

First Morphological Response of a Large Nearshore Nourishment Project using Fine Sand, Knokke (Belgium)

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Content

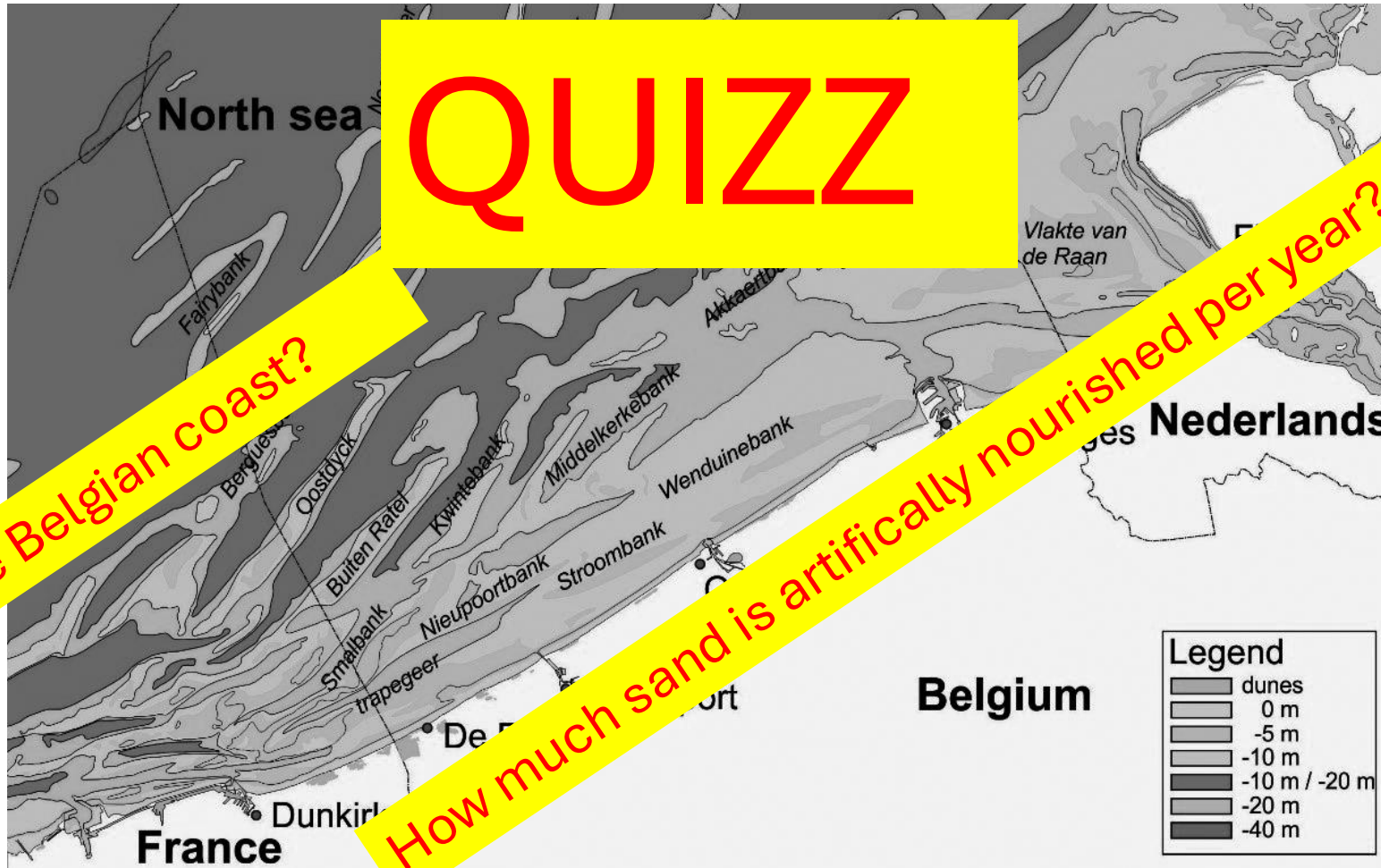
1. Morphology of the Belgian coast
2. Recent large nearshore nourishment in Knokke
3. Morphological evolution of the large nearshore nourishment
4. NbS - a future with sand: the coast as a living protection

Belgian coast

QUIZZ

How long is the Belgian coast?

How much sand is artificially nourished per year?



Flanders
State of the Art

Belgian coast

Moderate wave climate $H_s \sim 1.0$ m

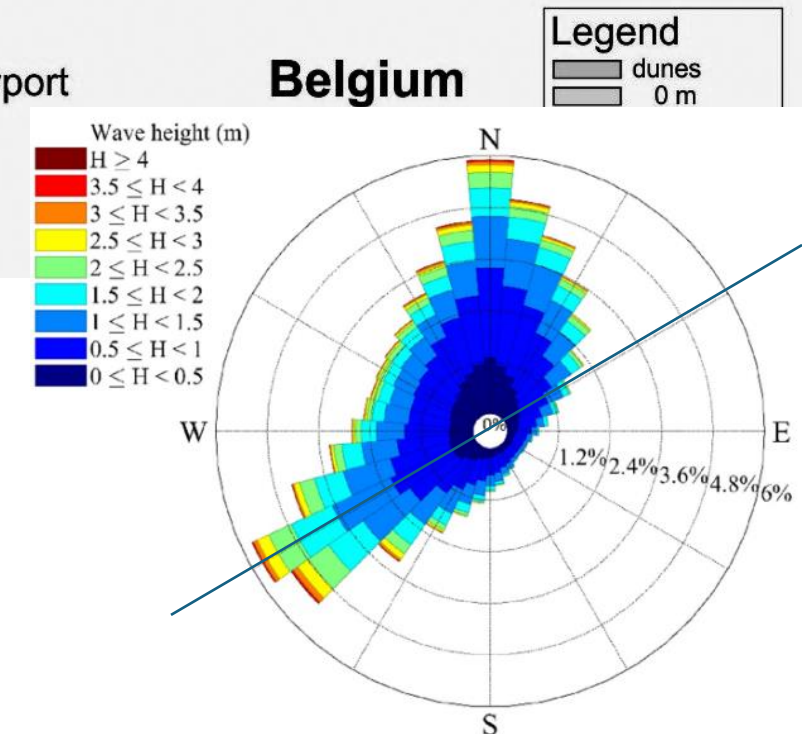
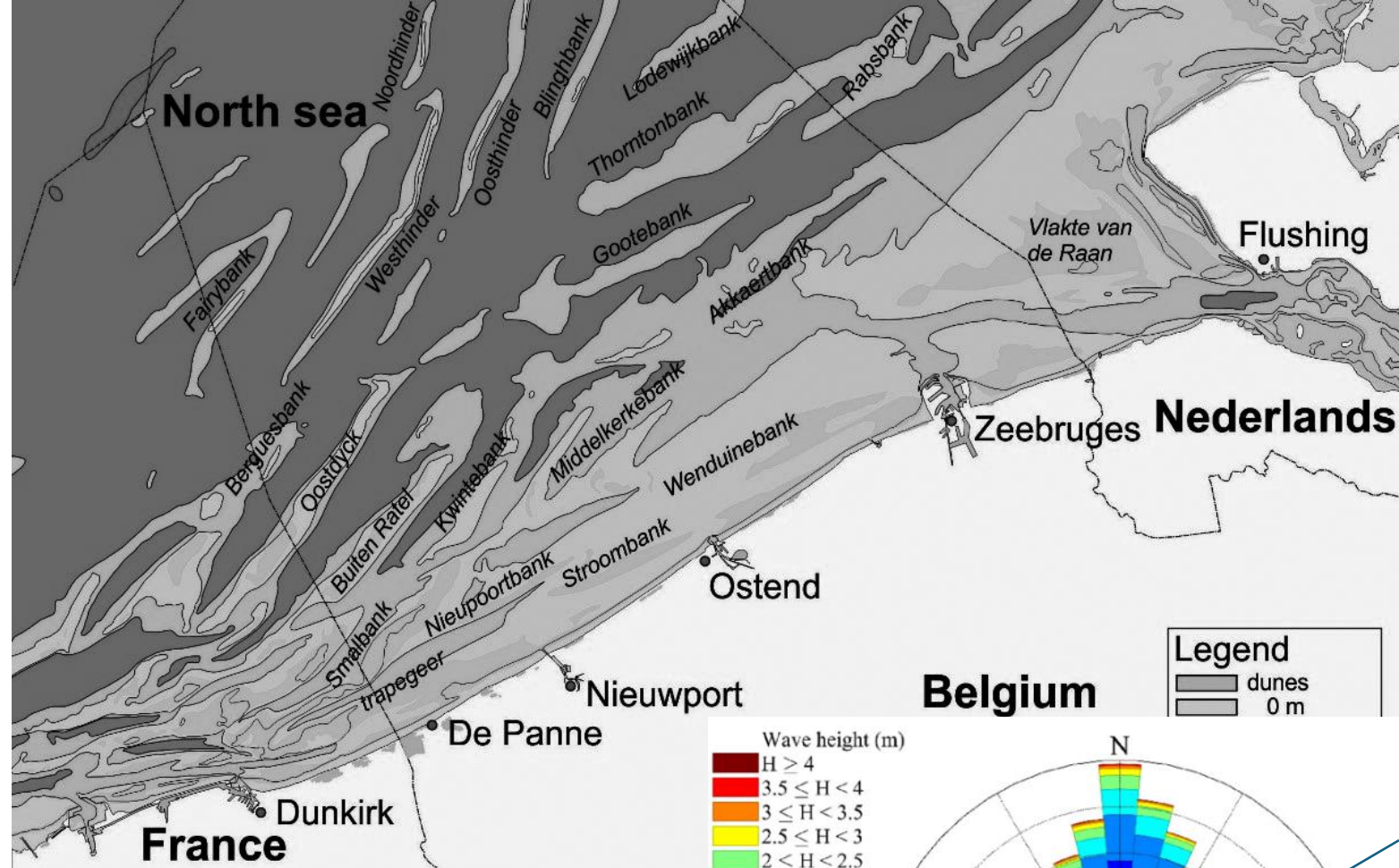
Macrotidal up to 5.0 m at spring tide

