



**7th international SedNet event**  
**6-9 April 2011**  
**Venice, Italy**

Hosted and co-organised by Thetis SpA

**Sediments and Biodiversity:**  
**bridging the gap between science and policy**

**INTEGRATED COASTAL SEDIMENT MANAGEMENT AT  
PHYSIOGRAPHIC UNIT SCALE, AN APPLICATION IN  
VERSILIA LITTORAL (TUSCANY, ITALY)**



**Damiano Scarcella (Msc)**



**Sergio Cappucci (PhD)**

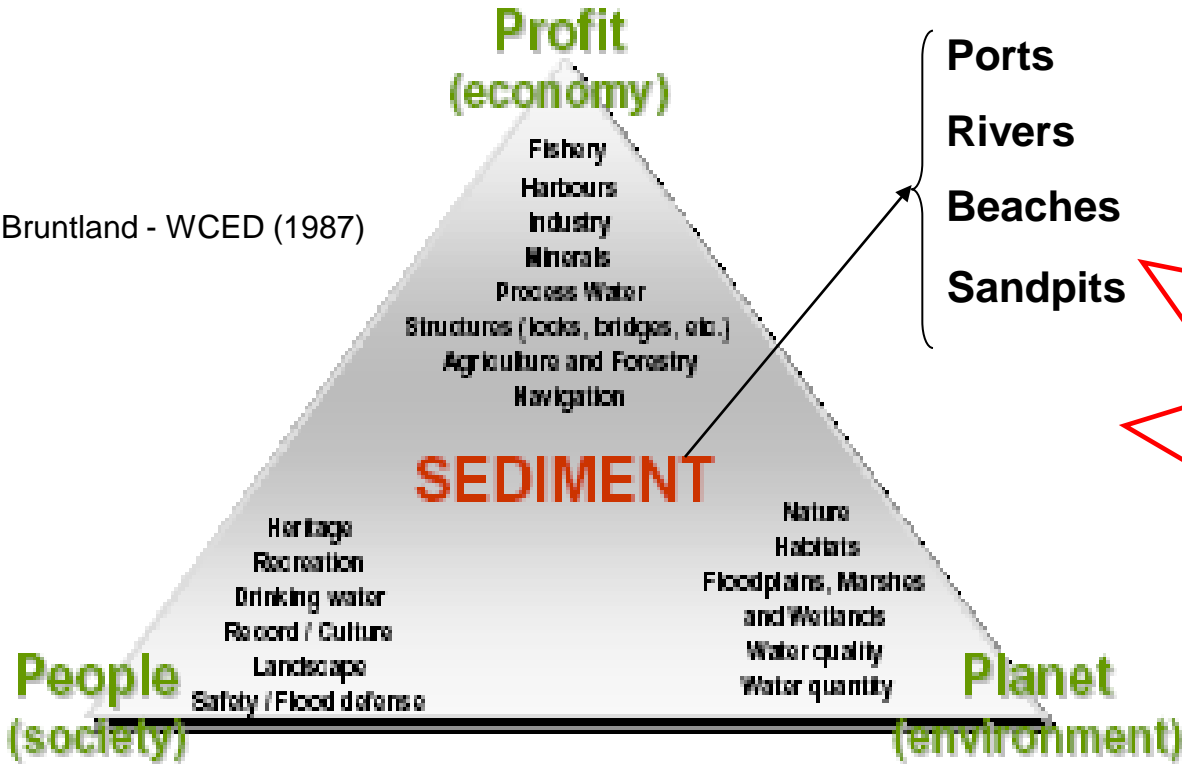


**Andrea Taramelli (PhD)**

## OUTLINE

- **Sediment management role in ICZM**
- **Need for a decision support system tool**
- **Principal features of the Sediment Management Decision Support System (SMDSS)**
- **Sediment management and policy making in port dredging: Marina di Carrara**
- **Data input and some expected output from SMDSS on Apuo-Versilian coastal cell**
- **Conclusions**

