

# Applied Sciences, Biology, and Territory

Achieved findings and new research frontiers at the University of Molise

*Department of Bioscience and Territory*

*Termoli, December 20, 2022*

The Departmental Research Day 2022 aims at providing researchers with a forum to discuss the research activities carried out by the different research groups of the Department in the field of **Applied Sciences, Biology, and Territory**.

This year the program also includes a session dedicated to the new **research frontiers** in the fields of interests of the Department of Bioscience and Territory. The goal of this session is to present ongoing research projects aiming at defining the agenda for future research directions.

Also, several working sessions will be organized to **facilitate knowledge and expertise sharing** among young and senior researchers, PhD students and postdoctoral fellows.

**The Departmental Research Day 2022 will be held in Termoli on December 20, 2022.**

## Abstract and poster presentation

To join the session “Applied Sciences, Biology, and Territory: New Research Frontiers at the University of Molise” it is required to submit an abstract by **December 9, 2022**, to the following email address: [piera.dimarzio@unimol.it](mailto:piera.dimarzio@unimol.it). Two different types of contributions will be accepted:

1. Proof-of-concept or early-stage studies with preliminary results (2 pages including references).
2. Late-stage or advanced studies with solid results (4 pages including references).

Submissions will not be peer-reviewed. All the abstracts will be collected in a proceedings book and will be presented in a dedicated poster session.

Abstracts must be written in English and must be prepared according to the provided guidelines.

## Participation

The interested participants must register by **November 30th, 2022**, using the following form: <https://forms.gle/W5BuXELVJkc5YRrg8>.

For any questions please do not hesitate to contact Prof. Rocco Oliveto ([rocco.oliveto@unimol.it](mailto:rocco.oliveto@unimol.it)).

## Organizing Committee

Piera Di Marzio – Rocco Oliveto – Marco Petrella – Marco Segatto

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## HUMAN ECOLOGIES AND CLIMATE VULNERABILITY OF THE LANDSCAPE

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This contribution illustrates the (partial) results of a research work that the authors are developing starting from the activities carried out so far in the context of the Erasmus+ KA203 strategic partnership project e-CREHA, “education for Climate Resilient European Heritage Architecture”, in which the University of Molise is involved together with Eindhoven University of Technology (Netherlands, coordinator), INSA-Strasbourg (France), Sofia University (Bulgaria), NIKU Research Institute (Norway), Tobb Ekonomi ve Teknoloji Universitesi (Turkey).

The objectives of the project are: i) the definition of an innovative learning methodology (which also includes an e-learning course) around the general theme of resilience to climate change of built cultural heritage in Europe; ii) the increase in the quality of training and design research applied to the reduction of the negative effects induced by climate change on the built cultural heritage; iii) the development of multidisciplinary knowledge aimed at the progressive construction of a design culture oriented towards the prevention and mitigation of the effects of climate variability.

Unimol's contribution to the research work addresses the issue of vulnerability, and in particular it deals with planning approaches and tools capable to reduce the vulnerability of the built cultural heritage to the hazards induced or increased by the effects of climate change, but also to simultaneously trigger processes of continuous regeneration of the heritage itself, as well as self-sustainable development of the settlements [1].

The research fits into the general framework of studies on the effects of climate change on human activities and focuses on the need to (re)conceive forms of human settlement that are more adaptable to the changing environmental contexts, thus reducing their vulnerability to pre-existing or new hazard factors, and the consequent negative effects on the built cultural heritage. The latter understood in an extensive and territorial sense, thus overcoming the limits of both the approach centred on the scale of the single artefact of particular value, and of that one focussed only on landscape assets or landscapes of outstanding universal value; considering rather the whole landscape as the “result of the action and interaction of natural and/or human factors”, which expresses the different civilizations which have contributed over time to shape it, including the contemporary one, .

In the context of the research work, these processes of “action and interaction” are considered according to an ecosystem approach that goes beyond the simple “interconnection” of “social, economic and ecological systems” [2], and also beyond the interpretation of the Social-Ecological System (SES) as “an integrated system that includes human societies and ecosystems, in which humans are part of nature” [2], which however still implies a clear distinction between “human societies” and “ecosystems”.

