EuDA-CEDA Workshop on

Sustainable Dredging Approaches to Climate Change Adaptation

May 2015, Copenhagen

The Dredging Contractors' Point of View

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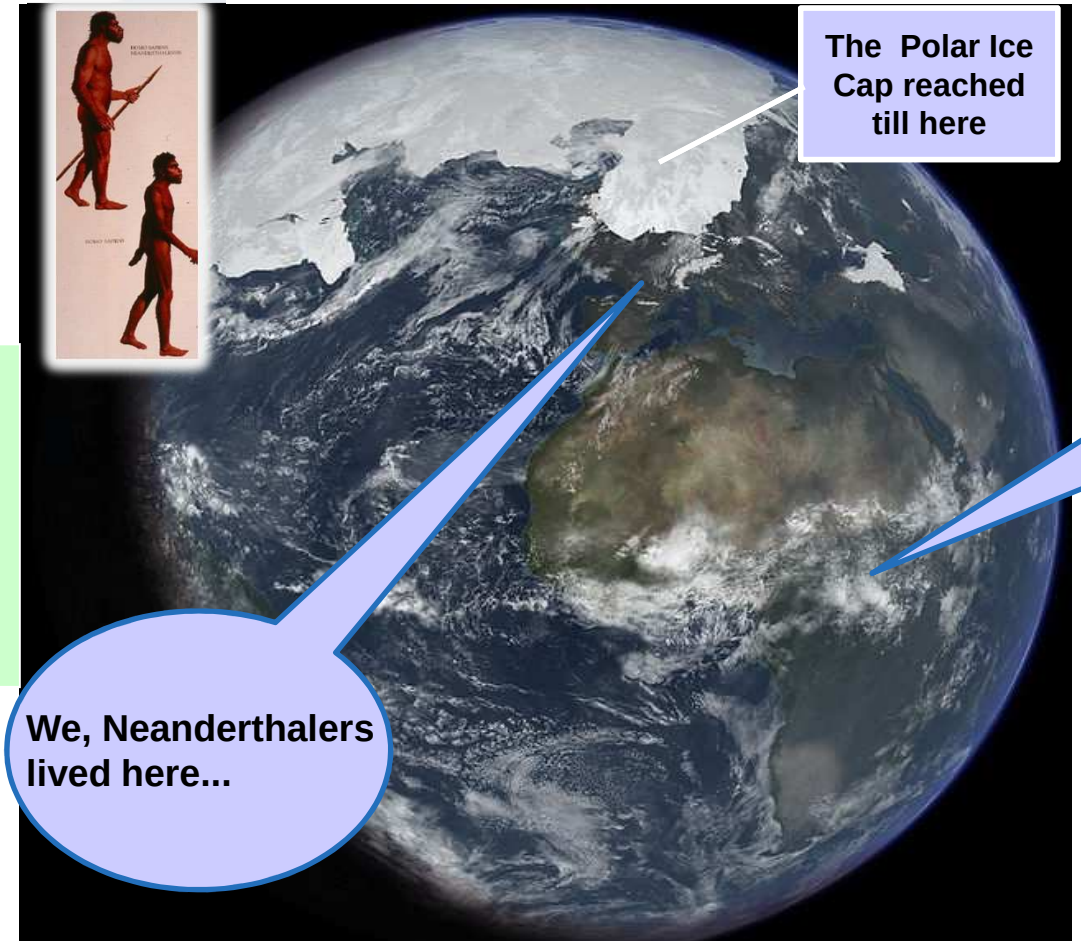
European Dredging Association

Agenda

- Historical overview
- Flanders Bays 2100
- Climate Change Adaptation
- Successful CCA Examples
- Conclusion

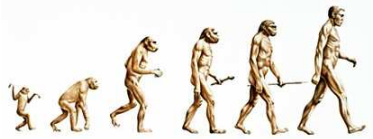
Historical overview
Humans during the Ice Age

When Human beings appeared on Earth climatic conditions were very different.

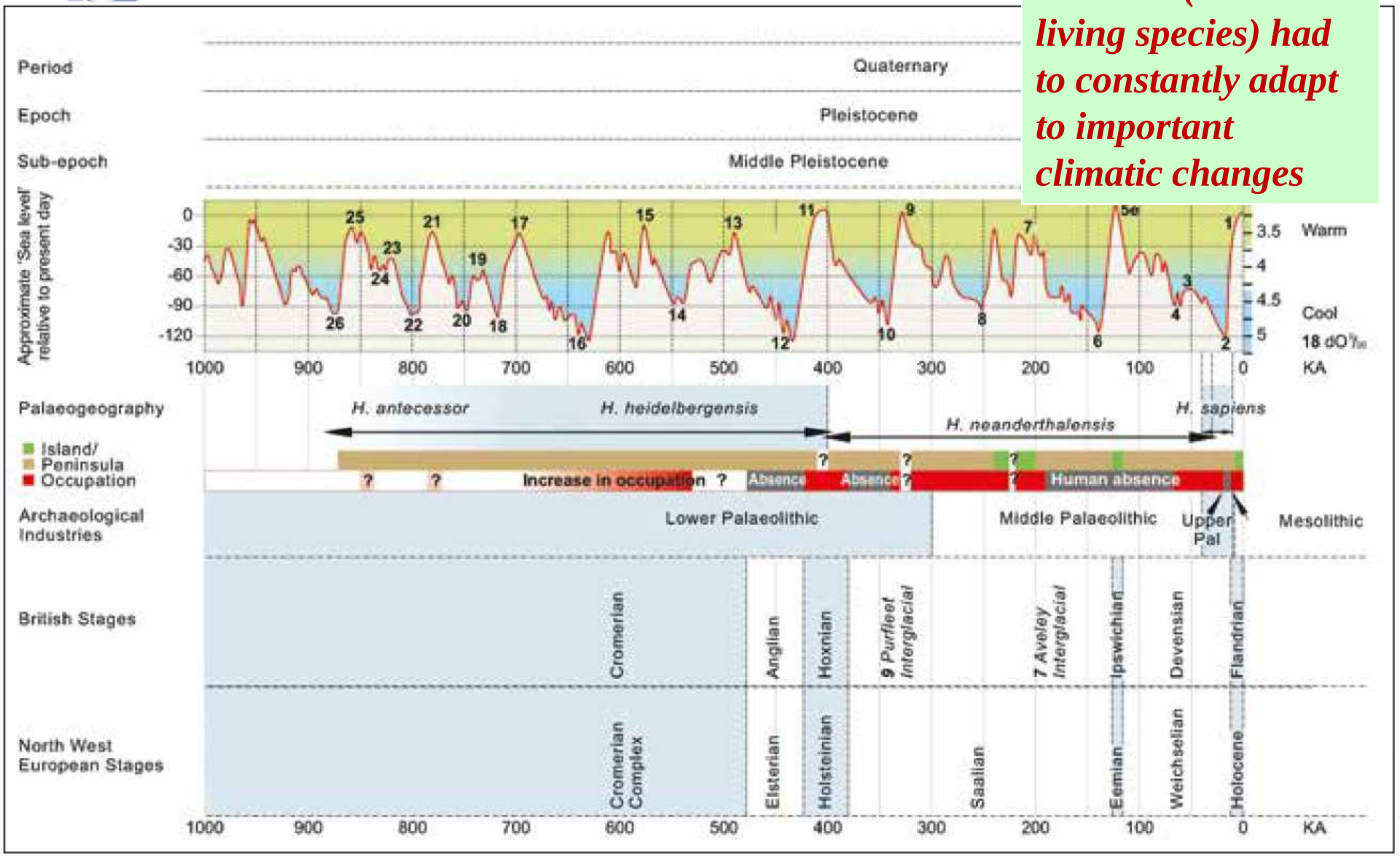


Planet Earth, some 20.0000 years ago in the Mesolithic Epoch: the Ice Age

Historical overview
Humans and Climate Change

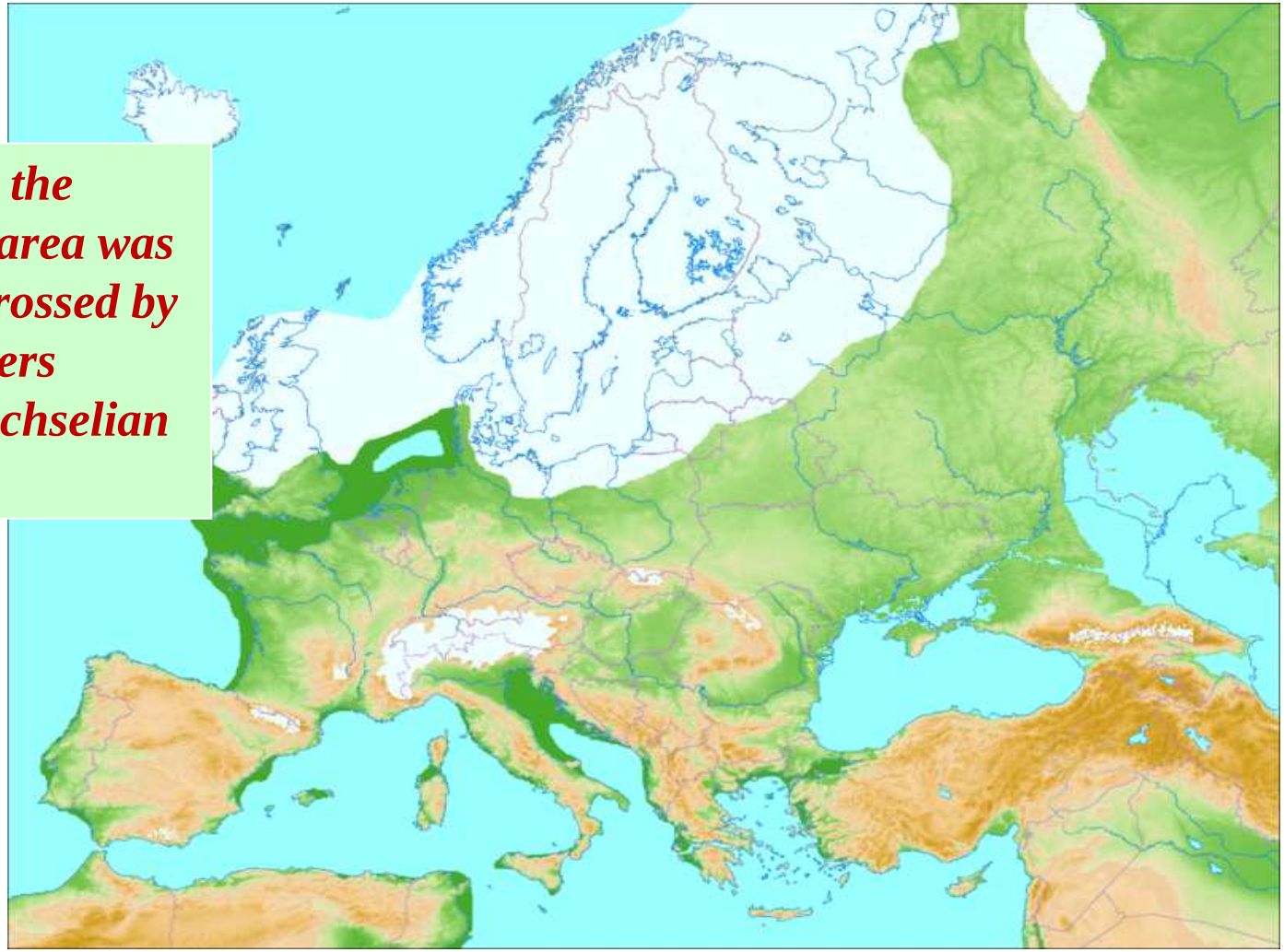


Humans (and all living species) had to constantly adapt to important climatic changes



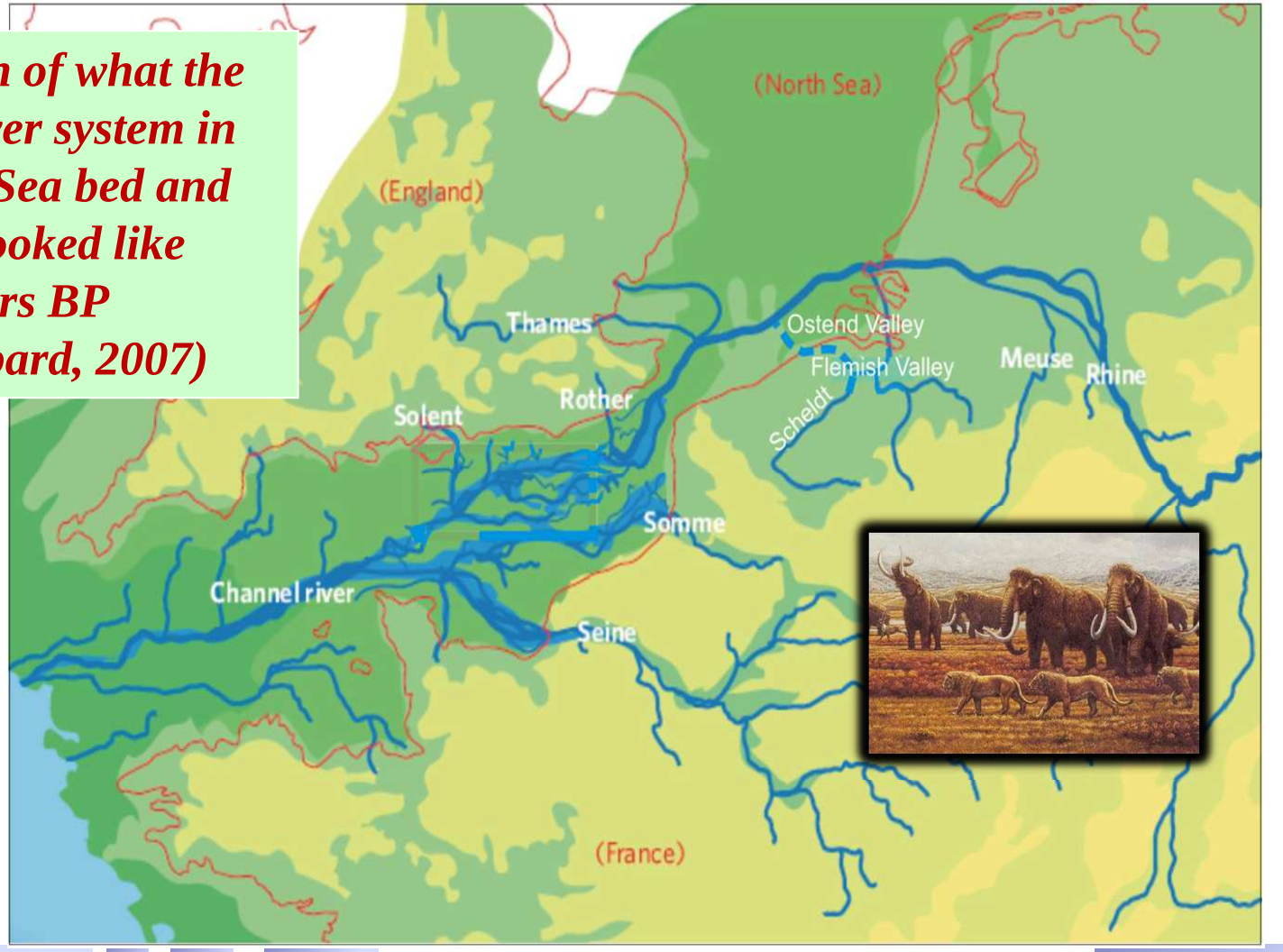
Historical overview
Situation in Europe

In Europe, the North Sea area was dry land, crossed by braided rivers during Weichselian Ice Age.



