Techniques of coastal environment diagnostic parameters

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APAT

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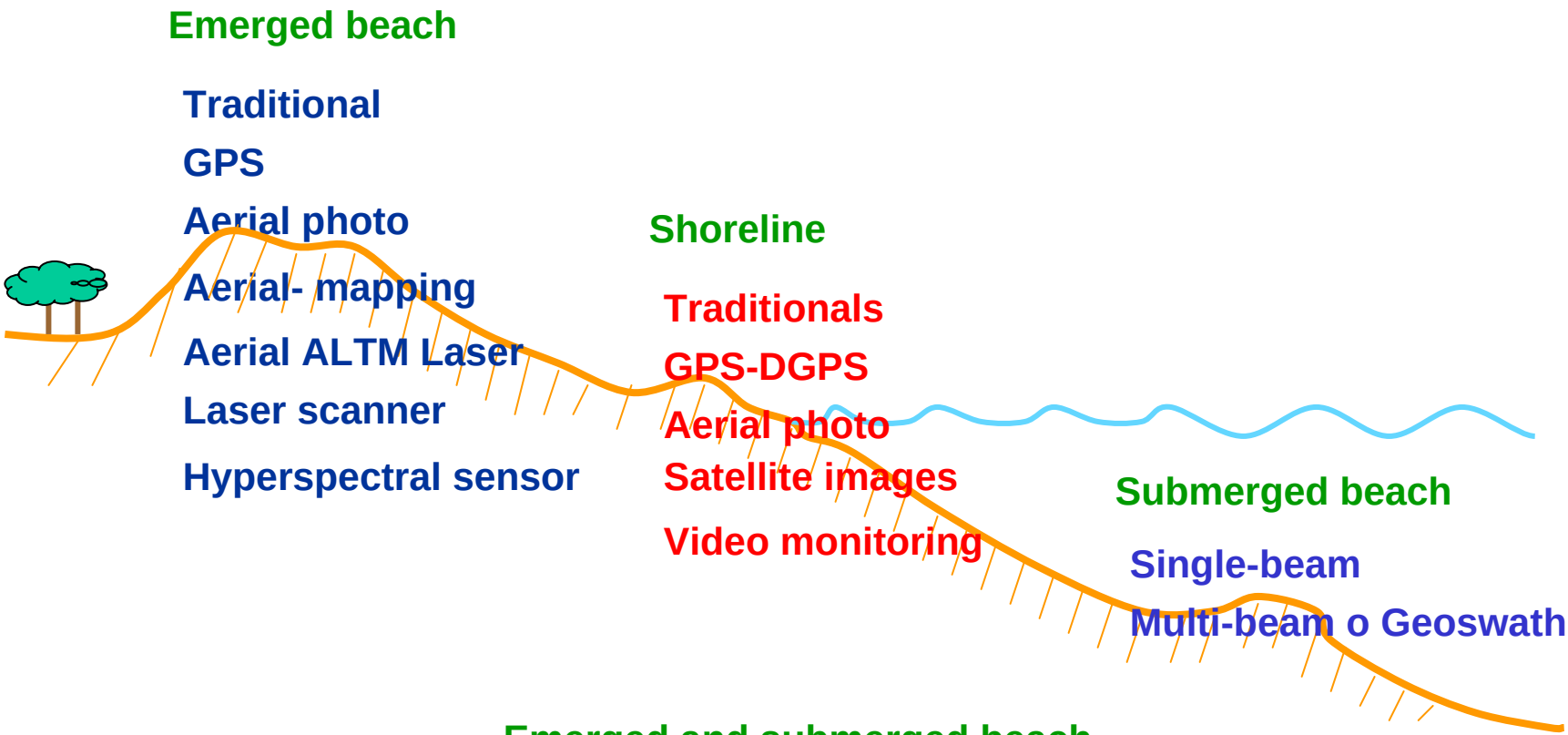
SURVEY METHODS MORE APPROPRIATE CONSIDERING:

- required absolute precision
- survey extension
- littoral morphology
- number of required points (density per square km)
- survey duration considering velocity of studied processes
- costs

ANALYSIS OF ASPECTS LIKE:

- coastal erosion relative to considered time scale
- shoreline definition and its variations in the time domain (natural and anthropic)
- linear, area and volumetric erosion
- methodological and statistical aspects for erosion calculation (software)

Main survey techniques



SURVEY TECHNIQUES AND RELATED PROBLEMS

1. LIDAR
2. REMOTE SENSING
3. WEBCAMS
4. SEA CONTROL POINTS

LIDAR SURVEY

There are 3 LIDAR systems in the world;
Their technical characteristics are similar;
Accuracy = 2,5 m (x,y); 0,25 m (z)

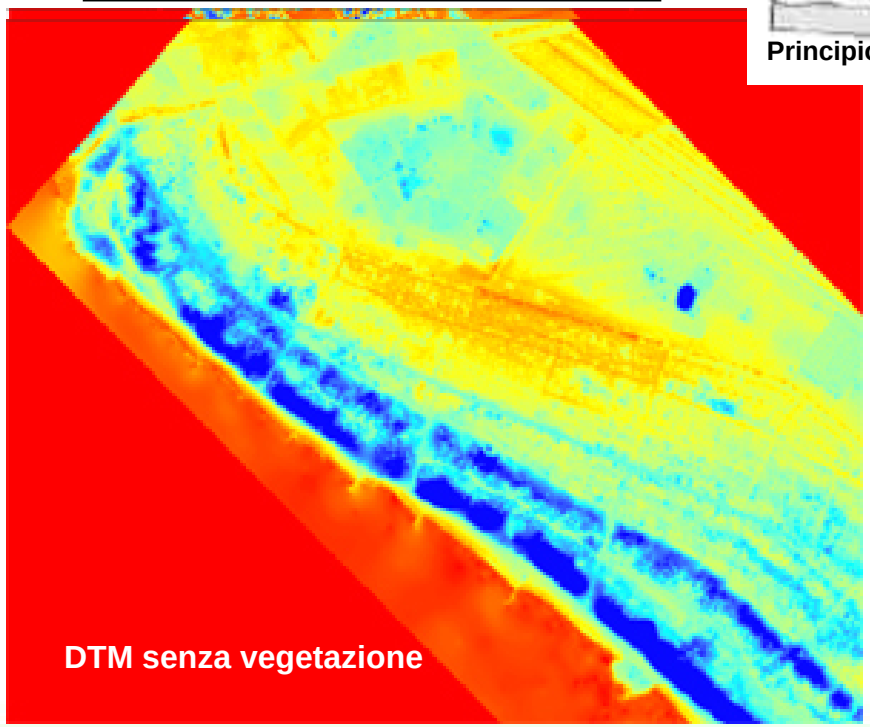
Mob/demob costs = € 100.000,
Additional survey cost = € 1.000 -2.000/km^2 (areas of circa 50-100 km^2)