Complex system of sand banks and channels

Urbanized coast: exploited with harbors, fishing, tourism, residential area

Beach and nearshore nourishments to maintain a stable sand budget

= essential components of a sustainable coastal protection strategy

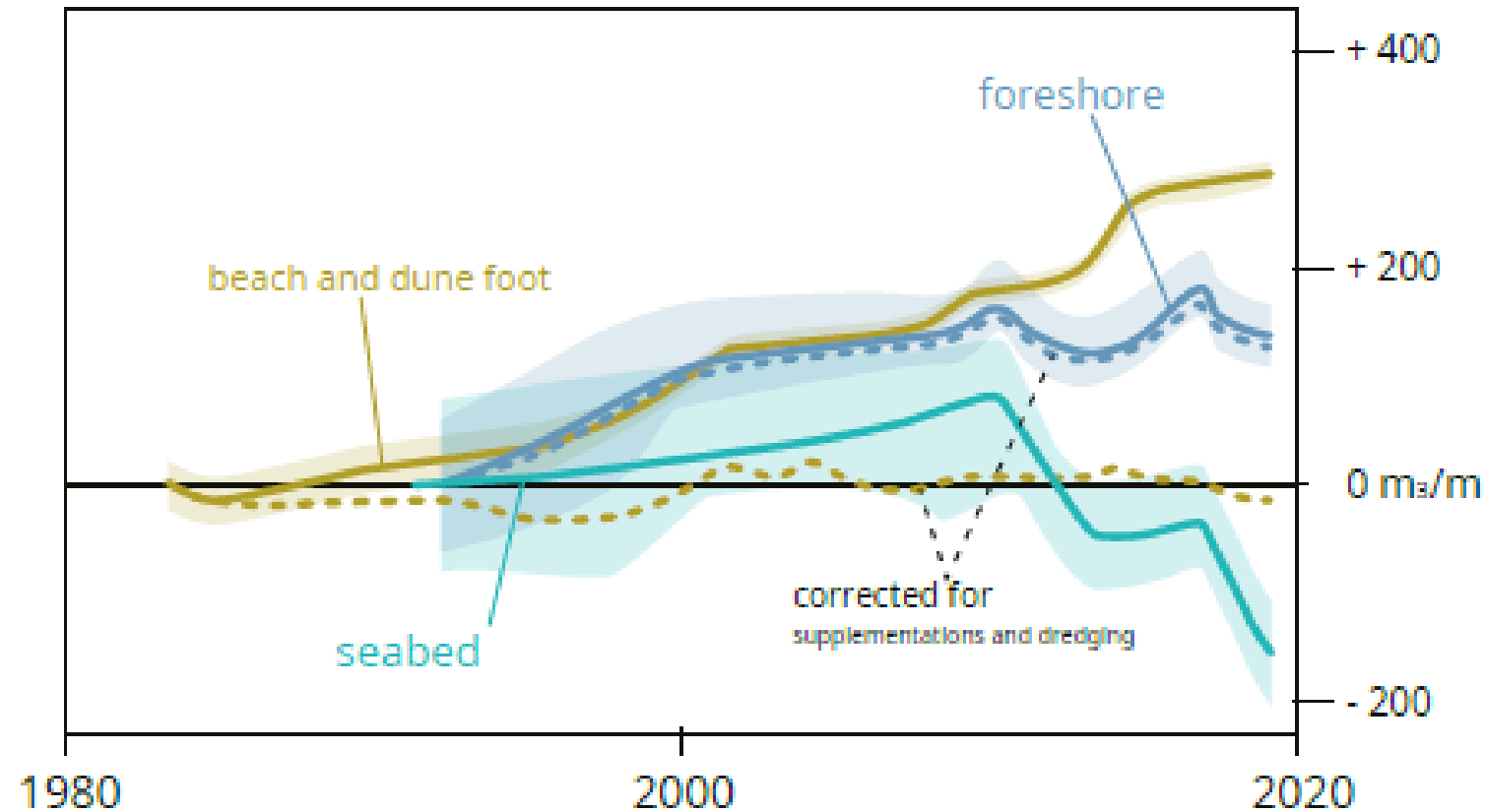


Sand budget and its evolution

Beach: bi-annual LiDAR survey

Underwater: annual single beam survey

The coast will gain sediment in the long term, with an increase of 1.06 million m³/y due to natural and artificial sand supplies



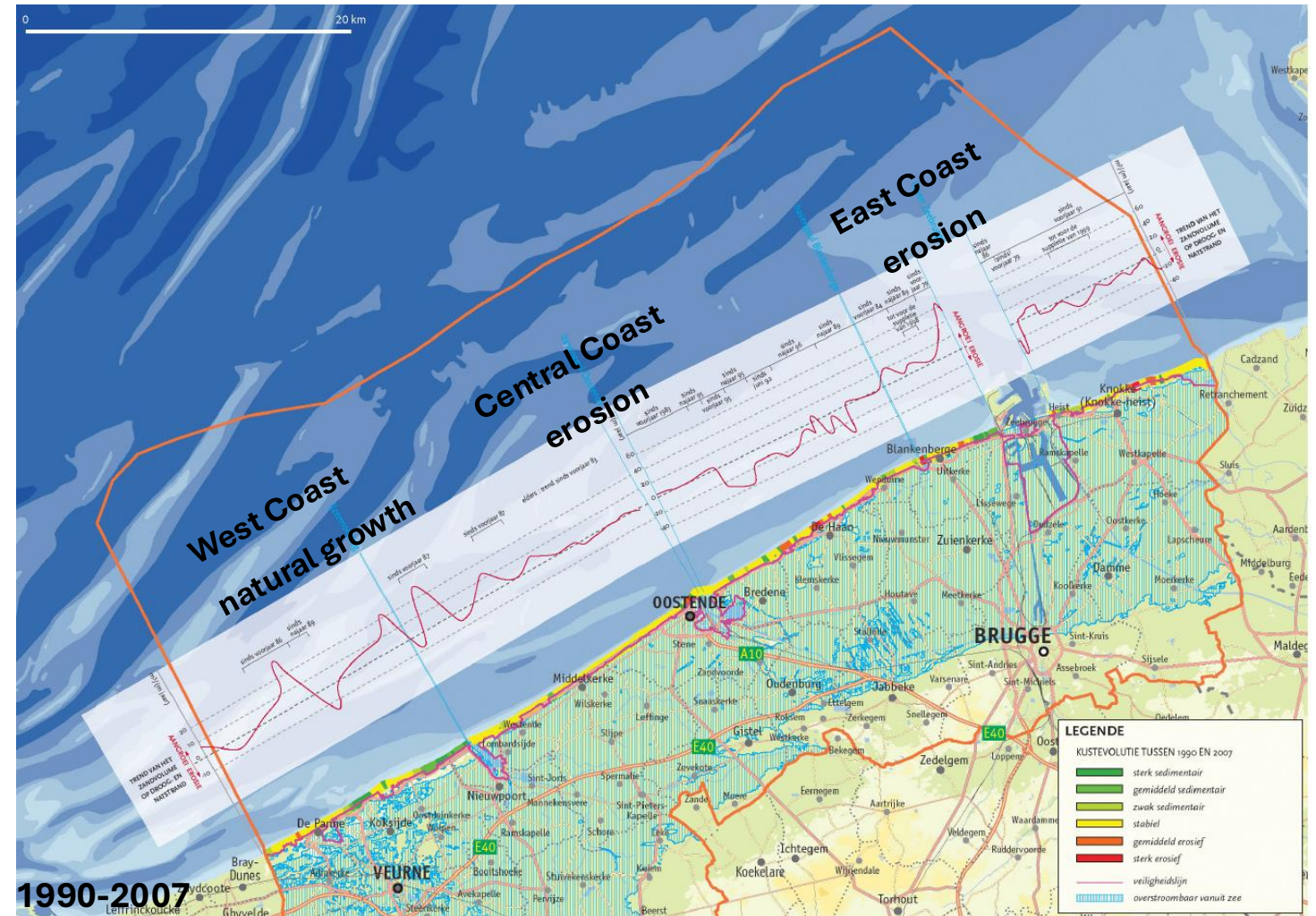
Morphological evolution of the entire coast

