# morphological trend analysis of beach and shoreface along the Belgian coast

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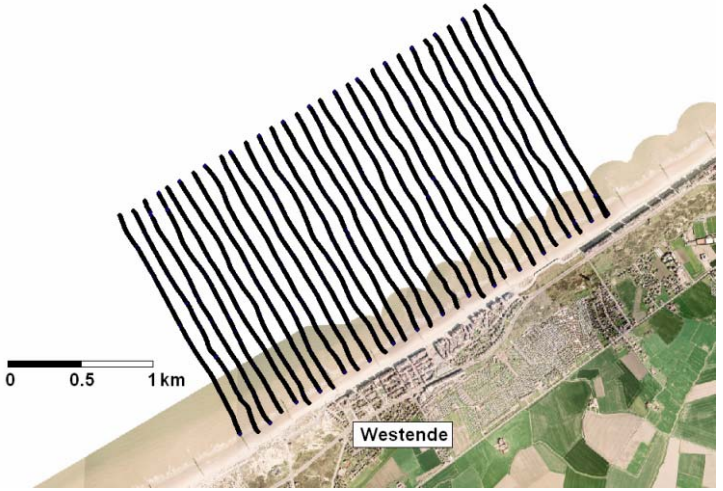
Flanders hydraulics Research
Quest4D final workshop

# morphological trend analysis: methodology

- = study of morphological evolution
  of beach and shoreface along Belgian coast
  from 1997 until now



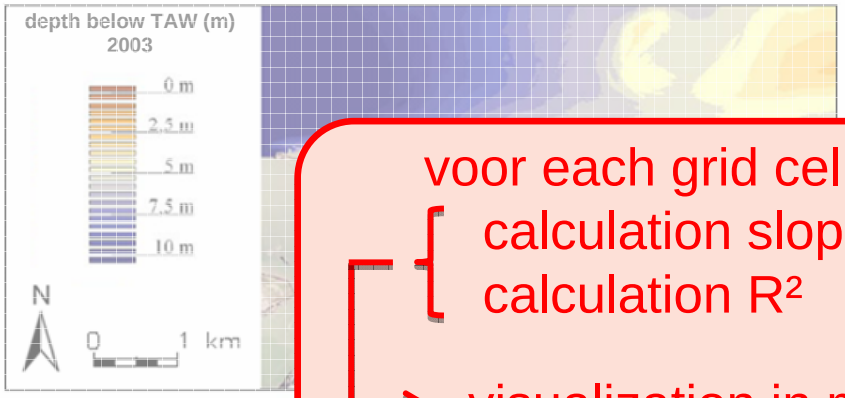

- based on: -beach measurements
  -shoreface soundings

→ only digitally available data sets were used: 1997-2010
→ data sets were delivered by Coastal Division (Flemish Government)

- methodology: using GIS software
  → interpolation of data sets to topo-bathymetric grids (resolution 2m x 2m)
  → performing for each grid cell a trend analysis on time series of depth
  values available for that grid cell

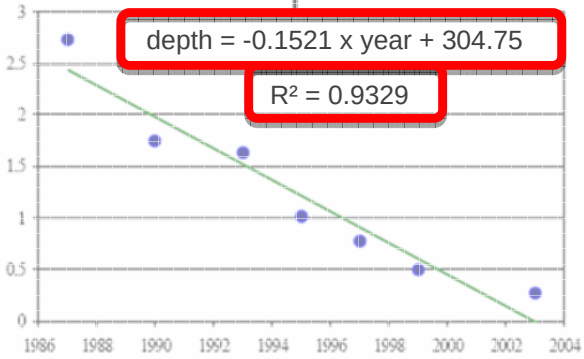
# morphological trend analysis: methodology

Method: linear least squares fit of a time series of depth values applied to each grid cell