ALTM

(Airborne Laser Terrain Mapping). Accuracy z= 15 cm – flying altitude 400 m

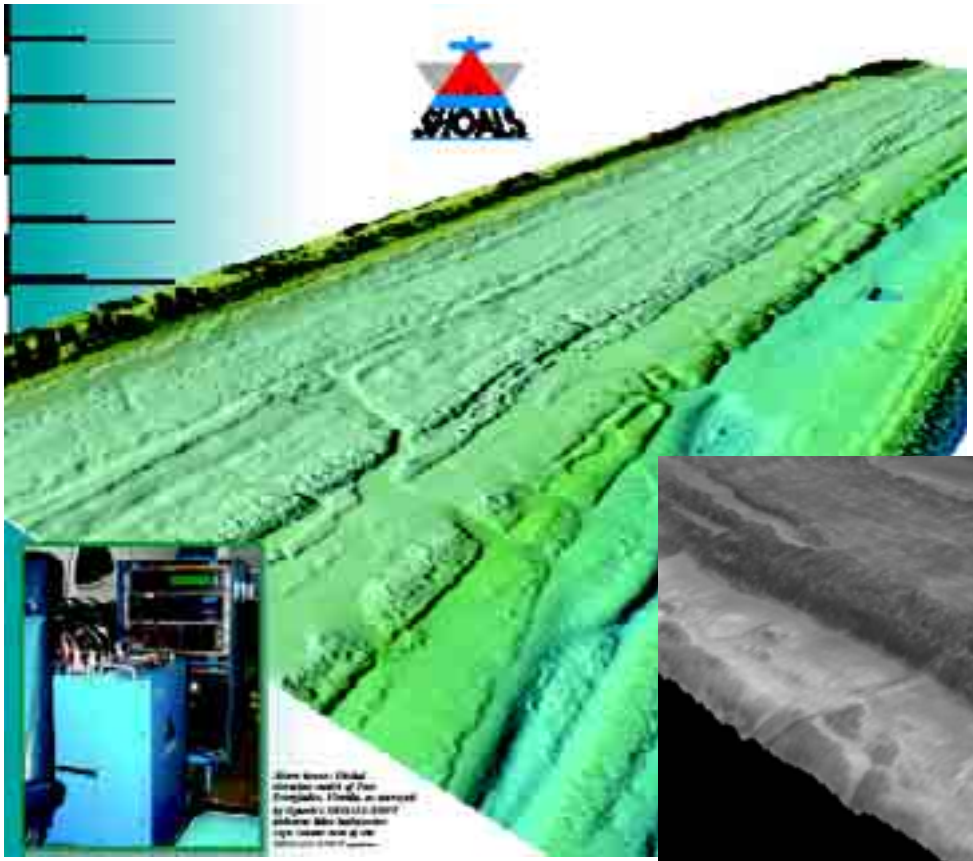
Principio del metodo

Example DEM (1x1m)

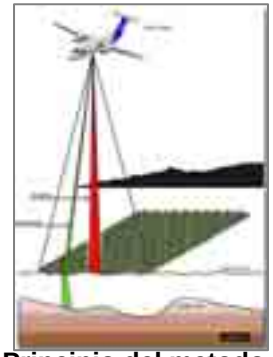


DTM senza vegetazione

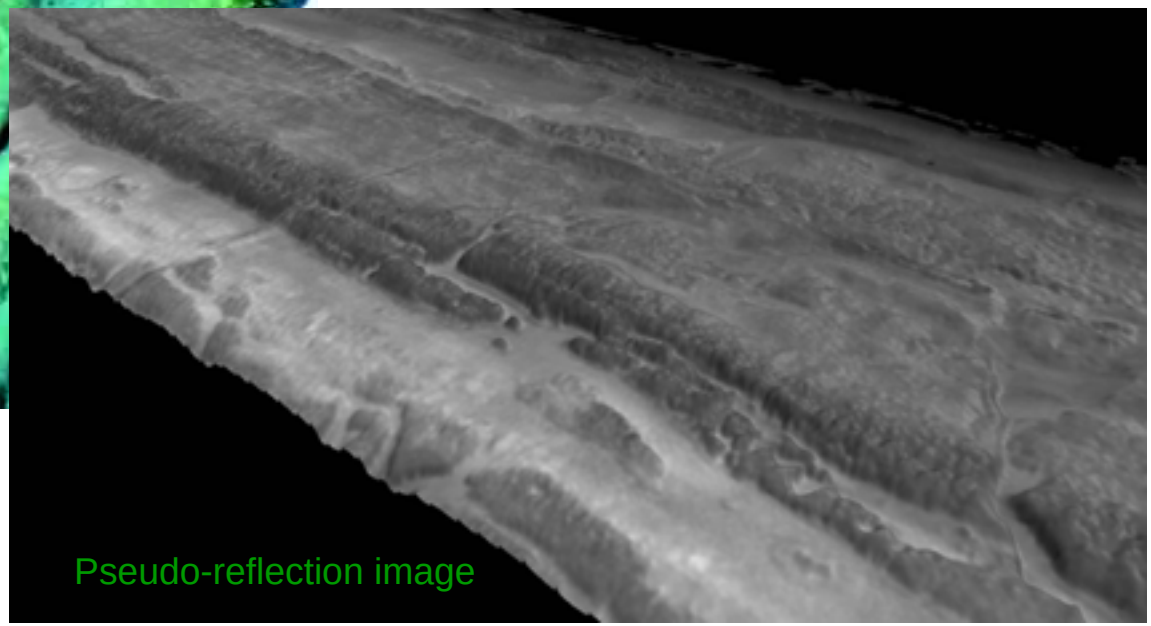
ALB (Airborne laser bathymetry)



is a tecnique to make bathymetric surveys in case of low water depth using laser pulses emitted by equipments installed on airplanes.



Principio del metodo



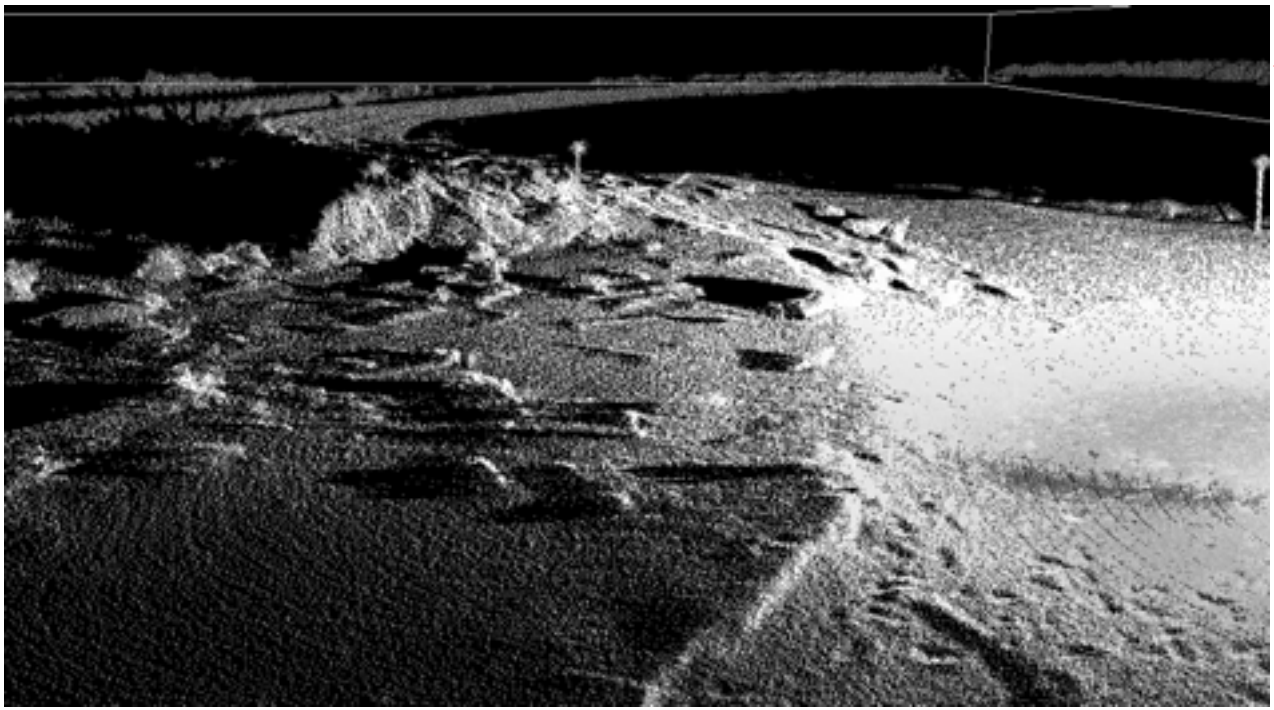
Pseudo-reflection image

Limitations due to cleaning of water and the low reflection of the sea floor.

