GESA
DISTART – PHASE C ACTIVITY

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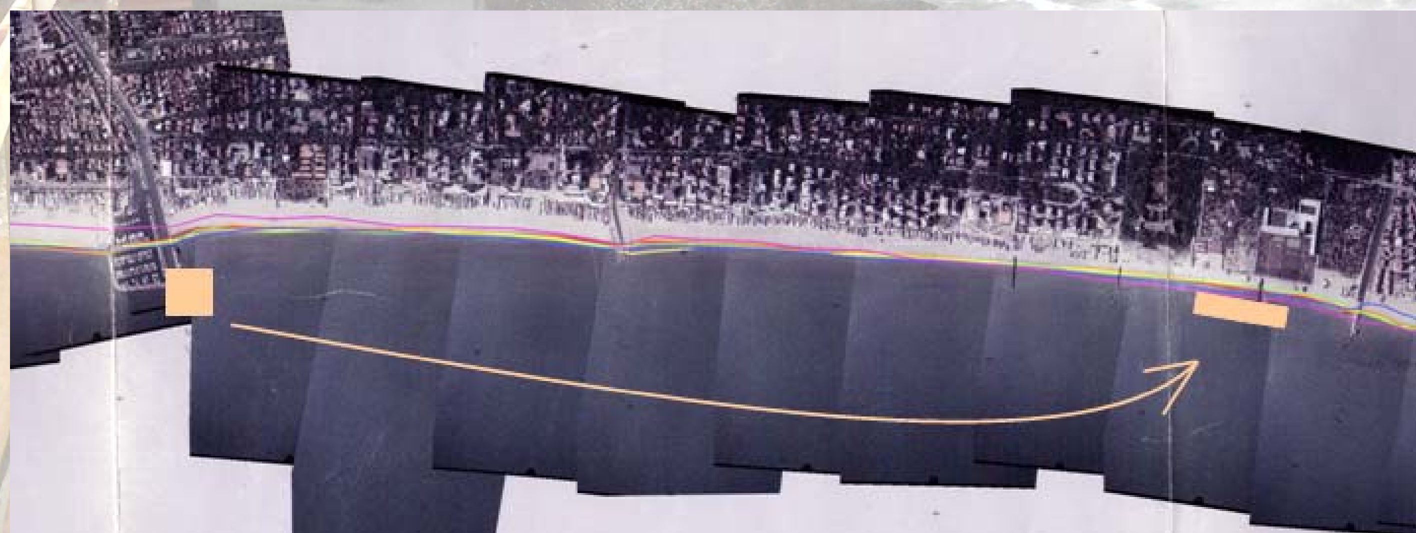
Contents

- Dossier de candidature and current state of advancement of the works.
- Treatment of the dredged sands
- Evaluation of suitability for re-nourishment of sediments present in the port entrance channel
- Numerical simulations under way with ROMS!!
- Information derived from monitoring



Dossier de Candidature

1. L´analyse comparative de toutes les technologies disponibles pour le traitement des sables dragués et, en particulier, celui chimique, physique, biologique et "naturel" (phyto-épuration), aptes pour les conditions environnementales de l’Emilia Romagna.
2. Choix de la meilleure technologie de traitement pour les sables dragués dans le cas d’étude
3. L´évaluation des quantités annuelles de sable à draguer dans les ports et leur caractérisation physique.
4. Établissement de la compatibilité entre la drague et le matériel de plage et de la stabilité de l'alimentation.
5. La simulation du cas de Scheveningen (NL) afin de vérifier la qualité de la modélisation.
6. Évolution de l’intervention de dragage et rechargement à Cervia

Percentage of advancement of activities

1. XXXXXXXXXX 100% (delayed from Phase A. Mainly carried out by subcontractor Envis)
2. XXXXXXXXX-- 80% (Deep research in Phase B, needs final input from granulometric treatment)
3. XXXXXXXXXX 100% (in Phase A)
4. XXXXXXXXXX 100% done
5. XXXXXXXXX-- 90% (delayed from Phase B, finished by 5 Dec)
6. XXXXX---------- 50% (The works were carefully monitored and simulated in phase B still 1 bathymetry missing in the comparisons, needed to complete 5 to complete the modelling)

Sediment and dredged material treatment

Sedimentation is a natural process and represents a fundamental part of ecosystem functioning. Due to human activities during the last decades, sediments have been contaminated, and it's likely that they will be contaminated also for the near future.

It can be assumed that **around 100 and 200 million cubic meters of contaminated sediment** might be produced yearly in Europe.

Dredging and sediment treatment need to be **integrated in the coastal management** and they should not result in unwanted impacts elsewhere or any time in the system

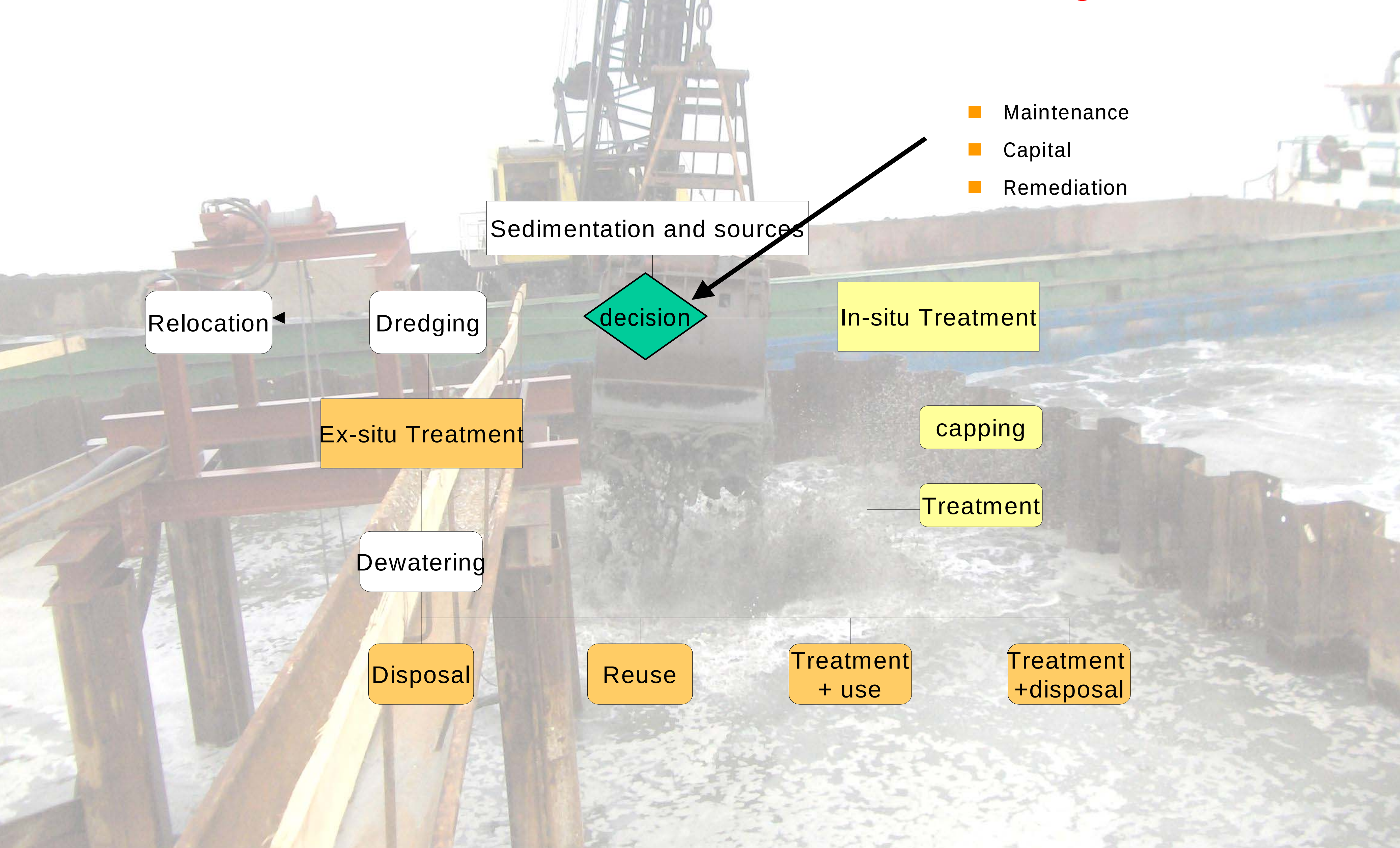
Sediment and dredged material treatment

National legislation and the current developments at the European level (Water Framework Directive, Soil Communication) are likely to have a further impact on dredged material management such as dredging, treatment and/or disposal in national and international catchment areas.

Up to now:

1. fragmented,
2. too strict (see Directive 76/464/EEC);
3. need for pre-normative research based on risk effect more than thresholds.

Treatment as Part of Sediment Management



Treatment and disposal technologies

There are worldwide experiences in handling and treating dredged material and sediment.
In many cases, the experiences of the soil treatment and soil remediation industry as well as mining industry can be useful adapted for the requested tasks.
In general, sediment and/or dredged material treatment technologies can be categorised as described here.

Processing Principle	
1. Relocation	***1. Open water disposal***
	2. Injection dredging
2. Mechanical separation	***1. Classification***
	2. Sorting
3. Dewatering	***1. Evaporation***
	2. Mechanical dewatering
4. Contaminant separation	***1. Chemical extraction***
	2. Thermal desorption
5. Contaminant destruction	***1. Biological reduction***
	2. Chemical oxidation
	3. Thermal oxidation
6. Contaminant immobilisation	***1. Chemical immobilisation***
	2. Thermal immobilisation
7. Disposal	***1. Sub-aquatic confined disposal***
	2. Upland disposal

1 - L´analyse comparative de toutes les technologies disponibles pour le traitement des sables.