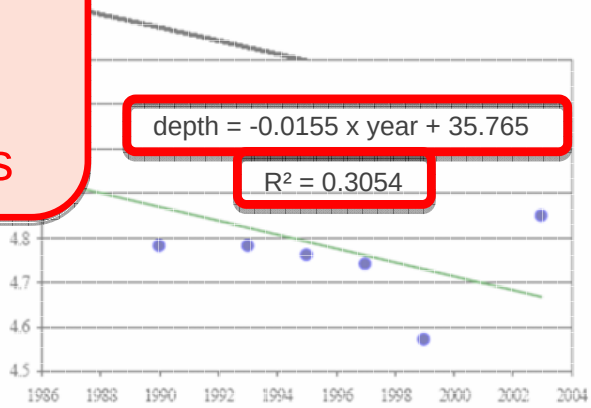

voor each grid cell:
- calculation slope
- calculation $R^2$

→ visualization in maps



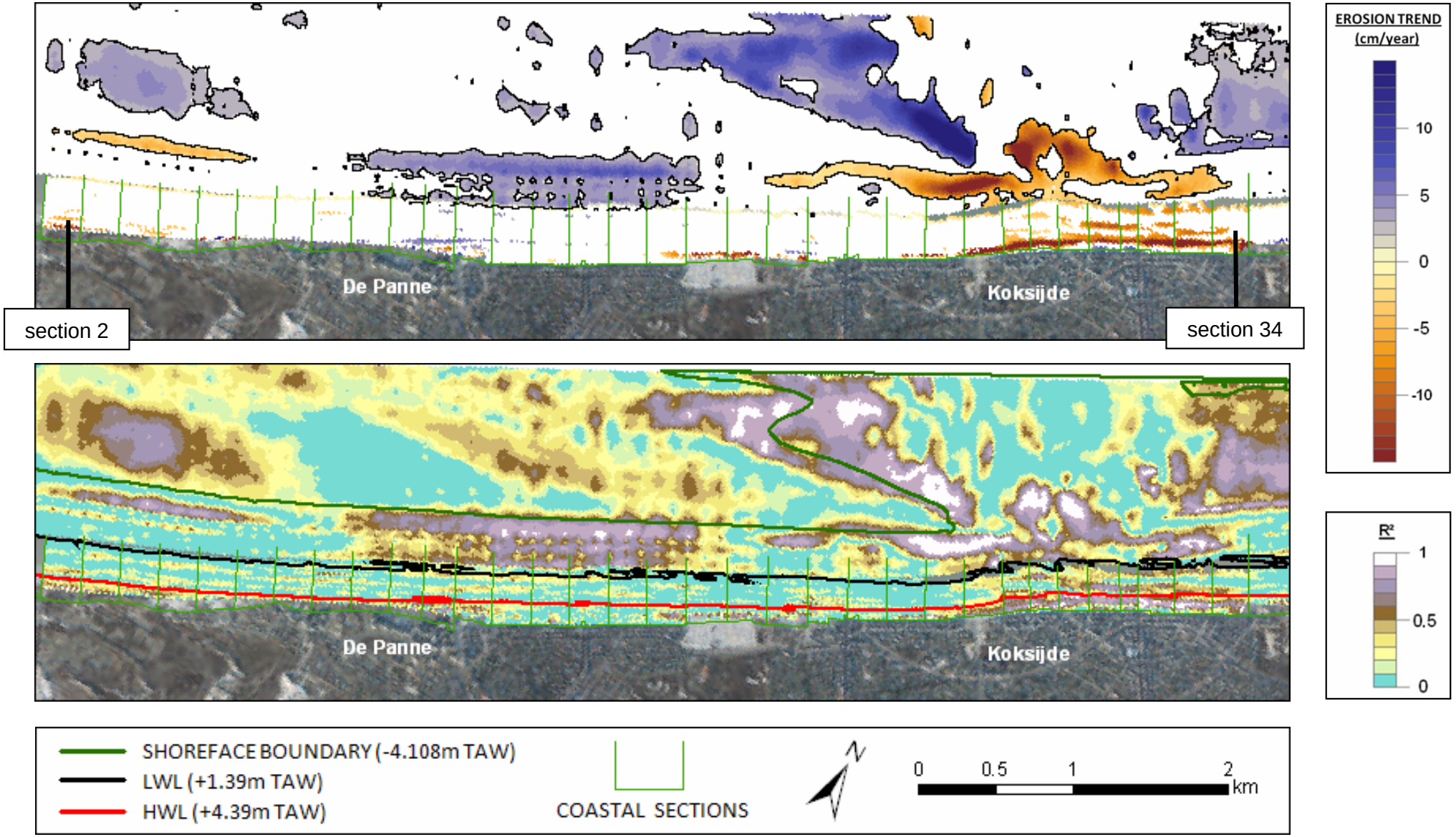

$R^2 > 0.5$ → significant trend

sedimentation rate of seafloor = 15 cm/year

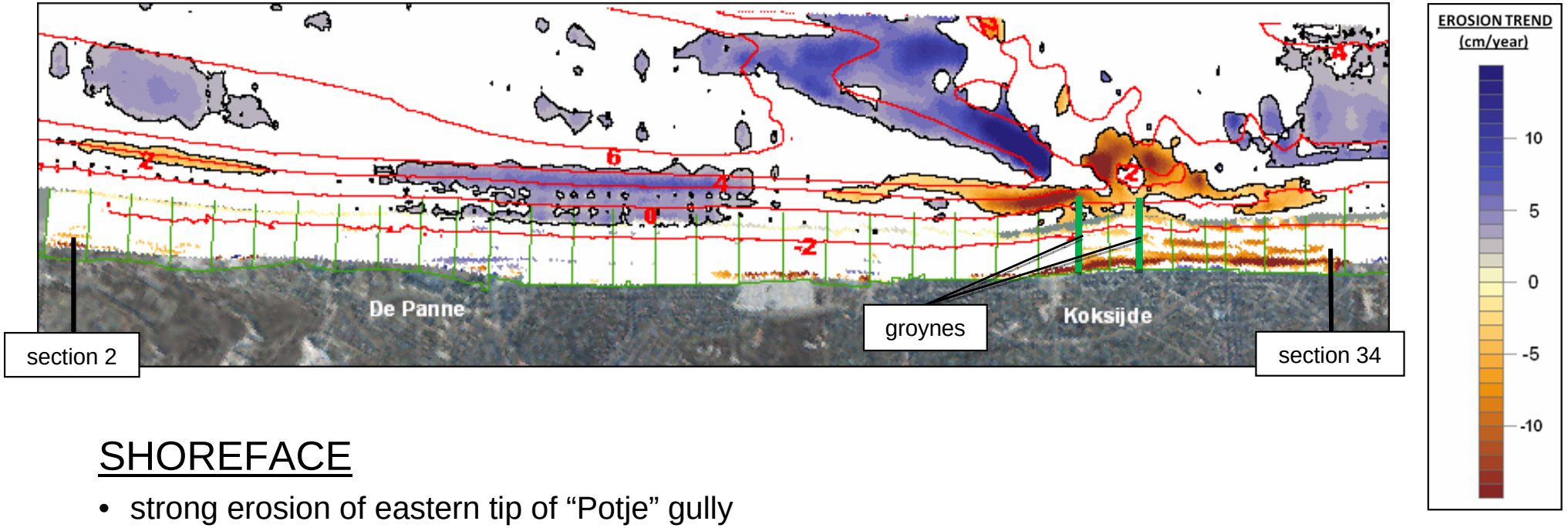



$R^2 < 0.5$ → no significant trend

# morphological trend analysis:
## beach and shoreface: sections 2-34



# morphological trend analysis:
## beach and shoreface: sections 2-34



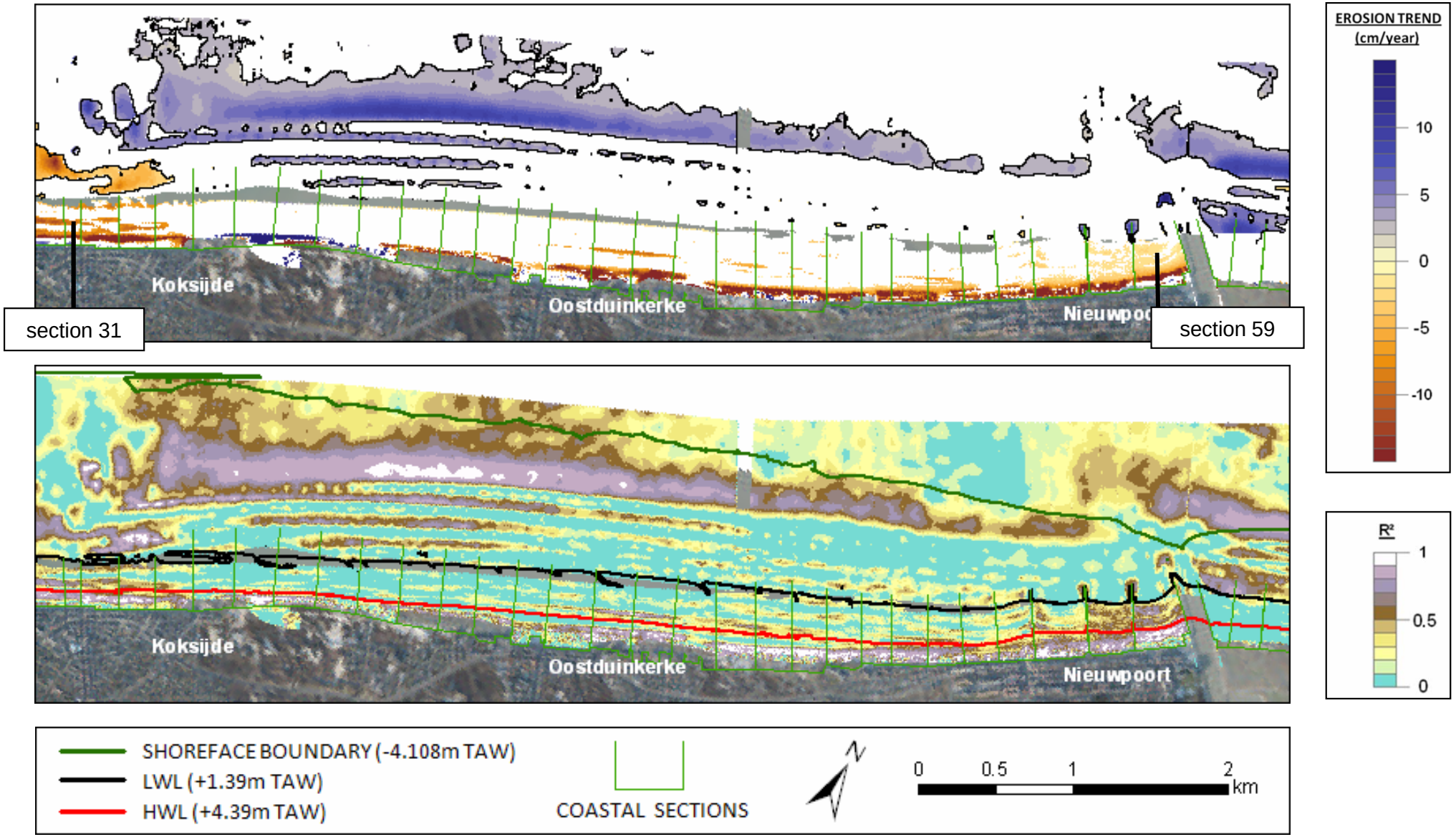

## SHOREFACE

- strong erosion of eastern tip of “Potje” gully
- further eastern expansion of “Potje” by groynes Koksijde (constructed in ‘85- ‘86)
- strong sedimentation trend around groyne

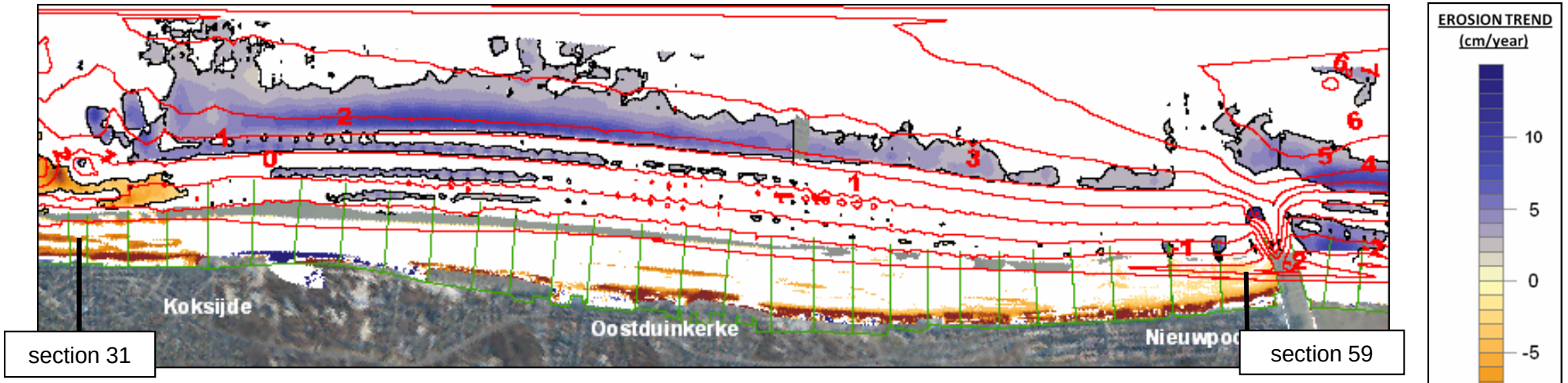
## BEACH

- sections 26-34: significant sedimentation at the foot of the dunes

# morphological trend analysis:
## beach and shoreface: sections 31-59



# morphological trend analysis:
## beach and shoreface: sections 31-59



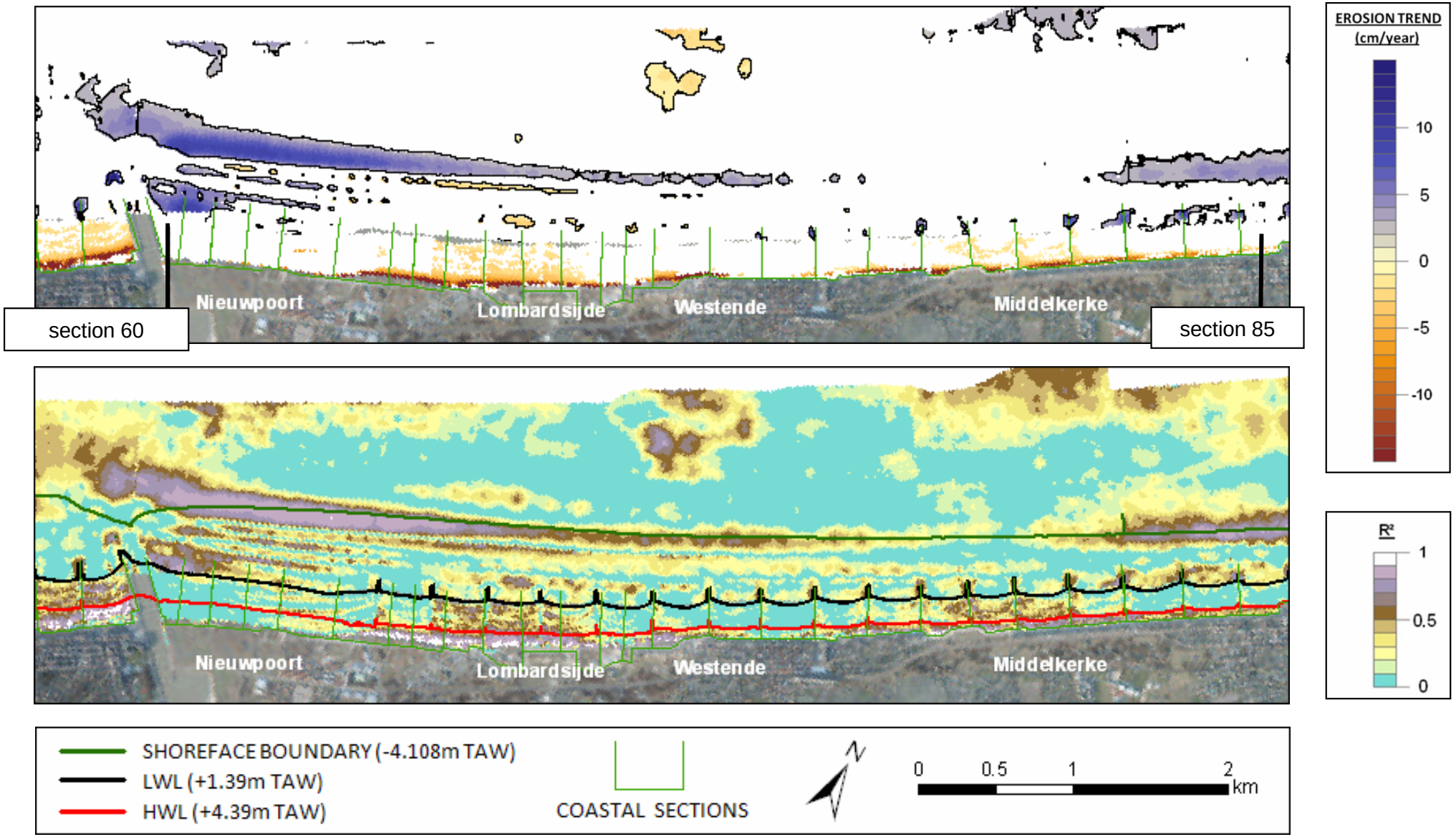

## SHOREFACE

- elongated erosion zone parallel to coastline
  → erosion of the foot of the shoreface
  (in transition zone between shoreface and seafloor)