Moreover, the research refers to that concept of SES which intends it as an ecological system closely connected and influenced by one or more social systems [3], in which the ecological system, in the broadest sense, is considered as an interdependent system of organisms or biological units, and “social systems” are all systems in which organisms of the same species tend to form cooperative and interdependent relationships relationships.

The specific purpose of the research is precisely to contribute to the development of this approach to SESs in a planning sense, i.e. identifying those settlement and production practices that make it

possible to reactivate local and networked processes of co-evolutionary interactions between human species and environment, aimed at reducing the vulnerability of the territory, through interventions that are not purely conservative.

Starting from the definition of human ecologies as a complex of “interactions between humans and their environments” [4] “at all scales, times, and places” [5], the research considers the multiform and multiple relational plots through which spread out the above interactions between human species and non-human natural elements producing evolutionary changes. It is therefore considered necessary that any planning intervention is aimed at (re)enabling the aforementioned ecologies, identified as the only ones capable of responding to the new and changing needs induced by the climatic variability affecting territories, both on a global and local scale.

An interpretation of human ecologies looking at anthropic interactions in the environment as a complex of retroactive processes (feedback) also allows to overcome the persistent idea of opposition between vulnerability and resilience - still existing in the definitions of IPCC [2] - consistently with a more innovative approach, defined as “resiliency vulnerability” [6], which instead places them within a relational continuum, in which the vulnerability factors themselves also can constitute resilience factors.

A further progress proposed by the research, always based on the notion of SES provided above, is the overcoming of the concept of “Built Environment” as anthropic polarity opposed to the natural polarity of the global environment - in turn still present in the IPCC contributions, although oriented towards a greater integration of the two terms - but rather as a field of synthesis and symbiotic integration between the human and non-human (abiotic and biotic) components of the environment.

The research also recognizes the substantial coincidence between this conception of built environment and the European Convention definition of landscape, further interpreted as “continuing landscape”<sup>1</sup> - i.e. as a landscape whose evolutionary process is still in progress and that at the same time exhibits significant material evidence of its evolution over time - provided that this interpretation would be referred not only to the landscapes of “outstanding universal value” but to all landscapes [7], considered as a whole as the ‘Built Cultural Environment’.

The reactivation of human ecologies is therefore identified as the most effective approach for reducing the ‘climate vulnerability’ of landscapes. In fact, “in human ecology, [since the beginning, ed] the concept of adaptation did not refer to the survival and reproduction of genetically heritable traits, but rather the continual process of choosing among and refining strategies of making a living (reproducing a way of life) in a changing world” [8]. It is also recognized in the literature that local and autonomous settlement practices have often allowed greater ability to adapt to the changing environmental contexts compared to institutional planning and interventions [9].

In the research framework, such an approach has been experimented in four areas of Molise region<sup>2</sup>, characterised by the widespread presence of environmental hazards (potentially accentuated by climate change) and by heritage elements already recognized (archaeological, architectural and landscape heritage) or recognizable (continuing landscapes). The four areas were selected for the purposes of the planning exercise foreseen in the programme of the e-CREHA workshop which took place at the Termoli branch of the University of Molise<sup>3</sup>, with the participation of tutors and students from all the partner institutions. The preliminary study for the exercise consisted in the implementation of a geographic information system to integrate data on the hazards and values of the areas under investigation.

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<sup>1</sup> UNESCO, “Operational Guidelines for the Implementation of the World Heritage Convention” (1994).

<sup>2</sup> Guardialfiera Lake area (CB); Pietrabbondante area (IS); Agnone area (IS); Petacciato area (CB).

<sup>3</sup> From 13/09/2022 to 22/09/2022.

The data were used to create planning proposals aimed at reducing the vulnerability of the built cultural environment. The proposals followed the approach described above, and therefore they also contemplated the use of Nature-based Solutions (NbS). Regarding in particular these latter, within the broader range proposed by the European Commission<sup>4</sup> [10], the typologies were identified which seem to be able to reduce the climatic vulnerability of landscapes, while at the same time outlining management systems of agricultural land, water and forest resources and ecosystem connections, as suggested by the European Environmental Agency [11]; or in the terms of our research approach, which are not purely conservative, but rather capable of re-constituting human ecologies, that in turn can re-generate landscapes, aka built cultural environments.

