Sand dynamics on beaches and shorefaces

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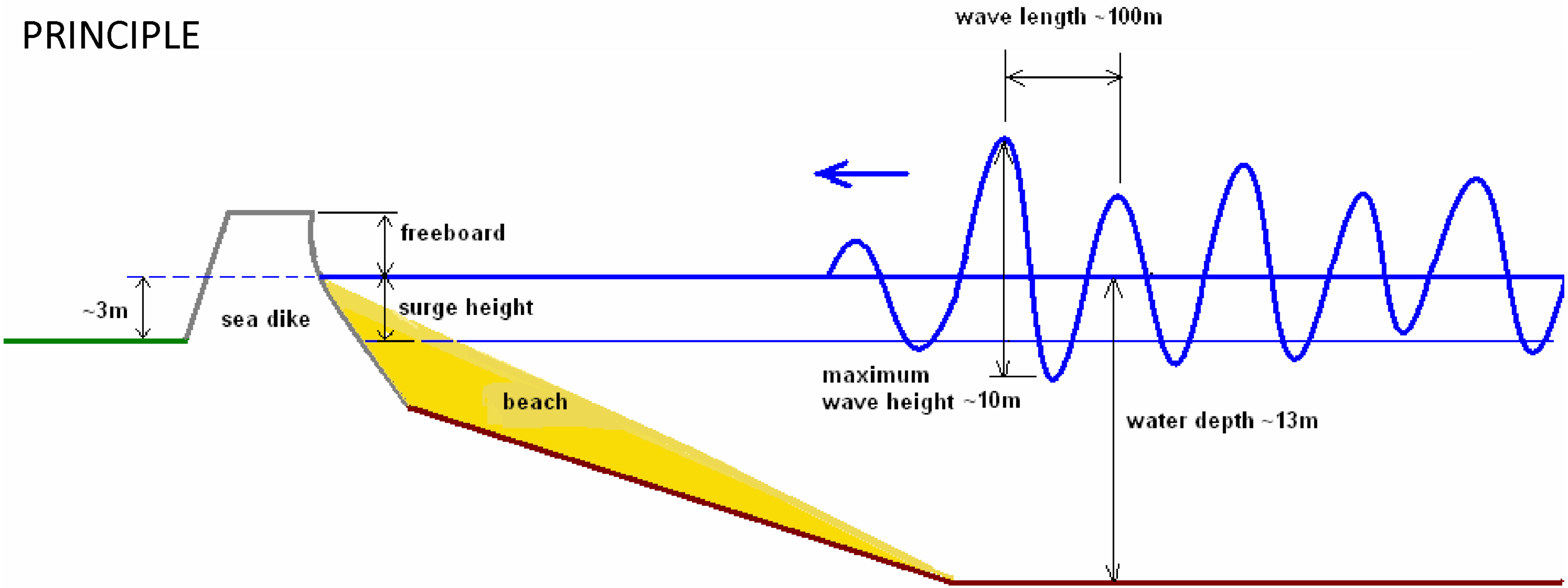
Point of view of coastal protection

1) Protection against superstorms

PRINCIPLE



PRACTICE

Masterplan Kustveiligheid: ±1 million m3 / 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