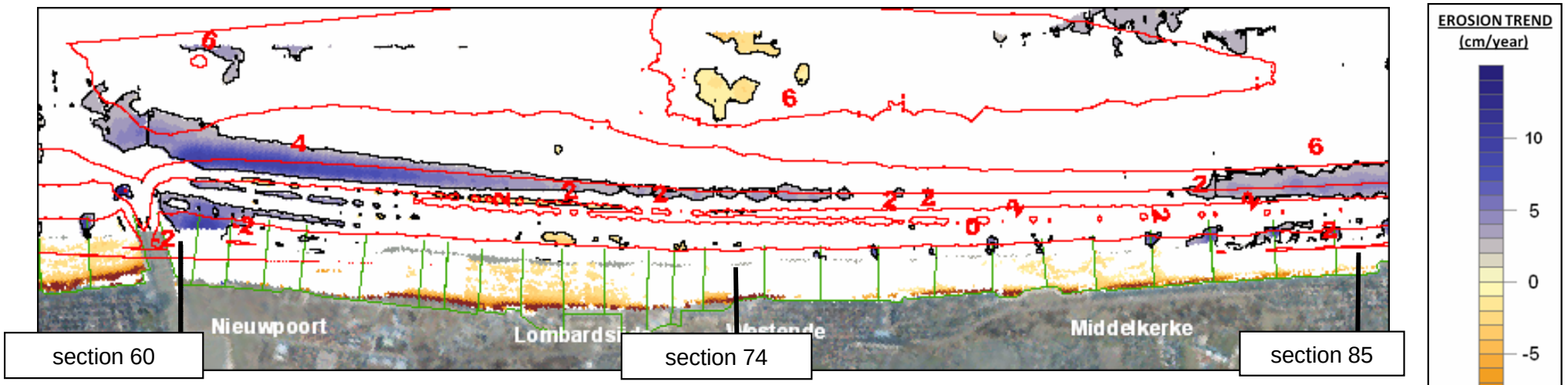
## BEACH

- sections 40-59: strong sedimentation of the foot of the dunes
- sections 36-38: erosion
  → dunes extend land inwards

# morphological trend analysis:
## beach and shoreface: sections 60-85



# morphological trend analysis:
## beach and shoreface: sections 60-85

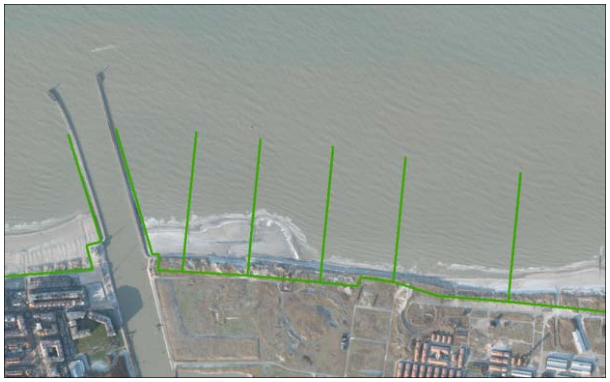



## SHOREFACE

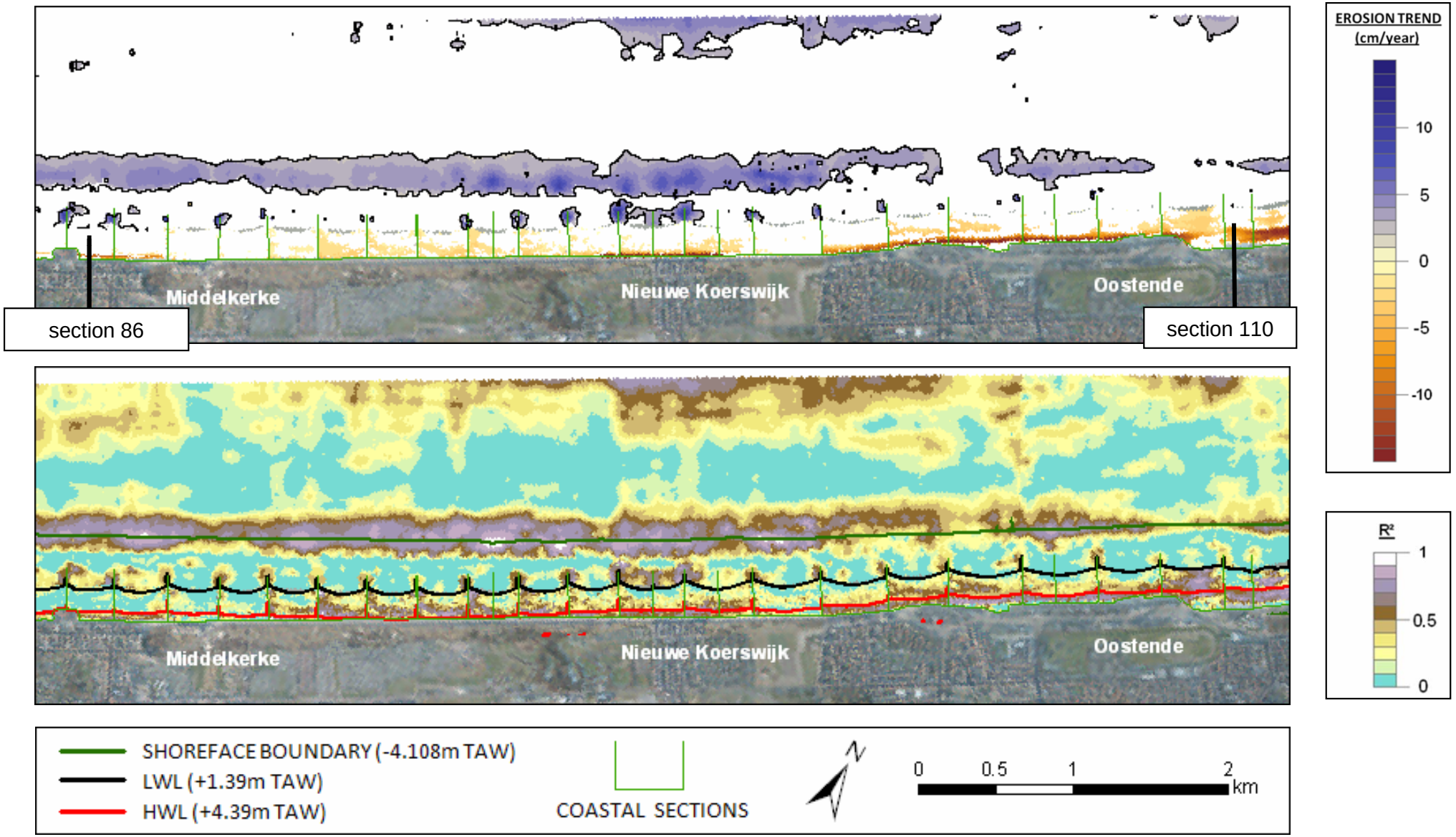
- again: elongated erosion zone between Nieuwpoort and Oostende (see also next slide)
  → erosion of the foot of the shoreface

## BEACH

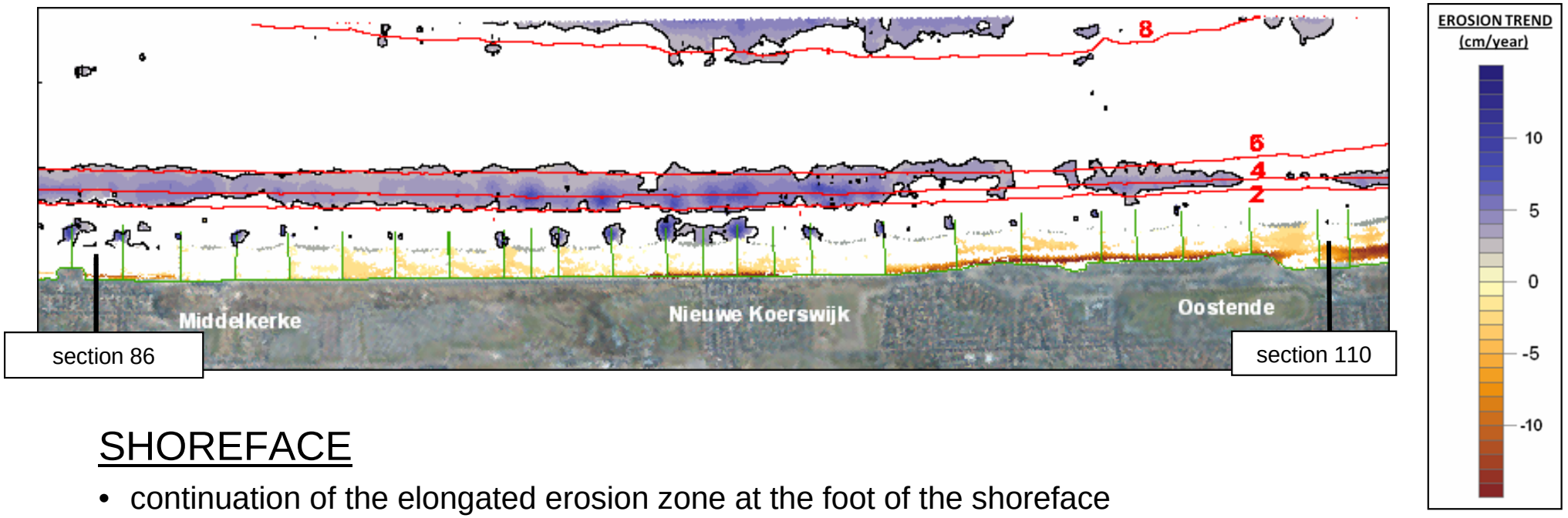
- sections 65-74: strong sedimentation of the foot of the dunes
- sections 75-85: sedimentation of dry beach close to dike



