



Rijkswaterstaat
*Ministry of Infrastructure
and Water Management*

NNBF Examples and Flood Risk Reduction Measures in the Netherlands

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Management

Rijkswaterstaat
TU Delft



I like to read history books..





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History provides a mirror to the present



I like to read history books..



Churchill on the Dutch:

“They are completely selfish and only fought when they were attacked and then only for a couple of hours”



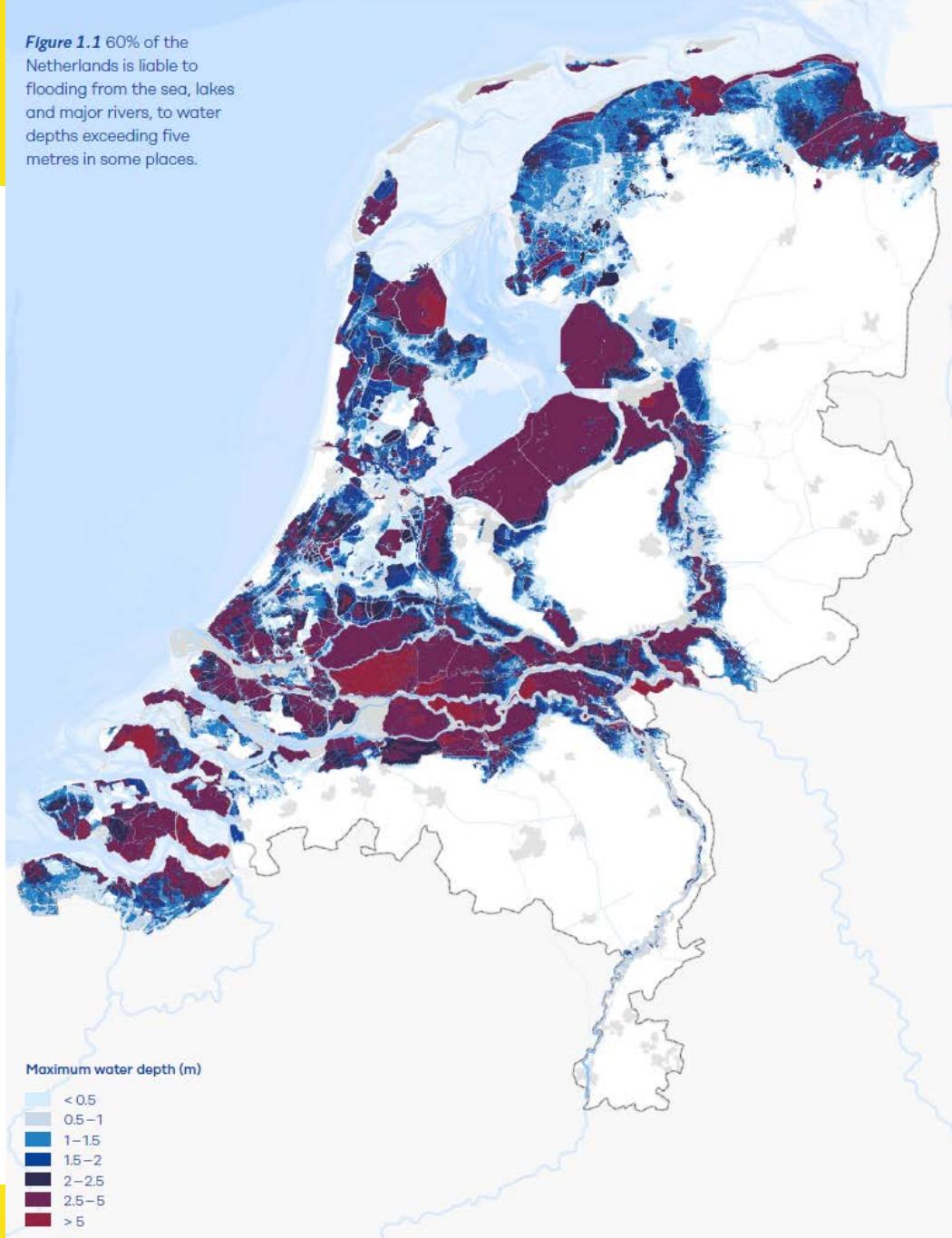
Holocene
Marine and
fluvial
sediments

Pre-holocene
glacial and
Aeolian
sediments

Flood Prone Netherlands

- 26% below sea level
- 55% is susceptible to flooding
- 60% of our population lives below sea level
- > 60 % of our economic value is earned in the lowest-parts of the country
- Strong correlation with sediment origin...

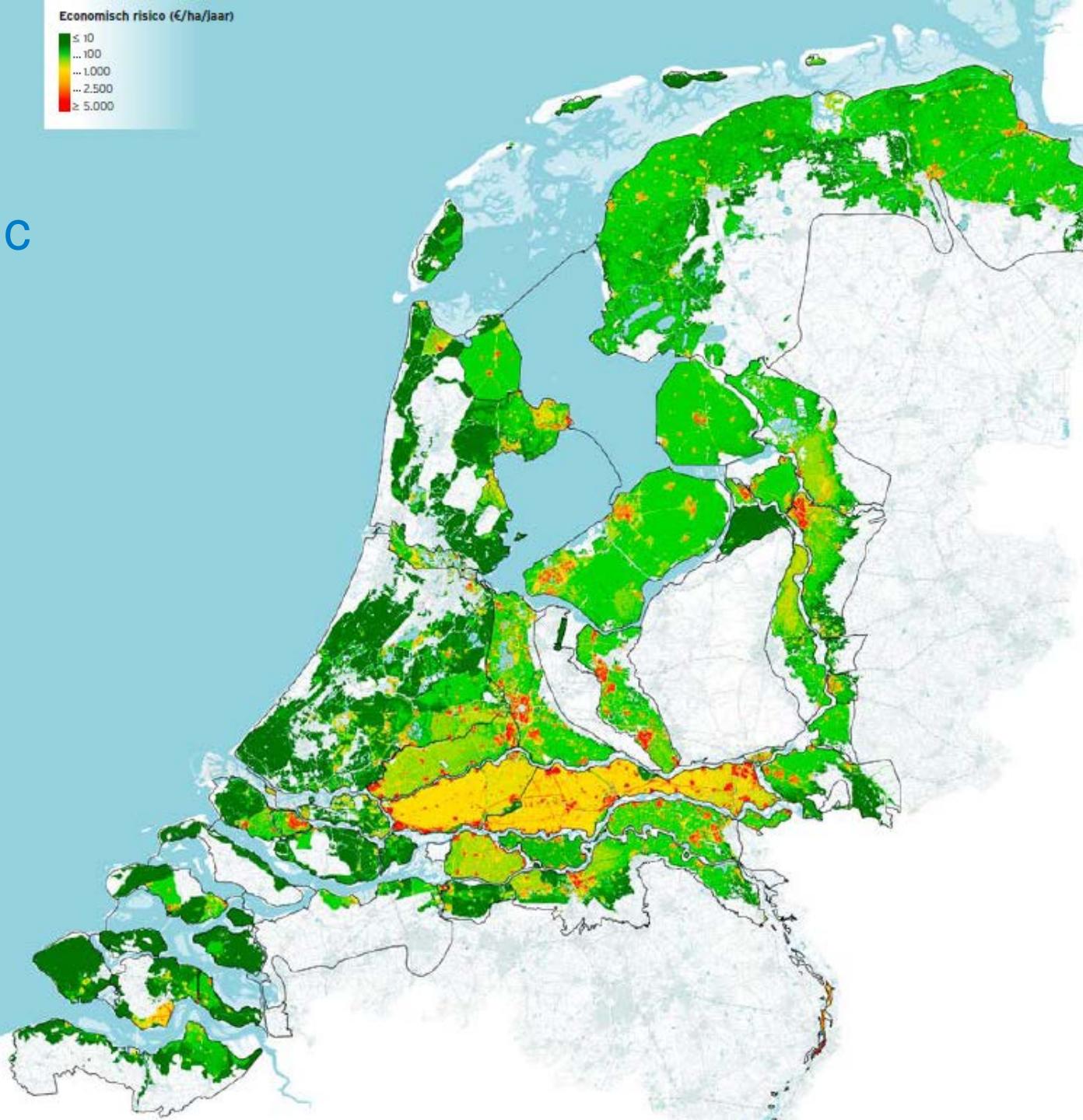
Figure 1.1 60% of the Netherlands is liable to flooding from the sea, lakes and major rivers, to water depths exceeding five metres in some places.



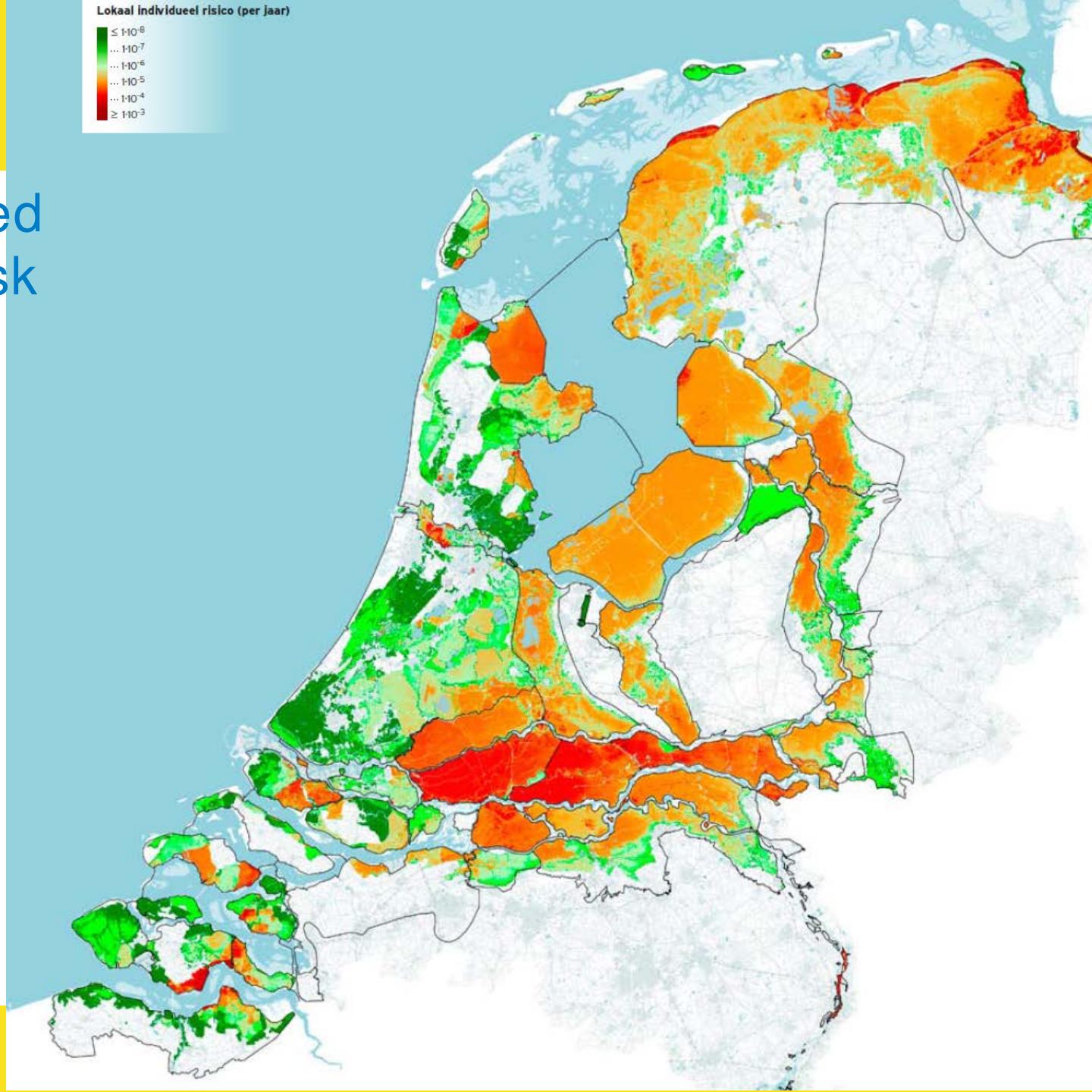
2020 Economic Flood Risk (€/ha/year)

Economisch risico (€/ha/jaar)

≤ 10
... 100
... 1.000
... 2.500
≥ 5.000



2020 Localized Individual Risk



Flood Risk Standards

Figure 4.3
Maximum permissible
flood probabilities: the
lower limits stipulated in
the Water Act.





Examples flood risk management for Rivers and the Coast

Key messages:

- Systems approach
- NBS/NNBF are used a lot, they are not a goal. Many times they turn out to be the most appropriate solution.