In conclusion, the ongoing research is demonstrating that the use of NbS, also possibly in integration with 'grey infrastructures' (i.e. "traditional" civil engineering interventions), can produce significant and long-lasting effects in reducing the climate vulnerability of landscapes only if it is also conceived as a trigger tool for the reactivation of continuous processes of co-evolutionary adaptation between humans and their environments.

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- 11) European Environmental Agency. Nature-based solutions in Europe: Policy, knowledge and practice for climate change adaptation and disaster risk reduction. EU Publications Office; 2021.

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<sup>4</sup>The general areas identified by the CE are: i) urban regeneration through NbS; ii) NbS for improving well-being in urban areas; iii) establishing NbS for coastal resilience; iv) multi-functional nature-based watershed management and ecosystem restoration; v) NbS for increasing the sustainable use of matter and energy; vi) NbS for enhancing the insurance value of ecosystems; vii) increasing carbon sequestration through NbS.

**HUMAN BEING ENVIRONMENT**

**VULNERABILITY RESILIENCE**

**HUMAN BEING ENVIRONMENT**

**BUILT ENVIRONMENT NATURAL ENVIRONMENT**

SES

(Intergovernmental Panel on Climate Change - IPCC, Sixth Assessment Report, 2022)

**VULNERABILITY RESILIENCE**

BUILT ENVIRONMENT  
(Intergovernmental Panel on Climate Change - IPCC, Sixth Assessment Report, 2022)

**ANTHROPIC ENVIRONMENT NATURAL ENVIRONMENT**

SES

(Anderies, Janssen, Ostrom, 2000)

