LIFE08 ENV/IT/436

PROJECT ACT

ADAPTING TO CLIMATE CHANGE IN TIME

Coastal environment

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ISPRA Institute for Environmental Protection and Research

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INTRODUCTION 1

The specific objectives of this contribution are:

- ✓ To recognise the threat to coastal zones posed by climate change.
- ✓ To adopt an indicator-based approach to evaluate the coastal vulnerability, both Ancona and Patrasso areas*.
- ✓ To ensure appropriate and ecologically sustainable coastal protection.

*Each of these sites is studied following the same methodology, the aim is to identify vulnerability indicators to climate change and anthropic pressure.

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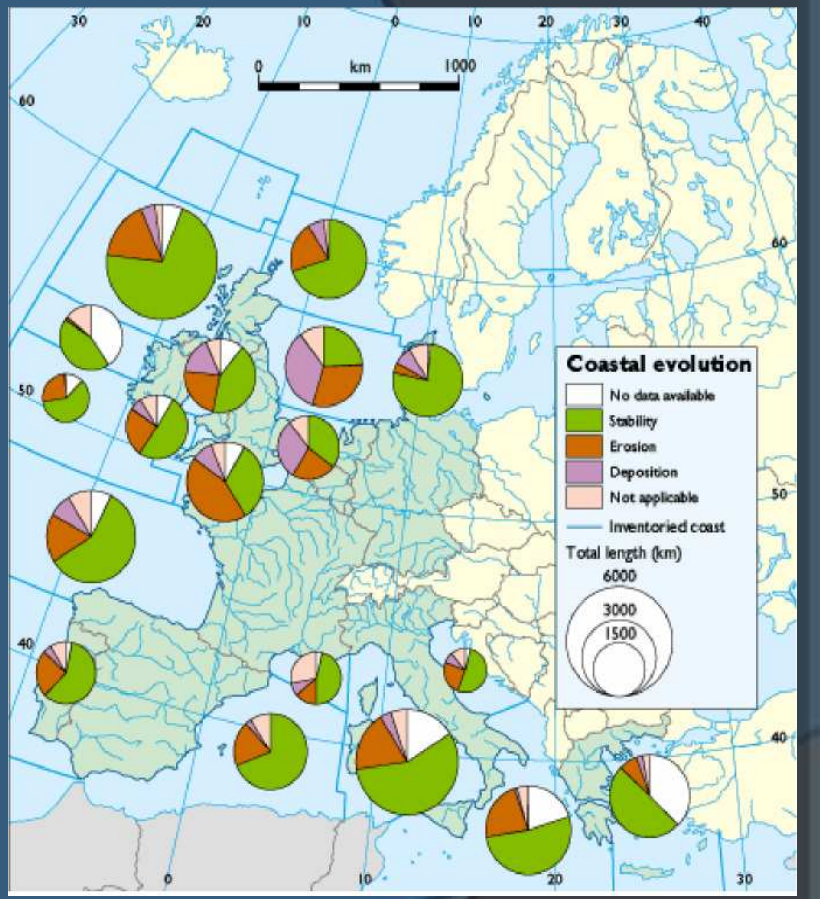
INTRODUCTION 2