Tecn. criteria	*Type of sediment*			*Level of contamination*			*Type of contamination*	
Process principle	*silty*	*silty / sandy*	*sandy*	*low*	*medium*	*high*	*organic*	*in-organic*
1.1. Open water disposal	+	+	+	+	+/-	-	+	+
1.2. Injection dredging	+	+/-	-	+	+/-	-	+	+
2.1. Classification	+/-	+	+	+	+	+	+	+
2.2. Sorting	+/-	+	+	+	+	+	+	+
3.1. Evaporation	+	+	+	+	+	+	+	+
3.2. Mechanical dewatering	+	+	+	+	+	+	+/-	+
4.1. Chemical extraction	+	+	+	+/-	+	+	-	+
4.2. Thermal desorption	+	+	+	+/-	+	+	+	-
5.1. Biological reduction	+/-	+	+	+	+	+/-	+	+/-
5.2. Chemical oxidation	+	+	+	+/-	+	+	+	-
5.3. Thermal oxidation	+	+	+	+/-	+	+	+	-
6.1. Chemical immobilisation	+	+	+/-	+	+	+	+/-	+
6.2. Thermal immobilisation	+	+	+/-	+	+	+	+/-	+
7.1. Sub-aquatic disposal	+	+	+	+	+	+	+	+
7.2. Upland disposal	+	+	+	+	+	+	+	+

\+ Process is technically available or not negatively affected

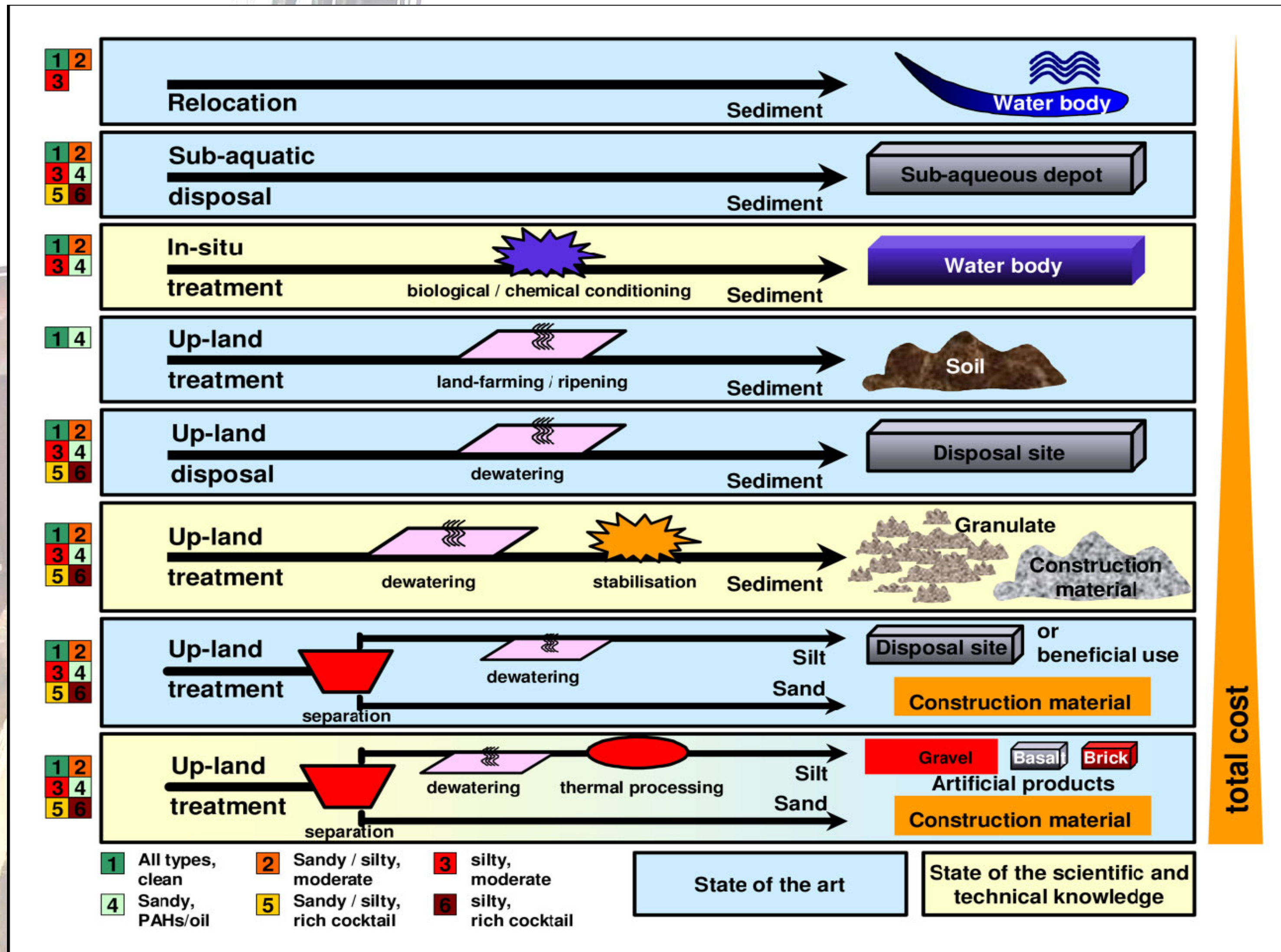
+/- Process is technically mostly available or mostly not negatively affected

\- Process is technically not available or negatively affected

(JSS – J Soils & Sediments 4 (4) 2004)

Treatment techniques and treatment chains

Some of the most promising **treatment chains** were described some years ago in the Netherlands using a simplified drawing



Treatment chains (Hakstege & Laboyrie 2002)

Conclusions – activity 1 -

- Solutions should be found in the context of the whole coastal system, in close interaction with stakeholders, need to respect natural processes and functioning.
- Relocation should be the first option, followed by beneficial use & finally confined disposal.
- All types of technologies for treatment and confined disposal are available: technology is not the problem, but innovation that leads to more efficient technologies is welcome. Experience still has to be gained for the large-scale applications, logistics and the market potential of the products.
- For beneficial use at a larger scale it is imperative to develop markets for the application of dredged material and products from treatment of dredged material.
- A site-specific approach is necessary for the choice of best available treatment or disposal option.

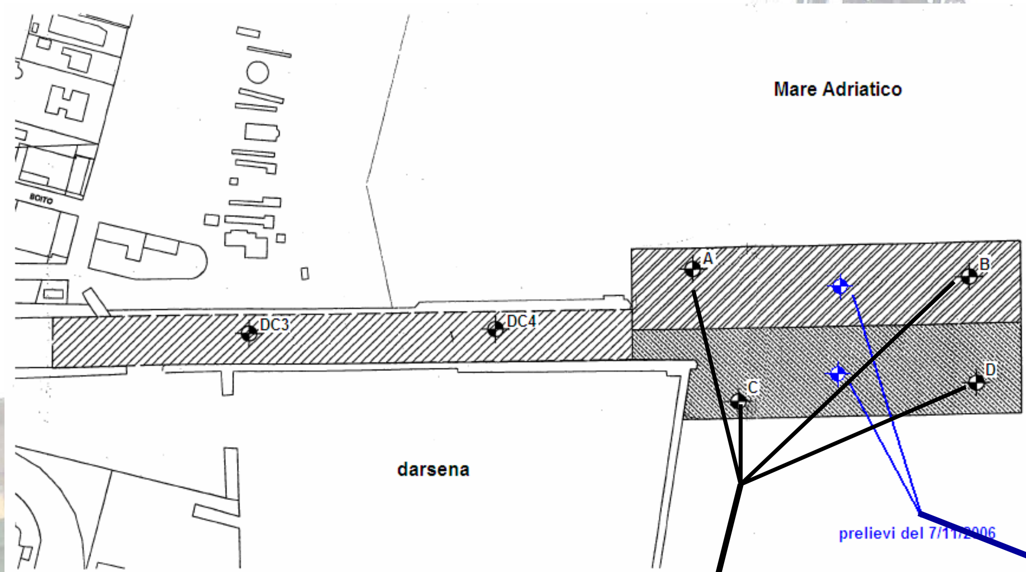
Conclusions – activity 2 -

- The sand is placed in a temporary deposit. The stability problem, the loss of material and duffusion of turbidity was studied in phase B
- Needs integration to design a treatment of the sands before/after the pumping (in series with the pump, the small and contaminated fraction is removed).

Conclusions – activity 3 -

- Sediment balance drawn in phase B

Collected sediment samples and analysis



	(A&B)s	(C&D)s	(A&B)d	BAT
Colour	gray/brown	gray/brown	gray/brown	gray
Smell	sulphureous	sulphureous	odourless	odourless
Thick fraction	shells	shells	shells	shells
Losses at 600°C (% s.s.)	3.2	2.9	2.8	1.0
Humidity at 105°C (%)	28.9	27.5	30.3	25.0
Gravel - 2 mm (%)	0.3	0.1	0.1	1.5
Sand - 0.4 mm (%)	94.7	94.9	93.9	97.5
Silt - 0.074 mm (%)	1.0	1.0	2.0	0.0
Clay - 0.02 mm (%)	4.0	4.0	4.0	1.0

	Sup	Deep
Humidity at 105°C (%)	22.87	35.98
Loss at 105°C (%)	77.13	64.02
Skeleton > 2mm (%)	2.2	< 0.1
Sand 2000÷1000 µm (%)	0.7	0.6
Sand 1000÷500 µm (%)	0.8	0.9
Sand 500÷250 µm (%)	5.0	2.4
Sand 250÷125 µm (%)	65.3	27.8
Sand 125÷63 µm (%)	23.7	12.9
Sand 63÷50 µm (%)	0.5	13.7
Silt 50÷20 µm (%)	< 0.1	19.3
Silt 20÷2 µm (%)	2.5	14.6
Clay < 2 µm (%)	1.5	7.8

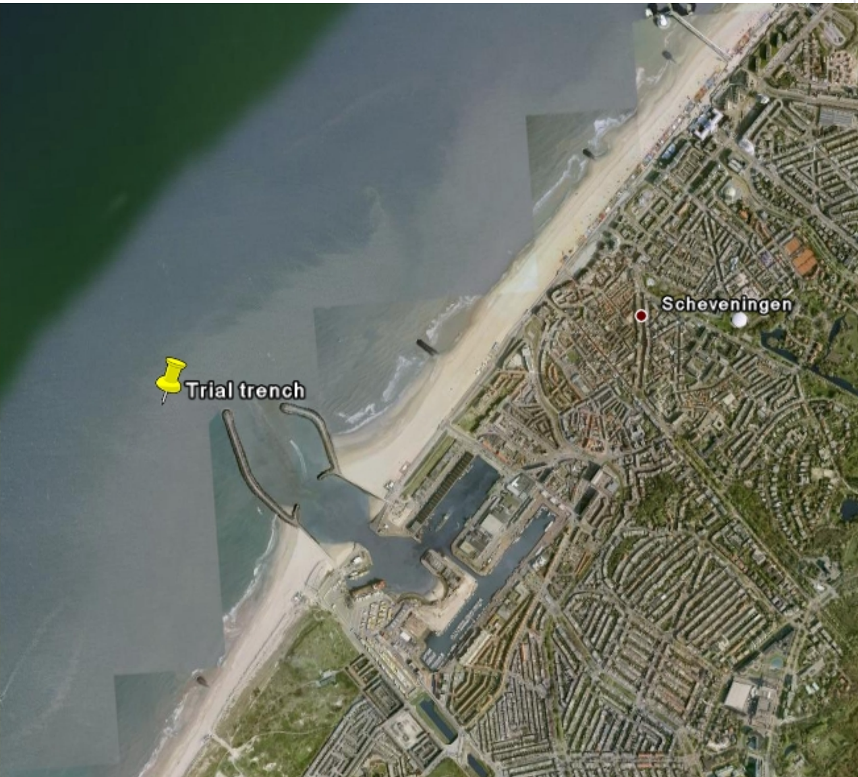
Conclusions – activity 4 -

- The material used for the nourishment is qualitatively suited to the nourishment. It is a little too fine, nevertheless all the available material was placed on the shore. Part of the dredged material needs to be treated? Only missing answer.
- Since our suggestion to place the material in the submerged area could not be accepted due to reasons connected to the tendering procedure, there will be no information on the accumulation of sand in the submerged profile.
- Therefore the promised morphological simulations will only consider the trench dredging case; simulations concerning the nourishment were substituted with different ones, aiming at optimizing the nourishment techniques on the shore (already carried out in phase B: results in terms of diffusion of turbidity, structural stability of off-shore temporary deposit).