# morphological trend analysis:
## beach and shoreface: sections 86-110



# morphological trend analysis:
## beach and shoreface: sections 86-110



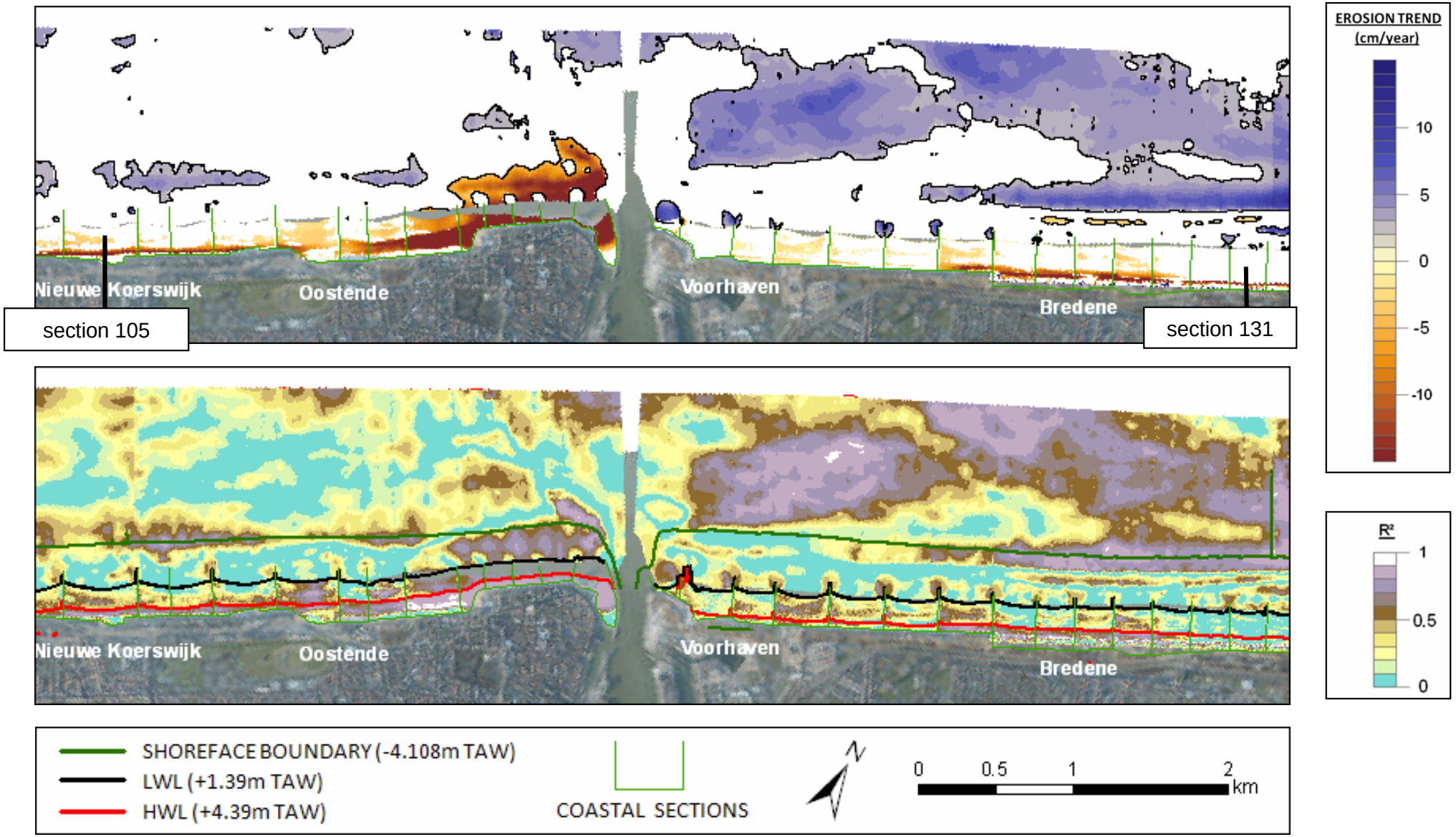

## SHOREFACE

- continuation of the elongated erosion zone at the foot of the shoreface

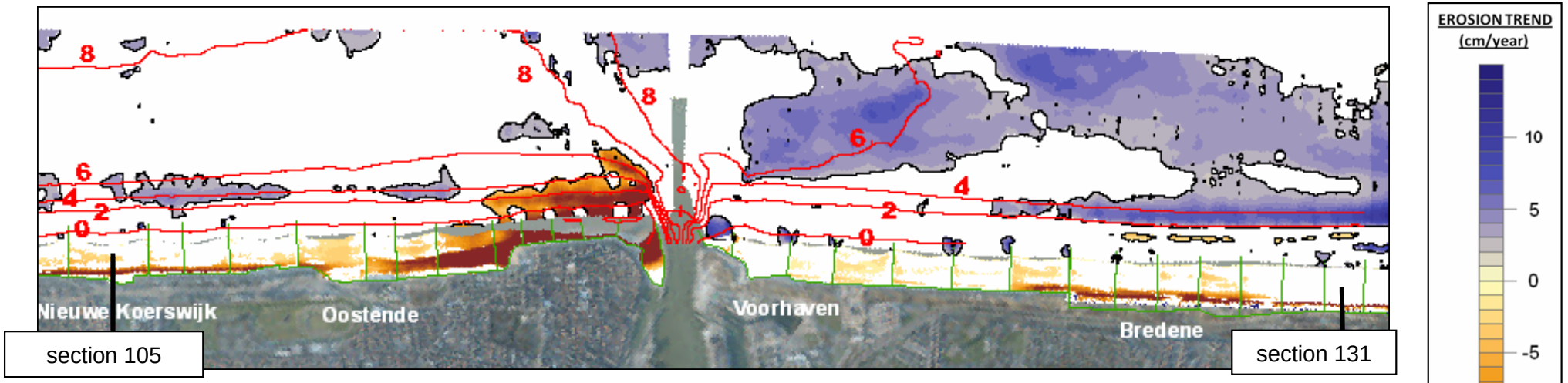
## BEACH

- dike present along entire depicted zone
- strongest “sedimentation” trend due to suppletions (sections 97-99, sections 103 and further)
- but also naturally occuring sedimentation of wet beach
- note: local erosion at the head of the small groynes (scouring)

# morphological trend analysis:
## beach and shoreface: sections 105-131



# morphological trend analysis:
## beach and shoreface: sections 105-131



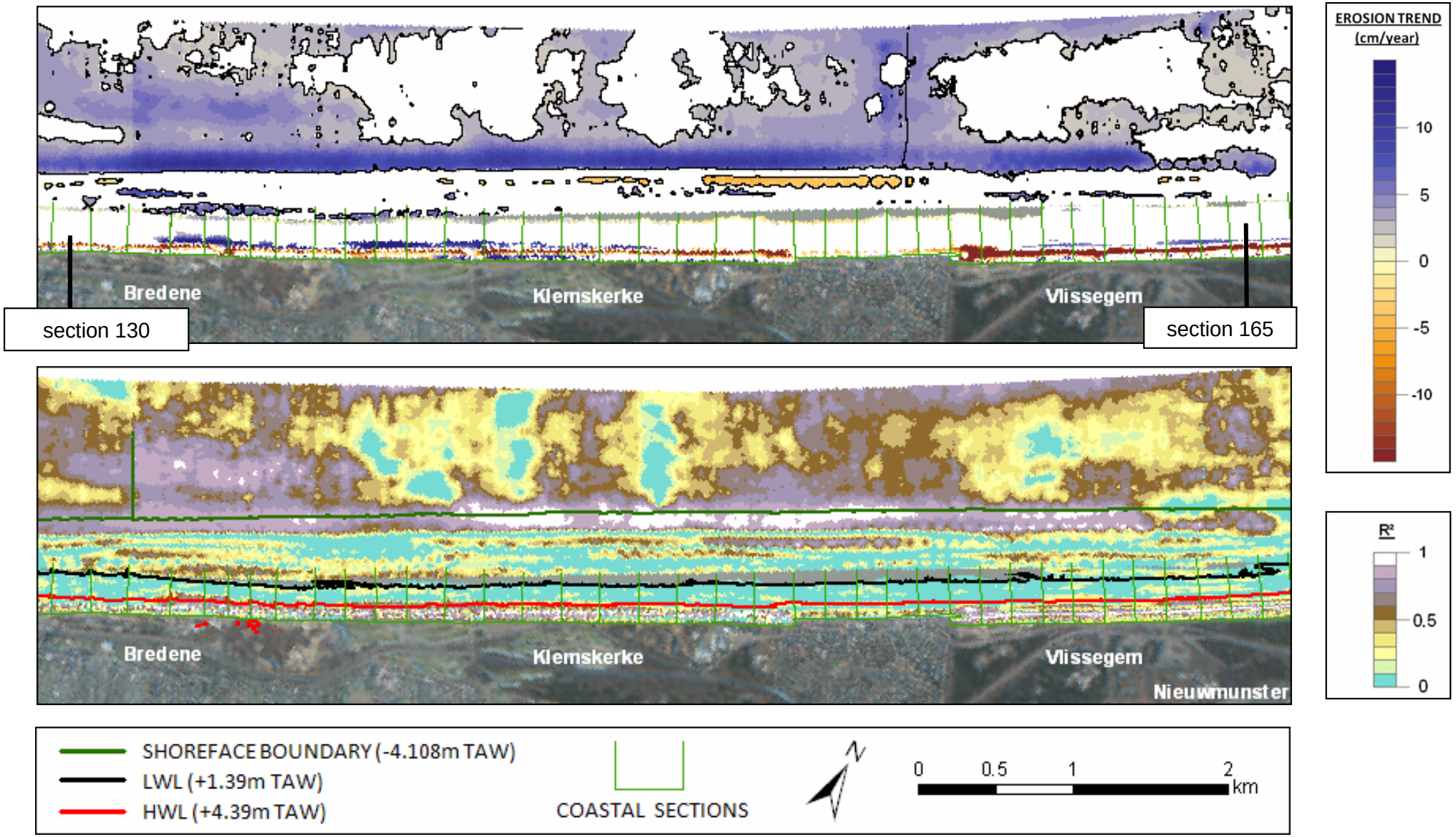

## SHOREFACE

- <u>again:</u> elongated erosion zone between Oostende and Wenduine(see also next slide)
  - → erosion of the foot of the shoreface
  - → but also of the neighbouring seafloor: erosion of “Grote Rede” gully

