

# A new tool for littorals management support in Emilia-Romagna the Littoral Cells Information and Management System (SICELL)

Roberto Montanari, Christian Marasmi – Regione Emilia-Romagna  
Margherita Aguzzi, Nunzio De Nigris – ARPA Emilia-Romagna

**EUREGEO 2012**

**Session 5 – Coastal System management**

---

Bologna, 15 June 2012

# The Littoral Cells Management System (SICELL)

INTRODUCTION

DATABASE CONTENTS

ANALYSES AND ELABORATION EXAMPLES

APPLICATIONS

ADVANCEMENTS

CONCLUSIONS

## INTRODUCTION

The **SICELL** (Littoral Cells management System ) is an information system created for coastal protection and management purposes, based on the subdivision of the territory by littoral cells

Developed within the COASTANCE project (MED Program) 

**Emilia-Romagna** regional working group :

- Soil and Coast Protection and land reclamation Service (coordination)
- Geological, Seismic and Soil Service
- Po di Volano Basin and Coast Technical Service
- Romagna Basin Technical Service
- SeaCoast Special Unit of ARPA Technical Directorate

**Publication 1st release distributed within COASTEXPO 2011 (Ferrara)**

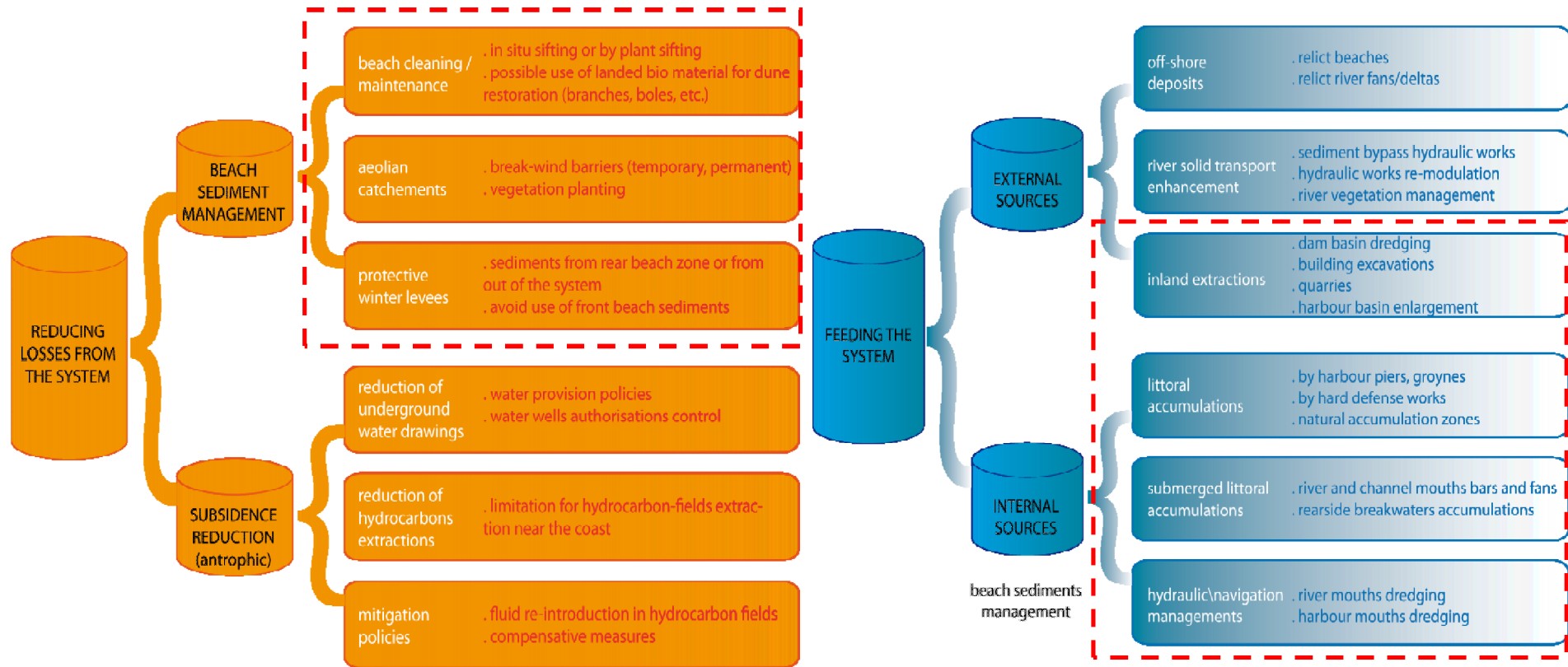
**2nd release distributed within EUREGEO 2012 (Bologna)**

**Soon available in English version**



## INTRODUCTION

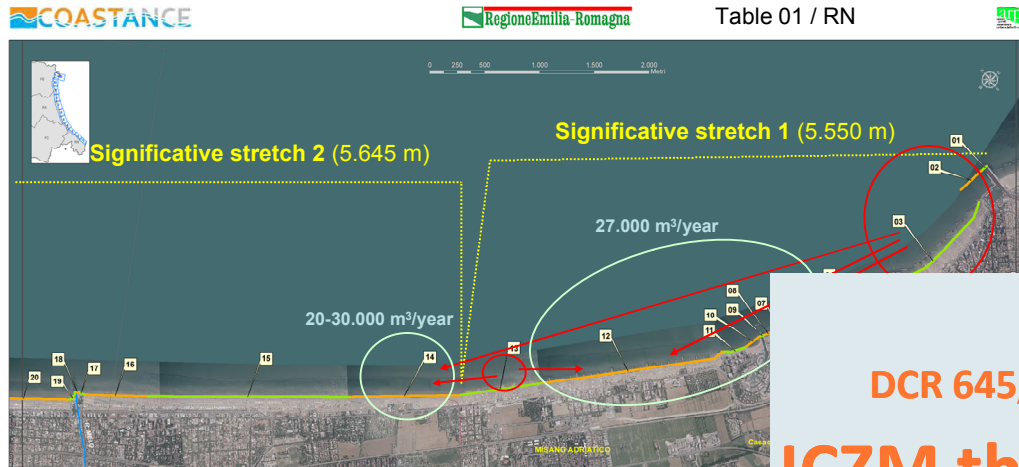
# The strategy for the sustainable management of littorals and sediments in Emilia-Romagna



