

Critical issues and strategies for the management and adaptation of the Emilia-Romagna coastline to climate change



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The Emilia-Romagna coastal zone

fragile environments

the coastal plain was largely formed after the last sea level rise (5 Ky B.P.), morphologies (dunes) and wetlands are only partially preserved

strategic area for regional economy - tourism is the pivotal asset

its development also depends on the preservation/restoration of coastal morphologies (dunes; beaches) and other resources (e.i. water, biodiversity)

urban sprawl in the last 70 y

particularly fast in the decade immediately after the II World War - high interference between human infrastructures & nature

extremely exposed to the effects of climate change:

- *Increase of floodable areas*
- *Aquifer and soils salinization and salt intrusion in the rivers*
- *Faster coastal retreat and loose of natural ecosystems and resources*
- *Impacts on the anthropic infrastructures/activities, thus on the society*

Main economies:

Tourism (overall contributes for the 11% of the regional GDP)

Transport and harbour facilities (26 ports/marinas)

Aquaculture (contribute to the 45% of national production)

Fishery (small scale- 609 vessels – 4500 workers)

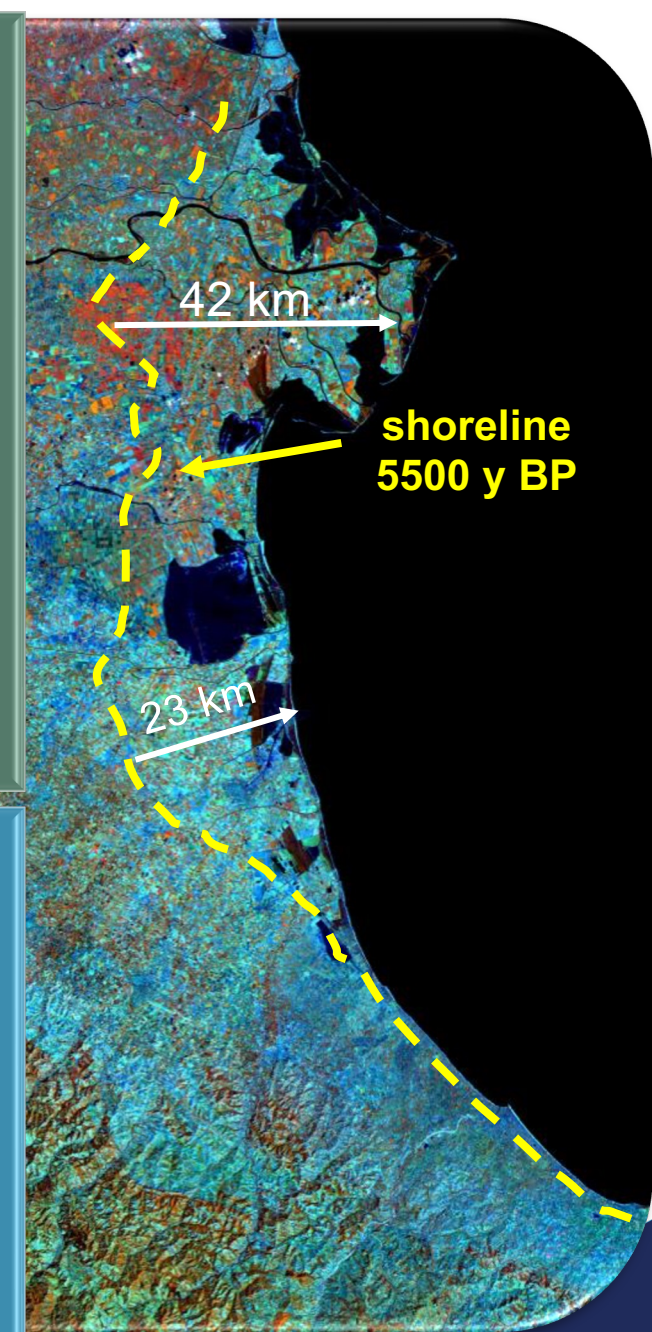
Energy (oil&gas and the uncoming regasifier and renewable energy)

Other values:

Cultural heritage (e.i. Ravenna, Rimini; Comacchio)