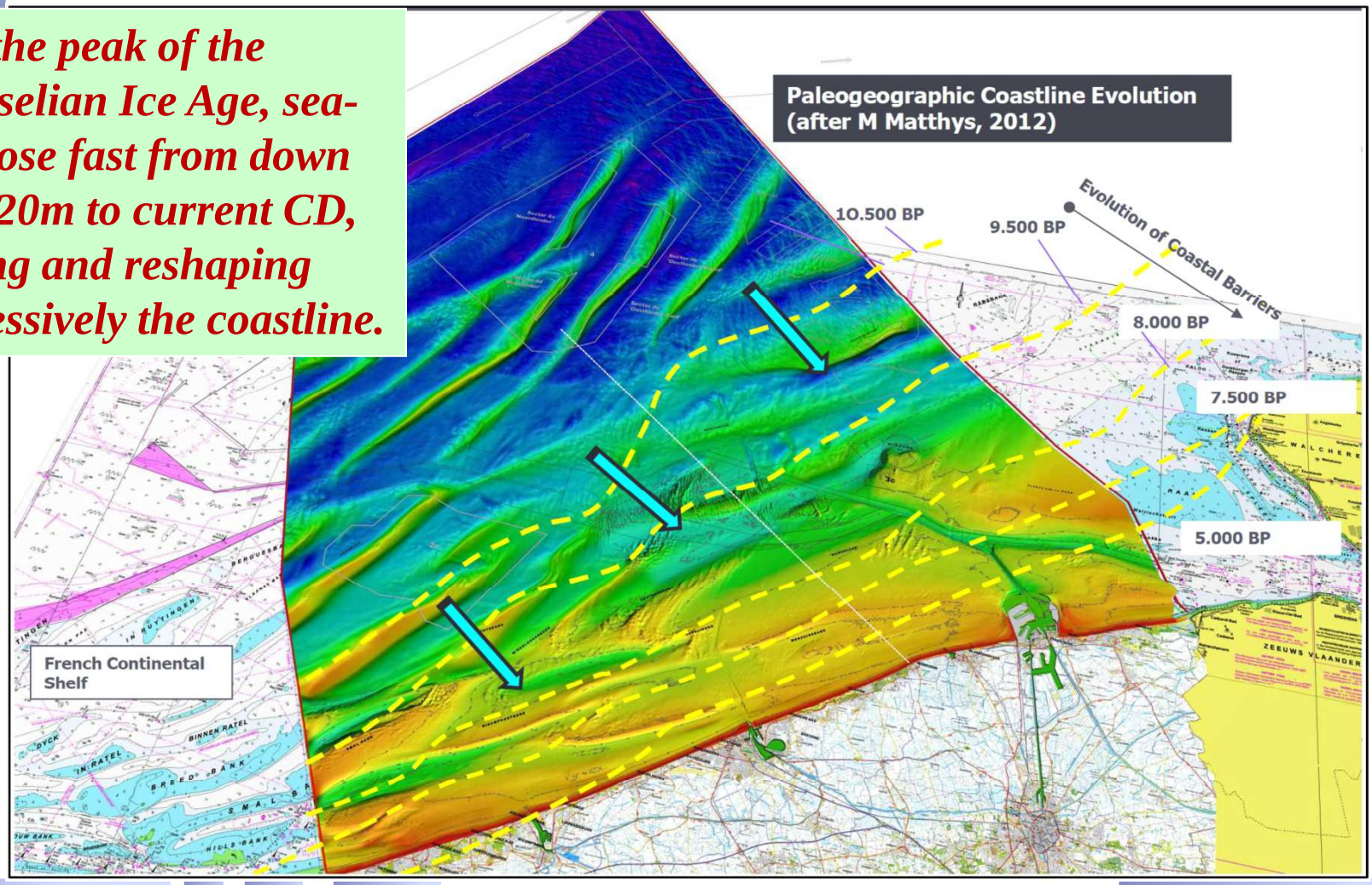
Historical overview
The Channel River System

Illustration of what the braided river system in the North Sea bed and Channel looked like 22.000 years BP (after Gibbard, 2007)

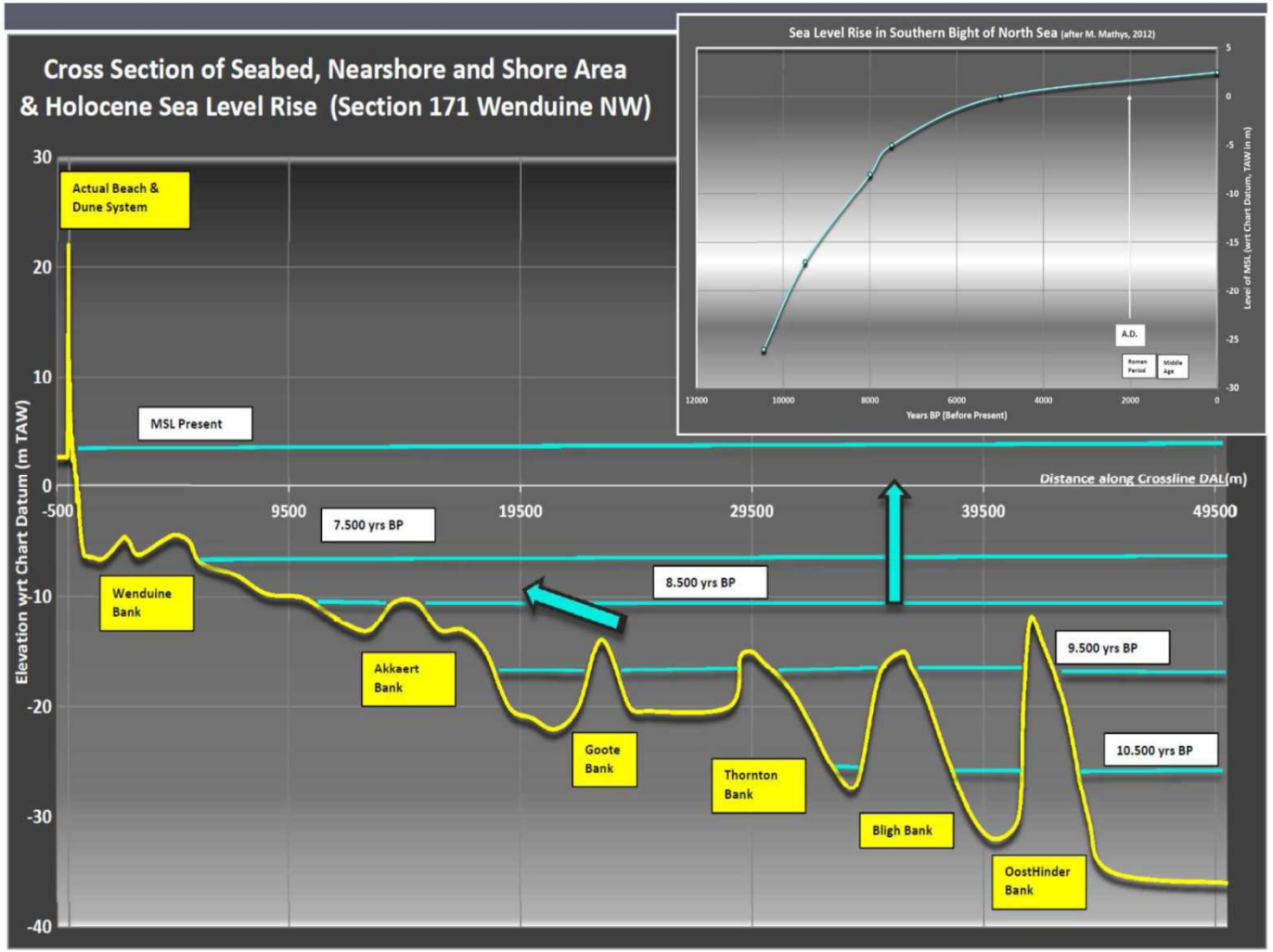


Historical overview
Sea Level was (much) lower

After the peak of the Weichselian Ice Age, sea-level rose fast from down CD- 120m to current CD, shaping and reshaping progressively the coastline.



Historical overview
Sea Level Evolution

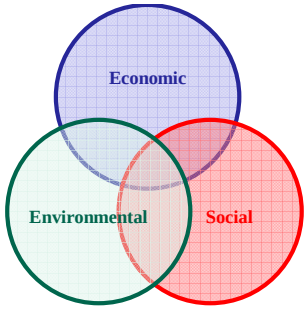


Flanders Bays 2100

Safe, natural, attractive, sustainable, developing

ARCADIS AT&M consultants Jan De Nul GROUP DEME Dredging, Environmental & Marine Engineering IMDC ORG

Flanders Bays 2100
Need for a Paradigm Switch

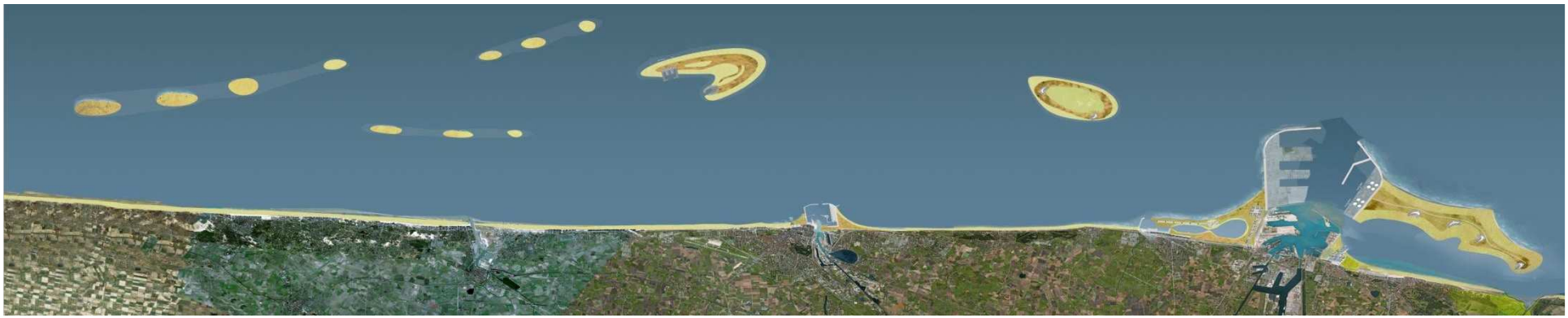


⇨ From defensive approach, minimising environmental impact,

"Environment = Constraint"

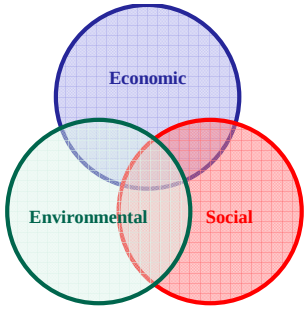
⇨ To constructive approach, optimising full (socio-)economic and environmental potential.

"Environment = Opportunity"



Flanders Bays 2100

Sustainable Approach and Philosophy



Principles:

- ⇨ Long Term Vision and Investment Perspective
- ⇨ No Regret: Preserve Ecosystem, Preserve Investment
- ⇨ Guarantee of Safety
- ⇨ Partnership with Nature

Consider the project's **added value** to:

Safety ?

