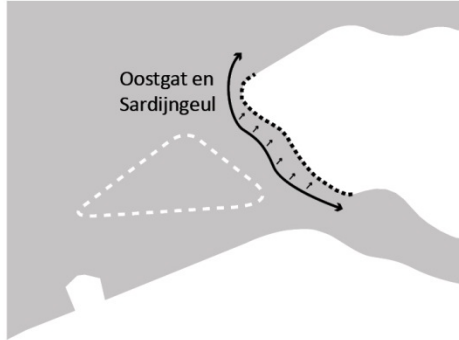
nature development

# the Vlakte van de Raan as strategic spot

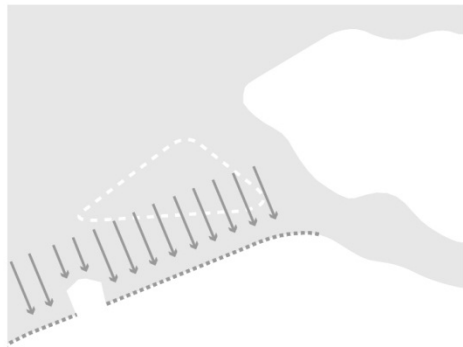
## climate impacts



tide in the Westerscheldt



coastal erosion Walcheren

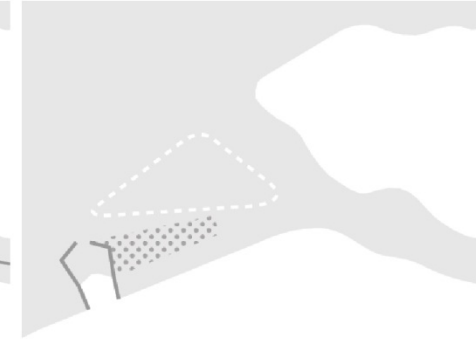


coastal protection

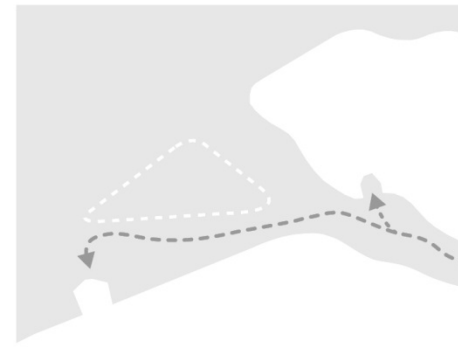
## socio-economic development



sea lanes Westerscheldt



port of Zeebrugge



estuary shipping



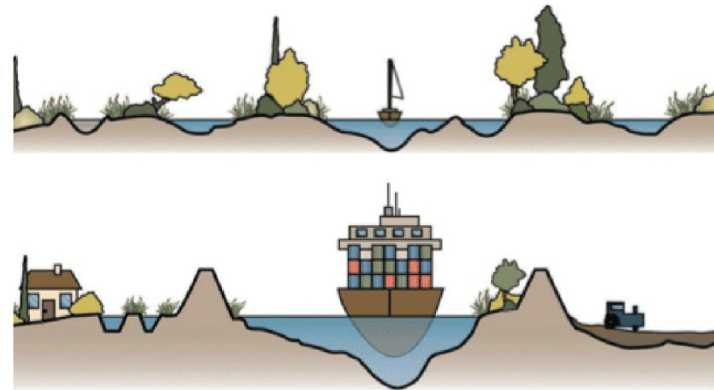
nature development



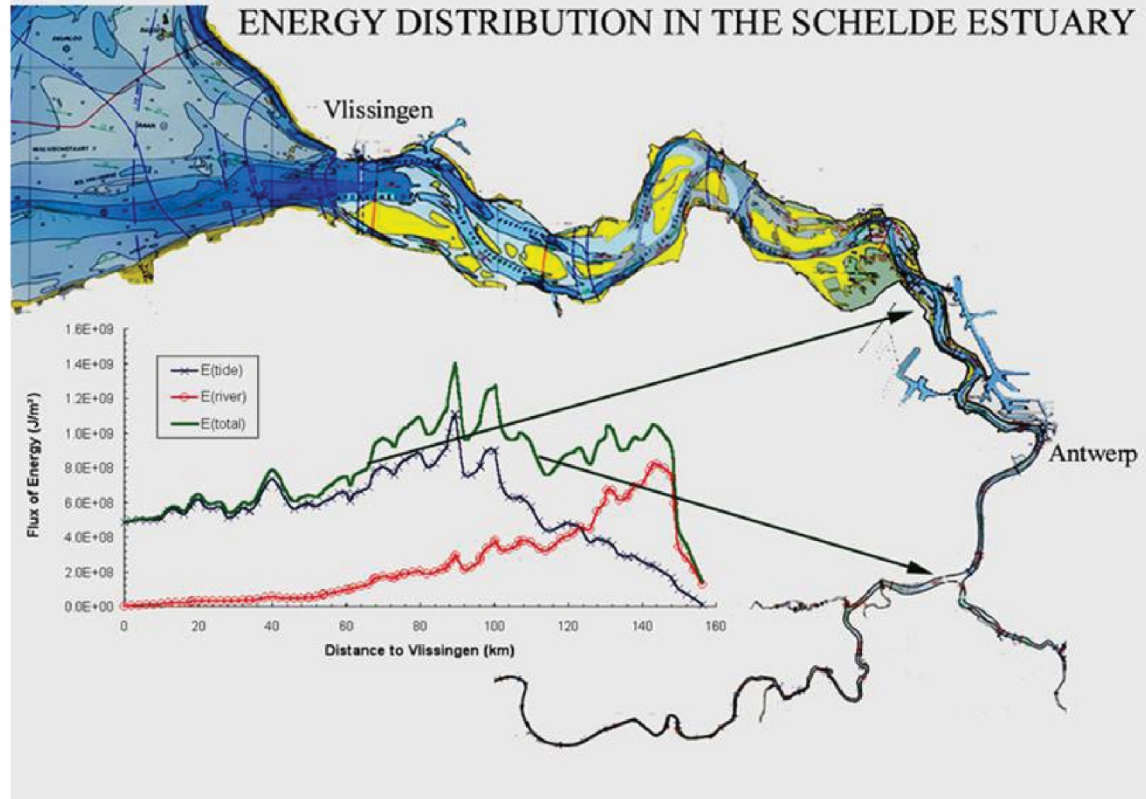
# climate impacts - TIDE IN THE WESTERSCHELD