Room for the River

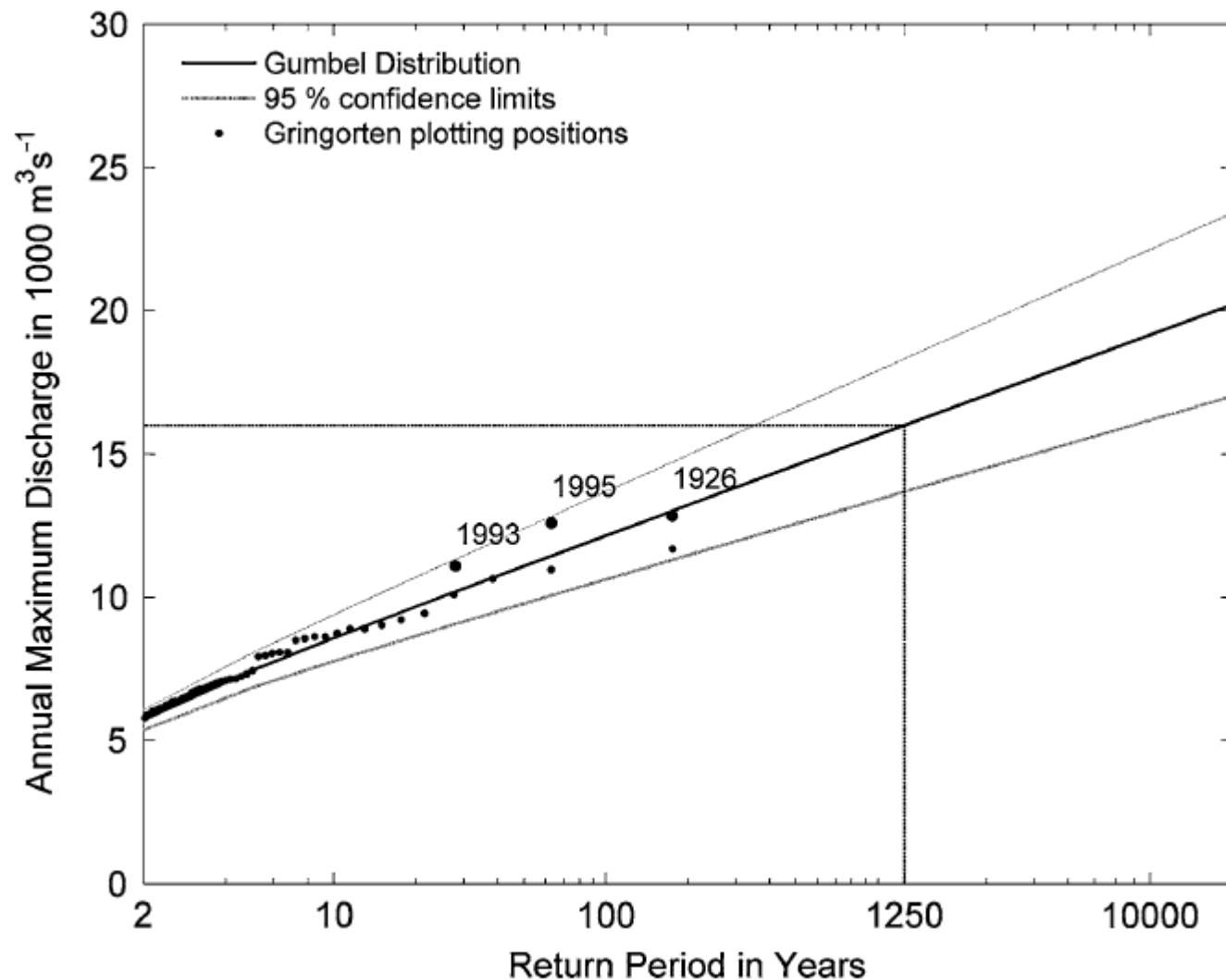
Flood Risk Management objective:

Reduce water levels occurring with a Rhine discharge of 16.000 m³/ s to the water levels of a 15.000 m³/ s.

$$H_{max}, Q_{16.000\text{m}^3/\text{s}} = H_{max}, Q_{15.000\text{m}^3/\text{s}}$$



Effect of high discharge events on statistics





Non Flood Risk Management objectives have been to enhance:

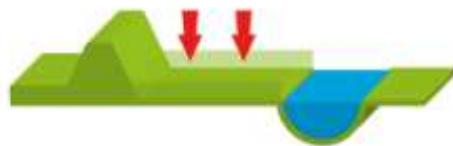
- Spatial Quality of the Landscape
- Nature values
- Recreational values



Adaptation to the plan was possible,
but combined all measures should
still deliver.

- > System Approach
- > Stakeholder Engagement





Lowering the flood plain



Deepening the summer bed



Water retention



Dyke relocation



Lowering perpendicular groynes and building attracting groynes



High water channel



Depoldering



Removing obstacles



Strengthening dykes



Examples

30 - 60 cm water level reduction
+ 4000 ha new river nature

Legenda

- [Icon] kreek
- [Icon] zoetwatergetijdegebied (0.40+ tot 0.70+ NAP)
- [Icon] onbekend (begraasd) grasland
- [Icon] bekend / bedijkt grasland
- [Icon] akkerland
- [Icon] gronddepot
- [Icon] bebouwing (bestaand/nieuw)
- [Icon] terp ■ = agrarische bestemming,
 ★ = indien extra grond van derden wordt aangekocht
 ★ = zoeklocatie nieuwe terp
- [Icon] hoogwatervluchtplaats
- [Icon] bos/riet
- [Icon] hoge kade
- [Icon] lage kade
- [Icon] verharde weg met parkeerplaats
- [Icon] fietspad
- [Icon] landbouwontsluitingsweg
- [Icon] brug(getje)
- [Icon] markant bouwwerk
- [Icon] veerpont
- [Icon] hoogspanningslijn

Inrichtingsplan Ontpoldering Noordwaard

04 augustus 2009

ruimte voor de rivier
ONTPOLDERING NOORDWAARD







Afferdense en Deestse Waarden



5 cm water level reduction
158 ha new river nature





Rijkswaterstaat



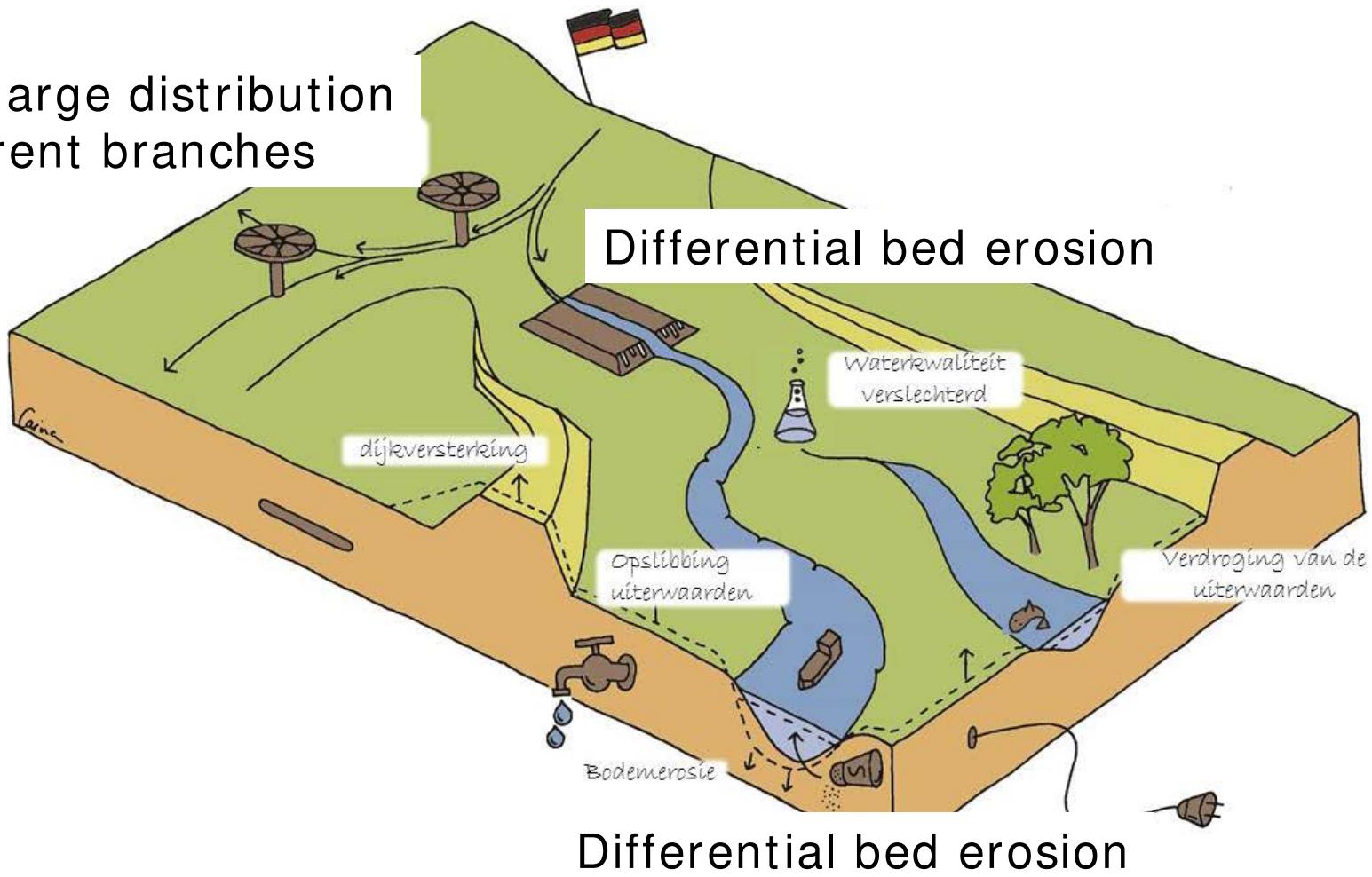
Performance, Metrics and Adaptive Management

- Water level reduction objective is known per measure and being monitored on a system scale.
- Non-FRM benefits are not always monitored very well.
- Non compliance with FRM goals will lead to adaptive management. Non compliance with Non-FRM generally not..



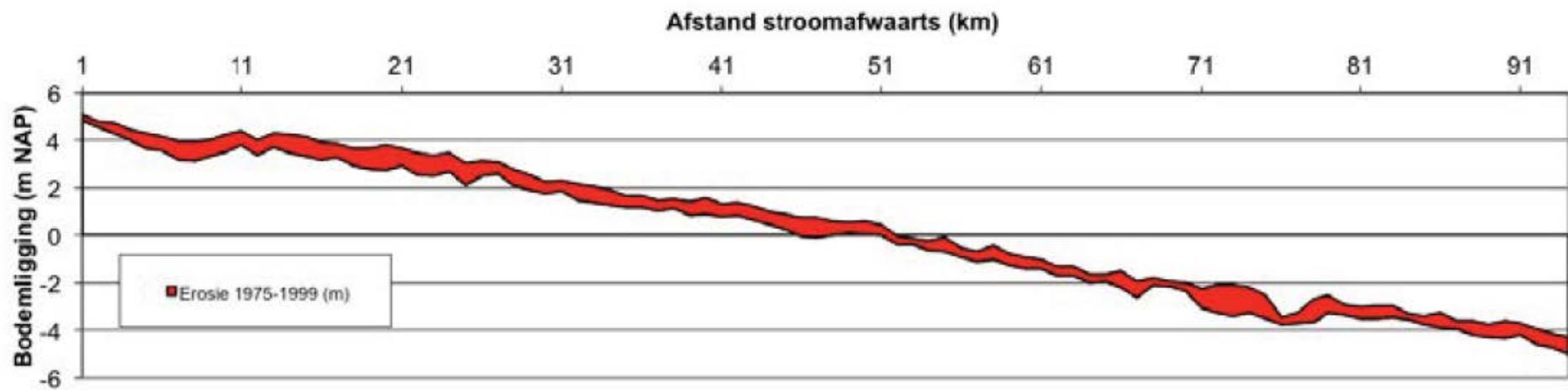
There is more then just high discharge events