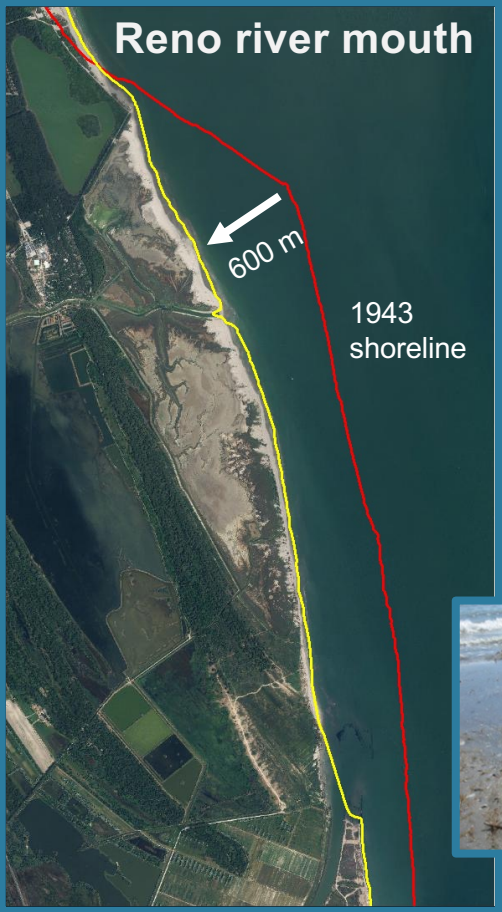
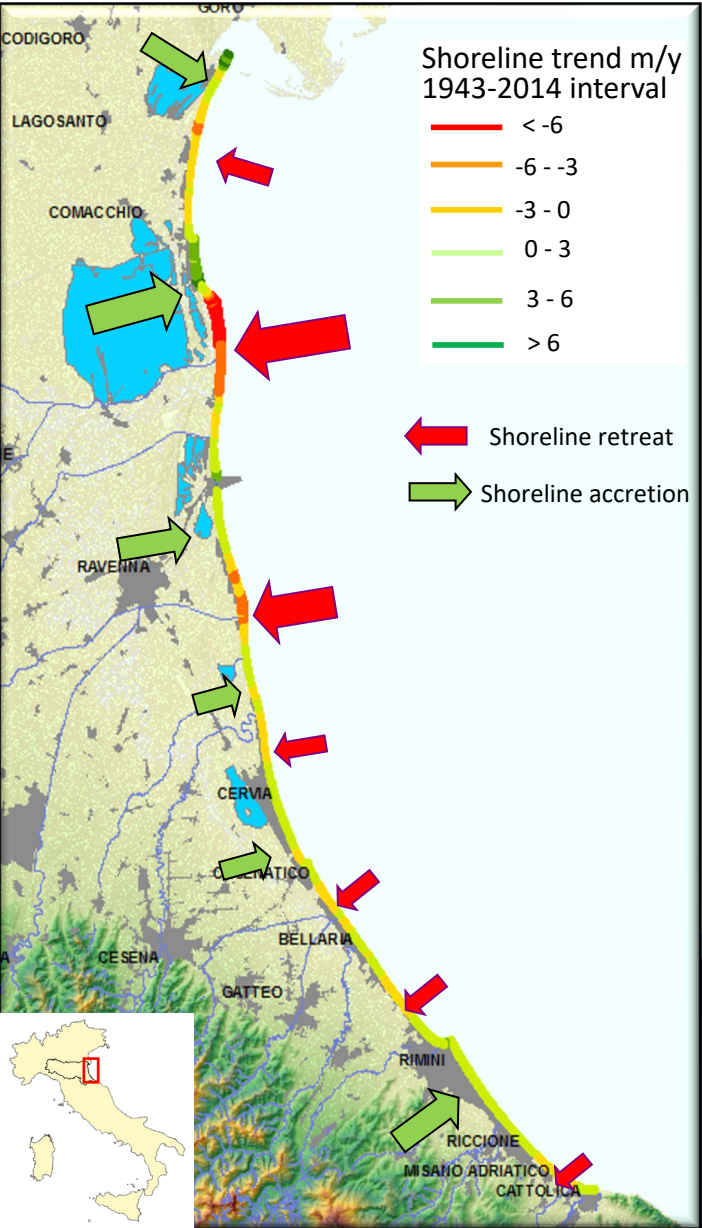
Protected areas (Mab-Delta Po – and several Special Areas of Conservation (SAC) interest)