**SICELL application ambit**

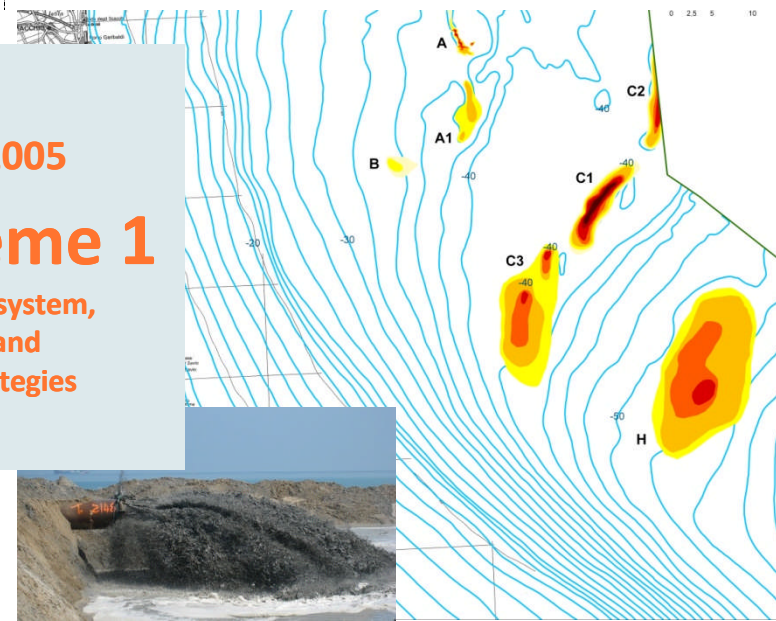
**INTRODUCTION**

**Emilia-Romagna Coastal defense assets and actions**



**2002 and 2007 interventions**  
 1,6 Million m<sup>3</sup> of sand from off-shore deposits  
 12 littoral stretches  
 19 km of total extension  
 26 M€ of total investment

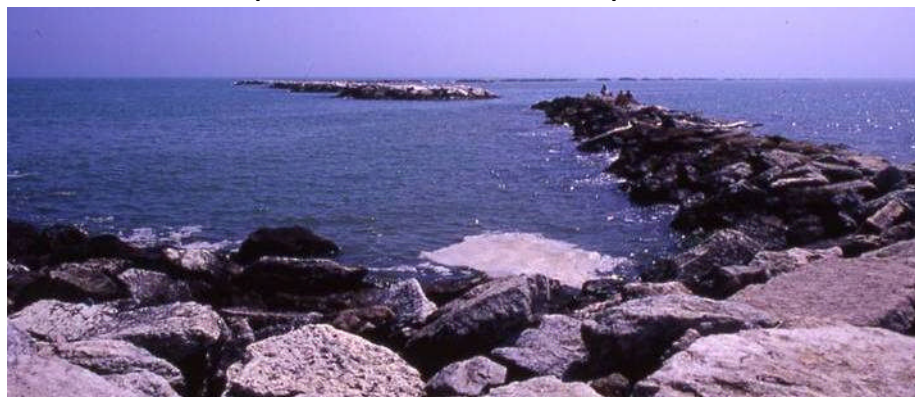
**DCR 645/2005**  
**ICZM theme 1**  
 Coastal physical system, risk factors and protection strategies



**Littoral Cells management system (SICELL)**

**Beach nourishments**

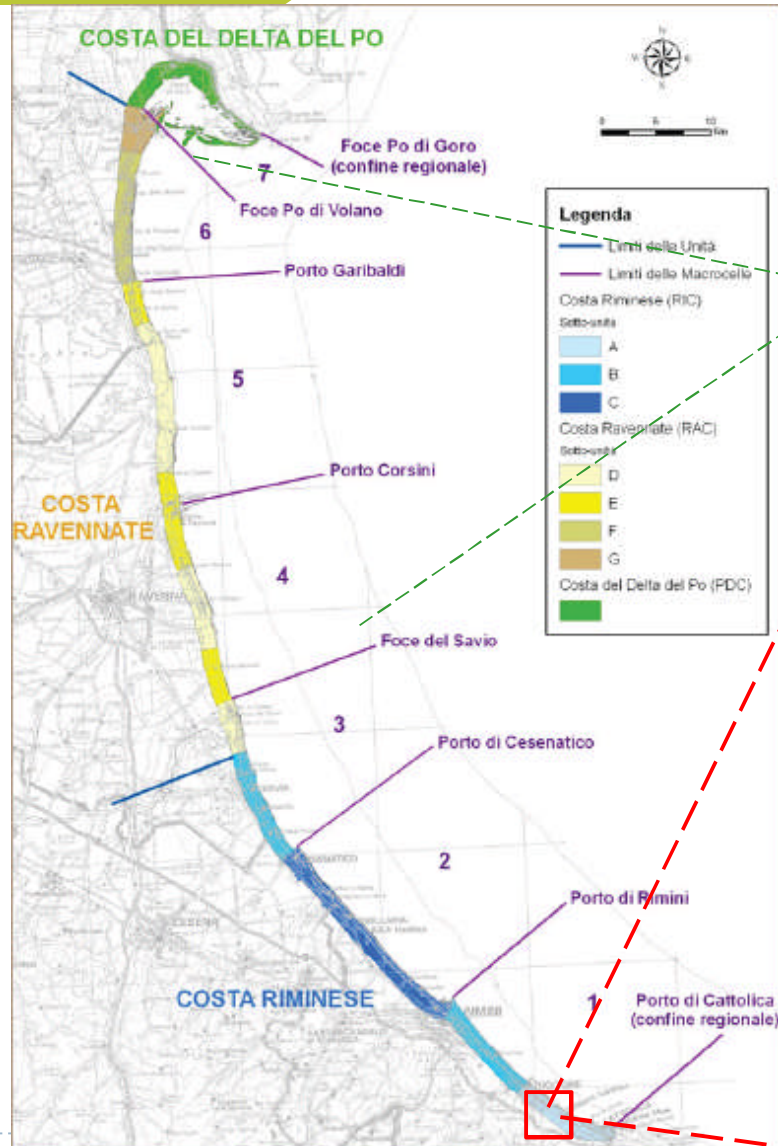
- littoral accumulation
- port dredging, building excavation
- off-shore deposits sustainable exploitation



**Hard defense maintenance, re-modulation or de-commitment**

- rocky materials
- wood, textile, sand & textile

## INTRODUCTION Subdivision of the regional coast by littoral management Cells



Littoral subdivision by **7 Macrocells**, limited by long harbour piers or by alongshore solid transport “zero\* points”, and by **3 Geomorphologic Units** (RIC, RAC e PDC) and 7 Sub-Units (A, B, C, D, E, F, G).

- \* Po di Volano river mouth – convergence zone
- \* Savio river mouth – divergence zone

### Littoral subdivision in 118 management Cells

littoral stretches characterized by homogeneous evolution of the backshore and shoreface different from adjacent cells (useful for action management)




## DATABASE CONTENTS

### 4 data sections on the 118 Cells

#### 1. Framework

*location, length, Cell typology, Macrocell, geo Unit and Sub-unit, ASPE class belonging*