Discharge distribution
Different branches



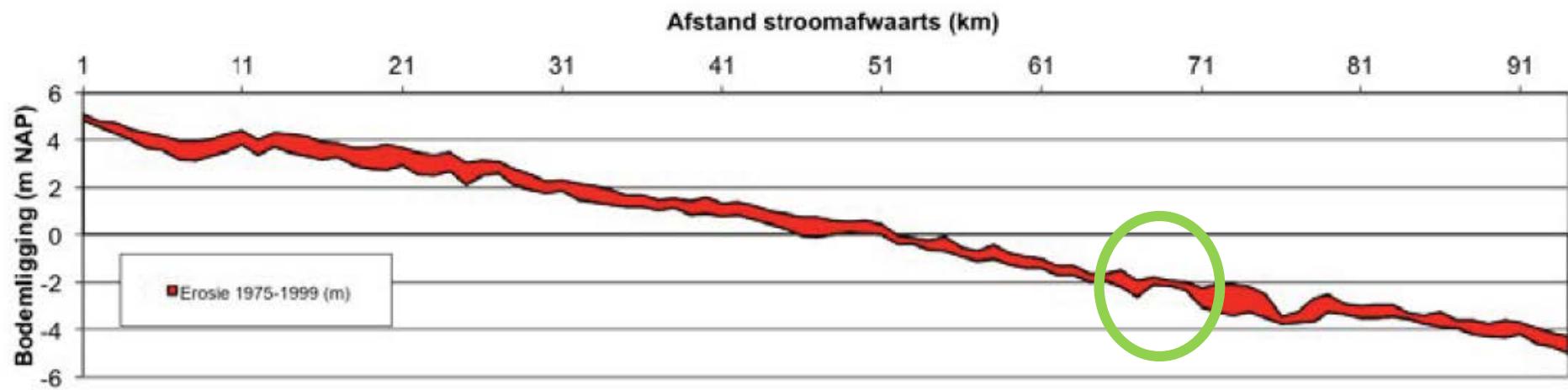


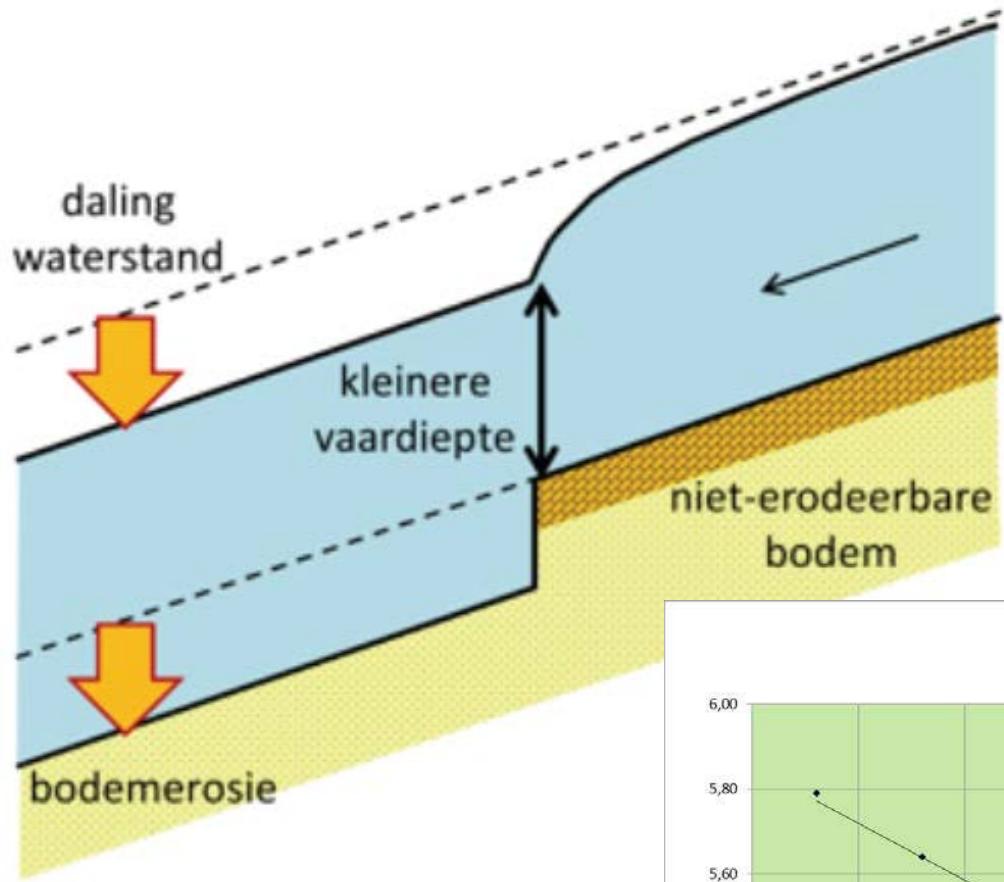
Bed erosion



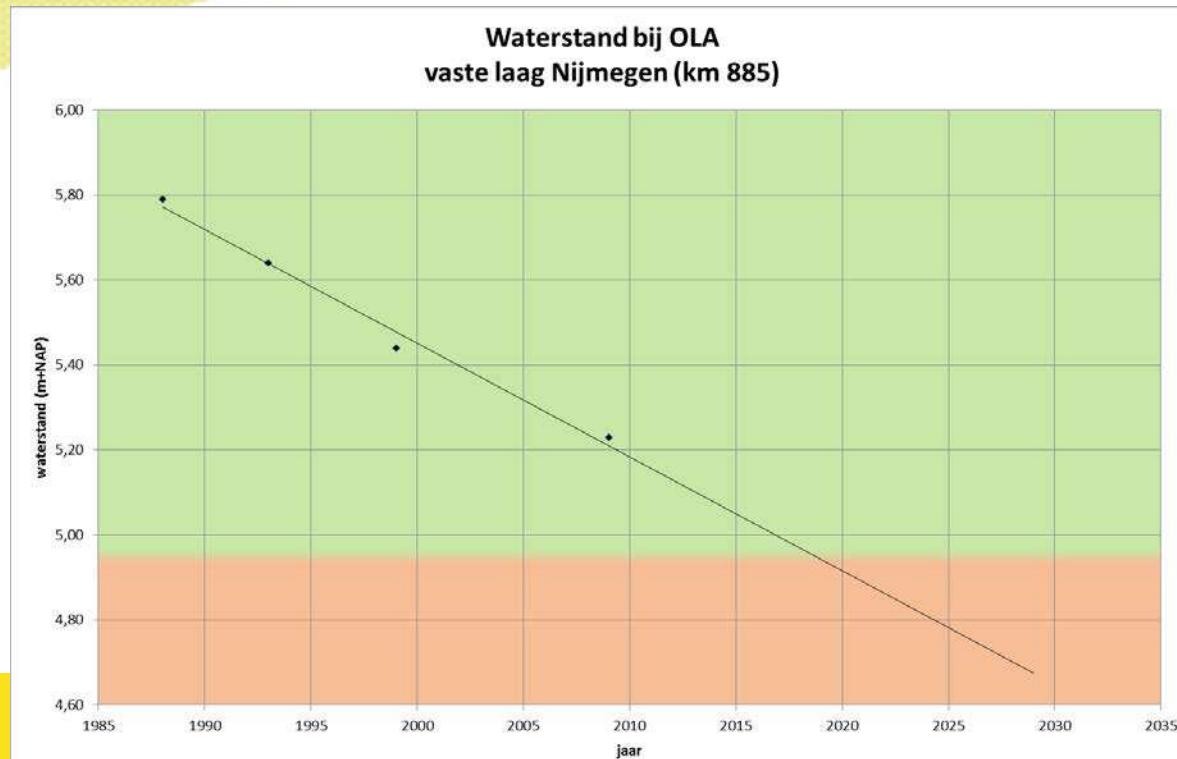


Bed erosion





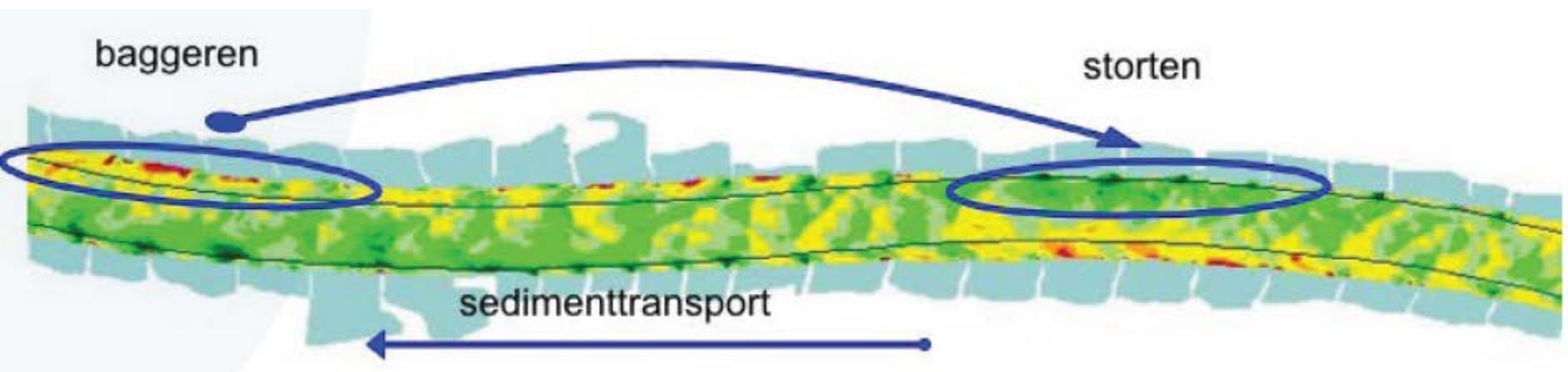
Negative effects on
navigation





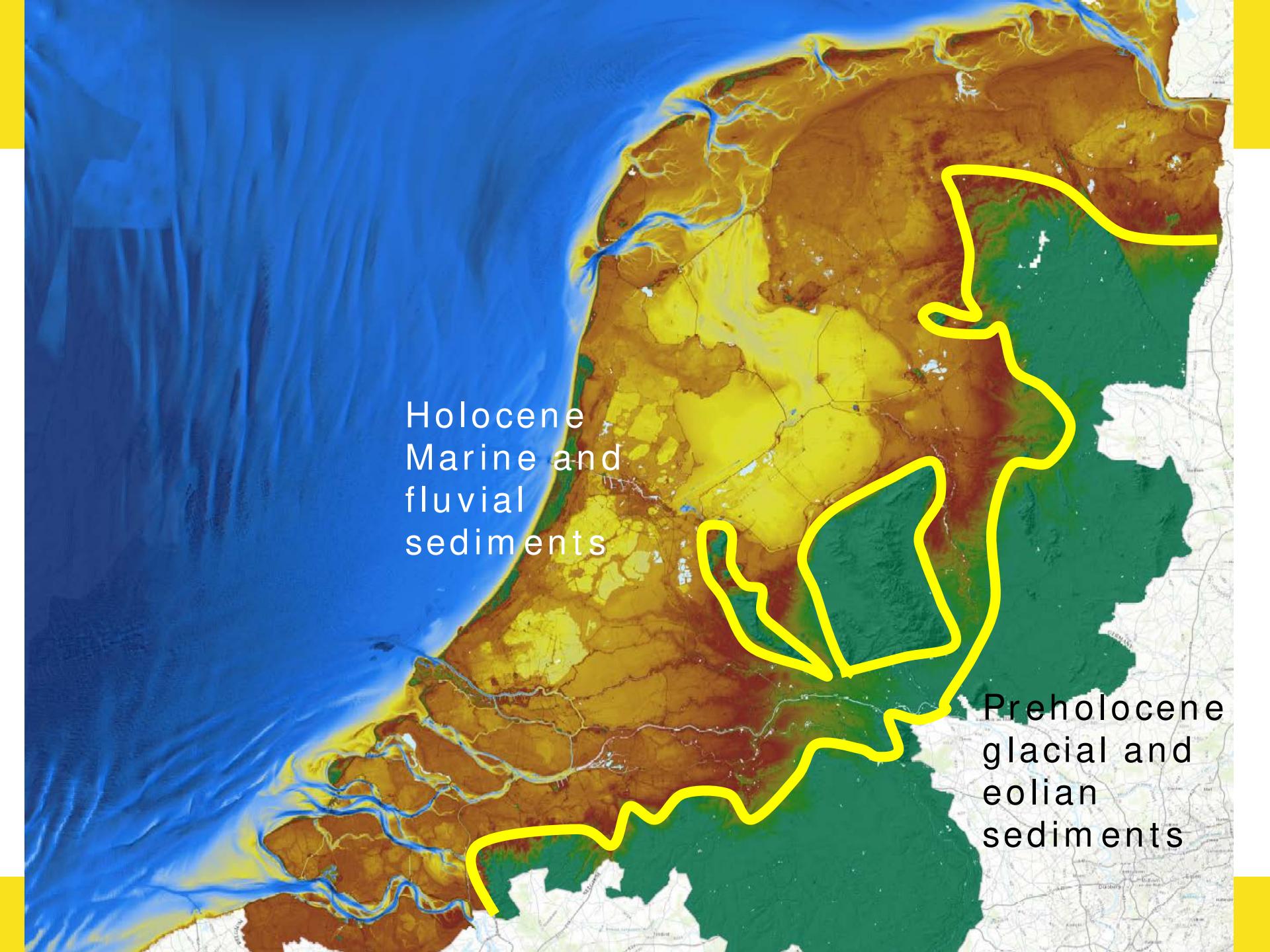
Sediment management in the river? Recycle sediments upstream?

Might be beneficial but quite some R&D
is needed before we commence..

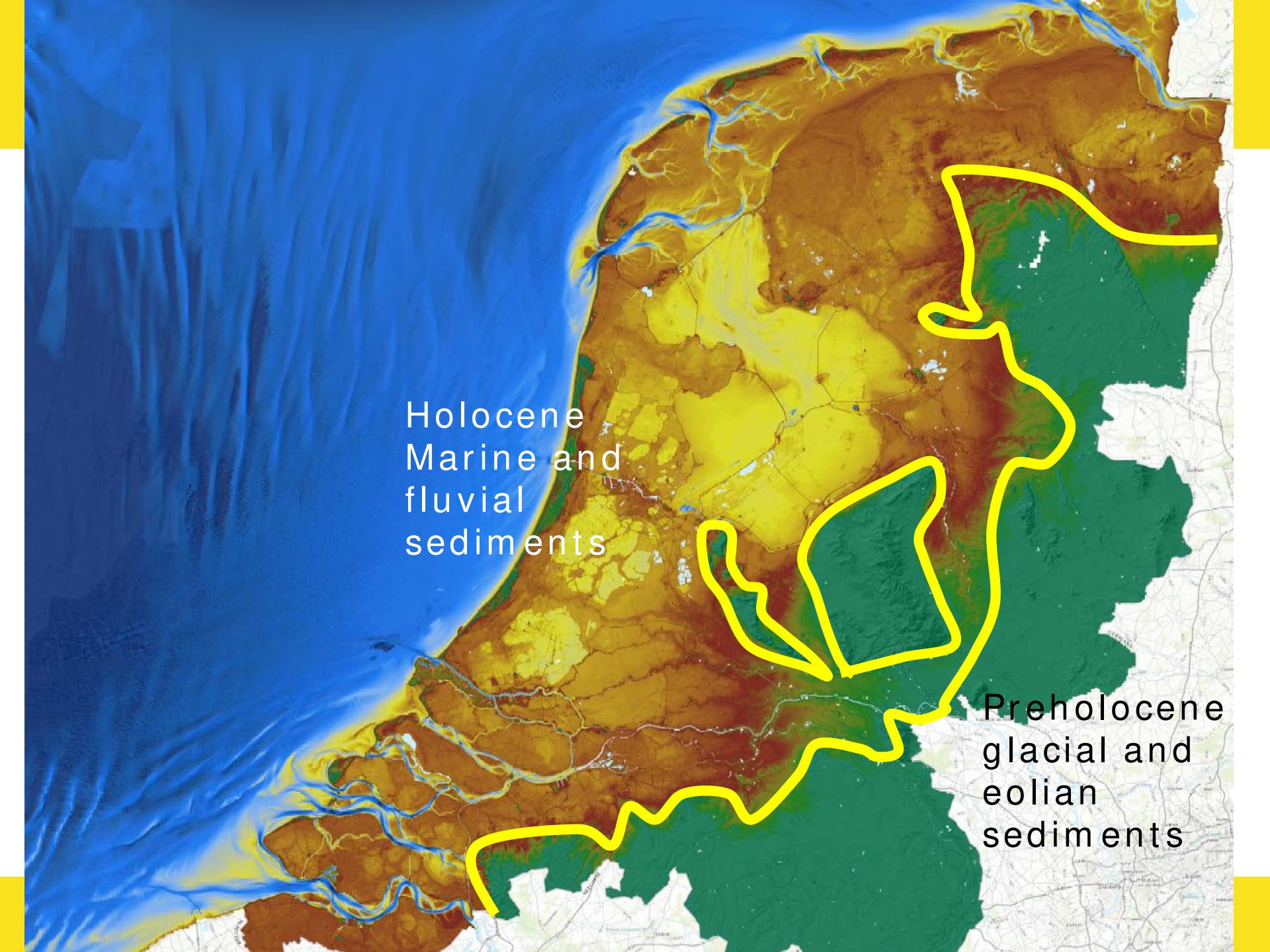




Coastal Management of Beach and Dune systems



Holocene
Marine and
fluvial
sediments



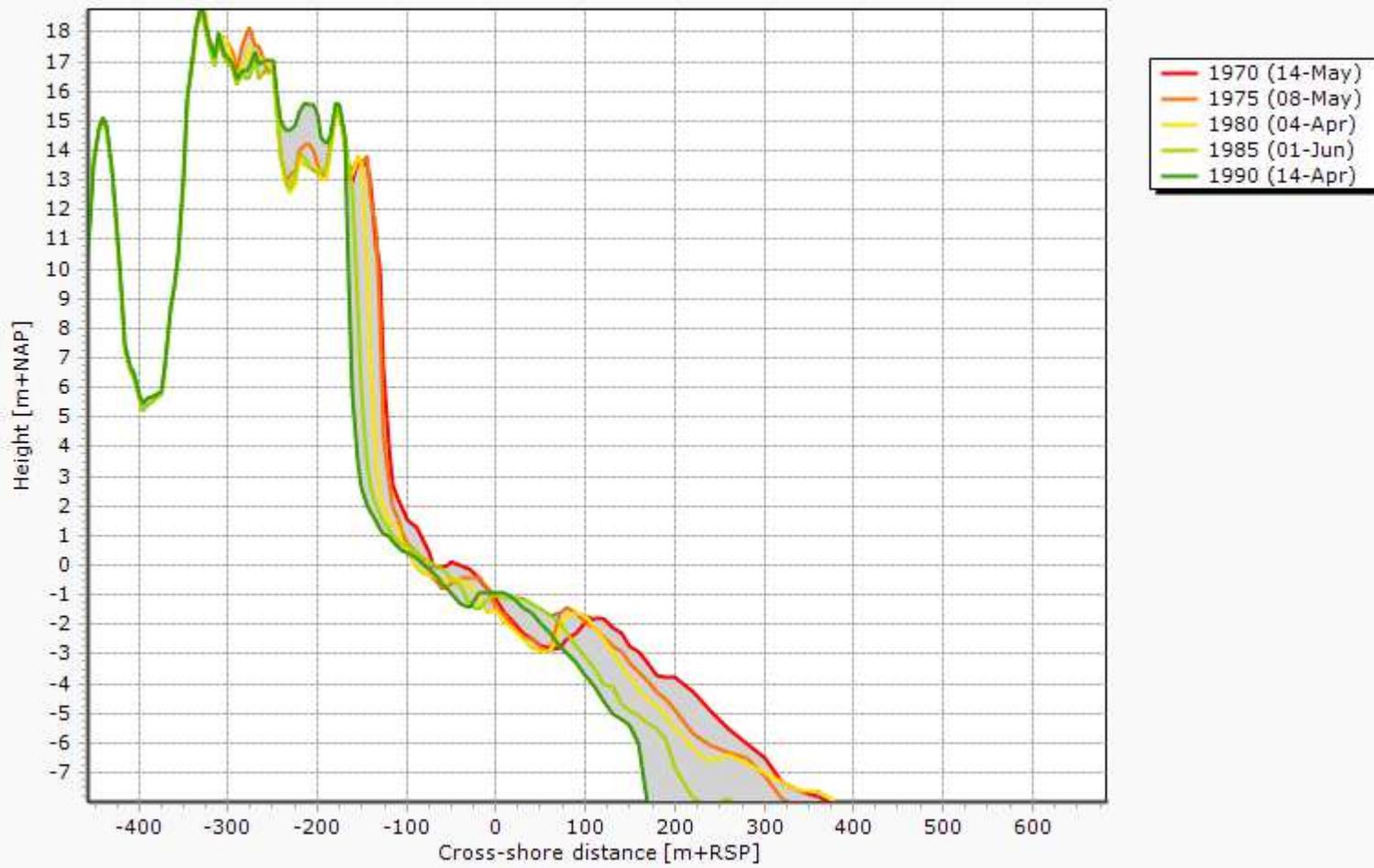
Preholocene
glacial and
eolian
sediments