controlled tidal inlet polder - Lippenbroek

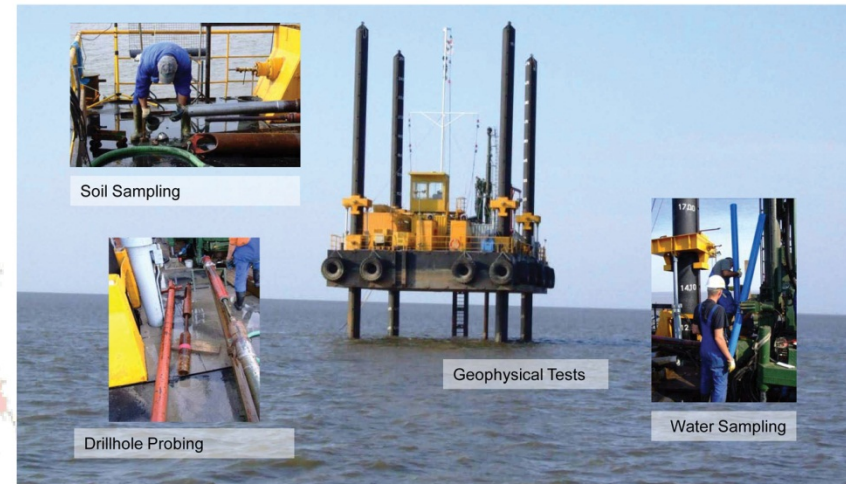
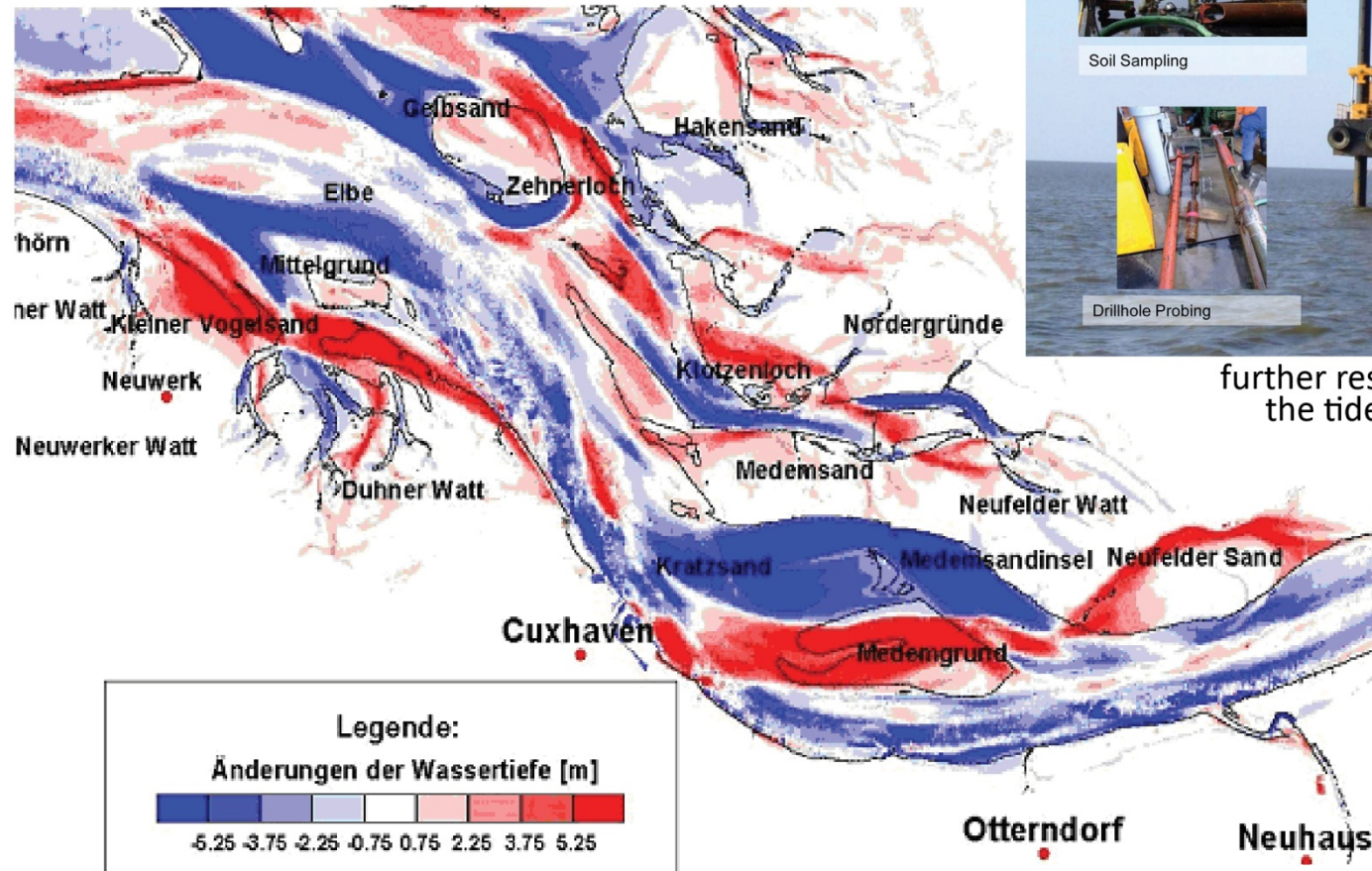


evolution Elbe estuary ([www.deltanet.eu](http://www.deltanet.eu))



(Wartel and Chen, 2002)

# climate impacts - TIDE IN THE WESTERSCHELDT



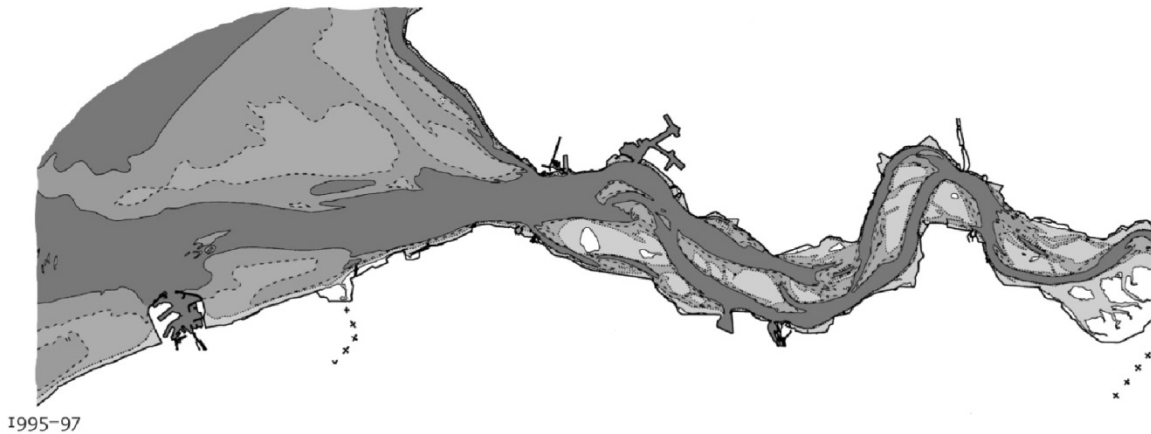
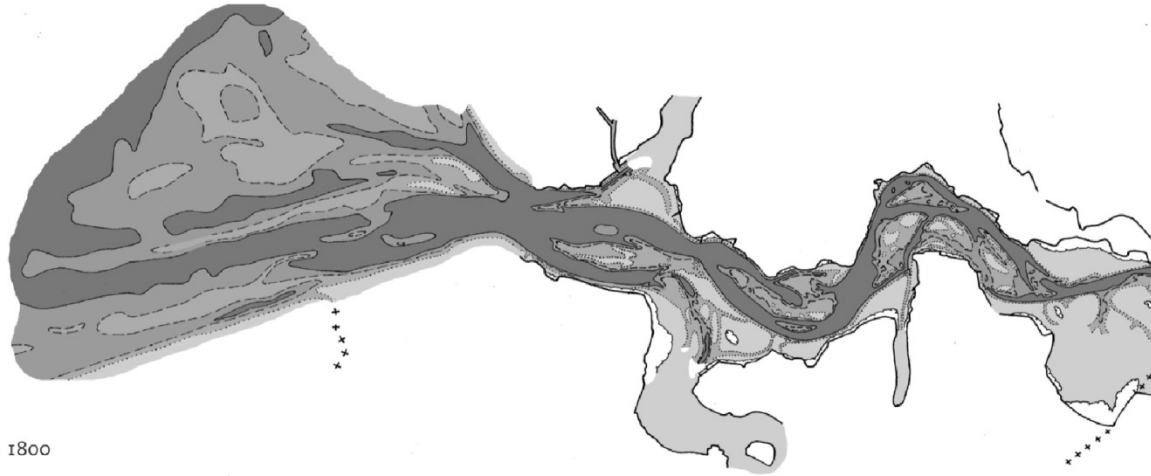
further research in the Elbe estuary within the tide project (Manfred Meine, 2011)

100.000 m<sup>3</sup> loss of soil in 30 years resulted in higher tidal inlet (Manfred Meine, 2009)

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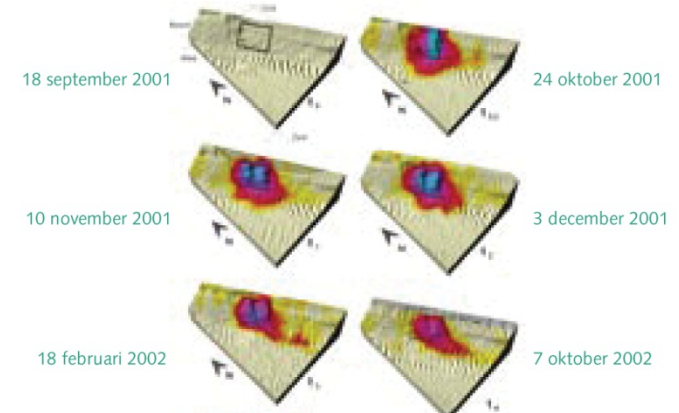
# climate impacts - COASTAL EROSION WALCHEREN



evolution Westerscheldt estuary (Peeters, 2006)