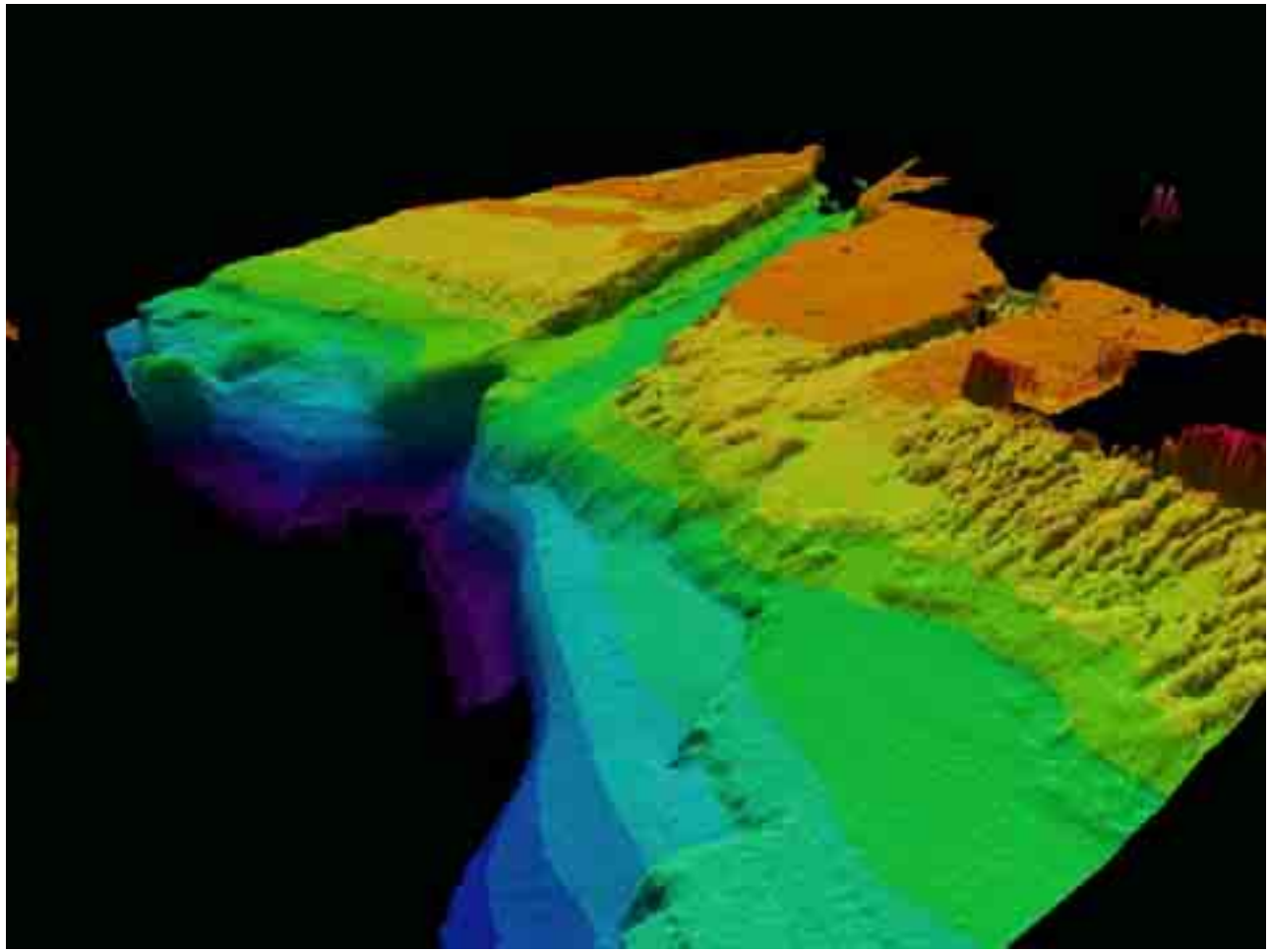
LASER SCANNER

Tri dimensional laser scanning; measures distance, colour and reflection – precision 1 cm (*dist. max. 50 m*).

Geo referencing



GPS **Riflettore**



Aerial bathymetric survey (Shoals 1000)

REMOTE SENSING

Zoom orto image

SURVEY OF SHORELINE USING ELABORATION OF SATELLITE IMAGES

Methods for low cost plan survey which, with the last generation satellites, can lead to sub-metric precisions.

Satellite	Orbit altitude	Panchromatic in grey tones	Multi spectral	New data cost
Quickbird II	450 Km	0.61 m	2.44 m	40€/km^2
Ikonos	680 Km	1 m	4 m	40€/km^2

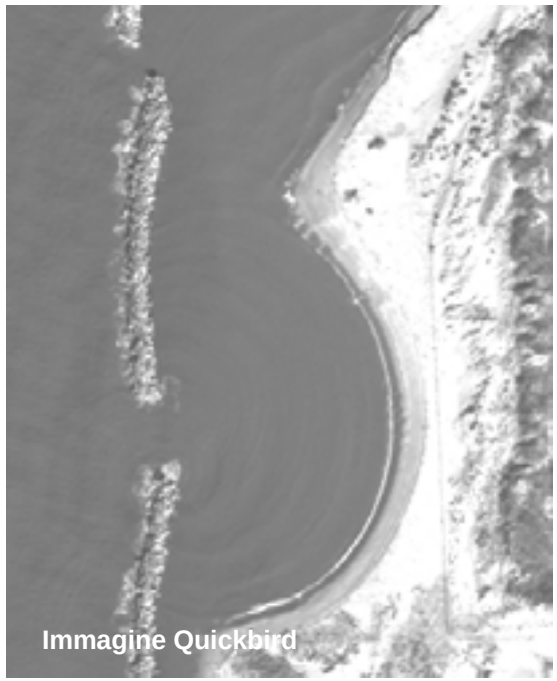


Immagine Quickbird

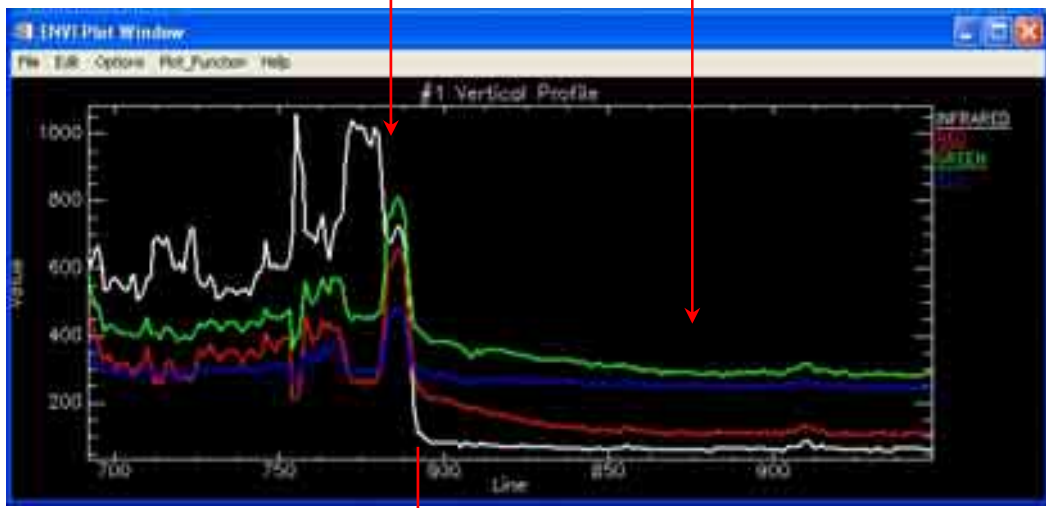
V Verifications:

- V geo referencing with known points on maps and GPS survey and shoreline tracing
- Pre sampling procedures to make better theoretical resolution of satellite sensor
- S solution to geometrical problems due to sea level variations
- S development of procedures to trace automatically the shoreline
- V contemporaneous GPS survey
- V data validation through compatibility with the precision topographic survey along the coast

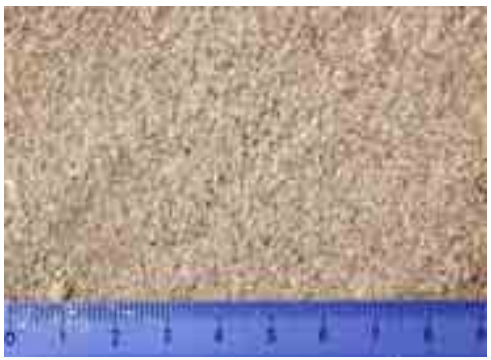
QUICKBIRD SATELLITE REMOTE SENSING

A-B Profile (X=6038)

