InCLIMATE

Integrating Climate Resilience in E.U. Higher Education

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Intellectual Output O5

"Climate Resilience Integrated Concept Map"

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1. General guidelines regarding the Climate Resilience Integrated Concept Map

1.1. Introduction

This section presents the general guidelines to be taken into account while preparing the Output 5 of the InCLIMATE project – the *Climate Resilience Integrated Concept Map*.

The output presents the evolution of the pre-ordinated cognitive structure (Output 4), resulting from the discussions and activities (at partner level and at consortium level) carried out during the project: the educational activities separately carried out by partners and the Intensive course for students. Conceived as a sort of wide hypertext, it will also reconnect, under a single profile, the resources collected and analysed during the various activities. The basic structure of the integrated map will be the same as the pre-ordinated cognitive structure, but will include new, more in-depth information on the project topics, as well as new interconnections.

Consequently, Output 5 is first of all based on the educational activities carried by the InCLIMATE project partners within their organizations within the first semester of the 2021 – 2022 academic year. These activities aimed to test the effectiveness and usefulness of the pre-ordinated cognitive structure as a teaching tool, and to further develop and improve it by adding concepts, links and materials on specific aspects.

Secondly, the Intensive Course for students held in May 2022 in Malta represented another opportunity to test and develop the integrated concept map, this time within an international and interdisciplinary learning environment.

Materials and methods

The starting point for the development of the Climate Resilience Integrated Concept Map (CRIc – map) was the Pre-Ordinated Cognitive Structure (POCS) dedicated to interdisciplinary topics related to climate change and urban resilience. Each educational activity carried-out by the InCLIMATE partners focused on creating new interconnections and adding new concepts to the POCS, according to the objectives and thematic focus of each discipline. The use of Open Educational Resources collected by partners was encouraged, especially scientific papers that could help students collect information regarding specific topics.

In most of the cases, the C-map Tools Software was used by both students and teachers for the development of new concept maps.

1.2. Phases of integration

In order to elaborate the Climate Resilience Integrated Concept Map, the following integration phases were proposed:

1. Integrated Concept Map at the level of each educational activity;
2. Integrated Concept Map at partner level;
3. First version of the CRIc-map;
4. Final version of the CRIc-map.

1.2.1. Integrated Concept Map – educational activity

The application of concept mapping methods for the educational activity of each InCLIMATE partner was adapted according to criteria such as educational objectives, discipline focus, level of students (undergraduate or masters).

The following principles were taken into account when planning the educational activities:

- Using the POCS as a starting point, with the possibility of detailing existing concepts or adding new interconnections and new concepts.
- Using Open Educational Resources collected during the InCLIMATE project activities (O1, O2, O3).
- Focusing on the background domain that is specific to each partner (Natural Environment / Built Environment).
- Using the Cmap Tools Software.

The educational activities related to climate resilience concept mapping could be either singular (e.g. one workshop during the semester) or could take the form of a project realized by the students during several weeks. Students could work individually or in teams, with the latter having the advantage of encouraging discussions and professional debate.

At the end of each educational activity, the teacher conducting the activity ensured the integration of the different concept maps realized by the students, thus developing an integrated concept map of that educational activity. The following scenarios could be envisaged:

- **Scenario 1 – collaborative:** The integrated concept map of the educational activity could be the result of a collaborative workshop, facilitated by the teacher with the group of students.

- **Scenario 2 – individual:** The teacher was responsible for the development of the integrated concept map, based on the series of maps submitted by the students during the semester. In this case, it was recommended that each student or group of students be responsible for the realization of a specific thematic map (e.g. – for one concept related to climate resilience), in order to make the integration easier.

The Integrated concept map of the educational activity presented a detailed version of the POCS, considering all of the new concepts and interconnections added by the students during their work.

1.2.2. Integrated Concept Map – partner level

This phase of integration was necessary only for partners that had applied the concept map method in more than one educational activity during the semester. Consequently, at the end of the semester, the teachers from each partner involved in the local educational activities would work together on creating an Integrated Concept Map.

The inputs for the CRIc-map at partner level were represented by the integrated concept maps realized by the teachers for each educational activity (Phase 1). The integration was prepared in a **collaborative workshop** where the following steps need to be taken:

1. Analysis of each of the integrated concept maps produced during Phase 1, in order to identify potential overlaps or inconsistencies.
2. The overlaps were solved by choosing the concepts and connections that were formulated in a clearer manner.
3. The inconsistencies were solved by appealing to information from scientific papers or policy documents.
4. A final form of the CRIc-map at partner level was agreed after integrating all of the individual concept maps realized during Phase 1.

The Integrated Concept Map at partner level was sent to the Leading Organization responsible for Output 5 (UAUIM).

1.2.3. First version of the CRIc-map

The Leading Organization produced the first version of the Climate Resilience Integrated Concept Map, based on the CRIc-maps drafted by each partner.

The integrated map was realized using the same steps described above, using:

- A collaborative approach within the Leading Organization – involving experts on different domains for integrating different parts of the partners' concept maps.
- A collaborative approach within the consortium – individual discussions between the Leading Organization and the other partners in order to resolve potential overlaps or inconsistencies.

The conclusions resulting from this phase of integration were used in the design of the C2 educational activities (Intensive Student Course in Malta).

1.2.4. Final version of the CRIc-map

The final version of the CRIc-map was produced by the Leading Organization, according to the results of the C2 activity and considering all of the comments and suggestions of revisions from the consortium partners.

2. Integrated Concept Maps at partner level

2.1. AUTH

2.1.1. Introduction

The team of Aristotle University of Thessaloniki conducted a seminar in December 2021 in order to develop and customize the Pre-Ordinated Cognitive Structure (POCS). The members discussed several versions that this seminar could have and decided that it would be better to happen with live presence of the students. This would give them the chance to take part in the development of the CMAP, to ask questions, make suggestions and understand the evolution of the graphs.