Additional sand supply necessary because of sea level rise and severe storms
-> maintain effective coastal defenses

Erosion and sediment supply not the same everywhere along the coast

These variations emphasize the importance of a well-managed sand budget

Re-assessing coastal trend/5y



Coastal protection

Coastal risk and vulnerability assessment framework for improving adaptive capacity implemented in the Master Plan for Coastal Safety in 2011

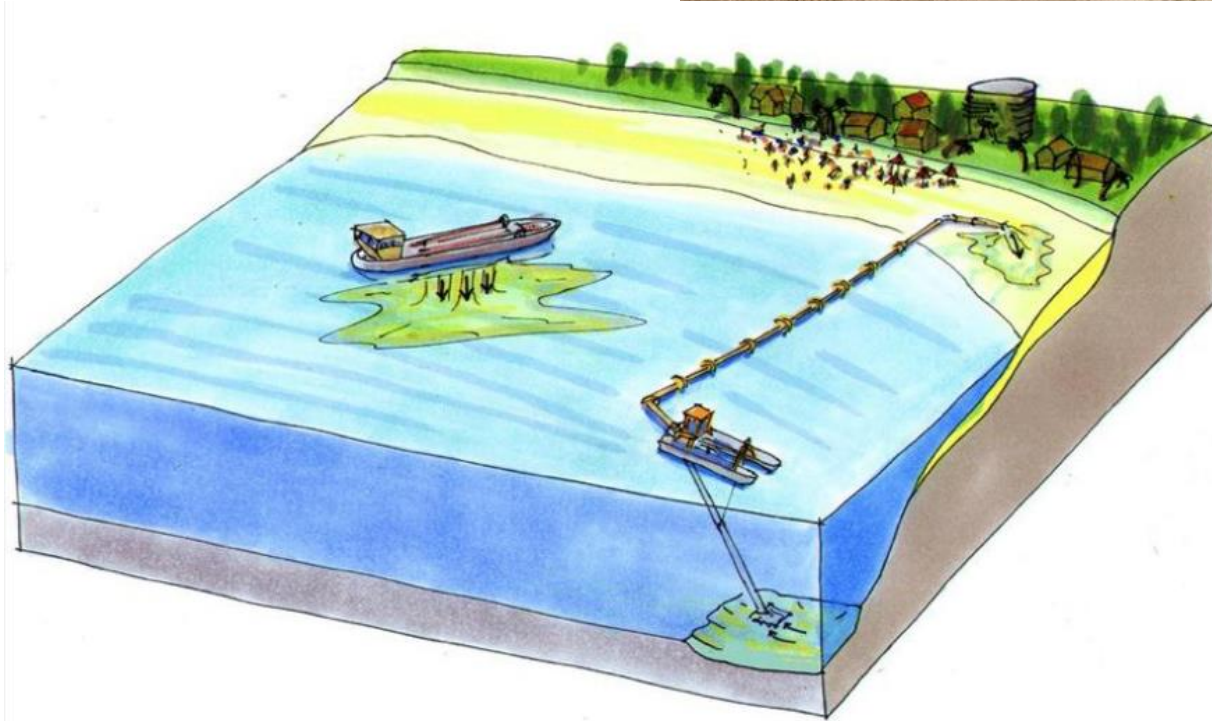
Vision - Soft engineering as much as possible and complemented by 'hard' measures where is necessary

Re-assessing every 6 y and after extreme storms



Coastal protection with artificial sand supply

Beach nourishments



Nearshore nourishments



Origin of the sand

Sand used for coastal protection comes from areas on the seabed of the North Sea->Marine Spatial Plan.