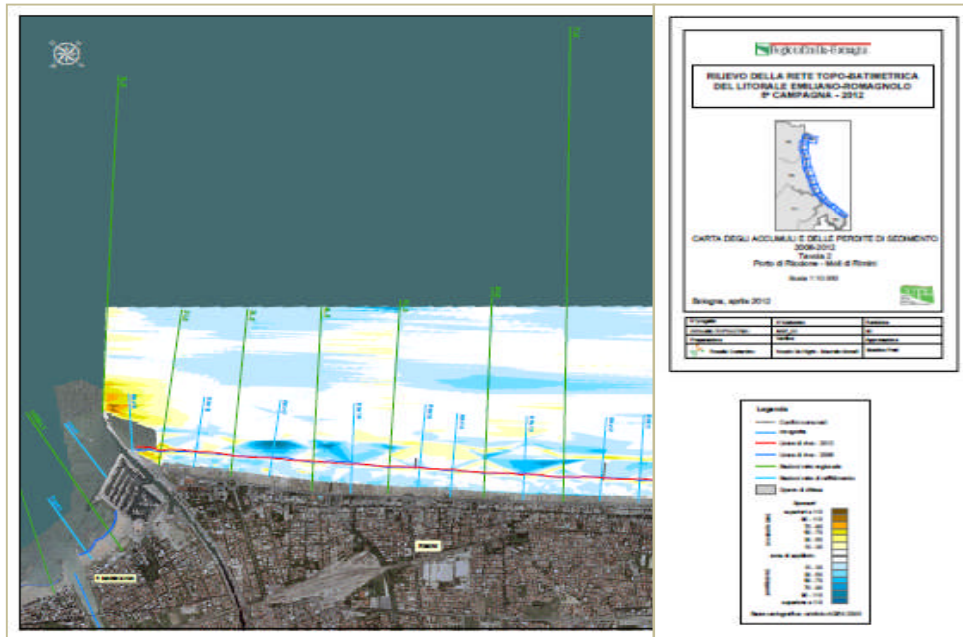
M1		COSTA RIMINESE		A	
	Denominazione	Bocca Tavelle		1	
	Tipologia della cella	Bocca portuale			
	Delimitazione fisica	Tratto compreso fra il molo sud e la darsena di Cattolica			
	Coordinate	l	Lon 43,9720186		Lat 12,75143229
		f	Lon 43,9719815		Lat 12,75211586
	Lunghezza cella (m)	55			
	Comune/i	Cattolica			
	Provincia	Rimini			
ASPE					

## DATABASE CONTENTS

### 4 data sections on the 118 Cells

1. Framework

2. Evolution status



*Sedimentary balance comparing subsequent topo-bathymetric campaigns*

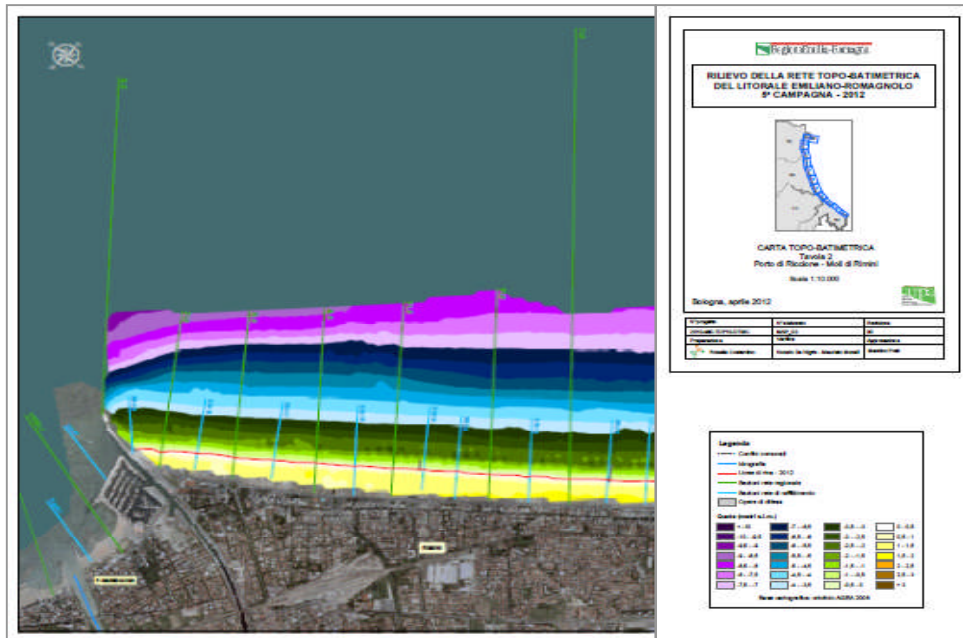
Opere di difesa	Opere di difesa rigide presenti nella cella
	Moli in cemento armato
	Opere di difesa rigide realizzate nel periodo di riferimento
Ripascimenti	Manutenzione opere di difesa nel periodo di riferimento
	Ripascimenti nel periodo di riferimento (m <sup>3</sup> )
Prelevi	Fonti o cella/e di provenienza delle sabbie
	Prelevi di sabbie (m <sup>3</sup> )
Altre informazioni	Cella/e di destinazione sabbie
	Volumi accumulati erosi nel periodo di riferimento (m <sup>3</sup> )
	Variazione volume sedimenti (m <sup>3</sup> /m)
	Variazione linea di riva