The seminar was communicated to the students during the lessons of the two members of the team, Konstantinos Papaspyropoulos and Anastassios Michailidis. The former teaches in the School of Forestry and Natural Environment, while the latter in the School of Agriculture of the Aristotle University of Thessaloniki.

In Addition to the information provided during the seminar, the students were also informed that the attendance of the seminar would be an important pre-requisite for being able to travel to Malta for the C2 activity of the In Climate project.

Two seminars took place on December 16th, 2021. Totally, 90 students took part in the seminars:

- 4-6 pm: 46 students
- 6-8 pm: 44 students

The distribution of the student was as follows:

- School of Forestry and Natural Environment: 82 students
- School of Agriculture: 7 students
- School of Spatial Planning and Development: 1 student.

2.1.2. Presentations

During each seminar three presentations took place:

Marios Trigkas, Associate Professor and Supervisor of the project, welcomed the participants and informed them about InClimate project, its objectives, its working packages, and its deliverables.

Anastassios Michailidis, Associate Professor, presented issues related to Climate Change and its impact on the economy, and especially on the agricultural economy. He then discussed with the students their perceptions about climate change, how the natural and urban environment can adapt to it, and how economies are affected by this phenomenon.

Konstantinos Papaspyropoulos, Associate Professor, presented issues related to climate change, the IPCC reports, the Stern Review on the Economics of Climate Change, and the Paris agreement. Then the Concept maps were presented, and they work as described in the next section.

2.1.3. Concept maps

The information (maps) elaborated were processed at the end of the teaching activities. The research team selected a set of meaningful concepts and relationships proposed by students.

Firstly, the concept maps methodology was presented, together with examples of the C-mapping. The Novak style C-map was explained, together with the Pre-Ordinated Cognitive Structure. After that, the steps for designing such a map were given to the students and the two following maps were created during the two seminars.