Littoral morphologies (Beaches and Dunes): important ecosystems



critical issues: the sediment balance

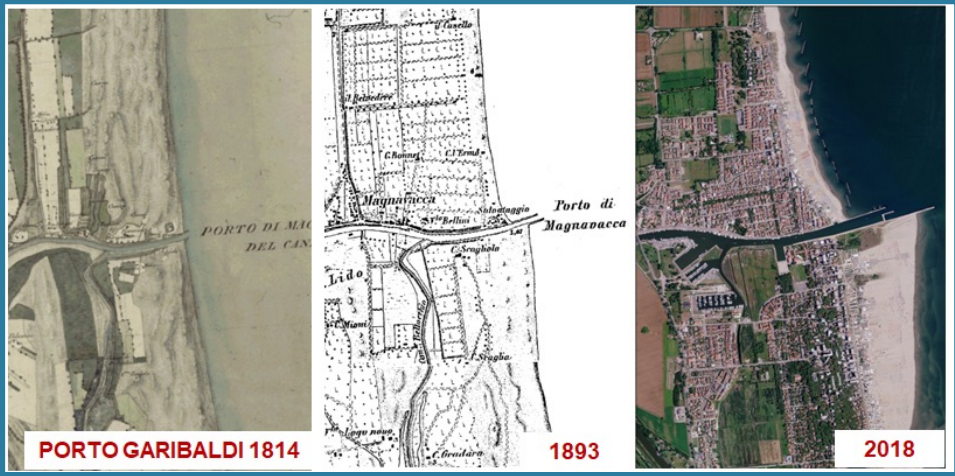
coastline rectification process



dismantling of the river mouths and outcropping of retrodune fine deposits

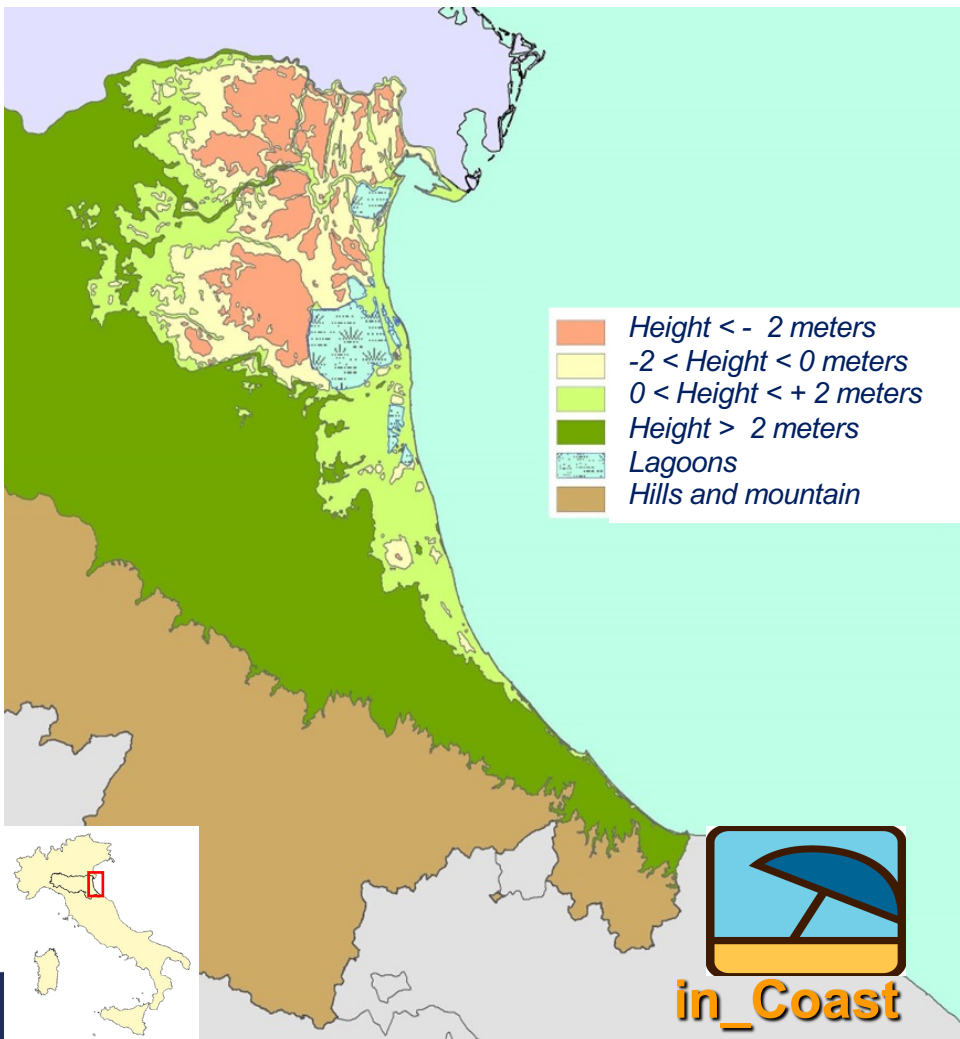
The geological surveys and cartographies of the historical shorelines and morphologies

highlight the dramatic reduction in sediment supply from rivers, since the end of the Little Ice Age (~ 1300-1860) that cannot be counteract with hard coastal defences



Effects of jetties on longshore sediment flows; the beach erosion and seabed lowering still affects around the 47%

critical issues: morphological setting & loss of dunes



1200km² of the coastal plain below m.s.l.;
detectable the morphologies of the fossil delta Po; lagoons and discontinuous dunes which are bordering low-lying areas, often reclaimed

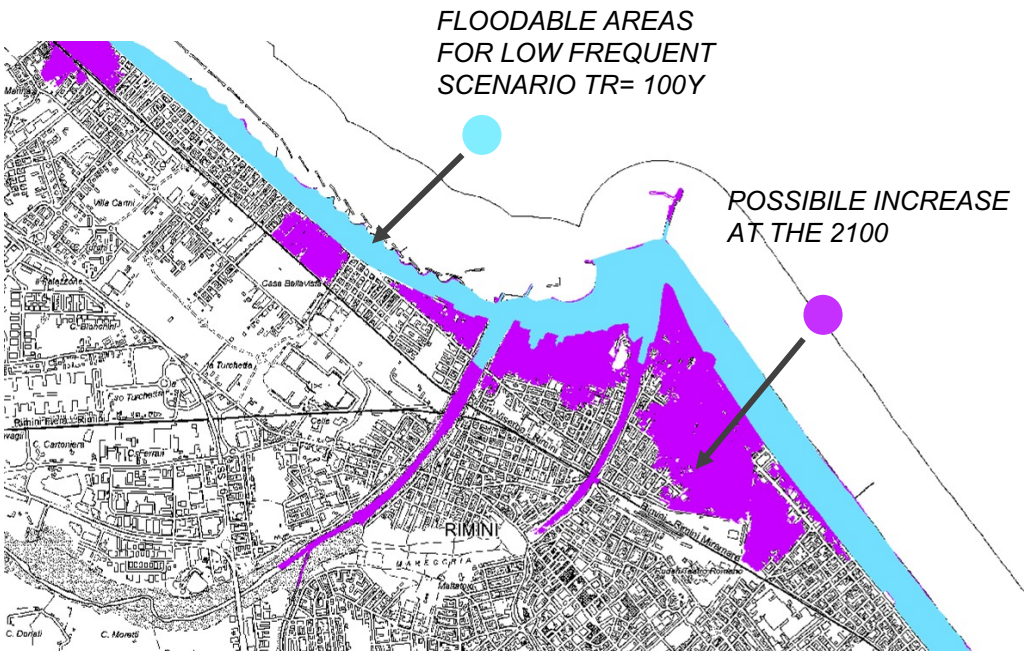
coastal dunes are present only along 43% of the shoreline (~ 50 km); 90% are 'stabilized dunes', dated between the XX and the XVII century
the 82% of the coastal dunes, mapped at the 2019, have an **elevation < 2 m,** therefore easily overtopping by swell

in the period 2004 - 2019 have been **lost around 10 hectares of coastal dunes,** most of them in the active portion