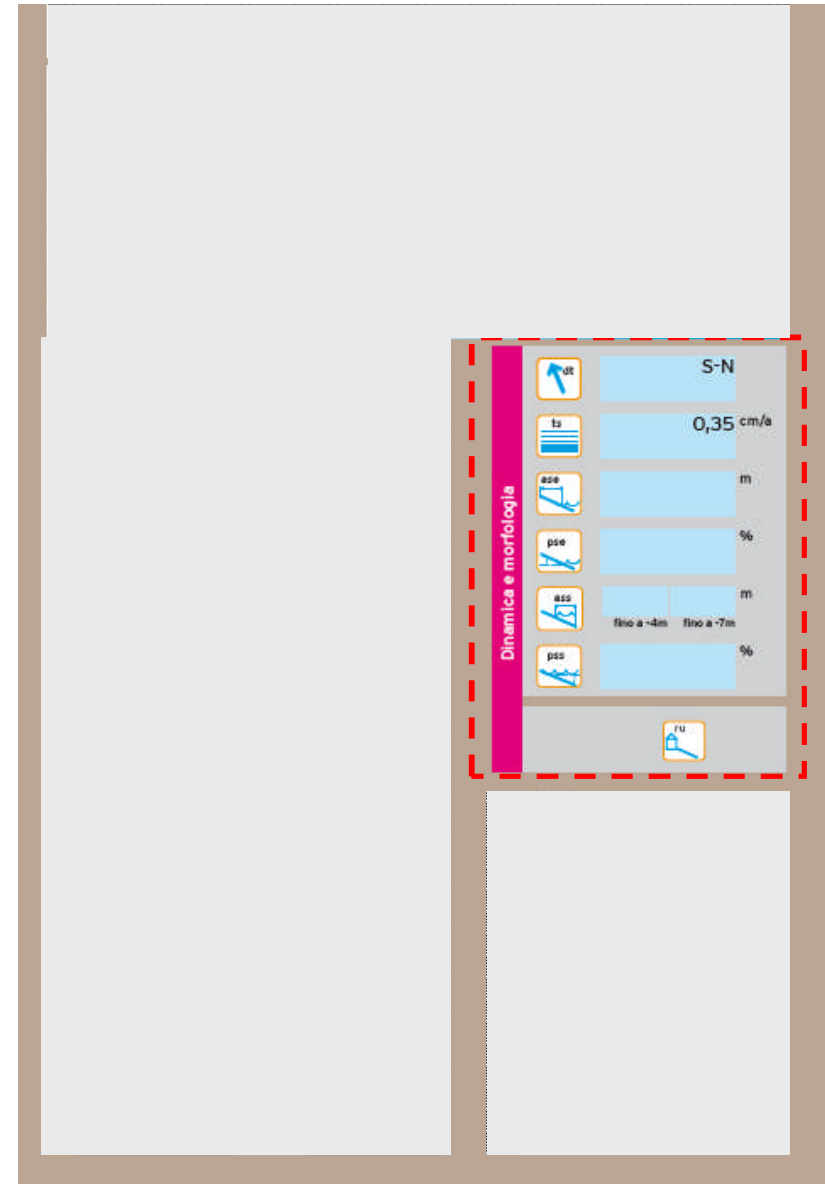
## DATABASE CONTENTS

### 4 data sections on the 118 Cells

1. Framework
2. Evolution status
3. Morphology and dynamics



Morphology changing comparing subsequent topo-bathymetric campaigns



## DATABASE CONTENTS

### 4 data sections on the 118 Cells

1. Framework
2. Evolution status
3. Morphology and dynamics
4. Management  
*constraints, strategic recharge points,  
withdrawal points, intervention needs*

Gestione	
Vincoli	no
Cella idonea al prelievo sedimenti	si
Cella idonea alla ricarica	no
Cella con necessità di intervento	no
Note	

# DATABASE CONTENTS



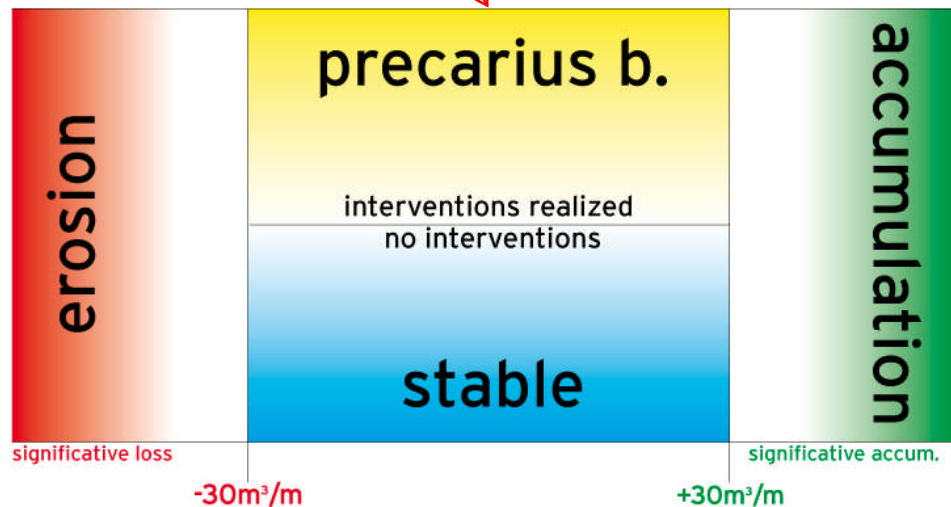
Denominazione	<b>San Giuliano</b>			<b>28</b>
Tipologia della cella	Cella con spiaggia			
Delimitazione fisica	Tratto compreso tra la darsena di Rimini e il molo sud del deviatore del fiume Marecchia			
Coordinate	I	Lon 44,07756059	Lat 12,57075514	
	F	Lon 44,07738665	Lat 12,56559098	
Lunghezza cella (m)	450			
Comune/i	Rimini			
Provincia	Rimini			
ASPE	2000			
	2006			

**1. Framework information:**  
 location, length, Cell typology, Macrocell, geo Unit and Sub-unit, ASPE class belonging

### Cells typologies

- Cell with beach
- Cell without beach
- River Mouth
- Harbour entrance
- Dock
- Draining channel
- Lagoon
- Lagoon mouth

### ASPE classification



## DATABASE CONTENTS




Opere di difesa	Opere di difesa rigide presenti nella cella   26 pennelli e barriera sommersa in sacchi pieni di sabbia
	Opere di difesa rigide realizzate nel periodo di riferimento
	Manutenzione opere di difesa nel periodo di riferimento
	Ricarica dei pennelli in sacchi e allungamento del pennello sud
Ripascimenti	Ripascimenti nel periodo di riferimento (m <sup>3</sup> ) <b>348.068</b>
	Fonti o cella/e di provenienza delle sabbie 
	Prelevi di sabbie (m <sup>3</sup> )
Prelevi	Cella/e di destinazione sabbie
	Altre informazioni
	Volumi accumulati erosi nel periodo di riferimento (m <sup>3</sup> ) <b>117.544</b>
	Variazione volume sedimenti (m <sup>3</sup> /m) <b>-167</b>
	Variazione linea di riva 

**2. Evolution state information** (also useful for ASPE classification): realized interventions, nourishments, sand draws, new hard defense works or maintenance of existing, sedimentary balance (accumulated or eroded volumes), coastline trend










### Nourishment sediments sources

	river and port mouth dredging
	inland quarry
	littoral deposits, beaches in accumulation
	off-shore deposits
	beach cleaning
	building excavation

### Shoreline

	advancing shoreline
	stable shoreline
	shoreline retreating







### Defense works

	emerged breakwaters
	low-crested breakwaters
	submerged breakwaters
	emerged groins
	submerged groins
	low-crested groins
	seawall
	river mouth, docks
	defense against marine ingression



# DATABASE CONTENTS

## 3. Morphology and dynamics information: alongshore drift direction, subsidence rate, beach morphology, use of the beach and of the back-beach

**Dinamica e morfologia**

	S-N
	0,86 cm/a
	77 m
	1,69 %
	411 1622 m fino a -4m fino a -7m
	0,63 %





**COSTA RIMINENSE**




### Alongshore drift

N-S
S-N
E-O
Convergence zone
Divergence zone

### Beach morphology

	emerged beach width: from shoreline to backshore
	emerged beach slope
	submerged beach width: from foreshore to -4m or -7m msl
	submerged beach slope

### Use of the beach

	urbanized backshore
	bathing establishment
	presence of dune

## DATABASE CONTENTS

**4. Management information:** presence of constraints, Cell suitability to be used as sand withdrawal zone or as strategic recharge point for nourishments, Cell needing interventions

Gestione	Vincoli	
	Parco regionale Delta del Po, SIC-ZPS IT4060003, Riserva Naturale dello Stato Sacca di Bellocchio, poligono militare di foce Reno	
	Cella idonea al prelievo sedimenti	no
	Cella idonea alla ricarica	no
	Cella con necessità di intervento	si

Cell already used, or potentially usable / suitable for sand draw for nourishment interventions on critical coastal stretches