SCHEVENINGEN TRIAL TRENCH

A trial trench was dredged in the North Sea bed near Scheveningen (NL) in March 1964 to obtain information of deposition rates with respect to the construction of a future sewer-pipeline trench. The field experiment, is part of Sandpit Project and the data were provided by UT Delft

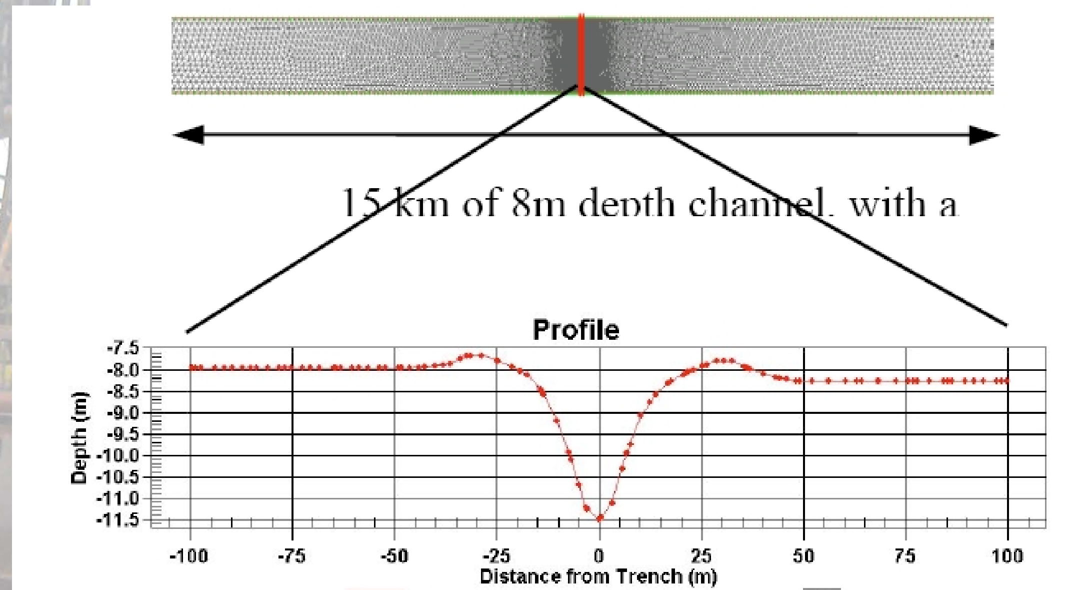
Where is the trench?

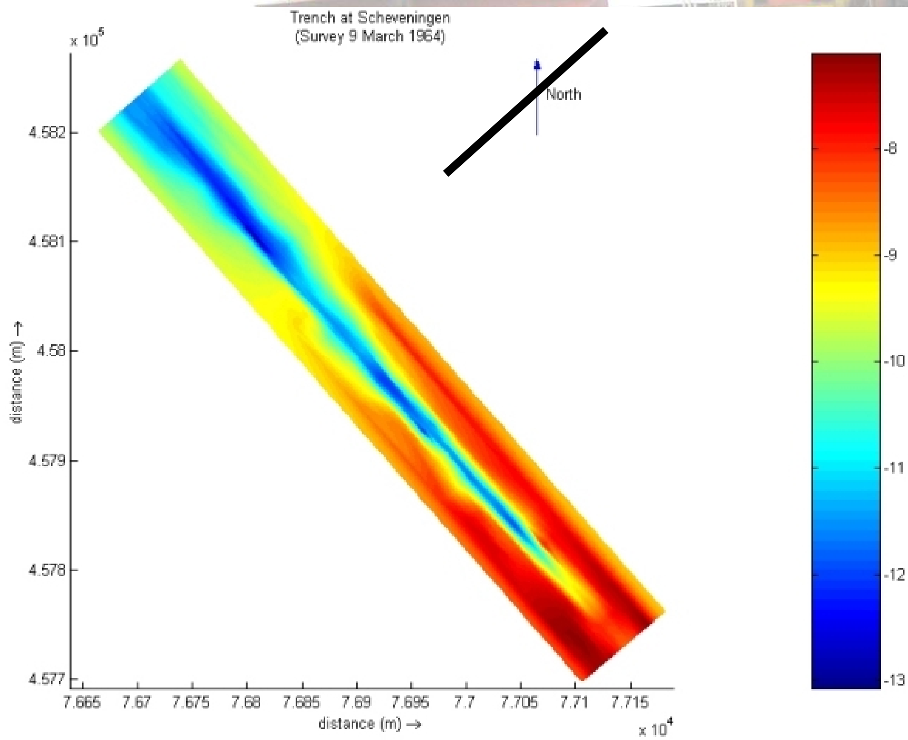


The trial trench was dredged perpendicular to the shoreline between 1 km (local depth of about 7 m below MSL) and 1.7 km (local depth of 10.5 m) from the RSP-baseline on the beach. The length of the trench along the main axis of the trench was about 700 m; the bottom width of the trench was about 10 m; the side slopes of the trench were about 1 to 7 and the trench depth below the surrounding sea bed was about 2 m. In all, about 30,000 m3 was dredged.

Measured bathymetric evolution

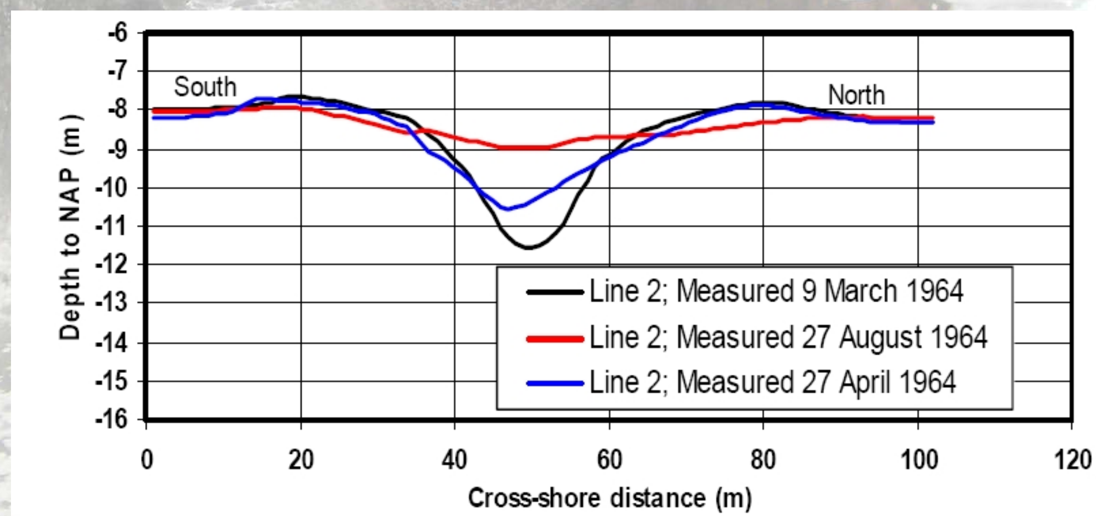
Dredged profile

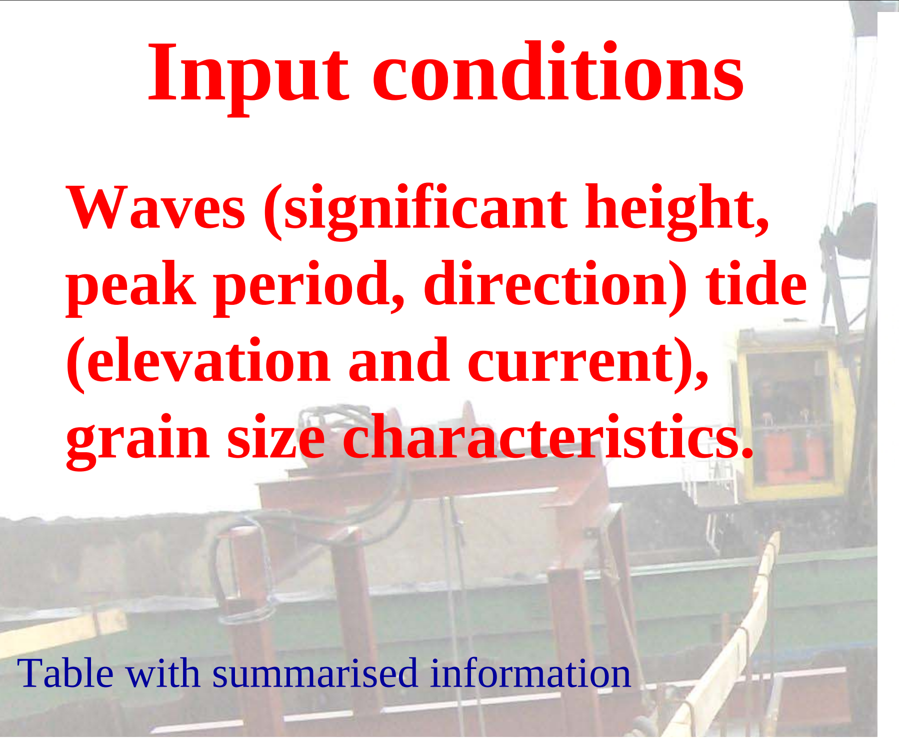




Trench at Scheveningen in North Sea

Sedimentation in trial trench near Scheveningen in North Sea.