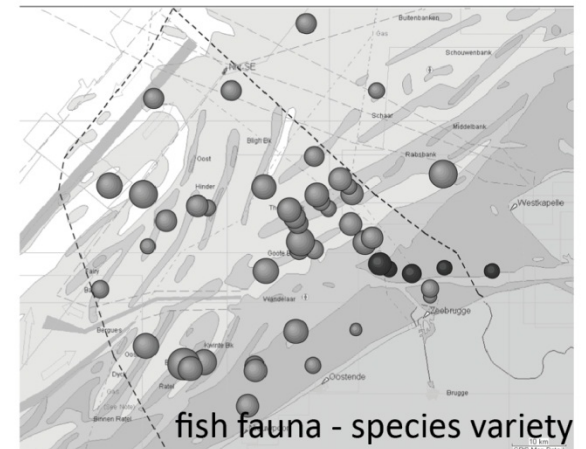
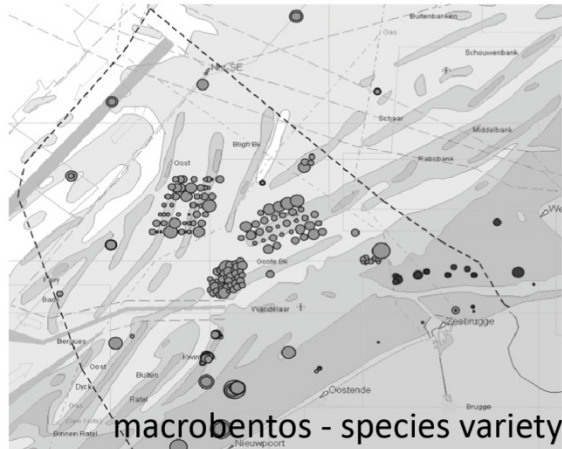
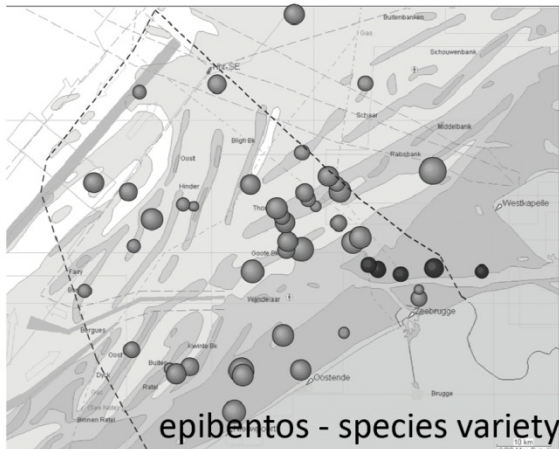
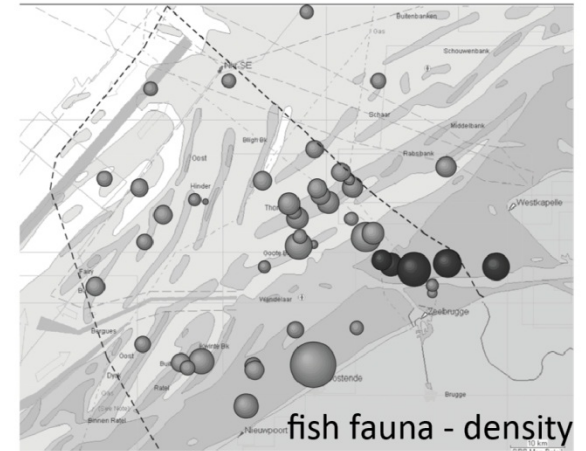
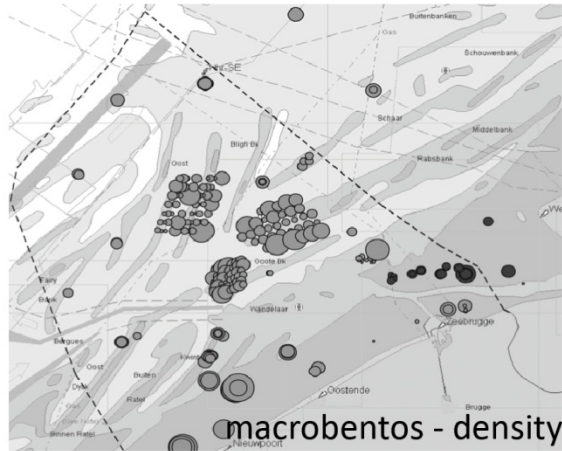
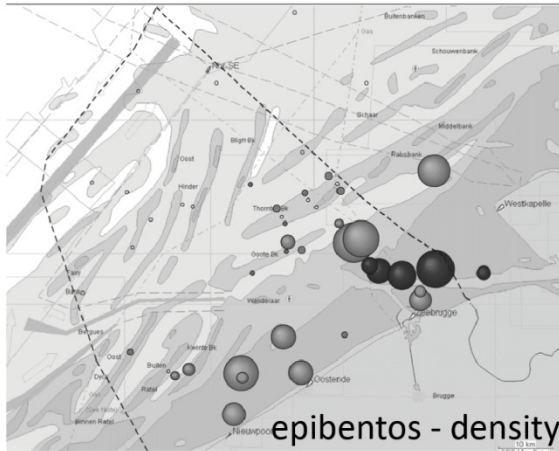
shipping near Walcheren



nourishments Walcheren



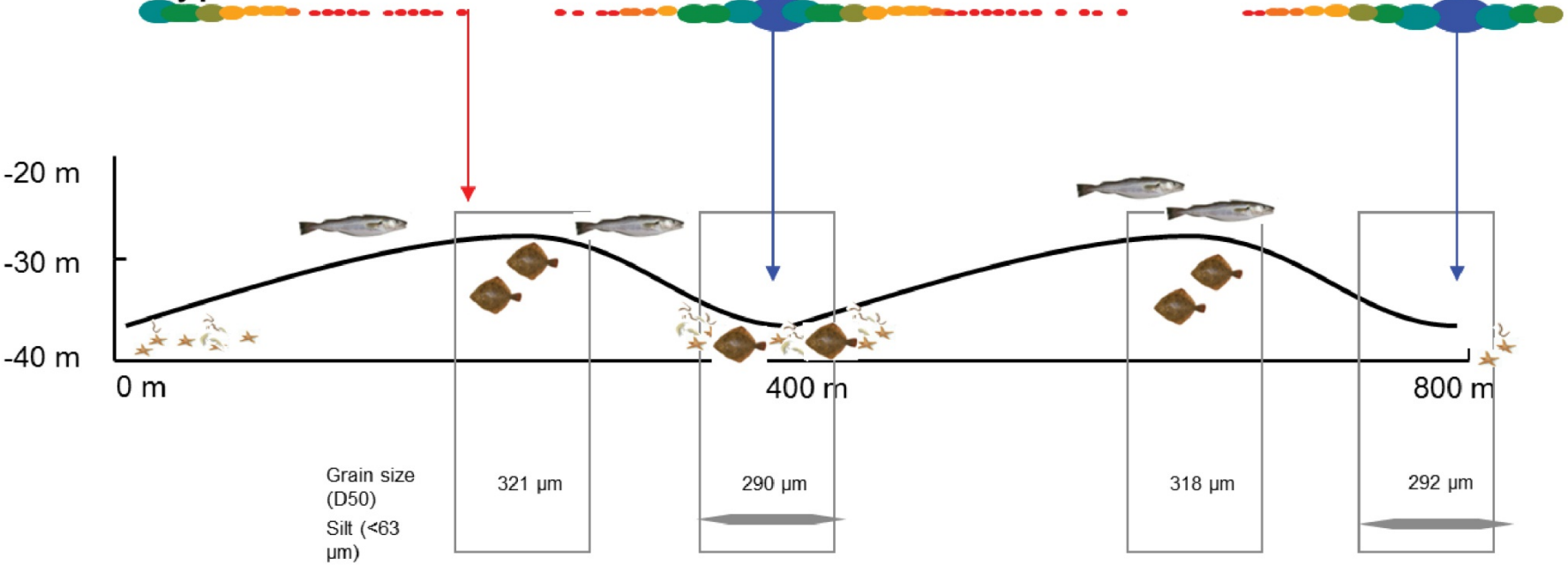
# socio-economic development - NATURE DEVELOPMENT



(Hostens, Moulaert, 2010)

# socio-economic development - NATURE DEVELOPMENT

## Hypothetical benthic fauna and demersal fish distribution

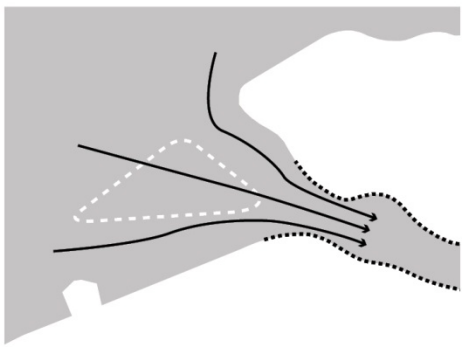


concept sketch project ECOPIT - the Netherlands  
(Jan Mulder, IMCORE congress 2011)