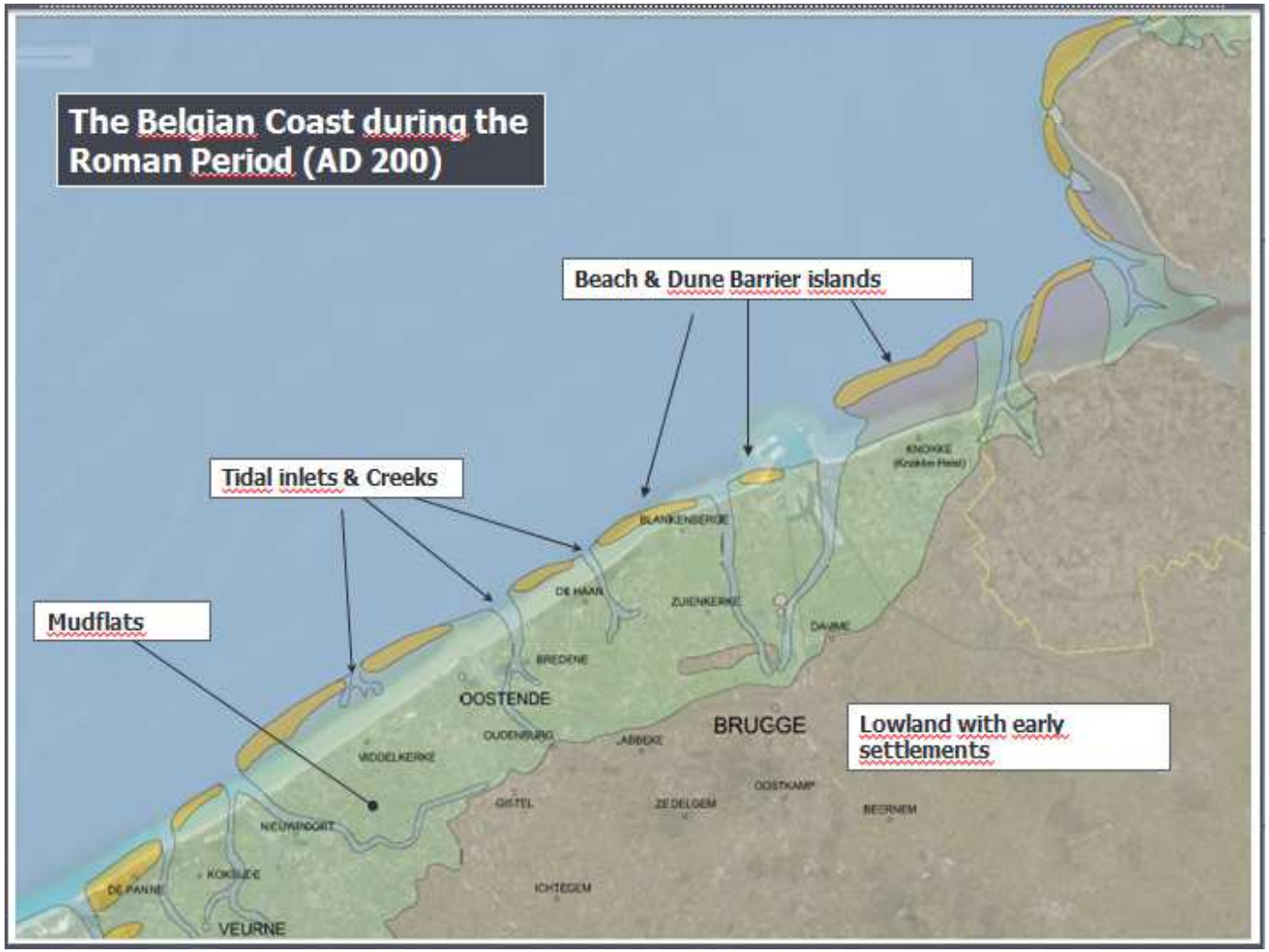
Nature ?

Attractiveness ?

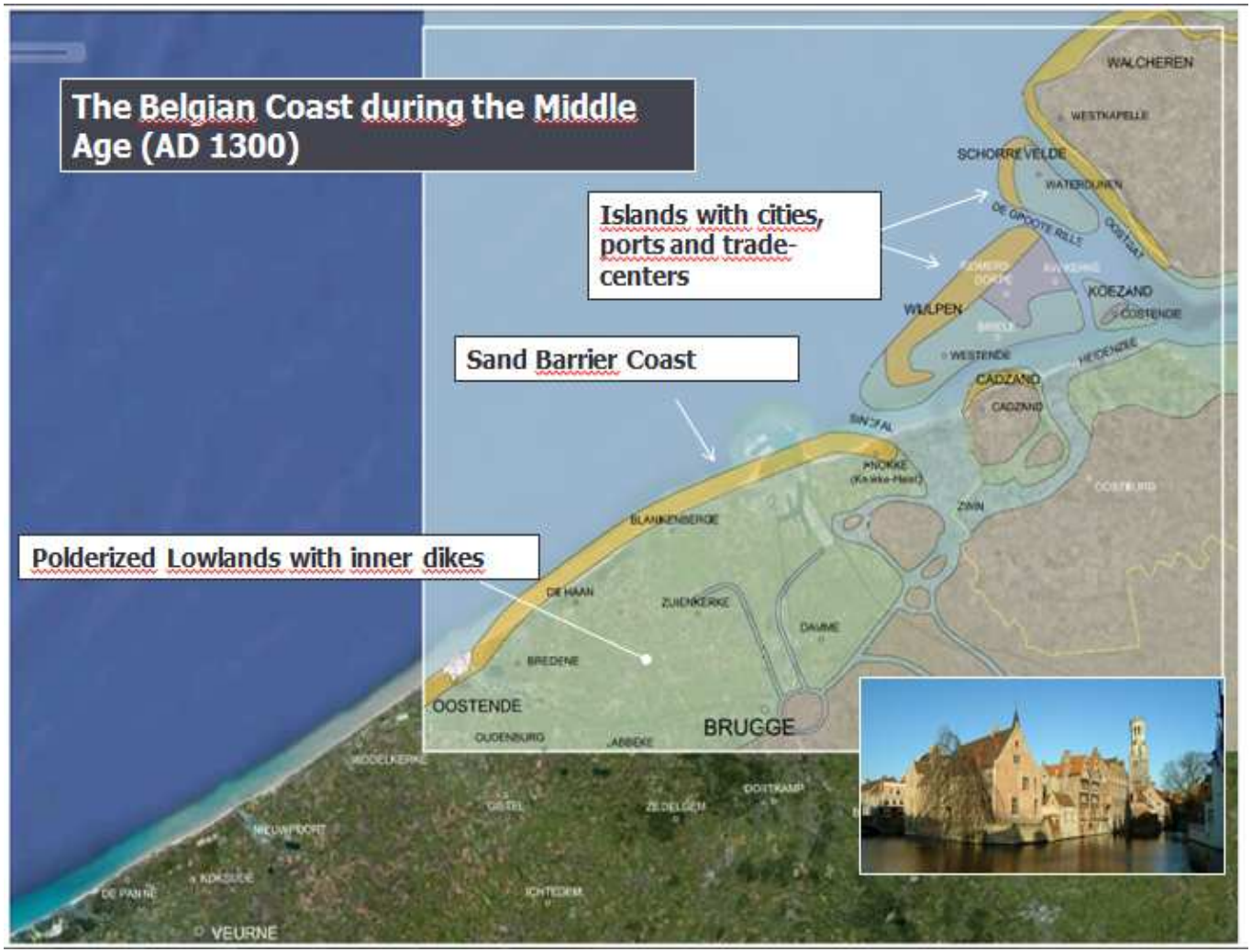
Sustainability ?

Society ?
Economy ?