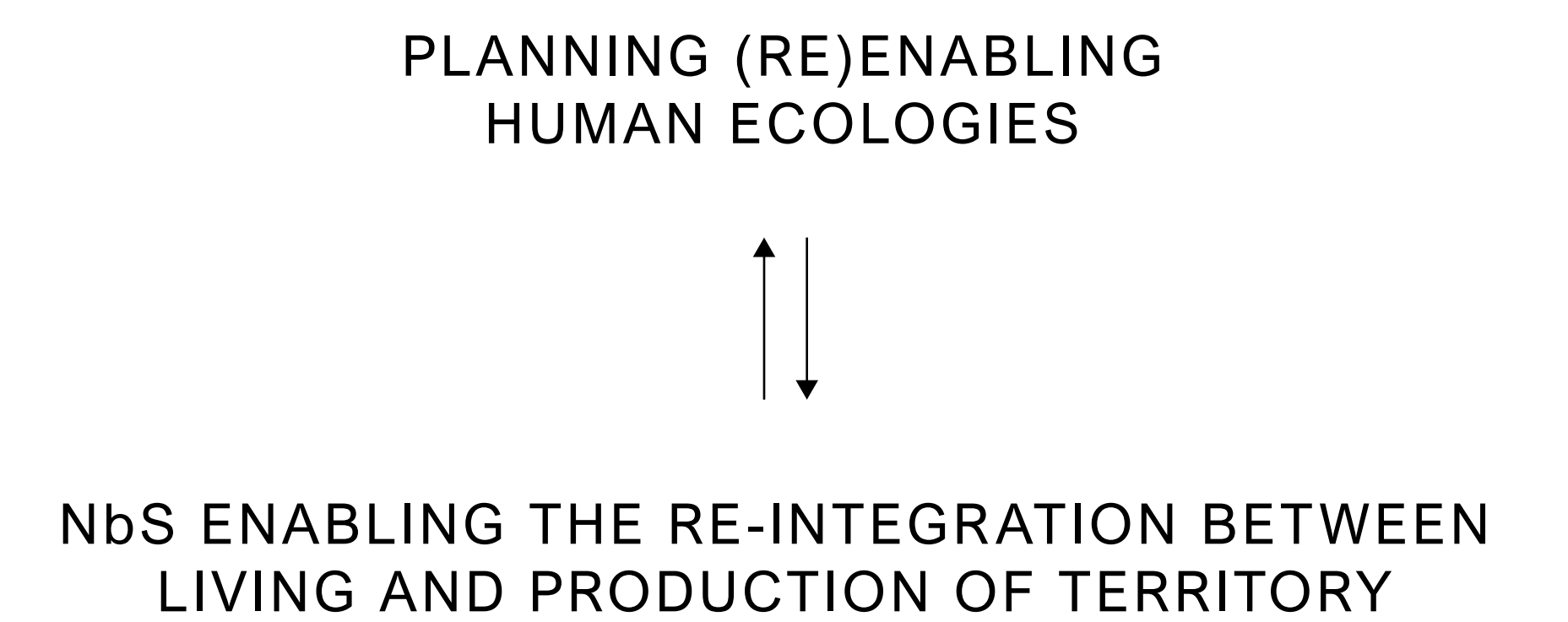
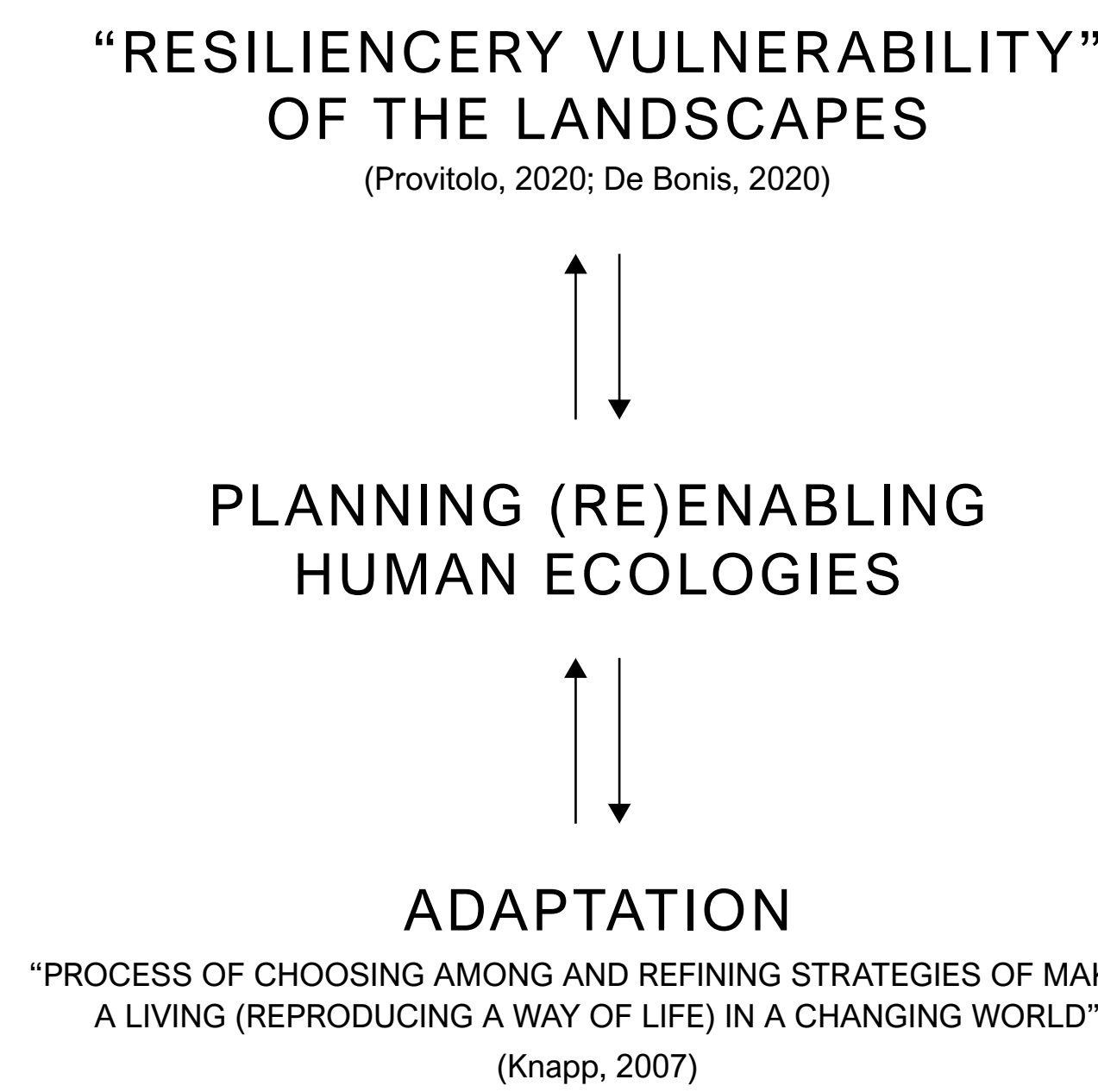