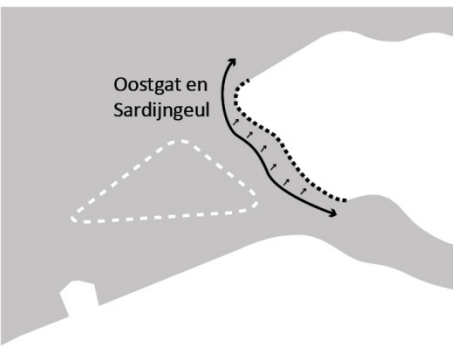
GLOBAL WARMING  
GLOBAL WARMING

# the Vlakte van de Raan as strategic spot

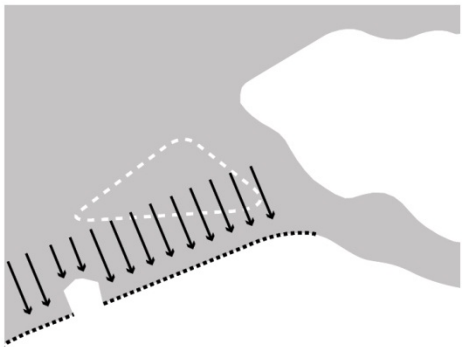
## climate impacts



tide in the Westerscheldt

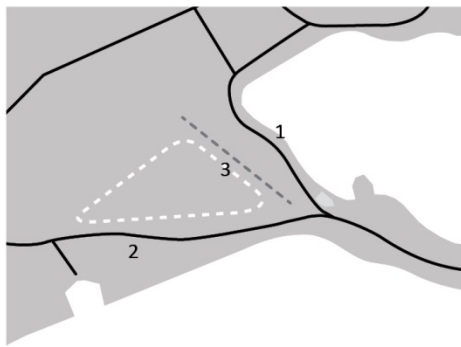


coastal erosion Walcheren

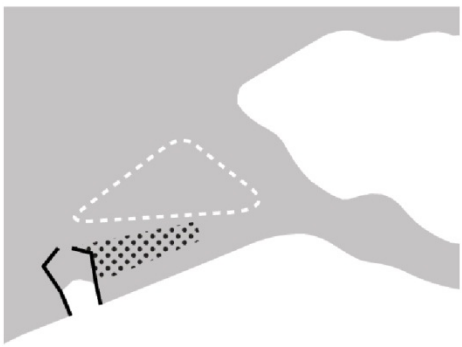


coastal protection

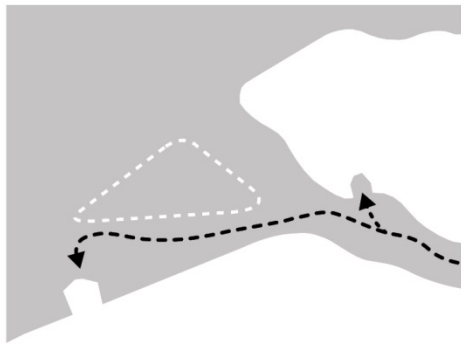
## socio-economic development



sea lanes Westerscheldt



port of Zeebrugge



estuary shipping

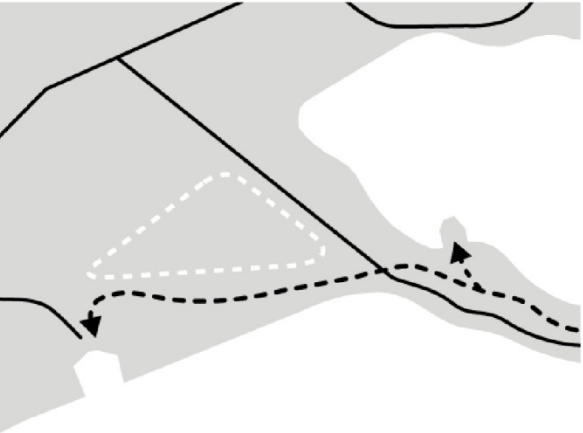


nature development

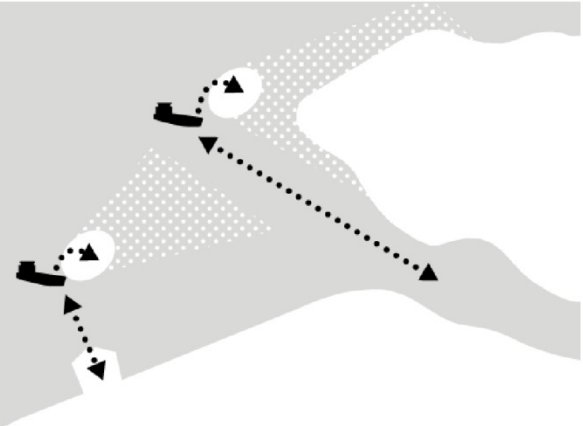




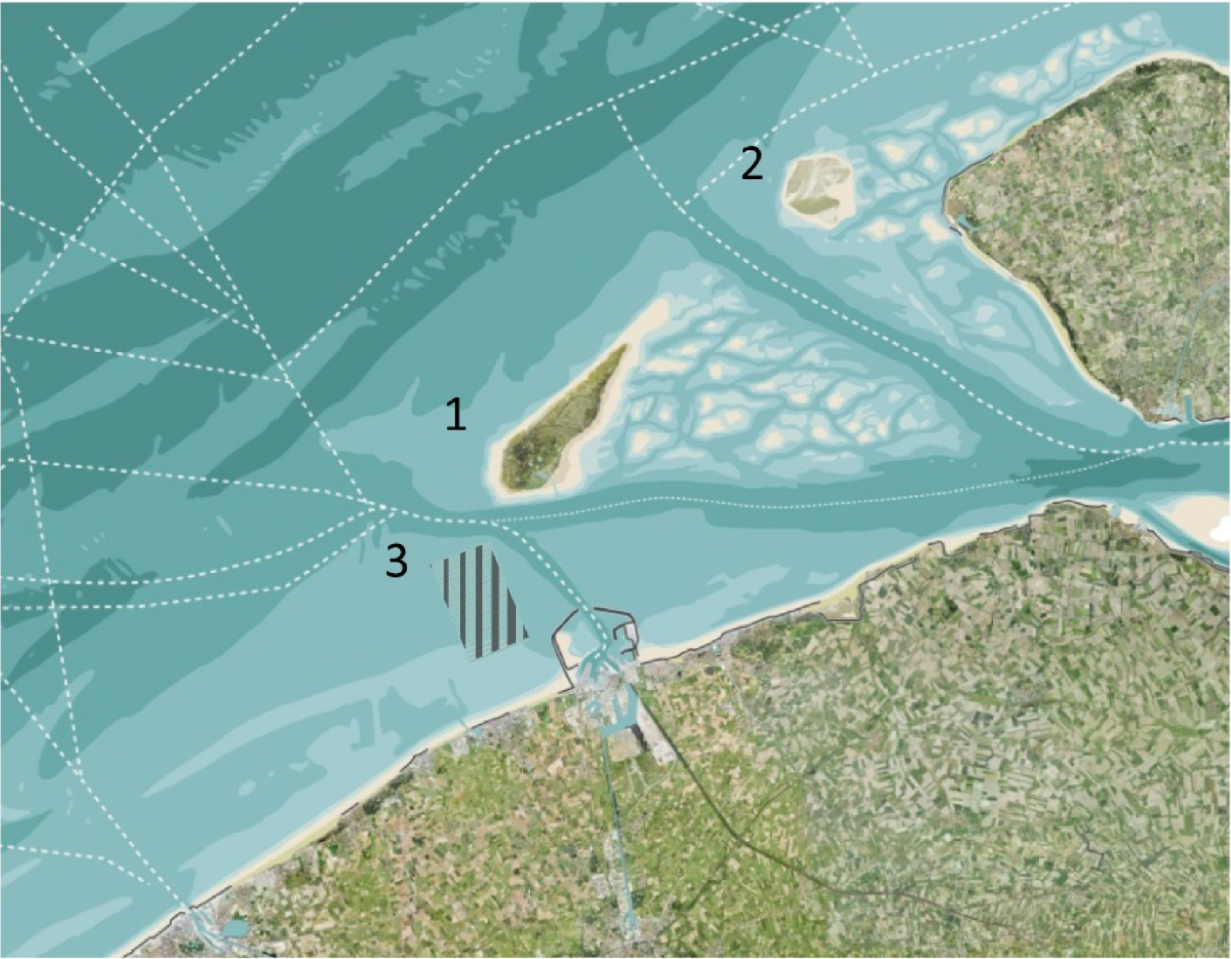
# first sketches proposal Vlake van de Raan



concept 1: reorganization sea lanes



concept 2: reorganization dredging



first design proposal Vlake van de Raan



## conclusions

- Island proposals may offer many opportunities for further development but mainly when the strategy is applied on strategic areas
- When looking for such zones for such climate adaptation one must consider climate impacts as well as socio-economic developments

**however much further research and consensus building is needed**

- how costly?
- how effective?
- how efficient?
- how sustainable?
- etcetera



islands as giant storm barriers  
(GAUFRE, 2005)



How will we protect the new islands?  
(modification of previous collage)



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#### **4. THE COMPARTIMENTALIZATION - FRAMEWORK FOR TECHNICAL AND SPATIAL ADAPTATION MEASURES**





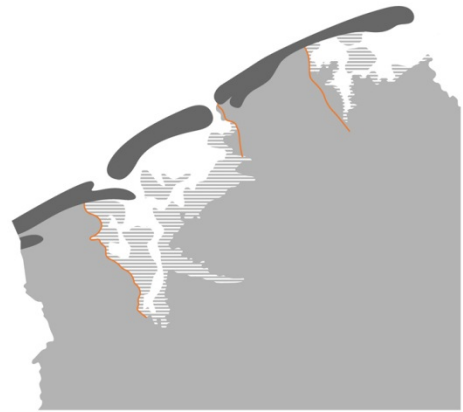
# coastal defence - from coastal zone to coast line



