
Climate change and socio-economic impact on the long term sediment balance in the Belgian Part of the North Sea

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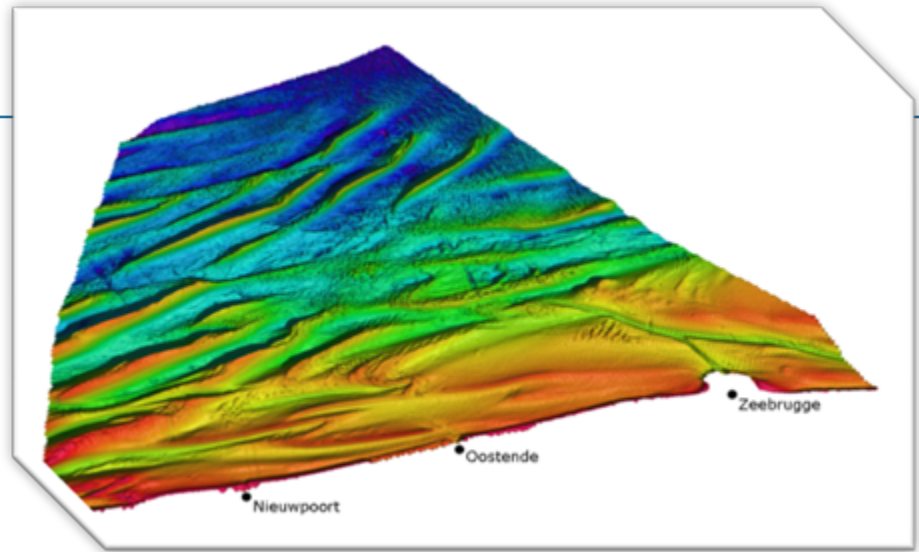


Outline of the presentation

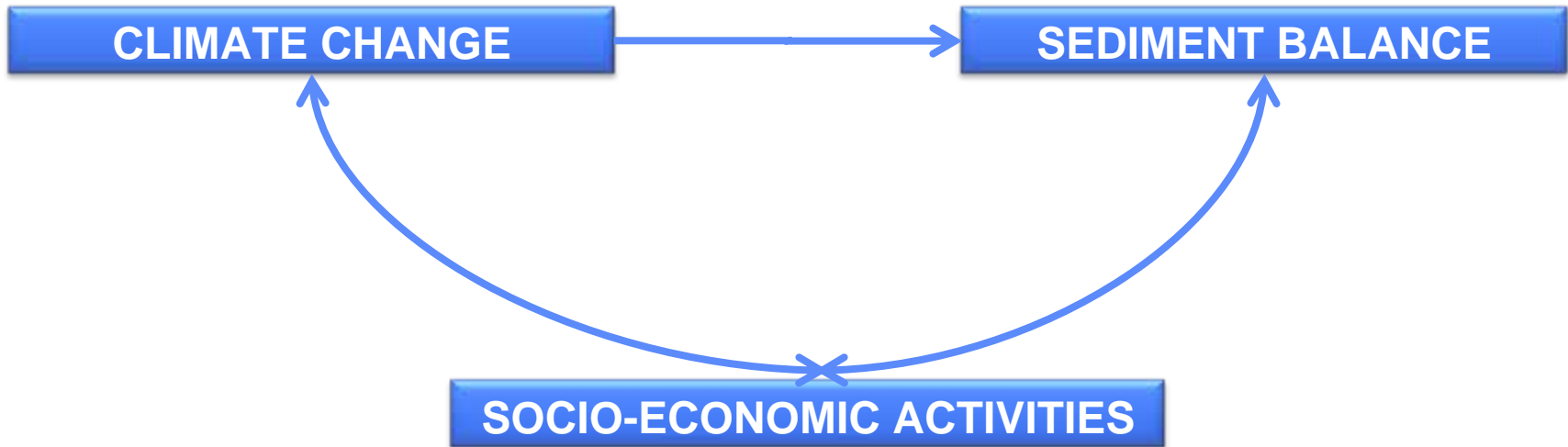
- Introduction
 - BPNS
 - Research projects
- Climar
 - Primary effects
 - Scenario's
- Quest4D
 - Antropic influence : case study sediment disposal
 - Natural evolution versus antropic influence
- Climar
 - Secondary impacts on different sectors
 - Sectoral CC adaptation with holistic view on sediment budget
- Conclusions