Ensure that sand extraction takes place in a regulated-sensible manner

Recent increase emphasis on reusing sand from marine projects



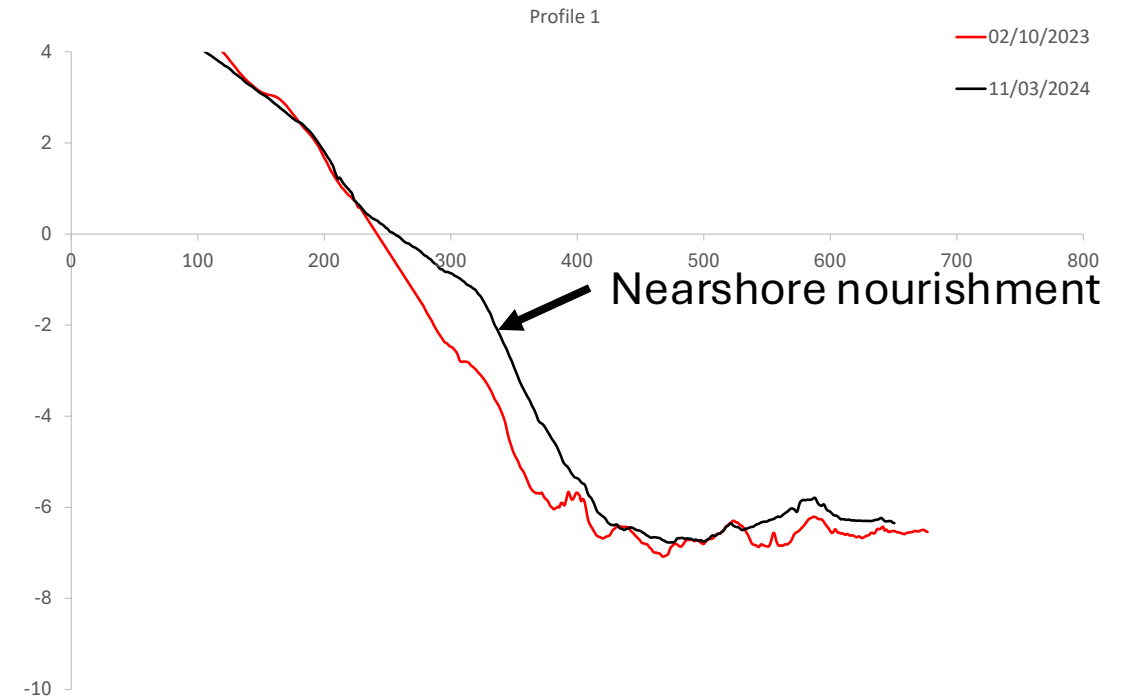
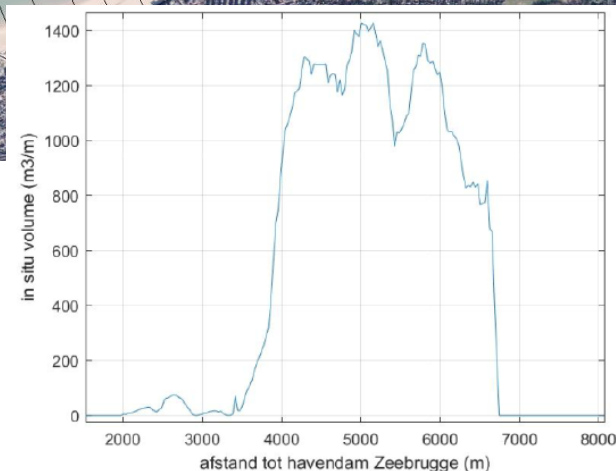
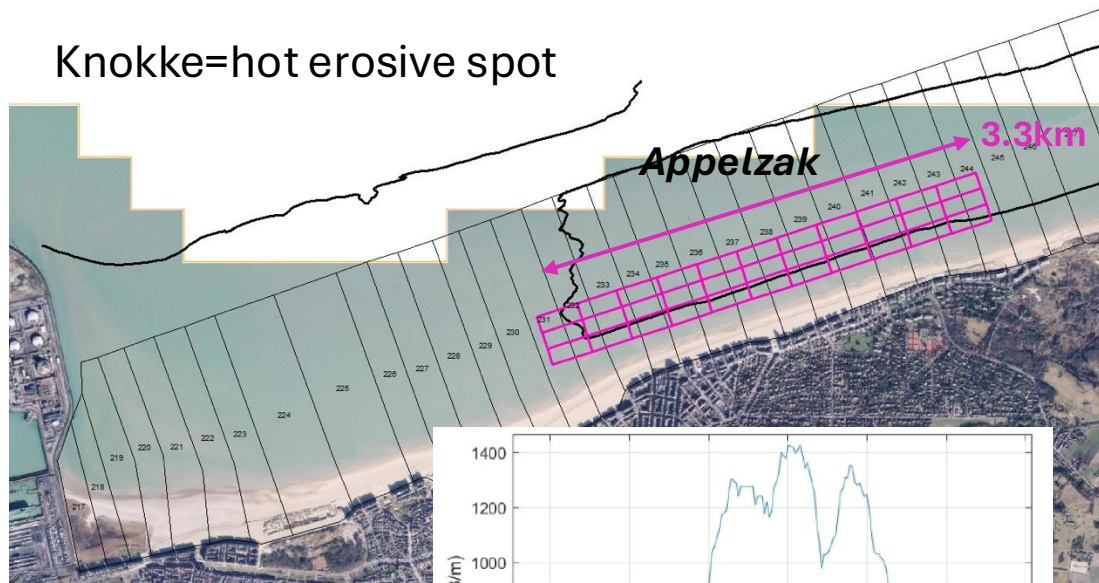
Large nearshore nourishment in Knokke

Large nearshore nourishment of 1.2 million m³ for the part below 0 m TAW from 10/2023-02/2024 in Knokke-Heist

Sand material from the new lock construction in Terneuzen (NL)

Medium to fine sand with a D50 of 150 µm

Knokke=hot erosive spot



Placement efficiency of the large nearshore nourishment

02/10/2023-11/03/2024	Area (m ²)	Volume (m ³)	Volume/area (m ³ /m ²)	Volume uncertainty (m ³)
Knokke nearshore nourishment area	1 316 950	731 950	0.56	92 190



Nourishment efficiency is estimated between 61% - 72%

Reasons of difference:

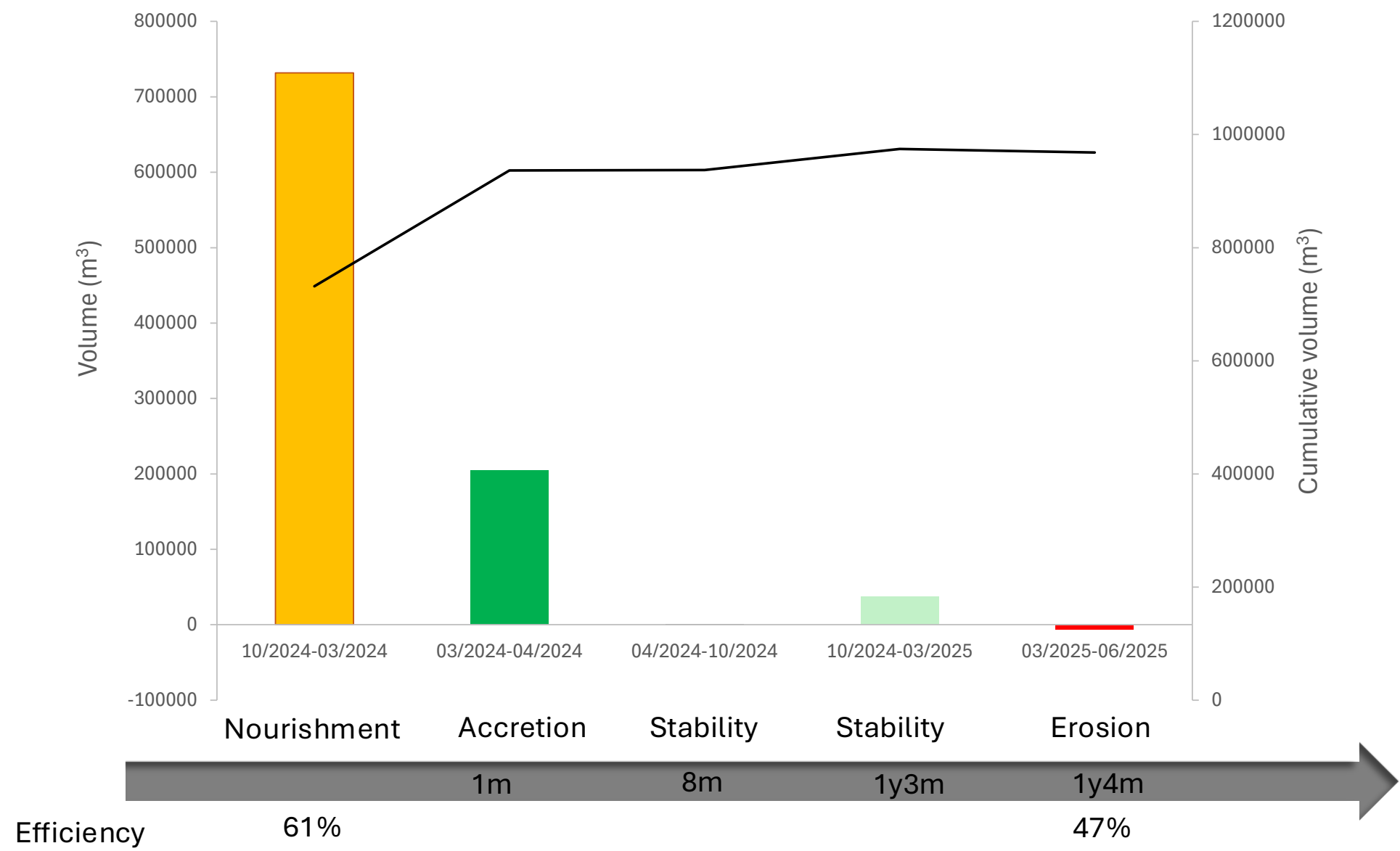
- location (nourishment carried out on the upper shoreface)
- sand spreading occurred during and just after the nourishment operations
- fine sand remained partly suspended after being released from the ships ->spreading out

Evolution of the large nearshore nourishment

10/2023-03/2024



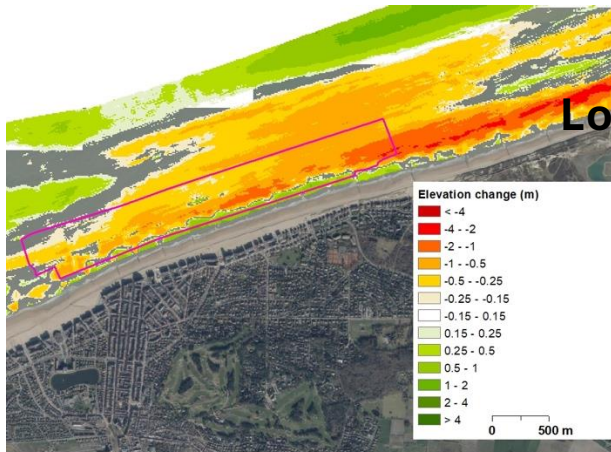
Evolution of the large nearshore nourishment