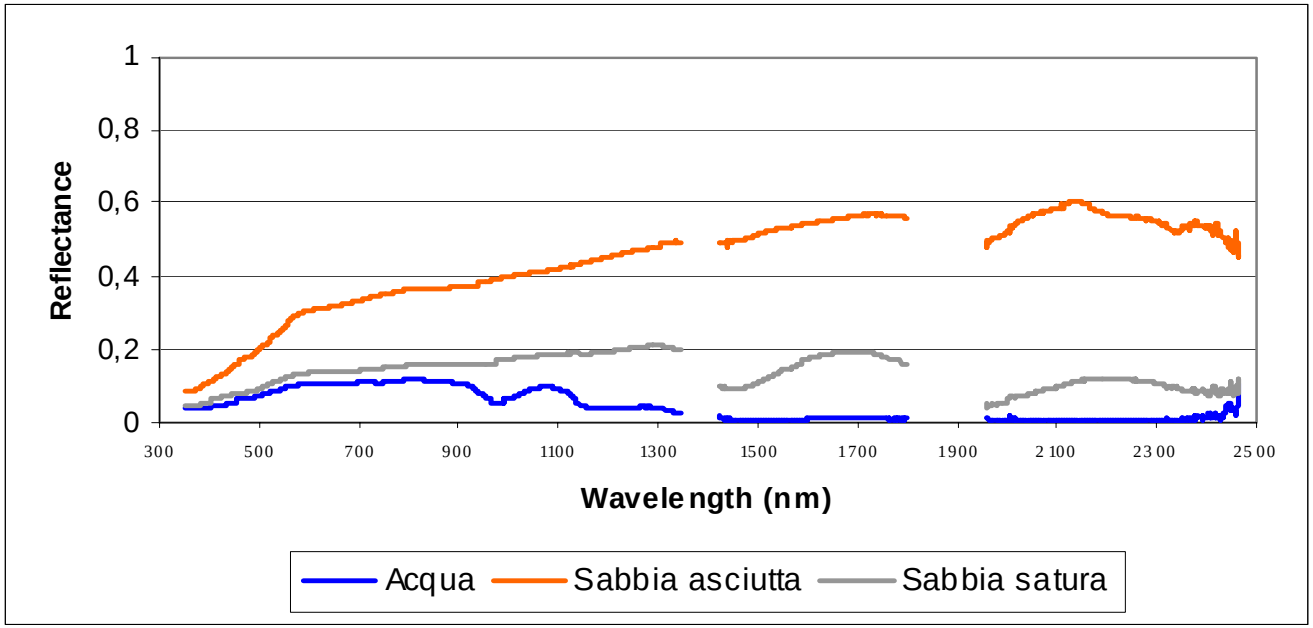
- Infrared Profile
- Red Profile
- Green Profile
- Blue Profile

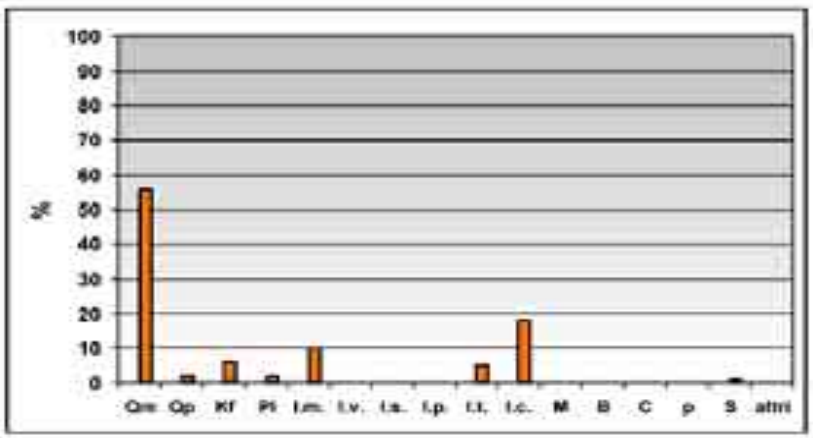


Beach/sea interface



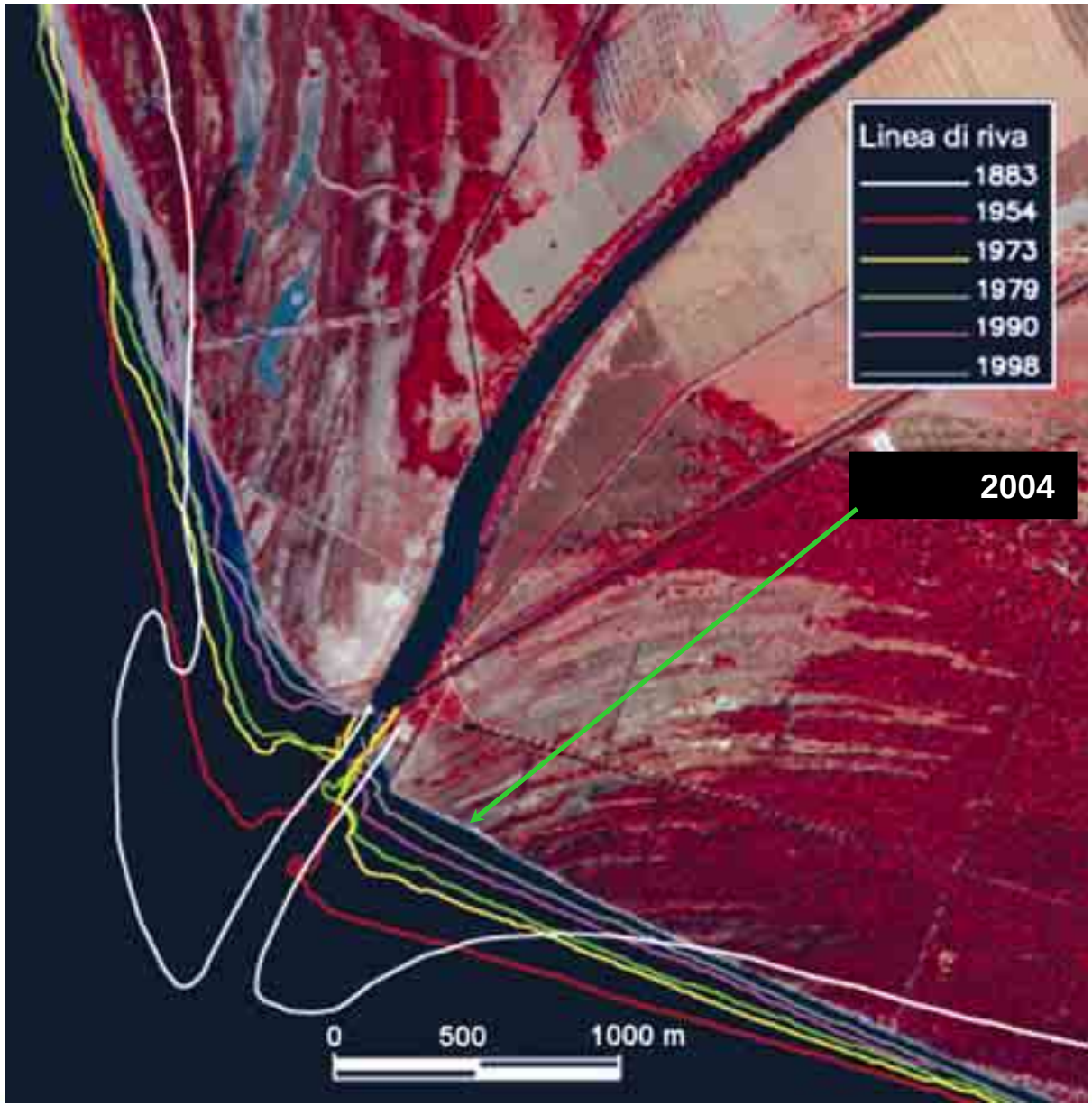
SATELLITE REMOTE SENSING





Qm= quarzo monocristallino
Qp = quarzo policristallino
Kf = feldspato potassico
Pl = plagioclasio
l.m. = litici metamorfici
l.v. =litici vulcanici
l.s. = serpentino
l.p. = litici plutonici
l.t. = litici terrigeni