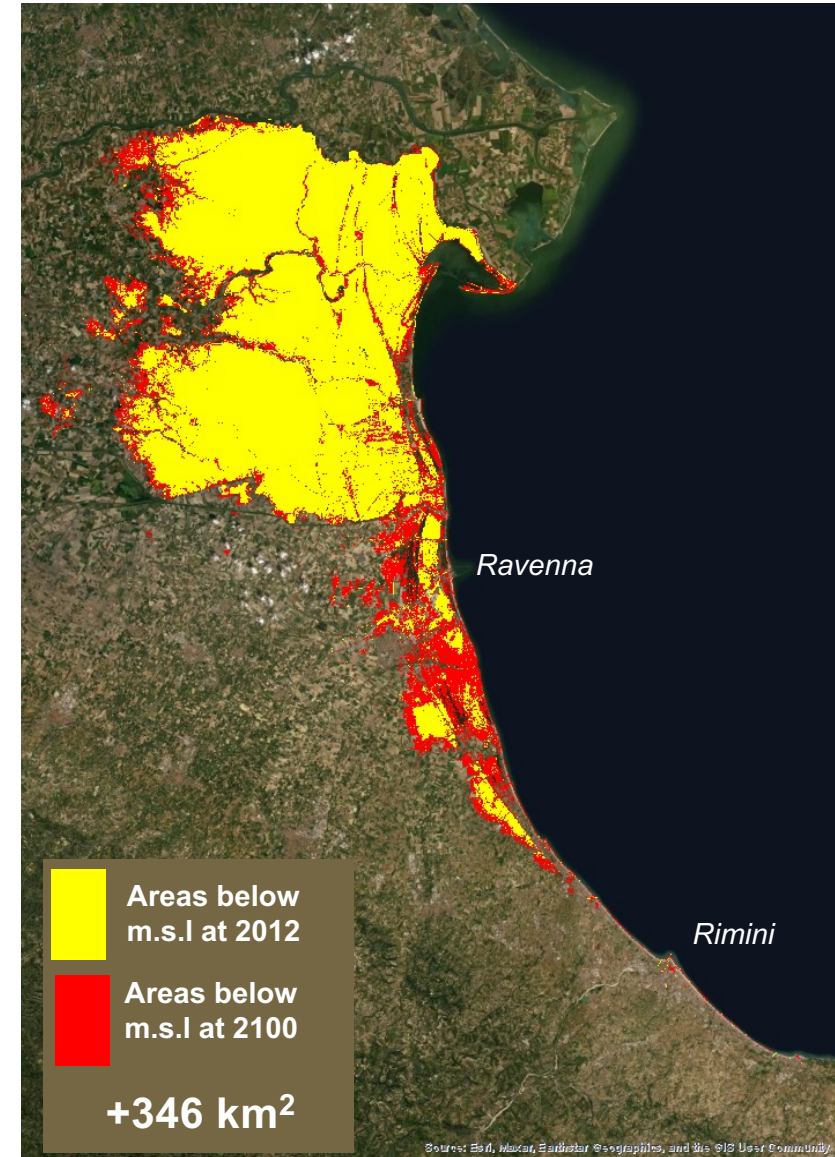
critical issues: effects of subsidence + sea level rise

The sea flood hazard, for Tr100 year events, may increase more than **3.5 times by 2100** (using IPCC-AR5 scenarios), if compared to the currently prone areas under the Floods Directive



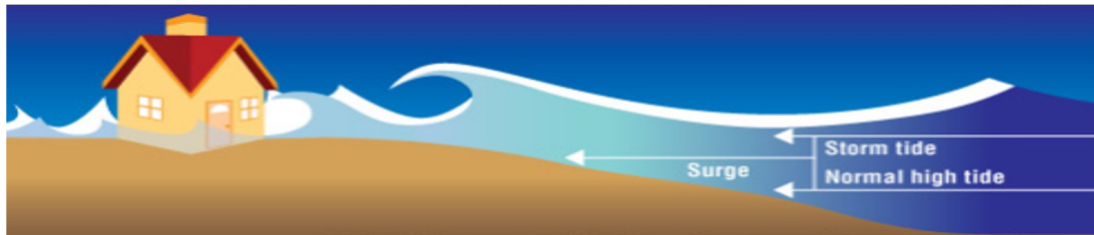
Impact of severe marine storms is already a matter that can concern around 70 Km² the coastal strip

The 1200 km² of low-lying areas - can increase of a 25% by the 2100 considering subsidence + SLR