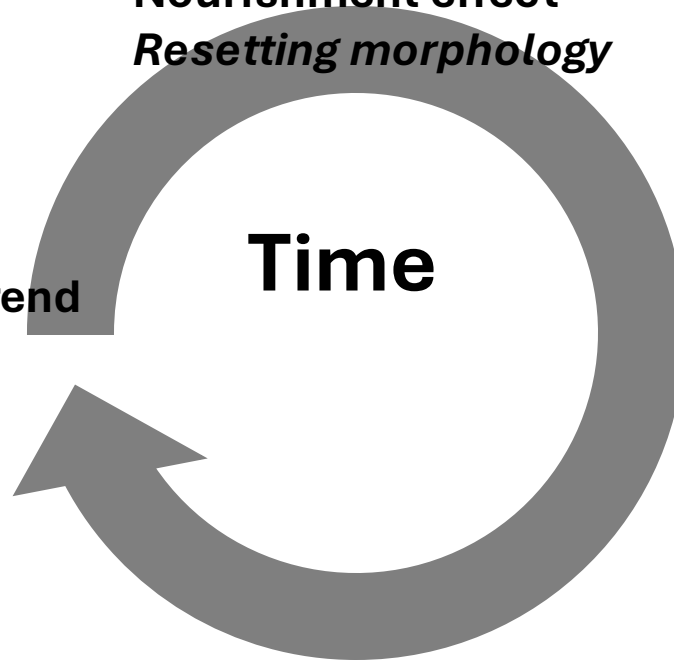
Evolution of the large nearshore nourishment



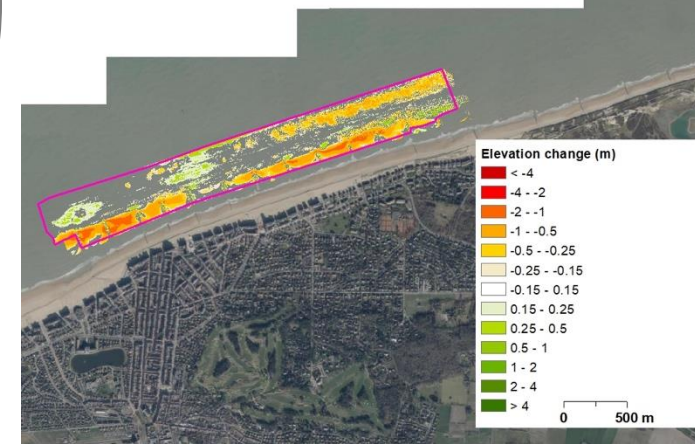
Nourishment effect
Resetting morphology



Long term trend
erosion



1y after nourishment
Progressively back to erosion trend



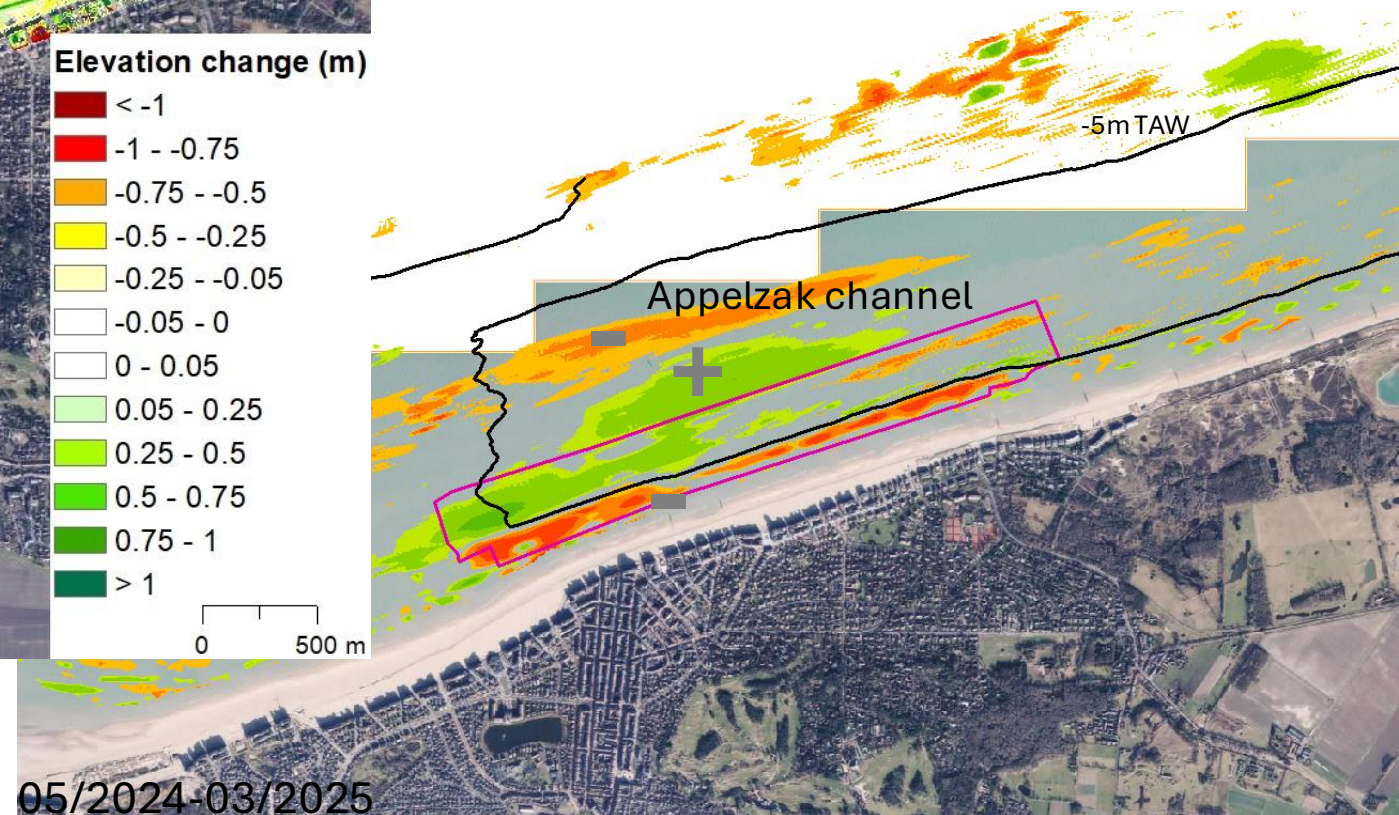
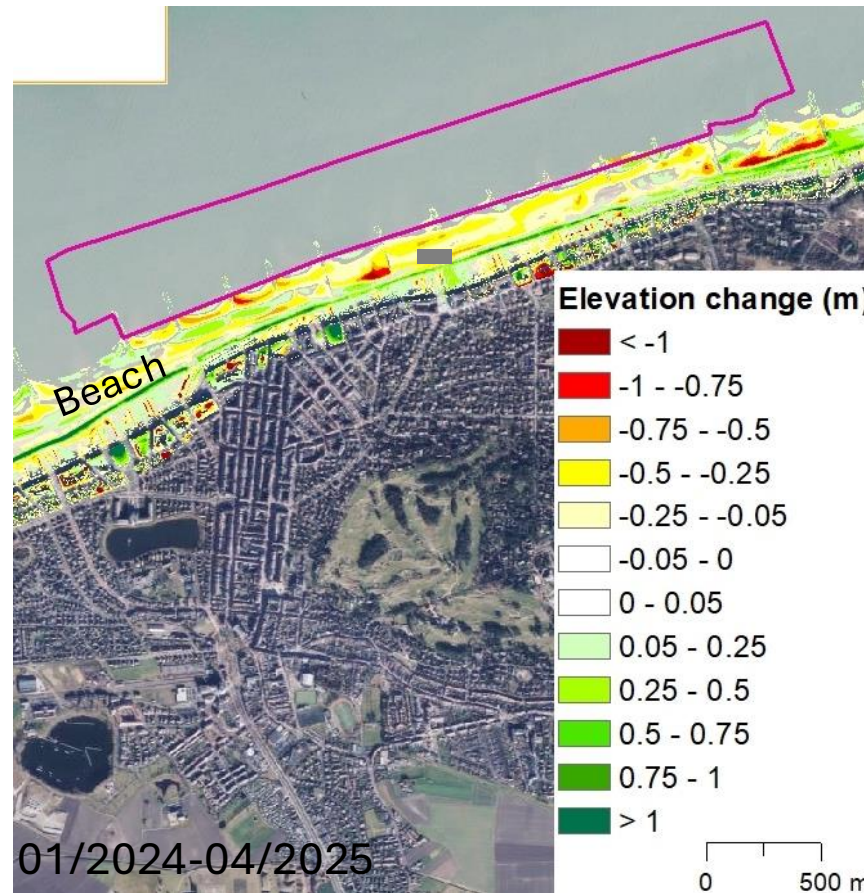
Evolution in the surrounding of the large nearshore nourishment in Knokke