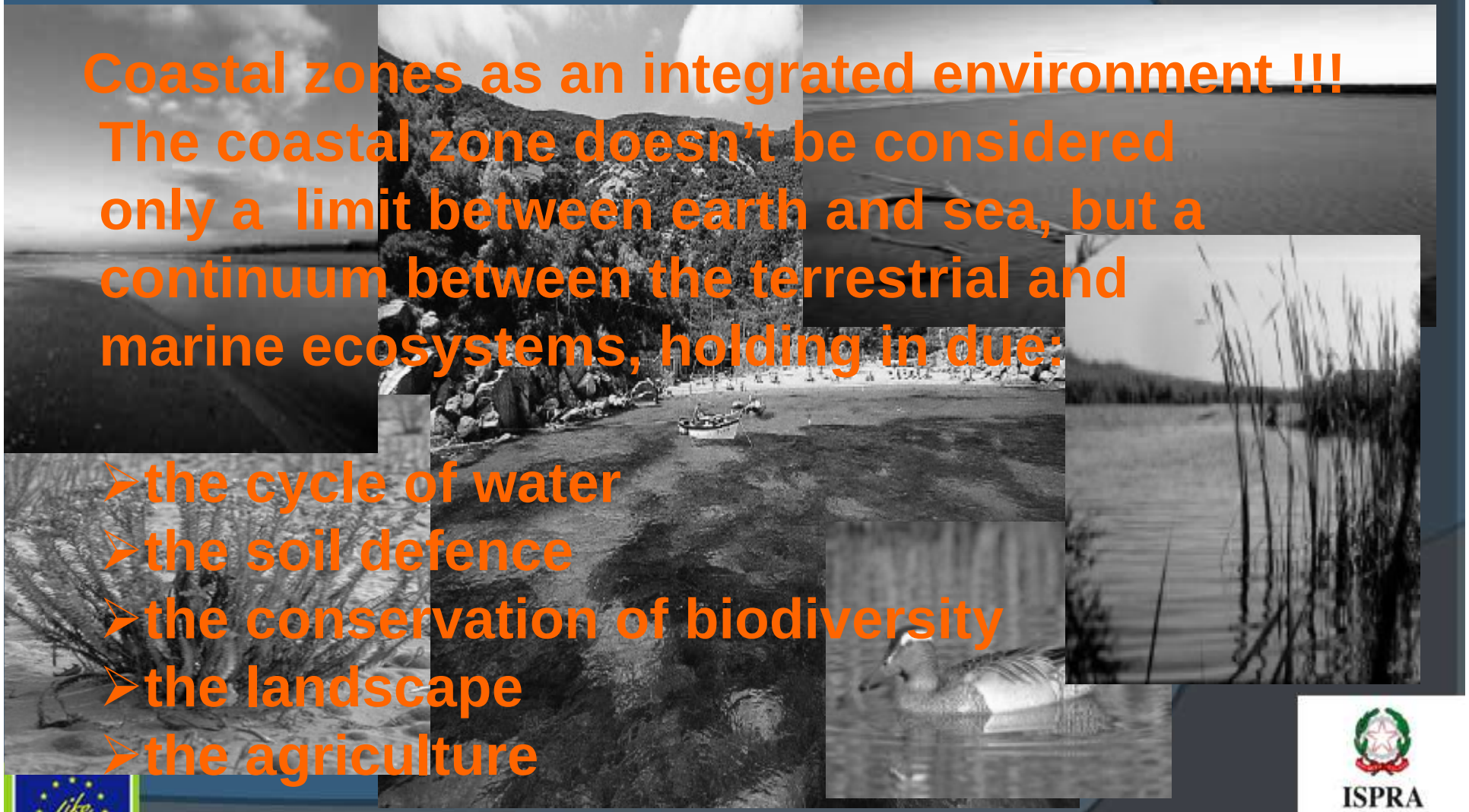
Coastal zones are extremely dynamic and vulnerable ecosystems!!!!!

An intense and growing urbanization

- has transformed the equilibrium between natural and anthropogenic resources,
- has induced evolution of littorals,
- has turned the natural dynamism of coastline into a serious risk for urban settlements.



INTRODUCTION 3



Coastal zones as an integrated environment !!!

The coastal zone doesn't be considered only a limit between earth and sea, but a continuum between the terrestrial and marine ecosystems, holding in due:

- **the cycle of water**
- **the soil defence**
- **the conservation of biodiversity**
- **the landscape**
- **the agriculture**