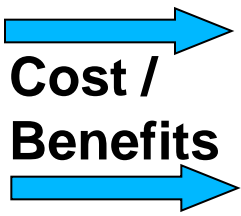
# COASTAL EROSION: A BROAD VISION



**1150 Km of sandy coast at Risk for erosion in Italy (ISPRA 2010)**

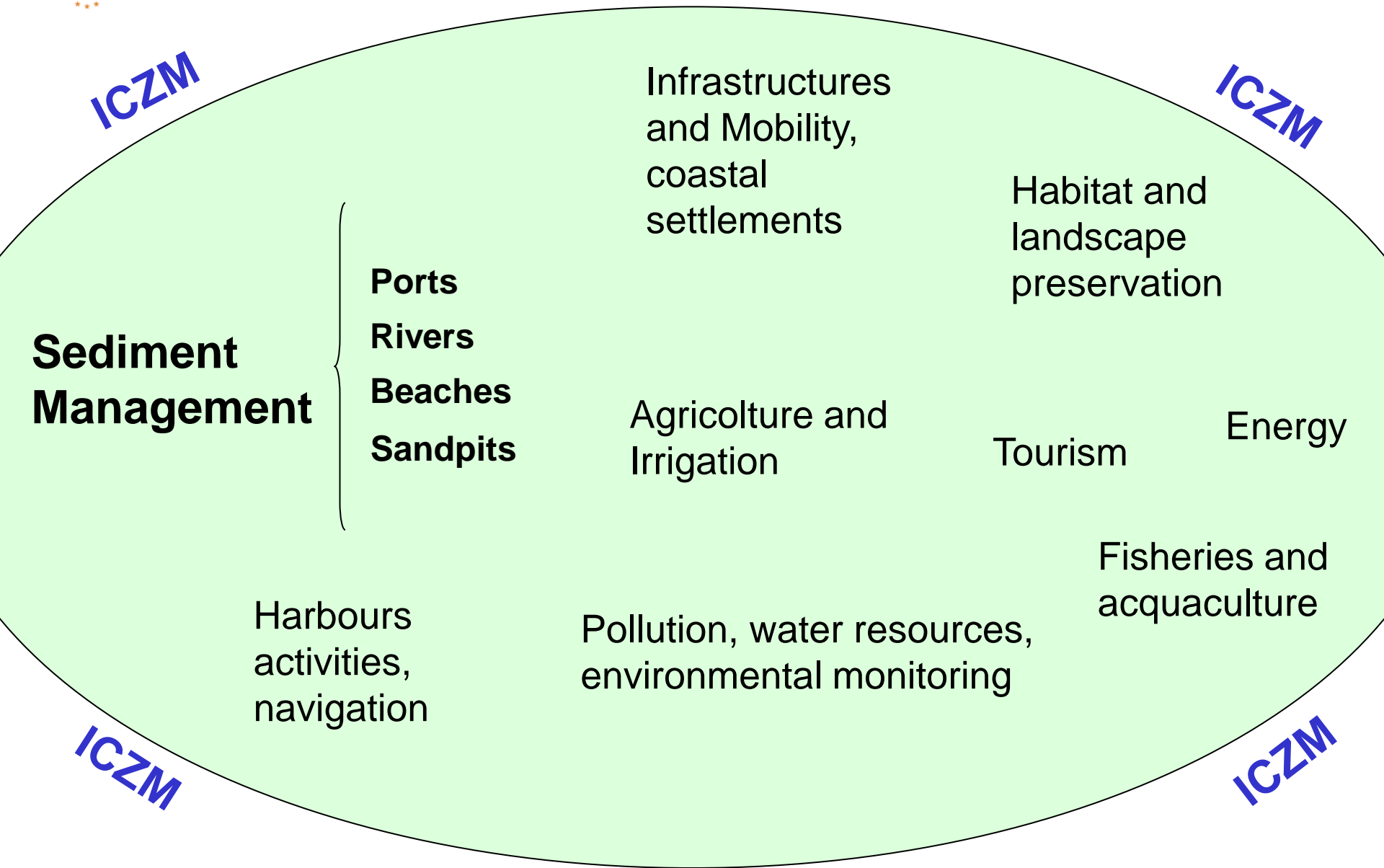
**Funding**

**Planning and design**



**Public Private Partnership and Project Financing**

**Integrated approach and best practice**



## ICZM IN EUROPE

May 2002 – EU Recommendation for actuation of ICZM in Europe

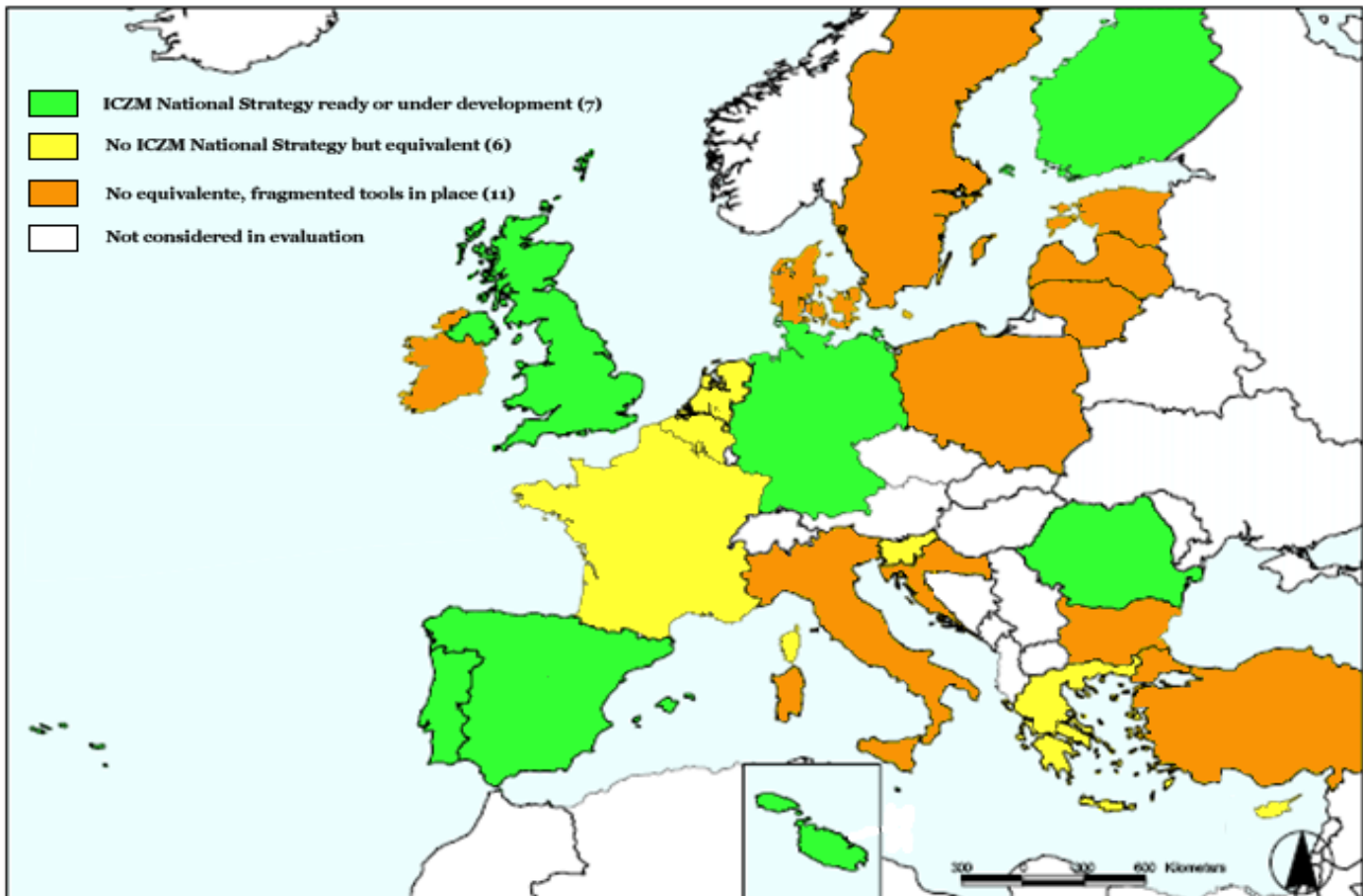
June 2006-Ottobre 2007, publication of green and blue Books of EU on Integrated marine policy (ICZM and use of the sea)

January 2008 (Madrid), VII Protocol of Barcellona Convention on ICZM in the Mediterranean Sea

September 2010: EU Adoption of the ICZM protocol

April 2011: EU Commission public consultation on possible EU action on ICZM

# ICZM IN EUROPE



- In eleven countries, namely Bulgaria, Croatia, Denmark, Estonia, Ireland, Italy, Latvia, Lithuania, Poland, Sweden, and Turkey, no ICZM equivalent policies are in advanced stages of preparation, only fragmented tools are in place to address coastal issues.

# PLANNING INSTRUMENTS AND DIRECTIVES INVOLVING SEDIMENTS

## EU

**ICZM procol**

**Water framework directive**

**Marine strategy framework directive**

## Local – Planning instruments

**Harbour masterplans**

**Municipalities masterplans**

**River basin masterplan for hydrogeologic risk (PAI) italian D.L. 180/98**

**Reservoir management plan italian Law 152/99**

**Regional ICZM planning**

# NEED FOR A DECISIONS SUPPORT SYSTEM

## INTEGRATED SYSTEM TO MANAGE PROCEDURES LINKED TO GEOGRAPHICAL FEATURES

**PEOPLE**

- Regions
- Provinces
- Municipalities
- Port Authorities
- Reservoir owners
- National research institutes
- Dredging companies

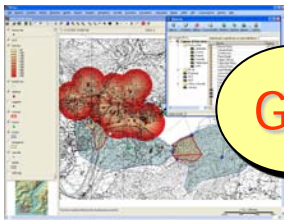
**RESOURCES**

**Sediments !**

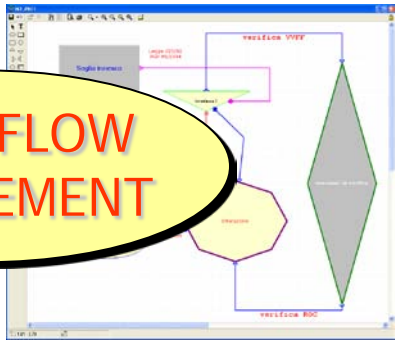
**ACTIONS**

- Port dredging
- Beach nourishment
- Hard coastal defence
- Marinas construction
- Reservoir management
- Offshore sandpit dredging
- Land reclamation
- Creation of sand trap
- River dredging