Flanders Bays 2100
Inspired by History

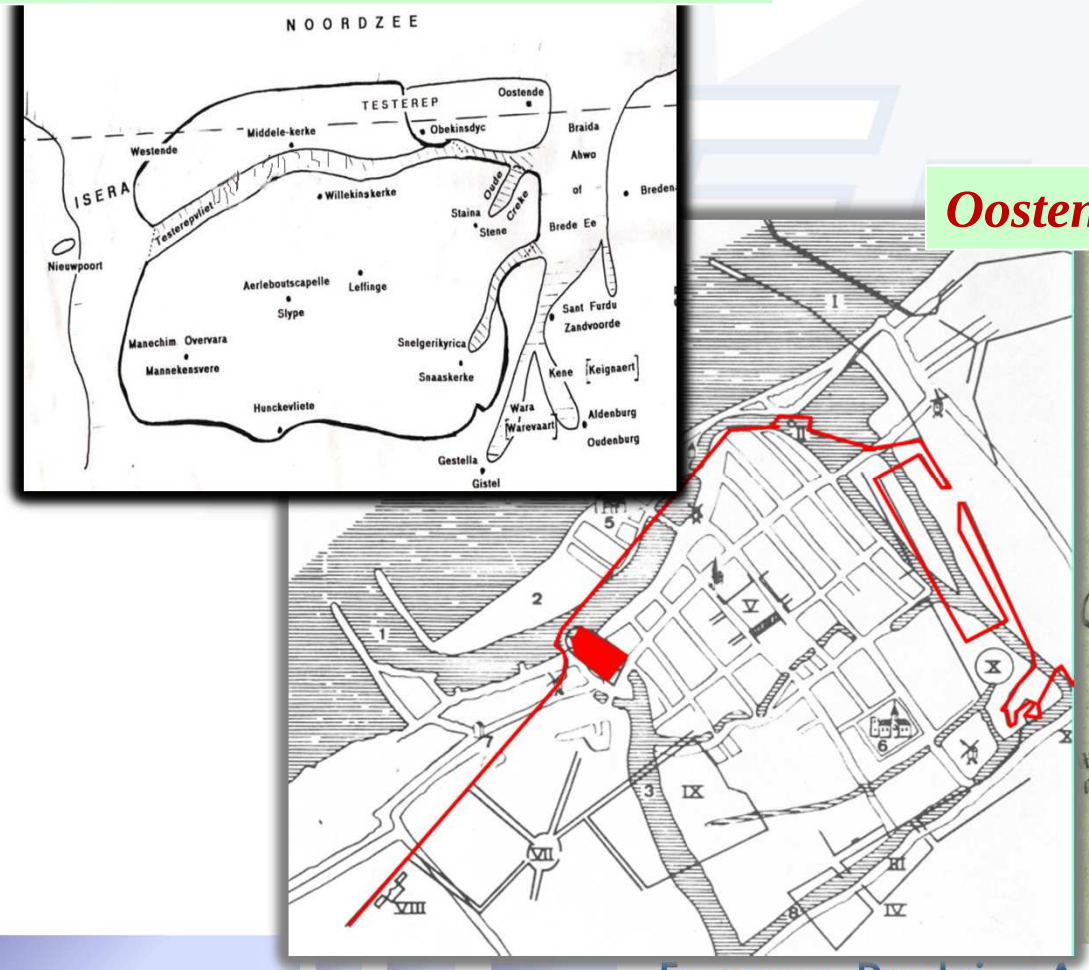


Flanders Bays 2100
Inspired by History

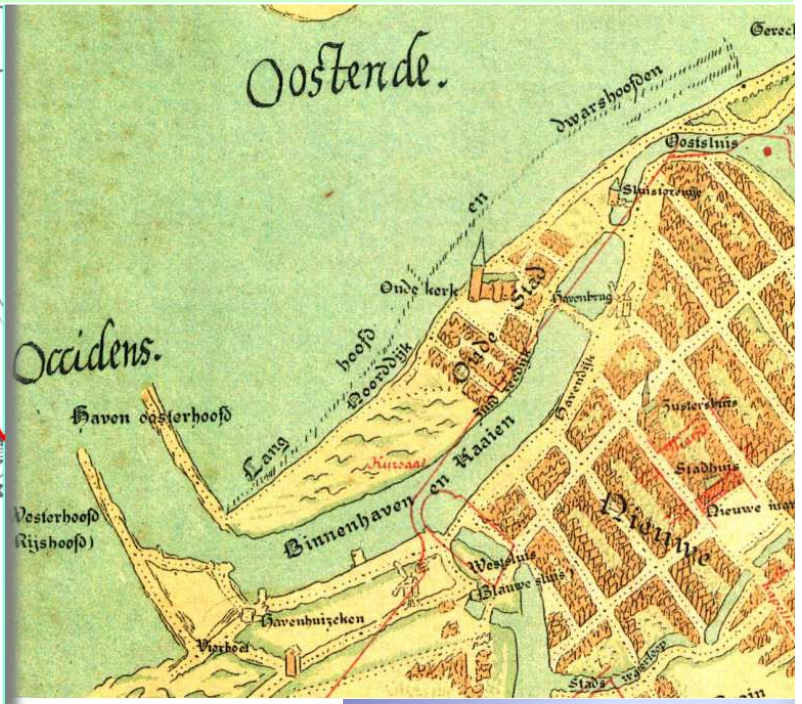


Flanders Bays 2100
Ostend and its Island

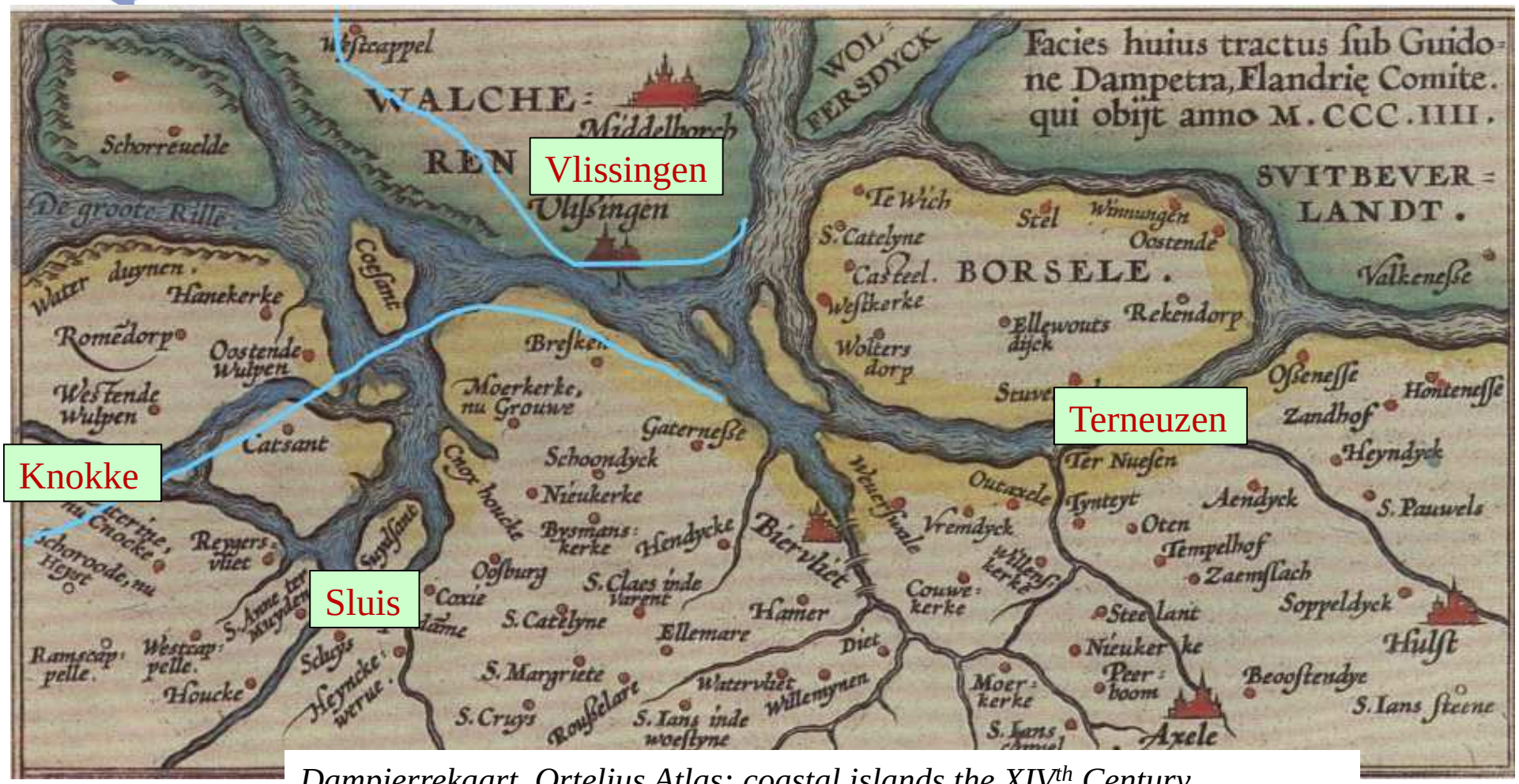
Island Testerep ('Ter Streep') in 1170



Oostende, ref Jacob van Deventer, 1550



Flanders Bays 2100
Estuary of the Schelde



Dampierrekaart, Ortelius Atlas: coastal islands the XIVth Century

Flanders Bays 2100
Drowned Settlements

Remnants of human settlements and activities on what is now an intertidal beach.

Medieval peat-extraction pits between Mariakerke & Raversijde Beach (Termote, 2012)

Foundations of a XIV-ieth dwelling house at Walraversijde

Flanders Bays 2100
Evolution of the Belgian Coast

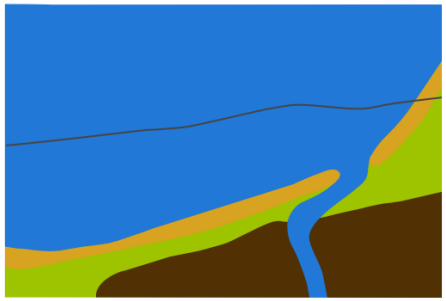


Fig. 3
bron: Ceunynck R. 1992

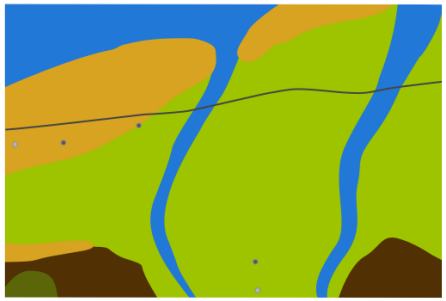


Fig. 10
bron: Ceunynck R. 1992

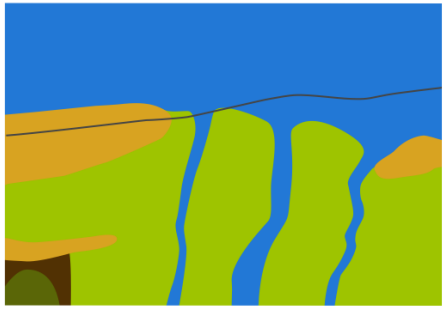


Fig. 13
bron: Ceunynck R. 1992

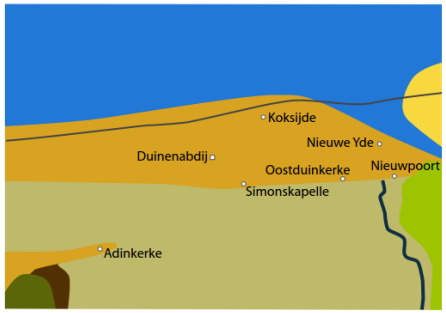


Fig. 14
bron: Ceunynck R. 1992

West coast in earlier days: sand-barrier islands evolved into a sand-barrier coast.

European Dredging Association 2015

Flanders Bays 2100
ICZM Case Study

Flanders Bays: a case study for integrated coastal zone and coastal seas management, including climate change adaptation, inspired by nature and by history

Between XI-th and XVII-th Century, Flanders lost ca 20.000 ha of coastal land, islands, ports and cities ...due to mismanagement of the flood protection system (wars, epidemiae, recession,...)

Between 1920 and now, wild unbridled urbanisation turned the wide sand barrier coast into a "squeezed coast"

The Primary Coastal Defence System – the beach and dune belt with or without seadikes – is insufficient for preventing flooding for extreme events. Need for sound and sustainable Climate Change Adaptation.

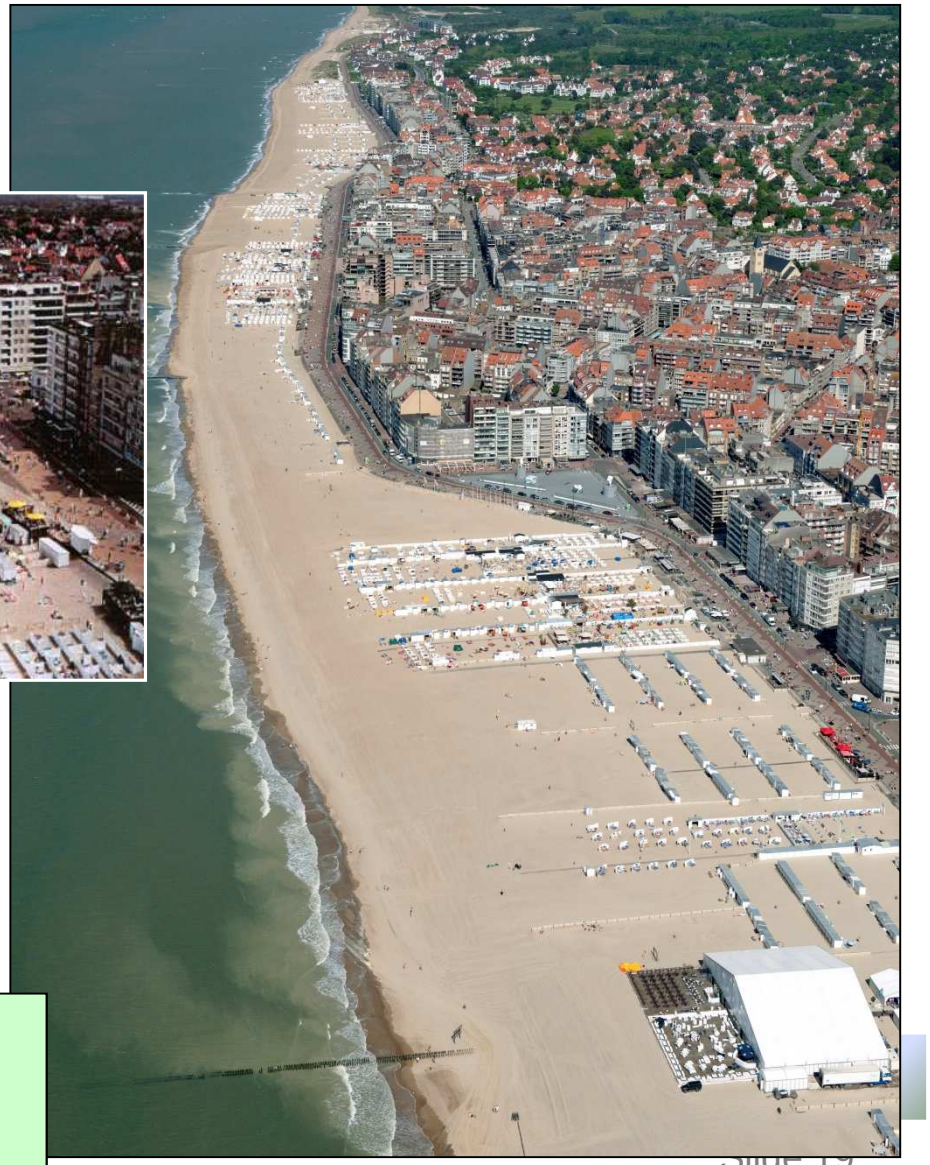
FLANDERS BAYS,
inspired by Nature and by History

Reconstruct wide gentle-sloped beaches for resilent coastal protection

Strengthen coastal sandbanks for sea-level rise mitigation and wave attenuation.

Reconstruct coastal islands for developments, nature compensation and coastal protection.

Flanders Bays 2100
Lessons from past Mistakes

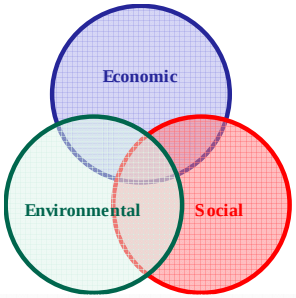


Whenever the Primary Coastal Defence System is becoming rigid by hard structures, the system loses its resilience ...

A century of hard coastal-defence works, human colonisation and urbanisations have transformed the sand-barrier into a “squeezed coast”.

Flanders Bays 2100

Need for a new Concept inspired by Nature



"Using the (physical & biological) forces of Nature, instead of fighting them"

"Flexible integration

- of **land** in **sea**
- and of **water** in the **new land**

making use of materials and forces/interactions, present in nature, taking into account existing and potential nature values and the bio-geomorphology & geo-hydrology of coast and seabed."

(Building with Nature was developed over the last 30 years by Ronald Waterman)

Flanders Bays 2100

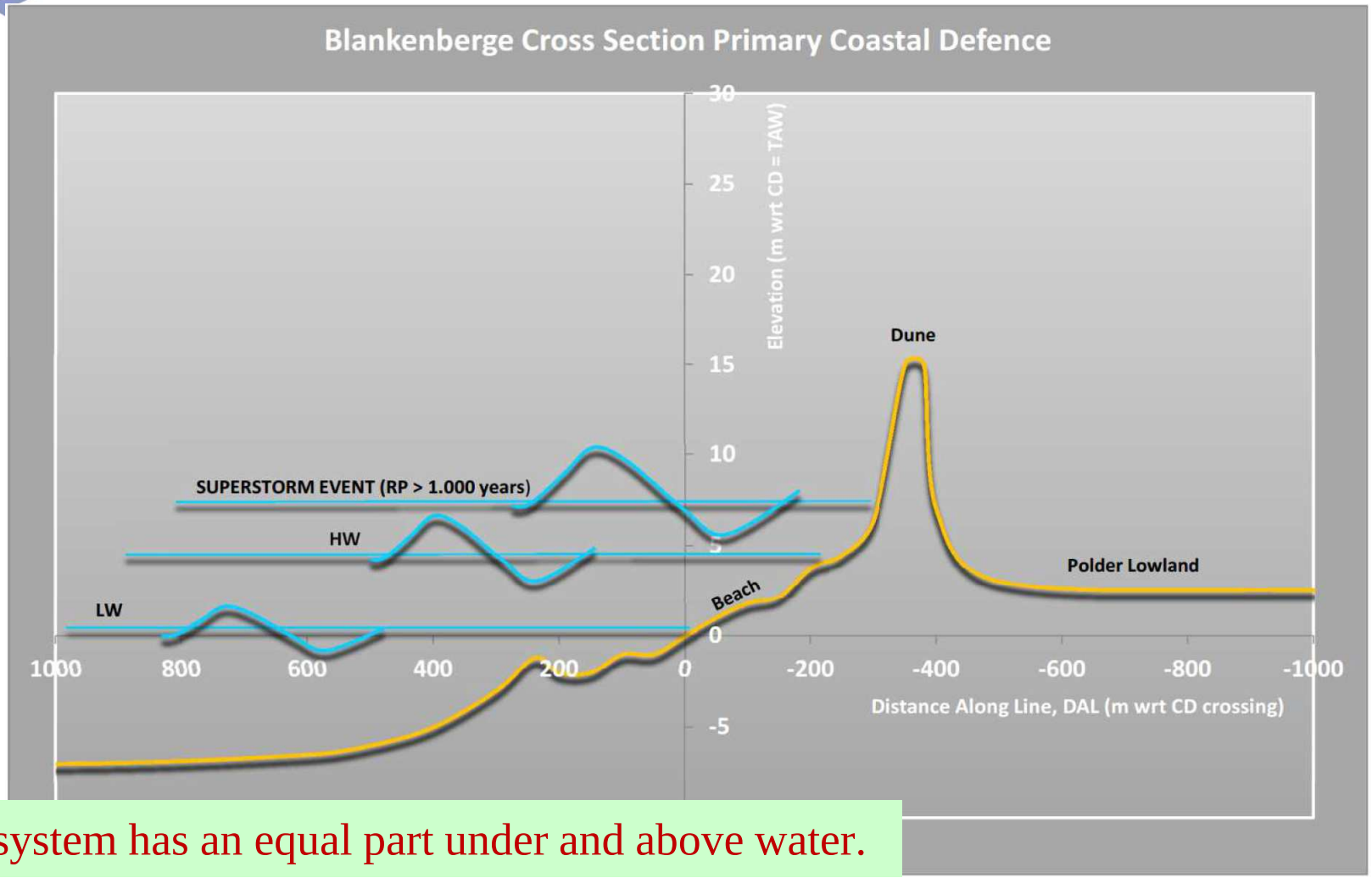
Inspired by Nature

Flanders Bays 2100
Impression of Sand-Barrier Island Coast

Flanders Bays 2100
Concept

Primary Coastal Defence System: a narrow but resilient and flexible sand-barrier system of dunes and beaches. A proven technology since million of years