Nearshore nourishment no benefit for the beach ≠ erosion on the beach

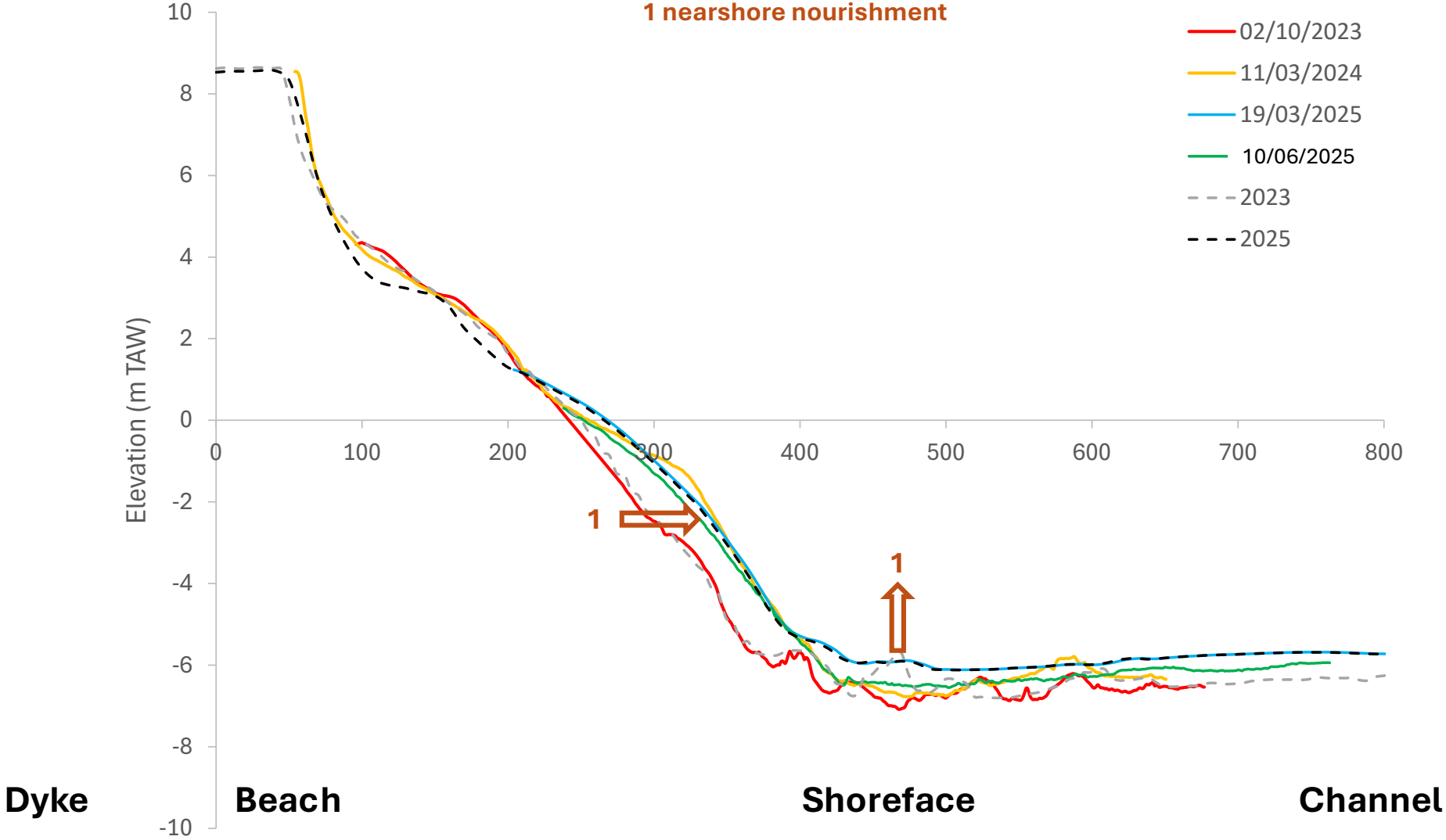
Eroded sand from the beach is transported to the s-s by wave cross-shore processes to be deposited on the Appelzak channel bed