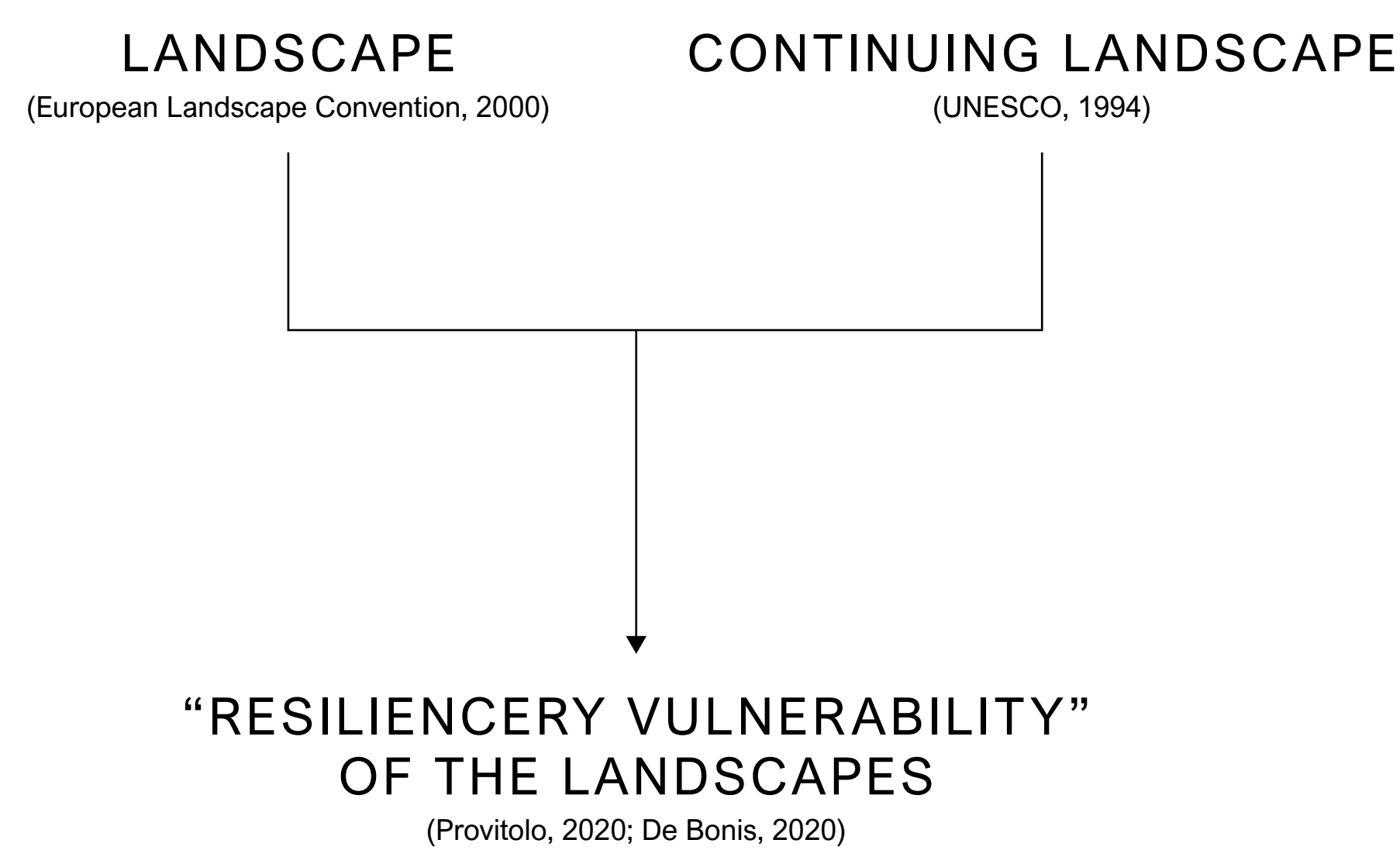
**RESILIENCY VULNERABILITY**  
(Provitolo, 2020)

