

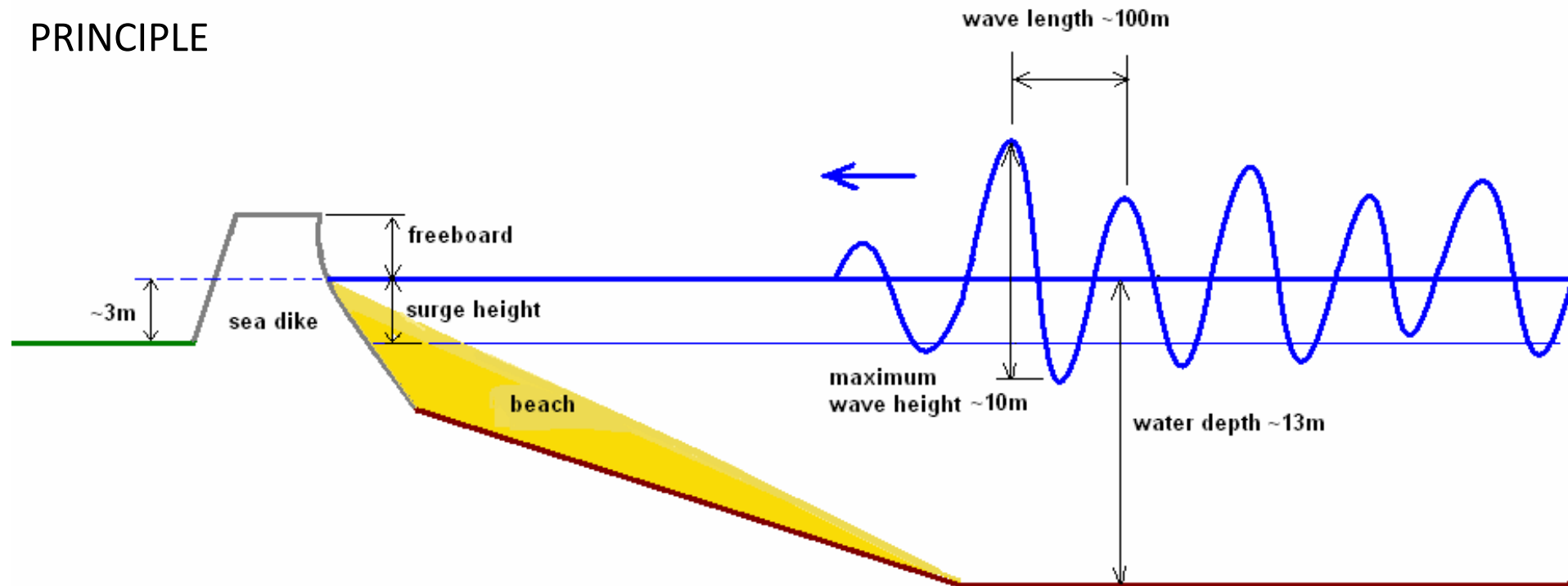
# Sand dynamics on beaches and shorefaces

*T. Verwaest, R. Delgado, J. Janssens and J. Reyns*

# Point of view of coastal protection

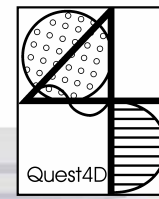
## 1) Protection against superstorms

### PRINCIPLE



### PRACTICE

Masterplan Kustveiligheid:  $\pm 1$  million m<sup>3</sup> / year (2010...2015...)



# Point of view of coastal protection

## 2) Protection against structural erosion

### PRINCIPLE

- Hold the line
- Seaward development
- Managed retreat

### PRACTICE

- NL, DK, Sylt (D),...: hold the line
- UK (local cliff erosion): managed retreat (locally)
- B: hold the line => seaward development ? => Vlaamse Baaien study