=>channel shallower
decreasing currents and waves

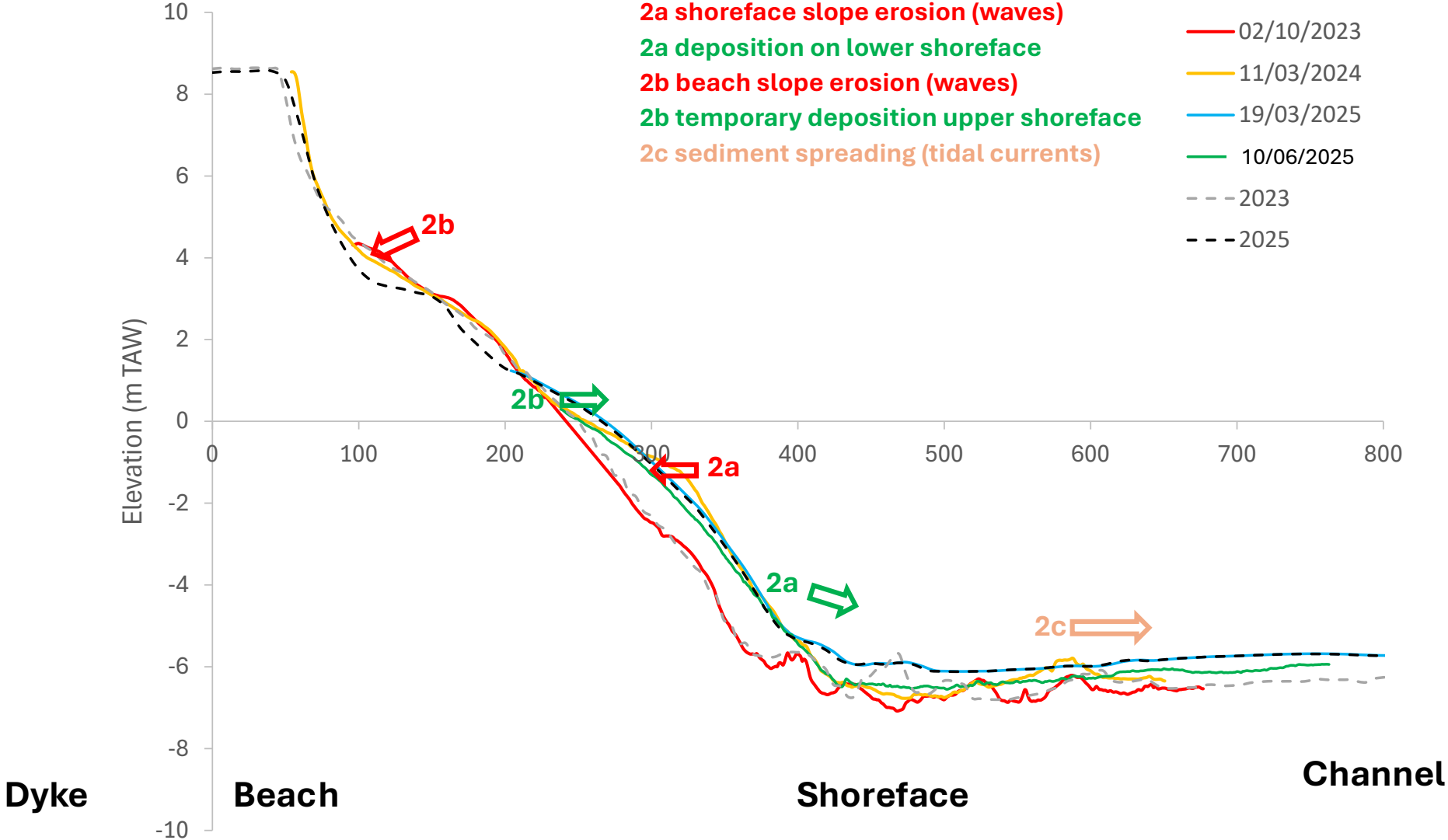
=>reducing coastal erosion



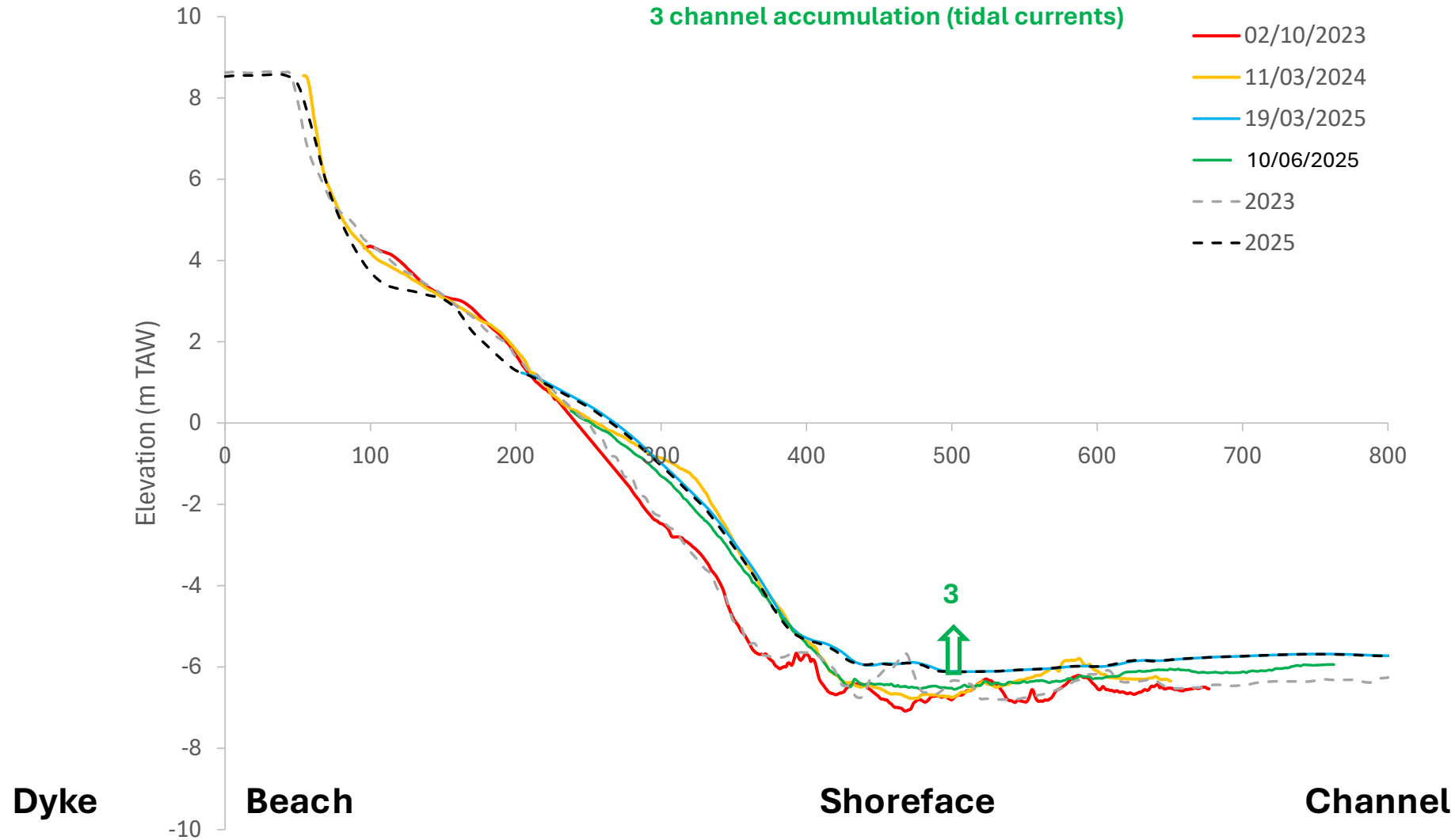
Conceptual model of evolution large nearshore nourishment in Knokke