SES  
(Anderies, Janssen, Ostrom, 2000)

**BUILT CULTURAL ENVIRONMENT = LANDSCAPE**  
(European Landscape Convention, 2000)

In the research work the processes of "action and interaction" between human being and their environment are considered according to an ecosystem approach that goes beyond the interpretation of the Social-Ecological System (SES) as "an integrated system that includes human societies and ecosystems, in which humans are part of nature", which however still implies a clear distinction between "human societies" and "ecosystems". The research refers to that concept of SES which intends it as an ecological system closely connected and influenced by one or more social systems, in which the ecological system, in the broadest sense, is considered as an interdependent system of organisms or biological units, and "social systems" are all systems in which organisms of the same species tend to form cooperative and interdependent relationships. This interpretation allows to overcome the idea of opposition between vulnerability and resilience consistently with an innovative approach, defined as "resiliency vulnerability", which places them within a relational continuum, in which the vulnerability also can constitute resilience factors.

The research focuses on the need to (re)conceive forms of human settlement that are more adaptable to the changing environmental contexts, thus reducing their vulnerability to hazard factors, and the consequent negative effects on the built cultural heritage. The latter understood in an extensive and territorial sense, thus overcoming the limits of both the approach centred on the scale of the single artefact of particular value, and of that one focussed only on landscape assets or landscapes of outstanding universal value; considering rather the whole landscape. A further progress proposed by the research, always based on the notion of SES already provided, is the overcoming of the concept of "Built Environment" as anthropic polarity opposed to the natural polarity of the global environment - in turn still present in the IPCC contributions, although oriented towards a greater integration of the two terms - but rather as a field of synthesis and symbiotic integration between the human and non-human (abiotic and biotic) components of the environment ("Built Cultural Environment").



The research recognizes the substantial coincidence between this conception of built environment and the European Convention definition of landscape, further interpreted as "continuing landscape" - i.e. as a landscape whose evolutionary process is still in progress and that at the same time exhibits significant material evidence of its evolution over time - assuming that this interpretation has to be referred not only to the landscapes of "outstanding universal value" but to all landscapes, considered as a whole as the "Built Cultural Environment". The reactivation of human ecologies is therefore identified as the most effective approach for reducing the 'climate vulnerability' of landscapes.

It is therefore considered necessary that any planning intervention is aimed at (re)enabling the human ecologies, identified as the only ones capable of responding to the new and changing needs induced by the climatic variability affecting territories, both on a global and local scale. It is recognized in the literature that local and autonomous settlement practices have often allowed greater ability to adapt to the changing environmental contexts compared to institutional planning and interventions.

The specific purpose of the research is precisely to contribute to the development of this approach to SESs in a planning sense, i.e. identifying those settlement and production practices that make it possible to reactivate local and networked processes of co-evolutionary interactions between human species and environment, aimed at reducing the vulnerability of the territory, through interventions that are not purely conservative. The research states that developing interventions that integrate (some type of) Nbs is the most effective way to re-enable integrated forms of inhabiting.

Biodiversity	Forests	Land use and forestry	Water	Agriculture	Climate change adaptation	Disaster risk reduction
Biodiversity Strategy for 2030 - Strategy on Green Infrastructure	Forest Strategy	LULUCF Regulation	Water Directive - Floods directive	Common Agricultural Policy	Strategy on adaptation to climate change	Action Plan on the SDRR 2015-2030
EA/EbAp Ecosystem Approach/ Ecosystem-based Approaches	SFM Sustainable Forest Management	SFM Sustainable Forest Management	NWRM Natural Water Retention Measure	NWRM Natural Water Retention Measure	GI/BGI Green Infrastructure and Blue-Green Infrastructure	Eco-DRR Ecosystem-based Disaster Risk Reduction
GI/BGI Green Infrastructure and Blue-Green Infrastructure	SM/EBM Sustainable Management and Ecosystem-based Management	SM Sustainable Management			SM/EBM Sustainable Management and Ecosystem-based Management	
SM/EBM Sustainable Management and Ecosystem-based Management						

**Climate Change Adaptation and Disaster Risk Reduction**

**'Umbrella concept' Nbs Nature-based Solutions**

Figure: Selection of Nbs based on the "Overview of nature-based concepts to climate change adaptation and disaster risk reduction and their related EU policy sectors", European Environmental Agency, Nature-based solutions in Europe: Policy, knowledge and practice for climate change adaptation and disaster risk reduction. EU Publications Office, 2021.