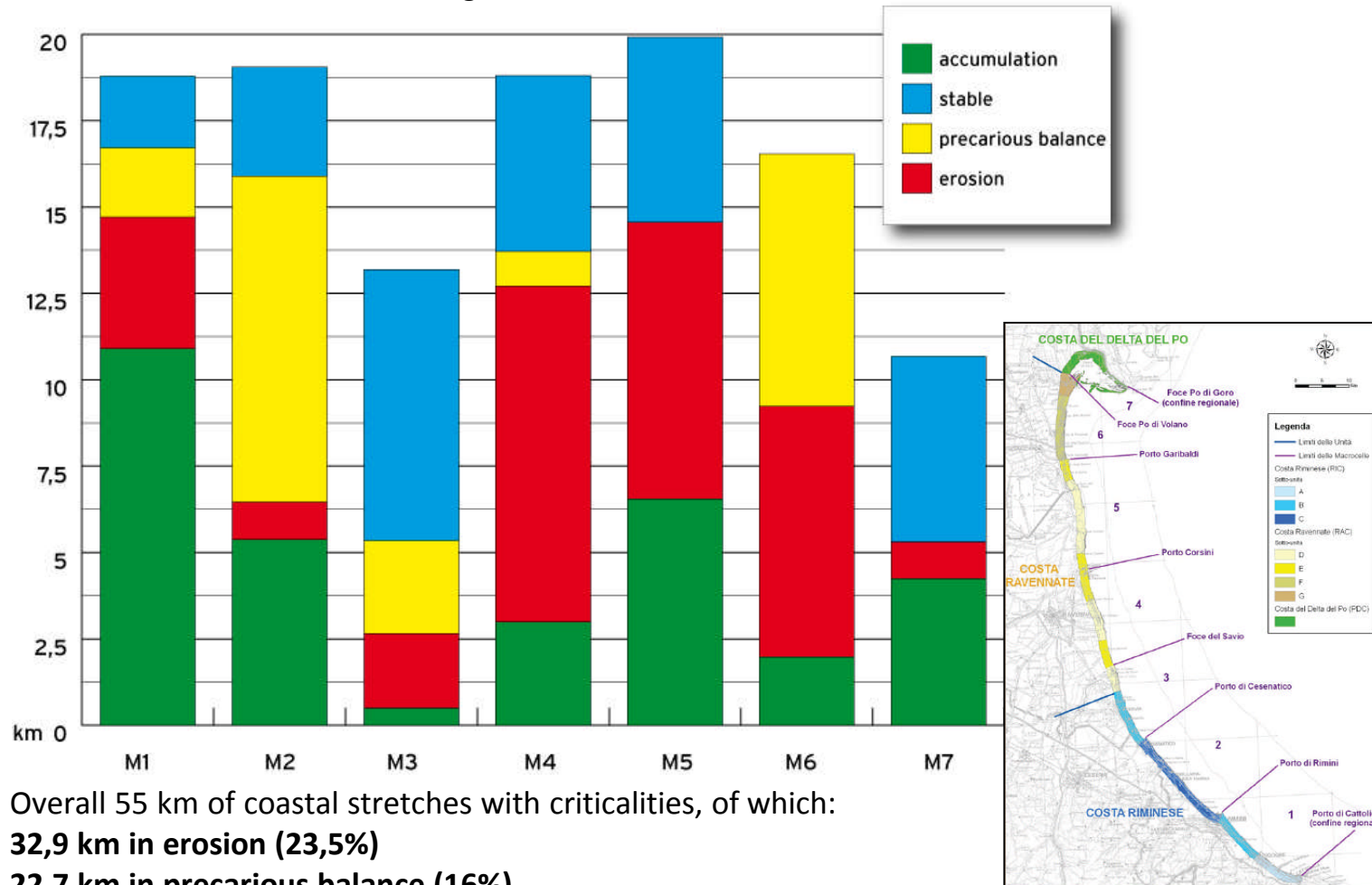
Cell in erosion or precarious balance suitable to be used as **strategic recharge point** for large nourishment that, by alongshore drift, redistributes with benefits for down-drift critical coastal stretches

**Cell** in erosion or in precarious balance, in the inland territory of which there are human activities, settlements, infrastructures, natural areas of environmental and economic relevance, **that needs defense interventions**

12 Cells as **strategic recharge zones** have been individuated, overall 9,5 km extension, 8 of which presents hard defense works, distributes in 5 Macrocells: 1 ▶ M1, 5 ▶ M3, 3 ▶ M4, 2 ▶ M5, 1 ▶ M6

## ANALYSES AND ELABORATION EXAMPLES

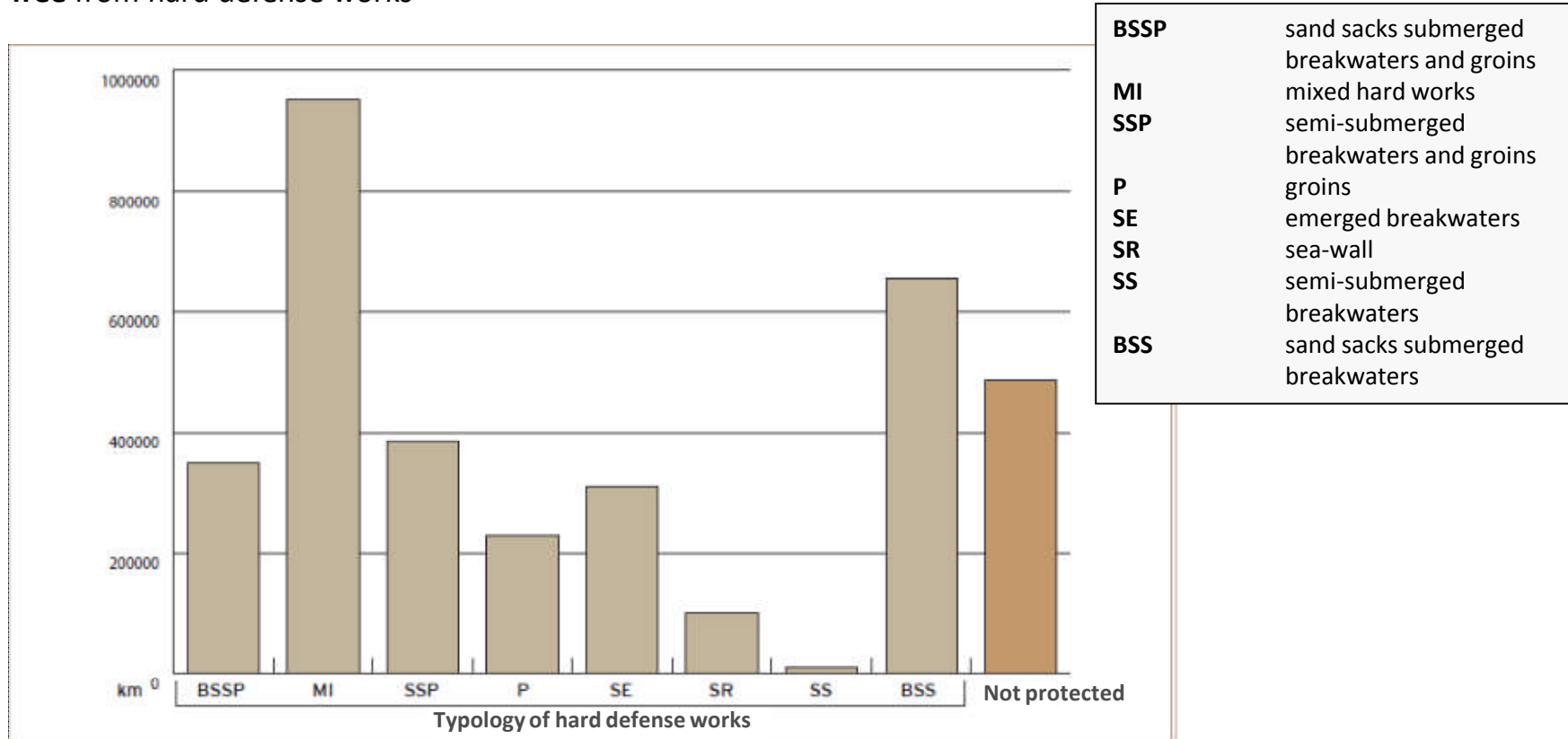
ASPE classification of the 7 Macrocells based on the classification of the 118 Cells in which is subdivided the Emilia-Romagna littoral