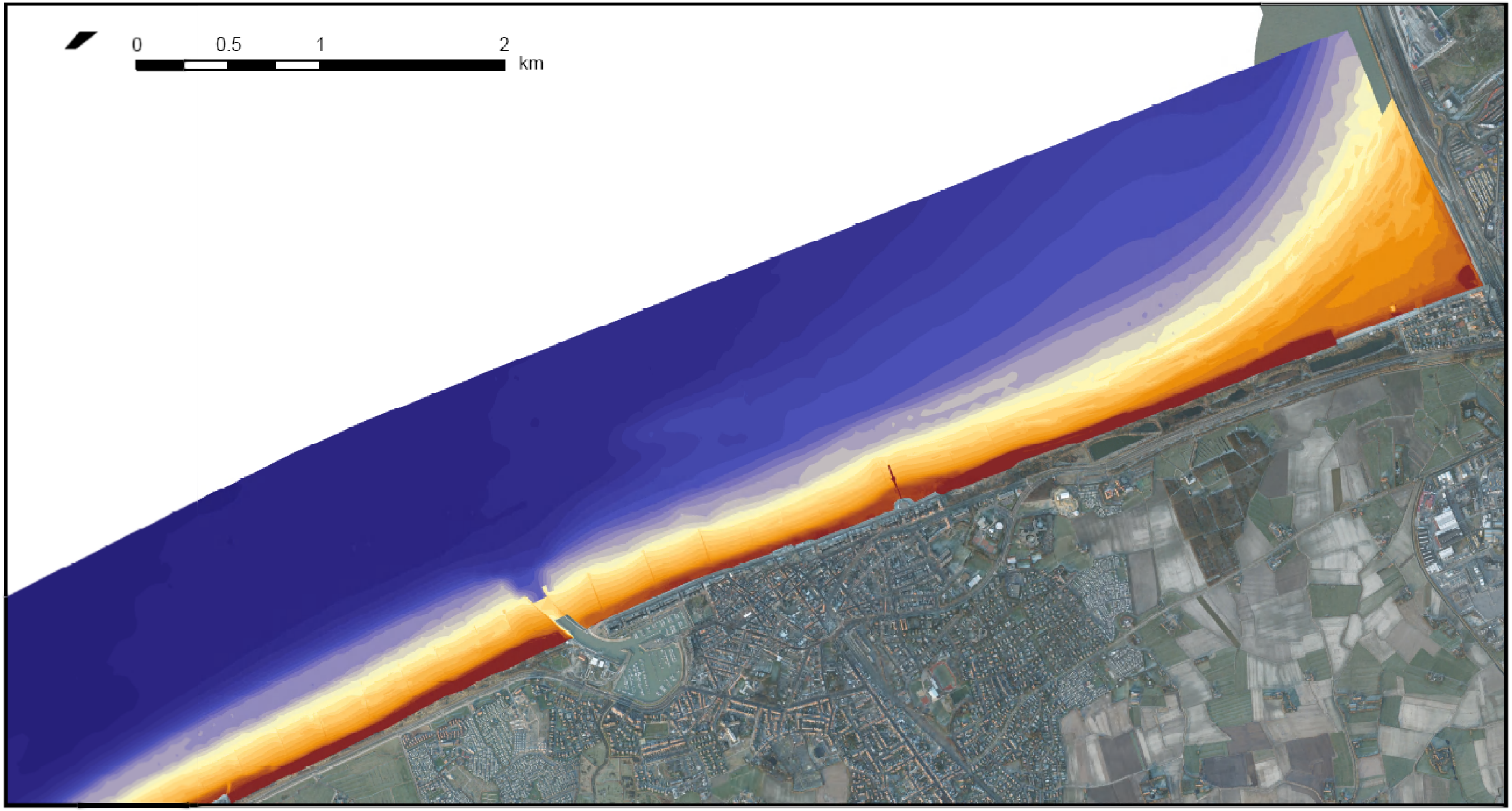
Complexity

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)

< -8	-6 - -5.5	-3.5 - -3	-1 - -0.5	1.5 - 2	4 - 4.5
-8 - -7.5	-5.5 - -5	-3 - -2.5	-0.5 - 0	2 - 2.5	4.5 - 5
-7.5 - -7	-5 - -4.5	-2.5 - -2	0 - 0.5	2.5 - 3	5 - 5.5
-7 - -6.5	-4.5 - -4	-2 - -1.5	0.5 - 1	3 - 3.5	5.5 - 6
-6.5 - -6	-4 - -3.5	-1.5 - -1	1 - 1.5	3.5 - 4	> 6