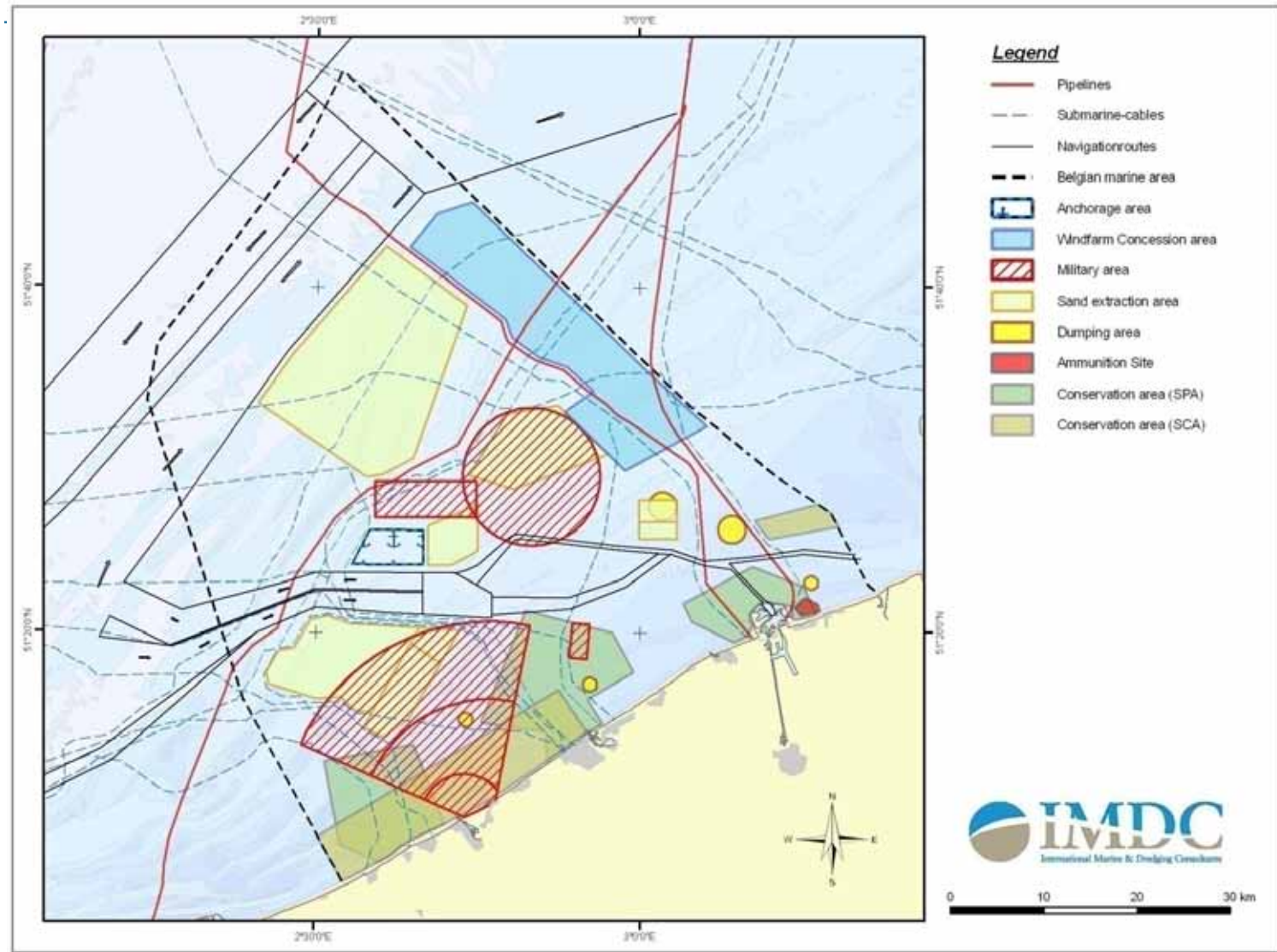
Introduction



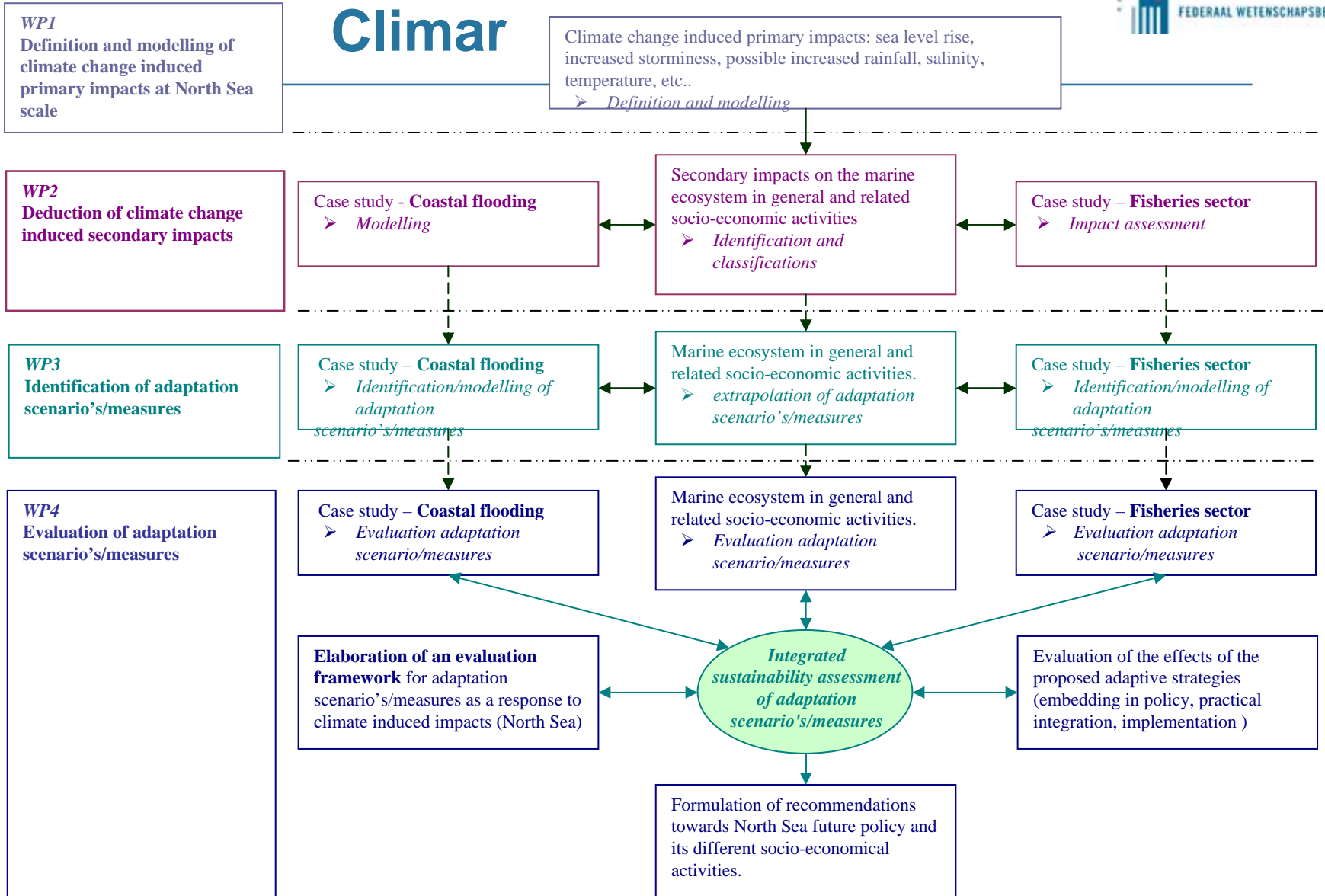
Van Lancker et al., 2007



Belgian Part of the North Sea

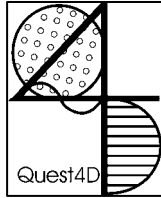


Climar



Quest4D

- New process studies and refined modelling
 - Quantification of changes and trends (depth, sediment, sediment transport, macrobenthos and their linkages);
 - Improvement of model input and integration
- Establishment of a baseline
 - Gilson dataset ~1900 (sediment and macrobenthos)
- Deciphering change, both naturally and anthropogenically- steered over the past 100 yrs



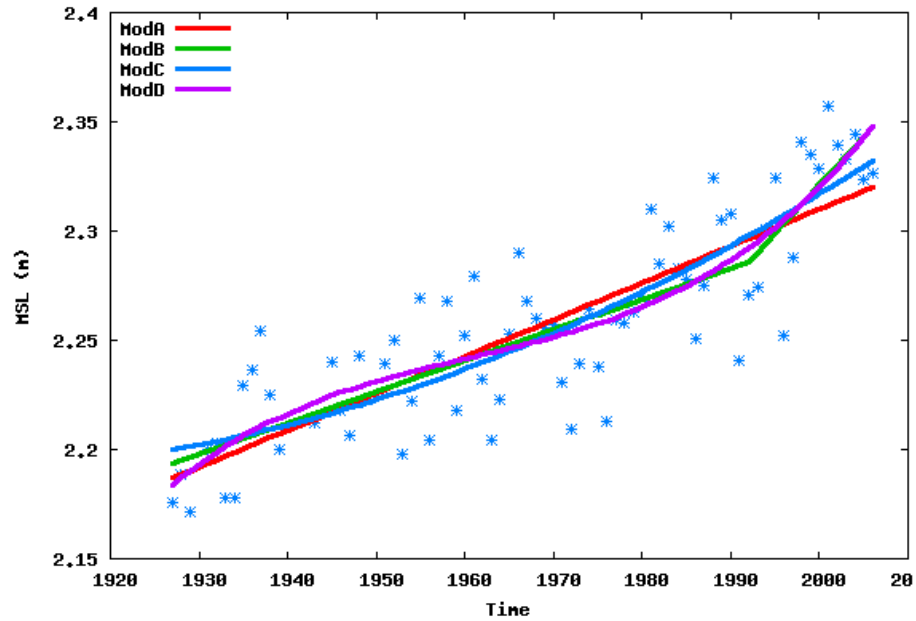
Ultimate goal:

- ▶ Better allocation of disposal grounds, sustainable marine aggregate extraction, sustainable coastal protection schemes, *in the view of climate change*
- ▶ Optimisation of monitoring practices

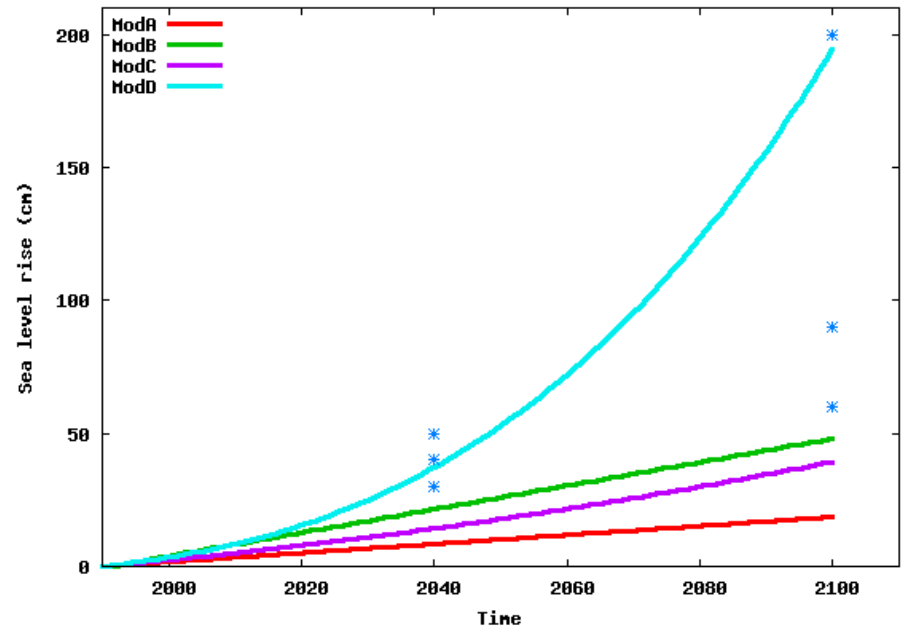


Primary effects : sea level rise

Oostende (1927-2006)



Oostende (1990-2100)



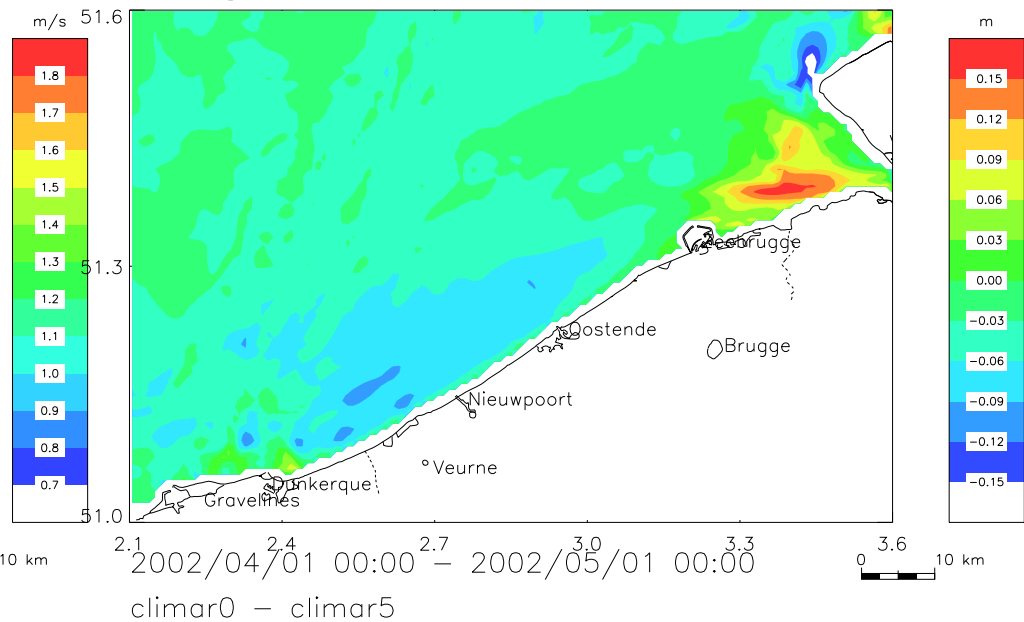
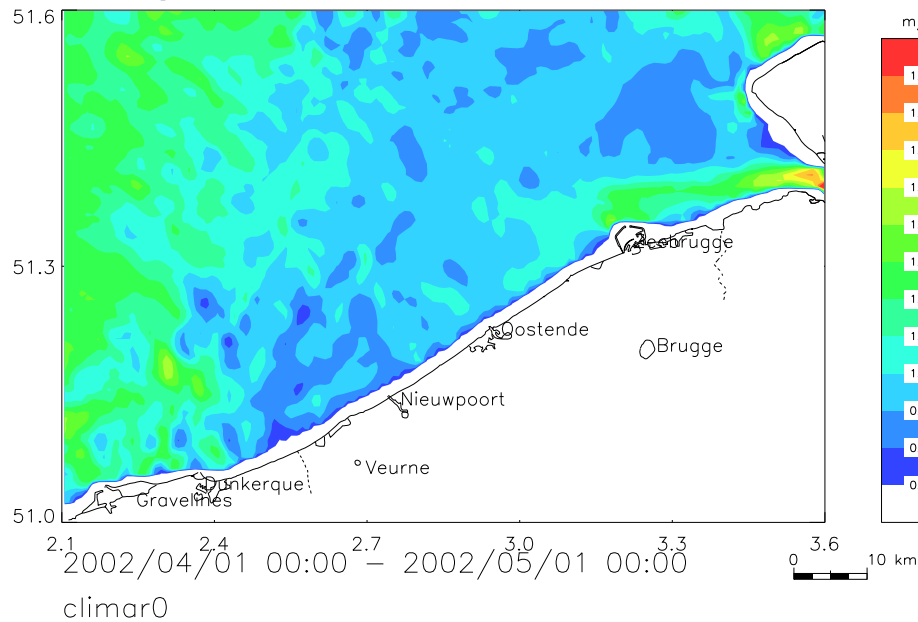
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Primary effects : change in currents