# Complexity

Natural sand dynamics and coastal morphology

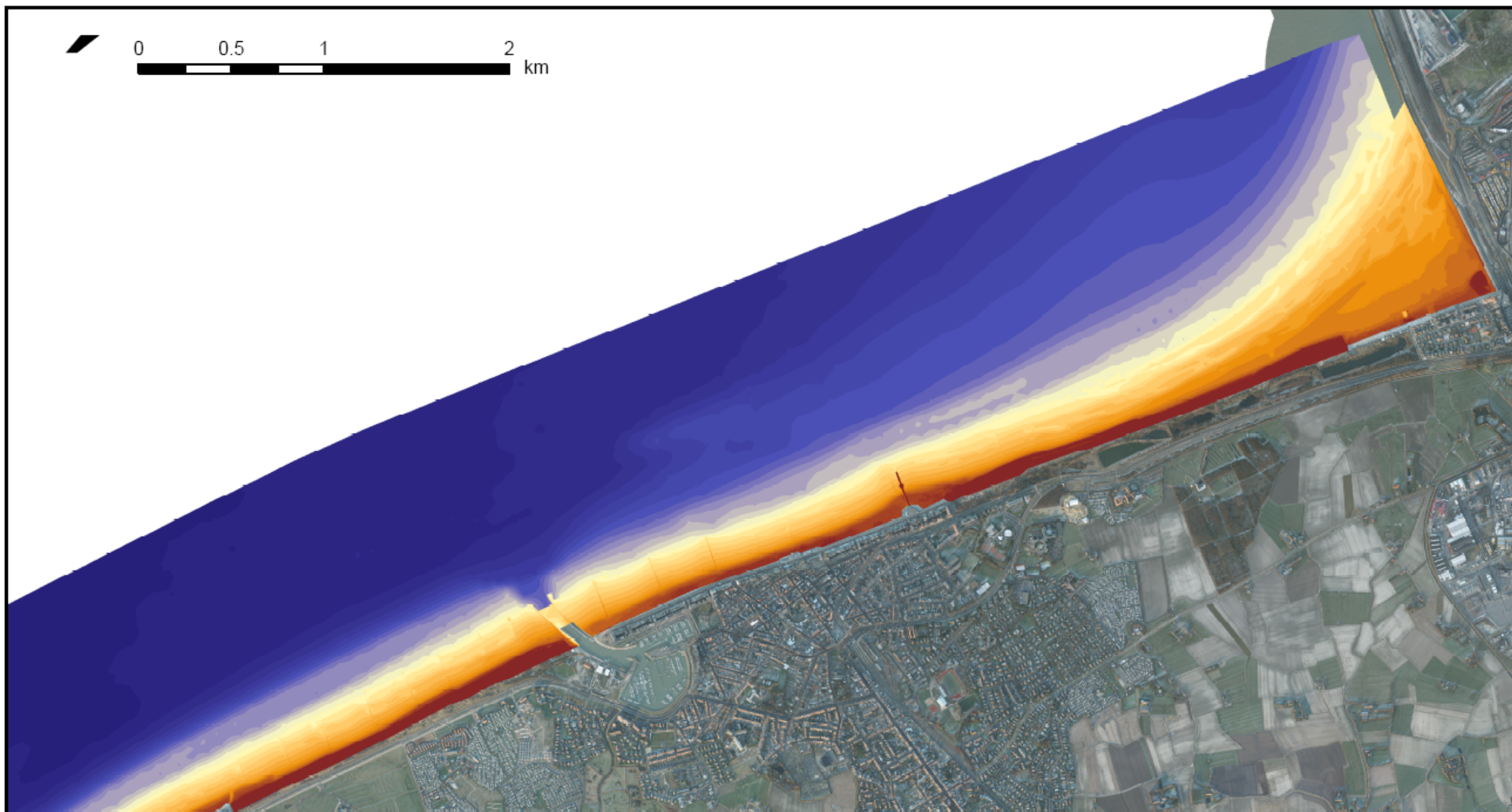
- Drivers: waves, tides, grain size distribution, human activities (infrastructure works, dredging, nourishments)
- Spatial scale: kilometers, dunes-beaches-shorefaces-gullies-sandbanks
- Time scales: years, decades, storm effects

⇒ present insight in coastal sand balans is limited

⇒ current models have limited predictive capacities

⇒ large needs for integrated research combining modeling with most importantly in-situ measurements / monitoring

Example of longshore sand transport in breaker zone (littoral drift)