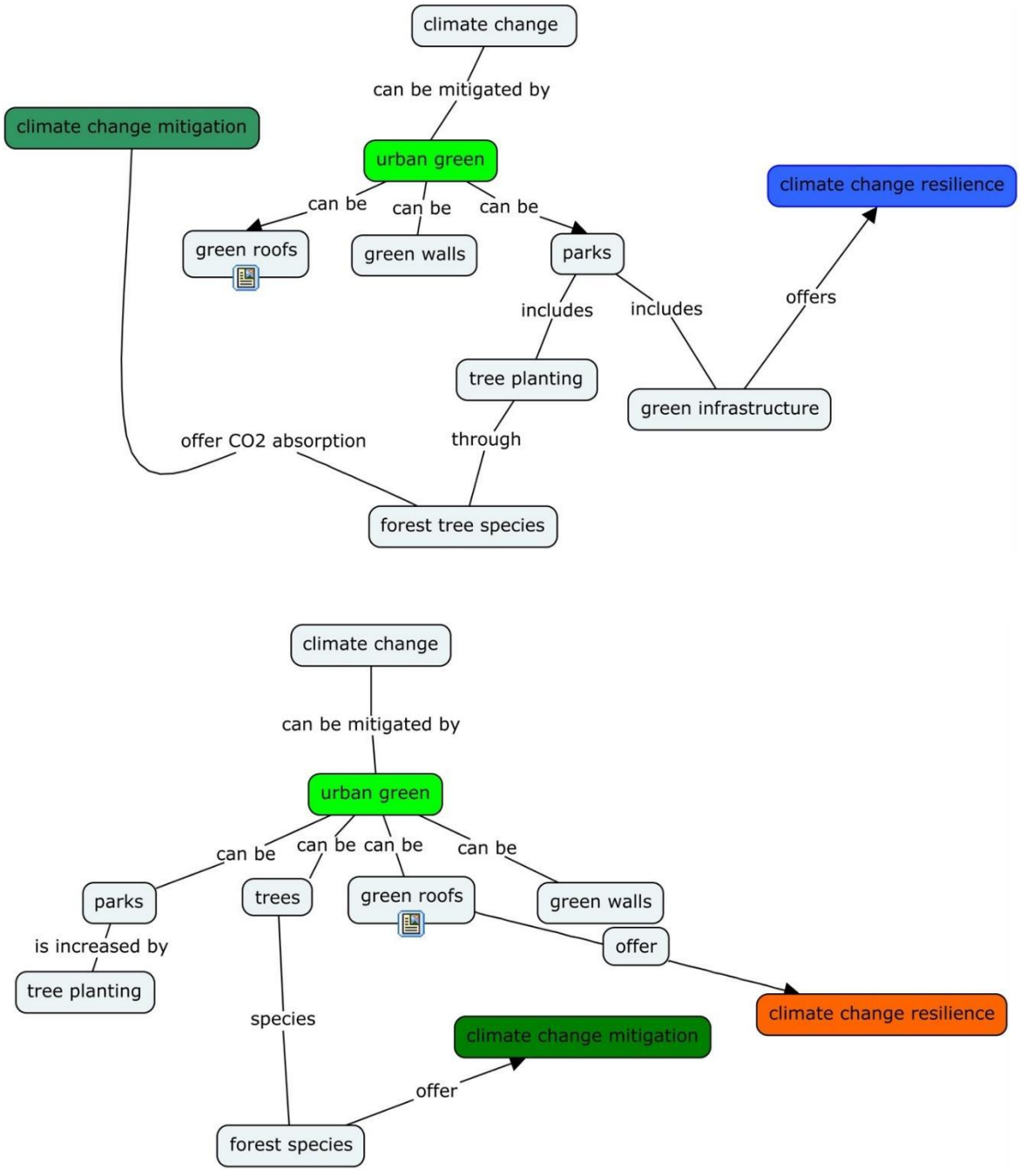


Fig. 1. C-maps created in the two seminars

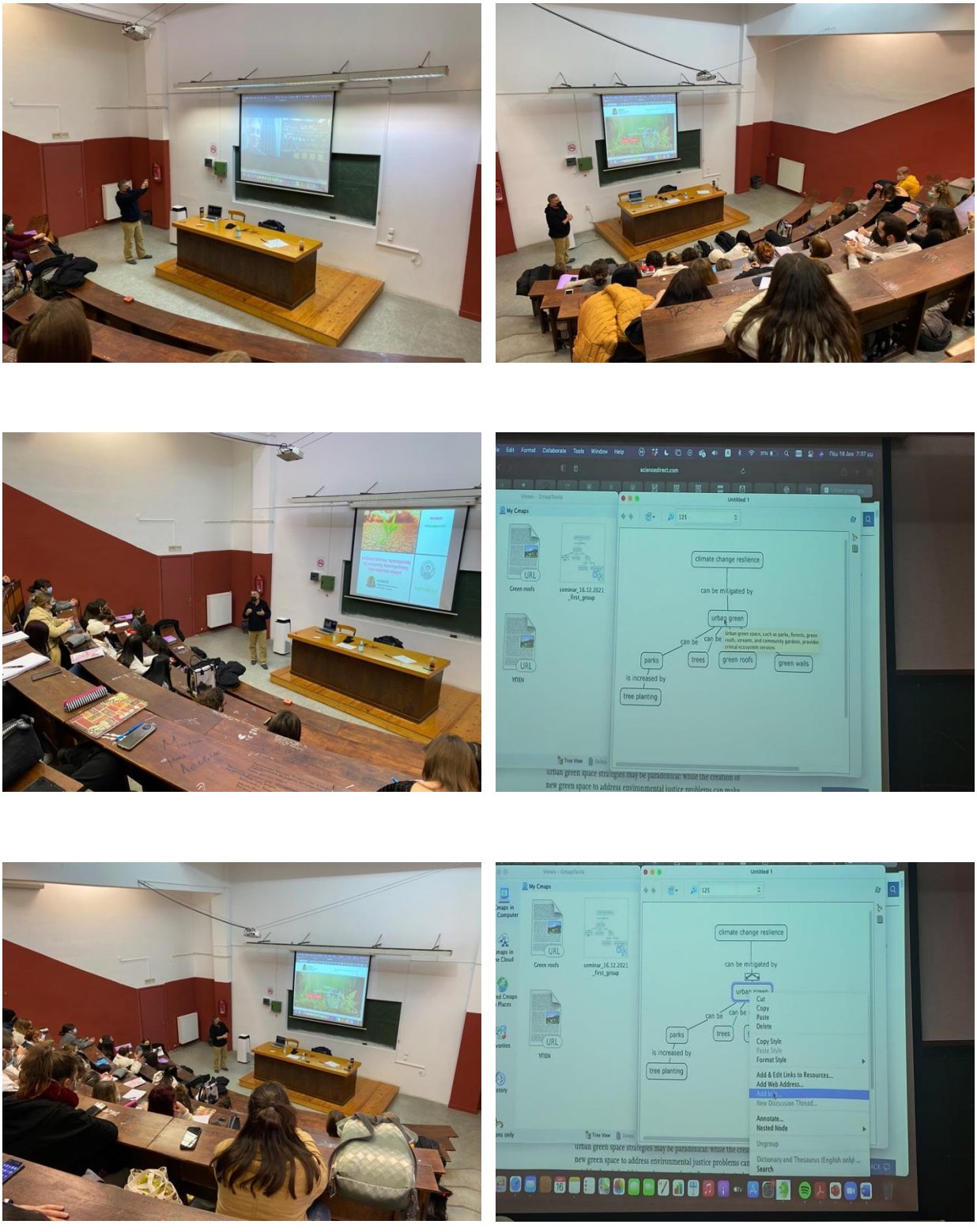


Fig. 2. Photos from the two seminars

2.2. OBU

2.2.1. OBU - Local teaching activities

In order to develop and customise the POCS a set of diverse teaching activities was conducted. These teaching activities were developed involving the following students belonging to different programmes and events:

- 31 students were engaged, belonging to the PG module of Urban Design in Challenging Contexts (MA in Urban Design). A day workshop (9 am-5 pm) was held on 26 Jan 2022. Module leader: Dr Regina Lee.
- 44 students were engaged, belonging to the UG module of Design the City and GIS (Undergraduate programme in Property Development and Planning). A day workshop (9 am-3 pm) was held on 3 Feb 2022. Module leader: Dr Maurizio Sibilla
- 30 UG and PG students attended the half-day seminar entitled "the Built Environment #OneStepGreener". This seminar was a part of the COP26 aligned events organised by OBU. The seminar was held on 10 Nov 2021. Organiser: Dr Avar Almukhata
- 49 students, belonging to the PG module of People, Leadership and Organisation (Master Degree programme in Construction Management), were engaged in a concept map tutorial. The tutorial was held on 26 October 2021. Module leader: Dr Esra Kurul.

Therefore, 85 students were engaged in using the POCS as a part of their mandatory modules focused on Climate Change and Urban Resilience topics. The results were used to adapt the POCS.

Other 79 students were engaged in using the POCS to improve their knowledge integration and exchange skills. The results were used as additional proof concerning the methodology adopted. However, they were not used to adapting the POCS.

2.2.2. OBU - Grid of observation

The grid of observation is composed of 5 criteria. These criteria refer to the components of the cognitive map. They were used to assess the interactions between the POCS and users.

The range of evaluation adopted is qualitative herein. So, during the brainstorming phases, the facilitator observed each group's main modification applied to the POCS.

Table 1 shows a synthesis of this observation, pointing out three relevant aspects:

- Both UG and PG used the main POCS without compromising the main structure. Indeed, no additional Domain of Knowledge emerged.
- Both UG and PG used to introduce new concepts as the main meaningful activity.
- The PG focused more on introducing new connections rather than UG. This could be justified with more confidence of PG concerning the topic explored.