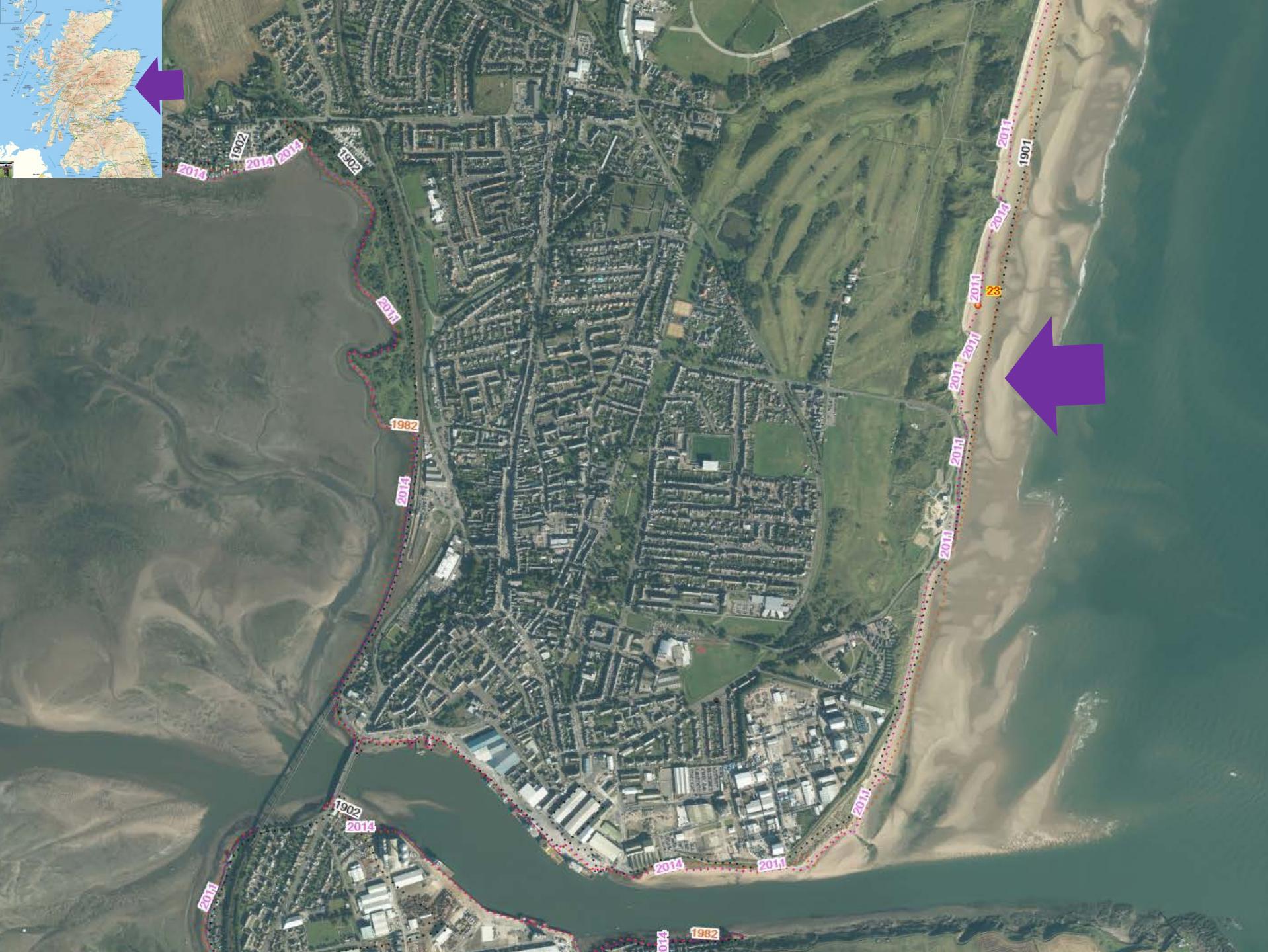




Noord-Holland - 489

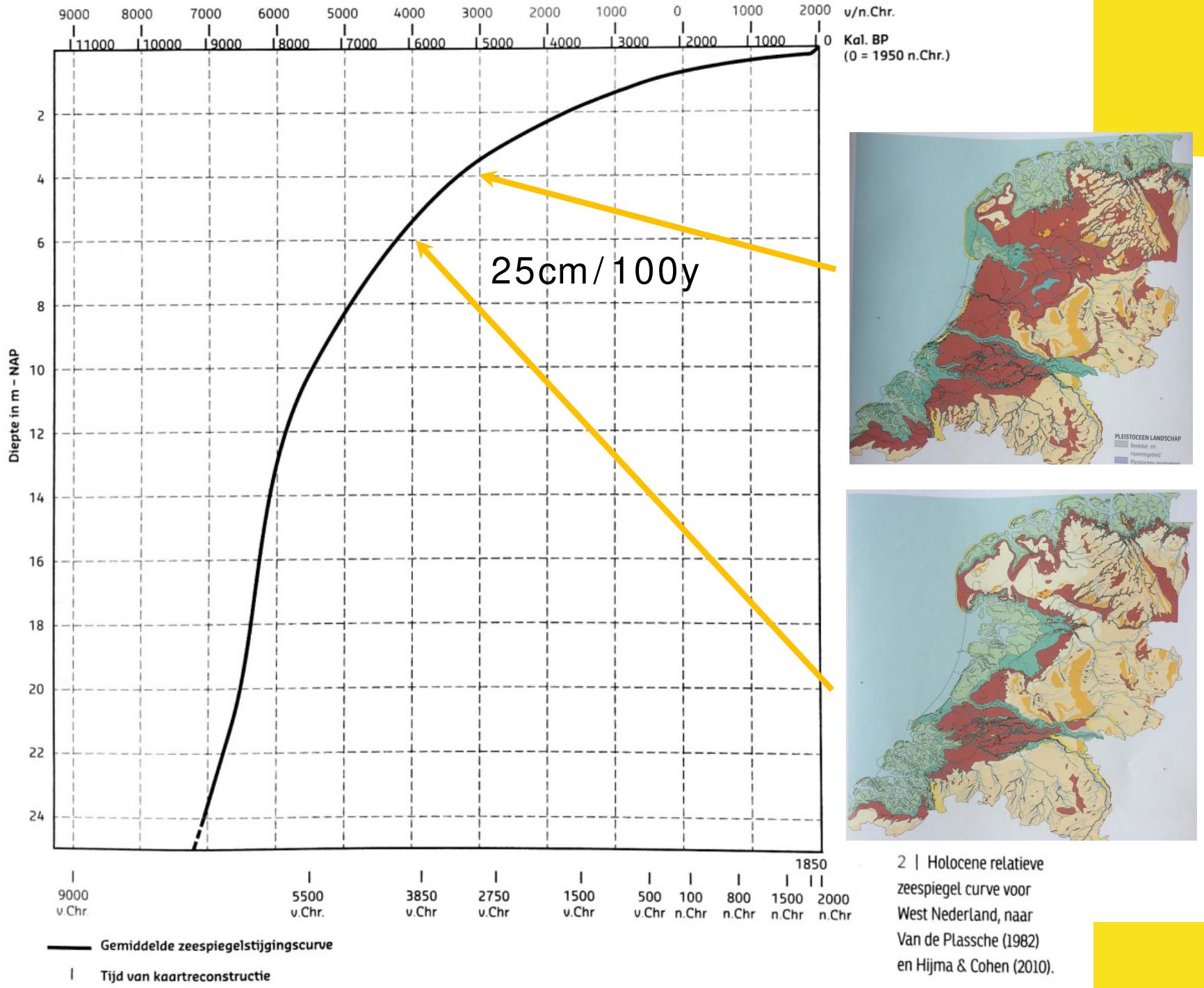


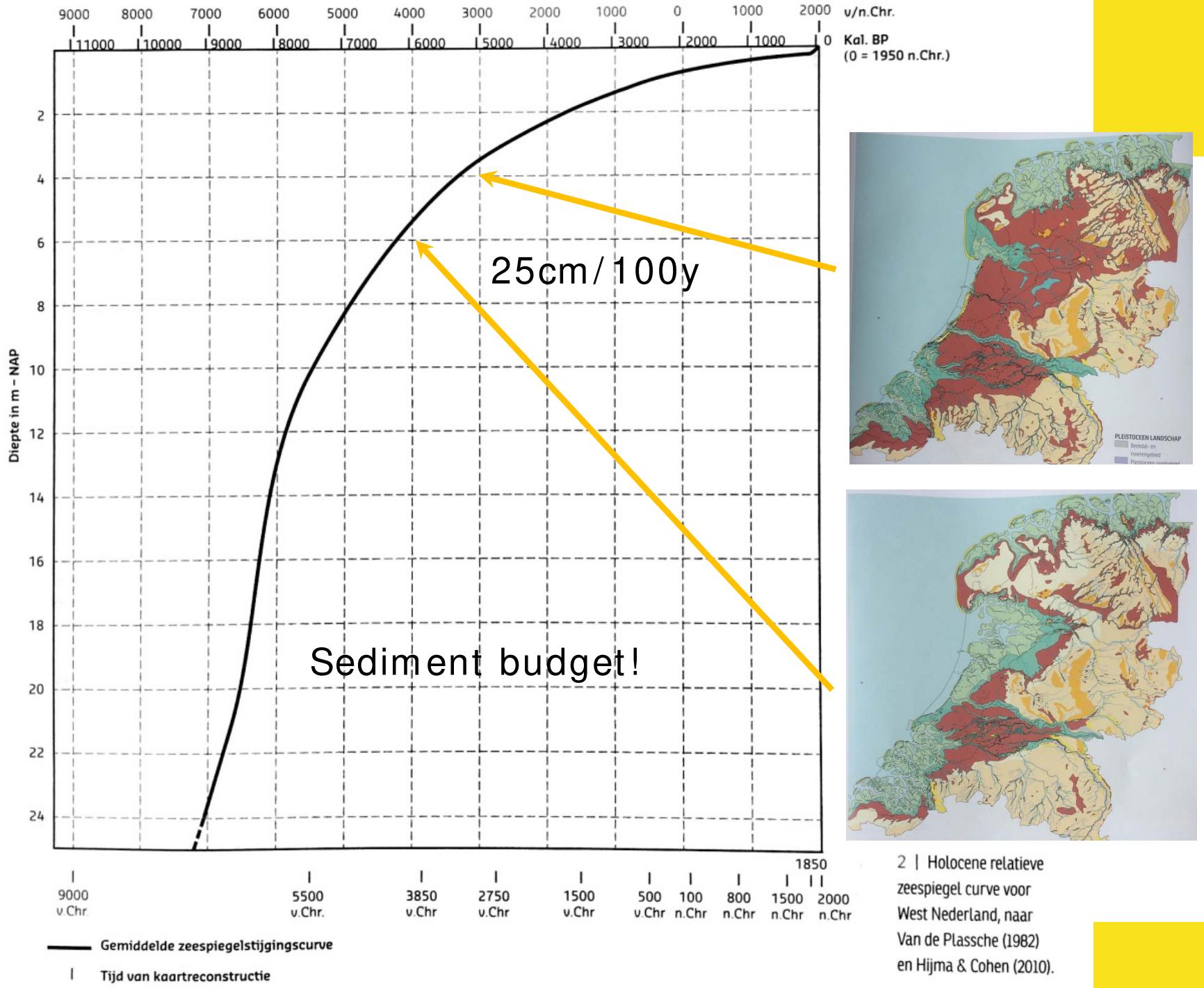














Strategic objective

Provide the conditions to sustainably preserve the functions of the coastal zone including:

- Protection against flooding
- Nature
- Recreation
- Fresh water extraction



Strategy

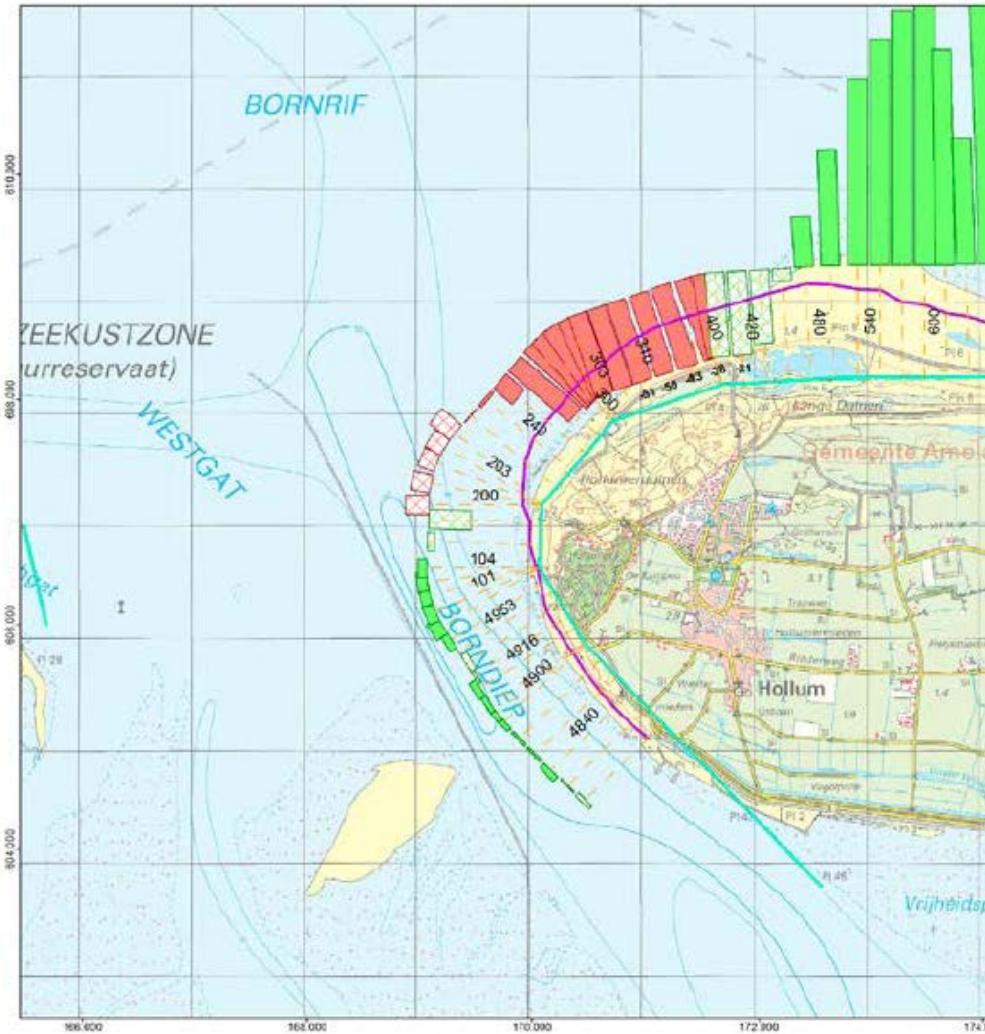
- Hold the line
- Grow with sea level

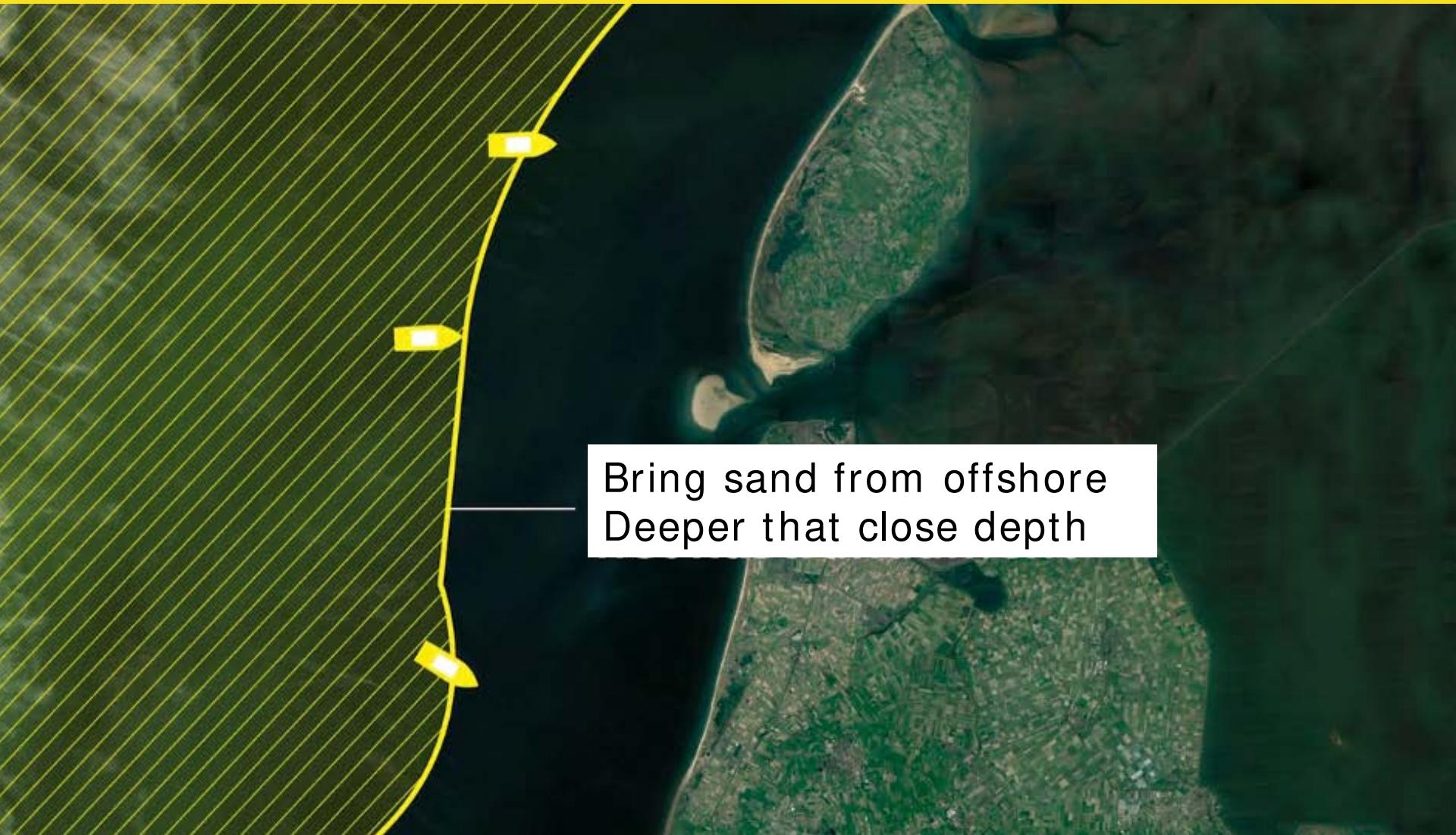
NNBF measure:
Feed the coast with sediments



Performance objectives & metrics

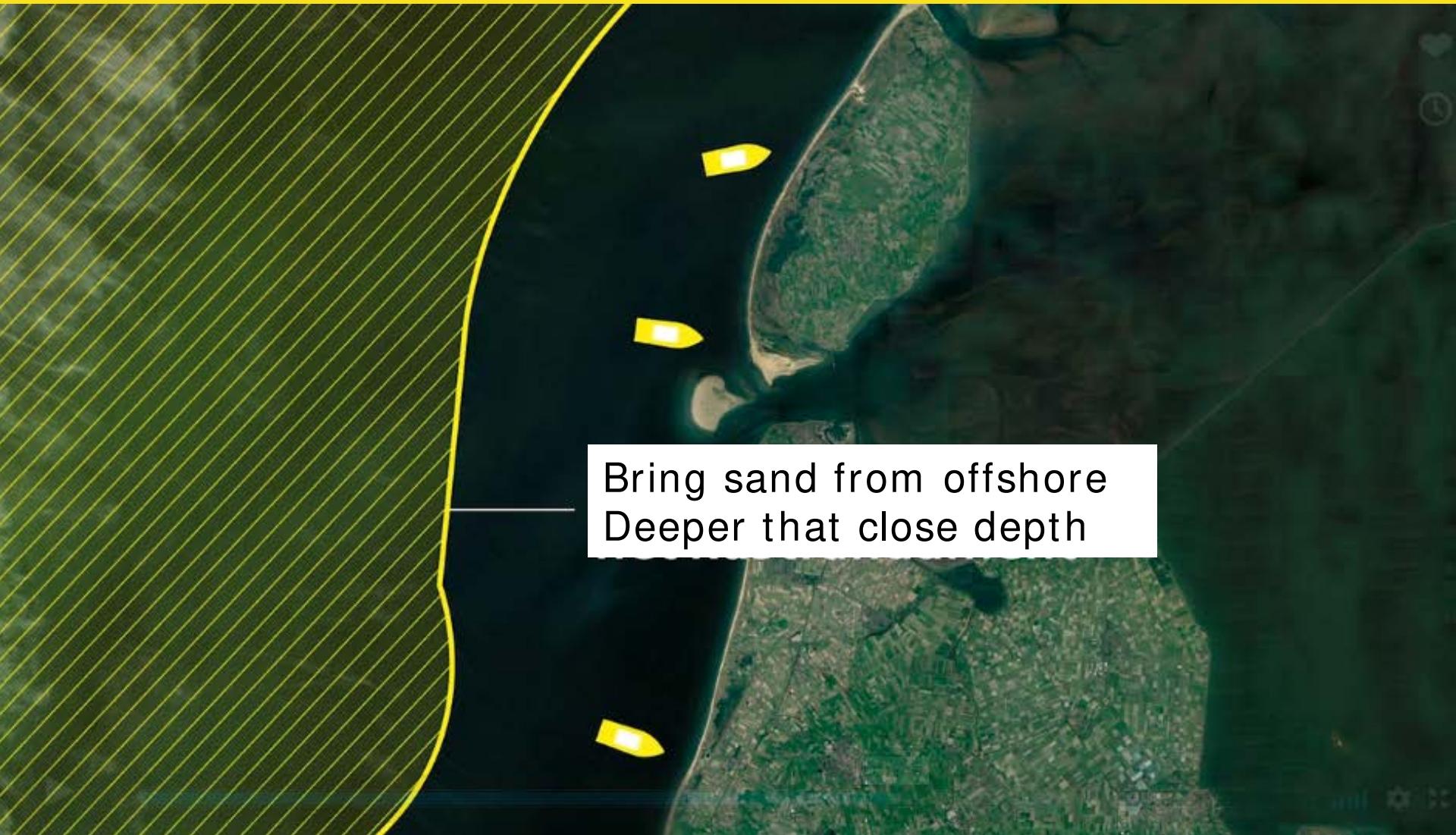
- Current coastline position wrt a reference coastline
- Probability of beaching of the flood defenses
- No significant negative impact on EU protected habitat and species