critical issues: sea storms effects

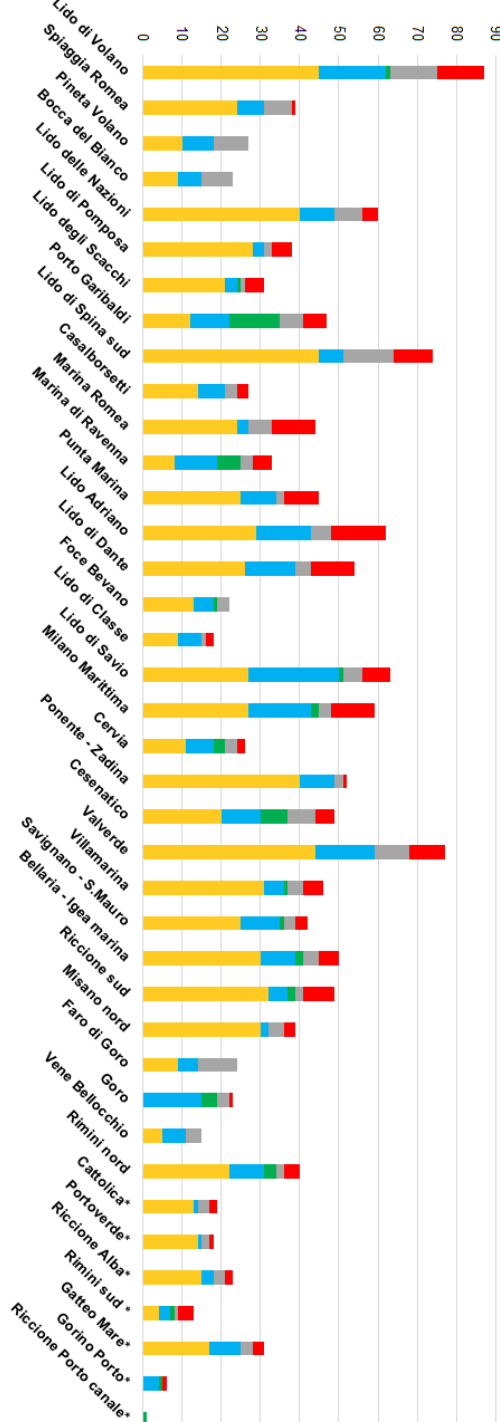
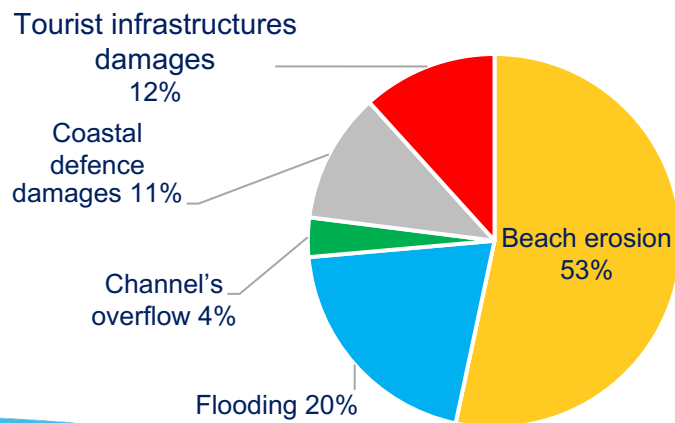
The major impacts recorded are related to the Bora (NE) winds, especially when coupled with high sea level (**storm surges**) – the only parameter showing a slight increasing trend



in_Storm

beach erosion represents the most frequent class of impact, followed by the sea flooding, that sometimes affect the urban areas

types of Impact 1946-2022



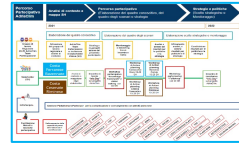
NIM indicator (Number of sea storm impacts) period 1946-2022



the GIDAC Strategy and the Participatory Process "Che Costa Sarà?"

Integrated Management for Protection and Adaptation of the Coast

Legal framework: the regional Strategy MACC (D.A.L. n. 187/2018); the PGRA - Flood Risk Management Plan - Dec 2021



Starting AdriaClim Tasks 06/2020

Participation Team constitution

Participatory process Design

INFODAY AC + CCS 23 Apr 21

Participatory WS fine-tuning strategy 16 Nov 2021

Adjust the Strategy basing on detailed Scenarios

Final document GIDAC Strategy December 2022

Monitoring system of the GIDAC Implementation

2020

2021

2022

2023

2023 ÷ 2030

IMPLEMENTATION

Regional Working Group 4 DGs + 3 RAs + AdBPo

Drafting the Preliminary Document

Preliminary Document guidelines for the strategy

Participatory Workshops 6-11-13-18-27 May 2021

E-R coast detailed Scenarios

Public Consultation April-June 2022

Intergenerational Pact for E-R Coast "Innovation Camp" 14-21-28 March 2023



- Environment & Territory
- Knowledge & Research
- Agriculture & Fishing
- Europe & Innovation

- ARPAE
- PRO-CIV
- ART-ER

- Local PAs | University & Research
- Economic operators and associations
- Citizen | Youth organisations
- Environmental associations

Decidim platform «PartecipAzioni»

JRC Directorate funding «Science Meets Regions»

CHE COSTA
SARA?

<https://partecipazioni.emr.it/processes/che-costa-sara>

What coast will it be? Results ...

2022

PUBLIC CONSULTATION

GIDAC strategy document

46 contributions:

36 proposal of integration/modification

10 expressions of support on specific topics

32 Proposals accepted

in whole or in part

4 proposals not acceptable

2021

Participatory
construction of
GIDAC Strategy

7 meeting
195 overall
attendance

Involved: Municipalities and other territorial bodies of the coast, associations and economic operators, universities and research institutes, environmental and local associations.

the process totaled

12.534
views

Emilia-Romagna. We make the future together.



General Objectives

Dealing with CC impacts, SLR, storm surges, coastal erosion, marine flooding, saltwater intrusion

GO1 Reduce the vulnerability of the coastal territory by ensuring an adequate safety trim of the coastline & beach system in relation to its function of “first protection structure” for the inland.

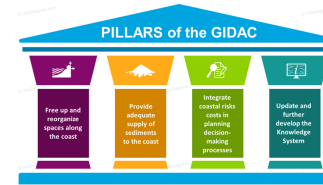
GO2 Ensure conservation and integrity of the coast environment, ecosystems, landscapes, geomorphology, for present and future generations.

GO3 Promote a sustainable development of the coastal zone regarding to a rational planning of human activities in relation to the expected scenarios and impacts of climate change.