	Grid of observation - criteria				
Participants	**Introduction of new concepts**	**Articulation of old concepts**	**Introduction of new connections**	**New propositions with the same concepts**	**Introduction of new domains of knowledge**
PG	**++**	**+**	**+**	**=**	**-**

UG	**++**	**+**	**-**	**=**	**--**

Range:
++ Very High Engagement; + High Engagement; = Medium Engagement; - Low Engagement; - - Very Low Engagement

2.2.3. OBU – Adaptation of the POCS

The information (maps) elaborated were collected and processed at the end of the teaching activities. Then, the research team selected a set of meaningful concepts and relationships proposed by students. These concepts and relationships were integrated into the POCS, providing additional specifications.

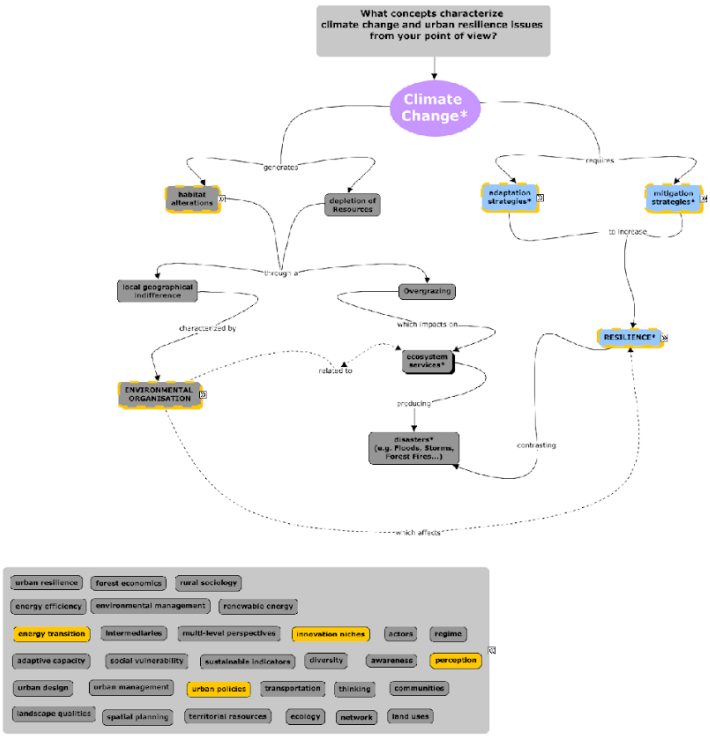


Fig. 3. POCS – first level of organisation. In yellow are marked the Domain of Knowledge articulated. The box concerning the Parking Lot displays the concept extracted and used from the list (in yellow).

The integration proposed was based on the following criteria:

1) The POCS must be readable. In this regard, a limited number of additional concepts were introduced to increase the tool's meaningfulness without making it too complicated.
   Specifically, 12 new concepts were integrated. For of them were already included in the parking lot.
2) As pointed out by the Grid of Observation, no additional Domain of Knowledge emerged by the local teaching activities. Therefore, the 12 new concepts were used to populate existing Domains. Specifically, 5 Domains of Knowledge were adapted and improved.
3) The integration proposed was based on a simple semantic structure among the old and new concepts. The integration was done according to the instruction reported in Report O4. Thus, the scope of the POCS is not to include all information but stimulate knowledge integration and exchange. Specifically, the structure of the maps continues to be based on two organisational levels. The first level is the same as the first version. By contrast, the second level was articulated, introducing new concepts and associating these concepts to the old ones.

The figure above (Figure 3) shows the first level of organisation, pointing out (marked in yellow) the Domain of Knowledge articulated. The figure below (Figure 4) shows the second level of organisation, making evidence about the new integration.