**GIS**



**WORK FLOW MANAGEMENT**



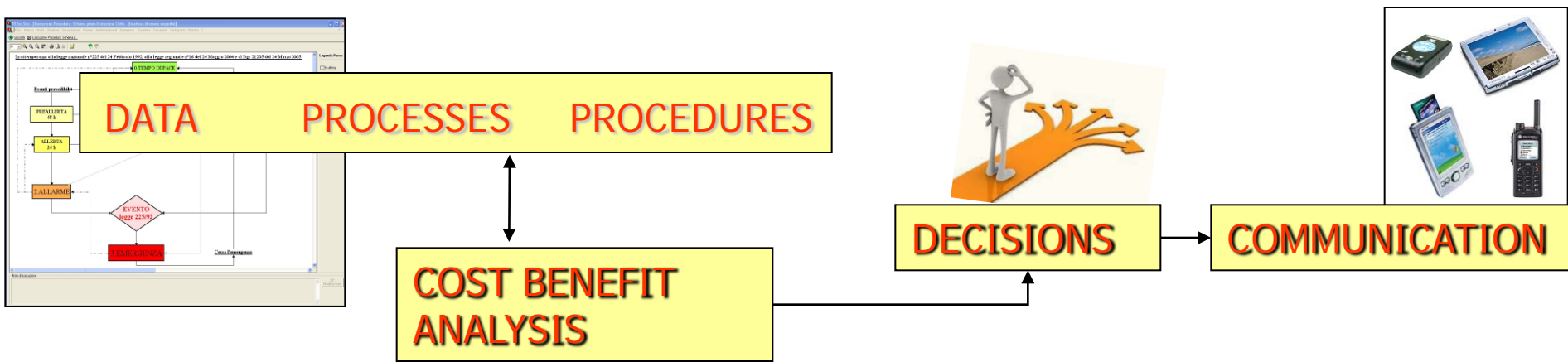
Adapted from Globo, 2008



# FEATURES OF A SM DECISIONS SUPPORT SYSTEM

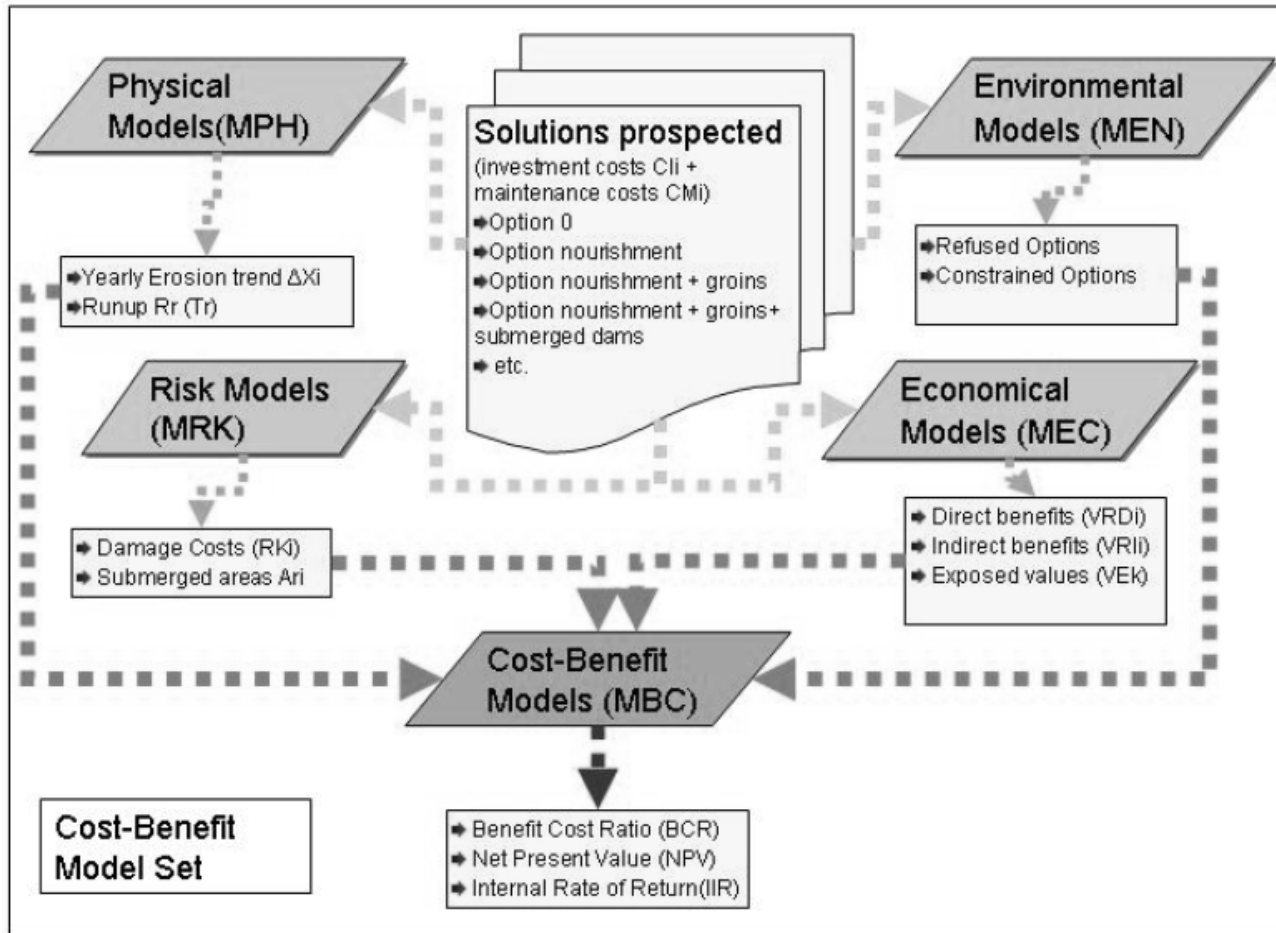
## COMPOUND DSS (database + rules)

1. **Inputs:** Factors, numbers, and features to analyze
2. **Users Knowledge and Expertise:** Inputs requiring manual analysis by multiple users
3. **Outputs:** Transformed data from which DSS "decisions" are generated
4. **Decisions:** Results generated by the DSS based on user criteria (cost-benefit, life saving...)