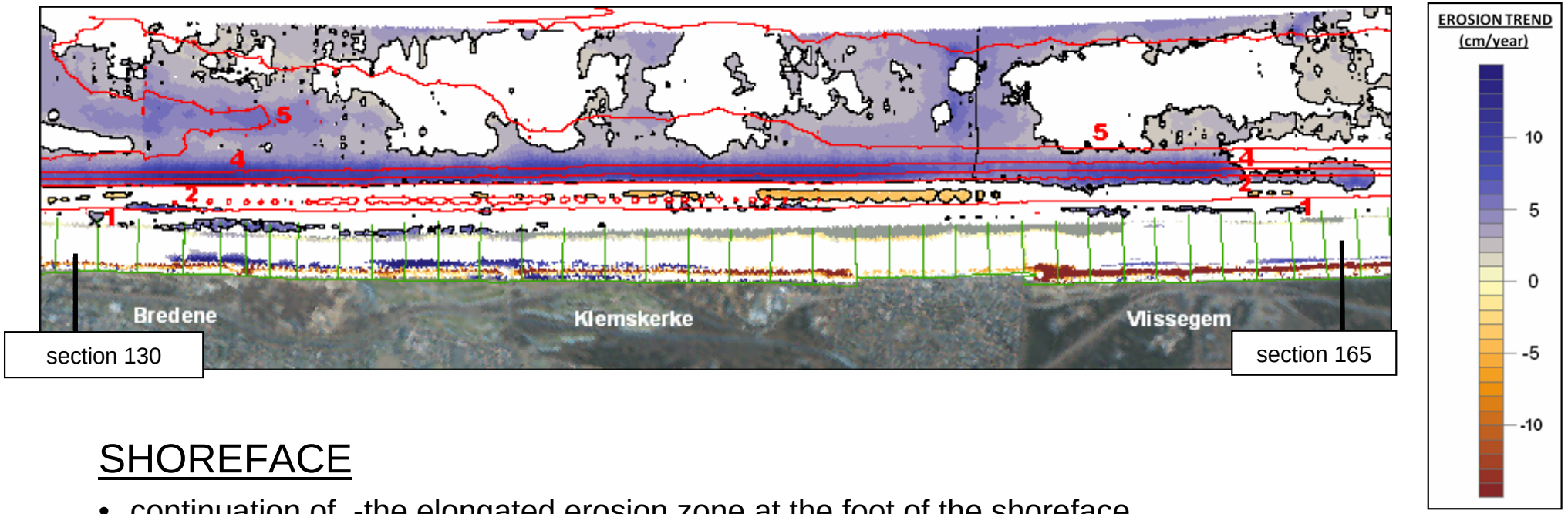
## BEACH

- sections 109-117: “sedimentation” due to large suppletion works in 2004 (noodstrand Oostende, sections 112-117, 460 000m³)
- sections 124-131: sedimentation at the foot of the dunes (west of 124: all dike, no dune)

# morphological trend analysis:
## beach and shoreface: sections 130-165



# morphological trend analysis:
## beach and shoreface: sections 130-165



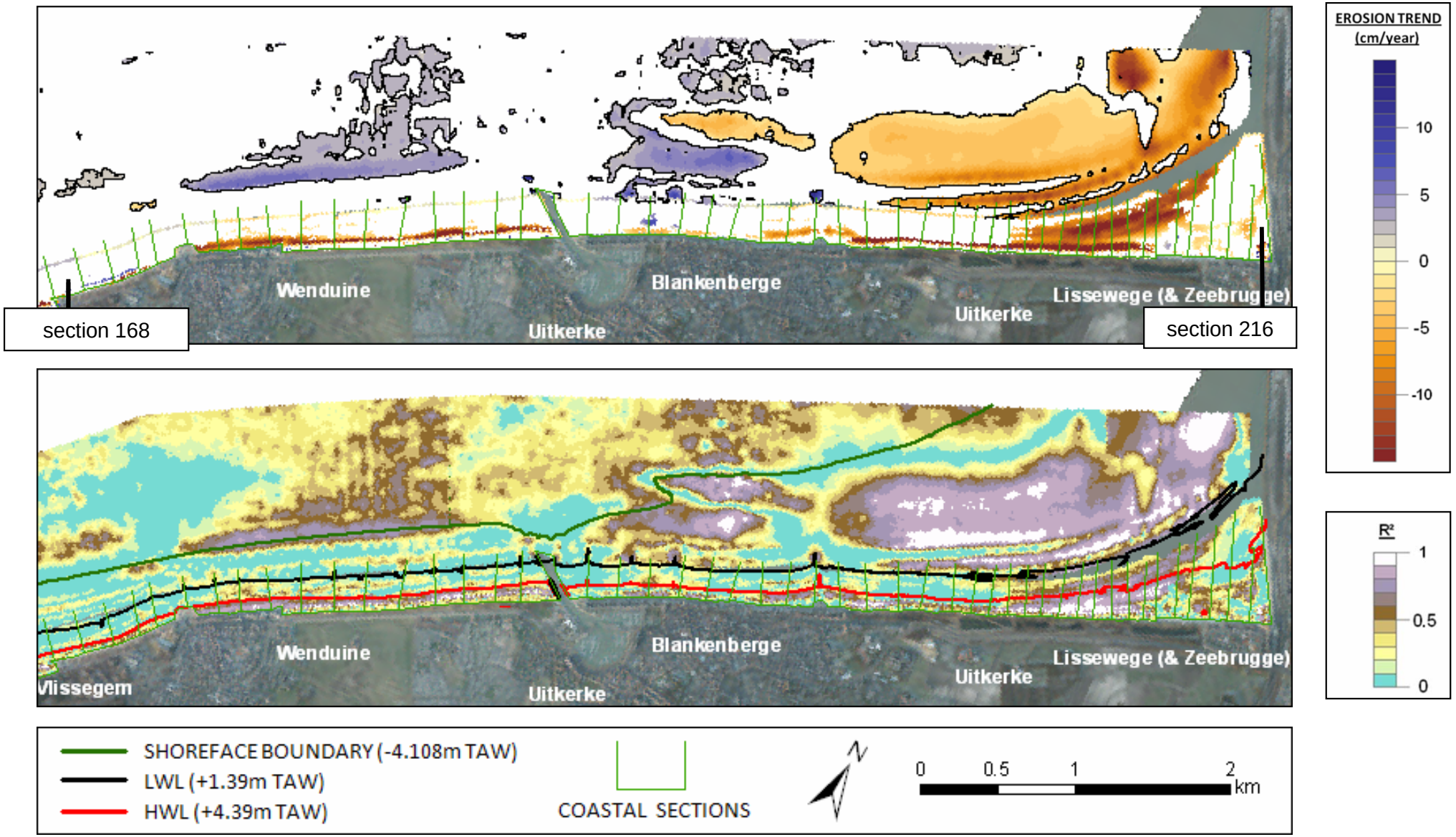

## SHOREFACE

- continuation of -the elongated erosion zone at the foot of the shoreface
  -erosion of the “Grote Rede” gully
- feeder berm: from 1991, 800 000m³ below low water line, along sections 132-169

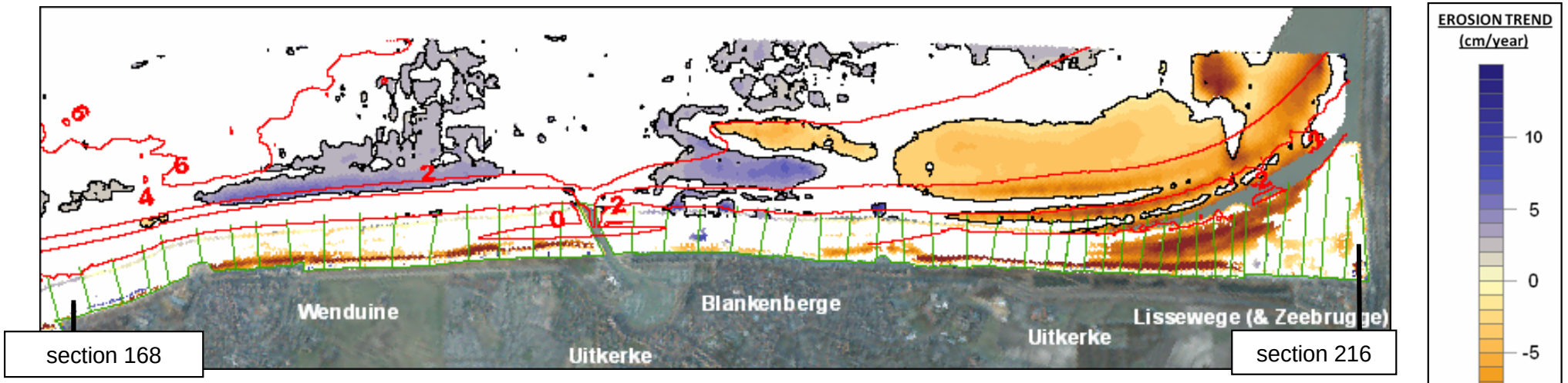
## BEACH

- if dunes are present (130-150 en 156-165): sedimentation at the foot of the dunes
- also strong sedimentation trends where artificial hedges are present
- sections 133-146: wet beach with erosive characteristics