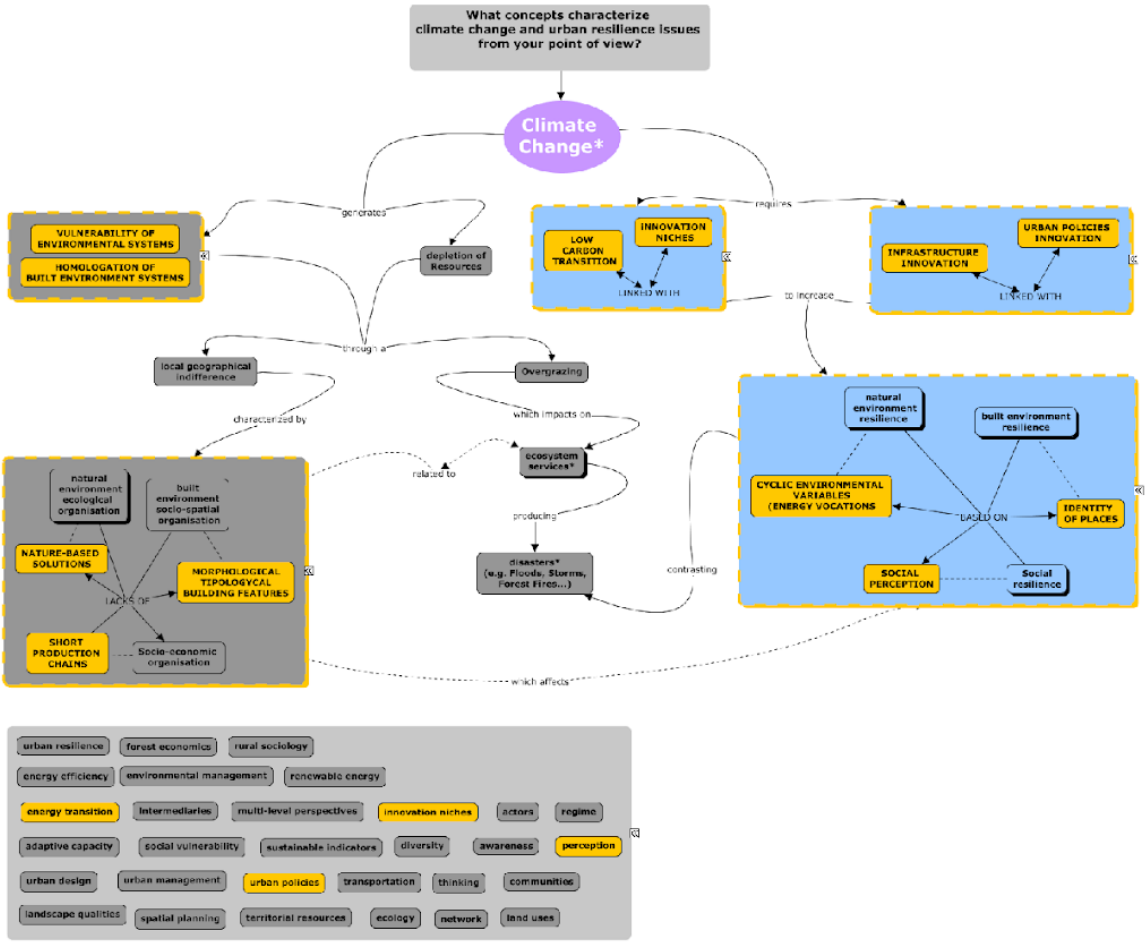


Fig. 4. POCS – the second level of organisation. In yellow are marked the Domain of Knowledge articulated.

2.3. UNIROMA3

The teaching on concept maps was incorporated within a cycle of lectures on urban resilience, made of two theoretical sessions and two sessions on concept mapping. The latter included two exercises: one based on the POCS, and a second one where students had to produce a map on policies and instruments for urban resilience, applying, in a more open and flexible way, the knowledge acquired during the theoretical sessions.

The methodology was slightly different from the one proposed in the general outlines, as the methods were adapted in line with the specificities of the research topics addressed during the educational activities.

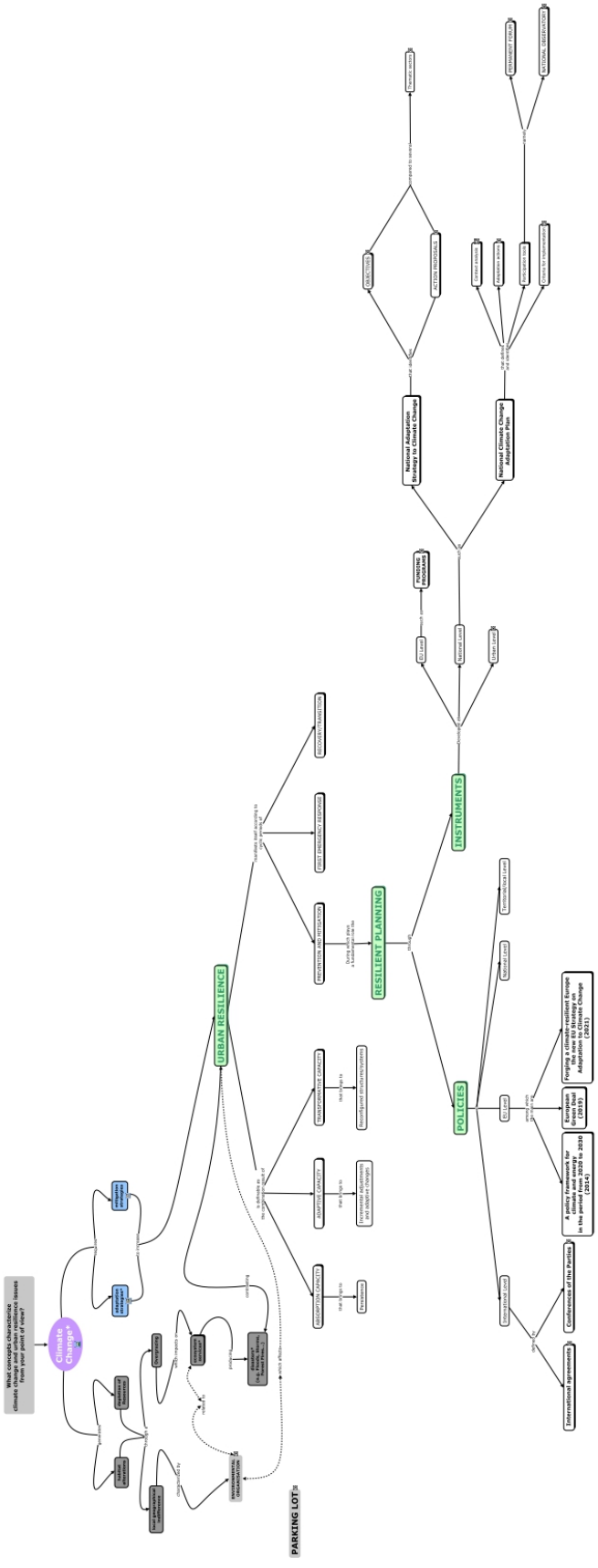


Fig. 5. UNIROMA3 Integrated Concept Map

2.4. UAUIM

2.4.1. Introduction to Urban Planning

Local teaching activities

The 'Introduction to Urban Planning' course is part of the Urbanism and Territorial Management Bachelor Programme. The course takes place during the first semester of the first year of study, the winter semester, and it aims to familiarize the students with basic urban planning concepts. The activities, unfolded over a period of 14 weeks, are structured into four modules covering the following topics: communities and activities, mobility, built environment and natural environment. The climate resilience problems are discussed in the last module. During the 2021-2022 academic year, 22 out of 25 enrolled students actively took part in the class. They had almost no prior knowledge about climate resilience. Given this framework, the climate resilience subject could only get a limited coverage during class.

Organization of InCLIMATE teaching activities

First, towards the end of the semester, the climate resilience subject was introduced during a lecture that ended with a Q&A and a discussion session. Following that, the students were asked to individually solve a home assignment. Thus, considering the subject-area and the problem they've studied during the semester, they had to:

1. Find the three most relevant concepts for climate resilience in that particular environment and to define each concept indicating their research references;
2. Explain why do they consider those concepts relevant;
3. Draw a conceptual map of those three selected concepts. They were encouraged to draw the map using CmapTools.