**GROUP 1**  
Tutors: Irene Curuli (TU/e), Paloma Guzman (NIKU), Burgin Yimaz (TU/e)  
Students: Marco Carrelli (UNIMOL), Antonio Simeonov Georgiev (SU), Rick Hulien (TU/e), Mikolaj Kaluzny (WROCLAW), Eif Sultan Kaya (TOBB ETU), Deborah Ricci (UNIMOL), Emiliana Vergato (UNIMOL), Maria Zocardi (UNIMOL)

**GROUP 2**  
Tutors: Sibel Acar (TOBB ETU), Pelin Guroi Ongoren (TOBB ETU), Asli Ozbek (TOBB ETU)  
Students: Utku Doganbey (TOBB ETU), Georgia-Christina Drellosi (NSA), Stephanie Kirsten (TU/e), Teodor Pavlov Kostov (SU), Gerardo Vesce (UNIMOL), Fabiola Zappalà (UNIMOL)

**GROUP 3**  
Tutors: Luciano De Bonis (UNIMOL), Rossella Nocera (UNIMOL), Giovanni Ottaviano (UNIMOL)  
Students: Moniek Buarsma (TU/e), Roberta Cipriano (UNIMOL), Daria Dobrzanski (WROCLAW), Michele Ranallo (UNIMOL), Trayana Stoyanova (SU), Sena Tanverdi (TOBB ETU), Yuan Zhou (TU/e)

**GROUP 4**  
Tutors: Sara Berahman (TU/e), Boyan Paskalev Bortchev (SU), Ezieta Grodzka (WROCLAW), Alessia Leuzzo (UNIRC), Michal Peltzarski (WROCLAW), Valentina Todorova Terzieva-Bogoycheva (SU)  
Students: Emilia Ceccacci (UNIMOL), Wiktoria Kaja (WROCLAW), Sara Kozłowska (WROCLAW), Hafsa Mahmoud (NSA), Ava Mustafa (TU/e), Sabiha Okur (TOBB ETU), Bişra Oruç (TOBB ETU), Sandropio Scoccola (UNIMOL), Maria Iolanda Spada (UNIMOL)

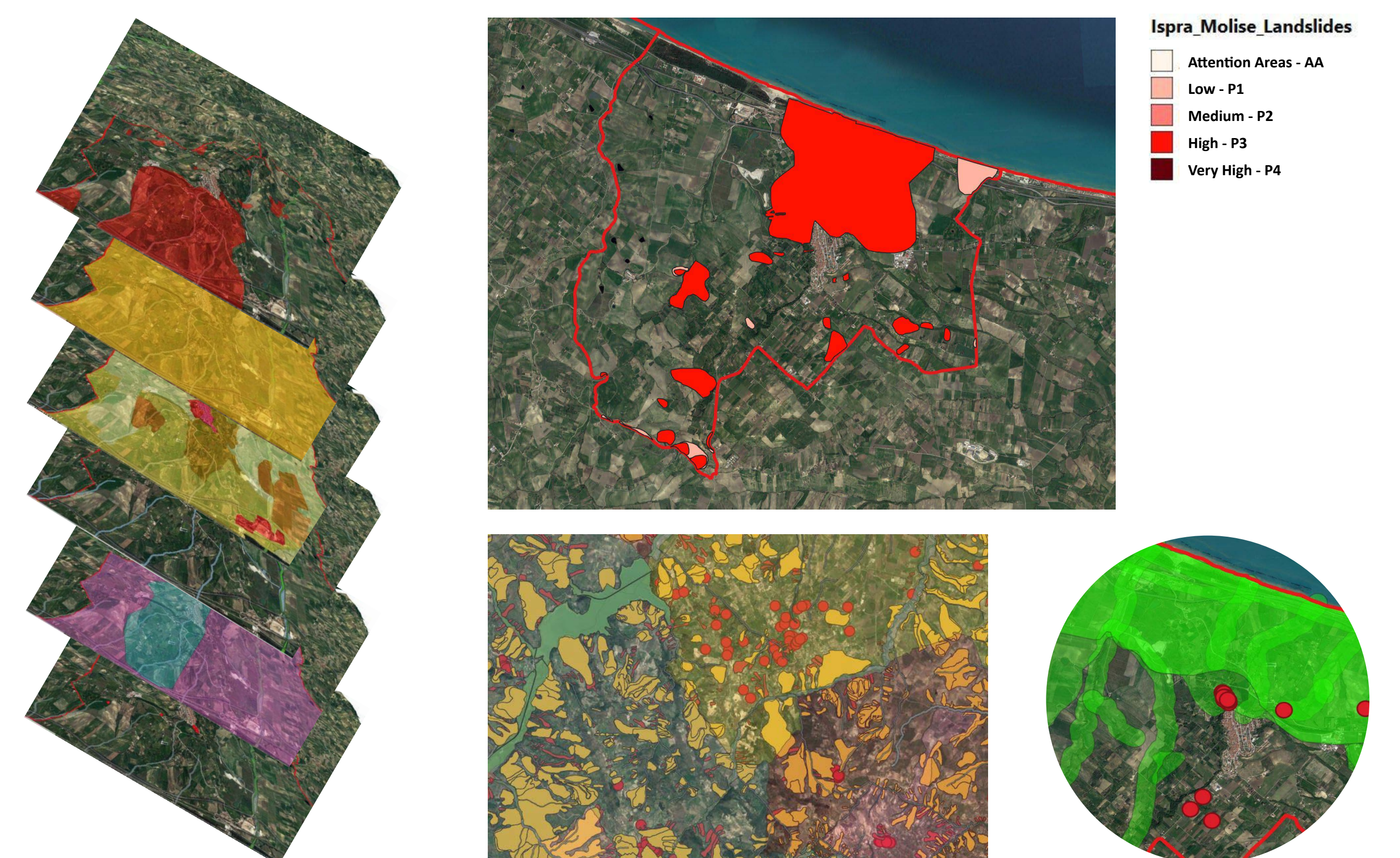
Figures: some of the planning proposals made by the participants in the e-CREHA workshop (top and bottom left); workshop participants (bottom right).