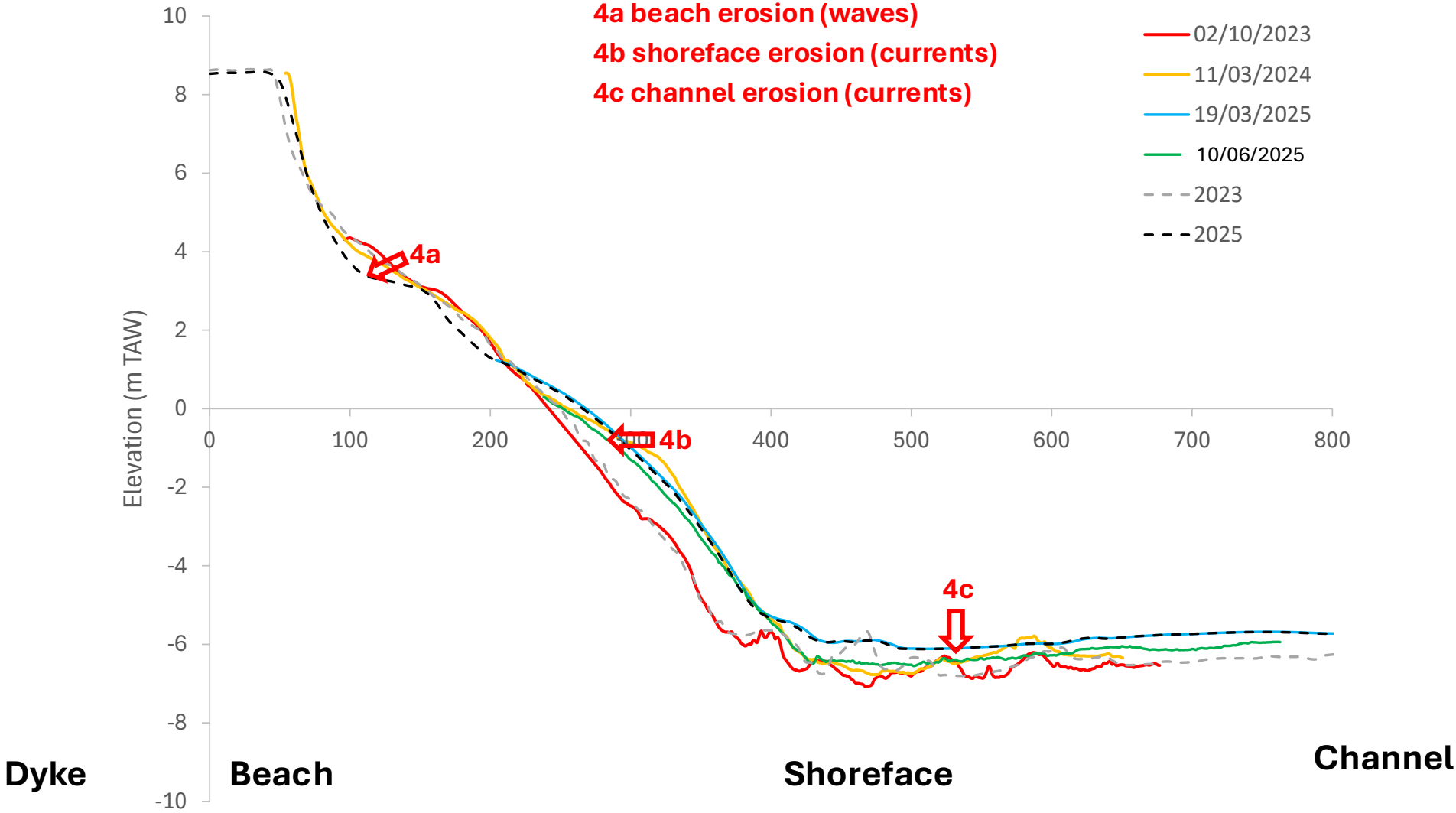
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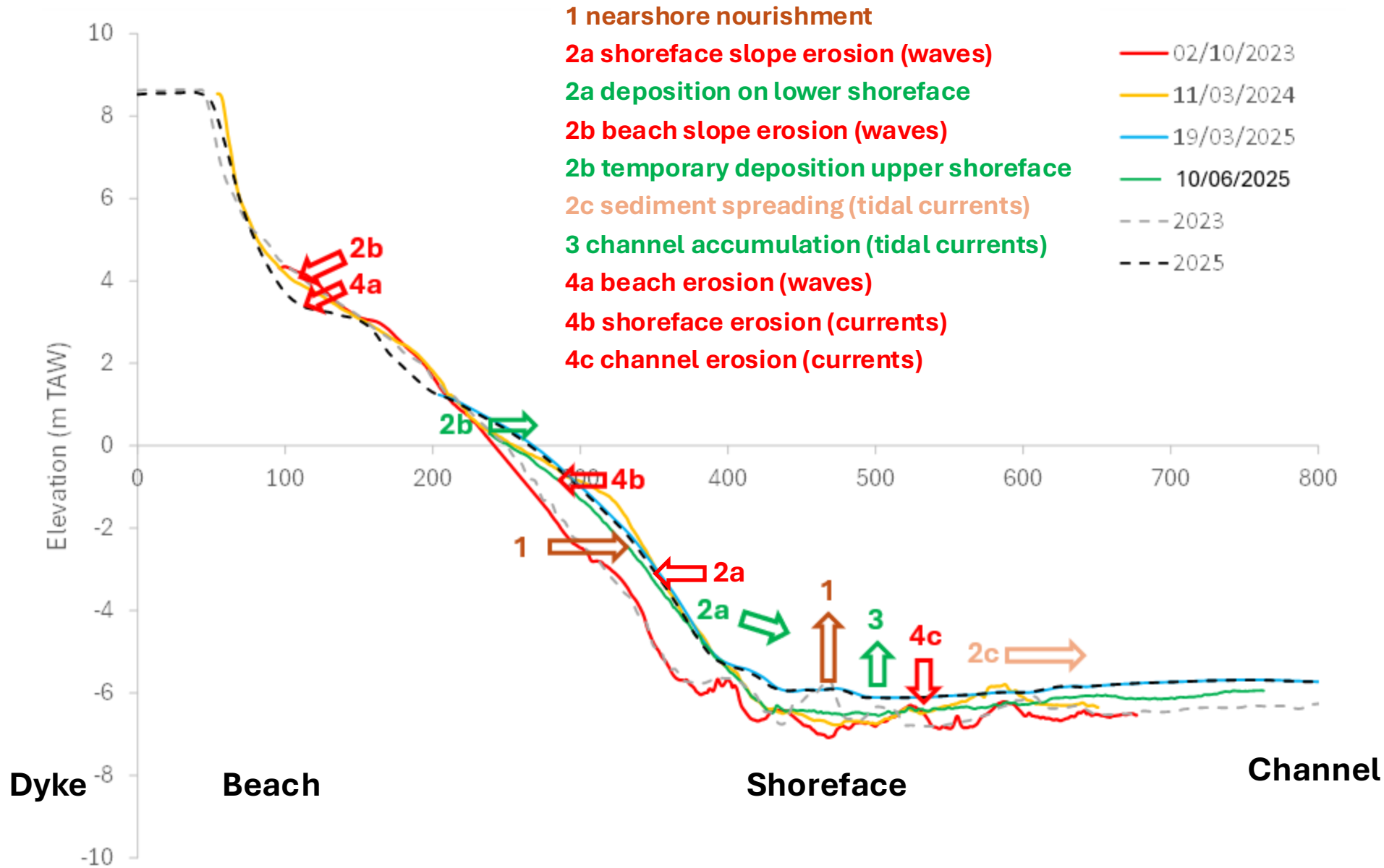
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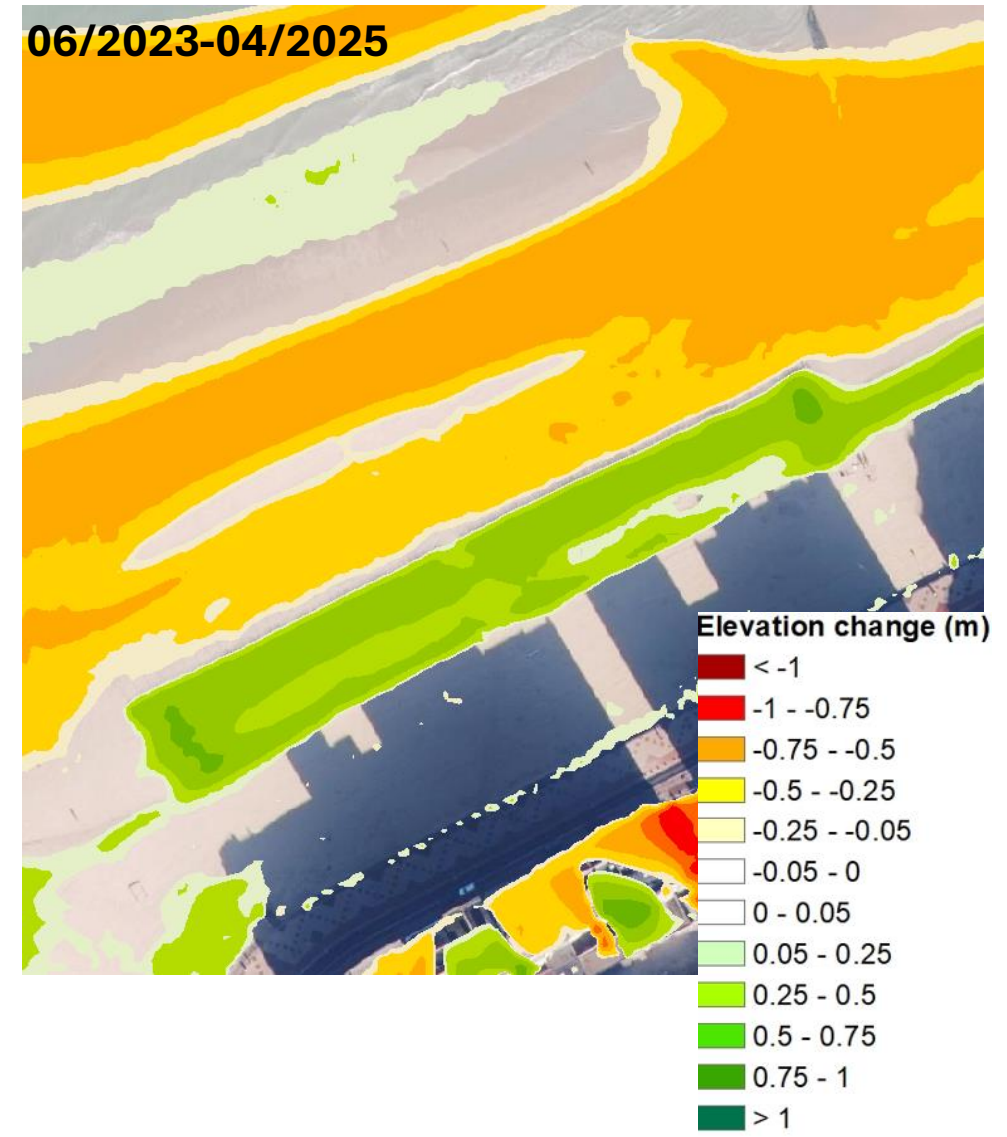
Conceptual model of evolution Large nearshore nourishment in Knokke



A future with sand: the coast as a living protection

NbS sustainable method to retain the sand supplied as effectively as possible in the desired location.

Dec 2022 installation of NbS with wooden poles and



Conclusions

- Placement efficiency of the large nearshore nourishment with fine sand is rapidly reduced over time
- Nourishment helps to reset the morphology but no stop of the sediment processes leading to erosion
(back to natural trend)
- Surrounding morphology plays an important role in the lifetime of the nourishment
- Future toward a hybrid solution combining nourishment and NbS

Thank you!