In the end, with the help of the lecturer, the students worked together to create a single map meant to include all the identified concepts.

Results – concept maps per discipline

During the last class, the students discussed their answers and together tried to create a unified map out of their 22 individual conceptual maps. By creating the end product, the students had to overcome several major challenges:

1. How to choose from a large array of concepts the relevant ones for a certain subject;
2. How to establish the logical connections between concepts;
3. How to identify and admit that their own rationale has some blind spots without losing negotiating power.

The lecturer tutored them during the entire process. The final map was designed using CmapTools software (Fig. 6. Introduction to Urban Planning CRIC-map).

Conclusions - assessment

Although the quality of the final map can be significantly improved, the learning process was successful. Starting from a limited set of knowledge and skills, the students developed the ability to identify climate resilience key concepts and to operate with them. The main challenge was to understand and to systemize the relations between a diverse array of concepts, while the individually gained skills were tested and

enhanced during the final team work exercise. Overall, this proved to be a lucrative learning method, worth using it in teaching about climate resilience.

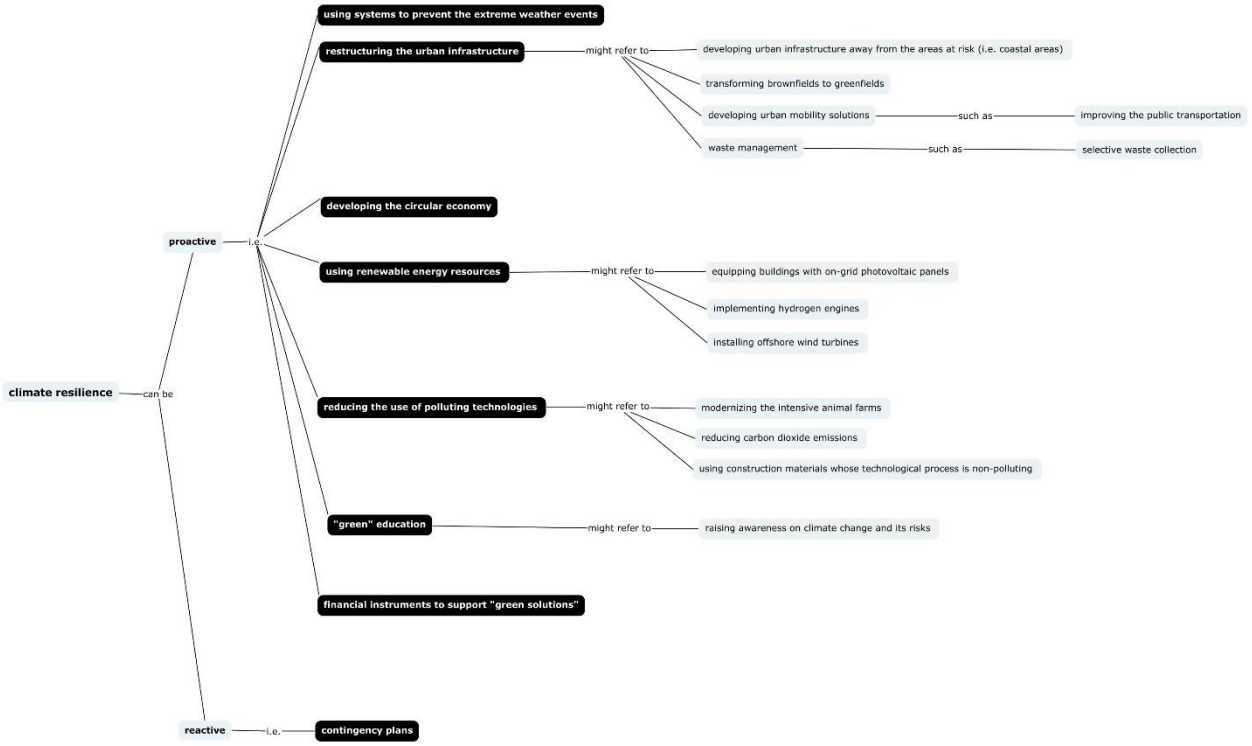


Fig. 6. Introduction to Urban Planning CRIC-map

2.4.2. Urban Geography and Ecology

Local teaching activities

The Urban Geography and Ecology course is held in the 2nd year (3rd semester) of the bachelor degree for students in Urban Design and Planning, Landscape Design and Planning and Urbanism and Territorial Management. During the 2021 – 2022 academic year, a total of 73 students (17 from the Urbanism and Territorial Management bachelor programme) participated in teaching activities where the Pre-Ordinated Cognitive Structure for Climate Resilience was used. The participating students had only basic knowledge regarding the main concepts linked to climate resilience issues, gained from the lectures held during the semester.

Organization of InCLIMATE teaching activities

Each team of students (2-3 students in the case of Urbanism and Territorial Management bachelor programme, 4-5 students in the case of the other two programmes) was assigned a concept to be integrated in the preliminary concept map. The requirement was that at least two new connections or sub-concepts be added to the concept map. The concepts assigned to the students were related to the themes presented during the lectures: urban heat island, nature-based solutions, sustainable neighbourhoods, integrated risk management or energy efficiency.

The teaching activity took place during the second half of the semester, in three main stages: (1) literature review (with each team choosing at least three studies, articles or book chapters to aid them in developing their concept maps), (2) preliminary concept map to be discussed with the tutor and (3) final concept map, with an explanatory text of 1,000 words motivating the final form of the map. The assignment was due to be delivered at the end of the semester, with tutoring sessions organized during the course in order to aid the students in their research and concept map creation. The Cmap Tools software was used for the final rendition of the concept map.

Results – concept maps per discipline

In the end, 27 concept maps were delivered by the teams of students. The integrated concept map for the entire course was realized by the teacher. It was a two-step process – firstly, if more teams had worked on the same concept, the best thematic map was selected for integration. Secondly, in case of overlaps, the concepts and connections that were formulated in a clearer manner were the ones selected.