Adapted from Globo, 2008

# COST / BENEFIT ANALYSIS FOR BEACH NOURISHMENT



From Lupino, 2006

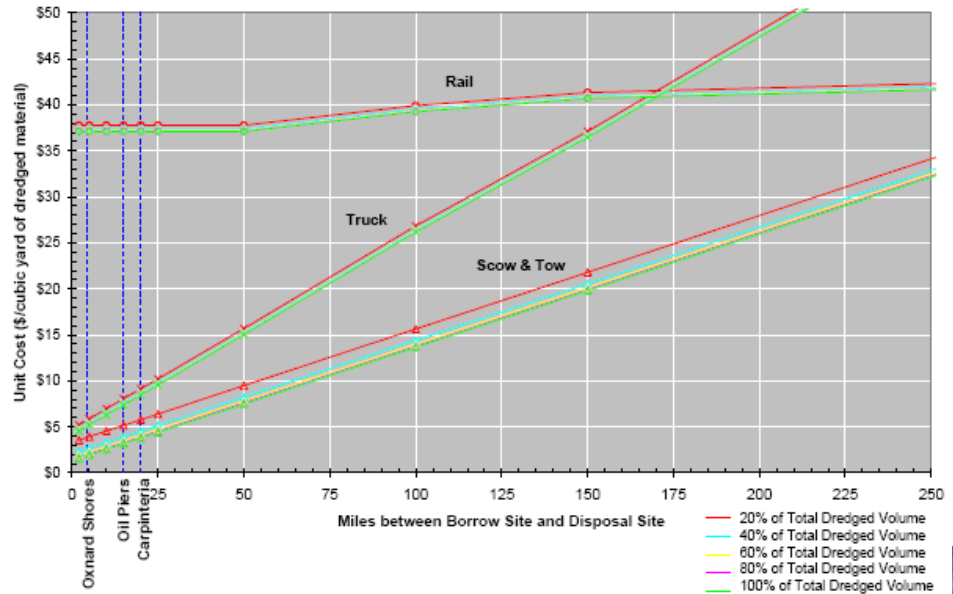
# COST / BENEFIT ANALYSIS FOR BEACH NOURISHMENT

## ... SOME COSTS

Nourishment vs. hard structures

- Hard defence: 4.5M€ / Km
- Soft defence: 4 M€ / Km
- (Italian Ministry of Environment, 2006)

Transportation cost for sediment  
(USACE RSM, 2004)

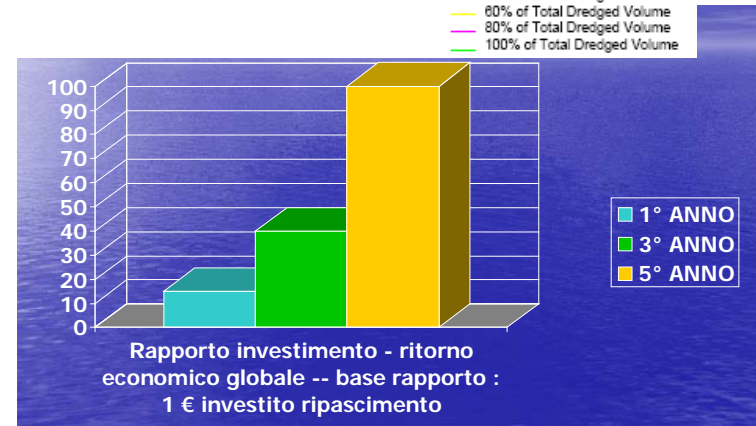


## ...SOME BENEFITS

Recreational value for beaches

- Local Interviews: 1.500€/m<sup>2</sup> (Nomisma, 2005)
- Travel cost method

Tax Revenues (Italy: State – Regions?)



Elaborated from Nomisma, 2005

## CASE STUDY: INPUT FOR A SMDSS: APUO-VERSILIAN COASTS

### INPUTS: Factors, numbers, and feature to analyze

#### Where

- Harbours
- Beaches
- Reservoirs
- Sand pits

#### What

- Capital dredging and maintenance of coastal structures
- Siltation rate ( $m^3/y$ ) of ports
- Long shore transport
- Water and sediment discharge of rivers
- Reservoir's storage capacity
- Periodic bathymetric and coastline surveys
- Sea bed mapping and classification
- Search and characterization of off shore sand deposits
- Pollutant contents for emerged-beaches and seabed sediments
- Possible sandtrap locations

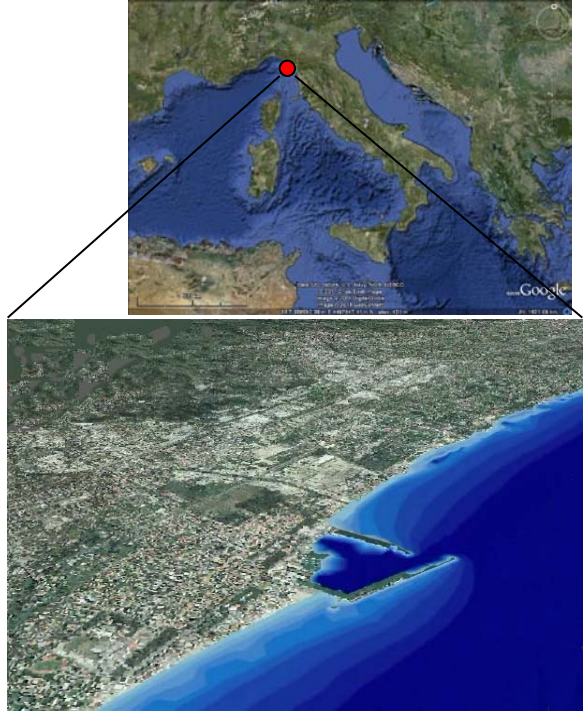
# DREDGING AND DISPOSAL OPERATIONS AT MARINA DI CARRARA



Integrated coastal zone management at Marina di Carrara Harbor: sediment management and policy making

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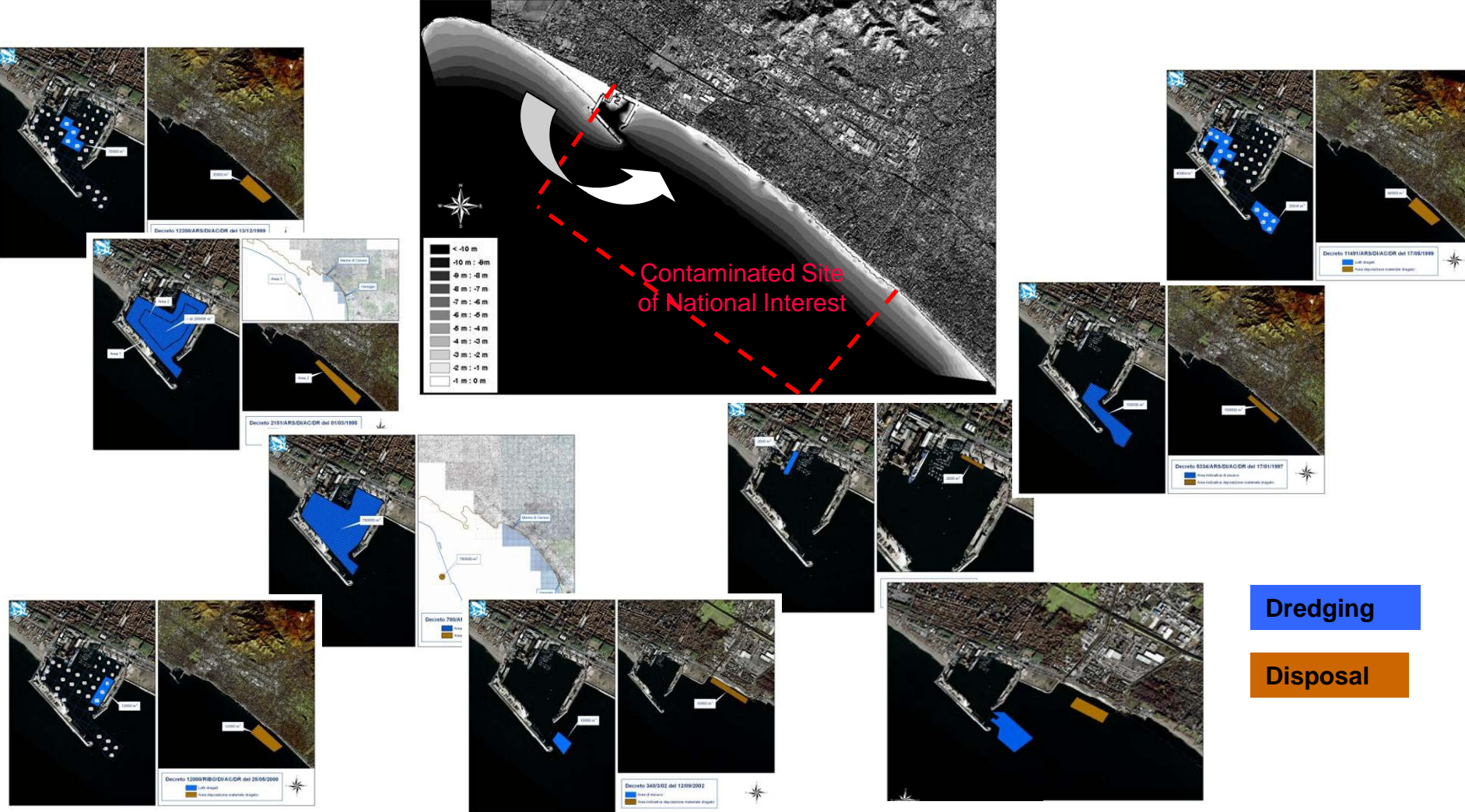
1993 - 2008