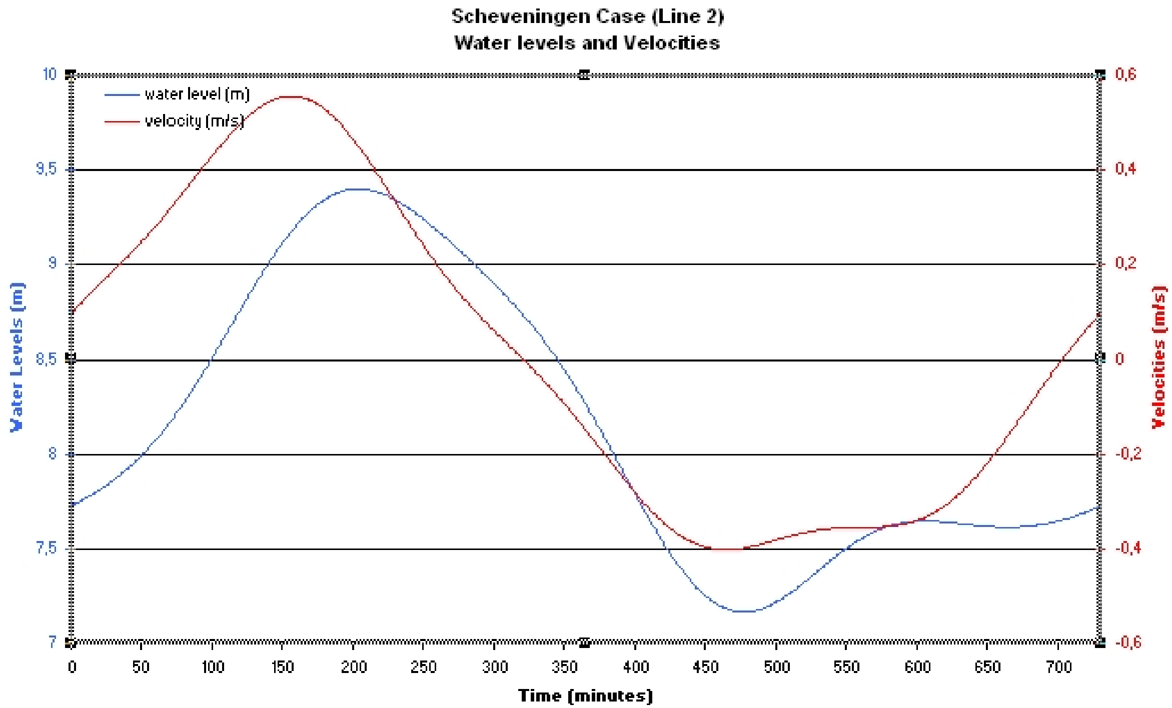




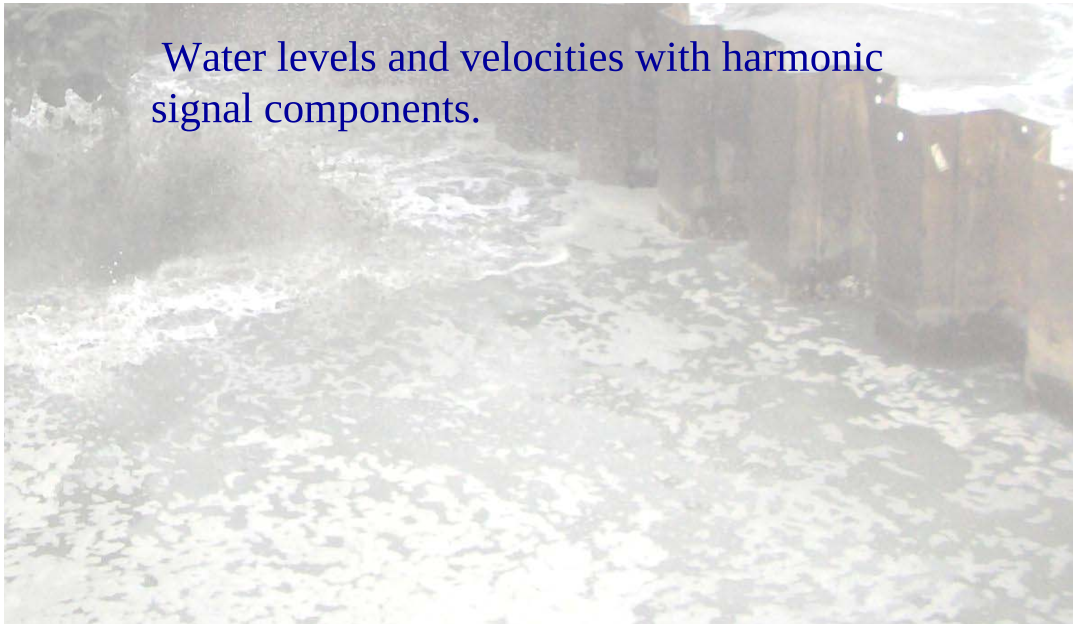
Input conditions

Waves (significant height, peak period, direction) tide (elevation and current), grain size characteristics.

Table with summarised information

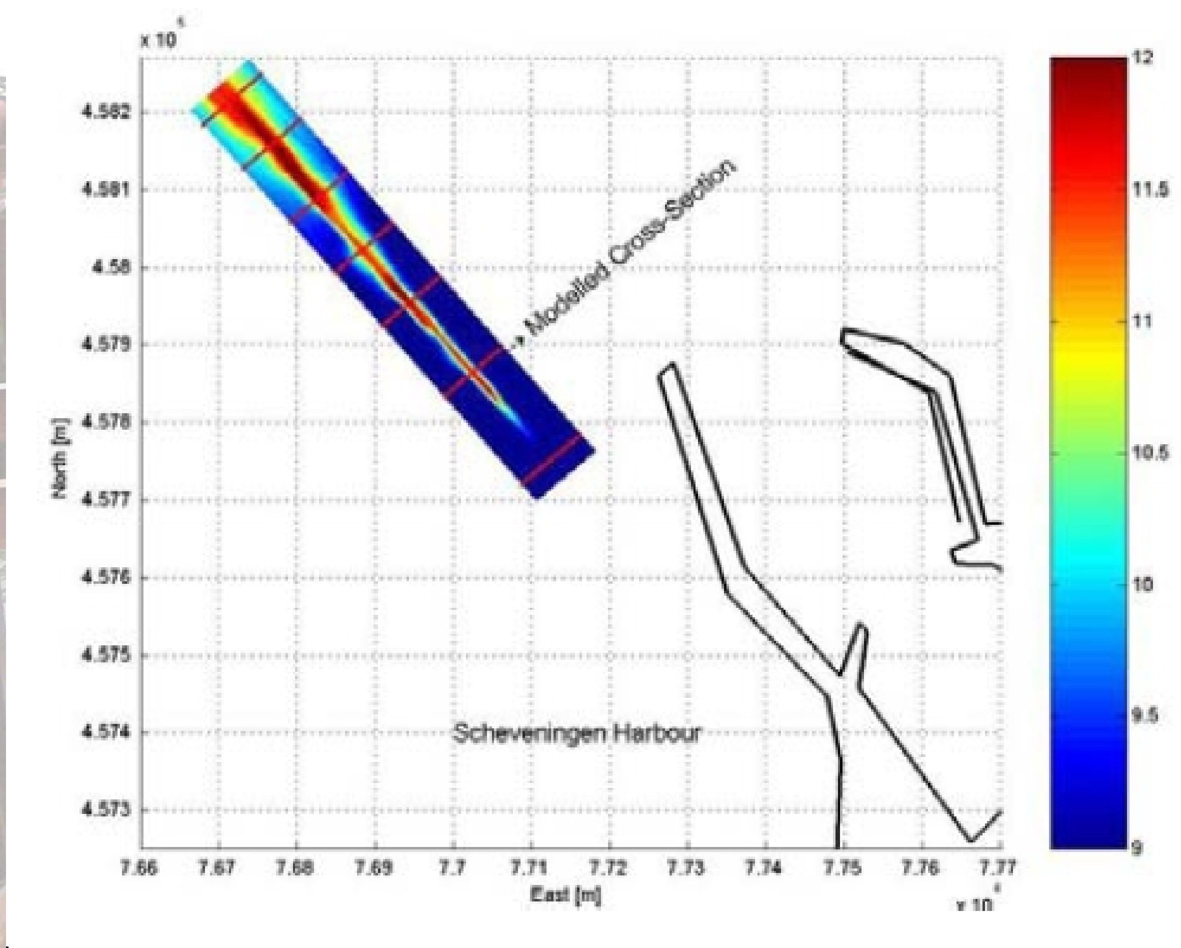


Trial trench	near Scheveningen in North Sea	
Inlet conditions	Water depth to MSL h_o (m)	7 to 11
	Approach angle α_o (degrees)	90
	Tidal range (m)	1.5 to 2
	Peak flow velocity (ebb) to south (m/s)	0.5
	Peak flow velocity (flood) to north (m/s)	0.6
	Measured wave height H_s (m) during 173 days peak period (s)	3 m during 1 day; 2.5 m during 7 days; 1.75 m during 14 days; 1.25 m during 30 days; 0.75 m during 50 days; 0 m during 71 days 5 to 8 s
	Sediment size d_{50}, d_{90} (fine sand in mm) Gross sediment transport (estimated in m^3/m, bulk volume incl. pores)	0.2; 0.3 40 to 55
Channel dimensions	Water depth in channel h_1 (m)	11 to 12
	Bottom width (m); top width (m); slope	10 to 20; 30 to 40; between 1 to 5 and 1 to 7
Sedimentation values	Sedimentation area (cross-channel, dry bulk volume in m^3/m, including pores)	30 to 35 during 173 days



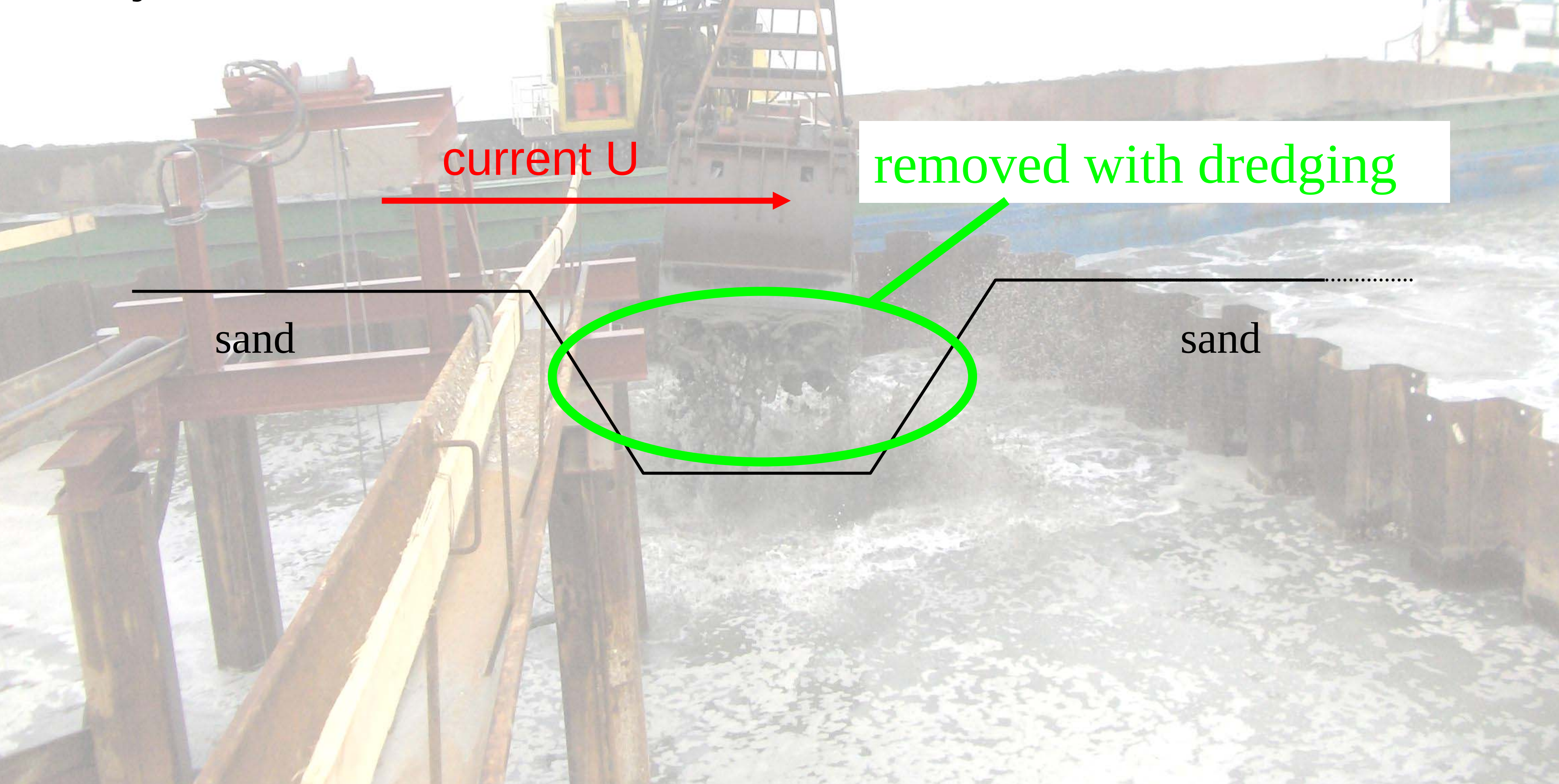
Water levels and velocities with harmonic signal components.