*percentages are related to the overall extension of the littoral Cells system (140 km)*

## ANALYSES AND ELABORATION EXAMPLES

Sand volumes brought for nourishment on beaches **protected** by hard defense works and on beaches **free** from hard defense works



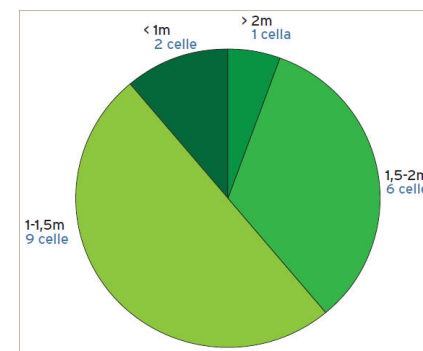
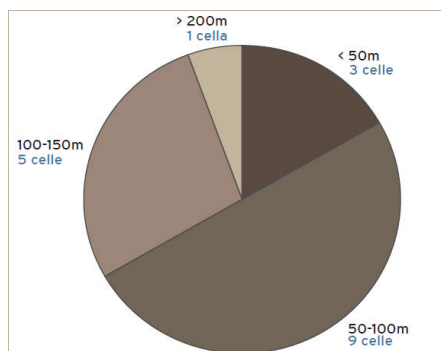
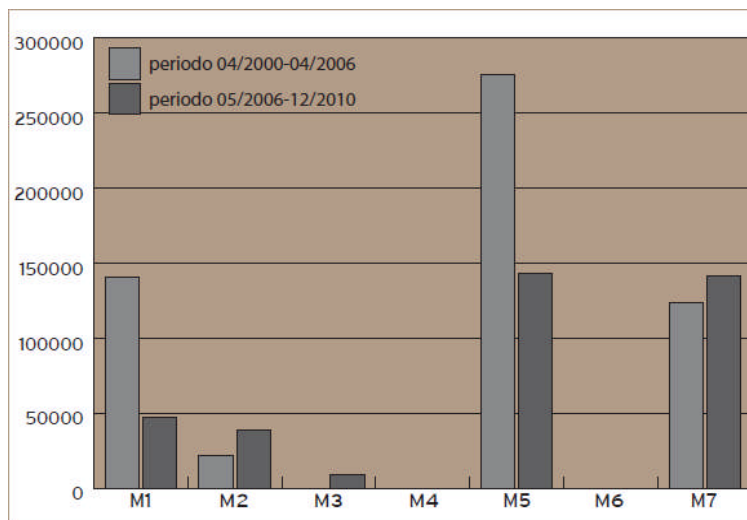
**3 million** of the overall 3,5 millions m<sup>3</sup> of sand brought for nourishment in the period 2000-2006, on 45 km of littoral extension, were **brought on stretches protected by hard defense works** (data of the second period, till the end of 2011, confirms this trend)



## ANALYSES AND ELABORATION EXAMPLES

**18 littoral Cells with accreting beach, already used (12) or potentially usable (6), for sand draw for nourishment of beaches in erosion + sand volumes drawn in the two periods**  
 April 2000 – April 2006 and May 2006 – December 2010

M	n	denominazione	prelievi m <sup>3</sup> 2000-2006	prelievi m <sup>3</sup> 2006-2010
1	3	Cattolica Sud	80.050	17.400
1	13	Misano Scogliere	18.450	10.620
1	23	Fogliano Marina	0	0
1	24	Miramare	32.700	19.665
1	25	Rimini Centro	9.650	0
2	30	Rivabella	0	5.000
2	31	Viserba Zona Sud Sortie	0	0
2	34	Viserba Nord	0	0
2	39	Igea Marina	7.000	14.000
2	42	San Mauro	0	1.250
2	48	Cesenatico	15.000	18.980
3	58	Milano Marittima	0	6.000
4	79	Marina di Ravenna	0	0
5	81	Porto Corsini	29.255	112.200
5	100	Lido degli Estensi	246.800	25.000
7	110	Scannone di Volano	123.500	141.295
7	117	Scanno di Goro Centro	0	0
7	118	Bocca laguna	0	0
<b>volumi totali</b>			<b>562.405</b>	<b>371.410</b>



## ANALYSES AND ELABORATION EXAMPLES

**7 Cells corresponding to harbor mouths, already used (5) or potentially usable (2), for sand draw (dredging) for nourishment of beaches in erosion + sand volumes drawn in the two period April 2000 – April 2006 and May 2006 – December 2010**

n	denominazione	prelievi m <sup>3</sup> 2000-2006	prelievi m <sup>3</sup> 2006-2010
1	Bocca Tavollo (Porto di Cattolica)	0	35.000
9	Canale Porto Verde	16.000	4.000
18	Riccione Porto Canale	48.200	42.400
26	Rimini Porto Canale	0	0
49	Porto Canale di Cesenatico	0	0
57	Porto Canale di Cervia	33.500	64.950
101	Bocca Porto Garibaldi	0	133.000
<b>volumi totali</b>		<b>97.700</b>	<b>279.350</b>

Sands drawn by **regional harbor mouths**, brought for beach nourishment:  
 from 1996 to 2000 about 83.000 m<sup>3</sup>  
 from 2000 to 2006 about 98.000 m<sup>3</sup>  
 from 2006 to 2010 about 279.000 m<sup>3</sup>

*Data highlights the development of this practice in the last 15 years in Emilia-Romagna, and the possibility of further developments represented by Rimini and Cesenatico harbors*

Material used for nourishments drawn within the enlargement works of **Ravenna national harbor**

n	denominazione	prelievi m <sup>3</sup> 2000-2006	prelievi m <sup>3</sup> 2006-2010
80	Porto di Ravenna	250.000	900.000

*Further enlarging works foresee, in the next years, the dredging of some millions of m<sup>3</sup> of material, of which the sand fraction, following compatibility analyses, will be used for nourishment aims on beaches in erosion along the Ravenna littorals*