The research identified the typologies of Nbs which seem to be able to reduce the climatic vulnerability of landscapes, while at the same time outlining management systems of agricultural land, water and forest resources and ecosystem connections; approaches that are not purely conservative, but rather capable of re-constituting human ecologies, that in turn can re-generate landscapes, aka built cultural environments. The research affirms that the use of Nbs, also possibly in integration with 'grey infrastructures' (i.e. "traditional" civil engineering interventions), can produce significant and long-lasting effects in reducing the climate vulnerability of landscapes only if it is also conceived as a trigger tool for the reactivation of continuous processes of co-evolutionary adaptation between humans and their environments.

In the research framework, such an approach has been experimented in four areas of Molise region, characterised by the widespread presence of environmental hazards (potentially accentuated by climate change) and by heritage elements (archaeological, architectural and landscape heritage). The four areas were selected for the purposes of the planning exercise foreseen in the programme of the e-CREHA workshop which took place at the Termoli branch of the University of Molise, with the participation of tutors and students from all the partner institutions. The proposals followed the approach described above, and therefore they also contemplated the use of Nature-based Solutions (Nbs). The preliminary study for the exercise consisted in the implementation of a geographic information system to integrate data on the hazards and values of the areas under investigation. The data were used to create planning proposals aimed at reducing the vulnerability of the built cultural environment.



**e-CREHA, "education for Climate Resilient European Heritage Architecture"**, is an Erasmus+ KA203 strategic partnership project in which the University of Molise is involved together with Eindhoven University of Technology (Netherlands, coordinator), INSA-Strasbourg (France), Sofia University (Bulgaria), NIKU Research Institute (Norway), Tobb Ekonomi ve Teknoloji Universitesi (Turkey). The objectives of the project are: i) the definition of an innovative learning methodology (which also includes an e-learning course) around the general theme of resilience to climate change of built cultural heritage in Europe; ii) the increase in the quality of training and design research applied to the reduction of the negative effects induced by climate change on the built cultural heritage; iii) the development of multidisciplinary knowledge aimed at the progressive construction of a design culture oriented towards the prevention and mitigation of the effects of climate variability. Unimol's contribution to the research work addresses the issue of vulnerability, and in particular it deals with planning approaches and tools capable to reduce the vulnerability of the built cultural heritage to the hazards induced or increased by the effects of climate change, but also to simultaneously trigger processes of continuous regeneration of the heritage itself, as well as self-sustainable development of the settlements.



Figures: GIS elaborations of hazards and heritage on some of the study areas made by the Unimol students.