Flanders Bays 2100
Current Primary Coastal Defence System



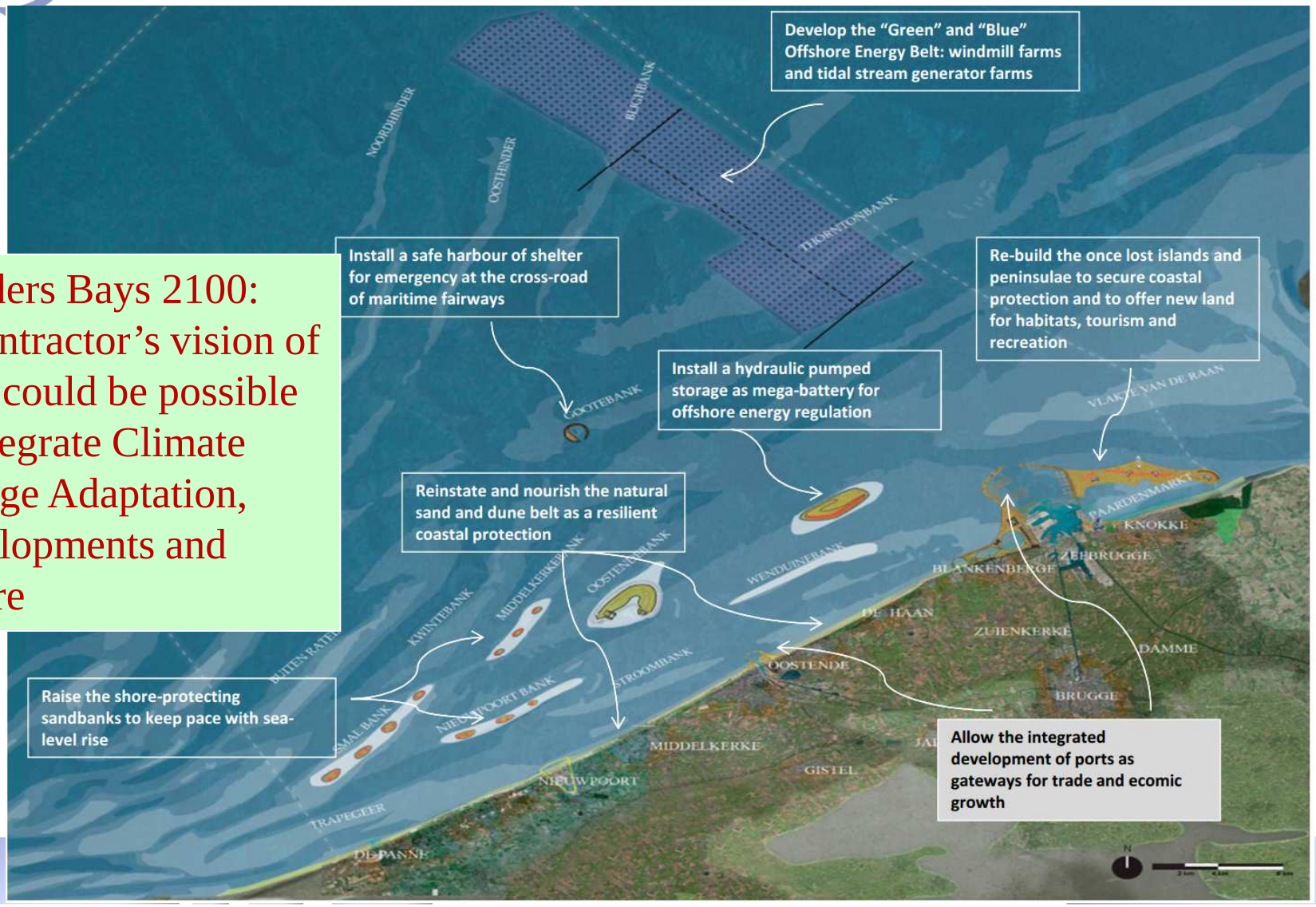
The system has an equal part under and above water.

Climate Change Adaptation
Future Primary Coastal Defence System ?

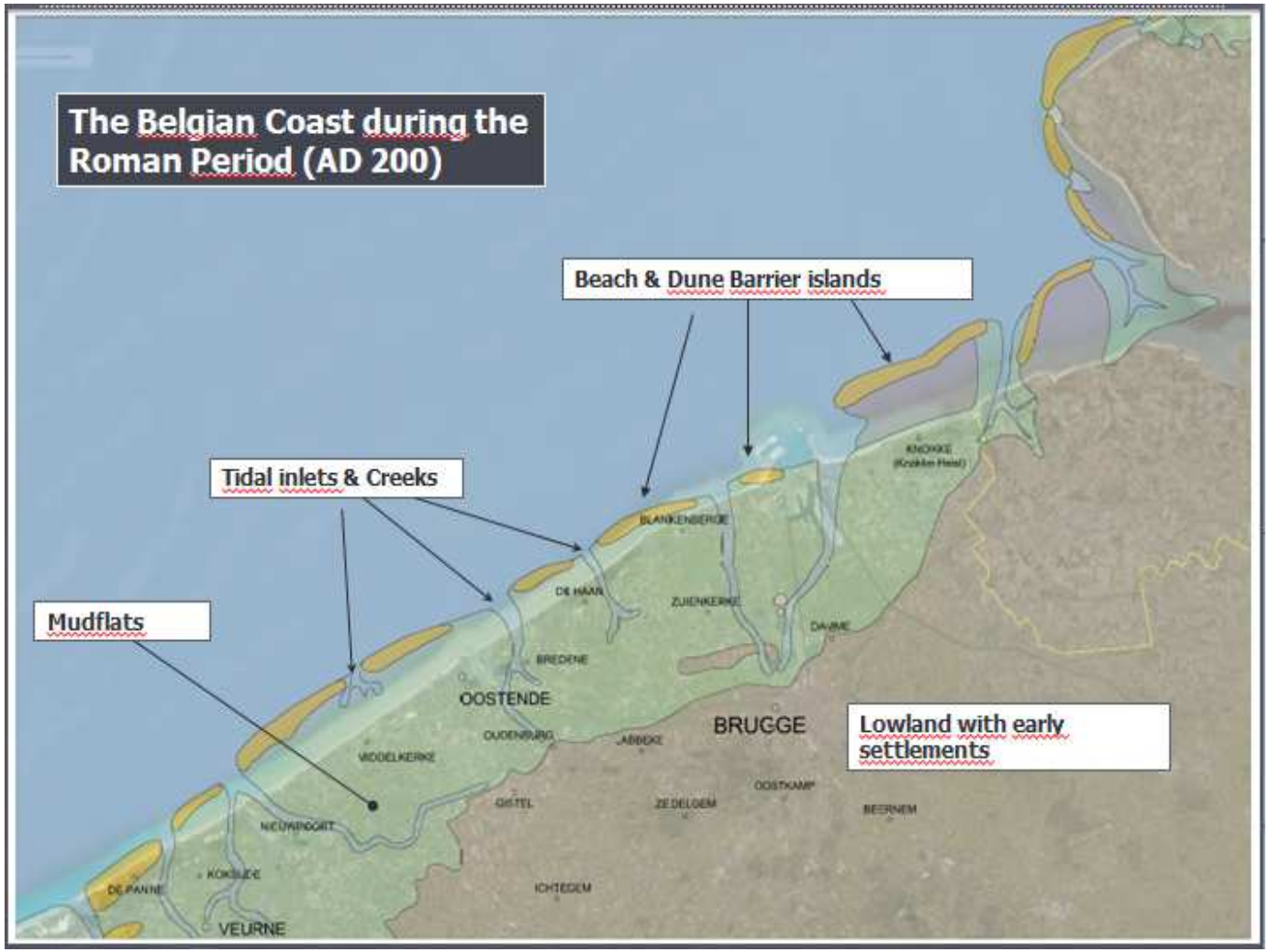
Climate Change and Sea-Level Rise might bring a different view on the future of the Primary Coastal Defence System.

Climate Change Adaptation
Flanders Bays Vision for 2100

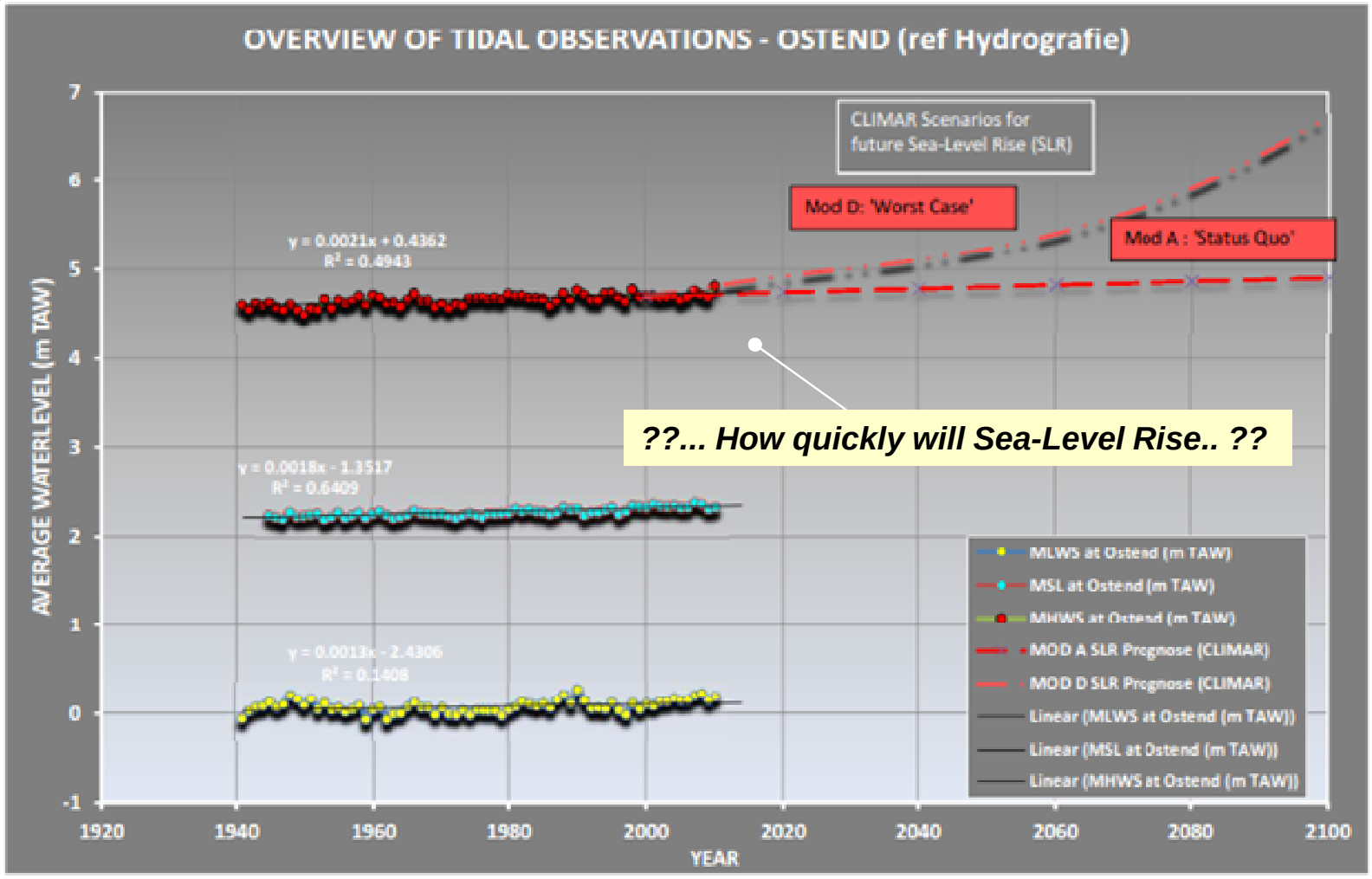
Flanders Bays 2100:
A Contractor's vision of what could be possible to integrate Climate Change Adaptation, Developments and Nature