GO4 Prevent/reduce the impacts on coastal territories related to sea level rise, storm surges, erosion and marine ingression, saltwater intrusion in the coastal groundwaters.

GO5 Ensure the sustainable management and coordinated use of the different sediments' sources for littorals nourishment and maintenance purpose.

GO6 Ensure coherence between public and private initiatives and decisions regarding the protection and adaptation of the coastal zone, the littorals management, the use and conservation of coastal and marine resources.



Pillars of the GIDAC

PI1 Free up space along the coast and keep beaches free from structures and infrastructures creating "buffer zones" for the unfolding of the dynamics of the sea, promoting the reorganization of critical coastal stretches and the retreat or realignment of the anthropic elements where necessary

PI2 Adequate supply of sediments to the coastal system, from the different internal and external sources, with the purpose of restoring and maintaining the sedimentary balance for current and expected climatic conditions.

PI3 Integrating coastal risks costs in decision-making processes on coastal transformations planning and investments, through a shared approach and an adequate coastal-risks-inclusive cost/benefit assessment methodology.

PI4 Maintain a Knowledge System always updated on coastal/rivers dynamics, erosion management and sediment sources, phenomena impacts and risks in current and future perspective, planning and implementing transformations and interventions along the coast.

OVERALL INDEX

PART A) GENERAL FRAMEWORK, PURPOSES, KNOWLEDGE FRAMEWORK, PARTICIPATORY PROCESS

PART B) STRATEGIC VISION, OBJECTIVES, SUSTAINABILITY, MANAGEMENT OPTIONS

PART C) ACTIONS AND IMPLEMENTATION GUIDELINES

PART D) COMMUNICATION, AWARENESS RAISING, PARTICIPATION strategies and tools, intergenerational approach and involvement

PART E) MONITORING & EVALUATION on GIDAC strategy implementation and effectiveness of proposed actions

PART F) MONOGRAPHS OF PROVINCIAL COASTAL STRETCHES critical issues and hot spots, sustainability of coastal management, interventions and resources needed

Annex 1 KNOWLEDGE FRAMEWORK extended version

Annex 2 TERRITORIAL WORKSHOPS "ACTIONS" results

Annex 3 COASTAL RISKS INCLUSION IN C-B ANALYSIS methods



Systemic Actions

24 Measures

- Integrated management of coastal sediments
- Improvement of river and coastal sediment transport
- Management and sustainable use offshore sediment deposits
- Management and use of sediments from building excavations
- Further reduction of the anthropic component of subsidence



Adaptation Actions

13 Measures

- Urban regeneration and adaptive transformations of waterfronts and urbanized fabric for CC resilience
- Planning for the reduction of vulnerability in the coastal area
- Widening and elevation adequation of the beach systems
- Strengthening of the coastal early warning system



Maintenance Actions

29 Measures

- Beach maintenance with nourishment
- Maintenance and remodeling of detached protection works
- Maintenance and adequation of hard defenses and internal embankments
- Port fronts, port channels, docks elevation adjustment



Cross-cutting Actions

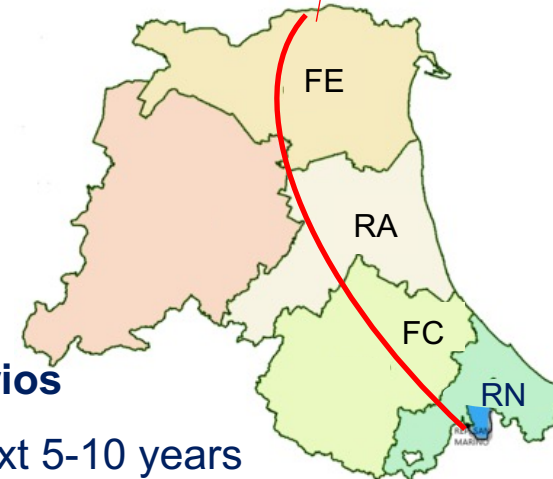
10 Measures

- Construction of a "Intergenerational Pact for the Emilia-Romagna Coast"
- Update and further development of the Knowledge Framework
- Cost-benefit assessment with coastal risks and sustainability evaluation for the interventions on the coast

16 Actions

66 Measures

Monographies on provincial coastal stretches (PART F)



For each provincial coastal stretch a brief report on:

- Pressure indicators
- Status indicators
- Impact indicators
- Response indicators
- Critical spots and proposed interventions
- Current management sustainability
- Sustainability of management for future scenarios
- Transformations on the coast foreseen in the next 5-10 years for adaptation and risks reduction

➤ Plus, an “Identity Card” showing the coastal stretch AT A GLANCE: features, indicators, management

Provincia di FERRARA celle 96-118 49,1 KM 30% costa naturale 62% costa protetta 8% costa fittizia

MACROCELLA 5, 6 E 7

Unità fisiografica secondaria il delta padano moderno e la piana costiera ferrarese

Assetto morfologico Morfologie tipiche di ambiente deltizio; sistema barriera-laguna (Sacca di Goro) e ampia piana costiera con aree sotto il livello del mare retrostanti o intercalate da cordoni litoranei. Quota media dune più recenti è di +2-3m, con punte massime fino a 8 m tra Lido degli Scacchi e Porto Garibaldi

Evoluzione millenaria Progradazione e successivo abbandono differenziale dei rami del Delta del Po. Crescita del Po moderno e del fiume Reno fino all'800; a seguire smantellamento differenziato nel tempo delle foci-accrescimento laterale per ridistribuzione del sedimento e rettificazione linea di riva

