#### **Interreg Greece-Italy** European Regional Development Fund







Climate change impact and adaptation in coastal areas

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# **Outline**

- Climate-related impacts in coastal areas
- Risk assessment: basic concepts and tools
- The national-scale CVI
- Shoreline evolution analysis in the Apulia region
- Climate adaptation in coastal areas
- Conclusions







# Background

- Climate change is both an unprecedented and a defining environmental challenge of our times, compelling urgent actions simultaneously on many fronts.
- Climate change adaptation and disaster-resilience planning contribute to transforming world economies along sustainable development pathways.
- Mainstreaming information on climate risks is a catalyst for awareness and action.

Assessing the risks of climate change is ineludible for deciding how to employ resources and in what policy mix





# **Climate-related impacts in coastal areas**

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- Global mean sea level is rising and will continue to rise in the 21st century due to climate change (+7 cm in the Adriatic and Ionian Sea for the 2050; Source: PNACC, 2018)
- Low-lying and subsiding coasts are vulnerable to storm surges flooding and coastal erosion
- Impacts on infrastructure, people safety, economic assets, cultural heritage, ecosystems.
- Together with changing hazard frequency and intensity, changing patterns of exposure and vulnerability, will be responsible of **multi-risk scenarios**.

#### **Relevant EU and International policies:**

- The European Flood Directive 2007/60/EC flood risk management plans / river and coastal flooding
- The EU Strategy on adaptation to climate change EU's preparedness to current and future climate impacts
- The **Sendai Framework for Disaster Risk Reduction 2015-2030** need to adopt a multi-hazard approach.
- The Community Civil Protection Mechanism coordinated, effective and efficient response to disasters, joining prevention and preparedness actions.







#### Stakeholders' needs for coastal zone management

Include CC impacts in the definition of Policies, Plans and Programs Integrate CC in Integrated Coastal Zone Management and Strategic Environmental Assessments

Need of **risk assessment protocols** and **tools** able to **deal with the complex interactions and dynamics between social and environmental systems**, supporting the development climate adaptation and risk reduction measures



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## **Risk assessment – basic concepts**



#### **Risk assessment**

is a complex procedure which requires collection and modeling of a huge amount of data and the integration of different disciplinary spheres (e.g. climate, environmental and socio-economic sciences).

Source: IPCC-AR5 (2014)

Changes in **climate system** (left) and **socioeconomic processes** including adaptation and mitigation (right) are drivers of hazards, exposure, and vulnerability







## **Risk assessment – basic concepts**

#### Hazard:

The potential occurrence of a **natural or human-induced physical event** or **trend** or **physical impact** that may cause loss of life, injury, or other health impacts, as well as damage and loss to property, infrastructure, livelihoods, service provision, ecosystems, and environmental resources. Vulnerability

Risk

Hazards

Exposure

In the IPCC AR5 report, the term hazard usually refers to climate-related physical events or trends or their physical impacts



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## **Risk assessment – basic concepts**



#### Vulnerability:

The **propensity** or predisposition to be adversely affected.

Vulnerability encompasses a variety of concepts and elements including sensitivity or susceptibility to harm and lack of capacity to cope and adapt.







## **Risk assessment – basic concepts**



#### **Exposure:**

The presence of people, livelihoods, species or ecosystems, environmental functions, services, and resources, infrastructure, or economic, social, or cultural assets in places and settings that could be adversely affected.







# **Risk assessment – basic concepts**

#### Risk:

Risk is often represented as **probability** of occurrence of hazardous events or trends multiplied by the impacts if these events or trends occur.

Risk results from the interaction among vulnerability, exposure, and hazard









# **Risk assessment – Tools & methods**

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#### THE DECISION MAKING FRAMEWORK



#### **DECISION MAKING TOOLS**

#### **RISK ASSESSMENT:**

A methodology to determine the nature and extent of risk by analyzing potential hazards and evaluating existing conditions of vulnerability that together could potentially harm exposed targets.