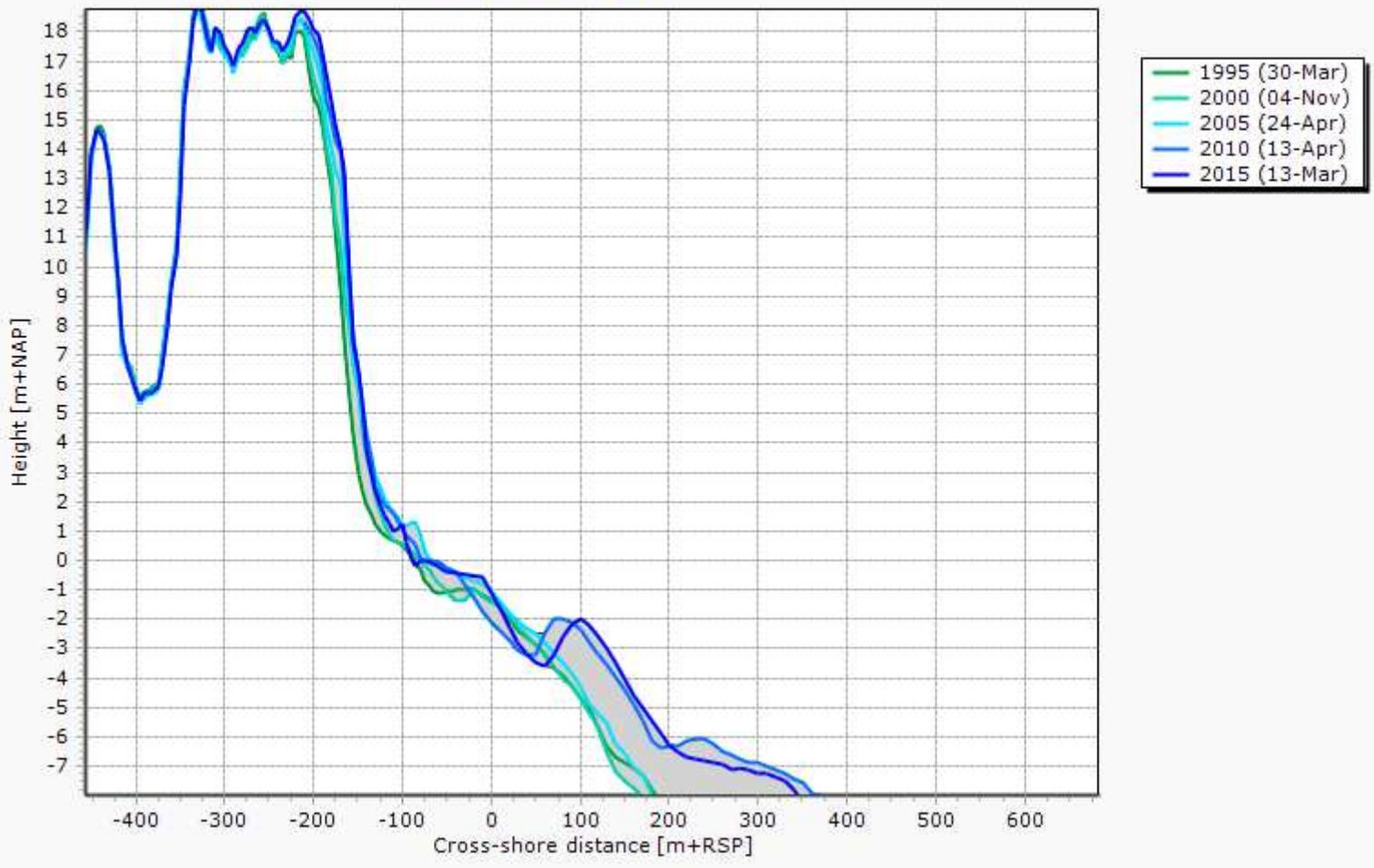


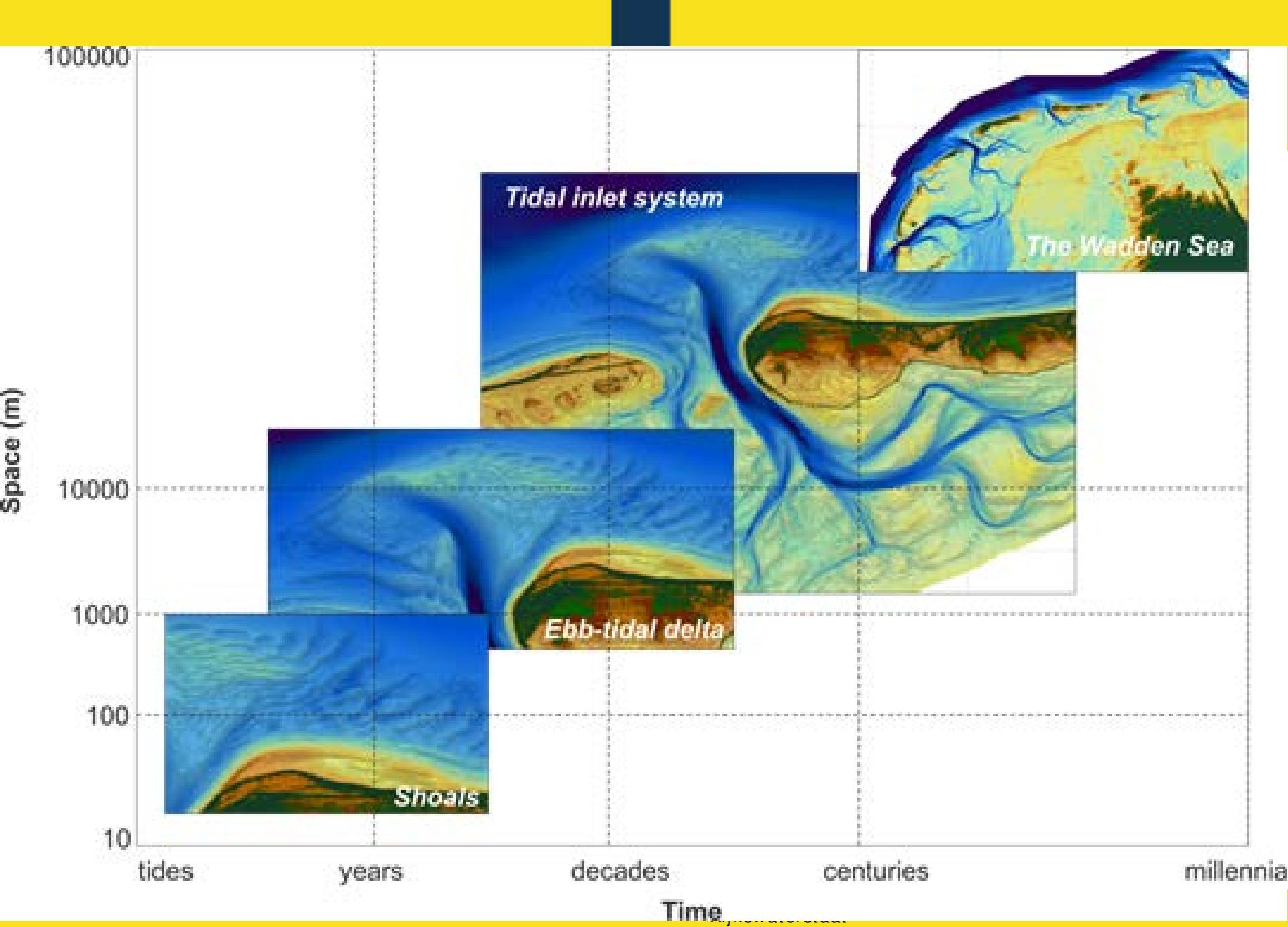
Rijkswaterstaat



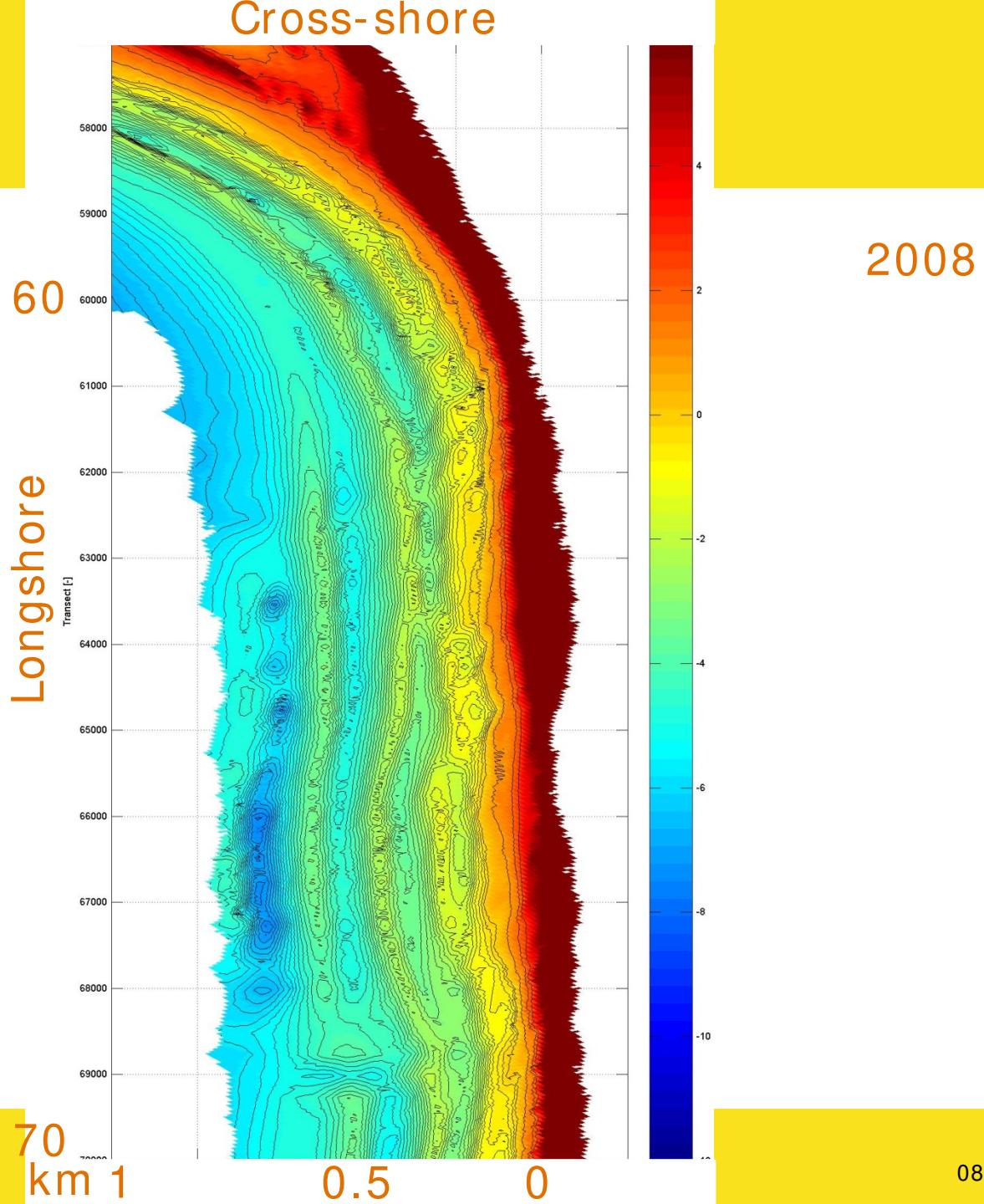


Noord-Holland - 489

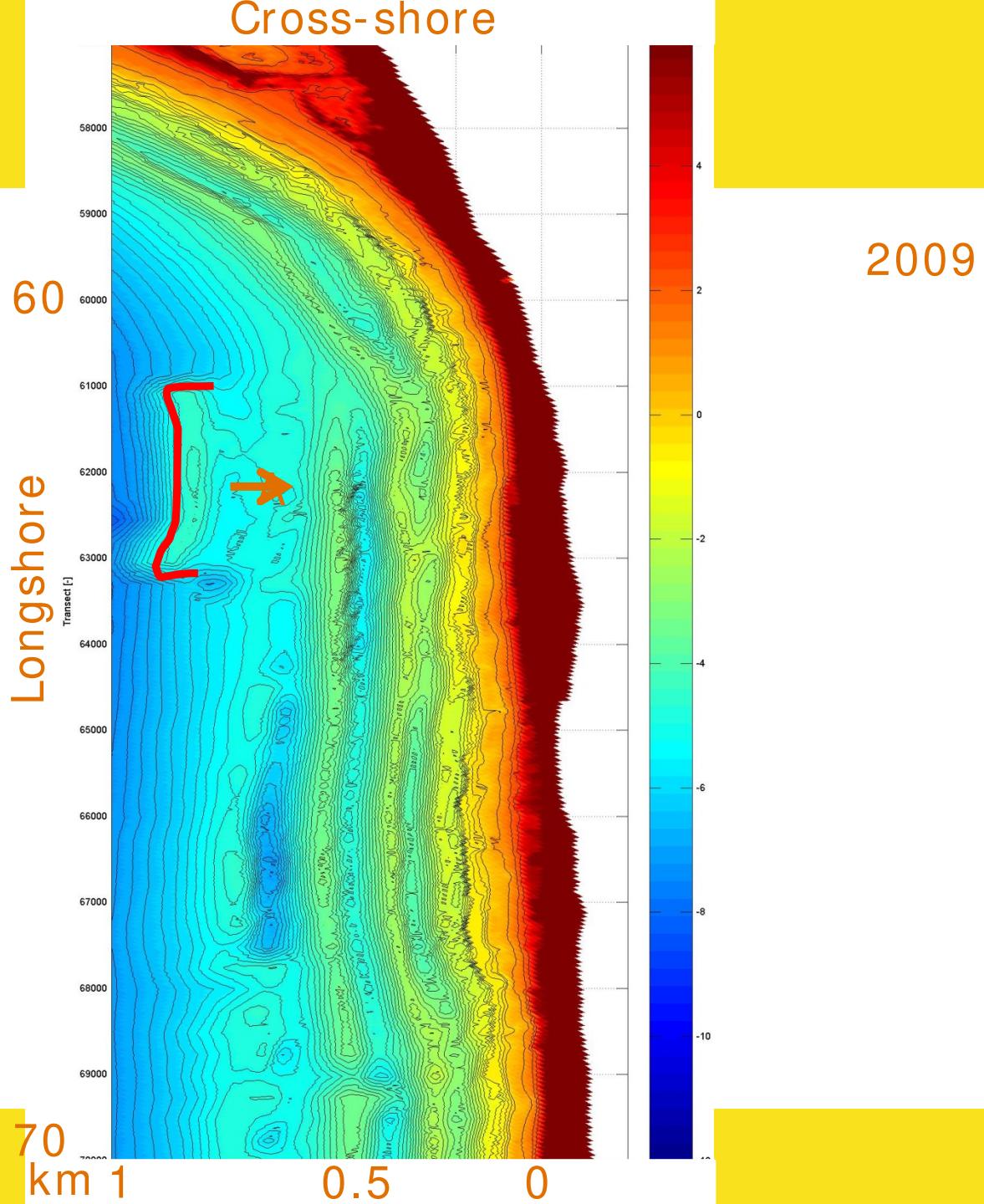




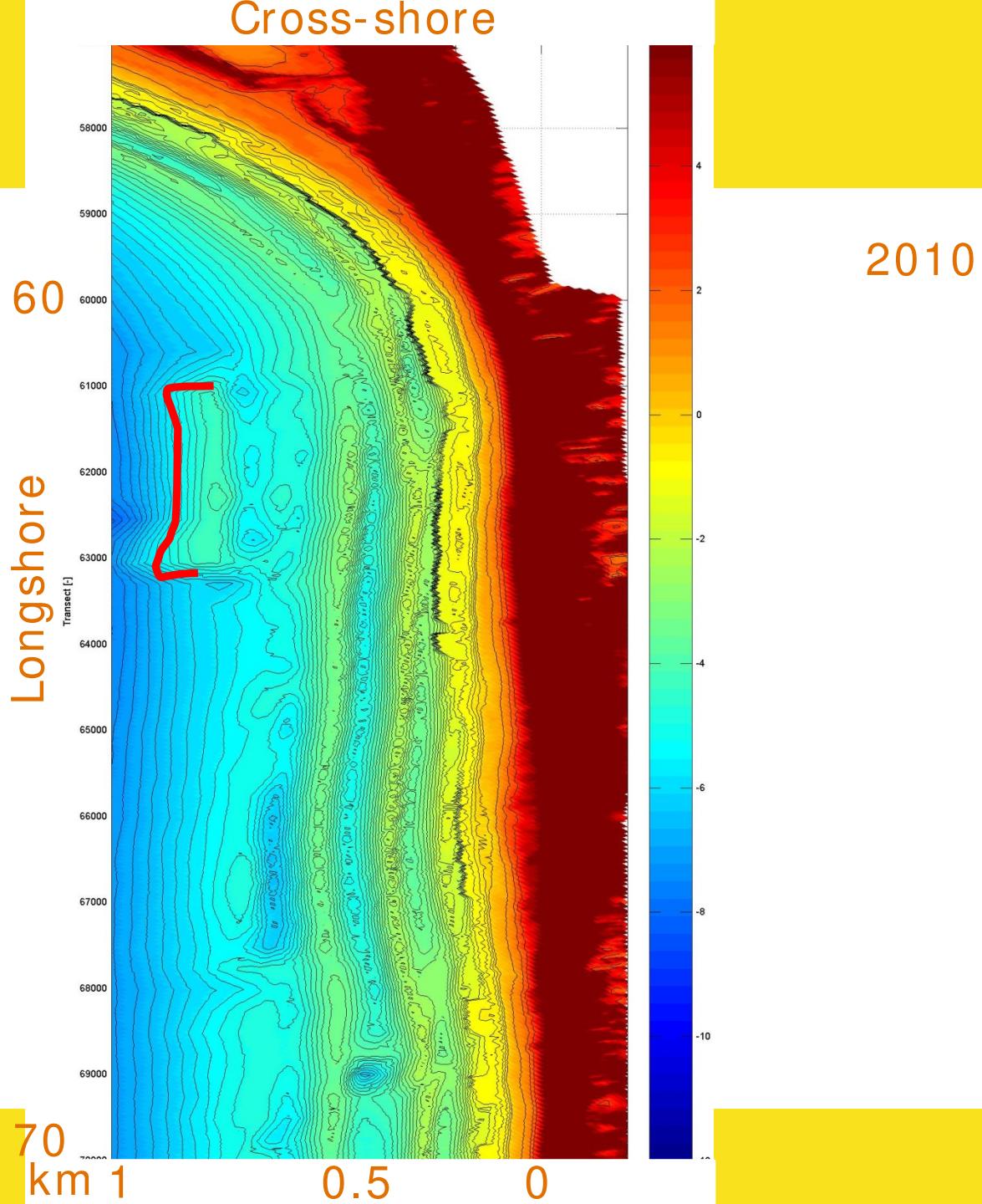
NL
Zandvoort



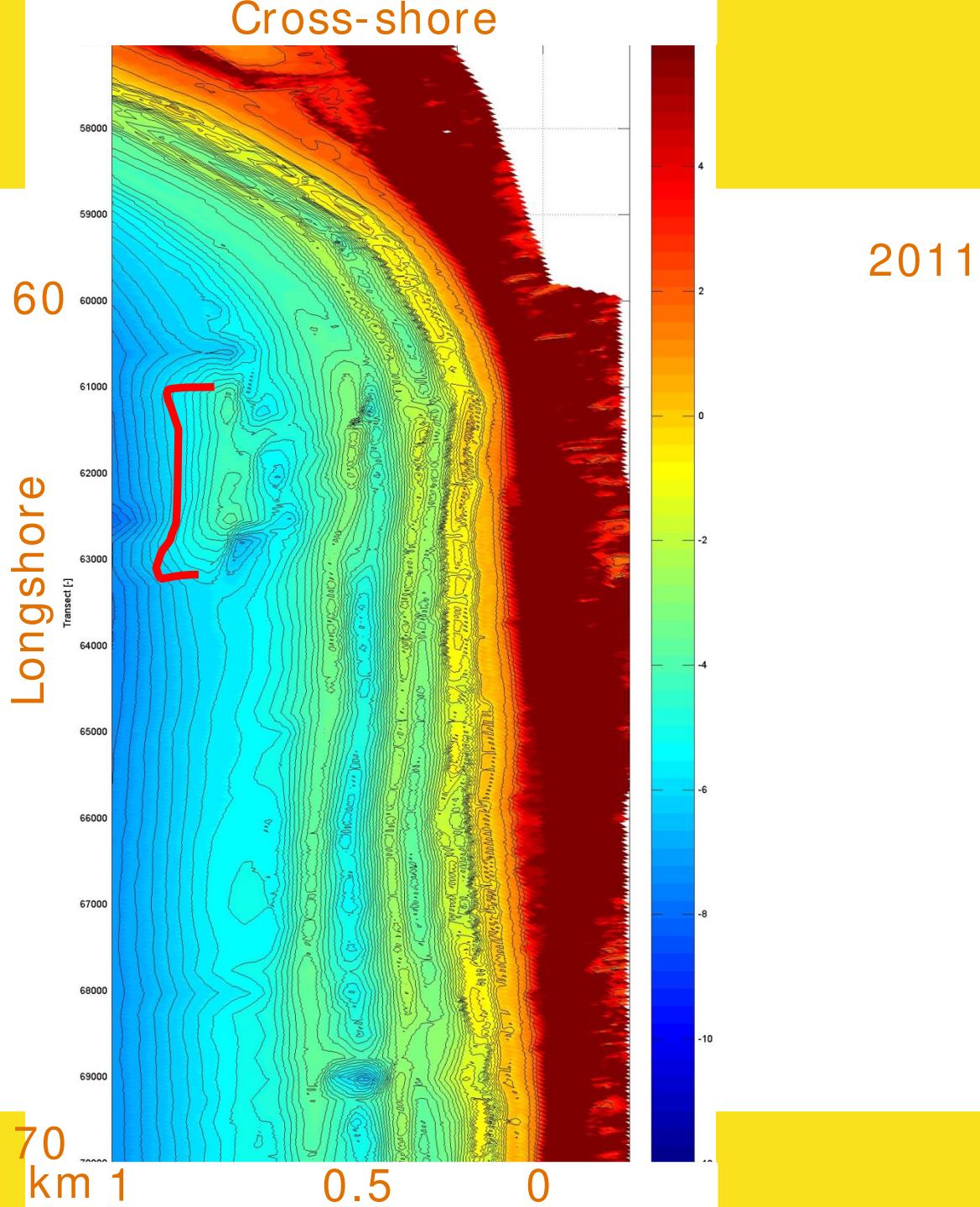
NL
Zandvoort