Simulations under way…
(Activity 5 non concluded yet)



2D Wave (SWAN) + 3D (ROMS SED)

Why ROMS?



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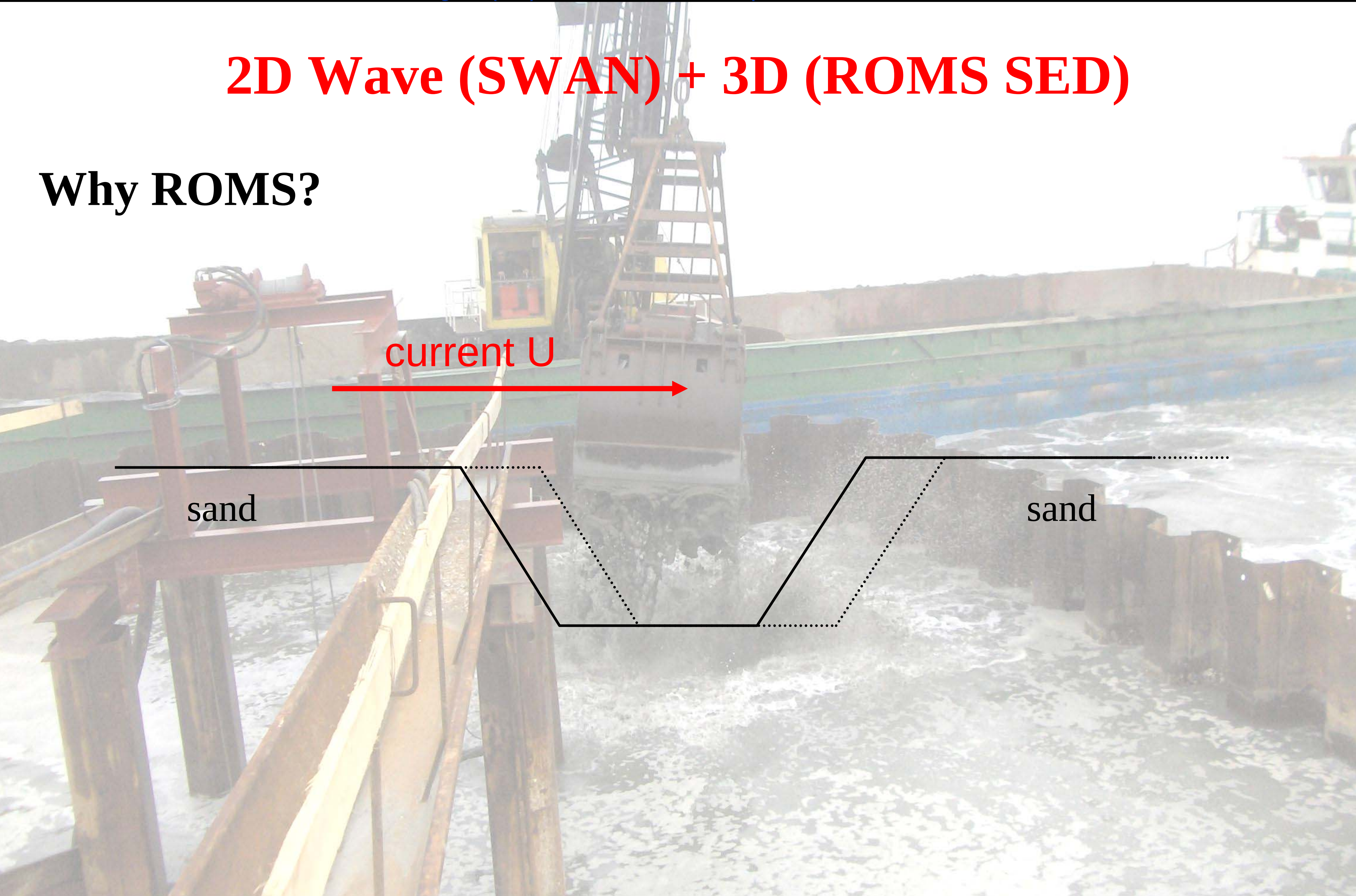

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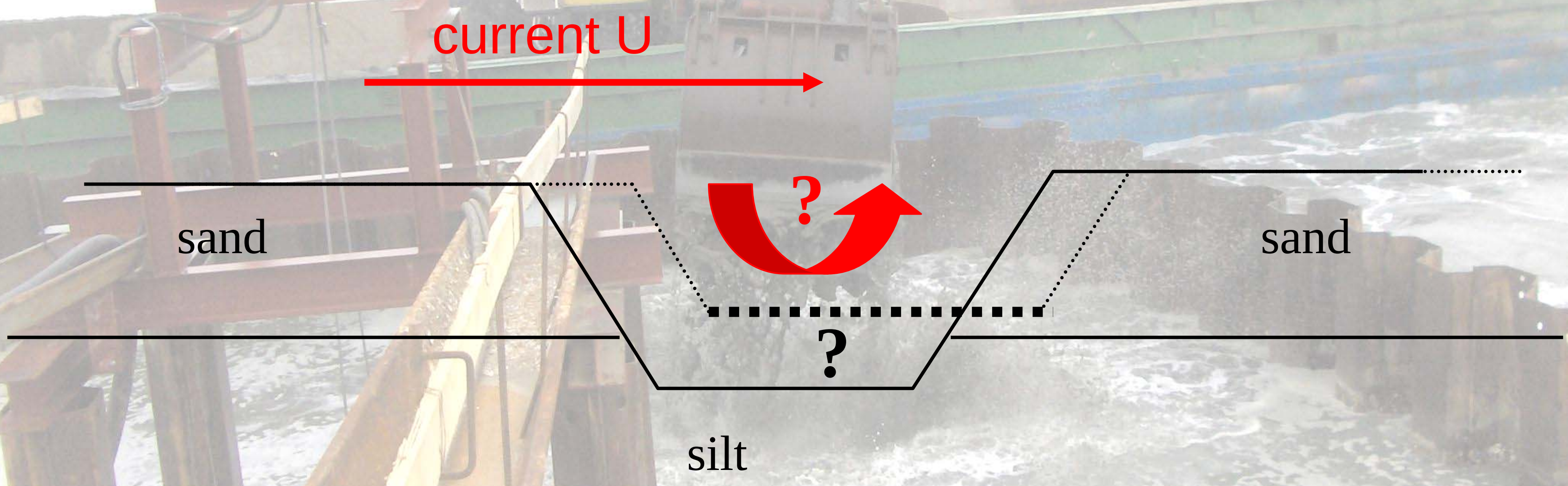