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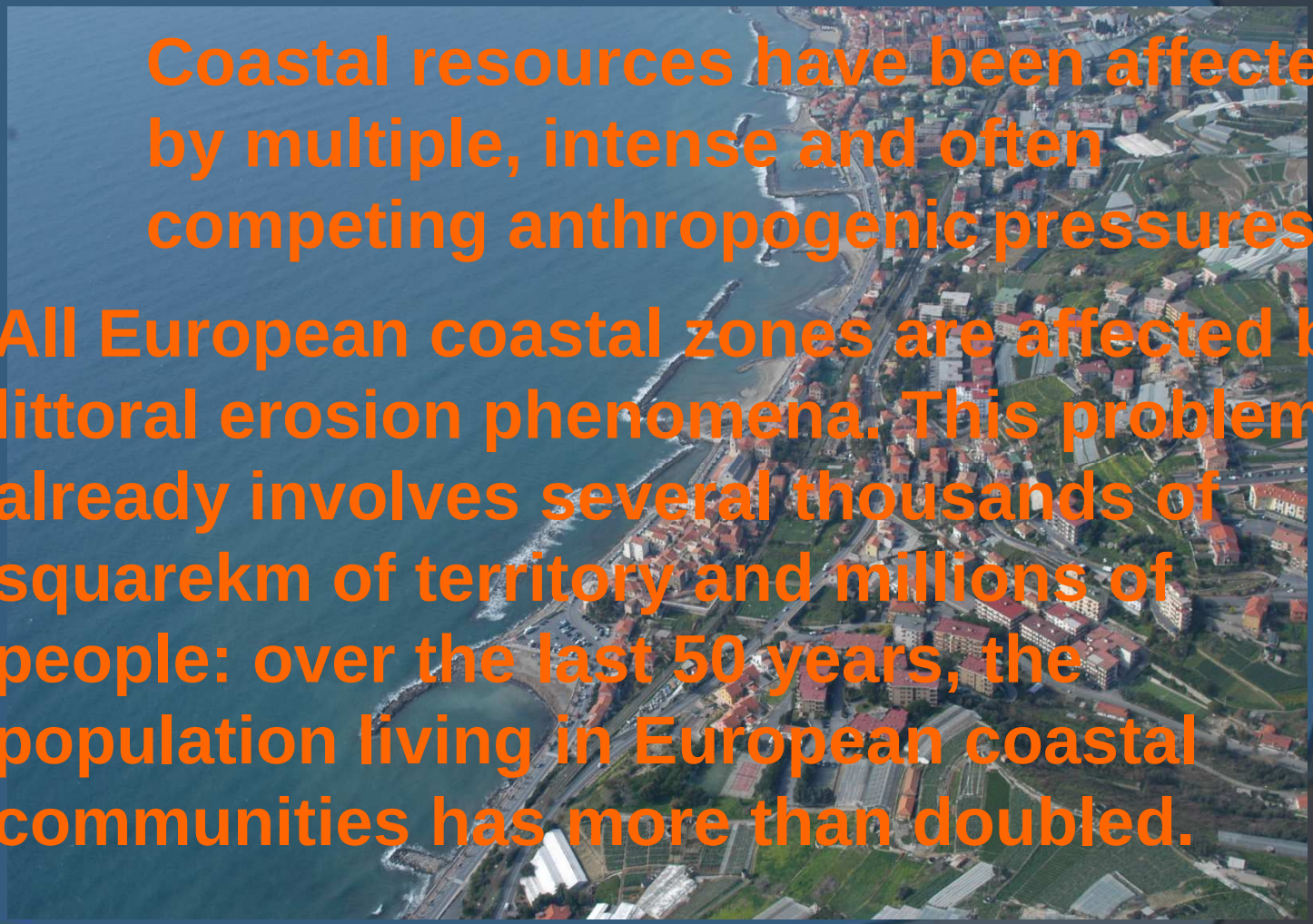
INTRODUCTION 4



Coastal resources have been affected by multiple, intense and often competing anthropogenic pressures.

All European coastal zones are affected by littoral erosion phenomena. This problem already involves several thousands of squarekm of territory and millions of people: over the last 50 years, the population living in European coastal communities has more than doubled.

INTRODUCTION 5

The Intergovernmental Panel on Climatic Change (IPCC) has indicated climate changes in coastal zone* due to :

- **Increasing average temperature**
- **Increasing relative sea level rise**
- **Increasing probability of high magnitude flood events**

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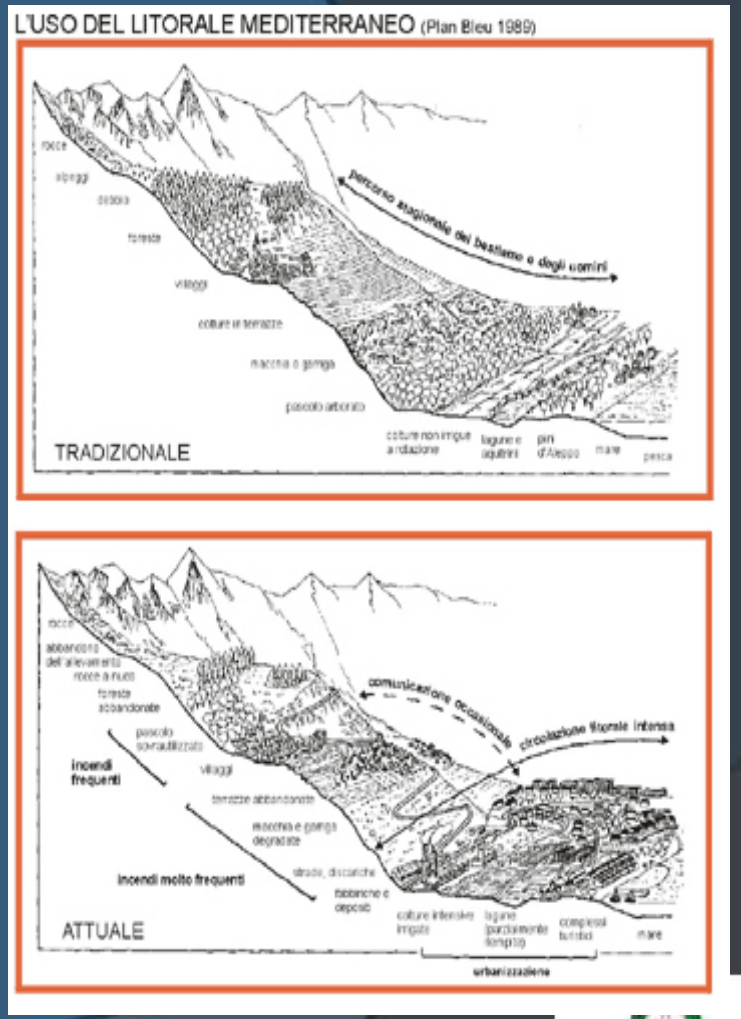
INTRODUCTION 6

The coastal modification connected to climate change:

- ✓ acceleration of lost in the coastal water quality,
- ✓ destruction of coastal and marine ecosystems,
- ✓ alteration of beaches morphology,
- ✓ interaction with storms waves.