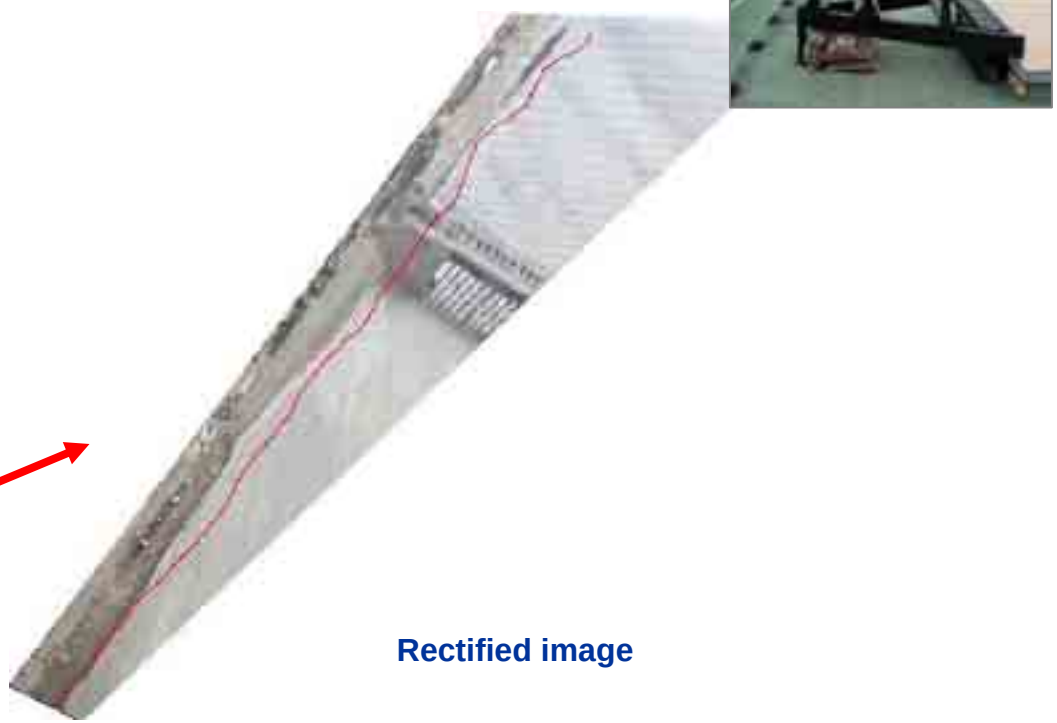
l.c. =litici carbonatici
M = muscovite
B = biotite
C = clorite
p = pesanti
S = selci
altri minerali


Linea di riva
1883
1954
1973
1979
1990
1998
2004
0
500
1000 m

WEBCAMS

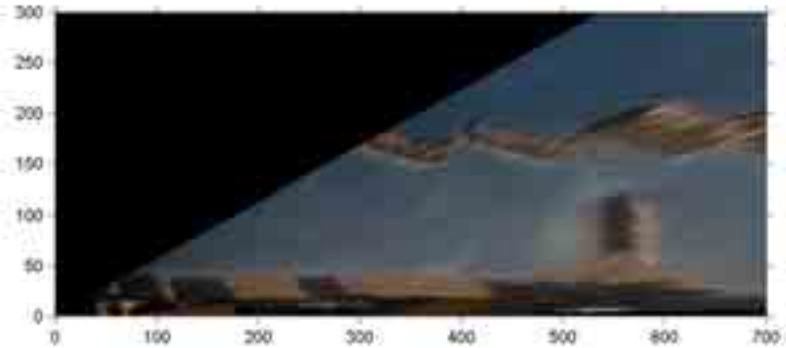
Shoreline survey with video monitoring

Autonomous system which collect, elaborate and transmit images of the coast.
(www.seatech.it/alassio/)



Rectified image

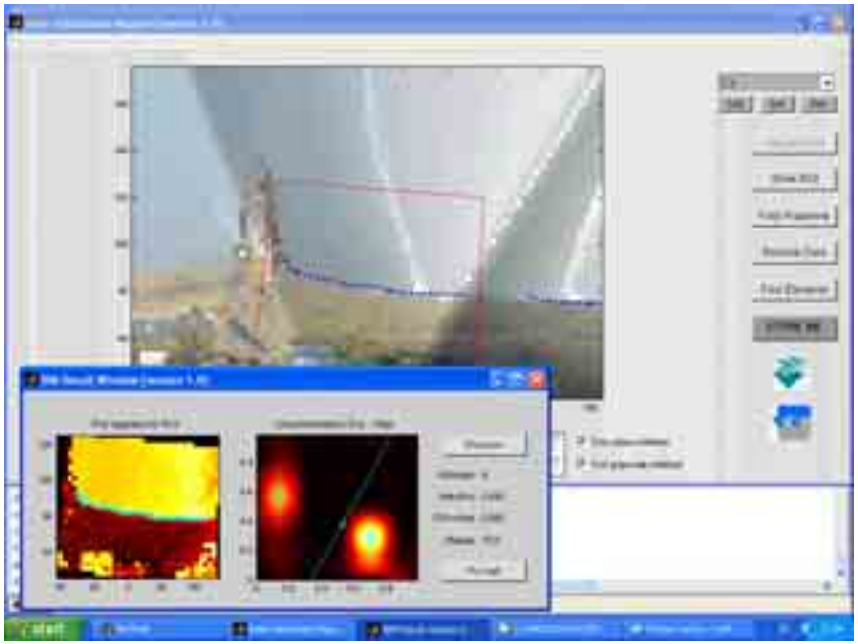
IMAGE ANALYSIS
SHORELINE DETECTION
ORTHO-RECTIFICATION



ANALYSIS OF SHORELINE EVOLUTION

PIC (*Pixel Intensity Clustering*)

(Aarninkhof e Roelvink, 1999)



RGB

(*Red Green Blue*)

HSV

(*Hue Saturation Value*)

Pixels (dry-wet) form two separate groups in the HS space

INTERTIDAL BEACH MAPPER

Using tides, for all hours of the day:

- shoreline is identified (x, y)

based on colour or luminescence;

- sea level is associated

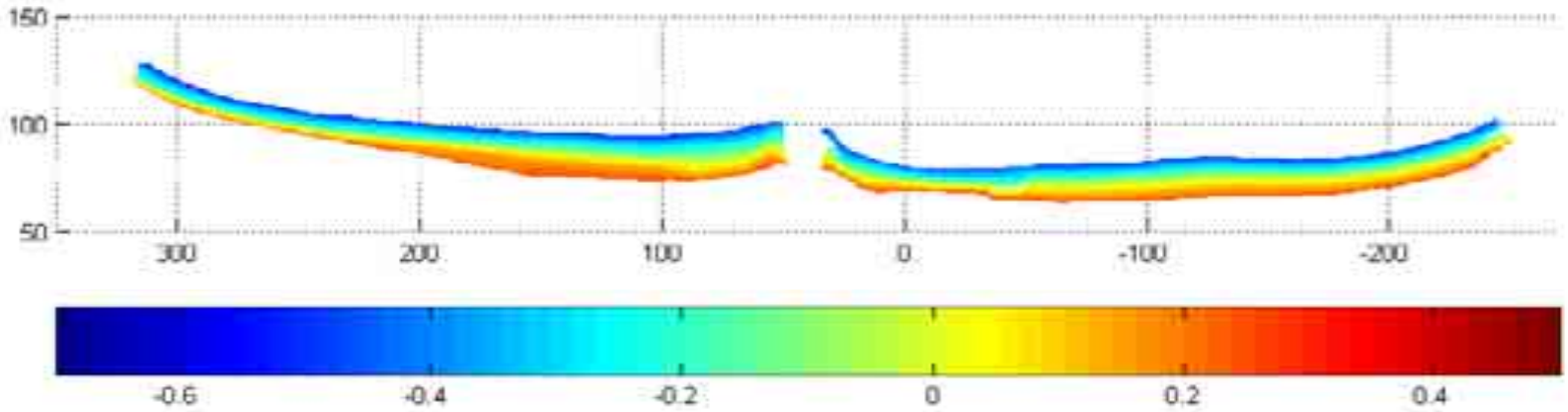
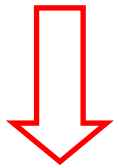
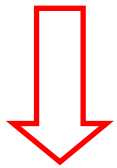