- Sedimentological evidence of infill process
- Time history of dredge and fill operations
- Contamination level

Sediment management

Influence on sediment budget

# DREDGING AND DISPOSAL OPERATIONS AT MARINA DI CARRARA



## DREDGING AND DISPOSAL OPERATIONS AT MARINA DI CARRARA

Reference	year	Dredged Volume (m <sup>3</sup> )		Destination (m <sup>3</sup> )			
				Sediment Transfer and Input		Sediment Output	
		Basin	Inlet	Shoreface Nourishment	Offshore Dumping	CDF	Landfill
Dec. 780	1993	305,000			305,000		
Dec. 2151	1995	86,000		86,000			
Dec. 5334	1997	100,000		100,000			
Dec. 11491	1999	66,500		66,500			
Dec. 12208	1999	35,000	-	35,000			
Dec. 12800	2000	12,000	-	12,000			
CDF project	2000	188,000				188,000	
Dec. 47/02	2001	2,000	-			2,000	
Dec. 340	2002	-	10,000	10,000			
Dec. 1719	2004	-	10,000	10,000			
File 2106/06	2006	-	10,000				10,000
Dec. 4010	2007	-	25,000	25,000		25,000	
<b>TOTAL</b>		849,500		344,500	305,000	215,000	10,000

- Dredged volumes authorized by MATTM with 10 decrees (2 authorized by local administrations in 2000 and 2006)

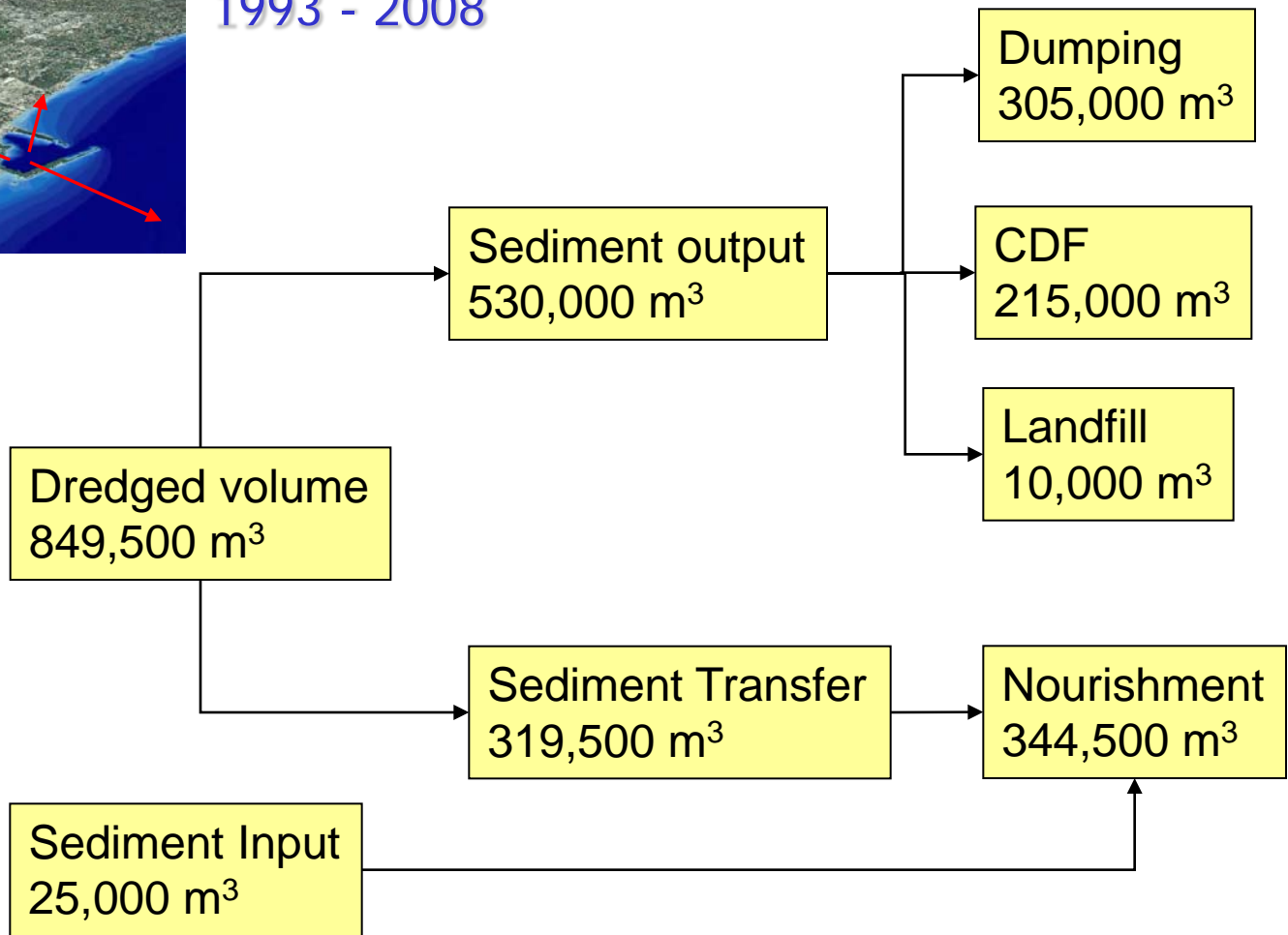
- The last 4 interventions (out of 12) were carried out at the harbor inlet, suggesting an **average filling of about 10.000 m<sup>3</sup>/y.**