# morphological trend analysis:
## beach and shoreface: sections 168-216



# morphological trend analysis:
## beach and shoreface: sections 168-216



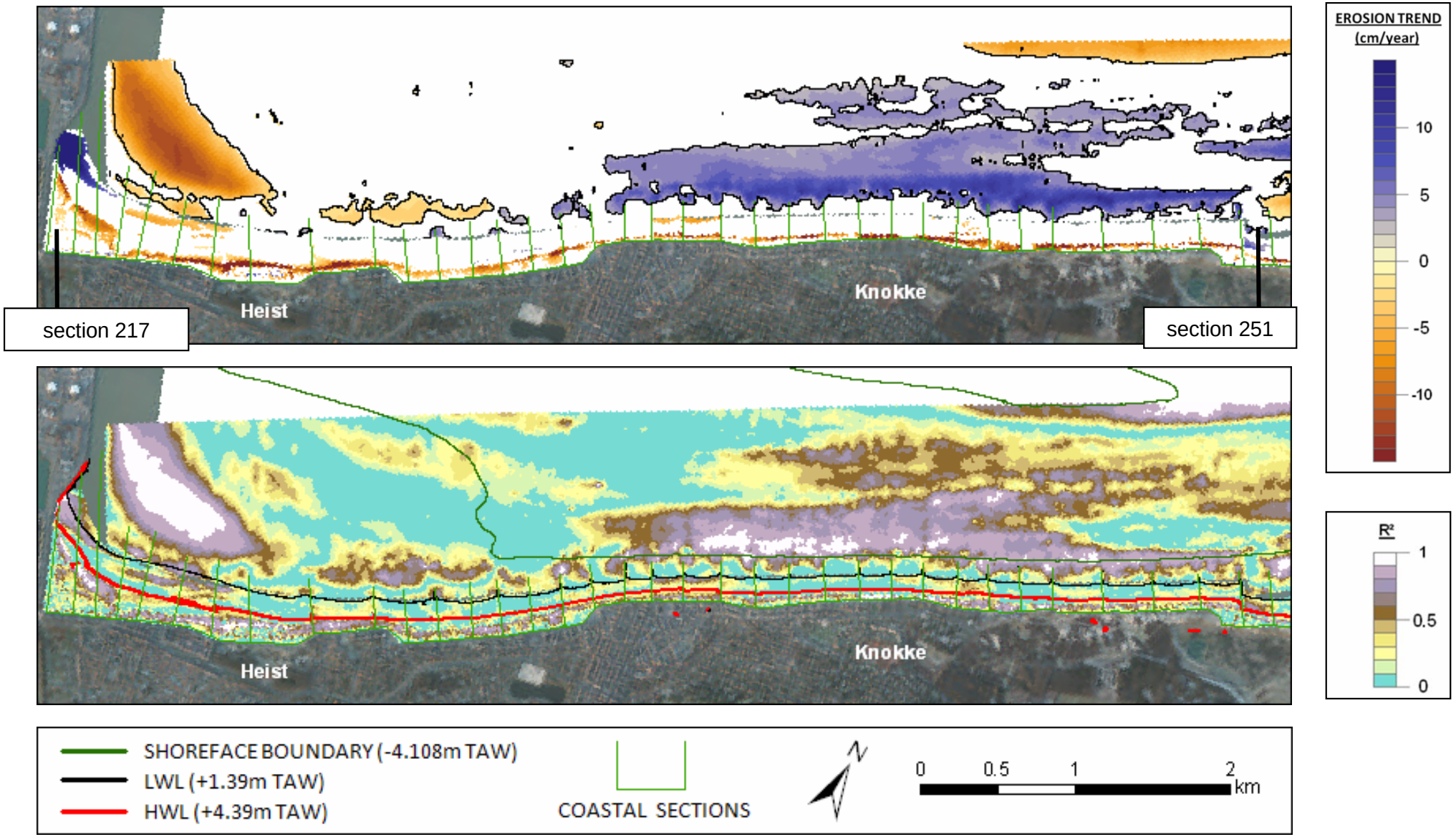

## SHOREFACE

- strong sedimentation trend west of western Zeebrugge breakwater (blocking of litoral drift)
- erosion at the foot of the shoreface
  but locally interupted by Blankenberge harbour

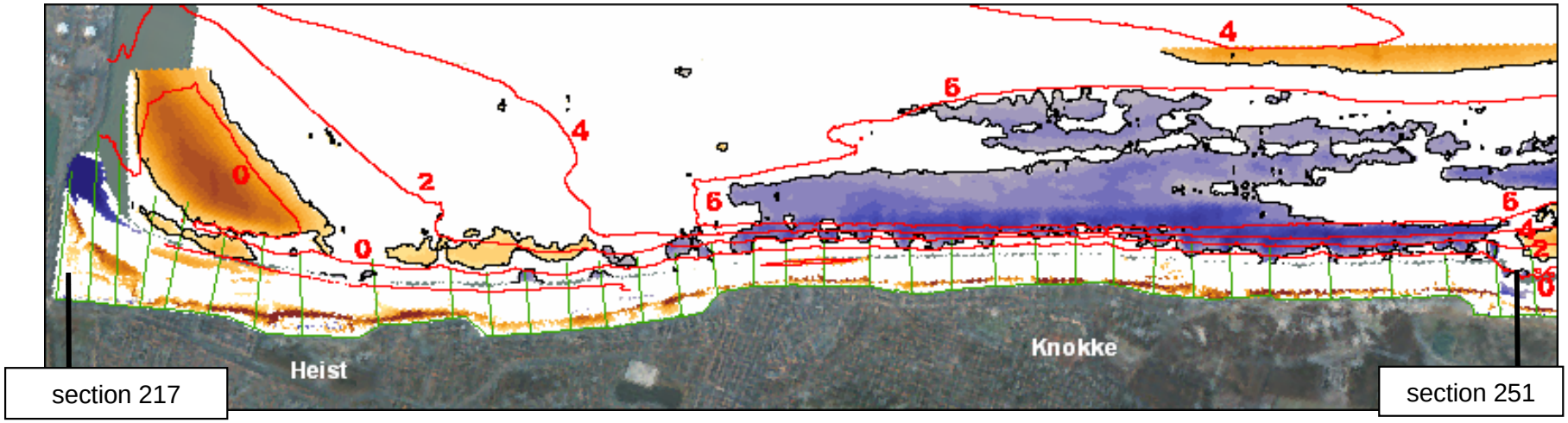
## BEACH

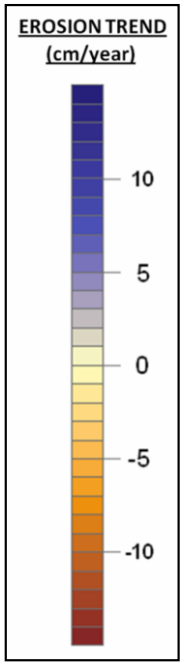
- sedimentation at the foot of the dunes

# morphological trend analysis:
## beach and shoreface: sections 217-251



# morphological trend analysis:
## beach and shoreface: sections 217-251




## SHOREFACE

- sedimentation east of the eastern Zeebrugge breakwater
  → further growth of sand bank in the Bay of Heist
- erosion of the “Appelzak” gully (Westerschelde ebb gully)

## BEACH

- sedimentation dry beach / dune foot

# morphological trend analysis:
## beach and shoreface: conclusions

- shoreface has erosive behavior

  erosion situated in transition zone between shoreface and seafloor

  → narrowing of the shoreface?

  → steepening of the shoreface?

- almost no significant trends on wet beach

  (! evolution disturbed by human interaction: suppletions,…)

- dry beach (at foot of dike or at foot of dune) exhibits often sedimentation
  note: vegetation (“rijshouthagen”) appear very effective sand traps

- large scale infrastructure works have great influence on morphological evolution

  → sedimentation near Zeebrugge breakwaters

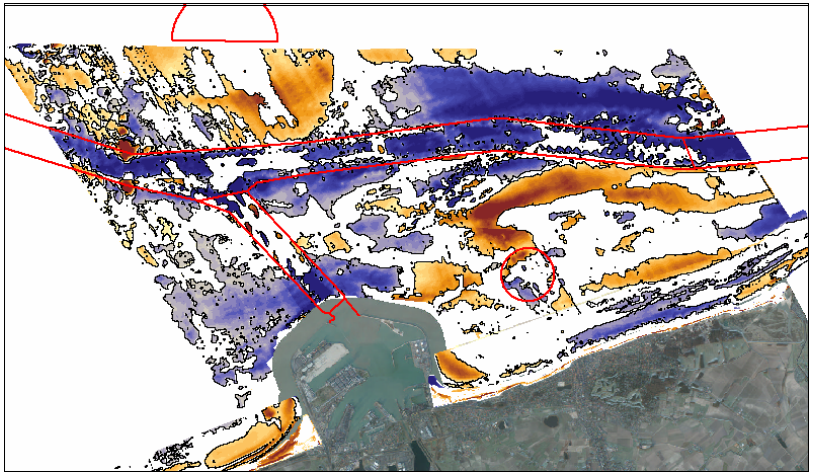
  → sedimentatie around Koksijde groynes