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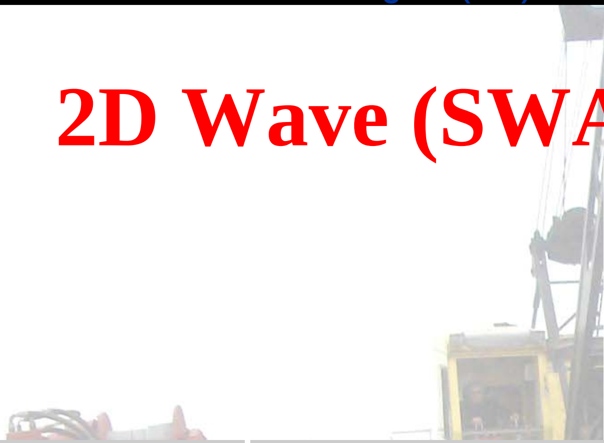
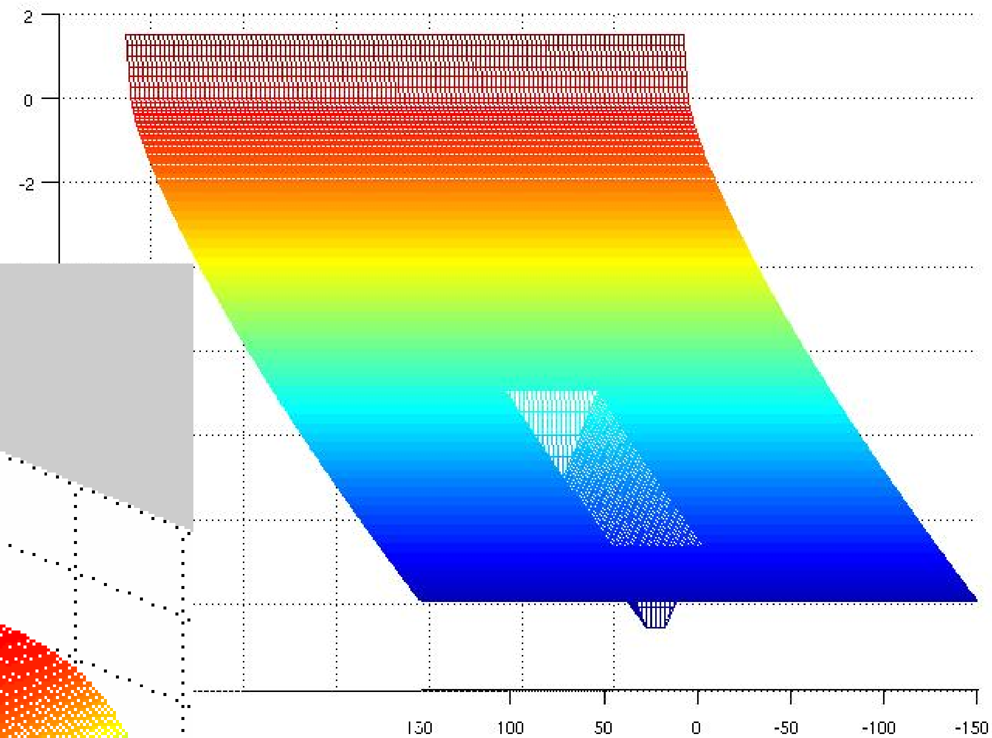
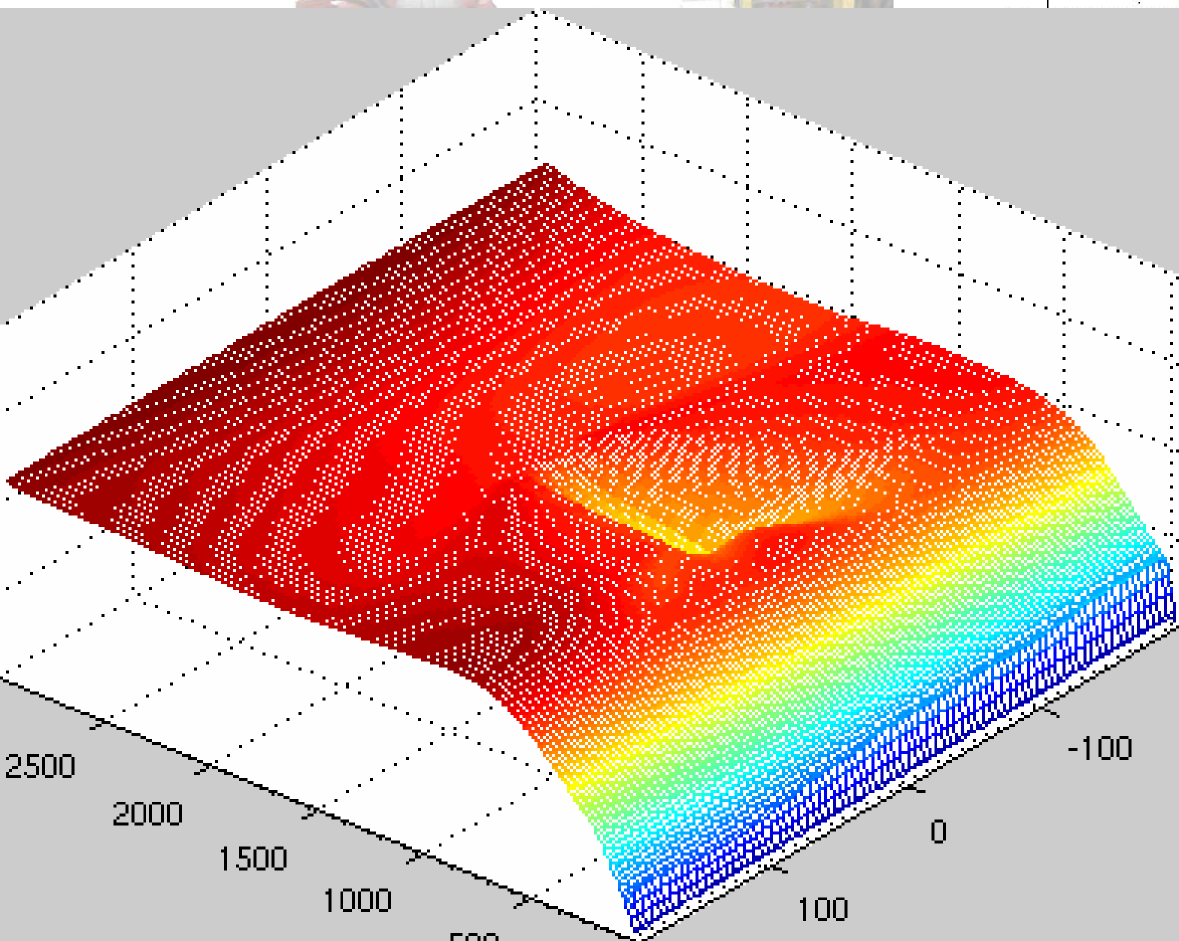
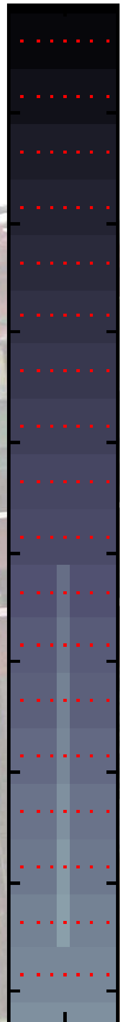
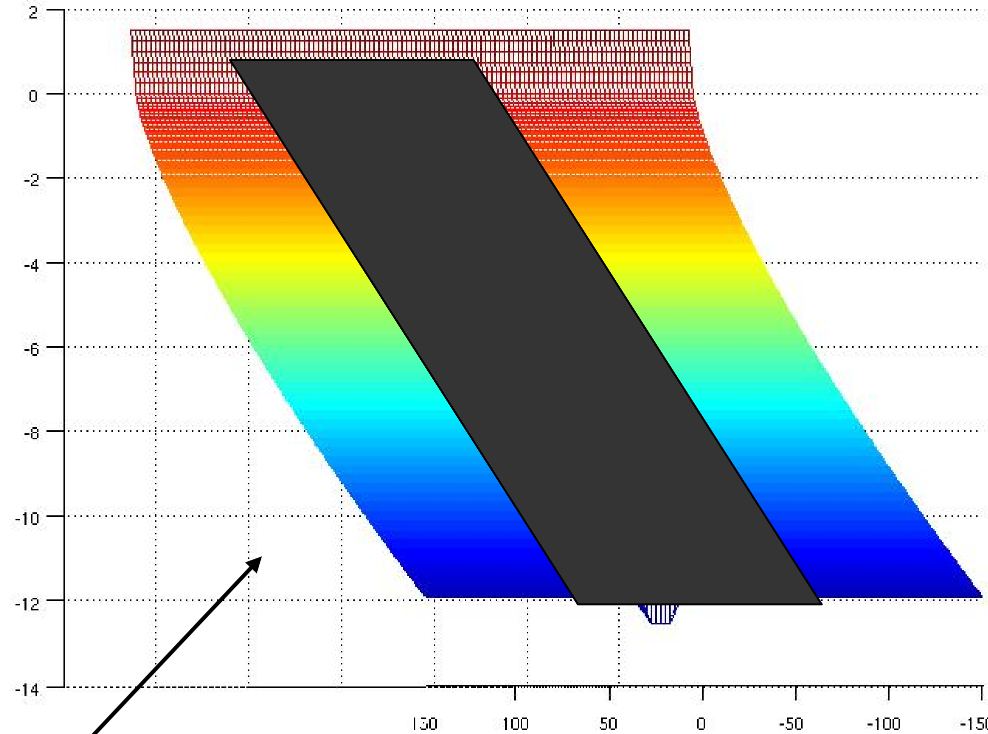






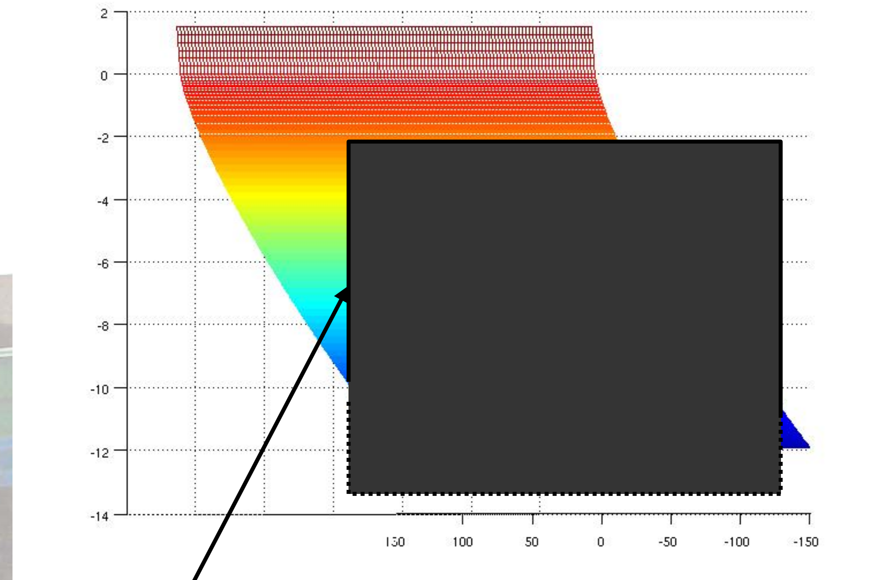
2D Wave (SWAN) + 3D (ROMS SED)

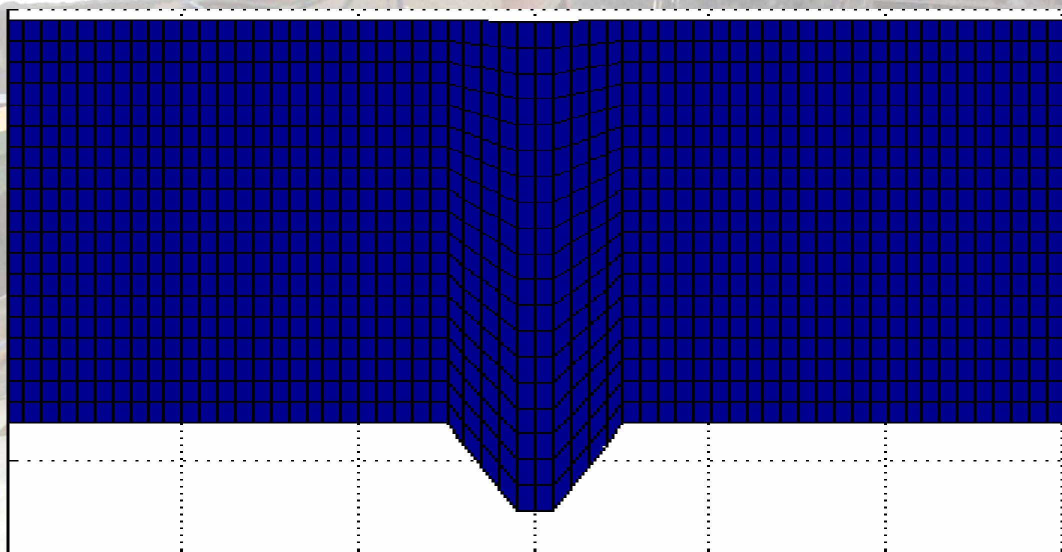




Plane view, currents

2D Wave (SWAN) + 3D (ROMS SED)