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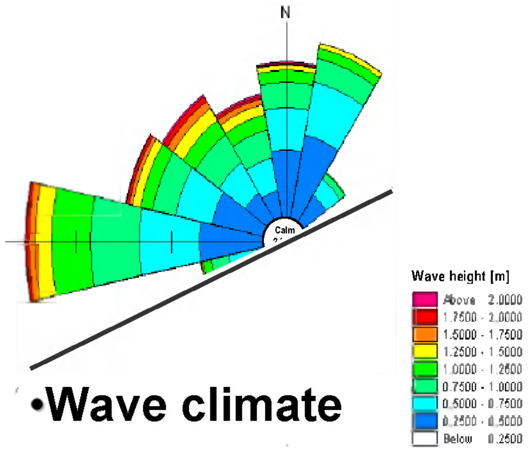
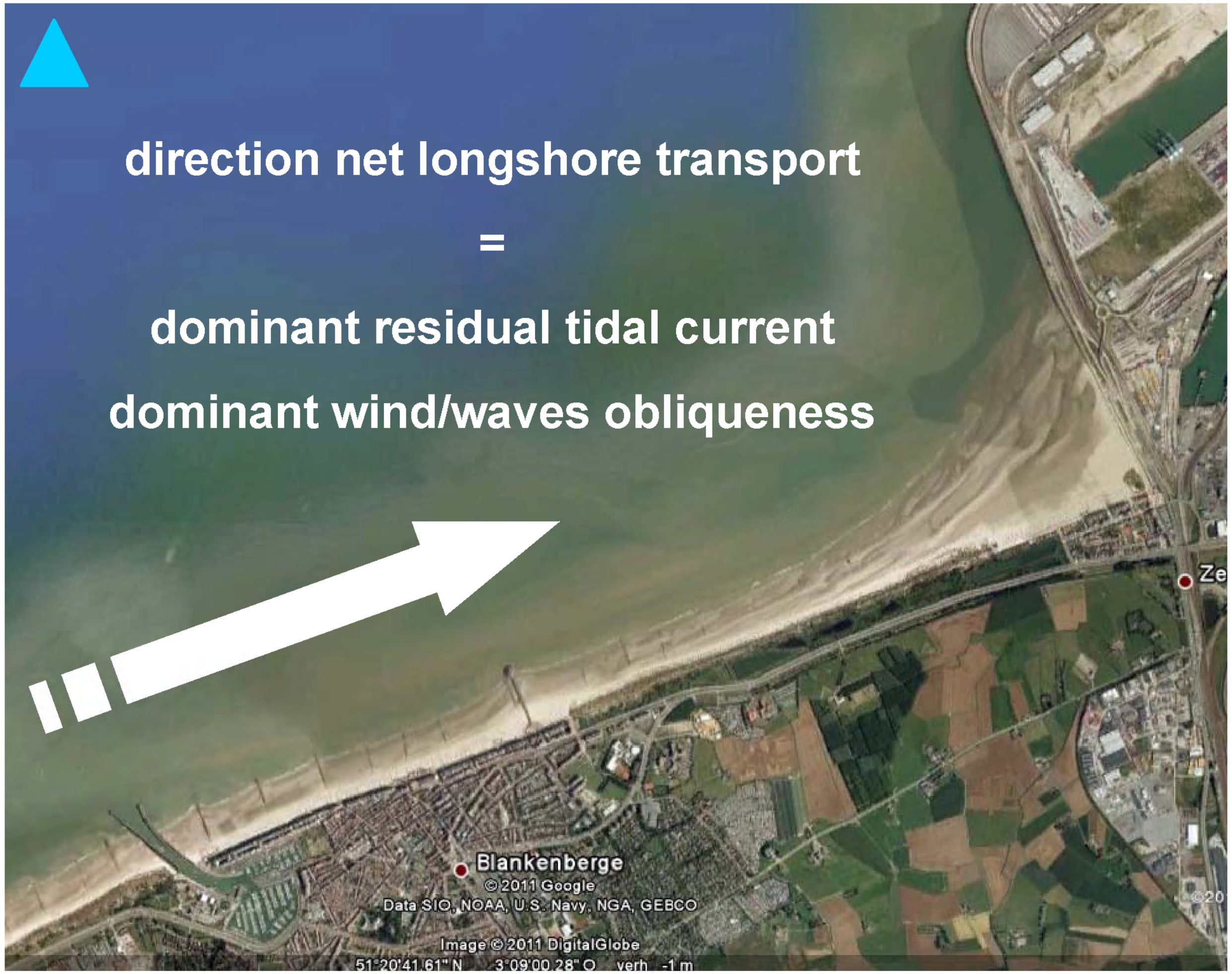
The problem