Thank you for your attention!
photo: BMM - KBIN

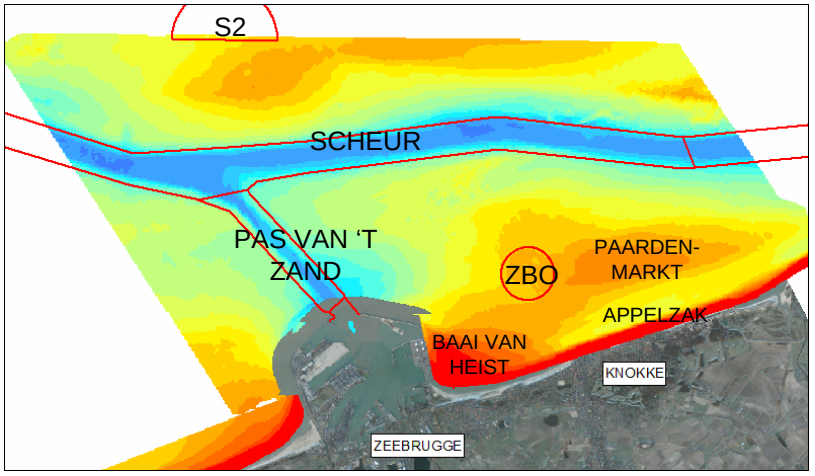
# morfologische evolutie

## kustnabije zone: Wielingen-Scheur

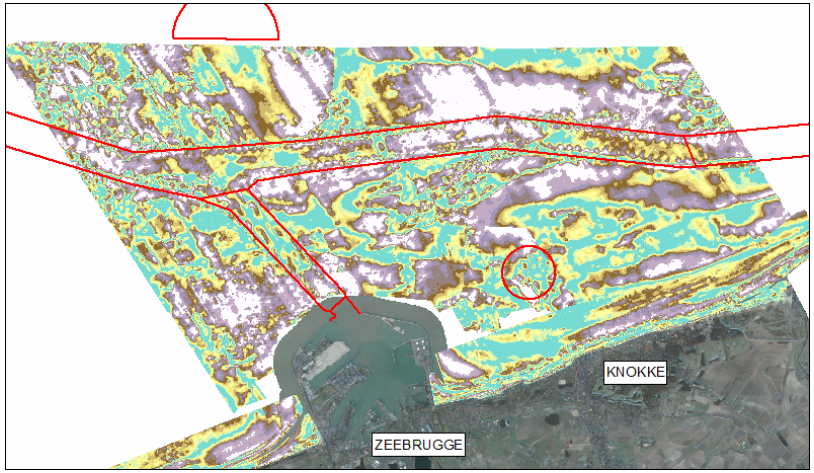
### EROSIETREND

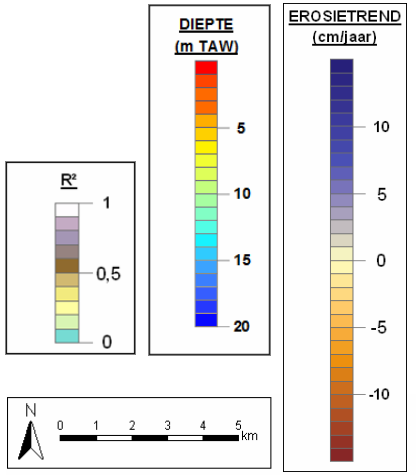


### BATHYMETRIE




### $R^2$

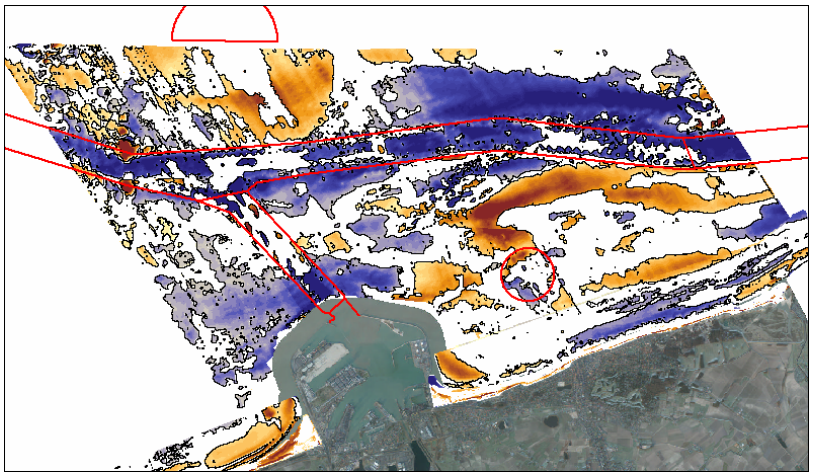


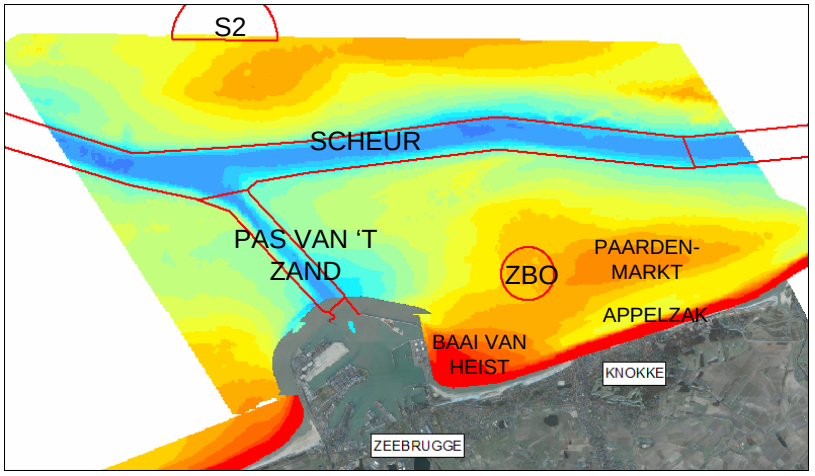
# morfologische evolutie

## kustnabije zone: Wielingen-Scheur

### SIGNIFICANTE EROSIETREND

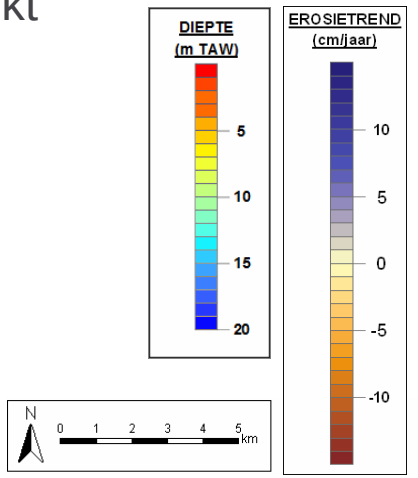


### BATHYMETRIE




- verdere sedimentatie van (kustwaartse zijde van) Paardenmarkt
- erosie aan haveningang Zeebrugge (contractie stroomlijnen)
- eroderende invloed van vaargeul op omgeving
- Maar wel sterke sedimentatietrend in gebied noordoosten haven van Zeebrugge

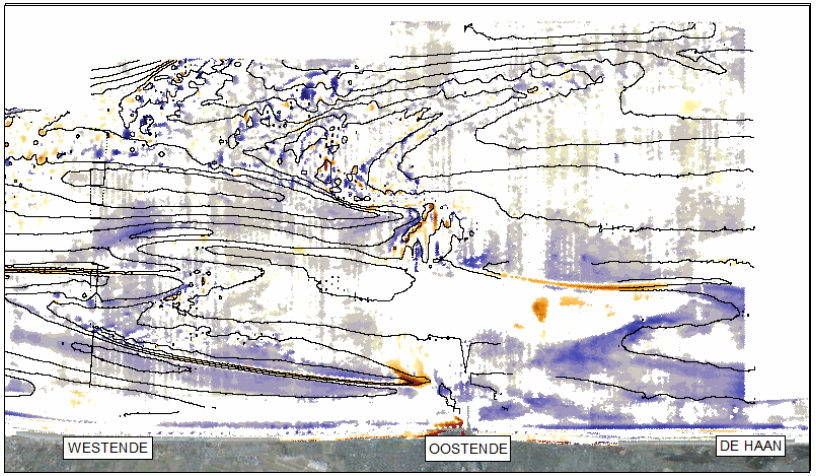
NB: beperkte tijdreeks van dieptegegevens!



# morfologische evolutie

## kustnabije zone: Westende-De Haan

### EROSIETREND

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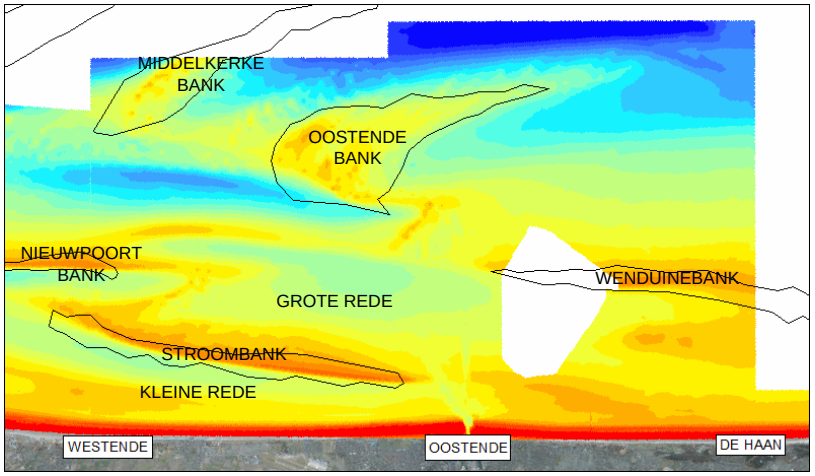


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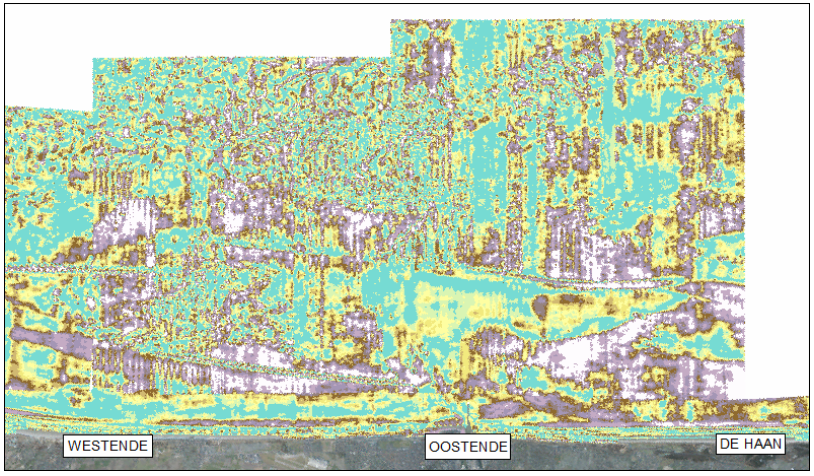


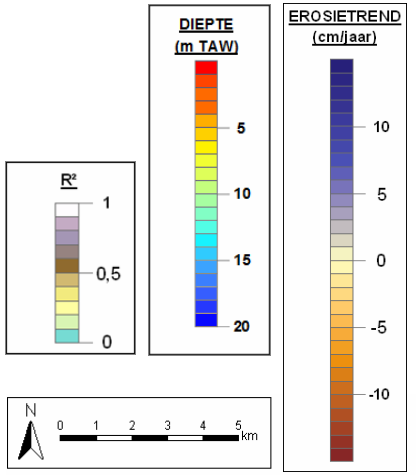

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## kustnabije zone: Westende-De Haan

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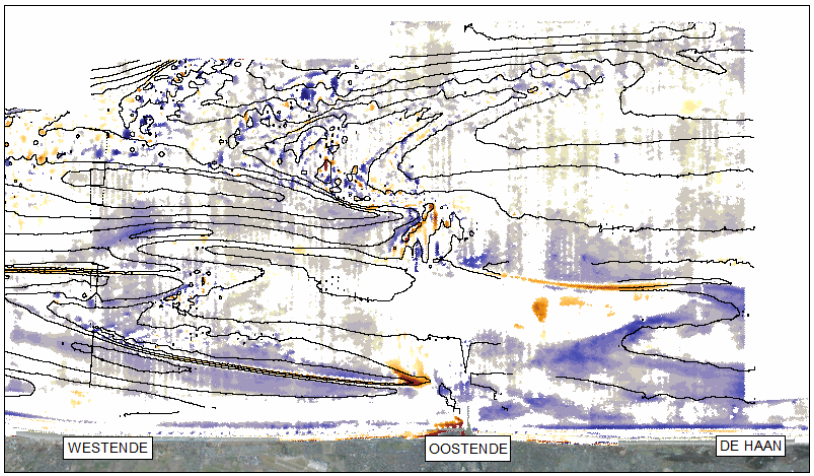