INTRODUCTION 7

Climate change will affect coastal environment through effects on:

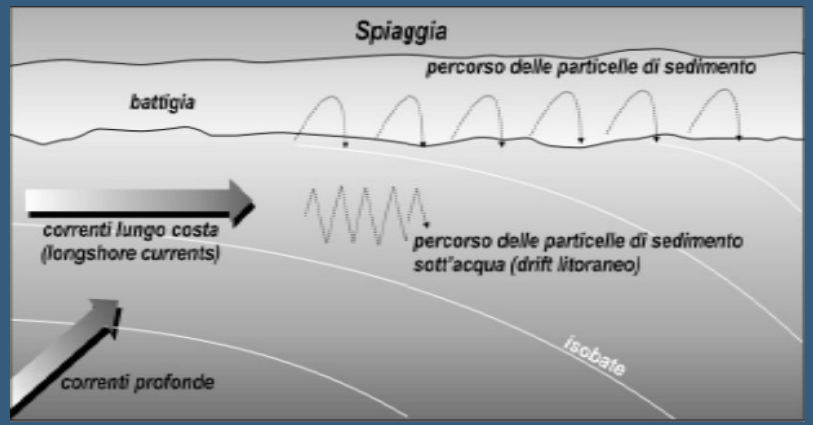
- **Population living in the coastal zone**
- **Build-up land**
- **Land take by agricultural use**
- **Area of natural and semi-natural habitat**
- **High ecological value areas**
- **Protected coastal and marine areas**

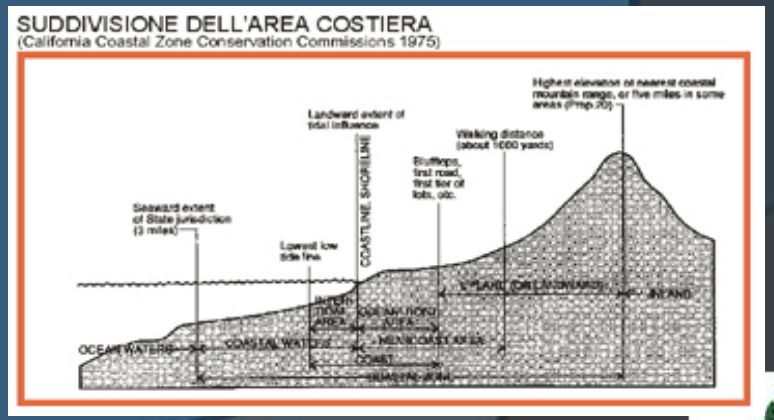
COASTAL EROSION 1

Coastal erosion results from a combination of several factors, both natural and human, which have different time, space patterns and nature: continuous or incidental, reversible or non-reversible.