- **Wave climate**



- **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)

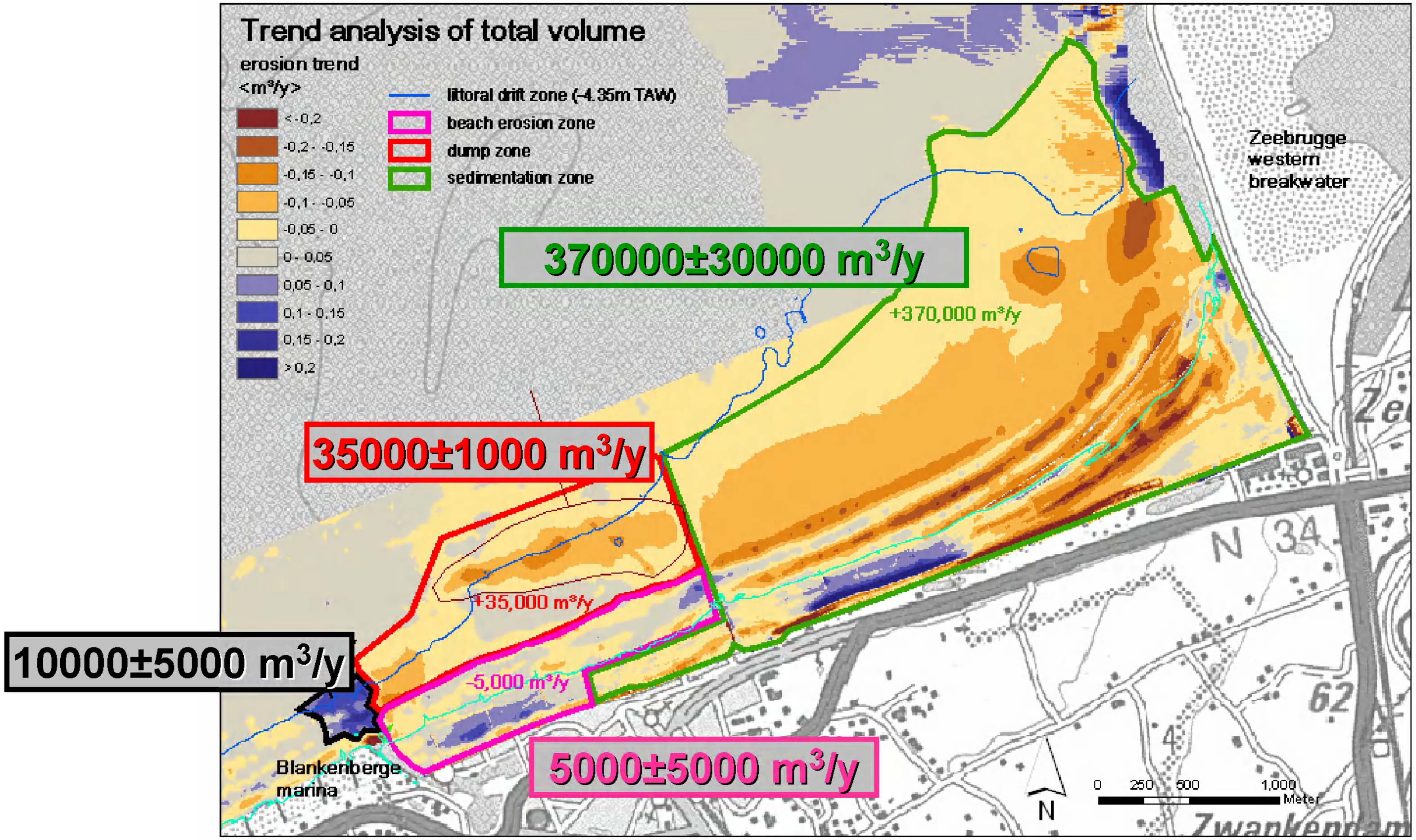
- Datasets completed by inventory of dredging, disposal and nourishment activities in the study area.