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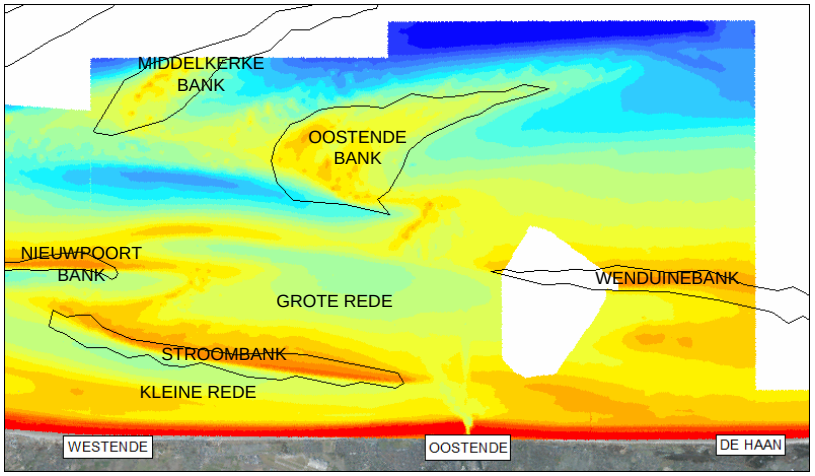
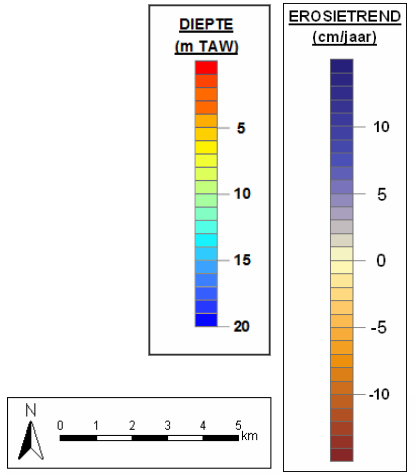



- overwegend erosietrends
- enkele sedimentatietrends op kruinen van enkele banken (Stroombank, Wenduinebank, Nieuwpoortbank)
- erosietrends voornamelijk in geulen: Kleine Rede, oostelijk deel Grote Rede

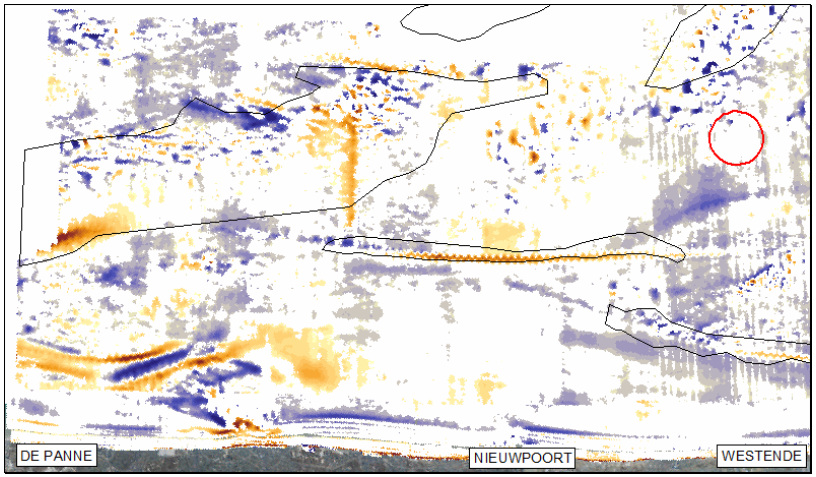
NB: beperkte tijdreeks van dieptegegevens!



# morfologische evolutie

## kustnabije zone: Zuydcoote-Westende

### EROSIETREND

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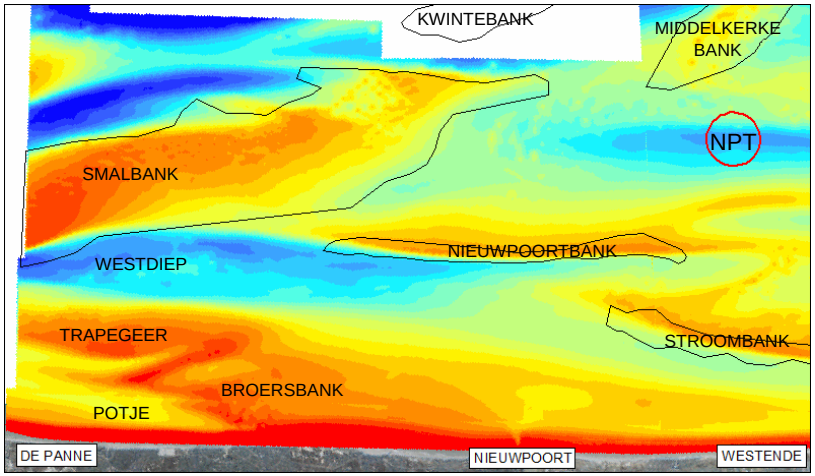


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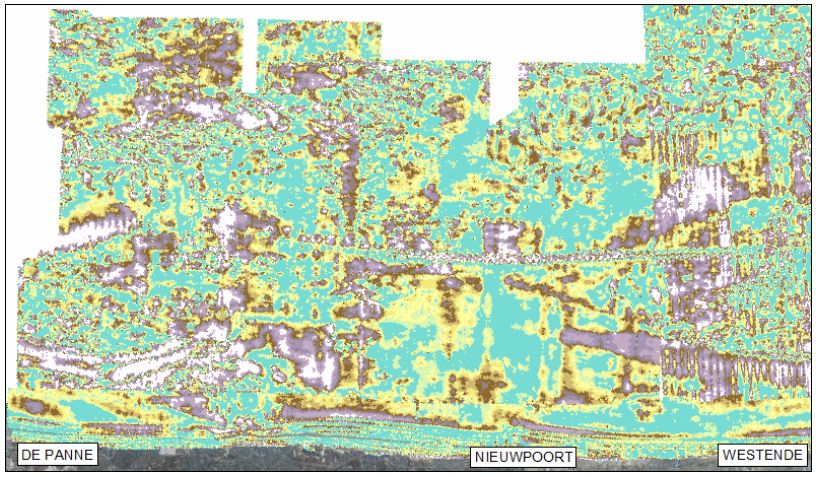


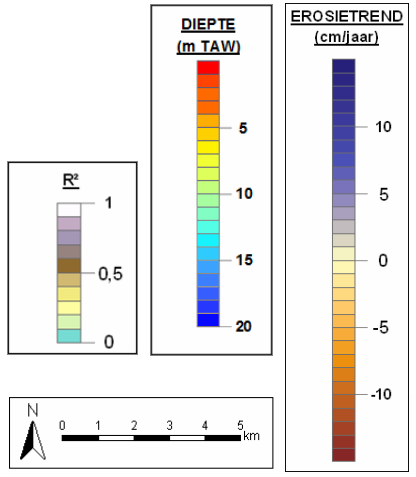

# morfologische evolutie

## kustnabije zone: Zuydcoote-Westende

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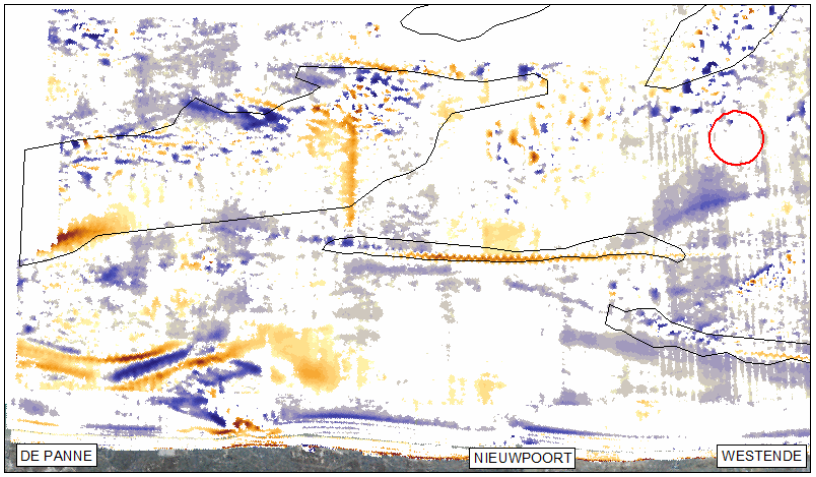


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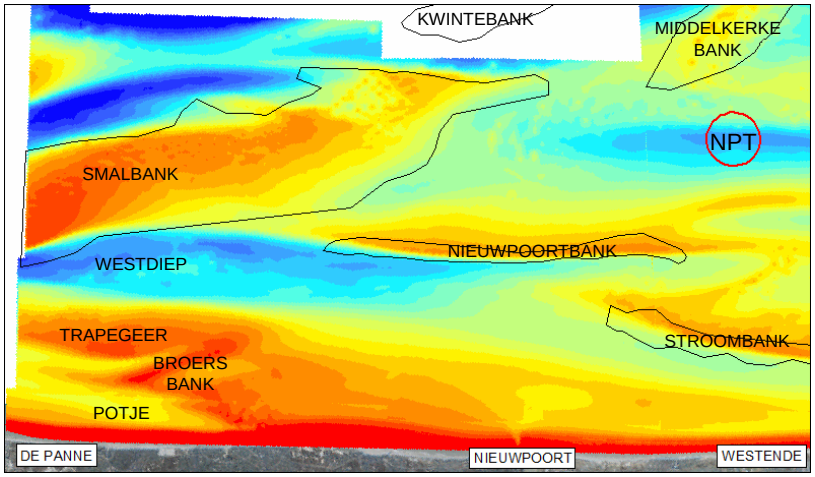


- weinig significante trends
- sedimentatietrend op kruin Nieuwpoortbank
- meest dynamische zone rond Potje / Trapegeer / Broersbank:
  sedimentatie geul zuiden van Trapegeer
  erosie Broersbank / verplaatsen Broersbank ?

NB: beperkte tijdreeks van dieptegegevens!