## ANALYSES AND ELABORATION EXAMPLES

**17 Cells corresponding to river and channel mouths, already used (9) or potentially usable (8) for sand draw for nourishment of beaches in erosion + sand volumes drawn in the two periods  
 April 2000 – April 2006 and May 2006 – December 2010**

n	denominazione	prelievi m <sup>3</sup> 2000-2006	prelievi m <sup>3</sup> 2006-2010
5	Foce Ventena	16.800	900
7	Foce Conca	14.150	0
22	Foce Marano	0	0
29	Deviatore Marecchia	0	0
40	Foce Uso	20.400	15.500
44	Foce Rubicone	0	3.050
53	Canale Tagliata	0	2.600
59	Canalino delle Saline	0	0
62	Canale di Via Cupa	0	0
64	Foce Savio	0	0
74	Foce Fiumi Uniti	0	0
84	Foce Lamone	0	56.000
87	Canale Destra Reno	0	0
95	Foce canale Gobbino	57.000	61.020
99	Foce canale Logonovo	247.800	170.444
111	Foce Po di Volano	0	0
115	Foce Po di Goro	120.000	0
<b>volumi totali</b>		<b>476.150</b>	<b>309.514</b>

9 Cells already used from 2000 to 2010 for an overall draw of 785.664 m<sup>3</sup> of sand brought for nourishment

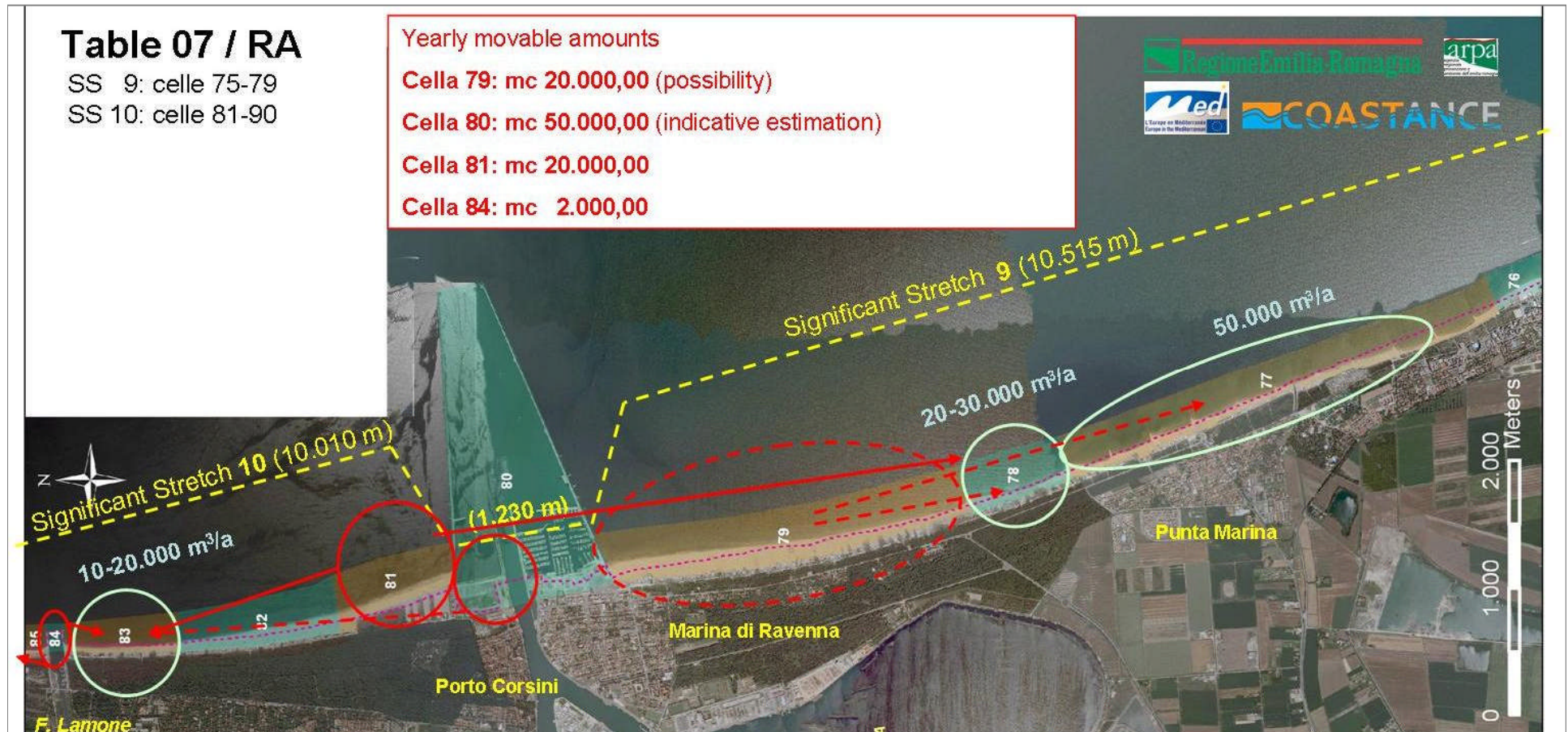
8 Cells potentially usable, to be submitted to a feasibility check



Logonovo channel mouth (Ferrara Province)

## APPLICATIONS → SEDIMENTS AND LITTORALS MANAGEMENT

- ✓ Littoral accumulations Management plans
- ✓ Management plans of material dredged from harbor mouths
- ✓ Plans and intervention Programs for coastal protection (sand draw, dredging, nourishments)
- ✓ Signaling and recording sea storm damns (volumes eroded from the beaches, damns to the existing structures) by regional Technical Services and Municipalities