Magnitude maximum currents of bcz

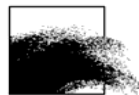
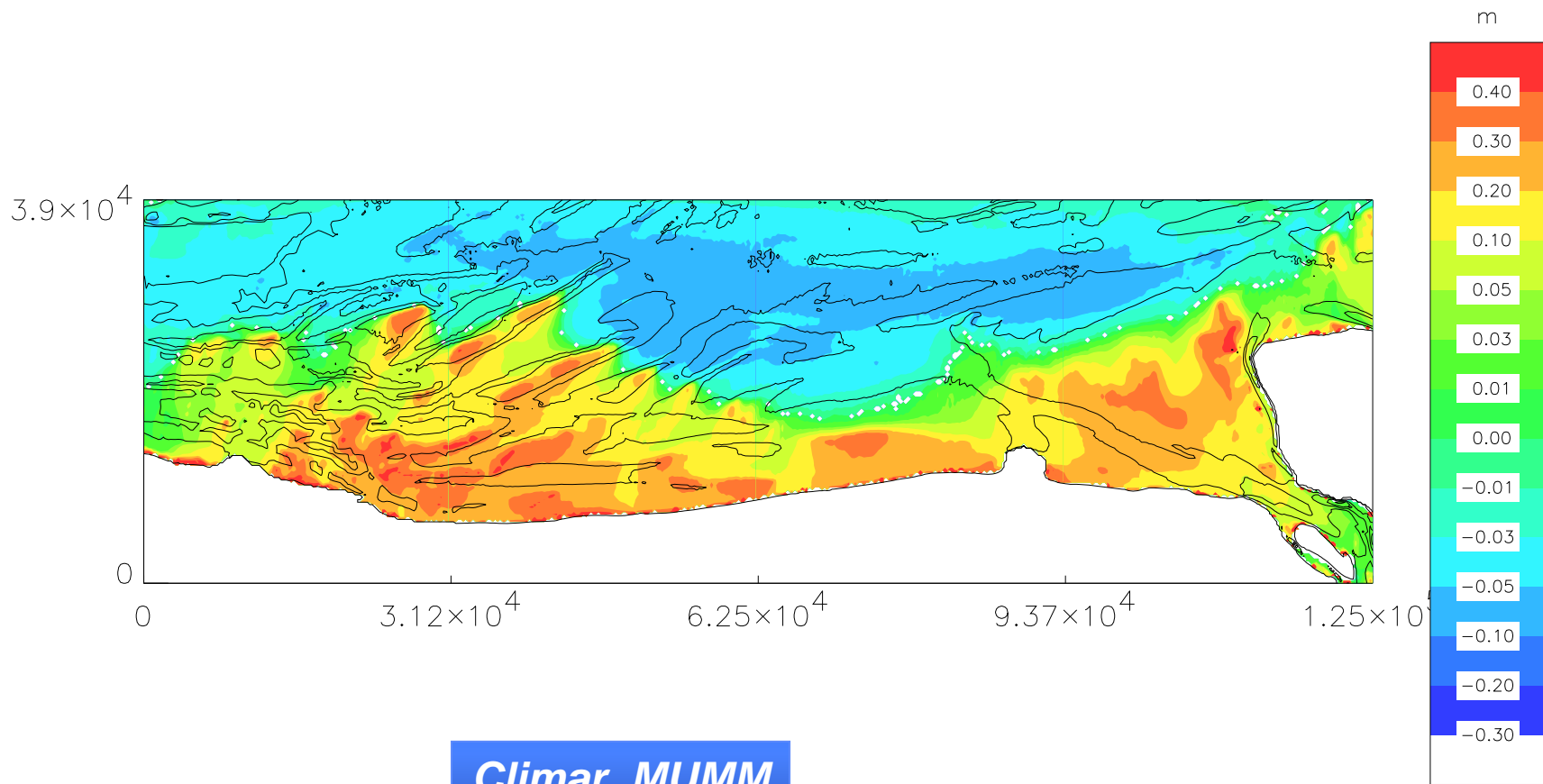
Magnitude maximum currents of bcz



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Primary effects : change in wave climate