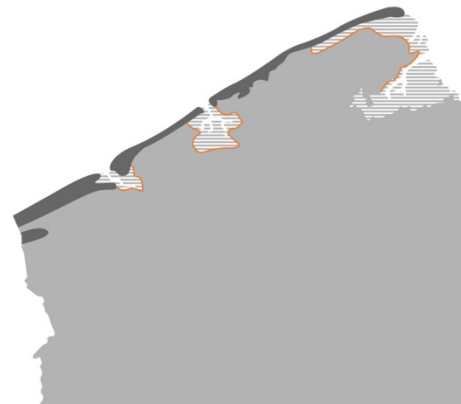
200 BC - 100 AD



400 AD - 800 AD



1000 AD - 1200 AD



1250 AD

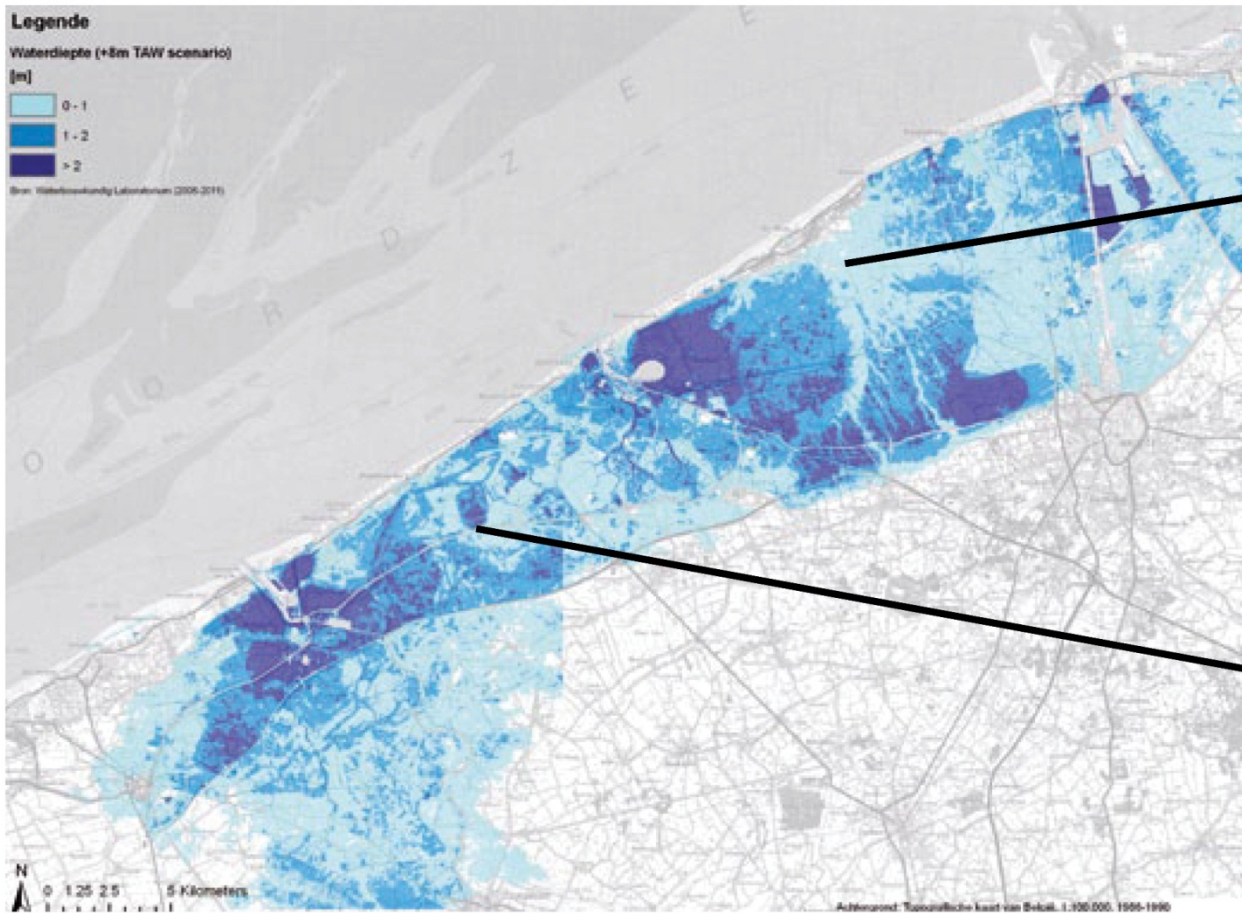


Nieuwpoort 1300 AD



coast line anno 2012

# but what role could the coastal zone play during storms?

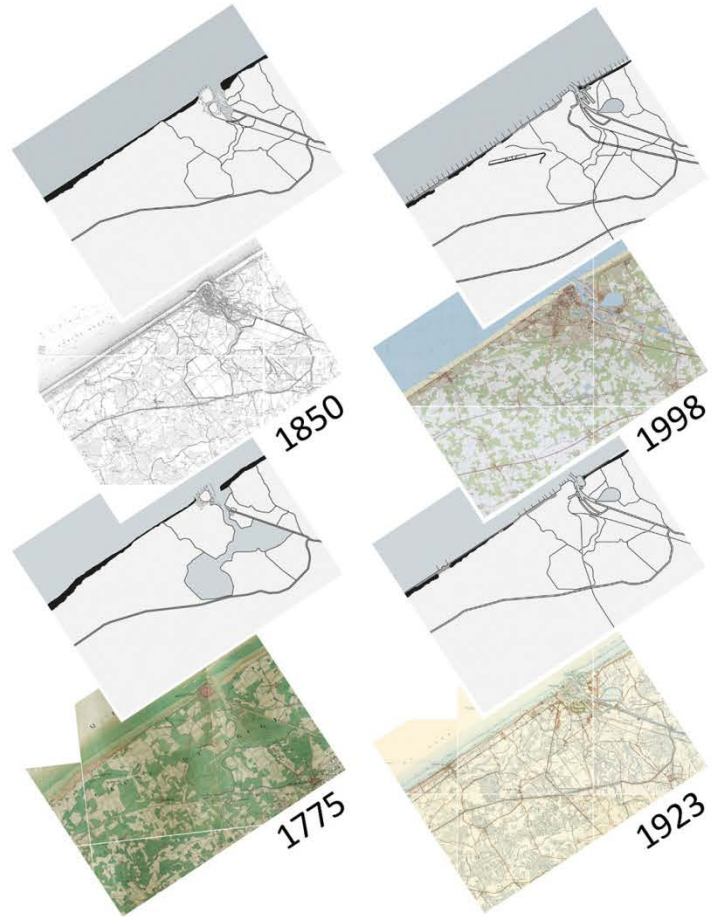


flood map - storm 1 in 17.000 years (Masterplan Coastal Safety, 2012)