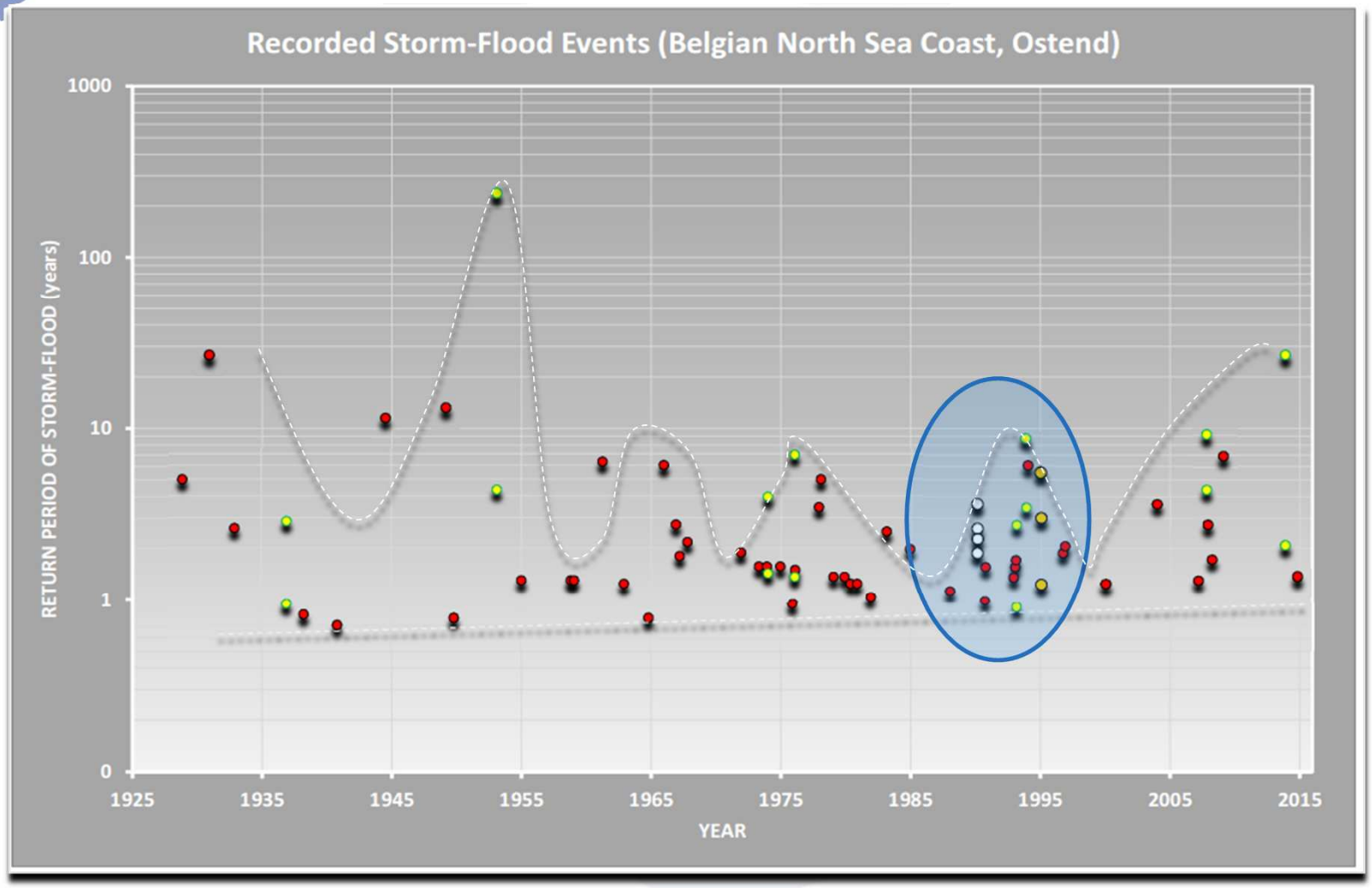
Flanders Bays 2100
Inspired by History



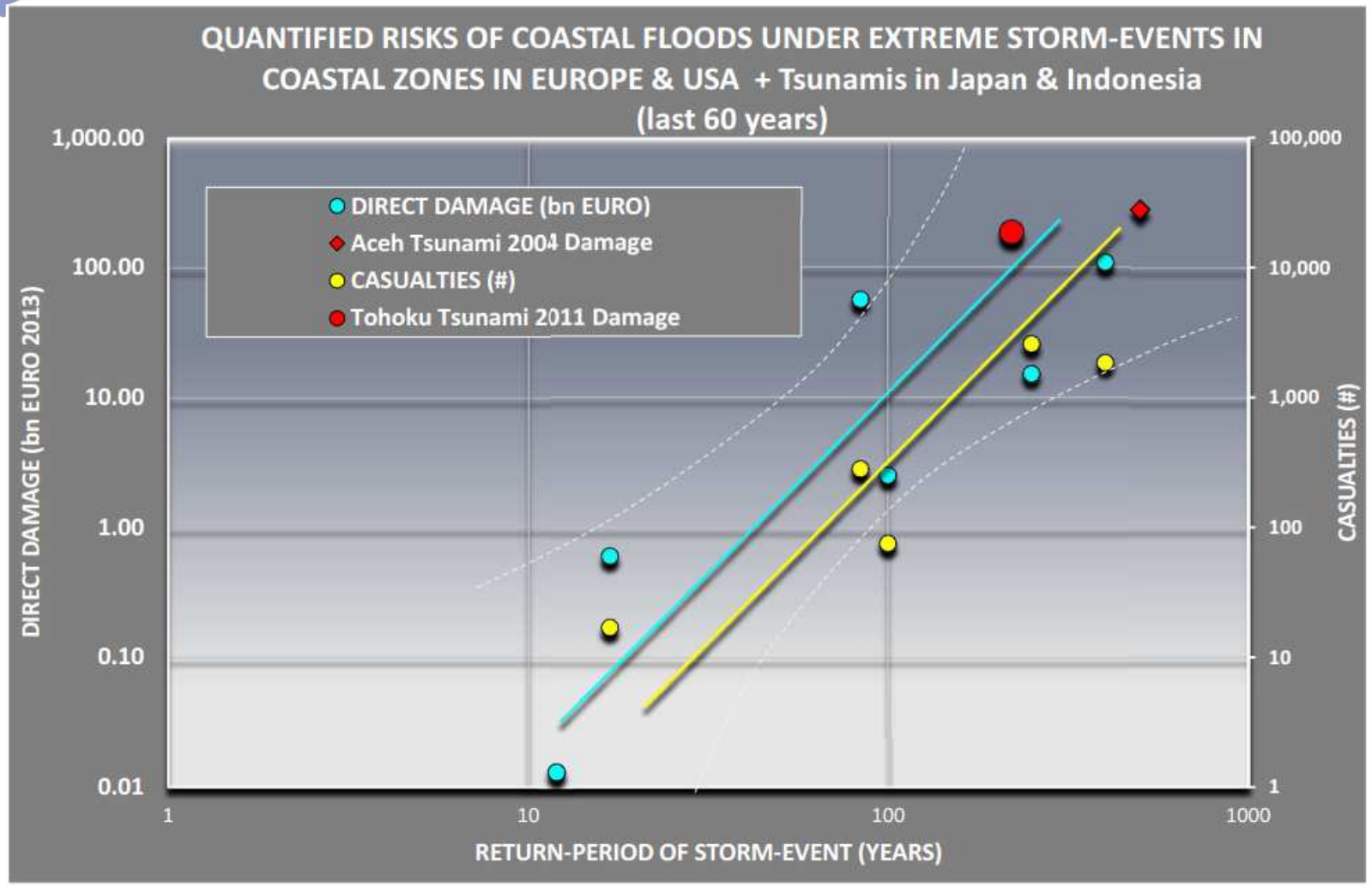
Climate Change Adaptation
Sea-Level Rise : a tangible reality?



Climate Change Adaptation
Increase in storminess, a tangible reality?