COASTAL EROSION 2

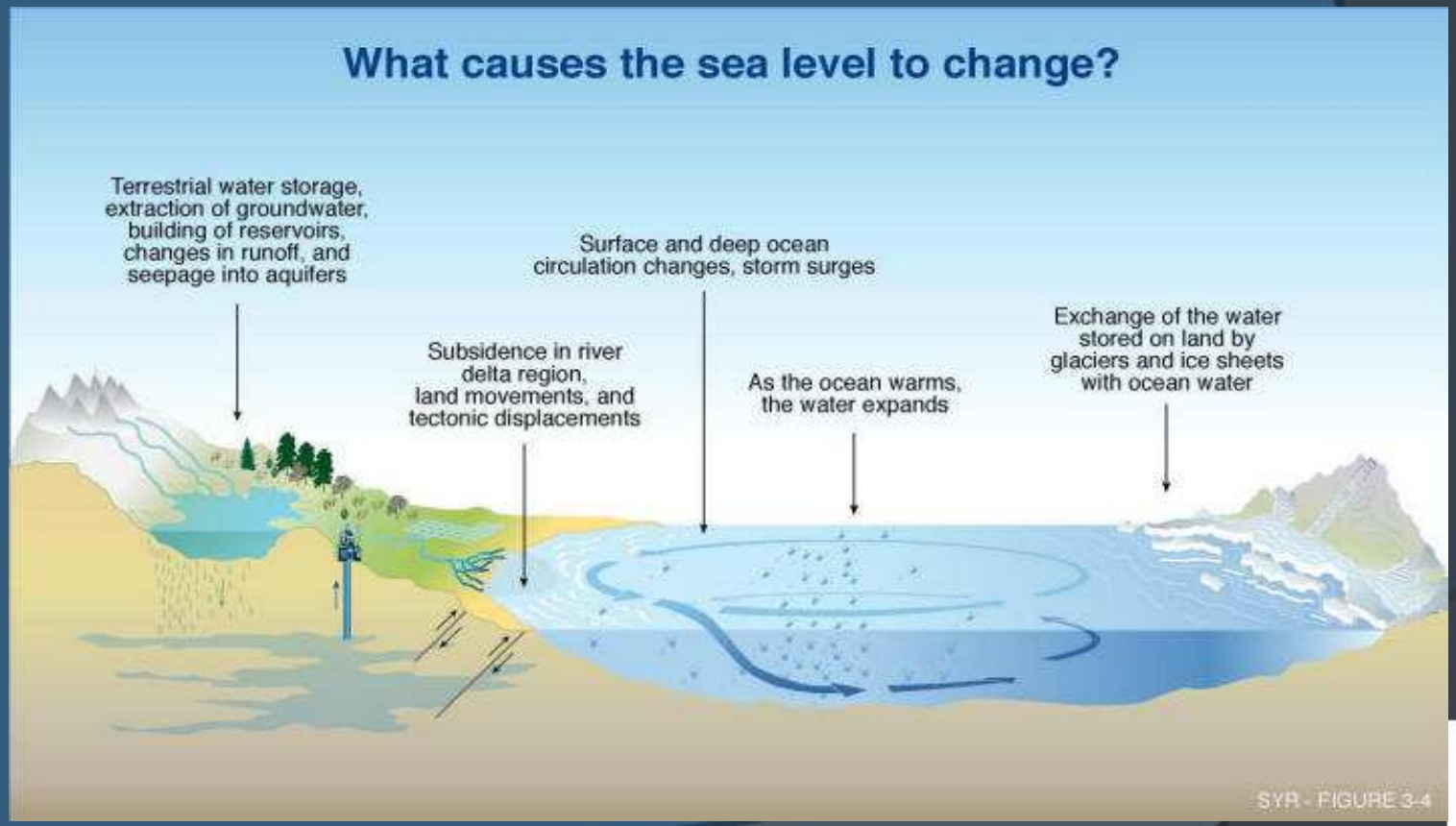
- ✓ **In nature, a stable beach is in a state of dynamic equilibrium, where usually have place erosion and accretion of the shoreline, for few meters, in a short time.**
- ✓ **In case of insufficient spaces and materials, the coastal ecosystem does not arrange a configuration of temporary equilibrium and the consequences are an increase of the erosive processes.**





COASTAL EROSION 3

- The increase of *medium sea level* involves the reversal of the shore line with consequent erosion of the coastline.



IMPACTS 1

The issue of future predictions of climate change and its impact on coastal urban zone and natural environment has received widespread attention in the last years.

IMPACTS 2

General impact

The climate conditions interact with coastal ecosystems through several and different mechanisms, ranging from effects on soil loss, temporary or permanent, to floods and flooding, due to the increase of the erosion activity of the sea.

IMPACTS 3

Direct impacts

- Loss of property in residential areas.
- Loss of land devoted to industrial and commercial.
- Loss of agricultural land.
- Impacts on the infrastructure of mobility and on the coastal tourism system.
- Loss of biodiversity linked to abduction of soil with natural habitats.
- Soil loss for coastal and marine recreation.
- Loss of areas affected by cultural heritage.

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IMPACT 4

In the literature we can find several examples of quantitative analysis and methodology for identification of exposed factors to coastal erosion and flooding by using specific indicators (i.e. DEDUCE, EUROSION, Life Response project).

ASSESSING SENSITIVITY 1

The *physical sensitivity* to coastal erosion and flooding, in the present contribute, is assessed by using indicators proposed by the EUROSION and DEDUCE projects.

The approach led to consider some indicators in relation with the current and expected future exposure to coastal erosion and flooding.

ASSESSING SENSITIVITY 2

The first methodological step is the definition of the concept of RICE area.