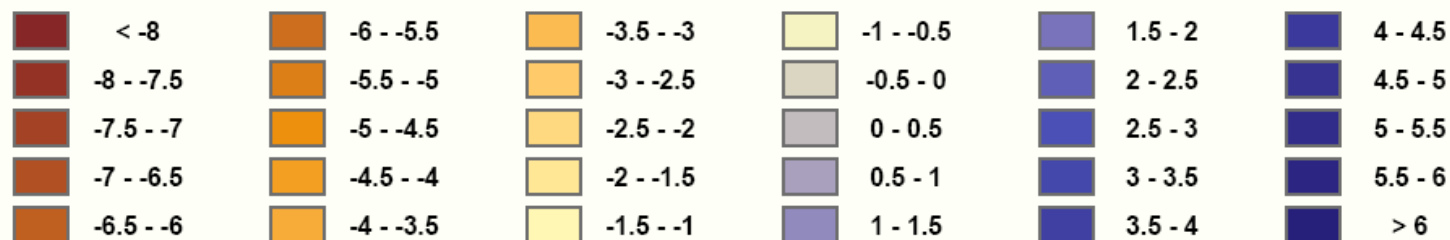


topography/bathymetrie

beach - shoreface

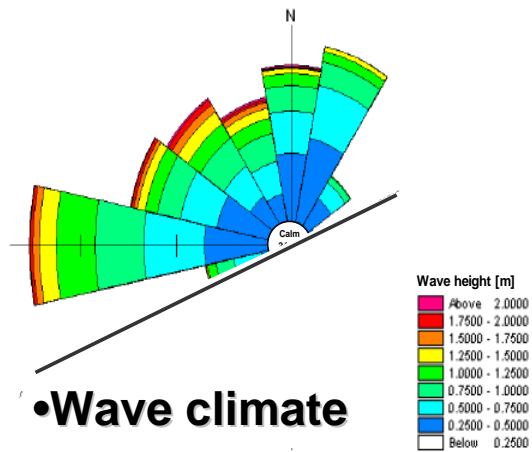
Blankenberge - Zeebrugge

Legend (depths are positive and in meter)