- The 2007 nourishment was imposed for compensation

# DREDGING AND DISPOSAL OPERATIONS AT MARINA DI CARRARA

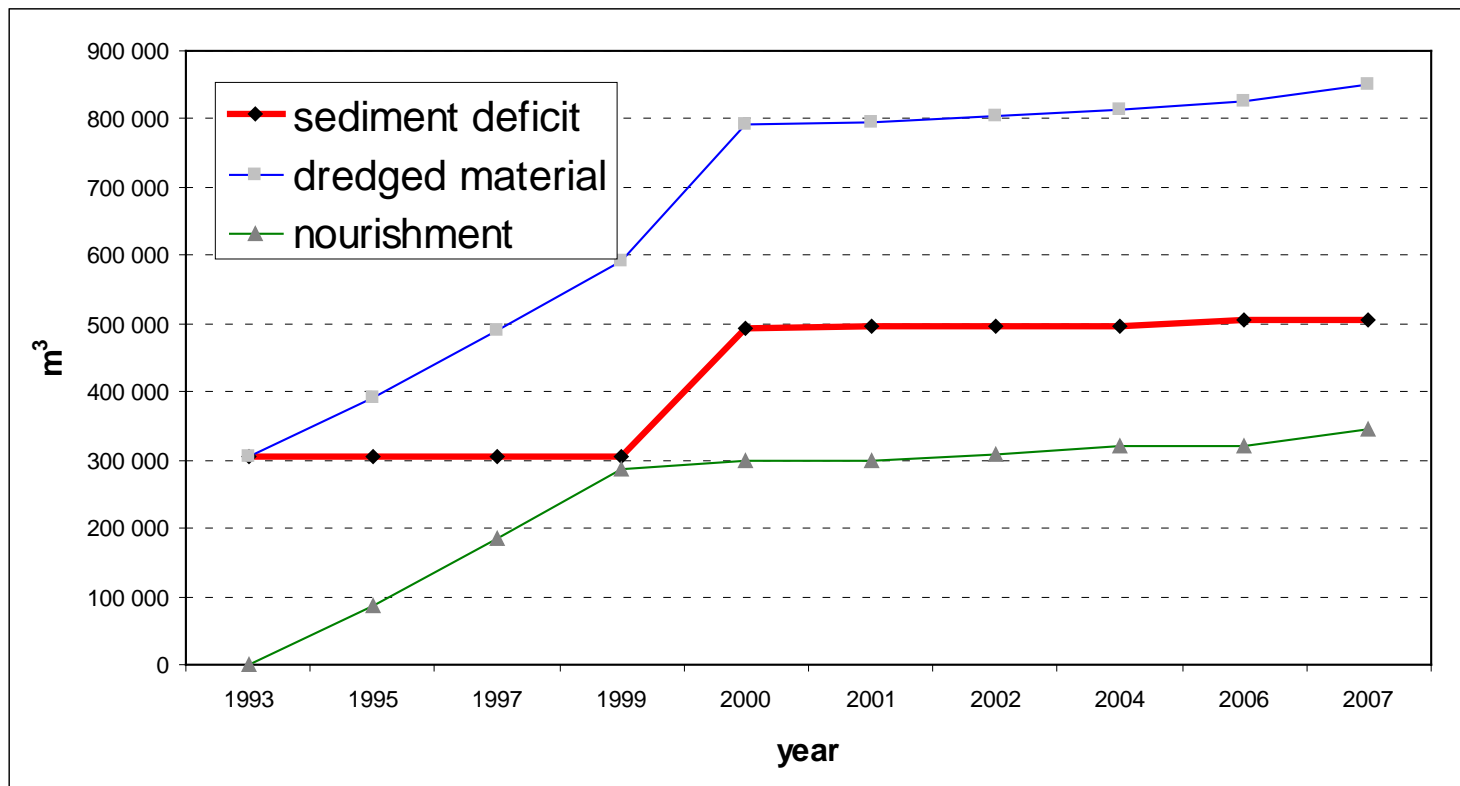


1993 - 2008





# DREDGING AND DISPOSAL OPERATIONS AT MARINA DI CARRARA



The sediment deficit mainly caused by the recent dredging of the harbor inlet to a depth of 10 m and delivery of the sediment to a CDF. After 2000 the small dredging has been almost compensated by downdrift nourishment. The compensation strategy was imposed only in 2007.

## APUO-VERSILIAN COAST CELL (north)

Length: 50 km  
(between Magra River and Livorno)

A S.I.N. was  
established in 1999

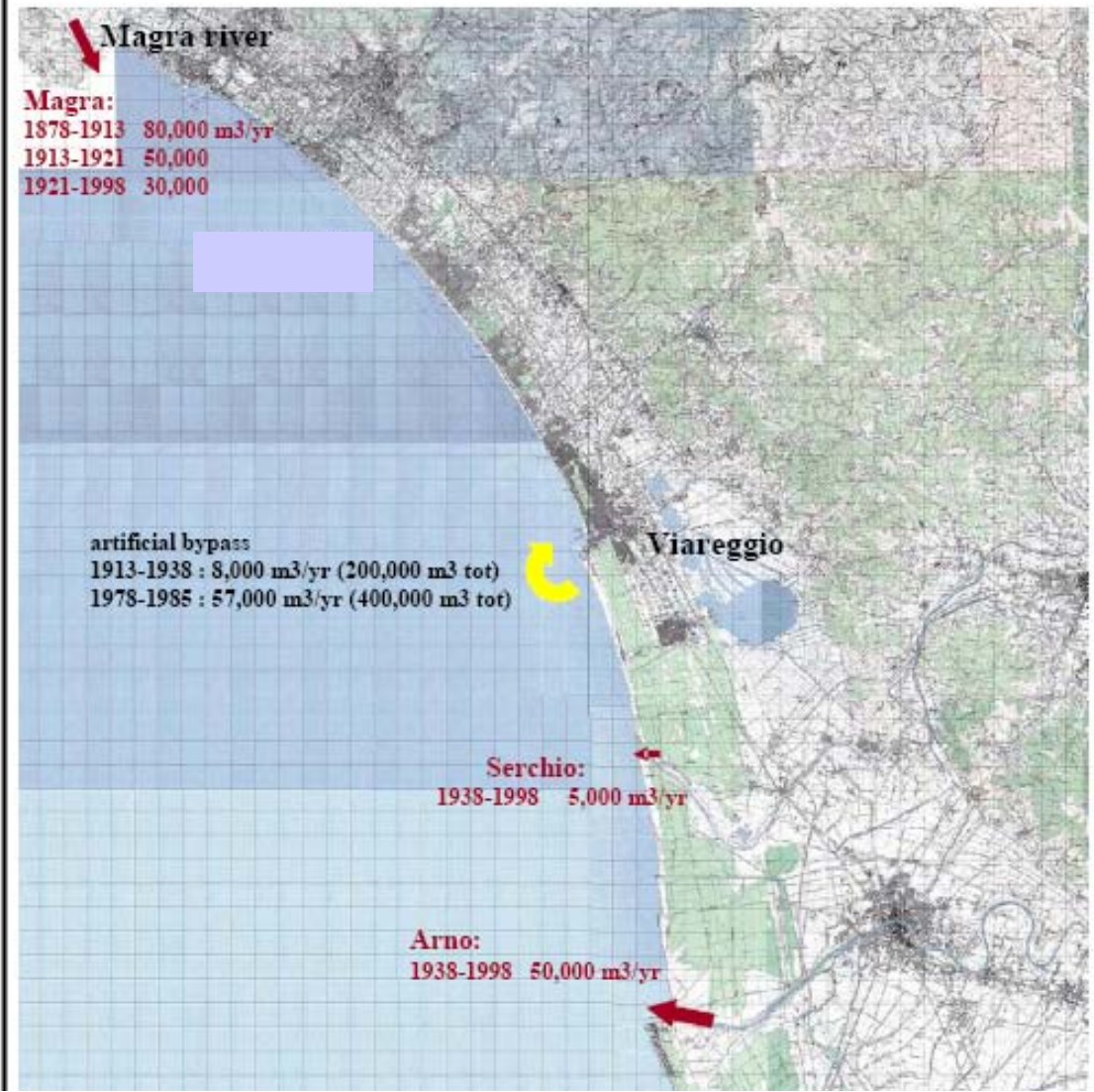
Marina di Carrara  
harbour was built in  
1924 and Viareggio  
in 1604. They both  
suffer periodical infill.