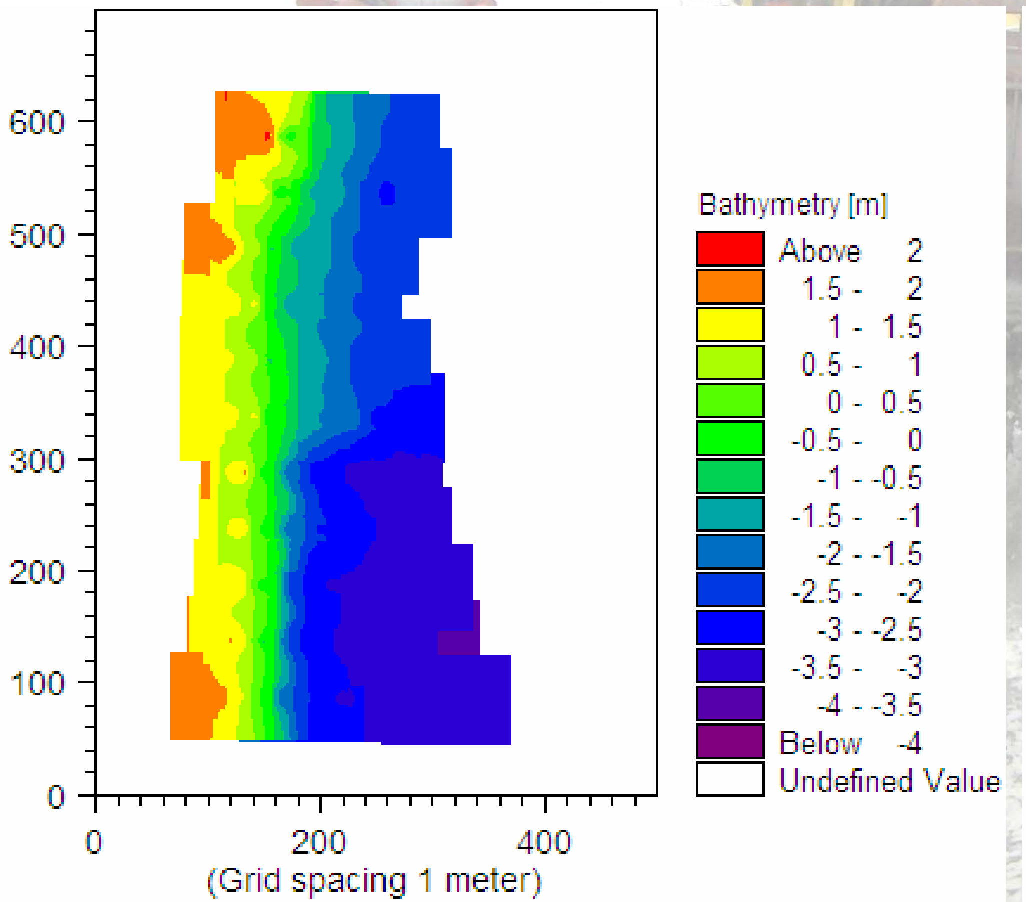


Cross section,

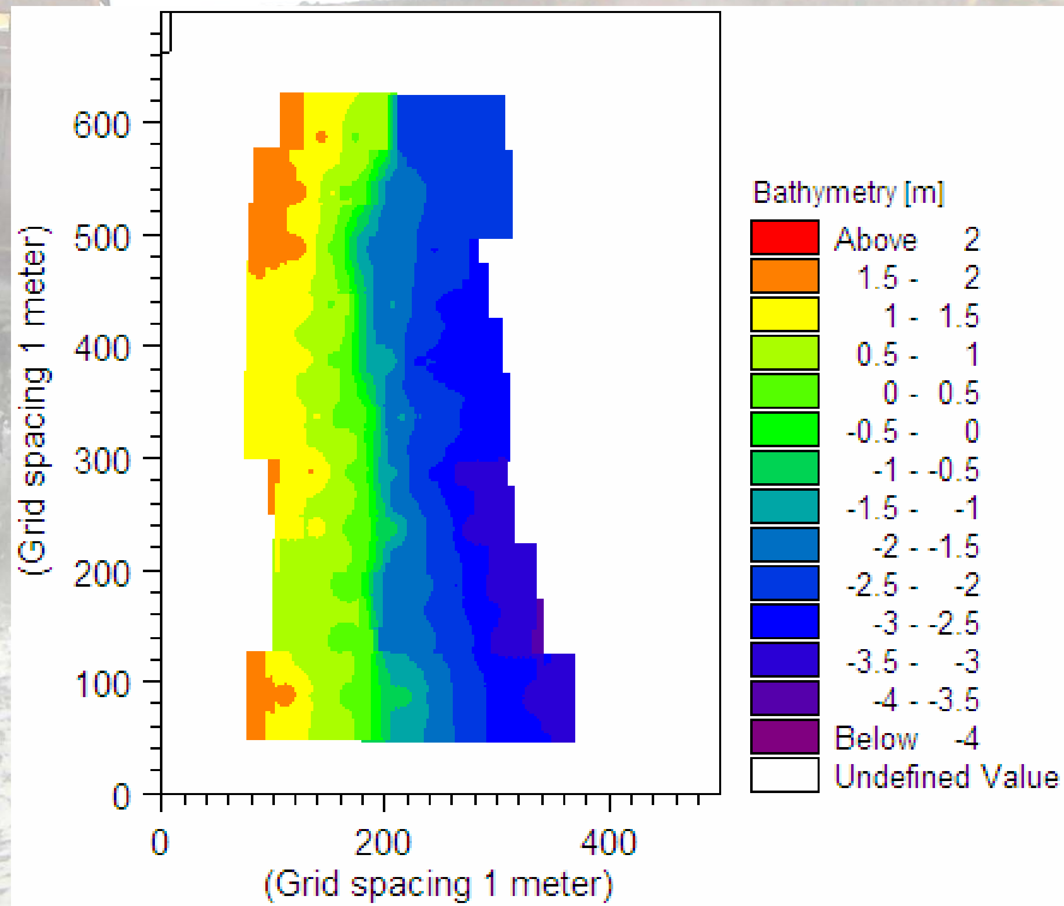
cohesive suspended sediment

New surveys in Milano Marittima

11 Aprile 2007 (M. Marittima, before works)

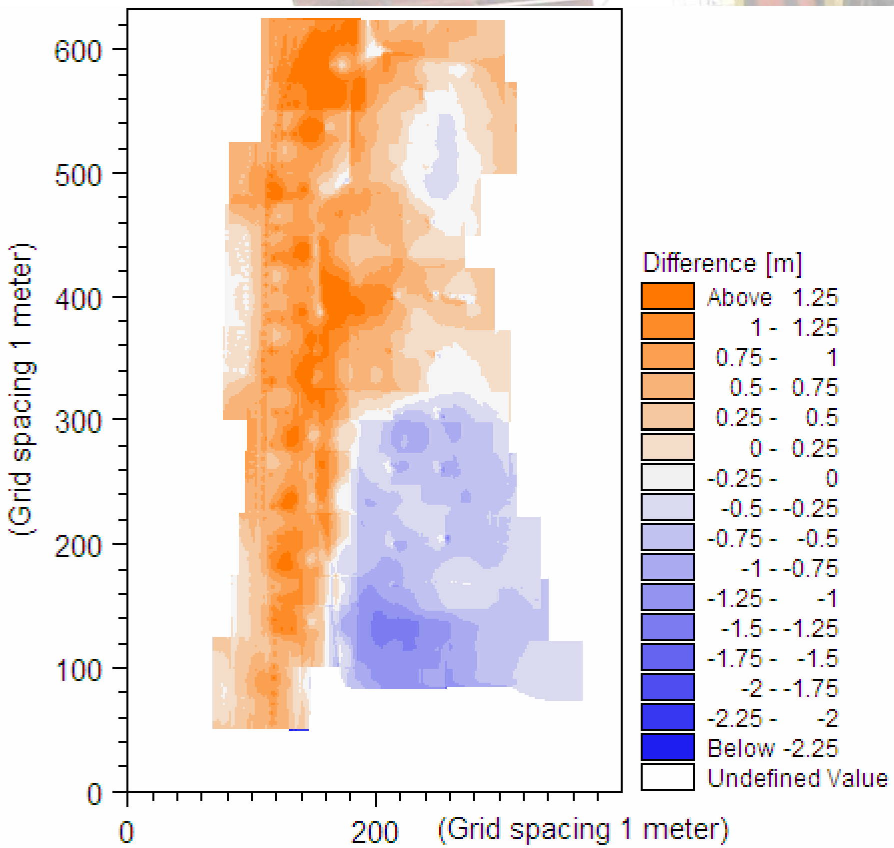


1 giugno 2007 (M. Marittima, after works)