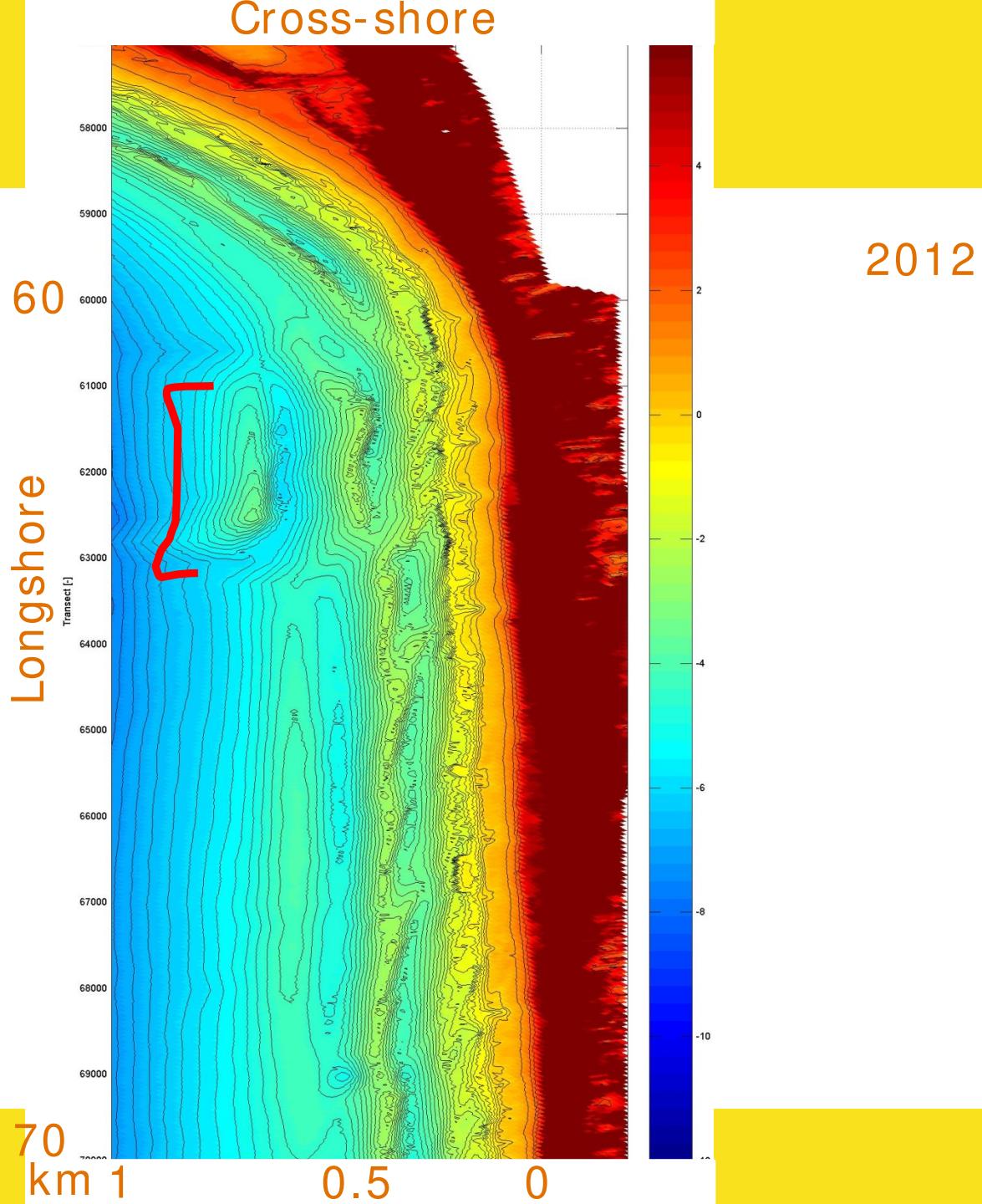
NL
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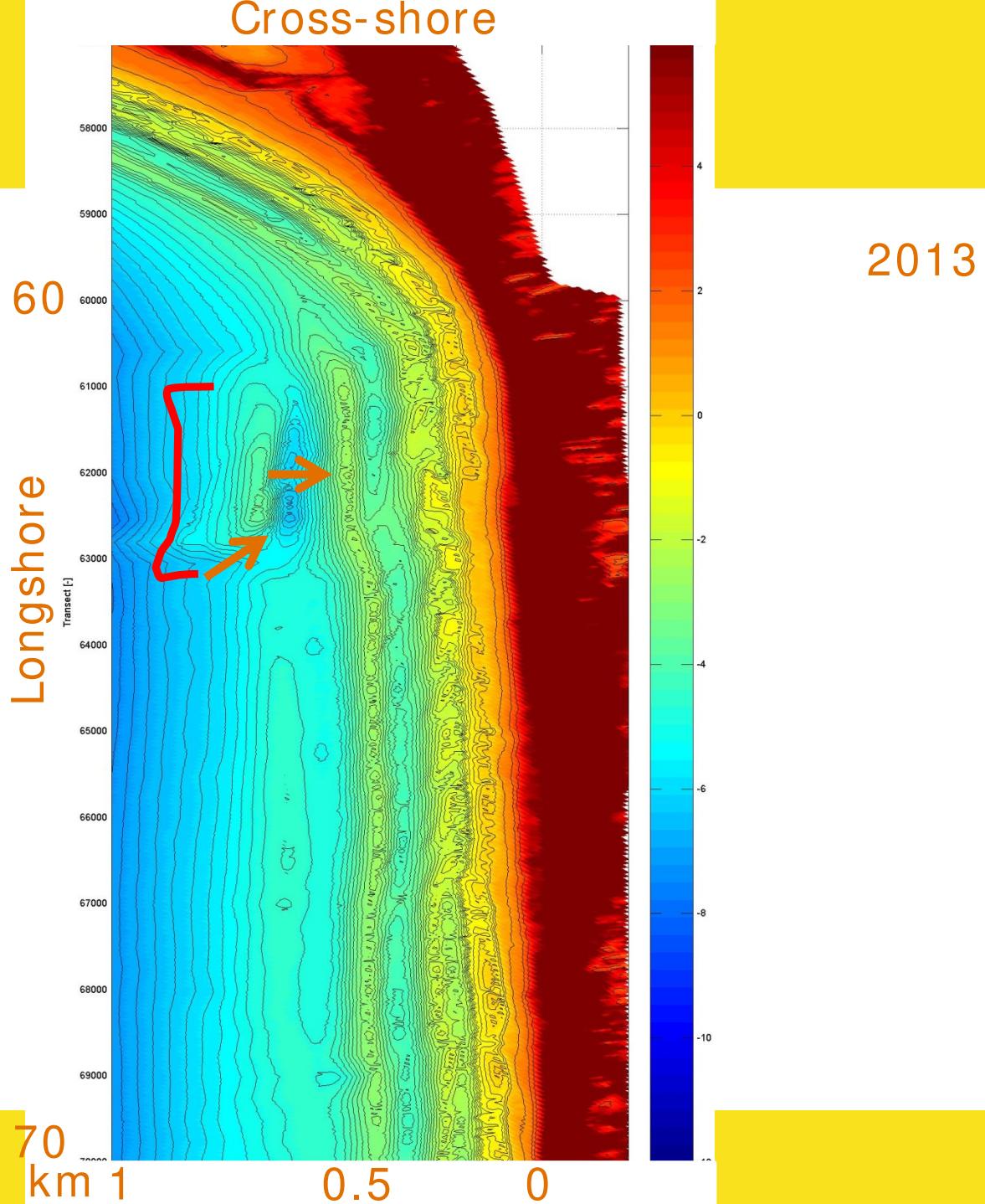
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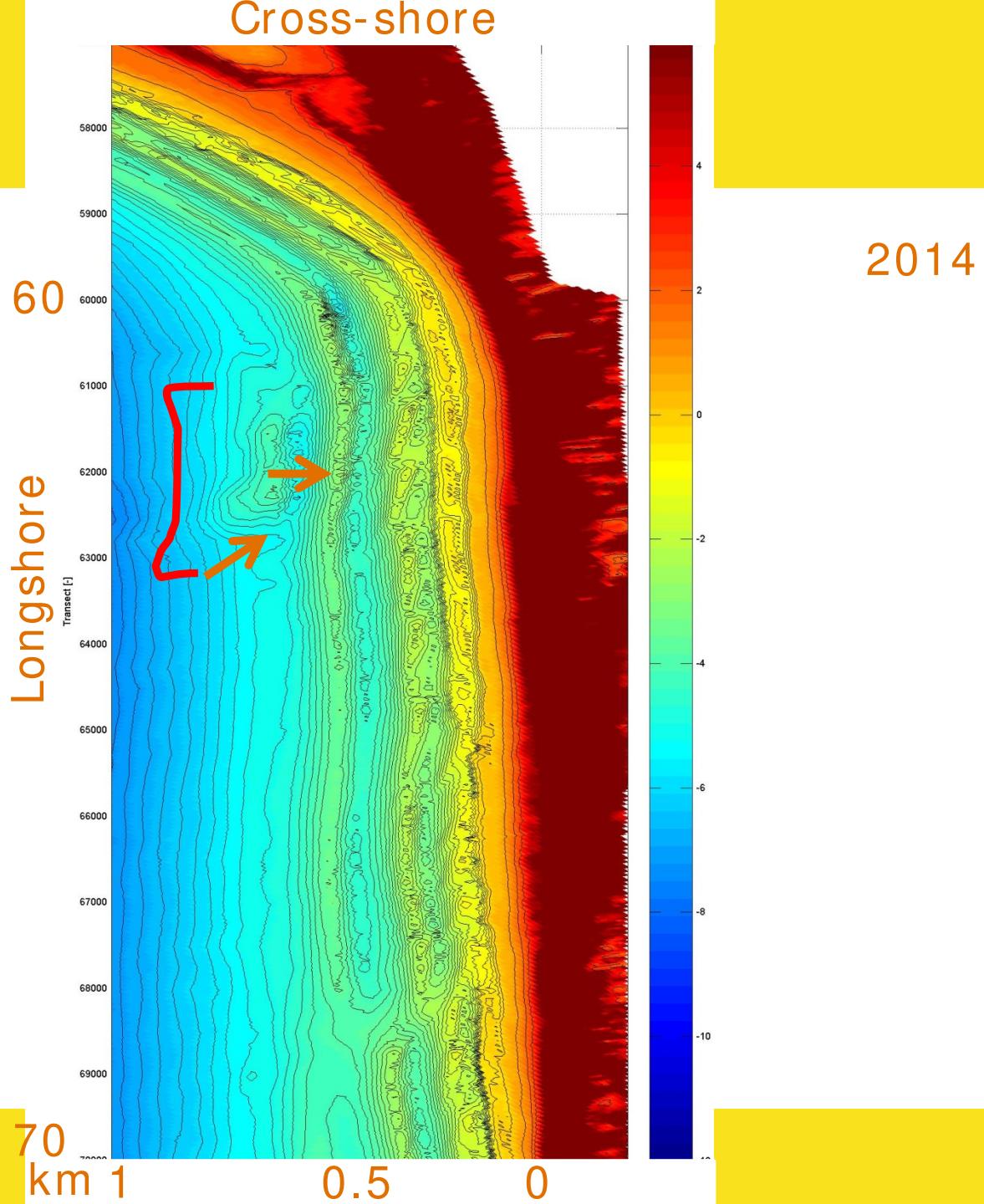
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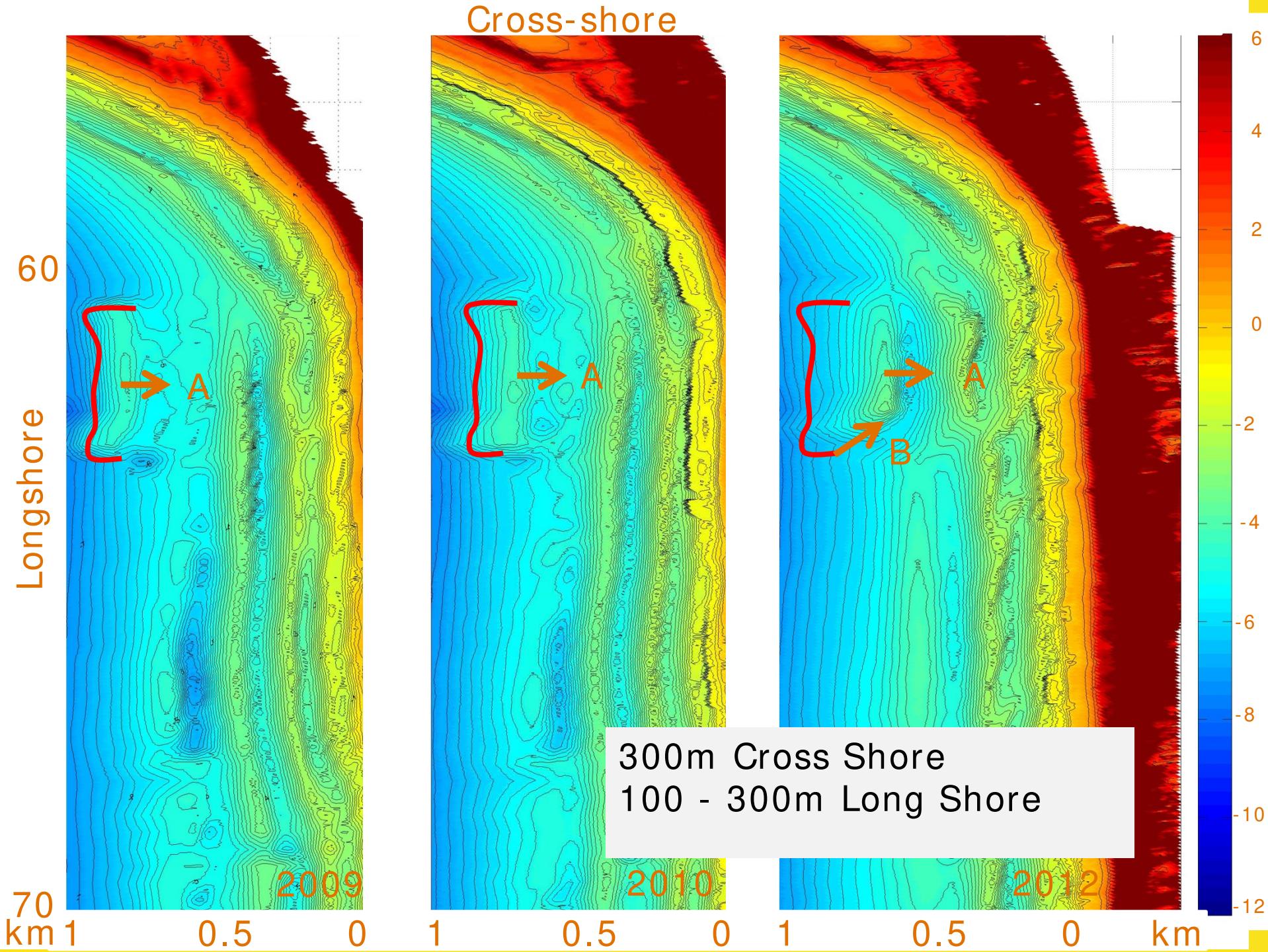