Evoluzione decennale/secolare in accrescimento: scanno di Goro alimentato dai depositi di foce, spit di Volano alimentato dalle spiagge dei Lidi Nord, tratto Lido Spina-Lido-Estensi. In arretramento: zona foce Reno e lidi nord

Processi sedimentari dominanti importante riduzione dell'apporto sedimentario dei fiumi da metà '800-inizio '900; trasporto litoraneo da sud interrotto dai moli di Porto Garibaldi. Il sedimento dai lidi nord favorisce la crescita dello scanno di Volano. alternanza di aree naturali e centri urbani/località turistiche

Uso suolo **Pressione antropica** 0-10%: 34,6 km | 10-30%: 4,4 km | 30-60%: 2,6 km | 60-80%: 2,6 km | 80-100%: 3,8 km

ampiezza spiaggia emersa
protetta = 12%
inferiore a 30 m = 25%
da 30 m a 50 m = 21%
da 50 m a 70 m = 12%
da 70 m a 100 m = 9%
maggiore di 100 m = 19%
fittizia = 2%

quota media spiaggia
protetta = 11%
inferiore a 1 m = 14%
da 1 m a 1,5 m = 38%
da 1,5 m a 2 m = 32%
maggiore di 2 m = 3%
fittizia = 2%

stato dosso costiero
ottimo = 6%
buono = 37%
medio = 39%
scadente = 6%
assente = 12%

quota di chiusura
protetta = 11%
inferiore a 1,5 m = 13%
da 1,5 m a 2 m = 42%
da 2 m a 2,5 m = 18%
maggiore di 2,5 m = 13%
fittizia = 3%

ASPE 37 (accumulo stabile) 12 (precario) 31 (erosione) 21 (erosione) **ASE** 19 (accumulo stabile) 34 (erosione) 47 (erosione)

Subsidenza 2006-2011: 2-3 mm/a
Subsidenza 2011-2016: 2-3 mm/a

Indicatore Numero di Impatti (2011-2020) max e località
NIM-20 Sp. Romea, Lido di Pomposa
NIM-30 Lido di Spina sud, Lido Nazioni, Lido di Volano

pericolosità massima da inondazione marina

Comune	Pi (kmq)	Lunghezza costa (km)	SArapp
Comoscchio	15.75	2.3	6.85
Codigoro	35.04	1.3	27.00
Goro (escluso lo scanno)	11.50	1.6	7.19

RIPASCIMENTI (2012-2018): 916.863 mc di sabbia

FONTI
Bocca laguna-Scanno di Goro: 394.618 mc
Scanno di Volano: 234.362 mc Canale Logonovo: 458943 mc
Pulizia spiagge: 27.802 mc Canale Gobino: 35.000 mc

Celle oggetto di RIPASCIMENTI
96 97 98 103 104 105 108 109

Celle oggetto di PRELIEVO
99 100 110 116 118

DISTRIBUZIONE DELLE OPERE DI DIFESA RIGIDE E TIPOLOGIE DI OPERE km complessivi; % sul totale di costa provinciale

- Litorali privi di difesa rigida
- Difese longitudinali distaccate emerse
- Difese longitudinali aderenti
- Difese trasversali
- Difesa mista (elementi trasversali e longitudinali associati)
- Area portuale/foce fluviale
- Argine fluviale

Intergenerational Pact for the protection and adaptation of the Emilia-Romagna coast

“Innovation Camp” financed by “Science Meets Regions” Program - EU DG Joint Research Centre (March-April 2023)

Designing a “Intergenerational Pact” involving 15 Senior and 15 Young representatives of the 4Helix:

Public institutions/local bodies – Economic activities/associations - Research/University – Civil society/Youth movements

2023

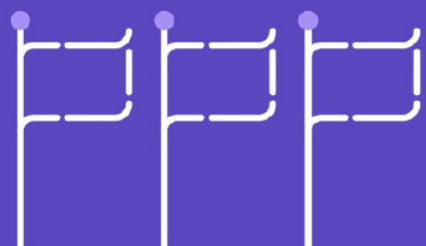
INTERGENERATIONAL PACT INNOVATION CAMP

Marzo-Aprile 2023



Chiamata all'azione per un patto intergenerazionale per la difesa e l'adattamento della costa ai cambiamenti climatici

science meets regions 2022 #EUSci4Regio



CHE COSTA SARA?

Il cambiamento climatico è e sarà un problema con forti implicazioni sul nostro modo di vivere e lavorare nel futuro.

Come collaborare tra le generazioni per affrontare le sfide e gli impatti del cambiamento climatico sulla costa dell'Emilia-Romagna?
Quali soluzioni possiamo trovare e sperimentare insieme?

L'Innovation Camp per il Patto

La Regione Emilia-Romagna ha lavorato alla costruzione partecipata di una nuova strategia per la difesa e l'adattamento della costa ai cambiamenti climatici (GIDAC).

In questo ambito, la Regione vuole predisporre un Patto con il territorio come strumento di supporto all'attuazione della strategia.

Il Patto, guardando al futuro deve necessariamente coinvolgere anche le generazioni più giovani, a partire già dalla fase di co-progettazione.

Per la costruzione del Patto è previsto un ciclo di laboratori (Innovation Camp promosso dalla Direzione Generale JRC della Commissione Europea) da svolgere a marzo 2023.

Partecipazione innovativa

L'Innovation Camp è uno metodo promosso dalla Commissione Europea per affrontare le sfide sociali attraverso lo sviluppo e il collaudo di prototipi di soluzioni per il futuro. Il metodo permette ai decisori e agli attori sociali di lavorare insieme per sviluppare e sperimentare idee innovative.