Goals:

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

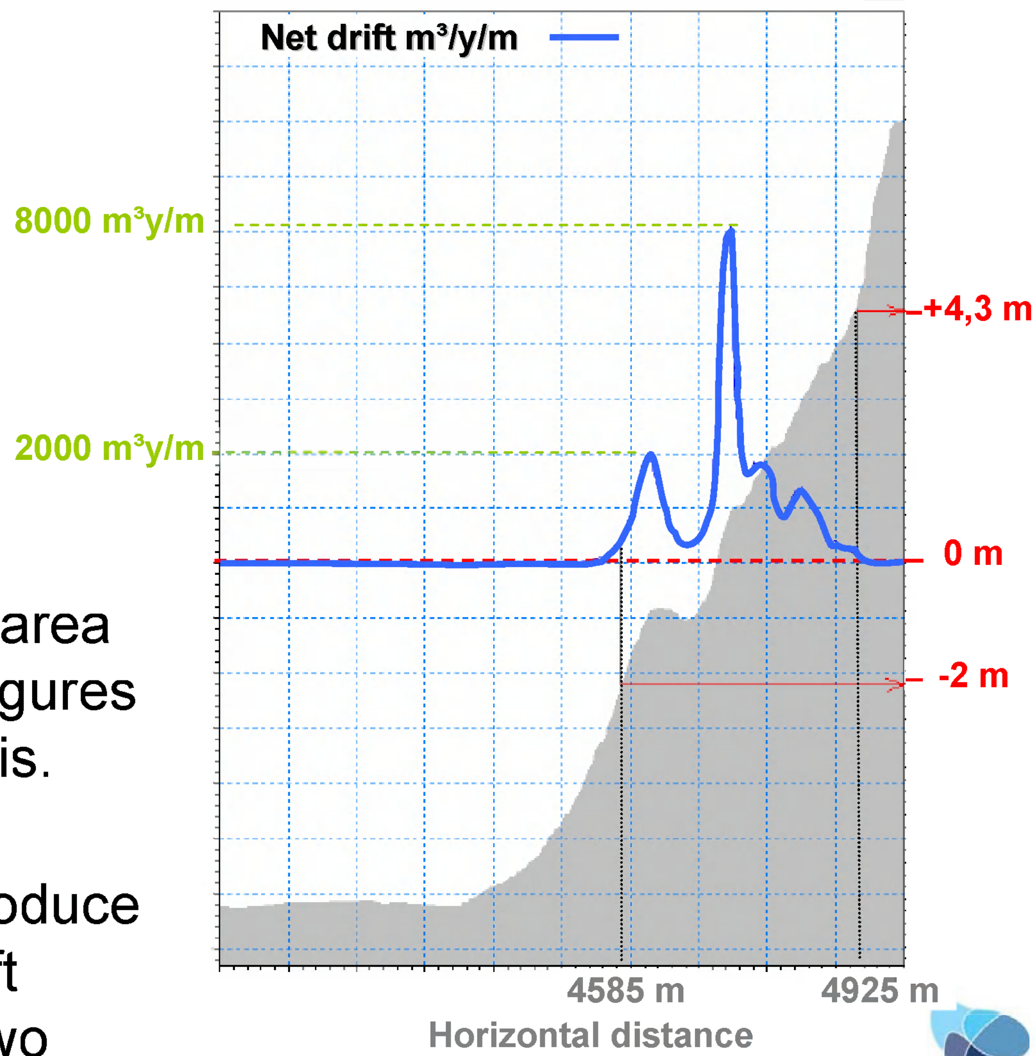
Results of the trends analysis

Net longshore transport estimation 400000±35000 m³/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

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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 +- 400.000 m3/year to NE
    - Bruto to NE +- 550.000 m3/year
    - Bruto to SW +- 150.000 m3/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