River Magra also  
needs dredging for  
navigation



# APUO-VERSILIAN COAST CELL: RIVER SOLID TRANSPORT

**Magra:**  
**66.000 m<sup>3</sup>/y**  
**(Cappucci et al, 2008)**

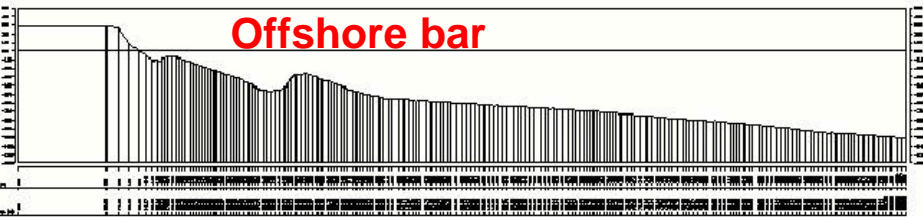


From Deltares, 2006

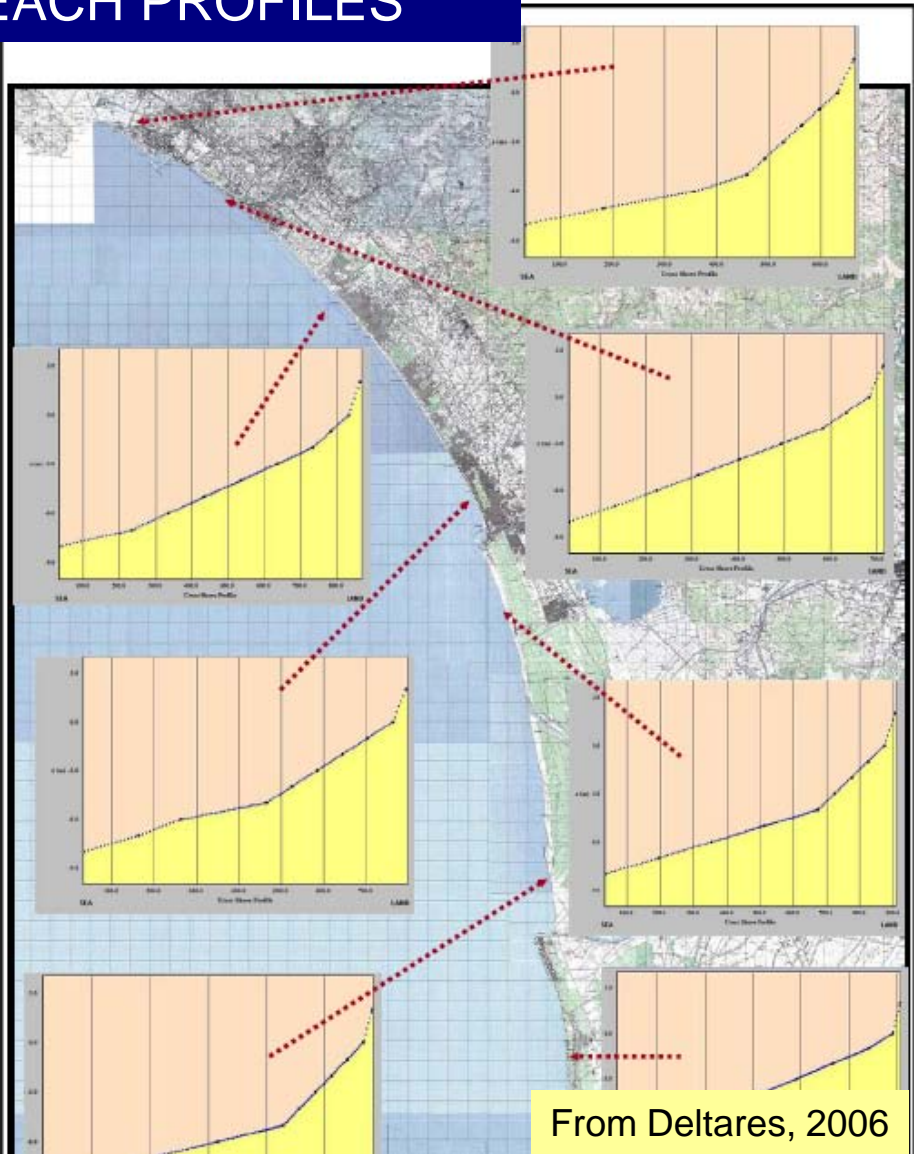
# APUO-VERSILIAN COAST CELL: BEACH PROFILES

Sedimentological surveys  
on 393 transects (Regione Toscana)