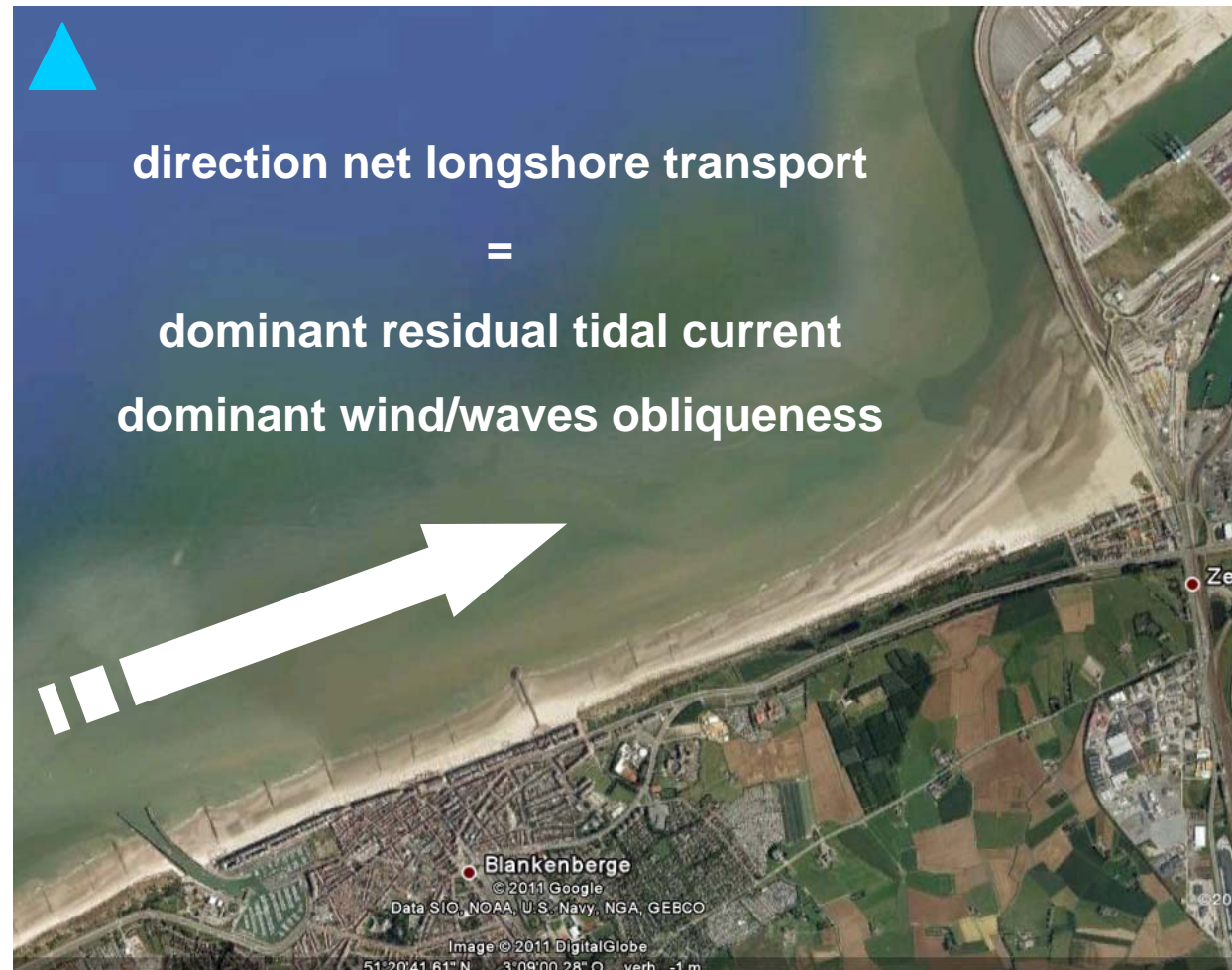


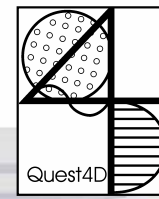


## The problem



•Tidal range ~4 m

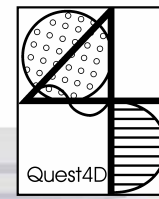





## The problem

**How to make a first estimation of the net longshore sand transport if....**

- No direct measurements available.
- Poor performance of available models.



## Methodology and tools

Complex problem  start with simple tools:

- GIS based morphological trend analysis.
- 1D Numerical modelling.



# Morphological trends analysis

**Tool:** ArcGIS

± 15 year topo-bathymetric data (1995-2010)