The resulting concept map for the Urban Geography and Ecology course details the pre-ordinated cognitive structure by adding five main groups of concepts: mitigation strategies (cyan), nature-based solutions (blue-green), integrated risk management (light green), sustainable neighbourhoods (green) and urban heat island (light grey) – see the next image.

Conclusions - assessment

The research papers that were delivered showcased the fact that most of the students have learned to use concept maps as an instrument for organizing knowledge, based on their literature review of a specific concept linked to climate resilience. We plan on using this teaching and research method in the next year as well, building on the concept map developed during this year's course.

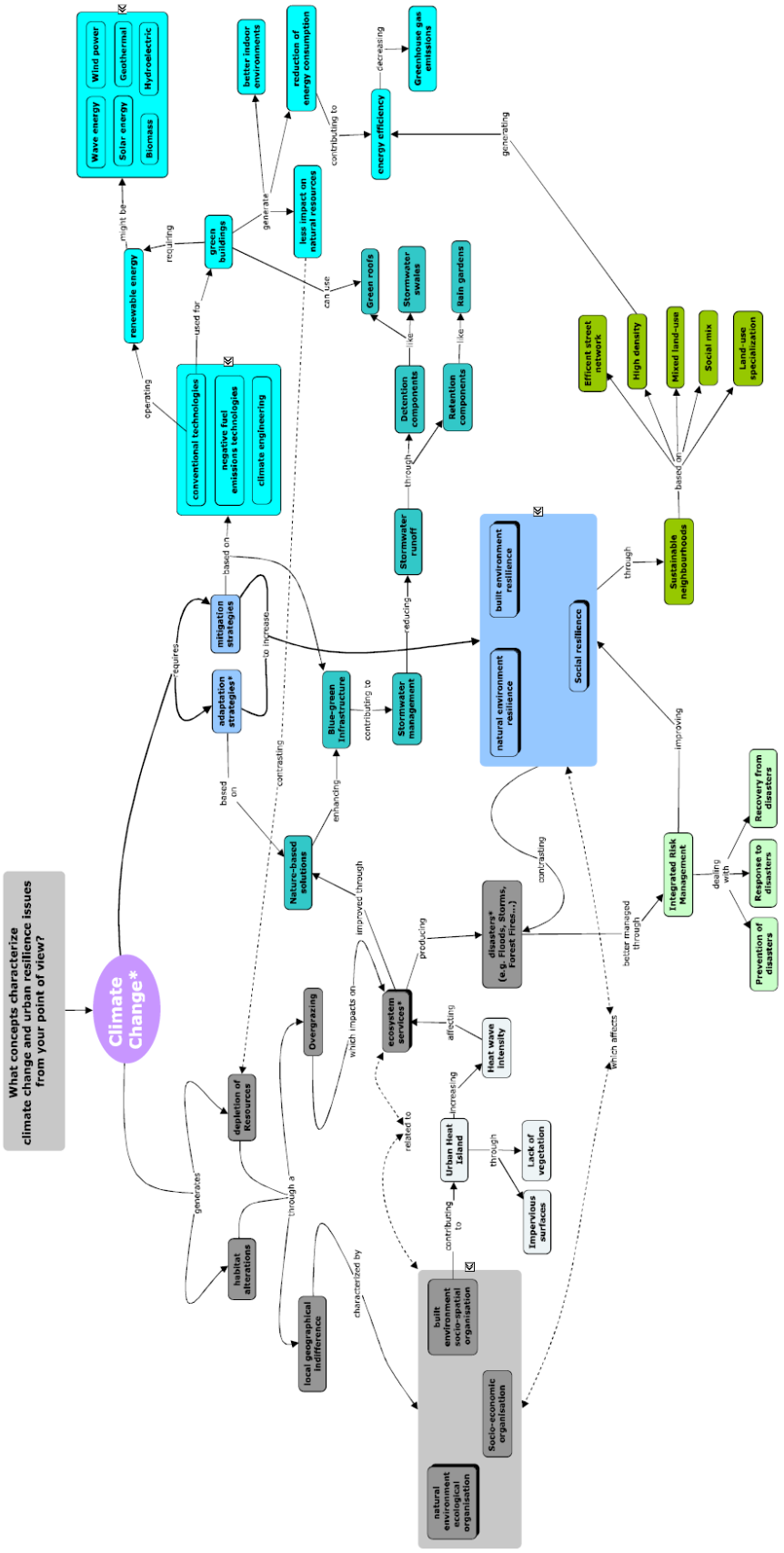


Fig. 7. Urban Geography and Ecology CRIC-map

2.4.3. Applied research and Urban Design

Local teaching activities

Participating students (73 students in total of the 4th year students in both bachelor teaching programs: urban planning - 51, landscape design - 22) had knowledge on the need for integration among the sustainable development spheres and of SDGs goals, but little previous awareness on climate resilience issues.

Organization of InCLIMATE teaching activities

This discipline is organized around a call for student presentations (similar to a call for papers). During the semester, students receive guidance in order to manage an applied research process: formulating the questions, identifying appropriated literature, organizing interviews, working on a best practice example as a case-study, formulating conclusions as answers to applied research questions.

The call 2021/2022 was connected to InCLIMATE concept map - exploring how Urban Design briefs can address climate change resilience. The second scenario was applied in this case: the team of teachers have launched the call based on the initial map – and, at the end of the semester, one integrated map resulted after placing the subjects the students have chosen to work on for their applied research approach. The various subjects that were addressed by the students were: community gardens, water management in urban design, electric vehicles and specific urban design solutions, recycling facilities, ecology in co-housing design, etc.

Results – concept maps per discipline

In order to match this discipline teaching objectives, the map that was initially presented was already emphasizing on urban design as an important contribution to reverse / minimize the negative consequences of climate change – and that addressing applied research questions helps to define an urban design brief that is helping towards more resilience.