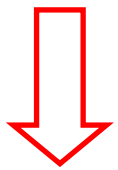
Image acquisition (commercial system)



Development of software for data elaboration
(Timex, Snapshot, Variance, rectification, shoreline digitalisation)



Interpretation of beach evolution and evaluation of beach nourishment



Field work to reduce error of interpretation and of calculations
(Detailed bathymetry, Topographical surveys of emerged beach, Topographical surveys of emerged beach, Grain-size analysis)


snapshot
20 JAN 06 -16h01


timex
20 JAN 06 – 16h


variance
20 JAN 06 – 16h

SEA CONTROL POINTS

Geodetic frame

Precision polygonal with benchmarks every 2 Km.
Connected at extremes to national levelling benchmarks network.

Sea level station for bathymetric survey, located close to the survey area.

More GPS benchmarks with static methodology and correction of elevation.

Local geodetic frames

Emerged beach survey

Different survey methods, using the same reference system:
Projection UTM Zone 32 datum WGS84 Spheroid WGS84 Ellissoid elevations

Traditional: equally spaced profiles every 50m with a suitable topographic instrument

GPS: equally spaced profiles every 5m with GPS type “RTK”

Shoreline survey with GPS technology

Geodetical GPS
With precision of about 5 mm (static), mono - dual frequency with phase measurement.

GPS "palm"
With precision of about ± 0.5 - 1 m with collection of phase measurement data

Survey with Single and Multi beam eco sounder

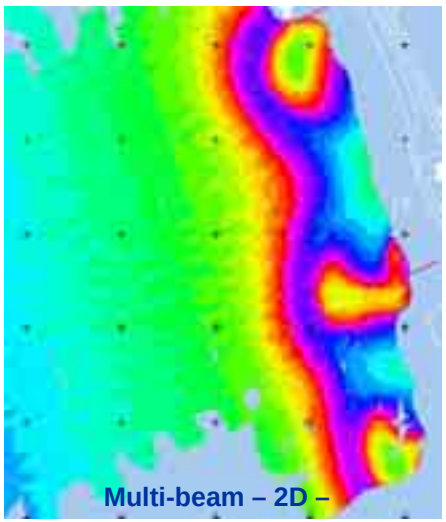
The Multi beam systems can survey a large belt of sea floor, of a width proportional to water depth.

Multi-beam

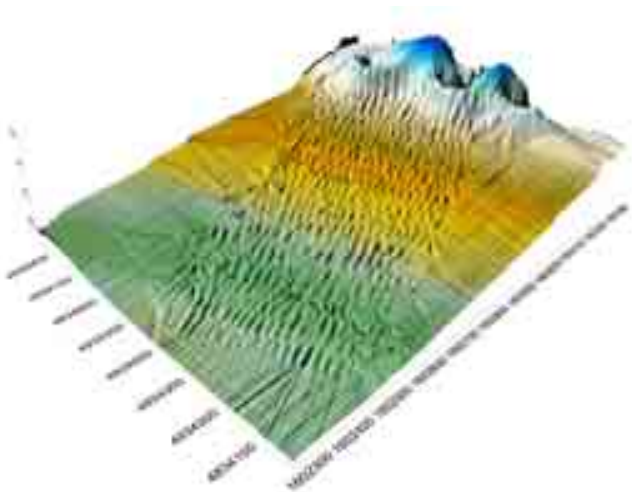
Contemporaneous survey should use the same reference system:

Single beam: section spaced 50 - 100 m

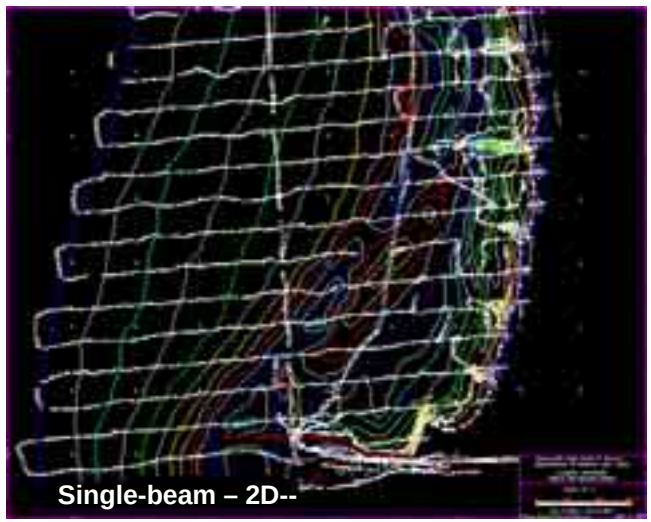
Multi-beam: Area 6 km²



Multi-beam – 2D –



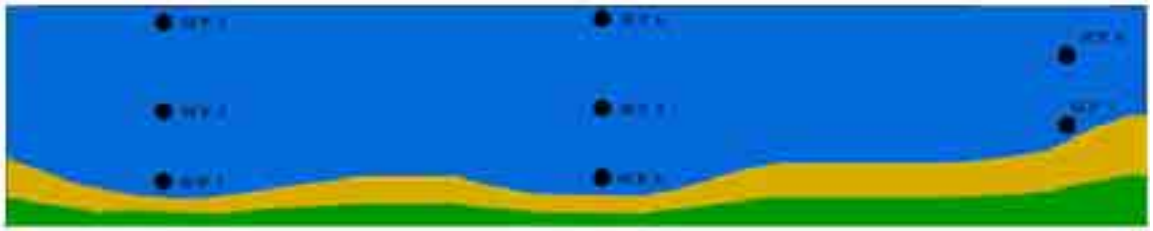
Multi-beam – 3D –

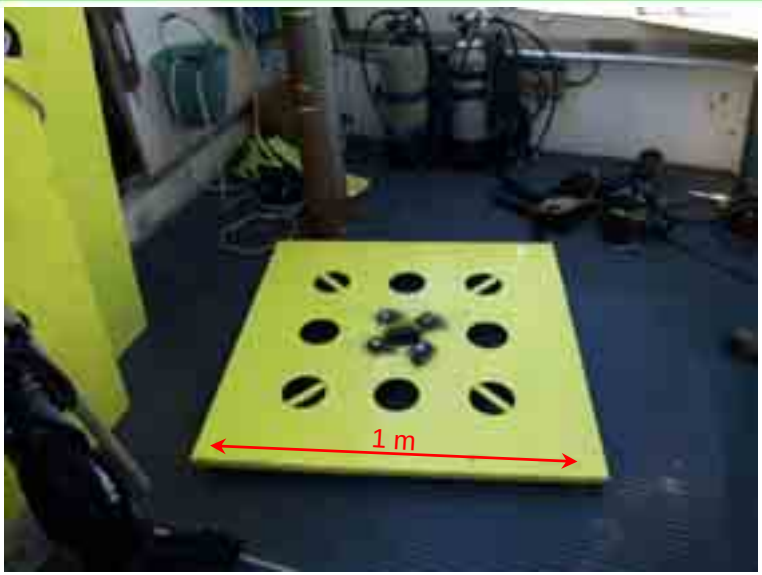


Single-beam – 2D--

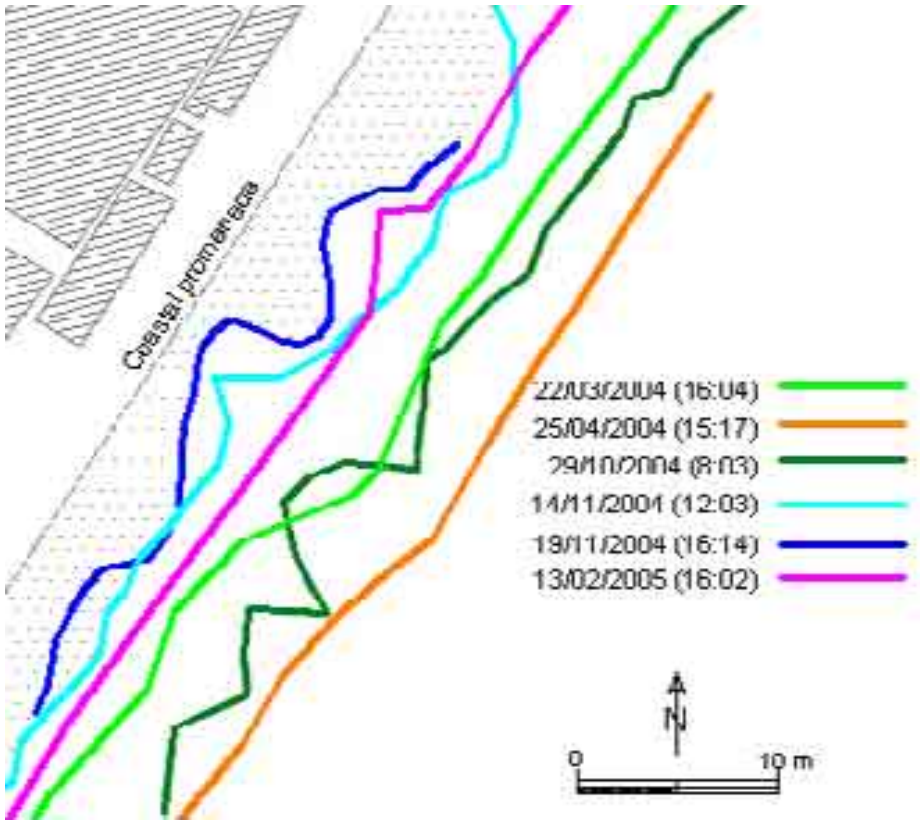
VVerifications: comparison of accuracy , volume calculations and profiles spacing, evaluations of times and costs, evaluations on low depth operability