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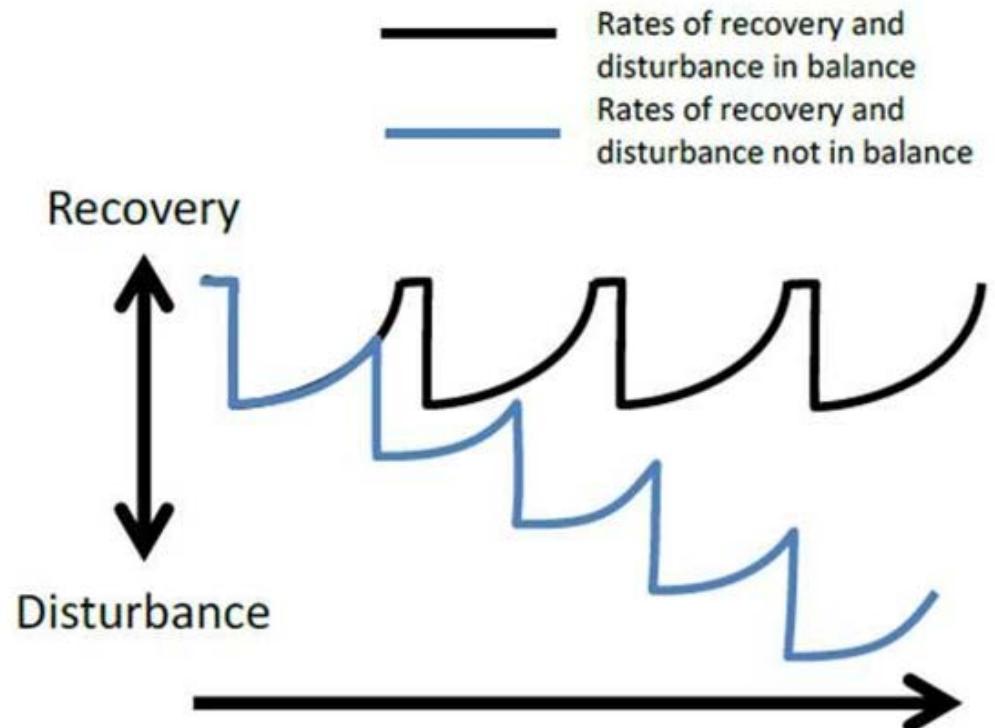




R&D

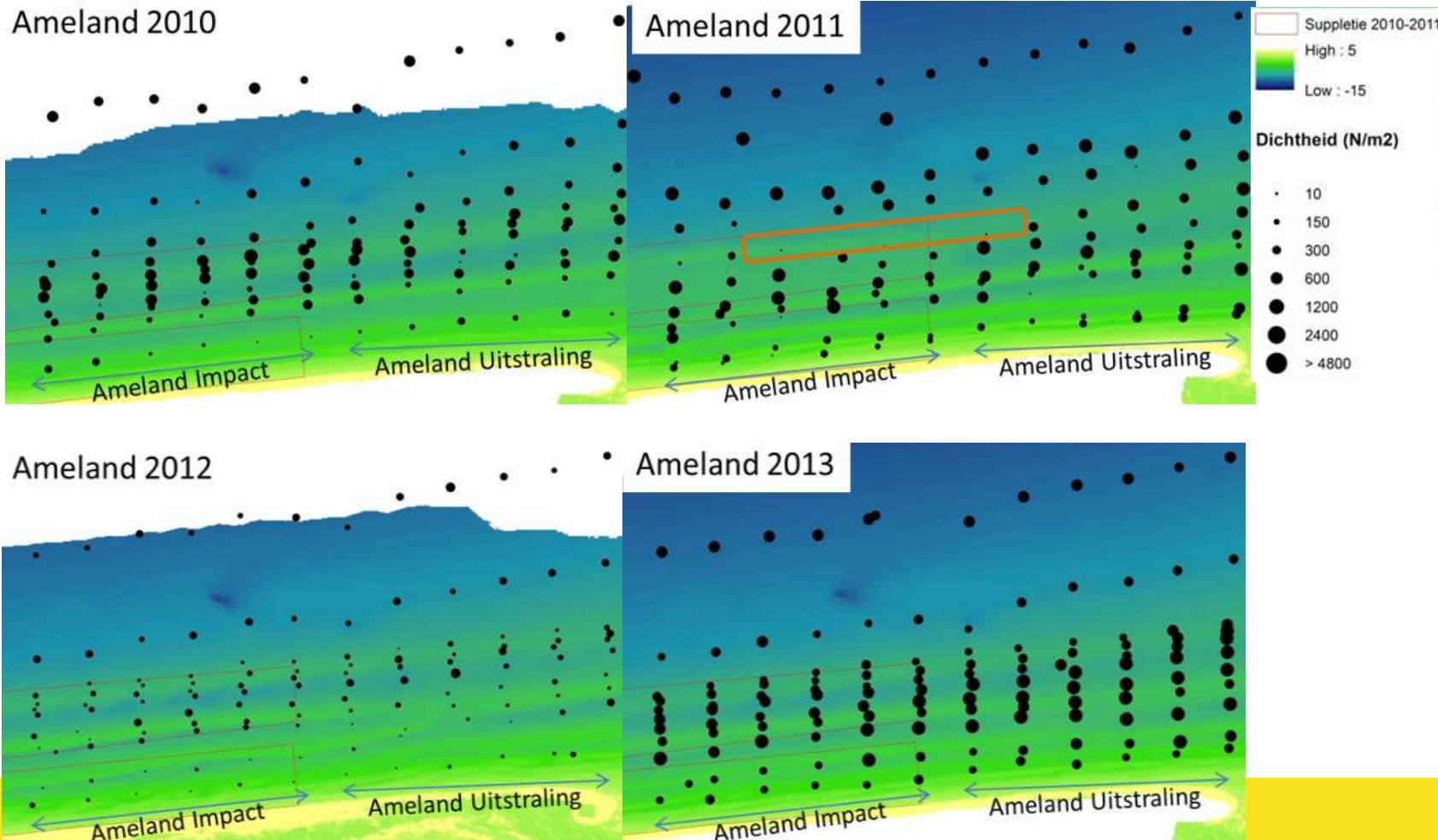
Effects of subsequent nourishments?

- Recolonization vs nourishment frequency
- Cumulating of effects?
- Monitoring



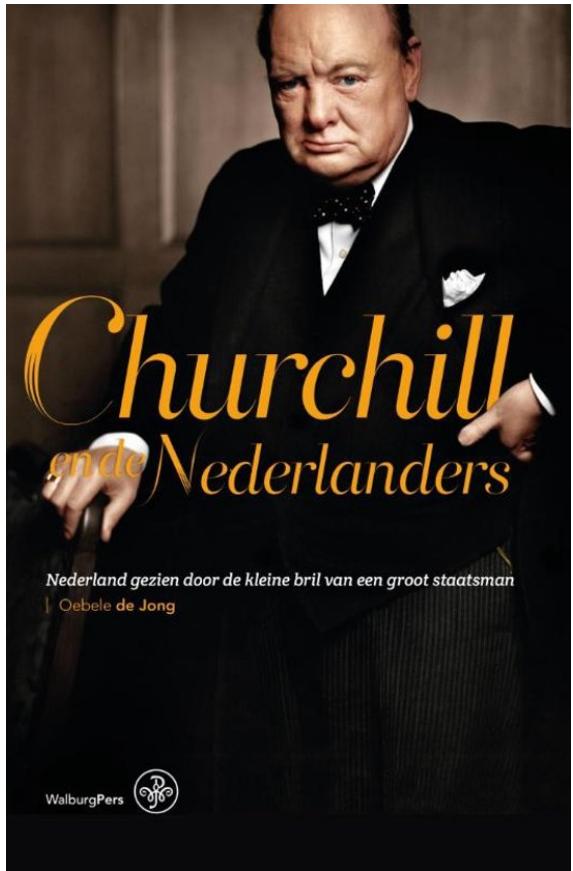


Ecological monitoring of Ameland Shoreface Nourishment



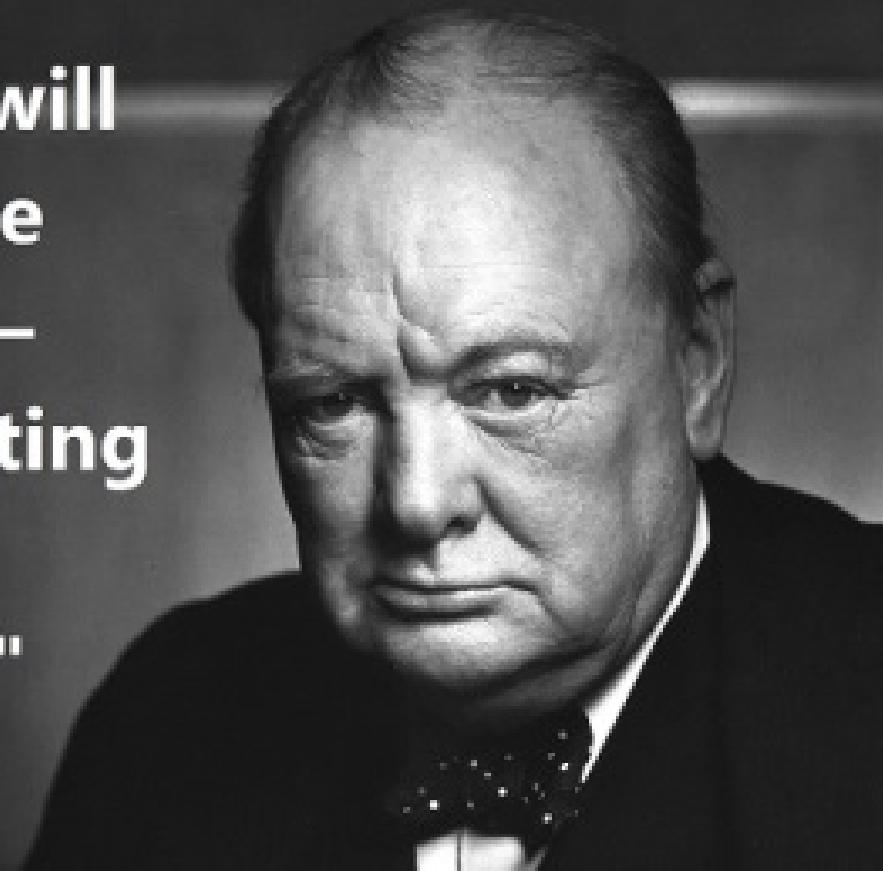


So... back to Churchill





**"Americans will
always do the
right thing —
after exhausting
all the
alternatives."**





I think you are doing the
right thing with our NNBF effort