#### TOOLS:

- Numerical models
- Indexes/indicators
- Cause-effect charts and matrixes
- Decision Support Systems (DSS)
- GIS-Spatial analysis and mapping tools
- Multi Criteria Decision Analysis (MCDA)
- Complex system methods
- Participatory methods







Multiple methodologies to evaluate coastal vulnerability to climate related hazards:

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## **The national-scale CVI**



Aims to respond to the need of people and assets prevention from natural disasters and sea level rise in Mediterranean coasts

#### **Specific objectives:**



Provide guidance and criteria for risk and vulnerability assessment Development of GISbased maps and indicators ranking the coastal areas at higher risks Improve risk governance and raise community awareness towards the impacts of climate change and sea level rise

#### http://www.savemedcoasts.eu



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## **The national-scale CVI**



Adapted from the multi-scale CVI by McLaughling & Cooper (2010)







## The national-scale CVI – analyzed scenarios



High challenges for mitigation and adaptation Little progress in reducing of resource consumption and fossil fuel dependency; in addressing local environmental issues: strong environmental degradation in some regions. Low population growth in industrialized countries and higher in developing ones

ESL, land use, population and GDP based indicators







# The national-scale CVI – methodology



**GIS-based physical, environmental and socio-economic** indicators spatially evaluated by:

**Aggregating** information at the **provincial scale** (nuts3 level) based on:

- Percentage
- Mean values

**Reclassification** of variables according to their capacity to determine detrimental changes to coastlines (1 - 5)



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# The national-scale CVI – results





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# The national-scale CVI – results

Great variety in vulnerability scores among the different provinces, mainly driven by the GDP indicator, that strongly varies along the country respect to the land use pattern indicator



Economic sub-index



Vulnerability clas

Comparing baseline with future scenario, vulnerability is expected to decrease according to the high GDP growth projected for the 2050

scenario across all Italian provinces

The reduction of the economic vulnerability connected with the decreasing vulnerability of the future GDP indicator is counterbalanced by the 2050 land use scenario: urban areas are supposed to expand, thus increasing the economic vulnerability of the area of concern

Austria

Slovakia

Hungar

Germany

Liechtenstein



2050

80 - 100



050

b2

Subindex vulnerability classes 0 - 20 20 - 40 40 - 60 60 - 80



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## The national-scale CVI – results









## Shoreline evolution analysis in the Apulia region



 1968 – Commissione De Marchi The study highlighted the main erosion sections along the Apulian coastline not providing specific information on length of each section.

CNR-MURST 1997, Atlas of Italian Beaches – The study updated information on coastline evolution: Significant reduction of Apulian shorelines (mainly along river mouths and nearby anthropogenic activities and settlements).



P.O.R. PUGLIA 2000-2006, Apulian coastline monitoring – The study updated information on coastline evolution (based on 2003 updated data) identifying a further significant reduction of Apulian shoreline.



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MATT 2006 (Italian Ministry of the Environment) Shoreline changes between 1950 and 2000, considering a shoreline deviation of 10 m the study identifies hot spots areas consistent with previous studies.

DGR 1694/2018; http://www.sit.puglia.it/portal/portale\_pianificazione\_regionale/Piano%20Regionale%20delle%20Coste/Documenti



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Physio-

graphic

Unit

UF1

UF2

UF3

UF4

UF5

UFD

UF7

Total

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## Supporting climate adaptation in coastal areas

The main purpose of risk assessment tools is to provide information to guide the process of adaptation.

#### The EU adaptation concept

"Reduce risks and damages by negative effects (actual or expected) induced by climate changes, in a cost-effective way and exploit the potential benefits and opportunities.

Integrated and cross-sectoral strategies and plans are required to be implemented at the national, regional and local scales. Anticipate impacts can reduce future costs and damages across targets

and sectors".

(EC Adaptation White Paper, 2009, EU Adaptation Strategy)







# Supporting climate adaptation in coastal areas

Coastal adaptation is a complex and iterative process, four basic adaptation strategies can be used:



#### Accommodate

Continue to use the land but accommodate changes by building on piles, converting agriculture to fish farming or growing flood or salt-tolerant crops



#### Protect

Use hard structures (eg sea walls) or soft solutions (eg dunes and vegetation) to protect land from the sea. May be prohibitively expensive, especially in the long term





#### Retreat

Withdraw, relocate or abandon assets that are at risk; ecosystems are allowed to retreat landward as sea levels rise



### Avoid

Identify future 'no build areas' and use planning tools to prevent new development in areas at risk now or in future



Adapted from: Coastal climate change Infographic series <u>www.coastadapt.com.au</u>



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## Conclusions

- Coastal erosion is a complex phenomenon affecting natural and human systems, including coastal economic activities.
- Advanced risk-based methodologies will be applied in the TRITON project to evaluate the effect of future climate change scenarios and potential adaptation measures.

Stakeholders involvement to address the TRITON pilot cases, selecting together key assessment endpoints and define suitable management scenarios

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# Thanks for your attention!

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