polders have clearly different heights and therefore have different flood risks

infrastructures form flood barriers even though not designed for these purposes

# reuse of infrastructures to create a compartmentalized coast...



evolution of infrastructures near the Ostend



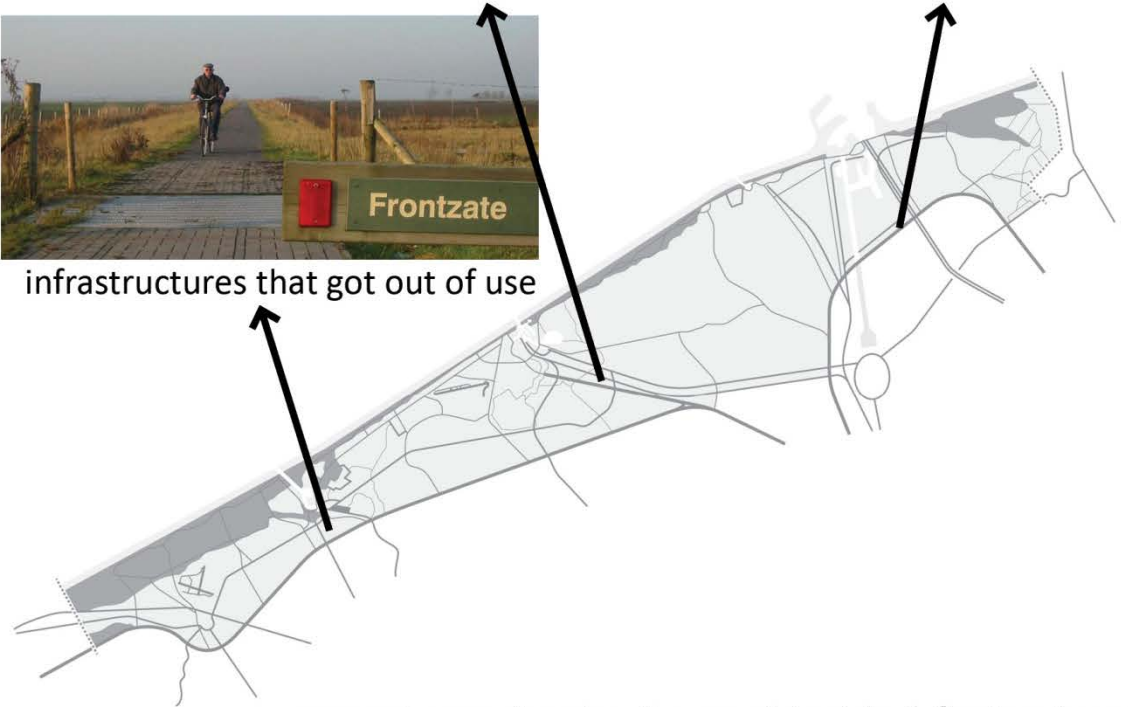
current infrastructures



future infrastructures



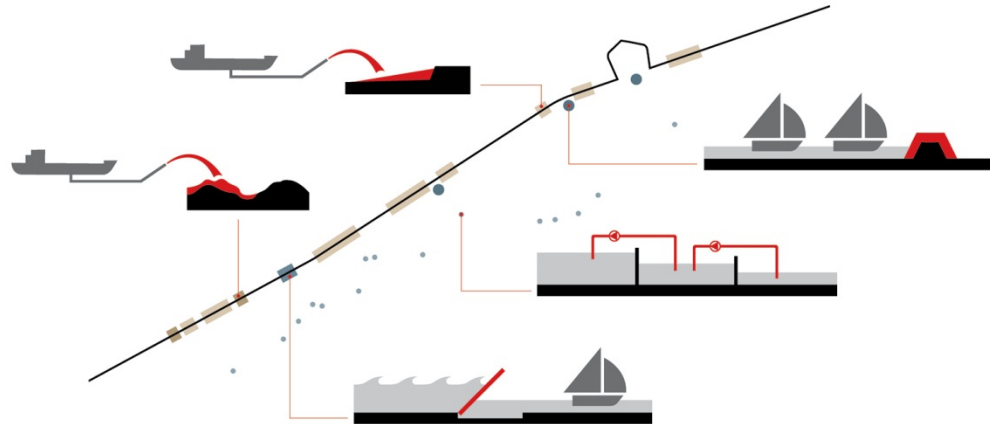
infrastructures that got out of use



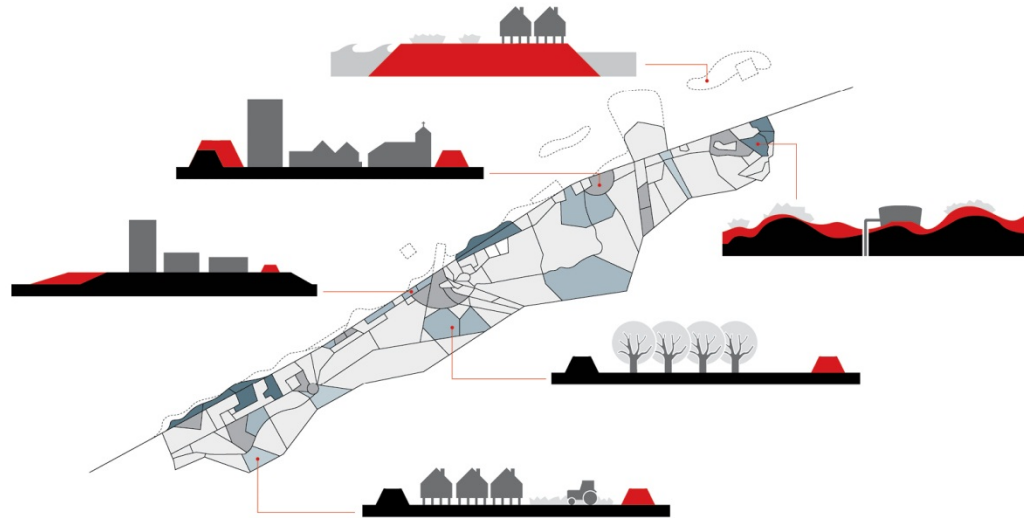
concept map showing the possible dike infrastructures