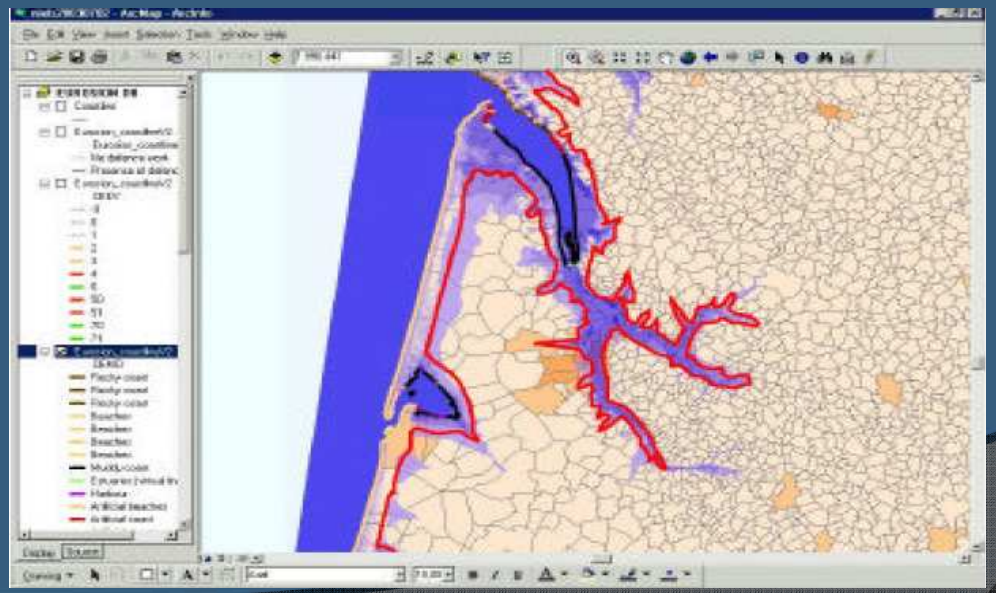
The RICE, *radius of influence of coastal erosion and flooding*, has been defined by EUROSION Project, as all terrestrial areas located within 500 meters from shoreline.

This assumption is based on the average observed erosion rates at time scale 100 years.

ASSESSING SENSITIVITY 3

The RICE radius of influence of coastal erosion and flooding is defined as :

- all urban areas located within 500 meters from the coastline,
- extended to areas lying under 10 meter.



ASSESSING SENSITIVITY 4

The **Sensitivity Coastal Index** (**ISC)** represents the sum of single points of every indicator listed below:

- Sea level rise - SLR
- Shoreline evolution – TEV
- Highest water level - HWL
- Geo morphological coastal type – GEC
- Elevation of nearshore coastal zone -ARice
- Coastal protection and defence works systems - ODC

ASSESSING SENSITIVITY 5

The **Sensitivity Coastal Index (ISC)*** will be calculated using the alghoritm listed below:

***ISC= SLR+TEV+HWL+GEC+ARice+ODC**

ASSESSING SENSITIVITY 6

Il fattore SLR (Sea level rise), che rappresenta la velocità media di innalzamento del livello del mare*

I punteggi assegnati ** sono i seguenti:

- VELOCITA' media di innalzamento del mare (mm./anno):

  < 0 = 0 punti
  0 ÷ 4 = 1 punto
  > 4 = 2 punti

*Per alcuni fattori di pressione, si è fatto riferimento al database messo a punto dal progetto EUROSION, che comprende 237 punti complessivi, posti tra i 50 ed i 100 km dalla costa, che forniscono i valori dell'ampiezza del regime di marea ed i parametri del vento (direzione ed intensità). Per l'Italia i punti di misura sono 46. Per approfondimenti http://dataservice.eea.europa.eu/dataservice/metadetails.asp?id=725

**Dal confronto con i valori di soglia di cui sopra si deduce che ai comuni costieri italiani è stato assegnato 1 punto per il fattore SLR per un innalzamento compreso tra 0 a 4 mm / anno

ASSESSING VULNERABILITY 1

Vulnerability can be express as the potential to suffer harm, loss or detriment from an human perspective.

Vulnerability is a function of **:**

→ **the sensitivity of the system to changes**

→ **the adaptive capacity**

→ **the degree of exposure of the system to hazards.**

An highly vulnerable system is very sensitive to modest changes in climate or sea level!!!!!!

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ASSESSING VULNERABILITY 2

The **Coastal Vulnerability Index (IVC)** represents the sum of points of every parameters listed below:

- Population living within the RICE or within the areas defined by distance from the coast line (P Rice).
- % of coastal urbanisation and industrial areas (U Rice).
- % of high ecological value areas in Rice (E Rice).
- % of urbanisation of coastal area in 10 Km (U10Km).