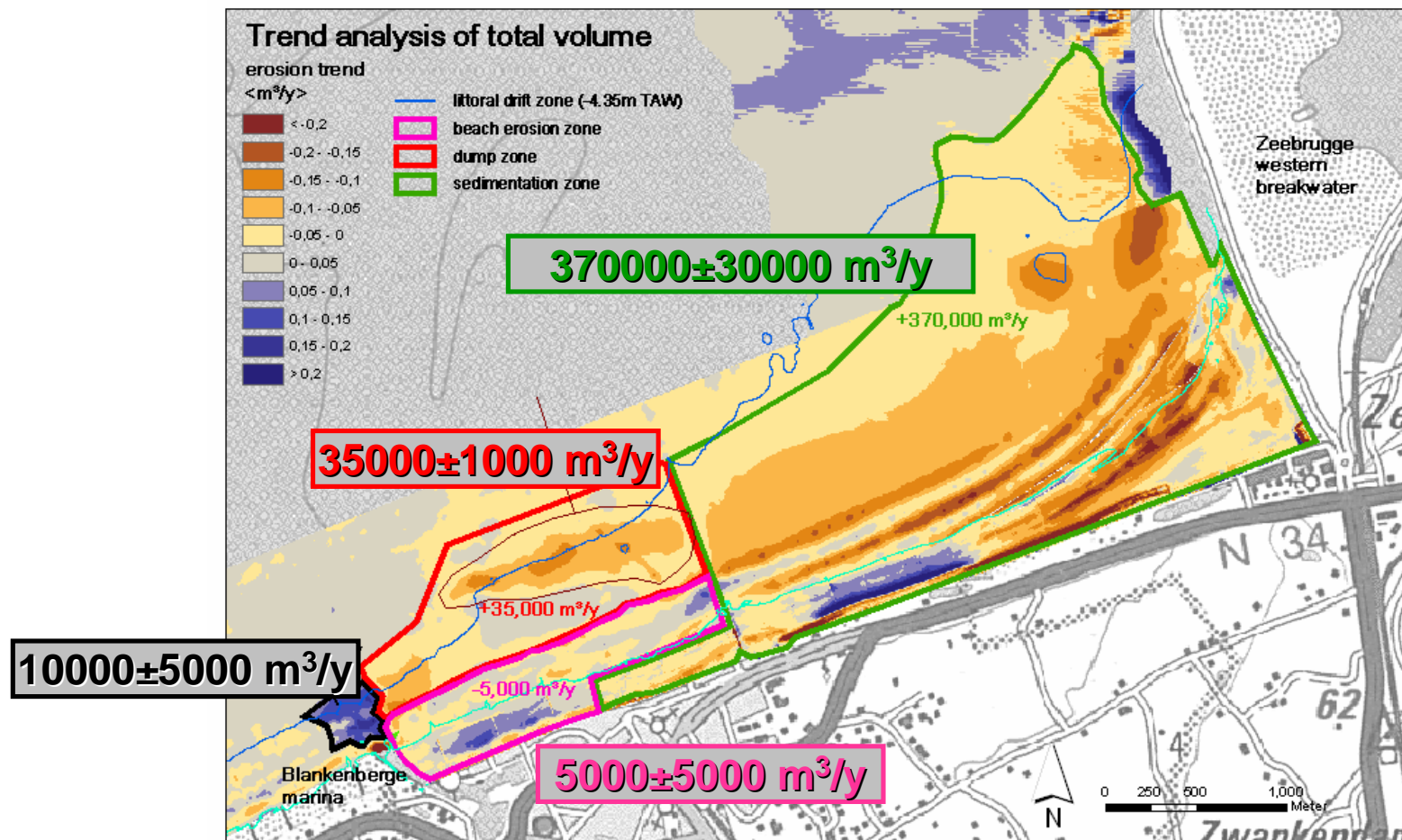
- Datasets completed by inventory of dredging, disposal and nourishment activities in the study area.

**Goals:**

- Identification of clear erosion and accretion zones.
- First estimation of net rates in the area.