Climate Change Adaptation
Coastal Floodings: the price of living at risk



Climate Change Adaptation
Coastal Protection alternatives

Primary Coastal Defence or Strenghthening Systems

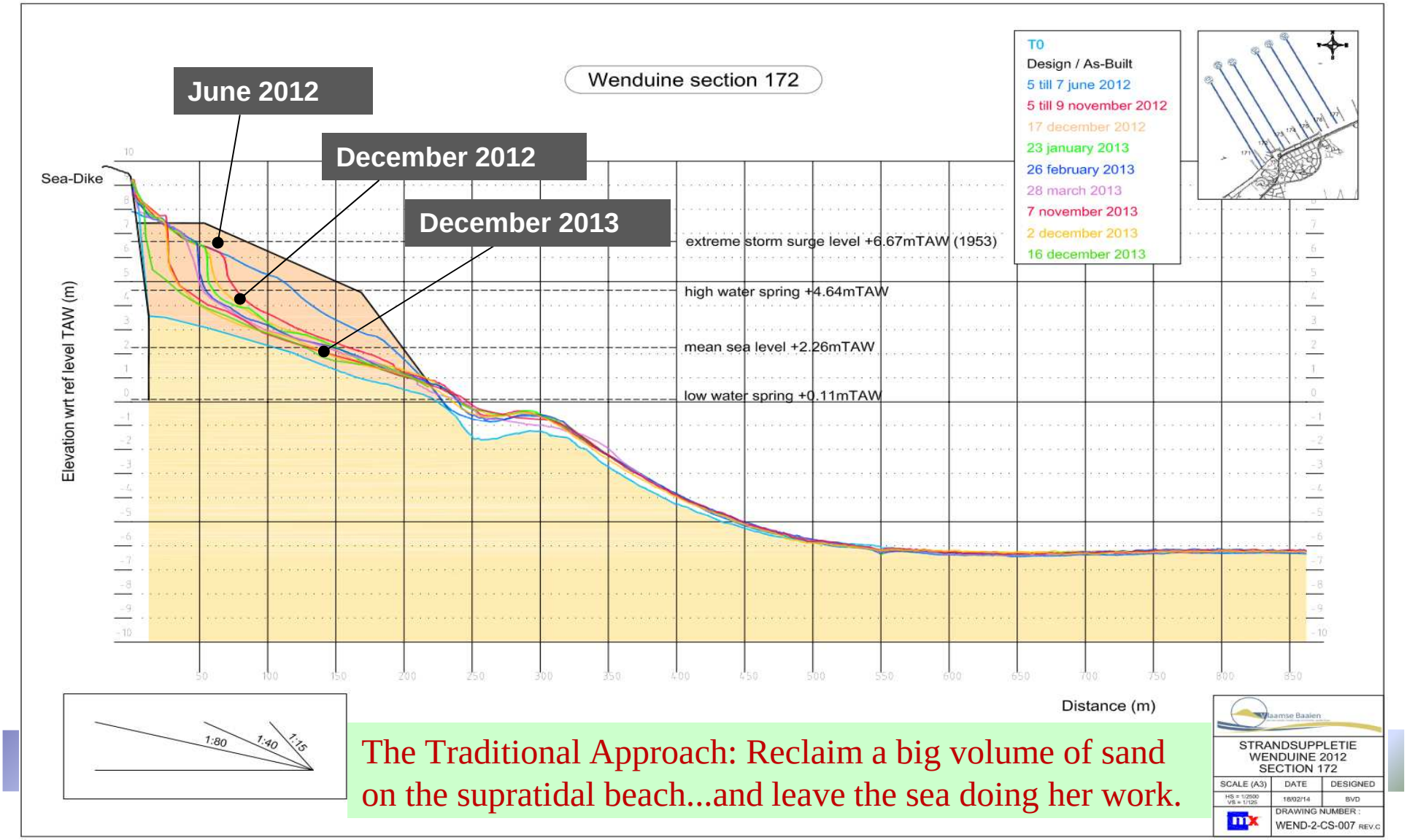
Fixid hard or Rigid Structures

Soft Systems

Concrete Seadikes & Parapet-Walls

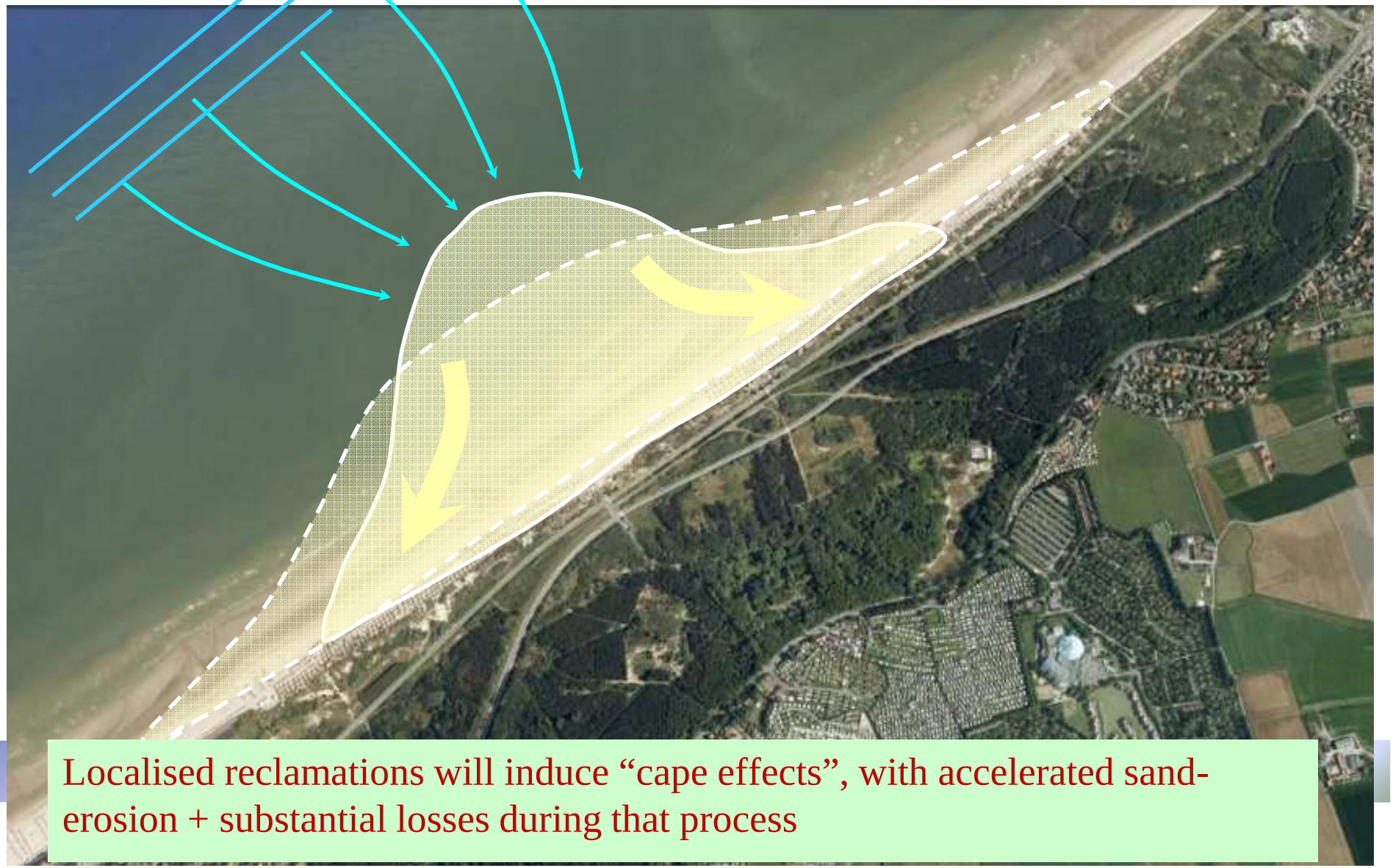
Geotubes, Geobags, Geo-containers

Climate Change Adaptation
Traditional Approach to Coastal Protection



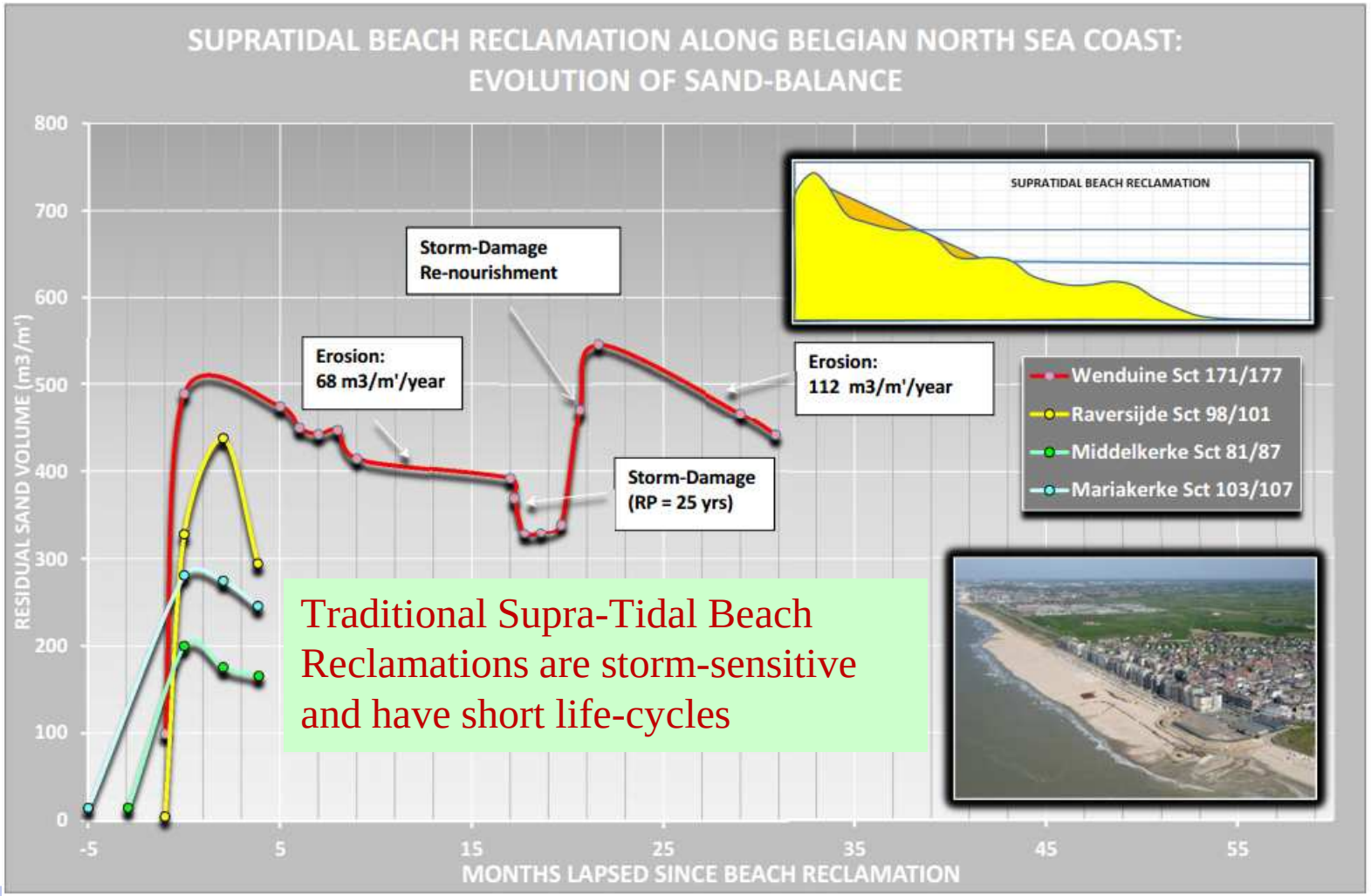
The Traditional Approach: Reclaim a big volume of sand on the supratidal beach...and leave the sea doing her work.

Climate Change Adaptation
Traditional Approach to Coastal Protection

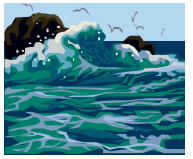


Localised reclamations will induce “cape effects”, with accelerated sand-erosion + substantial losses during that process

Climate Change Adaptation
Traditional Approach to Coastal Protection



Climate Change Adaptation
Need for Nature-Inspired Approach



Flanders Bays: observation is the mother of all sciences.

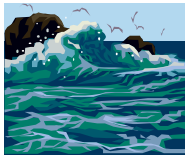
De Panne West: hoé de natuur ons met een breed strand veiligheid biedt.

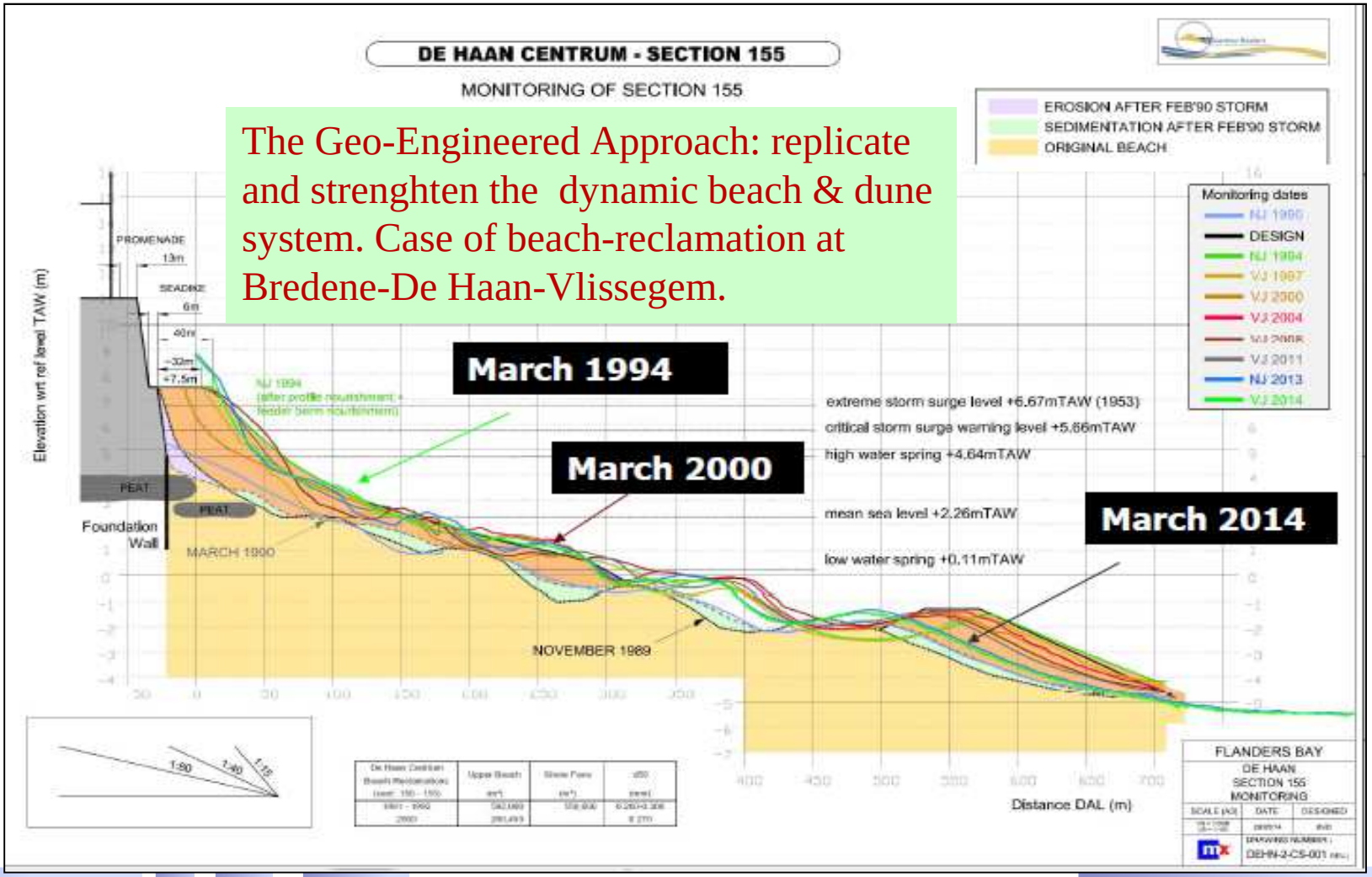
Middelkerke: hoé harde zeeweringen en uitsprongen met een nauw strand resulteren in een onveilige situatie

A wide upper-beach offers a resilient natural safety against extreme events with room for nature, recreation and living.

A “squeezed coast” decreases the attractivity and increases risks.

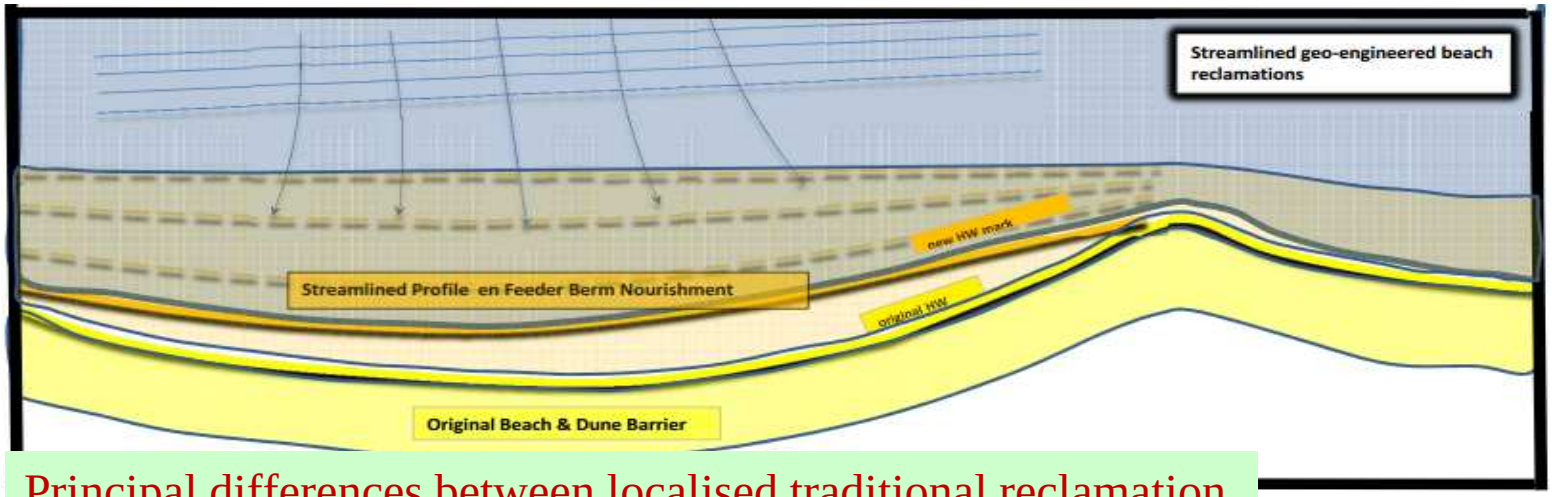
Climate Change Adaptation
Geo-Engineered Approach to Coastal Protection



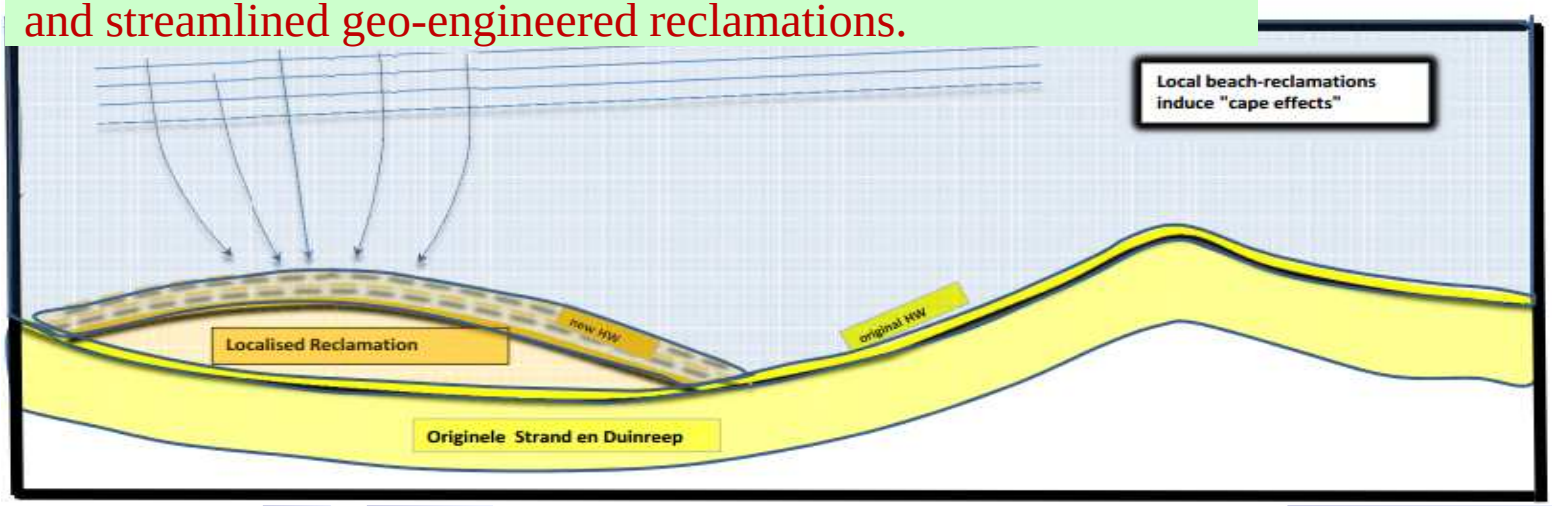


The Geo-Engineered Approach: replicate and strenghten the dynamic beach & dune system. Case of beach-reclamation at Bredene-De Haan-Vlissegem.