# ... as framework for technical and spatial climate adaption measures

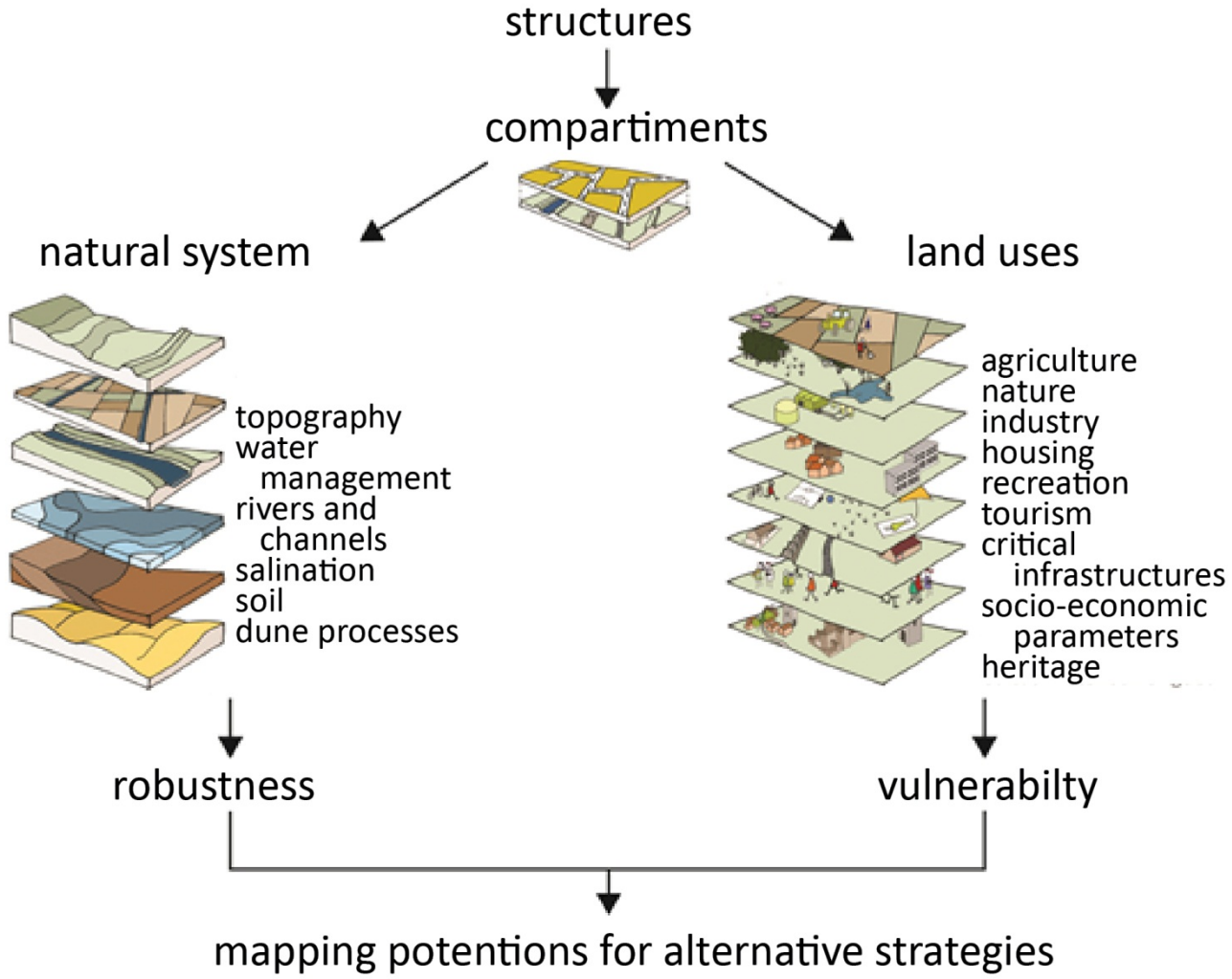


concept sketch 'hold -the-line' principle



concept sketch compartmentalized coast

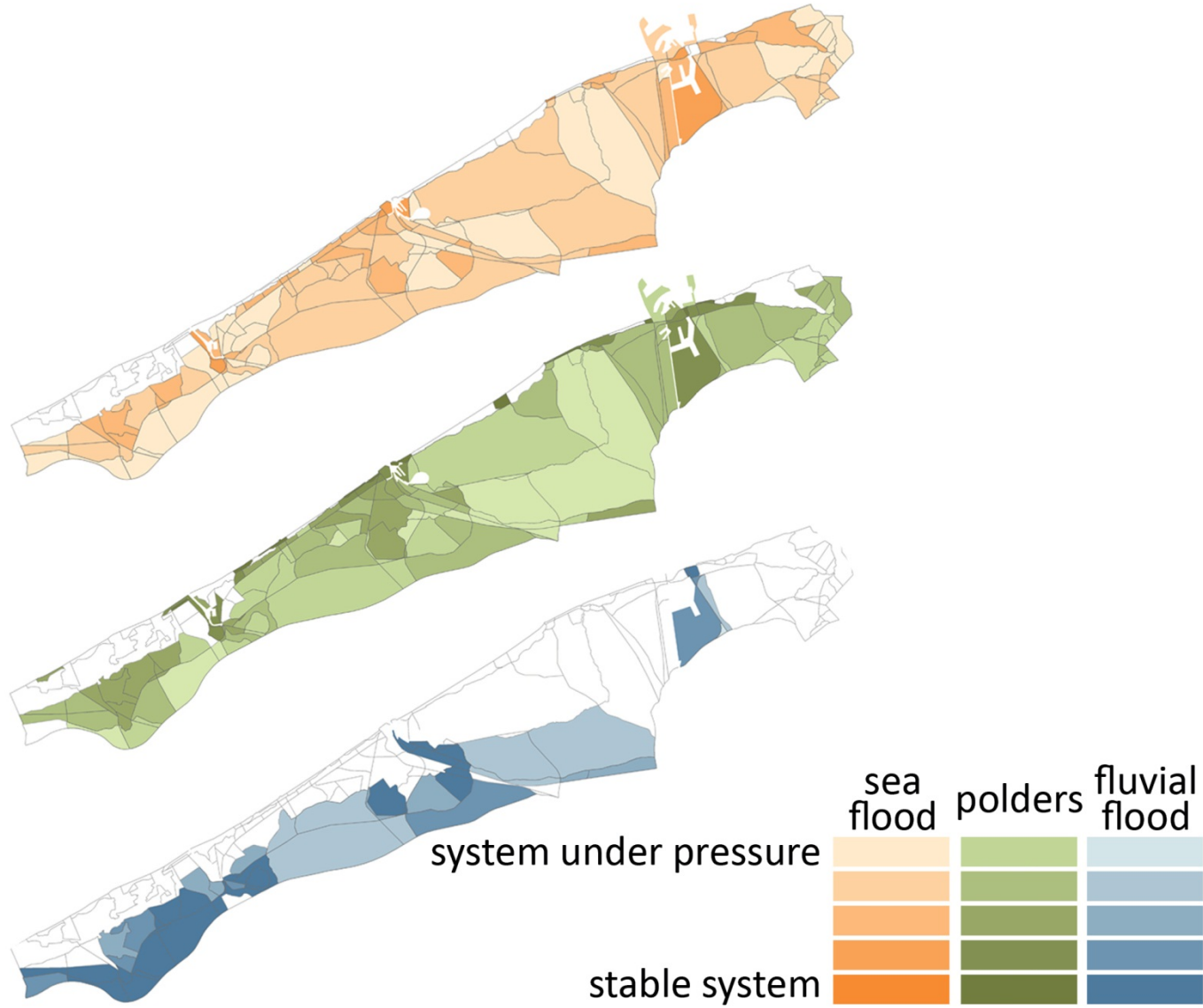
# assessing the compartementalized coast



overview of the GIS-analyses that were carried out



# assessing climate impacts in the compartementalized coast



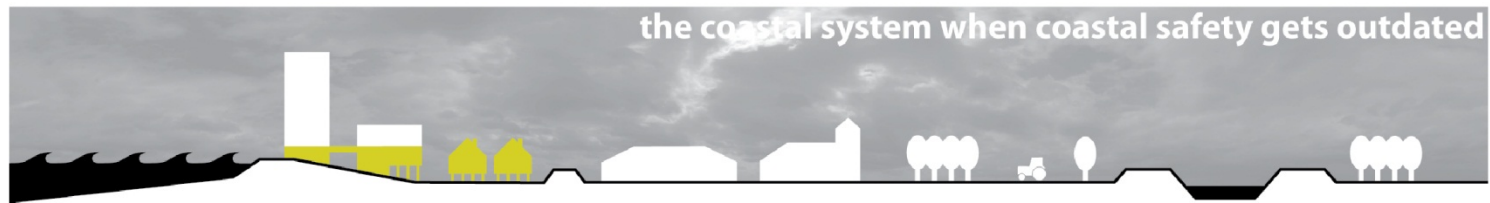


# development of the compartmentalisation on the long term



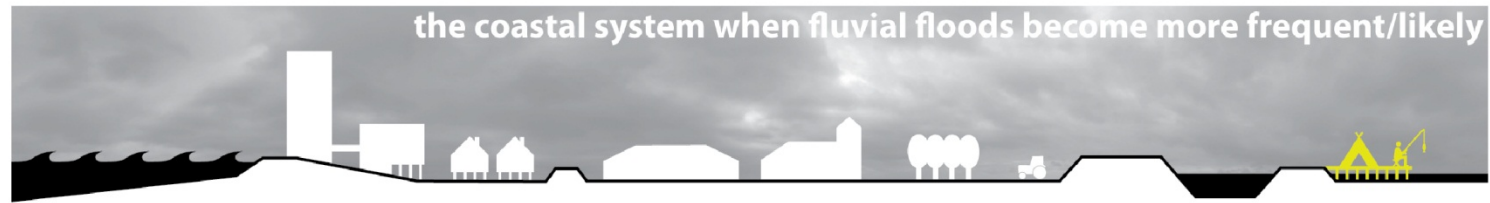
the coastal system in 2012 - 'hold the line'

infrastructures, like dykes, offer the necessary safety



the coastal system when coastal safety gets outdated

spatial measures assure the necessary safety



the coastal system when fluvial floods become more frequent/likely

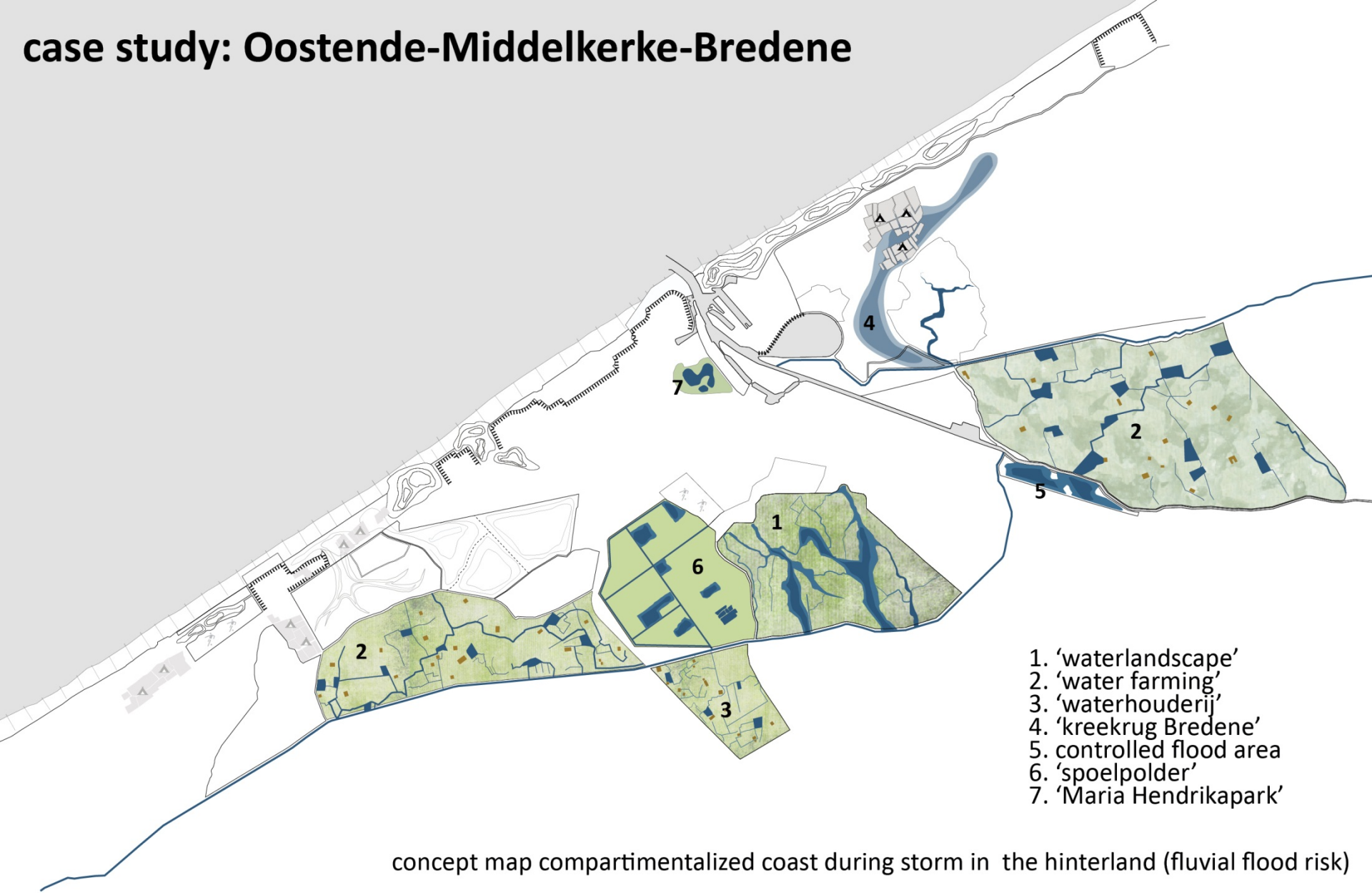
instead of raising river dykes flood risks are mitigated by flooding polders