Partecipanti



Giovani interessati ai temi dei cambiamenti climatici



Giovani motivati e portatori di proposte innovative per la propria Regione



Adulti che intendono lasciare un territorio sicuro alle future generazioni

Ci sono due livelli di partecipazione.

L'Innovation Camp (IC) genera prototipi di soluzioni e azioni con un gruppo ristretto di portatori di interesse delle diverse generazioni che lavoreranno su tre sfide concrete.

Le soluzioni emerse nell'Innovation Camp saranno condivise e messe in pratica con un pubblico intergenerazionale più ampio attraverso la piattaforma PartecipAzioni della Regione Emilia-Romagna.

<https://partecipazioni.emr.it/processes/che-costa-sara>

Participatory workshops issuing intergenerational discussions and proposals/prototypes on :

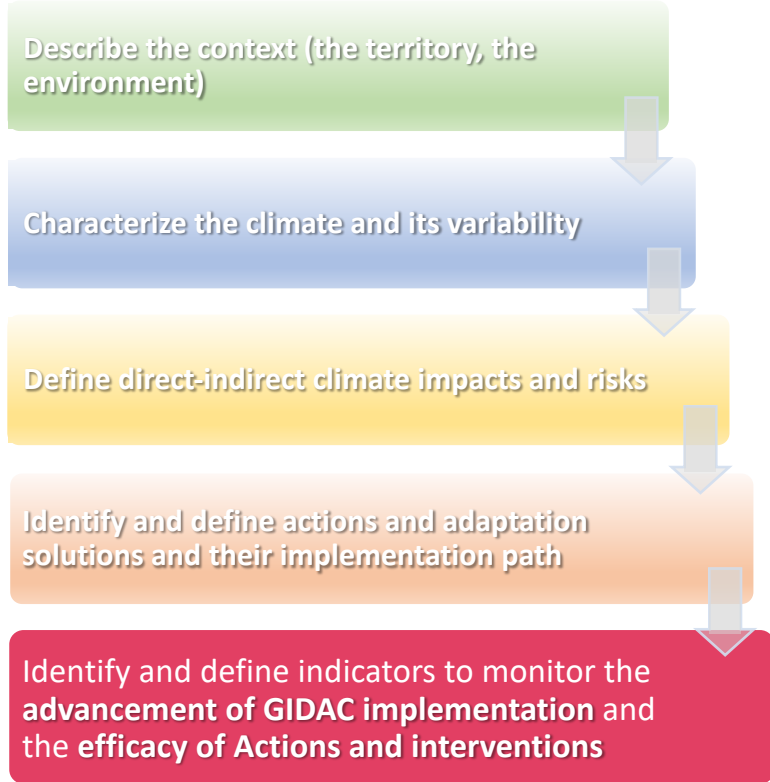
- **Governance** -> how can collaborate the different generations in the protection and adaptation of the coast (GIDAC Strategy) implementation?
- **Communication & Participation** -> how can we co-design an intergenerational not conventional communication and participation strategy?
- **Monitoring & Knowledge continuous improvement** -> how to promote continuous intergenerational learning on coastal protection and adaptation?

5 prototypes

<https://partecipazioni.emr.it/processes/che-costa-sara/f/405/>

Monitoring Plan of the GIDAC implementation

Phases of the GIDAC construction process



A set of the GIDAC indicators matches with measures/indicators of both the Flood Risk Management Plan (PGRA) and the National Plan for Climate Change Adaptation (PNACC) related to the parts focused on coastal areas

Strategy Implementation Indicators

Monitoring the advancement on transposition into local urban planning instruments and regional sectors of practices and guidelines for implementation of GIDAC Actions

Strategy Effectiveness Indicators

Monitoring the efficacy of Actions and Interventions throughout a set of indicators already consolidated on a regional scale, classified according to the DPSIR model

COASTAL RISK INDICATORS			
Indicator Type	Type of information	Indicator Name	Last reference year
Pressure	tendency	Susidence rates	2016
	qualitative	Interfering Works	2020
Status	tendency	ASE	2018
	tendency	ASPE	2018
	morphological	Amplitude free beach (SLI)	2019
	morphological	Beach Elevation	2019
	morphological	Coastal Hump	2019
	modeling	Floodable surface (SA)	2019
Impact	observation	Number of storm surge impacts (NIM)	2020
	modeling	Flood/Length (SARapp)	2019
	tendency	Variation of the seabeds	2018
Response	observation	% of protected coastline and type of work	2020
	observation	Sand inputs	2020
	qualitative	Level of protection	2020

Indicators of effectiveness are derived from the evolutionary analysis of some indicators of Pressure, Status and Impact.

IMPACTS by phenomena of	INDICATORS
Subsidence	Reduction of the Subsidence Rates indicator
Coastal Erosion	Improvement of ASE and ASPE indicators
Marine Ingression	Improvement of the Beach Elevation and Coastal Hump indicators Reduction of the Floodable Area (SA) indicator
Storm Surge	Reduction of the Number of Storm Surge Impacts (NIM) indicator

Investments in coastal management and risk mitigation

Investments for interventions on the Coast planned/realized (by typology) in the period 2020-2023

Ordinary nourishment	8,6 M€
Extraordinary nourishment (GProject4)	22,9 M€
Nourishment and restoration of defence works	6,2 M€
Marine ingression risk mitigation (RN)	8,4 M€
Hydraulic risk mitigation (RN)	8,7 M€
Maintenance and restoration of defence works	21,3 M€
Total in the period	76,1 M€

Thank you!

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