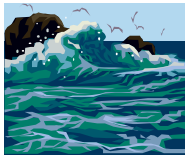
Climate Change Adaptation
Geo-Engineered Approach

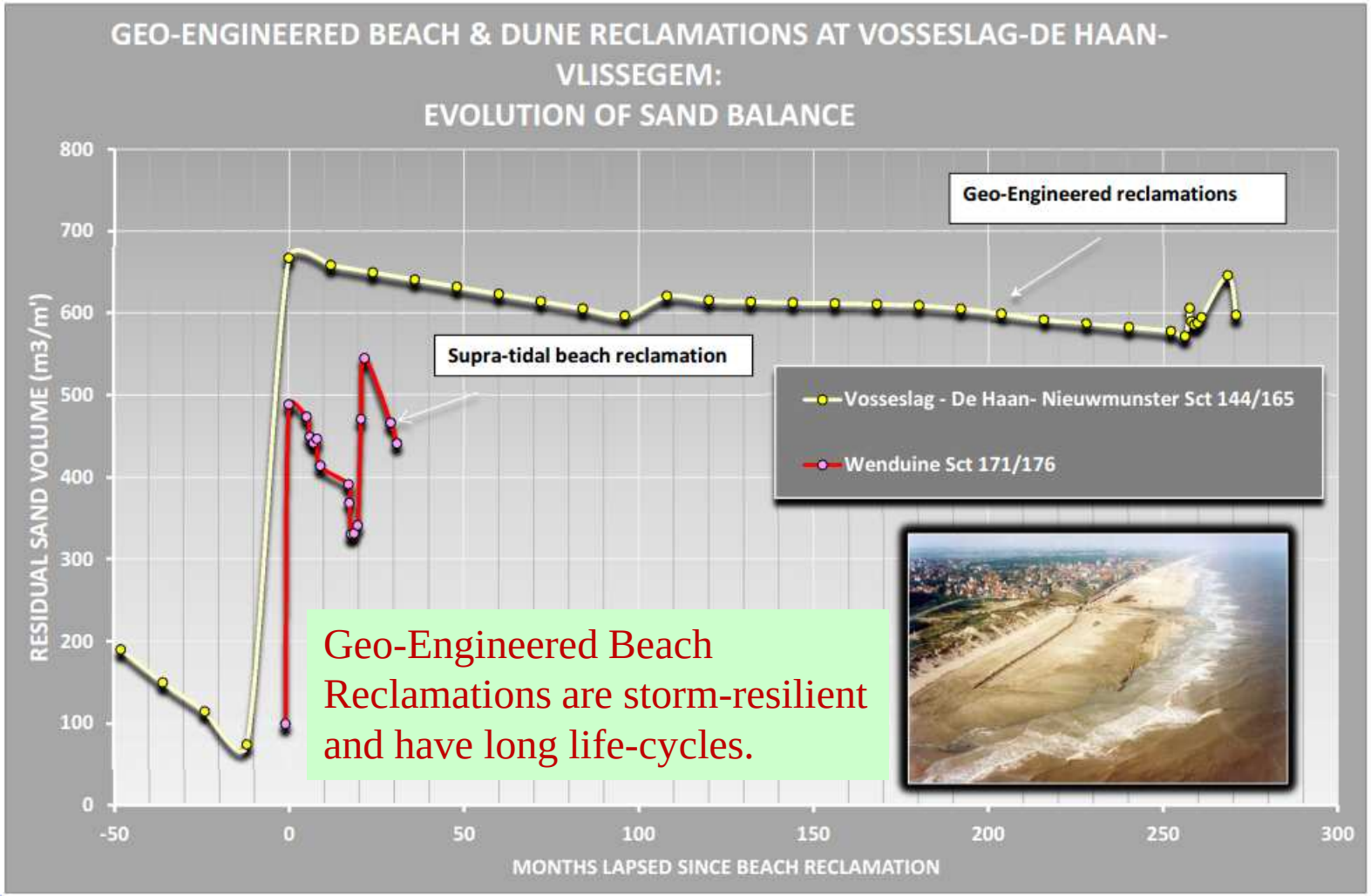


Principal differences between localised traditional reclamation and streamlined geo-engineered reclamations.



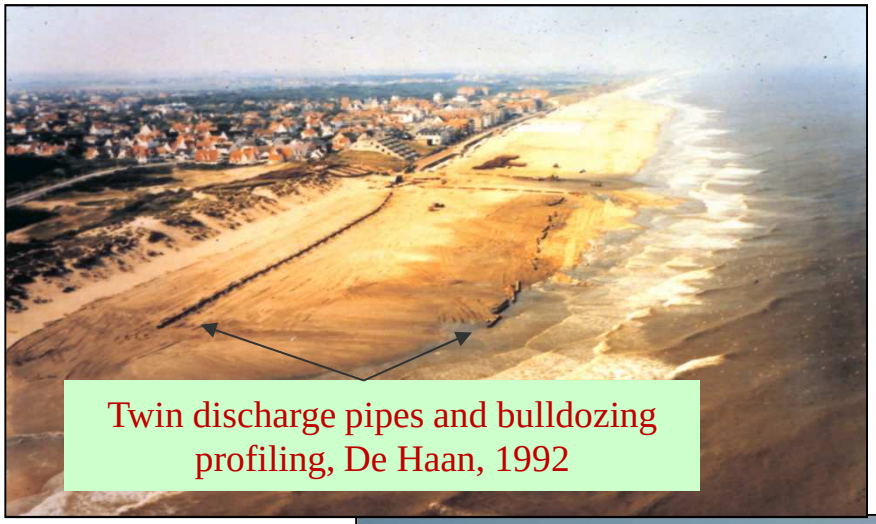
Successful CCA Examples
Geo-Engineered Reclamation





Successful CCA Examples
Geo-Engineered Reclamation

Execution of Morphological Nourishments:
Shoreface nourishment of subtidal beach & Profile nourishment of intertidal, supratidal beach and foredune.



Twin discharge pipes and bulldozing profiling, De Haan, 1992

Shoreface nourishment by dumping

Foredune nourishment with profile nourishment. Klemskerke , 1996

Successful CCA Examples
Geo-Engineered Reclamation

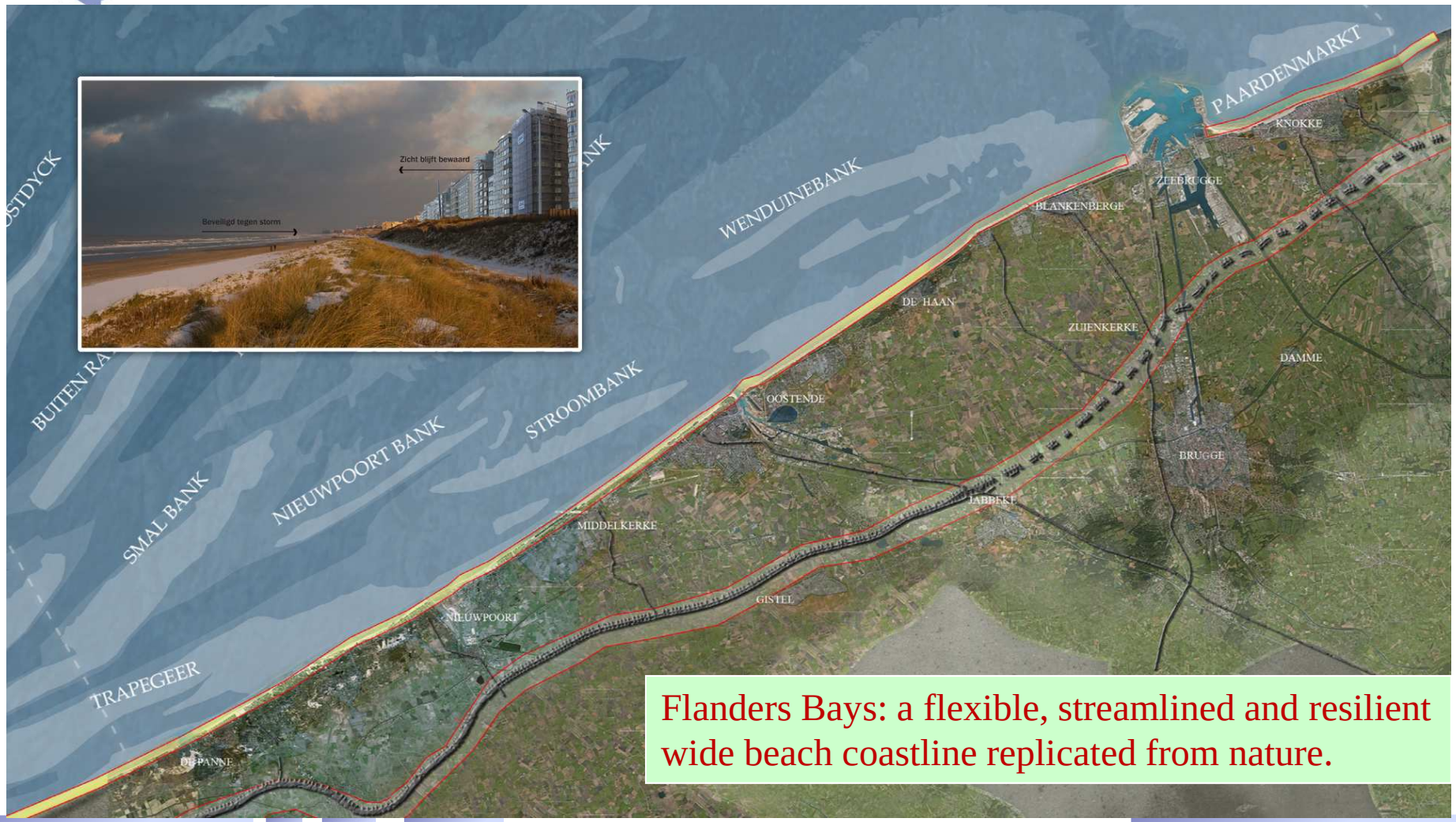
Execution of Morphological Nourishments:
Shoreface nourishment of subtidal beach &
Profile nourishment of intertidal, supratidal beach and foredune.

Bredene, Vosseslag, De Haan, Vlissegem, Nieuwmunster

Nourishment Scheme:

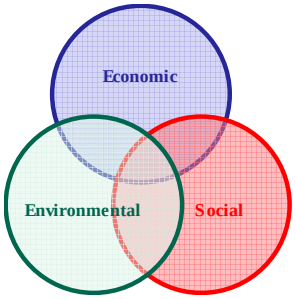
- **coastal length: 10.315m'**
- **volume of profile nourishment: 6,27 Mm3 (av 610 m3/m')**
- **volume of feeder-berm: 3,74 Mm3 (av 360 m3/m')**

Conclusion
Nature-Inspired Solutions for CCA



Flanders Bays: a flexible, streamlined and resilient wide beach coastline replicated from nature.

Conclusion
Implementing a Sustainable Approach



Building with Nature

is a partnership with Nature, integrating both physical and biological aspects of Nature in a project's design, EcoDynamic Design or Geo-Engineering, and implementation so that the project integrates more harmoniously and more harmlessly into Nature and when possible to Nature's benefits.

"Where Nature and Man build together for their mutual benefit."

Conclusion
Nature-Inspired Engineering delivers

Robust beach-reclamation technologies exist to strengthen the Primary Coastal Defence System of sand-barrier coasts.

Their basic principles rely on observation, understanding and replication of natural morpho-dynamic systems integrating the local eco-systems.

And the system yet belongs to proven technology...

Start acting now
to adapt our coasts to Climate Change and Sea-Level Rise with Nature making the best use of Adaptive Management and Adaptive Monitoring and building the knowledge along with the defenses !

Thank you !

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  Fax : +322 6466063

- Website:
  www.european-dredging.eu

EuDA

EUROPEAN DREDGING ASSOCIATION

"EuDA is the official interface between the European dredging industry and the European Institutions"

- founded in 1993
- represents the European Dredging Companies
- from 16 EU Members States
- world leaders (top 4)
- with a turnover (2013): € 8.3 bn
- +/- 25,000 European direct employment
- >50,000 indirect employment (*supply and service companies*)