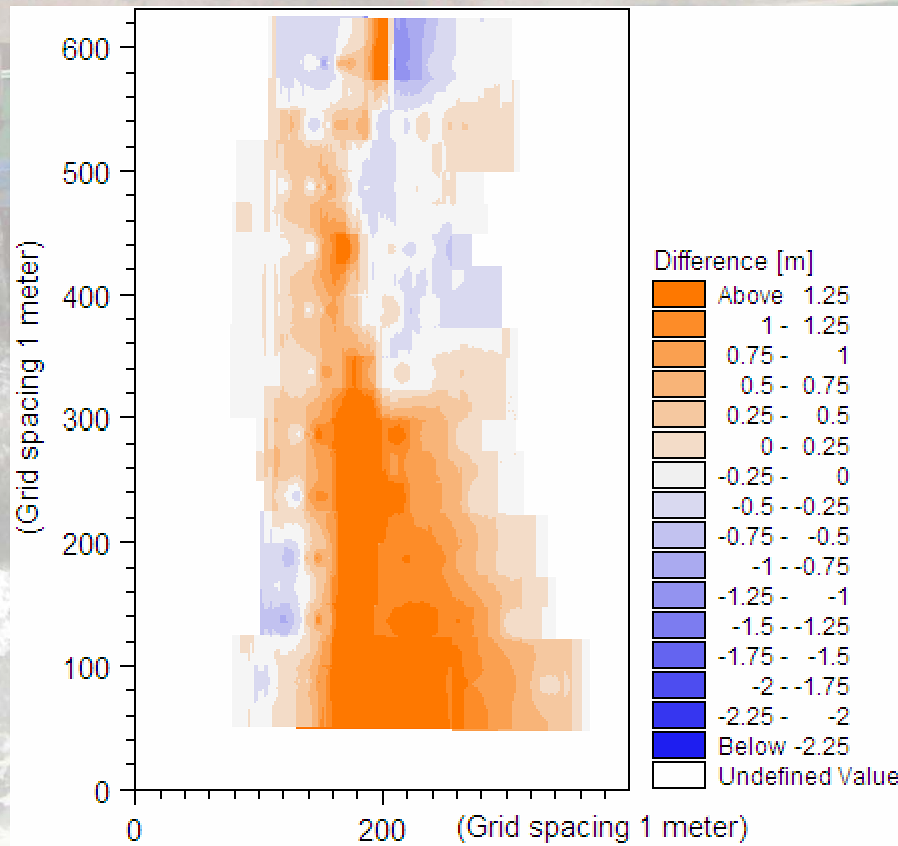


Comparisons

Defferences previous 39 months:
Jan 2004 – 11 April 2007

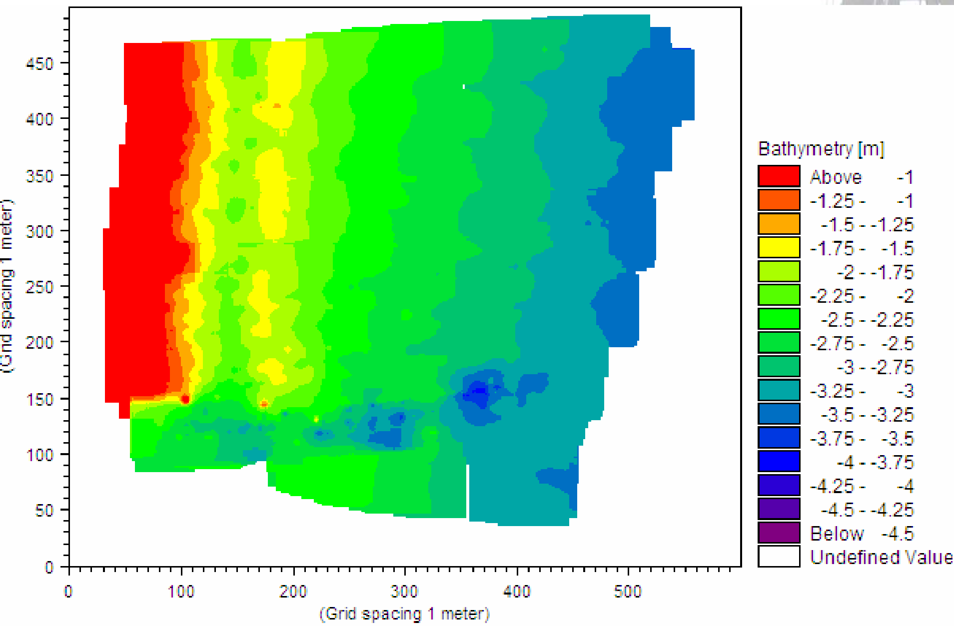


Differences:
11 April 2007 – 1 June 2007

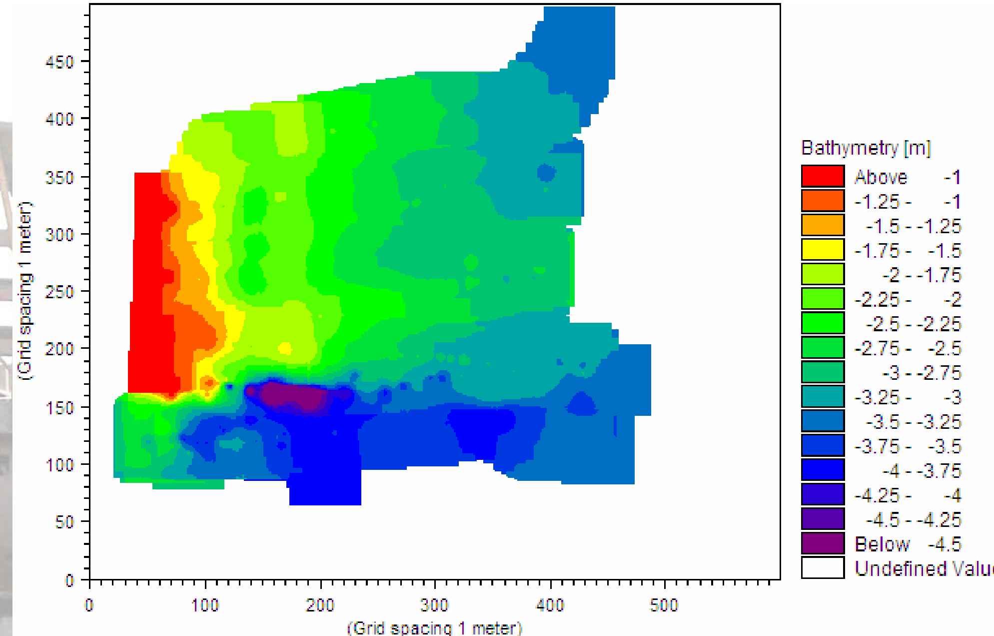


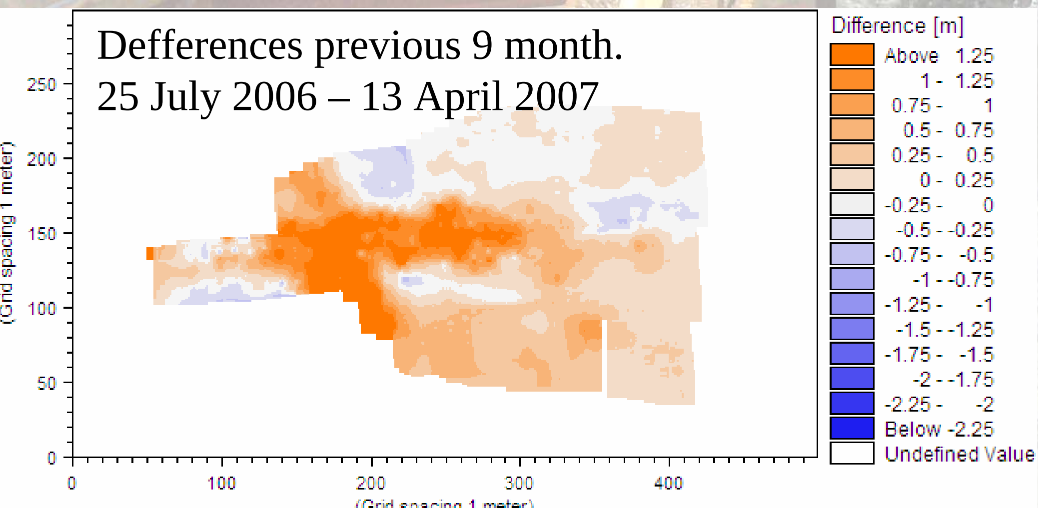
Cervia

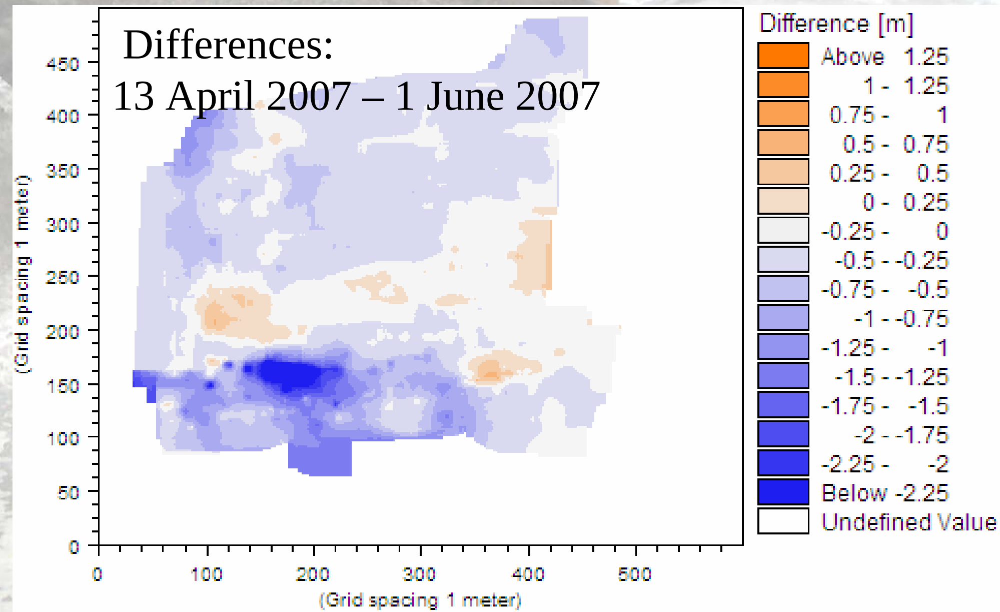
13 April 2007 (Cervia, before works)



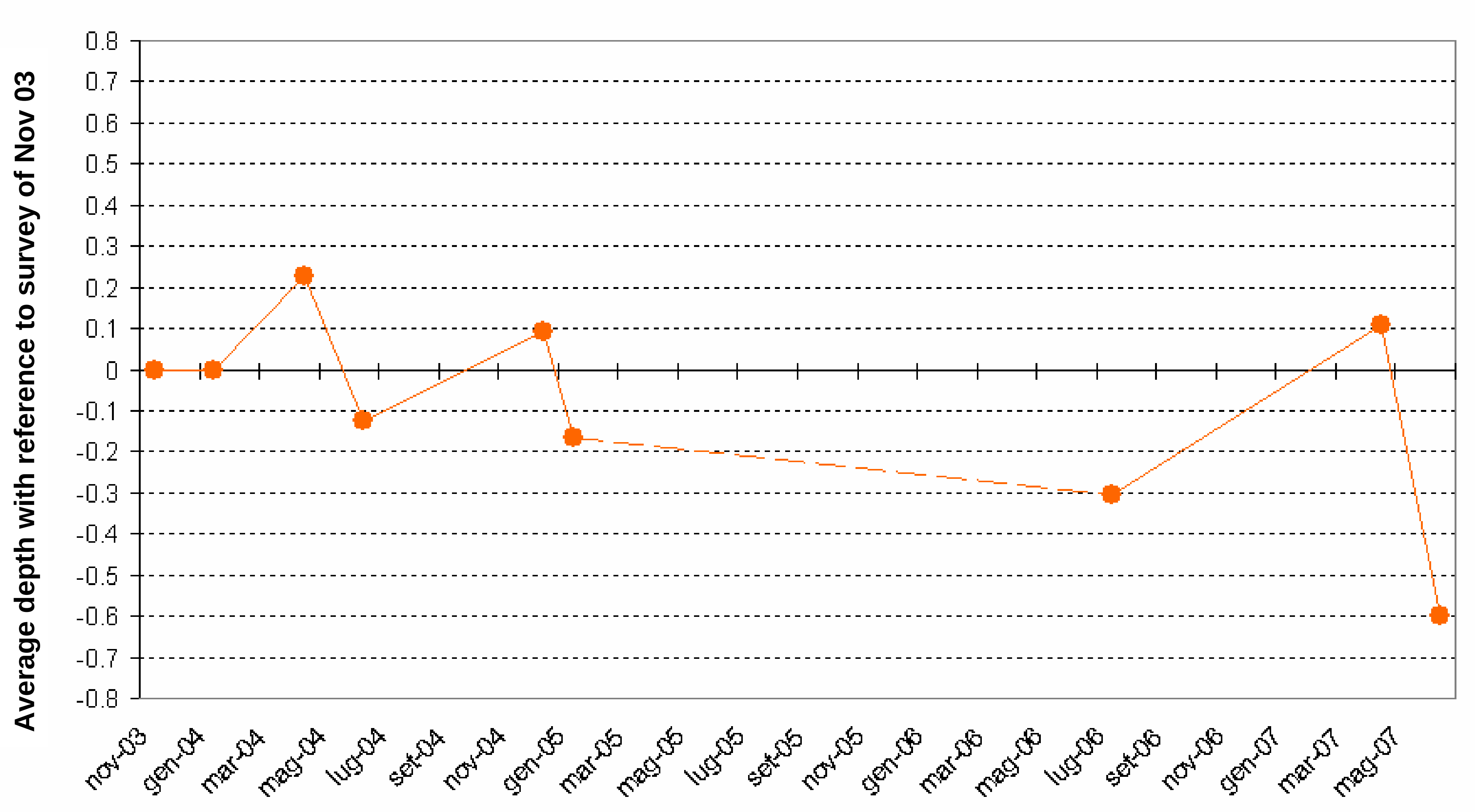
1 June 2007 (Cervia, after works)







Time history of average deposition/dredgings strategy of the port entrance channel



Bathymetries yet to be analysed

- 1 bathymetric survey Port of Cervia in October 2007
- 1 bathymetric survey Milano Marittima in October 2007

Simulations will follow

Conclusions – activity 6 -

The old dredging strategy was (a) to drag channels slightly deeper than required by the market.

By comparing the old bathymetries (Phase B) and the more recent ones (Phase C) it was seen that the port entrance channel is not filled with sediments but tends to bend on the direction of the storm, mainly southwards.

Strategy (a) alone did not prove much effective, since a single storm compromised the access to the port

The suggested dredging strategy is also to drag wider channels. The numerical simulations will give quantitative results.