**Offshore bar**

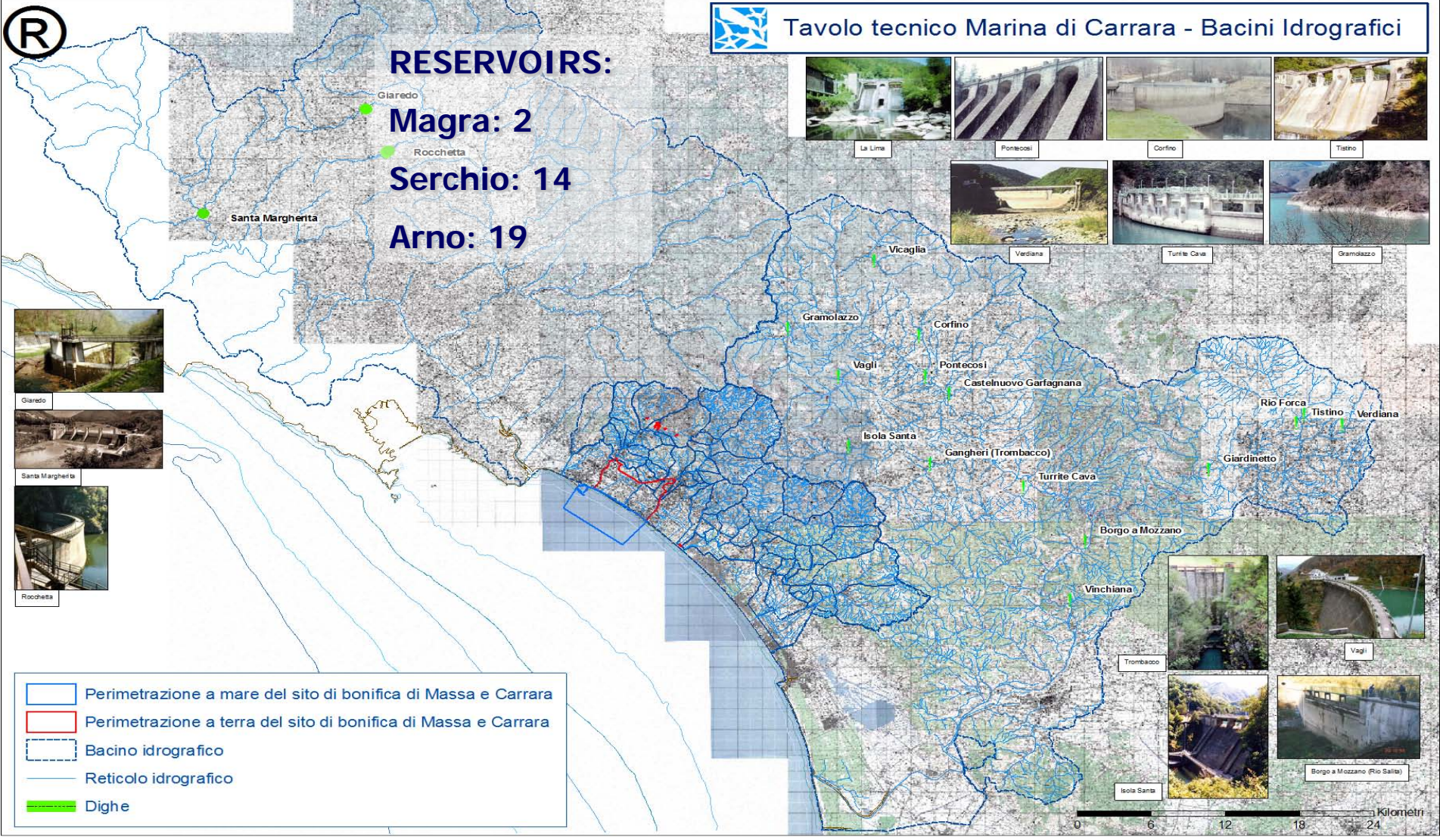


**Submerged breakwater**

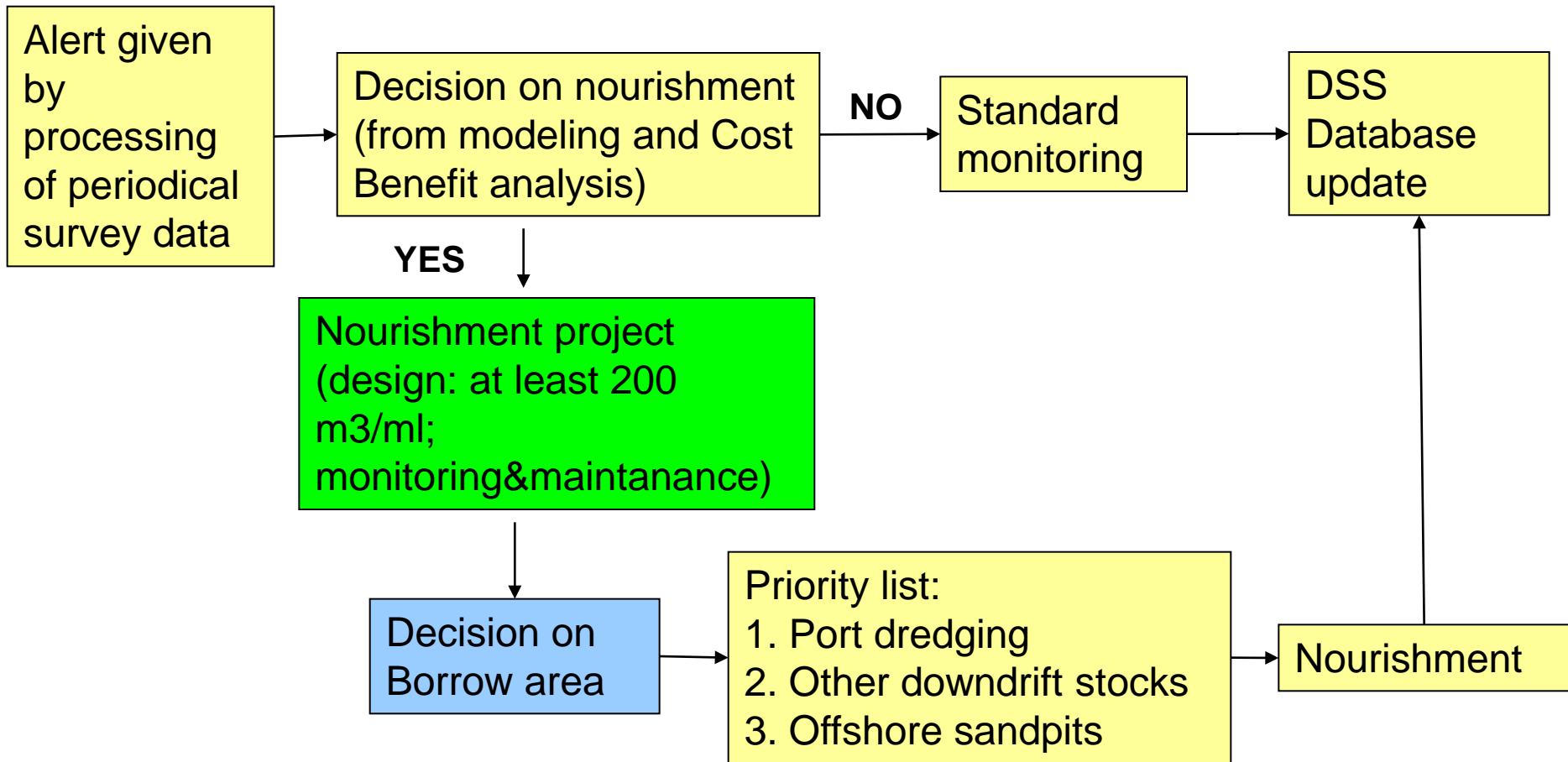


From Deltares, 2006

# APUO-VERSILIAN COAST CELL: RESERVOIRS



# NOURISHMENT PLANNING / LONG TERM EROSION



## CONCLUSIONS

- ICZM ask for an Integrated Sediment Management
- A DSS approach for sediment management (SMDSS) can help to better design any intervention and to obtain better cost/benefit performances
- Different users (responsible administrations) need the same DSS in order to keep the management integrated
- The SMDSS can be a compound DSS structured with database and rules that can come from numerical modeling
- DSSSM structure can be modular in order to better allow the deepening of any ring of the chain
- Input data for a prototype of SMDSS on the Apuo Versilian coast has been showed. The data must be shared, the action must be coordinated

**THANK YOU FOR THE ATTENTION !**

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