# Results of the trends analysis

Net longshore transport estimation  **$400000 \pm 35000 \text{ m}^3/\text{y}$**

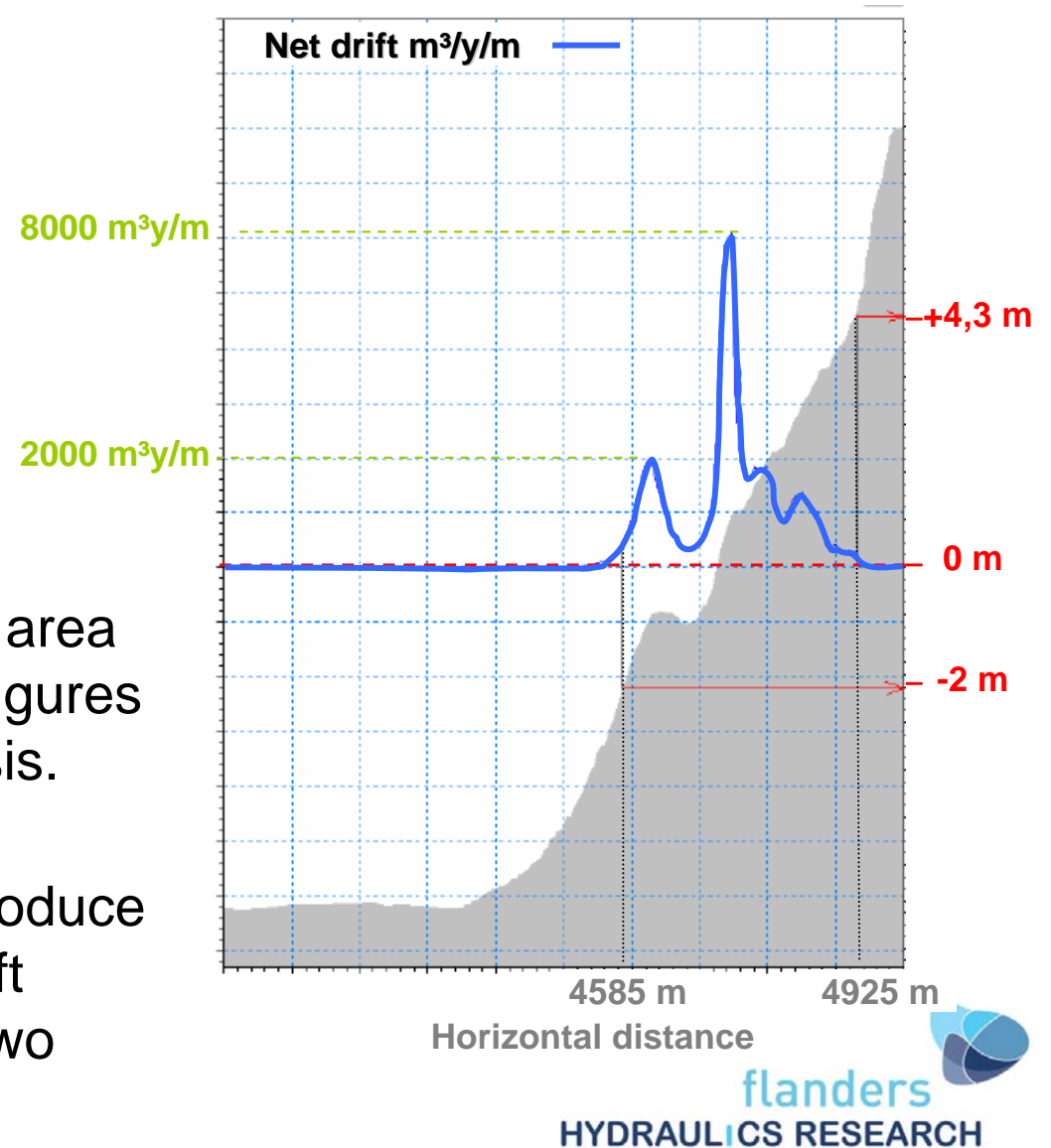


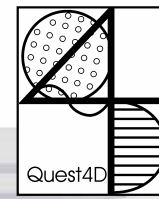
# Numerical modelling

**Tool:** LITPACK – LITDRIFT

**Goals:**

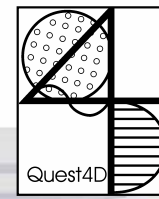
- Identification of most active area for longshore transport for figures obtained in the trend analysis.
- Calibrate roughness to reproduce empirical value of littoral drift and separate net rate into two bruto rates NE 3,5 ÷ SW 1





## Lessons learned

- The “taking a very simple first approach to a complex problem” principle helps to learn about how the problem should be tackled.
- It is possible to have an acceptable first estimation of net (longshore) transport based on morphological trends analysis. The method will be useful to compare with results from numerical models.
- It is necessary to further develop combination of different tools and methodologies.
- Estimate of littoral drift for B-coast:
  - NET  $\pm 400.000 \text{ m}^3/\text{year}$  to NE
    - Bruto to NE  $\pm 550.000 \text{ m}^3/\text{year}$
    - Bruto to SW  $\pm 150.000 \text{ m}^3/\text{year}$



## Current and further work

- Improving of numerical modeling tools for beaches and shorefaces sand dynamics / morphology / hydraulics :
  - Use of 2D models accounting for cross-shore as well as long-shore effects.
  - Investigating model abilities to account for the presence of structures (e.g. groins).
  - Calibration/validation with high quality data.
- Improving the trends analysis method:
  - Assess uncertainty on trend results from measurement inaccuracies (topo/bathy).
  - Using more datasets and including more accurate figures about dredging, nourishment etc.
- Intensive in situ measuring and monitoring on beaches and shorefaces
  - smaller scale to better understand processes
  - larger scale to better understand the system