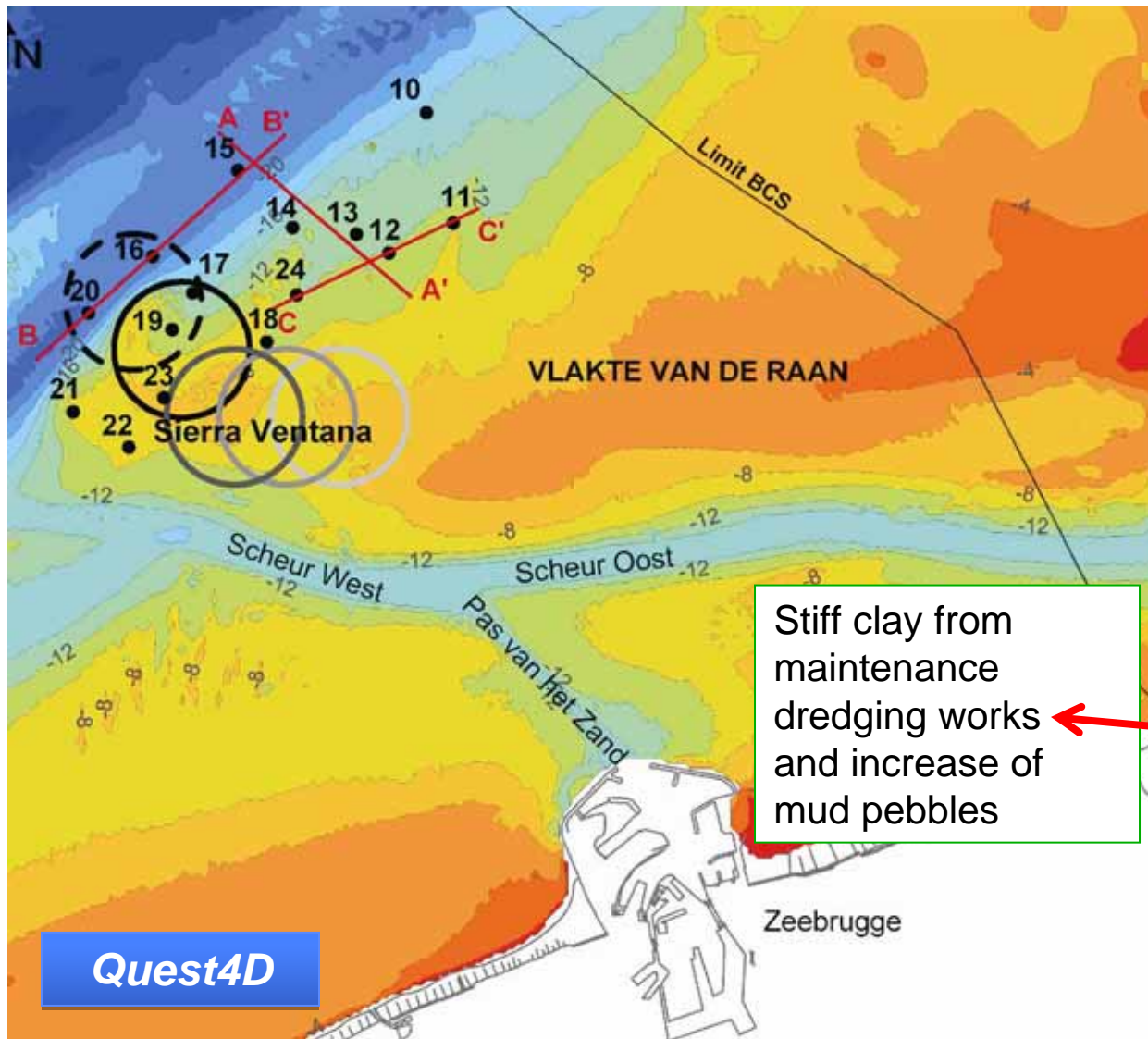
Working with CC scenario's

	M	M+	W	W+	Worst
Air temperature	+ 2 °C	+ 2 °C	+ 4 °C	+ 4 °C	+ 4 °C
Change air circulation	No	Yes	No	Yes	Yes
Winter precipitation	+ 8%	+ 14%	+ 16%	+ 28%	+ 28%
Wind velocity	0%	+ 4%	- 2%	+ 8%	+ 8%
Summer precipitation	+ 6%	- 20%	+ 12%	- 40%	- 40%
Sea water temp	+ 2.5%	+ 2.5%	+ 3.5%	+ 3.5%	+ 3.5%
Mean sea level	+ 60cm	+ 60 cm	+ 93 cm	+ 93 cm	+ 200 cm

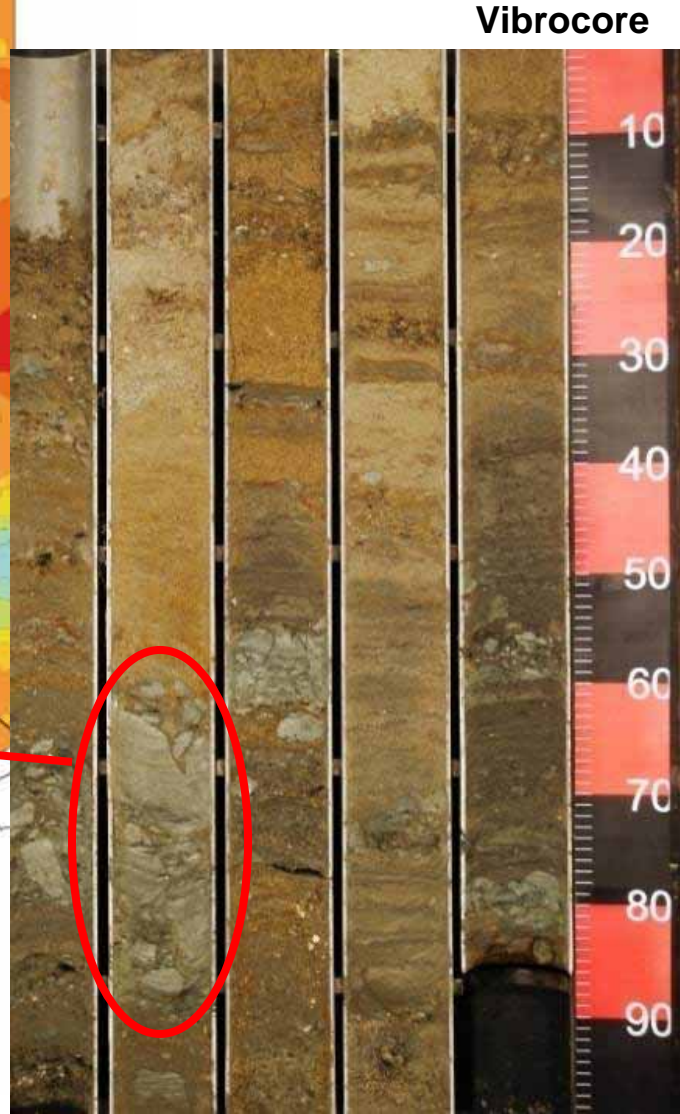
Climar, scenario 2100



Anthropogenic change → case study on the disposal of dredged material



Stiff clay from maintenance dredging works and increase of mud pebbles



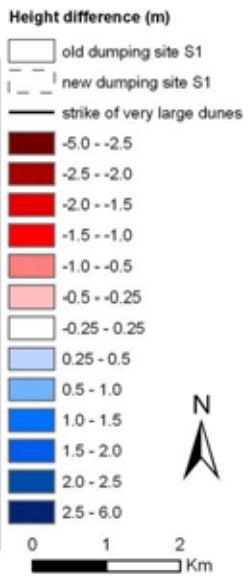
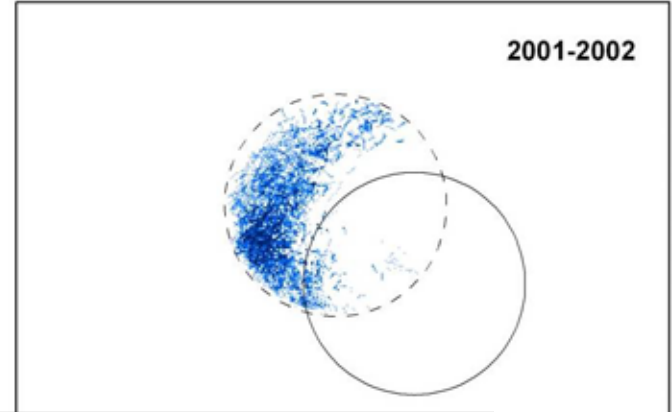
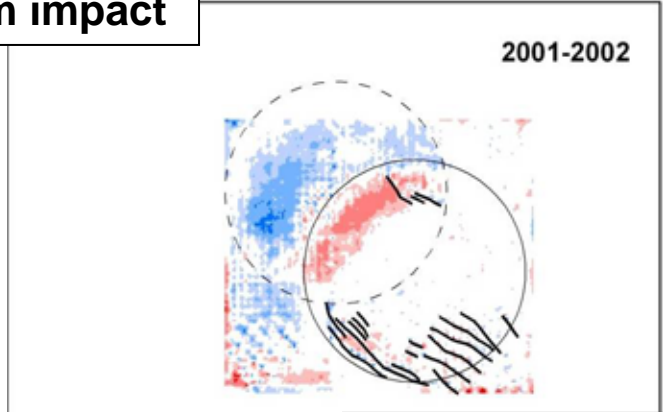
Anthropic change → case study on the disposal of dredged material