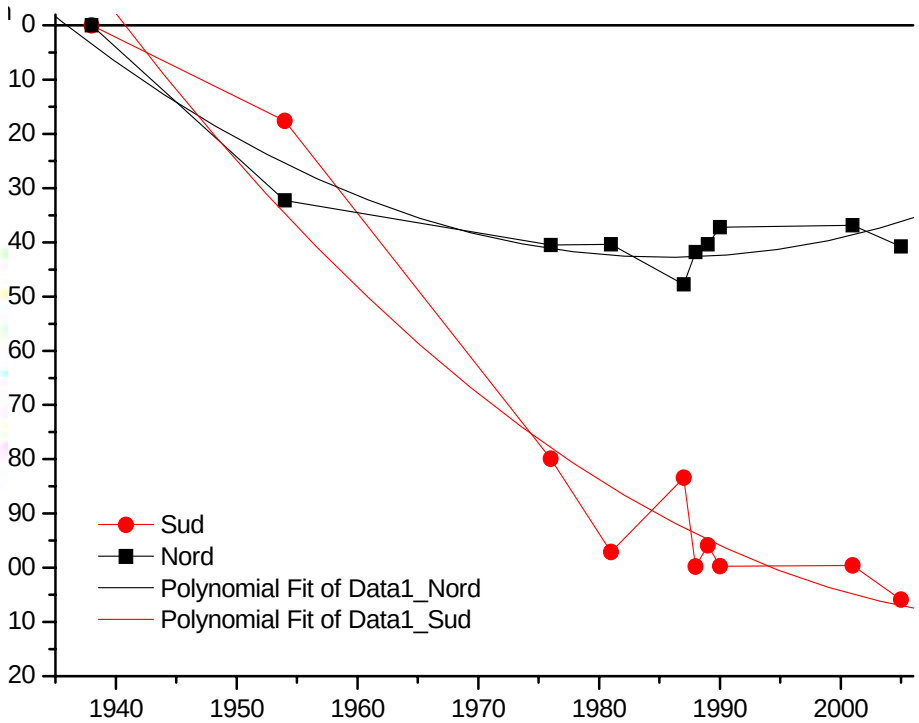
SEA CONTROL POINTS



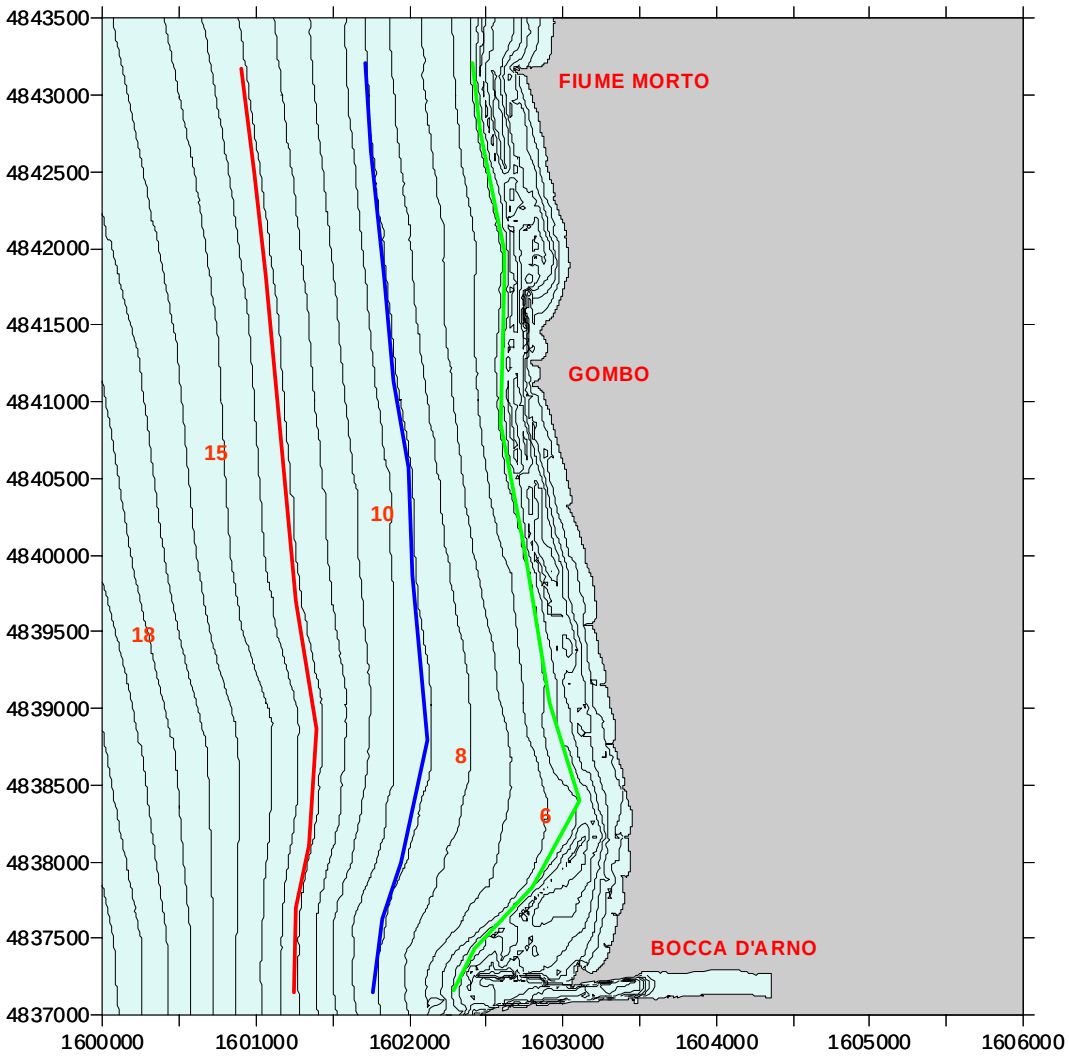


INTRINSEC BEACH VARIABILITY





EXAMPLE: LITTORAL AREA NEAR PISA

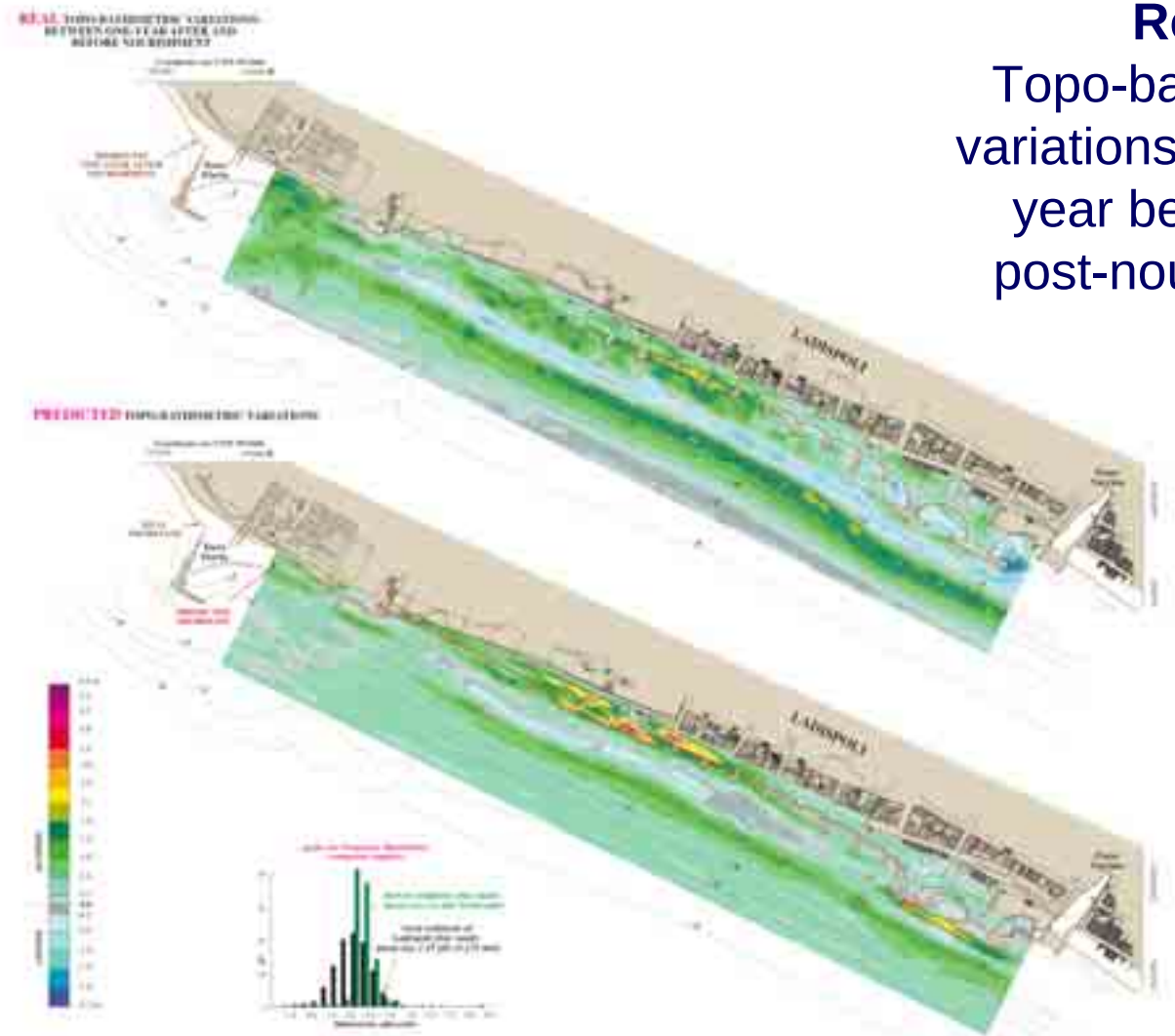


CLOSURE DEPTH 95% PROBABILITY

MAX CLOSURE DEPTH BASED ON WAVE CLIMATE 1993-2004

EXTREME CLOSURE DEPTH FOR A RETURN PERIOD OF 50 YEARS

CALIBRATION FOR MODEL APPLICATIONS



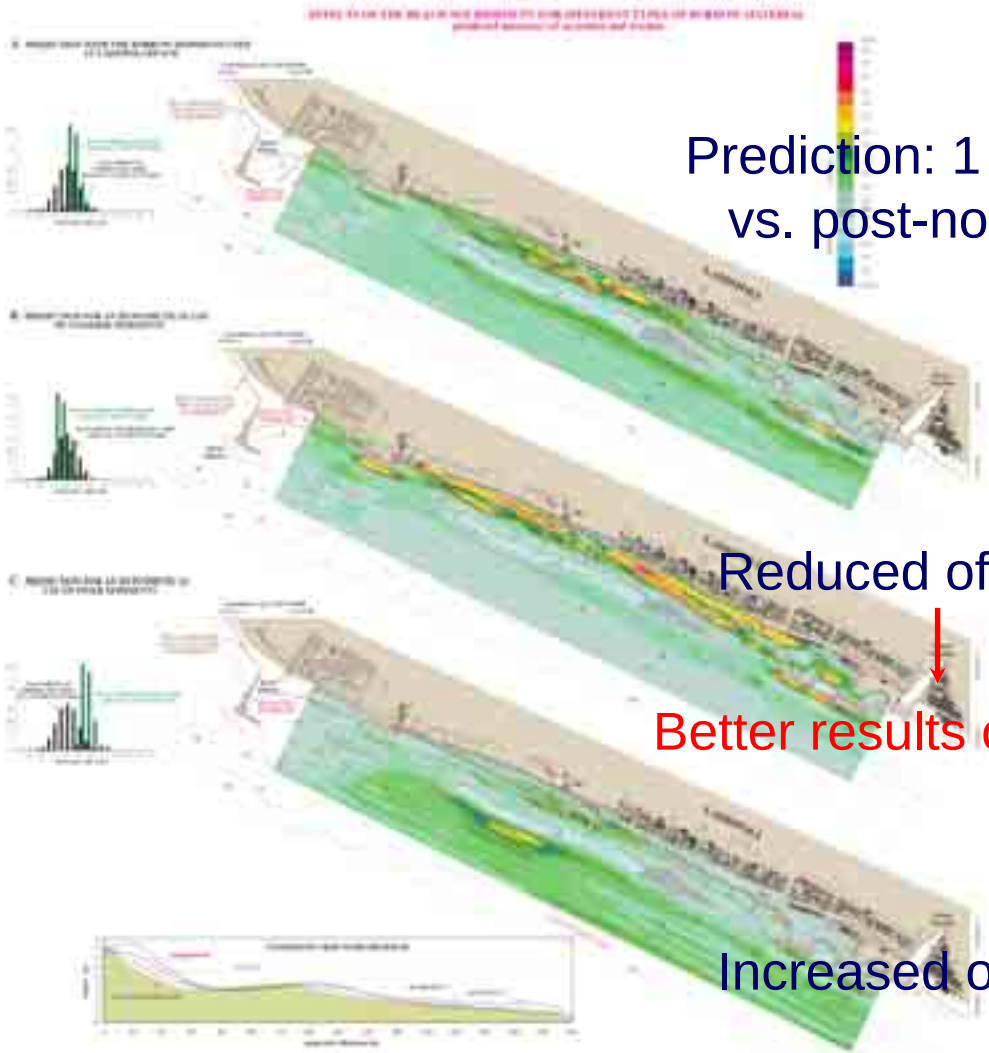
Real:
Topo-bathymetric variations between 1 year before and post-nourishment

Prediction

Ladispoli, April 2003: 367.000 m^3

Model sensibility for different grain size characteristics

CALIBRATION FOR MODEL APPLICATIONS



Prediction: 1 year before vs. post-nourishment

Reduced of 1 phi

Better results on beach accretion

Increased of 1 phi