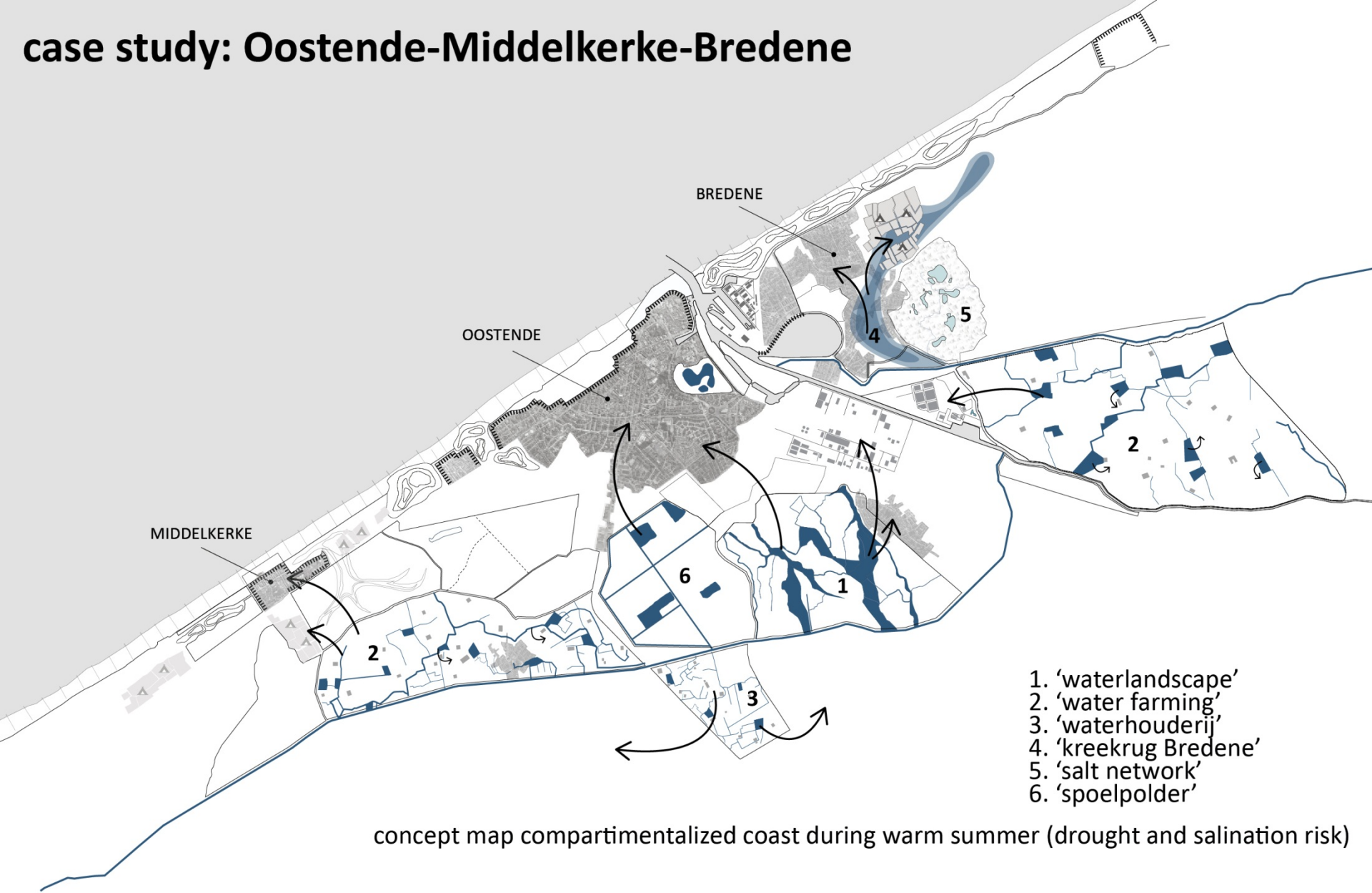
the coastal system when drought or salination is unavoidable

differentiated water management offers opportunities to rethink the water system

# case study: Oostende-Middelkerke-Bredene

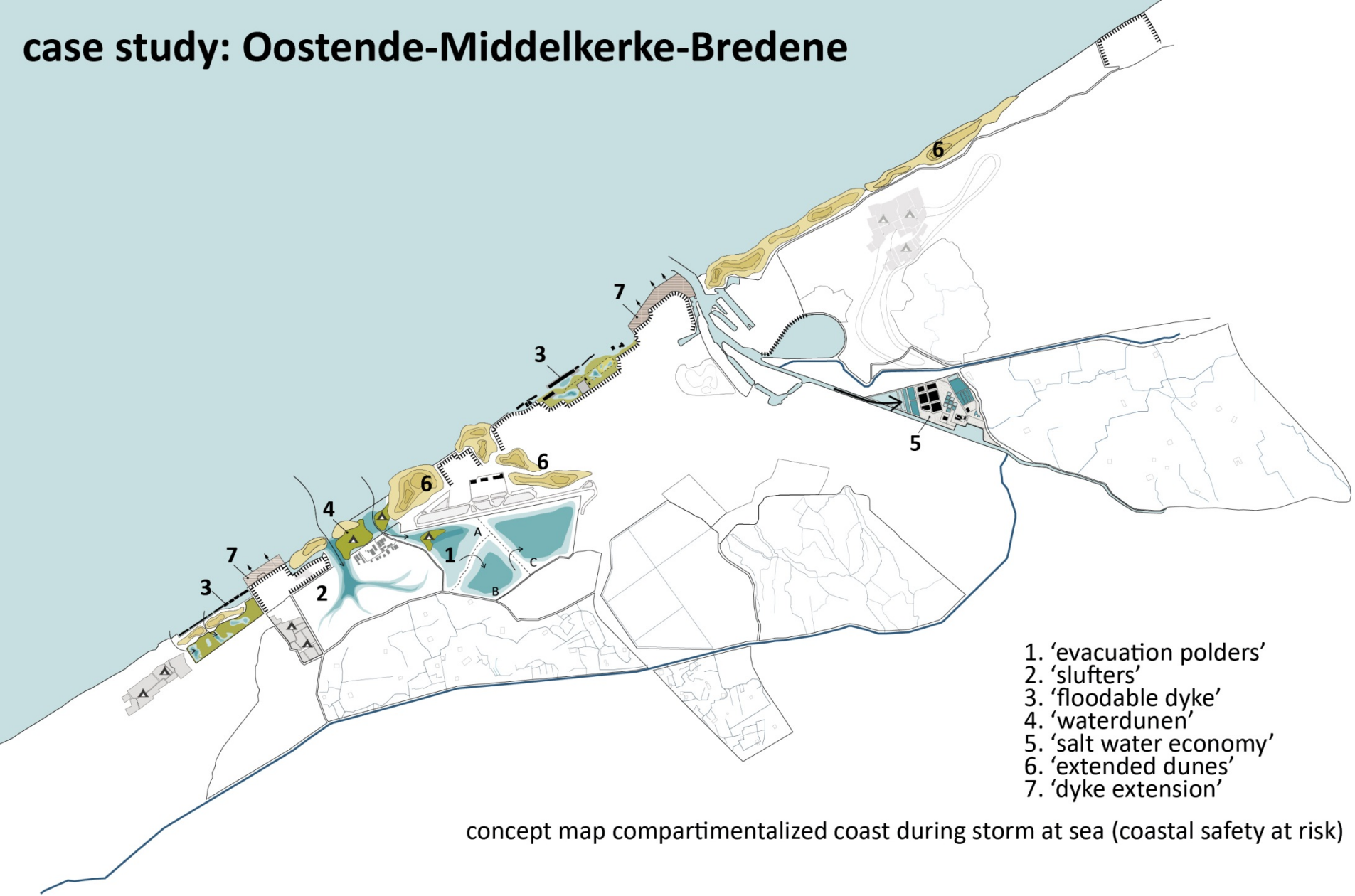


# case study: Oostende-Middelkerke-Bredene





# case study: Oostende-Middelkerke-Bredene



# conclusions



collage 'floodable dyke'



collage 'water farming'

- Although global warming is an universal issue, the climate impacts depend on local conditions
- At the flemish coast a big spatial differentiation is apparent
- Shifting from line to zone (by means of compartmentalisation) offers opportunities to rethink adaptation
- Far more ways to adapt can be thought out but this demands further (interdisciplinary) research and consensus building



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## 5. CONCLUSIONS AND REFLECTIONS





## overall conclusions

- 1. THE CLIMATE CHANGE PROBLEM IN COASTAL SYSTEMS IS MORE THEN JUST AN OUTDATED COASTAL DEFENCE**
- 2. ADAPTATION STRATEGIES SHOULD BE FOCUSSED ON THE LONG TERM, THEREFORE PROTECT MIGHT NOT BE THE BEST CHOICE**
- 3. THE NATURAL SYSTEM AND THE LANDSCAPE DYNAMICS SHOULD BE INTEGRATED IN THE ADAPTATION PLAN**
- 4. IT IS POSSIBLE TO APPLY CLIMATE ADAPTATION FOR FURTHER SOCIO-ECONOMIC DEVELOPMENT, SO EACH ADAPTATION PLAN MUST BE PART OF A BIG MASTERPLAN FOR THE COASTAL AREA**

I DON'T BELIEVE IN  
GLOBAL WARMING

**thanks for your attention!**

**tip: for more information on the effect of  
climate change on the Flemish spatial  
structure and possible adaptation measures visit  
our CcASPAR congress!  
(17 & 18 december - Ghent)  
[www.ccaspar.ugent.be](http://www.ccaspar.ugent.be)**