1 Analysis of bathymetric data

2 Analysis of corresponding data on the disposal of dredged material

Short-term impact

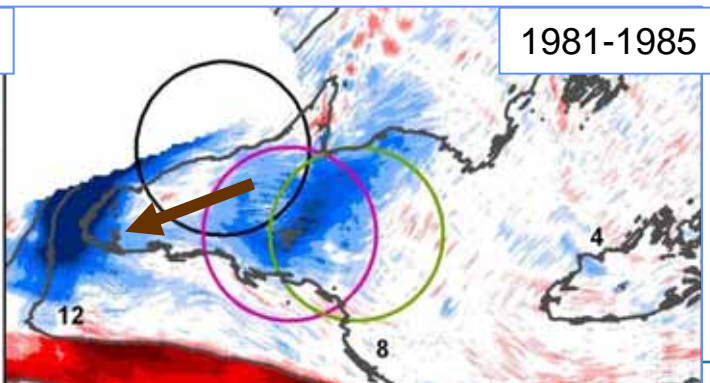
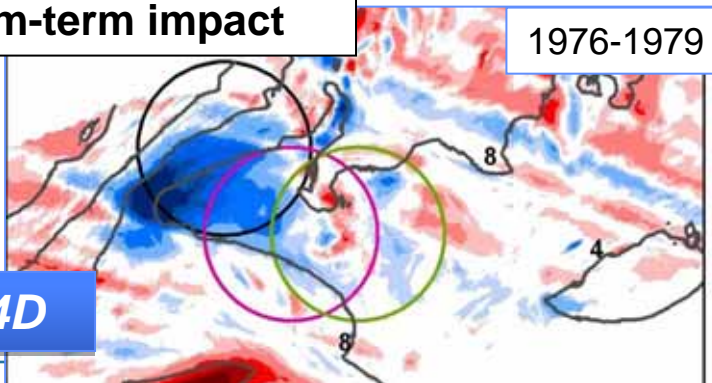
Active cooperation end-users



Deciphering thresholds of 'anthropic' change

Data compiled from the Flemish Authority

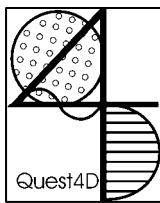
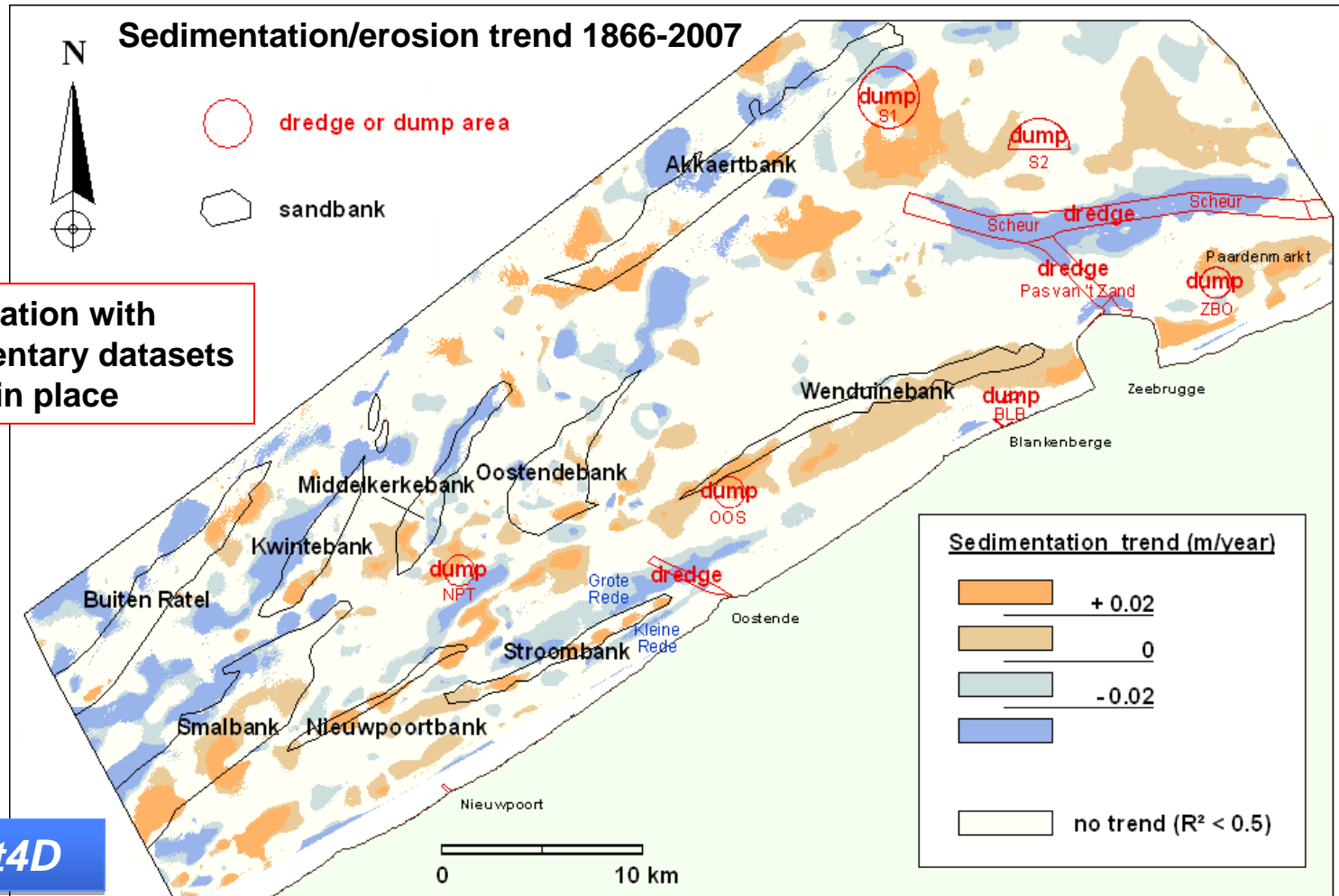
Medium-term impact



3 Analysis of vibrocores:
 • top 25-50 cm highly dynamic
 • natural vs anthropic sedimentation patterns

Regional sedimentation beyond the disposal grounds, in the direction of navigation channels

Long-term erosion/sedimentation patterns



Quest4D

Sandbanks within +/- 20 km zone: **no apparant movement during last 150 years**

→ accretion of banks + erosion of troughs between the banks (few cm/year) → steeper slopes of the banks

Major change Zeebrugge area: maintenance and deepening works + disposal of dredged material:

Natural vs anthropic

Natural evolution

Sediment volumes vs hydro-meteo from measuring piles (Flemish Authorities)

