A new tool for littorals management support in Emilia-Romagna

the Littoral Cells Information and Management System (SICELL)

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The Littoral Cells Management System (SICELL)

INTRODUCTION

DATABASE CONTENTS

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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

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

2002 and 2007 interventions
- 1.6 Million m$^3$ of sand from off-shore deposits
- 12 littoral stretches
- 19 km of total extension
- 26 M€ of total investment

Littoral Cells management system (SICELL)

ICZM theme 1
Coastal physical system, risk factors and protection strategies

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
 DATABASE CONTENTS

4 data sections on the 118 Cells

1. Framework
2. Evolution status

Sedimentary balance comparing subsequent topo-bathymetric campaigns
DATABASE CONTENTS

4 data sections on the 118 Cells

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

Morphology changing comparing subsequent topo-bathyimetric 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
1. Framework information:
location, length, Cell typology, Macrocell, geo Unit and Sub-unit, ASPE class belonging
### 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
3. Morphology and dynamics information: alongshore drift direction, subsidence rate, beach morphology, use of the beach and of the back-beach.

**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
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

- 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

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

Overall 55 km of coastal stretches with criticalities, of which:
- 32.9 km in erosion (23.5%)
- 22.7 km in precarious balance (16%)

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$^3$ 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)
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

Sand volumes drawn from accreting beaches by Macrocell in the two periods
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

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

Sands drawn by regional harbor mouths, brought for beach nourishment:
- from 1996 to 2000 about 83,000 m$^3$
- from 2000 to 2006 about 98,000 m$^3$
- from 2006 to 2010 about 279,000 m$^3$

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**

<table>
<thead>
<tr>
<th>n</th>
<th>denominazione</th>
<th>prelievi m$^3$ 2000-2006</th>
<th>prelievi m$^3$ 2006-2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>80</td>
<td>Porto di Ravenna</td>
<td>250.000</td>
<td>900.000</td>
</tr>
</tbody>
</table>

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

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

<table>
<thead>
<tr>
<th>n</th>
<th>denominazione</th>
<th>prelievi m³ 2000-2006</th>
<th>prelievi m³ 2006-2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>Foce Ventena</td>
<td>16.800</td>
<td>900</td>
</tr>
<tr>
<td>7</td>
<td>Foce Conca</td>
<td>14.150</td>
<td>0</td>
</tr>
<tr>
<td>22</td>
<td>Foce Marano</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>29</td>
<td>Deviatore Marecchia</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>40</td>
<td>Foce Uso</td>
<td>20.400</td>
<td>15.500</td>
</tr>
<tr>
<td>44</td>
<td>Foce Rubicone</td>
<td>0</td>
<td>3.050</td>
</tr>
<tr>
<td>53</td>
<td>Canale Tagliata</td>
<td>0</td>
<td>2.600</td>
</tr>
<tr>
<td>59</td>
<td>Canalino delle Saline</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>62</td>
<td>Canale di Via Cupa</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>64</td>
<td>Foce Savio</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>74</td>
<td>Foce Fiumi Uniti</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>84</td>
<td>Foce Lamone</td>
<td>0</td>
<td>56.000</td>
</tr>
<tr>
<td>87</td>
<td>Canale Destra Reno</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>95</td>
<td>Foce canale Gobbo</td>
<td>57.000</td>
<td>61.020</td>
</tr>
<tr>
<td>99</td>
<td>Foce canale Logonovo</td>
<td>247.800</td>
<td>170.444</td>
</tr>
<tr>
<td>111</td>
<td>Foce Po di Volano</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>115</td>
<td>Foce Po di Goro</td>
<td>120.000</td>
<td>0</td>
</tr>
</tbody>
</table>

9 Cells already used from 2000 to 2010 for an overall draw of 785.664 m³ 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

Table 07 / RA

<table>
<thead>
<tr>
<th>SS 9: celle 75-79</th>
<th>SS 10: celle 81-90</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yearly movable amounts</td>
<td></td>
</tr>
<tr>
<td>Cell 79: mc 20,000,00 (possibility)</td>
<td></td>
</tr>
<tr>
<td>Cell 80: mc 50,000,00 (indicative estimation)</td>
<td></td>
</tr>
<tr>
<td>Cell 81: mc 20,000,00</td>
<td></td>
</tr>
<tr>
<td>Cell 84: mc 2,000,00</td>
<td></td>
</tr>
</tbody>
</table>
**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

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

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

**Table 11 / FE**

SS 13: cells 106-110
SS 14: cells 111-118

*Yearly movable amounts*

- Cell 115: mc 200.000 (depending on Po di Goro field)
- Cell 118: mc 250.000
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
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 2nd 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

www.facecoast.eu

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