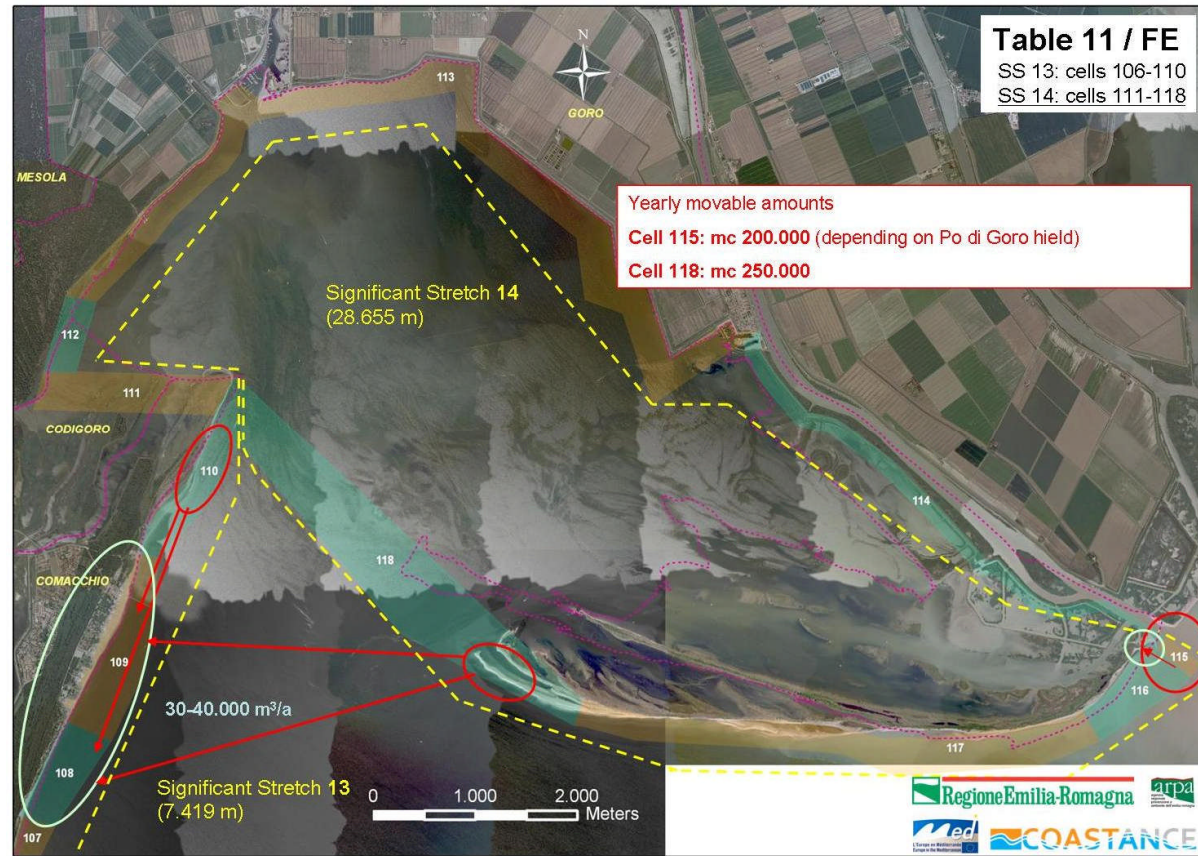


## APPLICATIONS REGIONAL REGULATIONS

“SIGNIFICANT STRETCHES” for managerial purposes individuated for the new regional Act regulating the authorizations for littoral sediments moving (ex art. 109 Dlgs 152/2006) ...*under formulation*

14 groups of littoral Cells have been individuated and relative “Significant Stretch Forms” with SICELL data set will constitute reference within the authorization procedures for draw/dredging and nourishment interventions

SS	Cells	Lenght m
1	1 - 13	5.550
2	13 - 21	5.645
2	22 - 26	8.265
4	27 - 39	11.460
5	40 - 49	9.145
6	50 - 55	7.530
7	56 - 64	6.180
8	65 - 74	8.585
9	75 - 79	10.515
10	81 - 90	10.010
11	91 - 100	10.580
12	101 - 105	9.240
13	106 - 110	7.419
14	111 - 118	28.655



The Cell 80 – Ravenna harbor (1.230 meters) is considered not as a SS, but exclusively as “harbor basin”

## APPLICATIONS MATCHING SEDIMENTS NEEDS AND LITTORAL SOURCES

Estimation of possible balance within a single Significant Stretch, and of eventual further needs to be satisfied with sediments from other Significant Stretches or from out of the coastal system (i.e. from submarine deposits)

### Example on Significant Stretch 1

**Table 01 / RN**

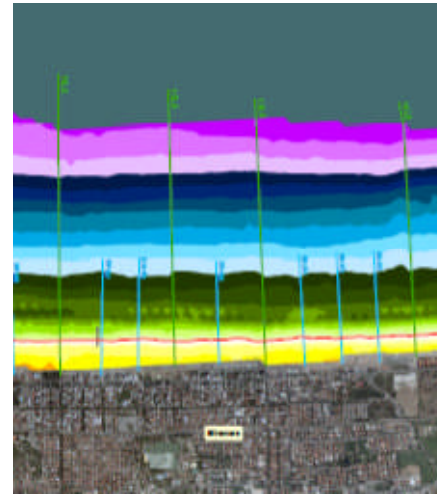
Significant Stretch 1: cells 01-13  
Significant Stretch 2: cells 13-21



Cell	Name	Tipology	Length(m)	ASPE	Sediment needs m <sup>3</sup> /year	Sediments availability m <sup>3</sup> /year
1	Bocca Tavollo	Harbour entrance	55			5,000
2	Dock di Cattolica	Dock	250			
3	Cattolica Sud	Cell with beach	1,230	S		8,000
4	Cattolica Nord	Cell with beach	615	A		
5	Foce Ventena	River mouth	40			
6	Colonia Navi	Cell with beach	260	P	3,000	
7	Foce Conca	River mouth	175	A		2,000
8	Porto Verde Sud	Cell with beach	65	E	2,000	
9	Canale Porto Verde	Harbour entrance	40			
10	Porto Verde Nord	Cell with beach	165	P	2,000	
11	Porto Verde Scogliera Radente	Cell with beach	220	E	5,000	
12	Misano Pennelli	Cell with beach	1,680	E	15,000	
13	Misano Scogliere	Cell with beach	755	A		8,000
			5,550		27,000	23,000

# ADVANCEMENTS

- Maps of the coast and tabs with framework data are published on the Soil and Coast protection Regional Service Web site <http://ambiente.regione.emilia-romagna.it/suolo-bacino/temi/difesa-della-costa/sicell>
- The system is already in use by the regional Technical Services operating on the coast, with data for the two periods, 2000-2006 and 2007-2011
- 2012 updating is on going on draw, dredging, nourishments data, hard defense works modification and maintenance
- Updating of ASPE classification for the period 2007-2012, is taking place started after the completion of the topo-bathymetric campaign (March 2012) and subsidence data elaboration, now under processing
- Communication and dissemination towards local stakeholders (coastal Municipalities, harbor managing Boards, local operators, etc.) under preparation, with the aim to make the SICELL a reference tool within the framework of their competence operations
- “Significant Stretch Forms” under preparation within the regional Act proposal for littoral sediment moving authorizations, dredgings and nourishments (*under formulation*)
- English version of the SICELL publication 2<sup>nd</sup> release 2000-2010 under preparation



## CONCLUSION

### The SICELL construction operation has meant:

- Capitalization of knowledge and experiences
- Reorganization of existent data, for their specific use in littorals and sediments management

### The SICELL supports:

- Systematization of coastal protection interventions (nourishments, dredgings, works)
- Optimization of resources exploitation in dredging and managing of littoral sediment accumulations

### The SICELL is a tool:

- Multi scale, that allows to rapidly switch analyses from local level (Cells), to sector level (Macrocells) and to the littoral system as a whole
- Shared by regional Structures operating in coastal protection field, within knowledge development, planning, programming, managing, interventions implementation
- Easy usable by other local stakeholders operating on the coast (Municipalities, Port Authorities, local operators)
- Transferrable as a model in other territorial context, Mediterranean and European coastal regions



THANKS FOR YOUR ATTENTION...



[www.coastance.eu](http://www.coastance.eu)



[www.facecoast.eu](http://www.facecoast.eu)



<http://ambiente.regione.emilia-romagna.it/suolo-bacino>

[rmontanari@regione.emilia-romagna.it](mailto:rmontanari@regione.emilia-romagna.it)