ASSESSING VULNERABILITY 3

For the aim of the present work the **Coastal Vulnerability Index (IVC)*** will be calculated using the algorithm:

***IVC= P Rice+ U Rice + E Rice +U10km**

ASSESSING VULNERABILITY 4

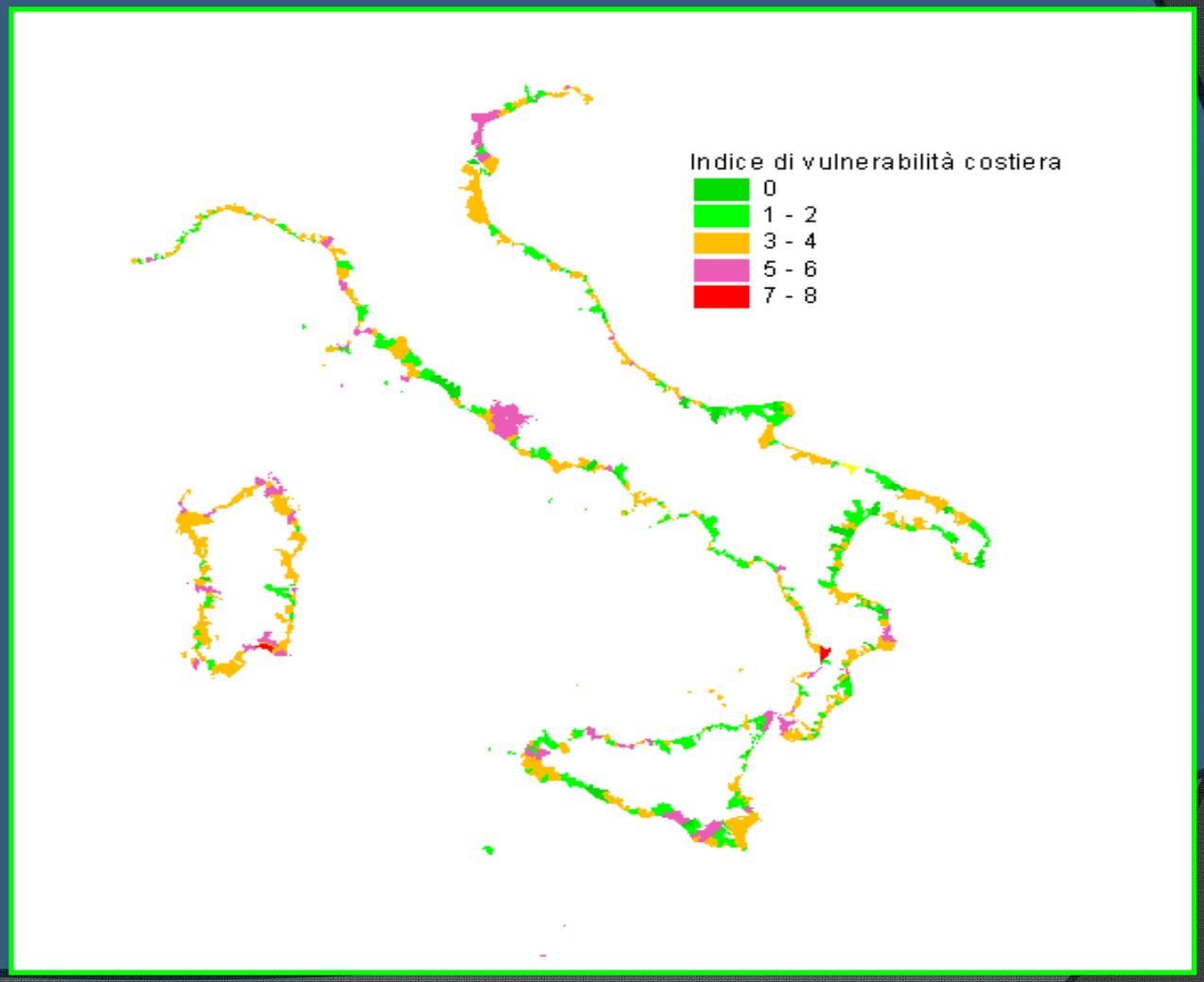
- **An example of Coastal Vulnerability Index: fattore URICE**
  Rappresenta la percentuale di area comunale urbanizzata e/o industrializzata nell'area di RICE, rispetto al totale della superficie comunale interna al RICE.

- I punteggi assegnati per ogni comune costiero sono:
  < 10% = 0 punti
  10% ÷ 40% = 1 punto
  > 40% = 2 punti

*(Fonte: CORINE Land Cover 1990 – 2000, dati censimento)

ASSESSING VULNERABILITY 5

IVC mapping in Italy



RISK ASSESSMENT 1

Within the RICE area identified, some indicators will utilized for the characterization of coastal risks, not only as a probability of occurrence of an event harmful to population and to environmental resources, but as a parameter, according to the following equation:

$$RC = ISC * IVC$$

RC Coastal Risk

ISC Sensitivity Coastal Index

IVC Vulnerability Coastal Index

RISK ASSESSMENT 2

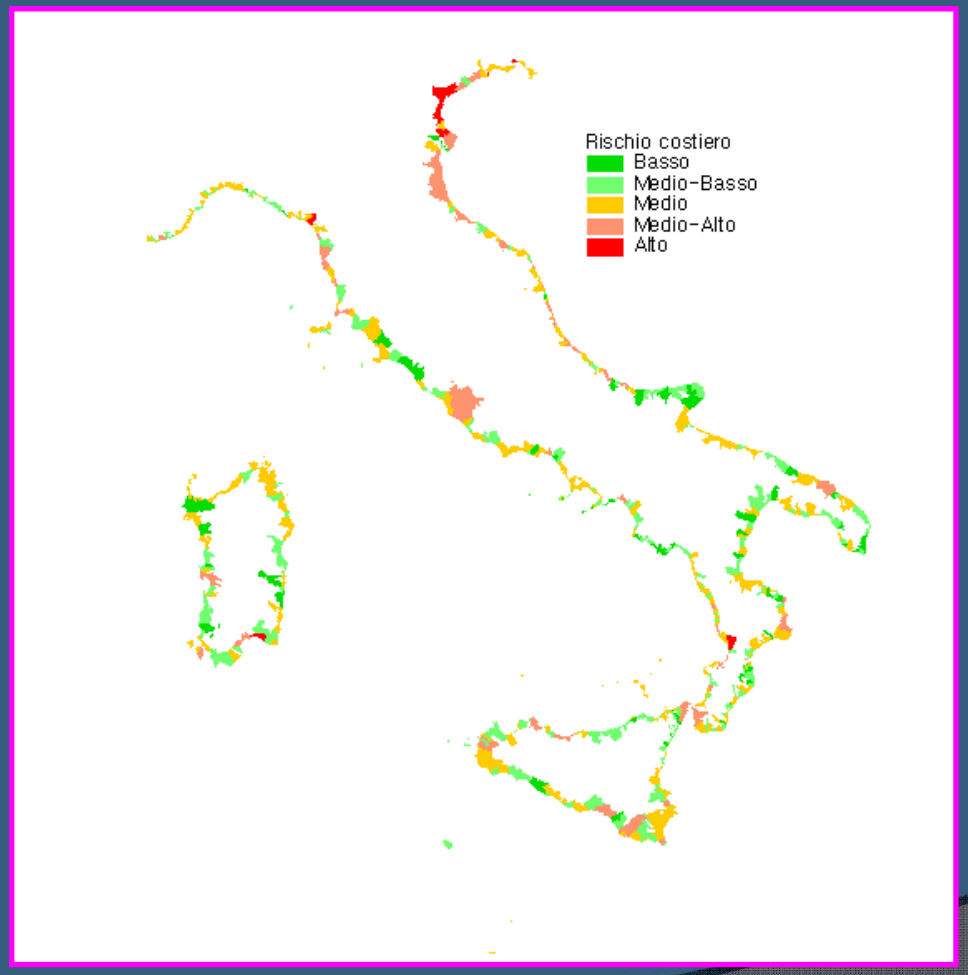
The results of the previous equation don't express numerically the expected damage

but is

a **quantitative assessment** of the presence of causal factors of events at potential risks for the coast.

RISK ASSESSMENT 3

RC Mapping in Italy



RISK ASSESSMENT 4

Strategies for reducing risk to coastal life and property have generally focused on two fields:

Hazard assessment

Coastal erosion hazard assessment has been identified as the first step before investing in protective measures in the coastal zone.

Impact assessment

The impact of coastal erosion may be the loss of human lives, of economical assets and valuable ecological areas. Cost - benefit analysis and Environmental Assessment instruments can be used to evaluate potential impacts.

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ADAPTATION 1

In general, it is difficult to find in the literature, consolidated methods and indicators for the quantitative assessment of adaptive capacity of a coastal system.

Support in that direction, but still experimental, is detectable in the methodology used in the Project Life Response.

ADAPTATION 2

Adaptation strategies of coastal systems are numerous and extremely diversified.

They include:

- ✓ **Technological**
- ✓ **Behavioral measures**
- ✓ **Management actions**
- ✓ **Political decisions**

ADAPTATION 3

Adaptation strategies for economic activities in coastal zone:

- withdrawing to safe areas from flooding,

or

- construction of protective structures systems.

ADAPTATION 4

Considering that rising sea level
will occur over a fairly long time, it will be possible, in some cases, moving some functions to secure areas protected from the effects of flooding.

CONCLUSIONS 1

The impact, the cost and the risk of human induced coastal erosion should be controlled through better internalisation of coastal erosion problems in planning and investment decisions.

AND

Public responsibility for coastal erosion risk should be limited and an appropriate part of the risk should be transferred to direct beneficiaries and investors.

CONCLUSIONS 2

Some open problems:

- **The uncertainty** that still characterizes the prevision of global climate change scenarios.

- **The inadequate assessments** that have as object the interdependence between the environmental effects of climate change and the resulting synergies of the territory.

THANKS FOR ATTENTION !!

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