- Wind
- High- and low frequency waves
- Currents
- Water levels

Varying sediment volumes over sandbank areas

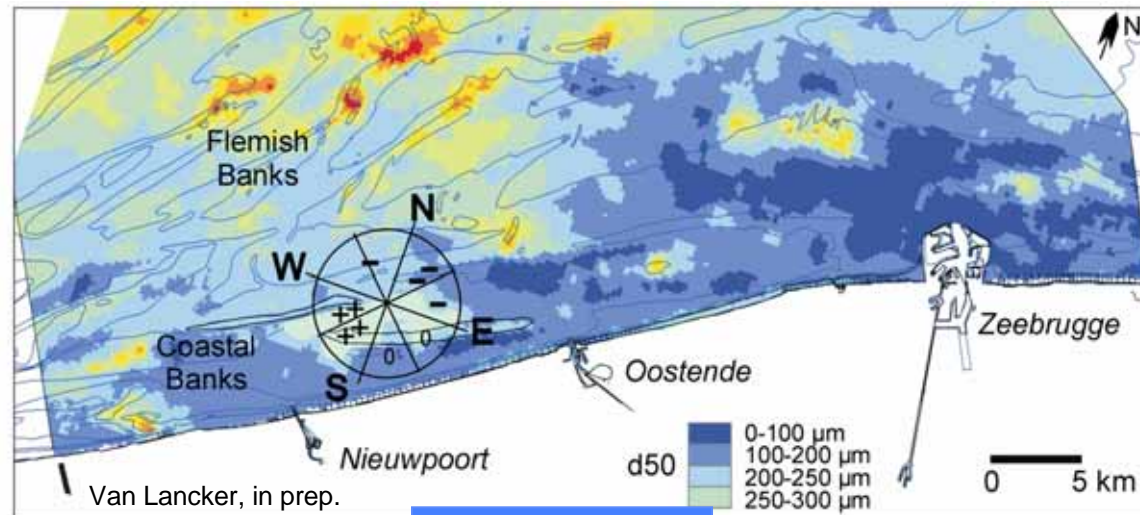
Surveys	9609	9611	9612	9702	9709	9711	9802	9803	<i>maximum change</i>
9609		0.05	0.03	0.09	0.01	0.05	0.05	0.04	<i>0.09</i>
9611			-0.02	0.03	-0.04	0.00	0.00	-0.01	<i>-0.04</i>
9612									<i>0.05</i>
9702									<i>-0.08</i>
9709									<i>0.04</i>
9711							0.00	-0.01	<i>-0.01</i>
9802								-0.01	<i>-0.01</i>
9803									<i>0.00</i>
<i>maximum change</i>	<i>0.00</i>	<i>0.05</i>	<i>0.03</i>	<i>0.09</i>	<i>-0.08</i>	<i>0.05</i>	<i>0.05</i>	<i>0.04</i>	

Deciphering thresholds of 'natural' change

Baland Bank bathymetric surveys.

Matrix of all the intersurvey volume differences per surface unit (m³/m²). The maximum differences are indicated in italic. Surveys are indicated as YYYYMM.

Event-driven vs. yearly-averaged changes



Findings along 'undisturbed' near coastal small sandbank:

- (1) Enhanced SW conditions bring in sediment
- (2) Persistent NW and NE conditions evoke erosion
- (3) Overall shallowing of the area



Scenario's will be used to predict sediment transport changes, due to climate change

Secondary effects and indicators of climate change

Ecological

Primary production

Geographical shift

Decoupling phenological relationships
(recruitment, food availability)

Non-indigenous species & harmful blooms

Loss of habitat

Biodiversity

Economical

Shipping: accident risk,
Sediment processes in navigation routes, oil pollution, ...

Fisheries/ Mariculture:
fish loss, risk,...

Industrial activities
(Wind energy, sand & gravel): sediment processes, risk,...

Tourism: beach (pollution, loss), sea quality, accommodations

Employment

Social

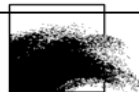
Health: heat/cold, allergies, stress, water quality, blooms of spp.

Food quality (fish, seafood)

Accommodations

Safety

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Secondary effects on tourism - TCI index as a measure of climate attractiveness of a coast

The TCI index is weighted and computed as follows (Amelung et al., 2007):

$$TCI = 2 * (4CID + CIA + 2R + 2S + W)$$

<i>Subindex</i>	<i>Variable(s)</i>
Daytime comfort Index (CID)	Maximum daily temperature (°C)
	Minimum daily relative humidity (%)
Daily comfort Index (CIA)	Mean daily temperature (°C)
	Mean daily relative humidity (%)
Precipitation (R)	Precipitation (mm)
Sunshine (S)	Daily duration of sunshine (hours)
Wind speed (W)	Wind speed (m/s or km/hr)



Belgian coast → more attractive

Climar, Ugent - Arcadis



Coastal tourism

- Impacts and adaptation strategies ~ stakeholders
- Climate change opportunities !
- Certainly needs beach nourishment ← coastal defence

Climar, Ugent - Arcadis



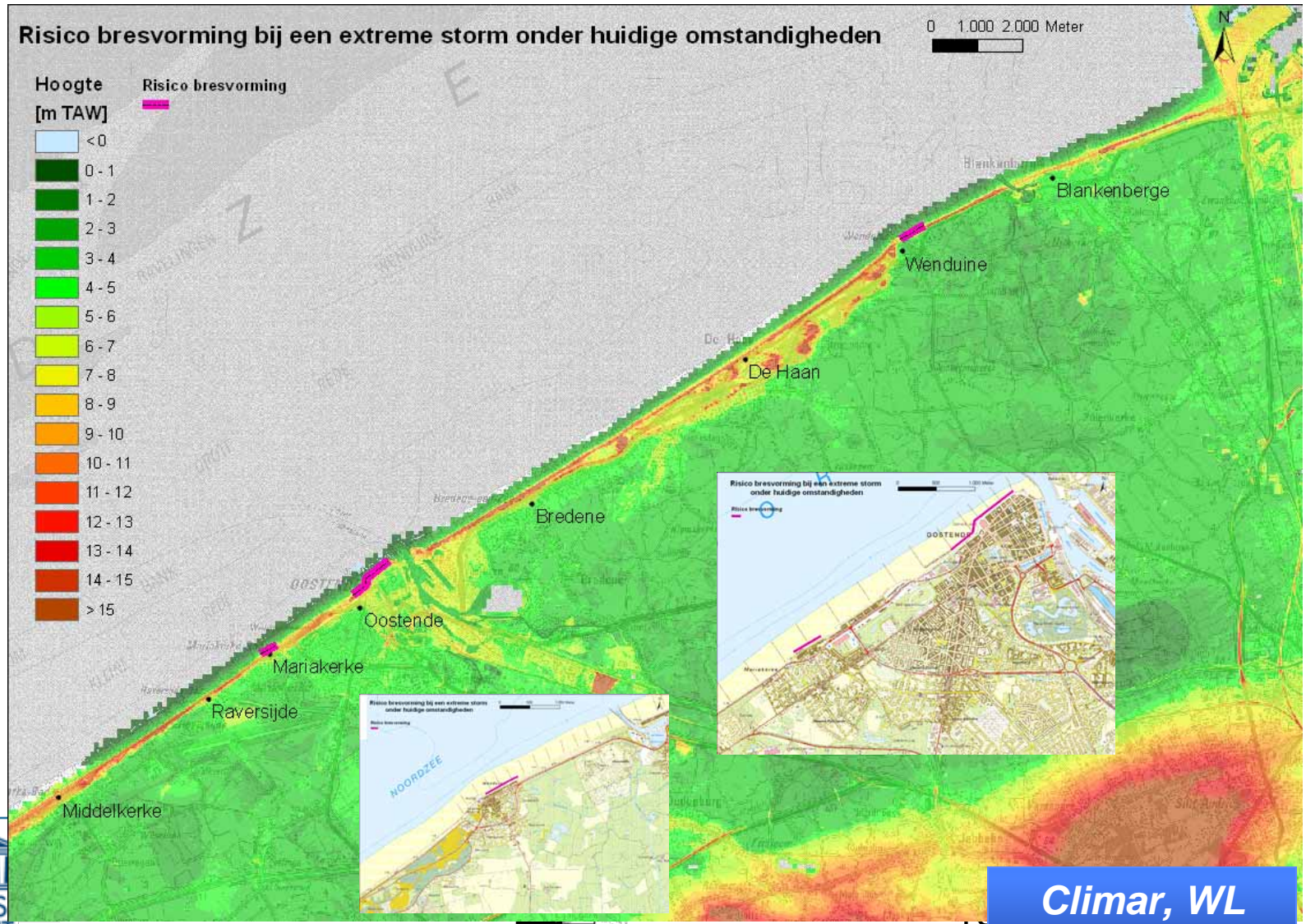
Coastal defence

- Risk estimate : current versus future
- Link with ongoing Coastal Safety Plan
- Link with need for sand extraction → clear influence on “natural sediment balance”



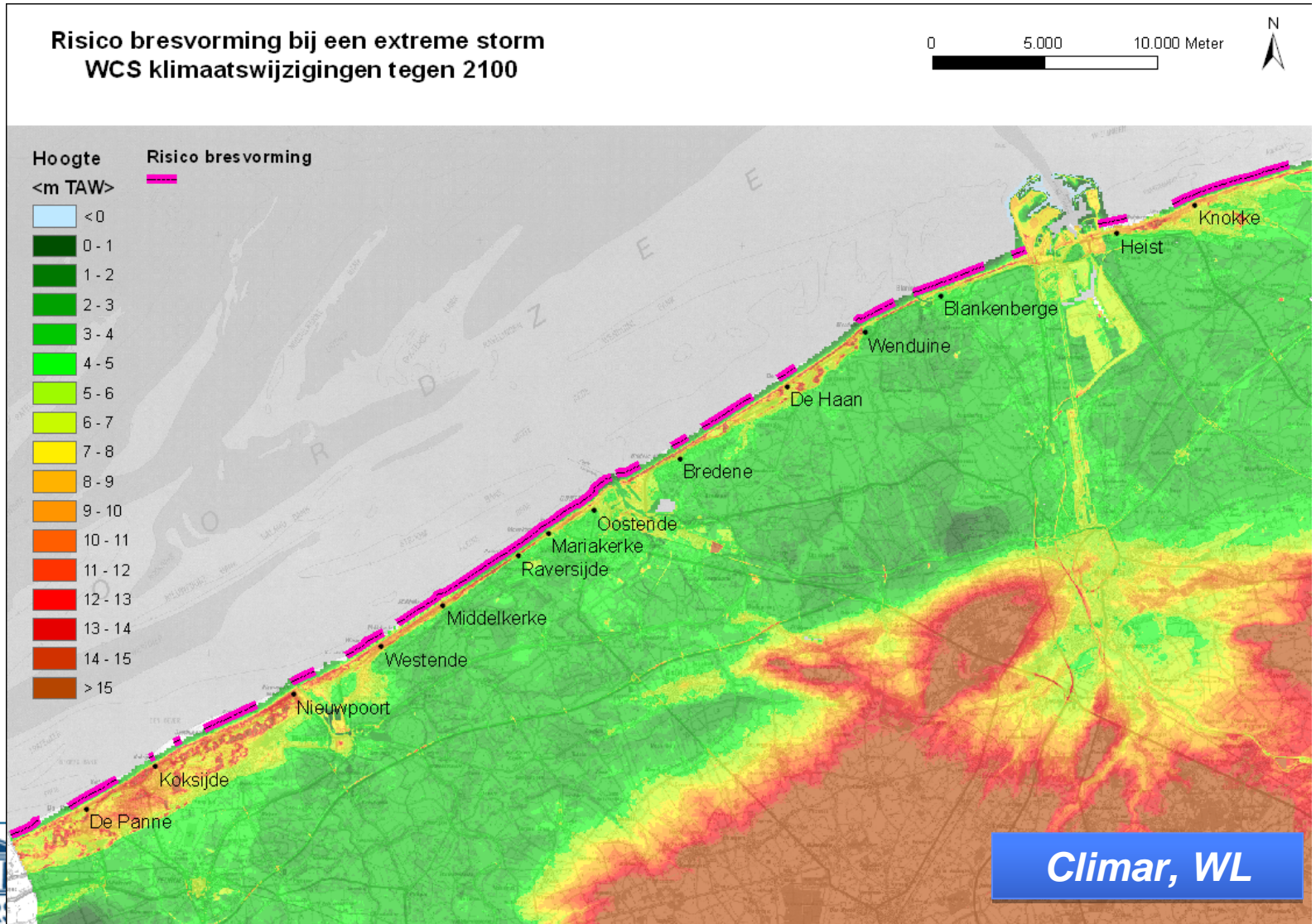
Risk on coastal flooding

1. Current situation – 13 (385) profiles fail



Risk on coastal flooding

2. Worst Case Scenario 2100 – 194 profiles fail



Coastal safety plan



www.afdelingkust.be

CC adaptation – future ideas Vlaamse Baaien 2100



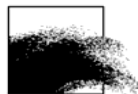
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www.deme.be & www.jandenul.be



Future work

- **Climar**
 - Form adaptation strategies for different sectors
 - Development of evaluation tool
 - Evaluation of adaptation scenario's
- **Quest4D**
 - Evaluate impact of climate change on sediment budgets
 - Recommendations for a more sustainable exploitation of the seabed
 - Recommendations for beach nourishment schemes



Conclusions

- Sediment budget of the North Sea is complex and poorly understood →
 - Need for more research (e.g. extreme events, input-output, carrying capacity)
 - Need for policy instruments (e.g. sediment management plan)
- Climate change
 - Working with scenario's is inevitable
 - In balance with socio-economic evolution
 - Policy relevant assessment tools
- CC as a “driver” for sustainable sediment budget ?