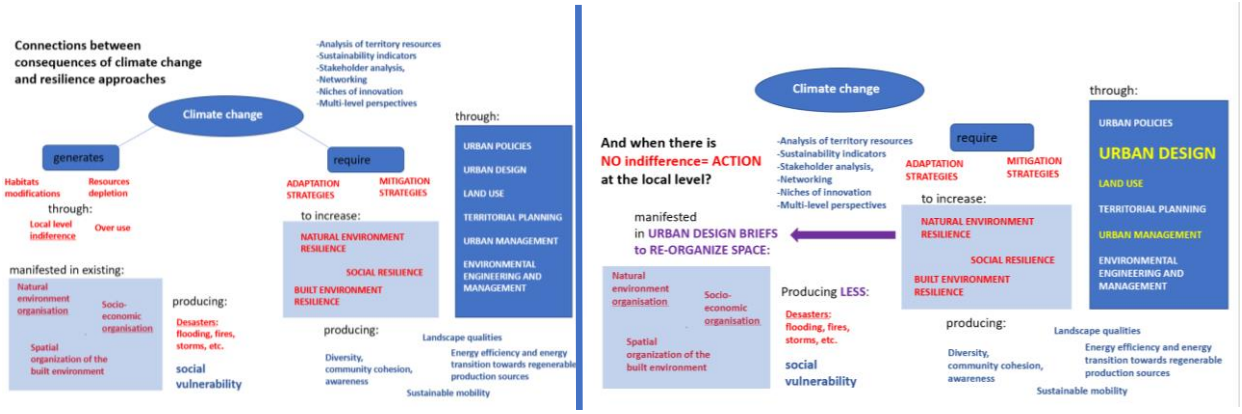


Fig. 8. Applied Research and Urban Design – call launching map source: Vera MARIN

Conclusions - assessment

The use of the concept map has helped students to make connections between establishing objectives related to climate change adaptation and mitigation that can be addressed through urban design processes.

2.4.4. Urban Mobility

Local teaching activities

The theme of "mobility and transport resilience to climate-change" was approached in two courses: Urban mobility (master course – year 1), Mobility policies and plans (master course-year2)

All of the students had a good level of understanding of the climate change causes and effects, and on the urgence of its mitigation. However, at the beginning of the course the knowledge about the specific challenges in the mobility domain were generic. Yet, the topic of climate change is not new for the two mentioned courses that are structurally framed by the logic of sustainability. The theoretical knowledge, mobility policies, mobility schemes and transport systems are oriented towards the mitigation of the environmental impacts since the years 70', when scientists highlighted the threatening tendencies of a fast climate change process and discussed its potential catastrophic impact. The InClimate results enriched the courses with a higher focus on resilience, especially on the component of adaptation to the effects of the climate changes, and with the C-map tool for studying mobility resilience to climate change in a structured and holistic manner.

Organization of InCLIMATE teaching activities

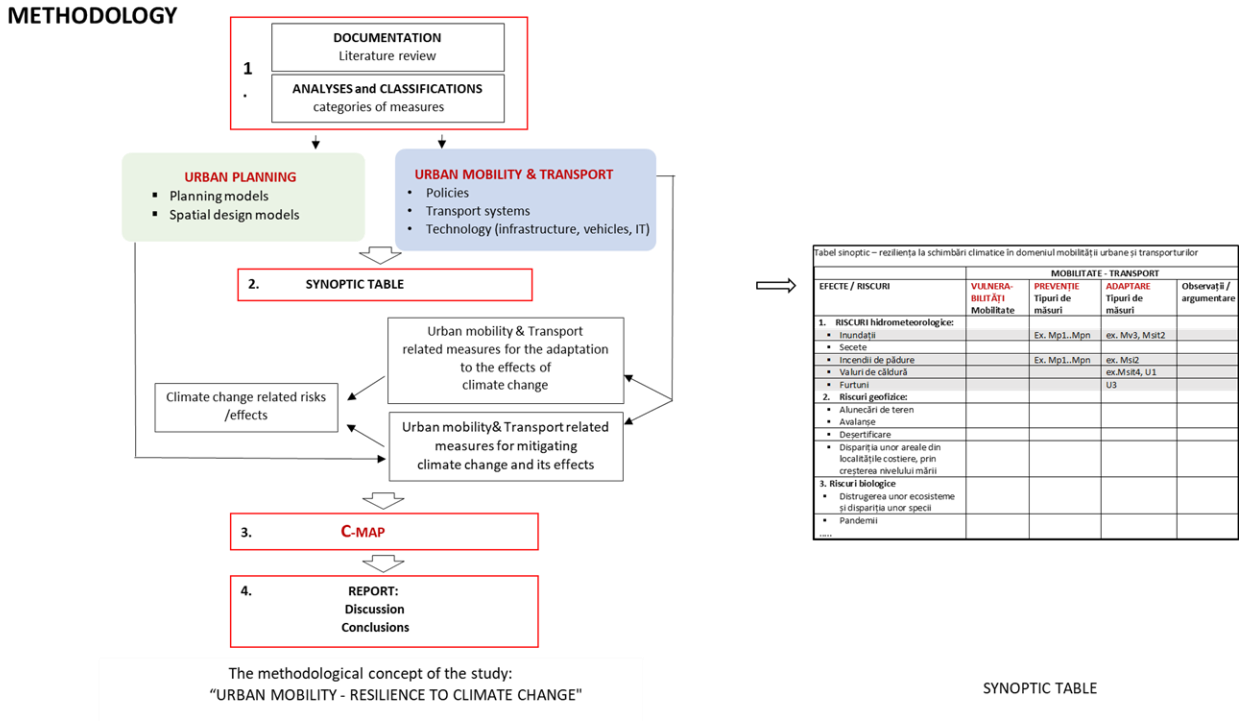
The InClimate teaching activities were integrated in the Urban Mobility related disciplines, as well as in other different disciplines of the academic curricula in Urban Planning at the UAUIM, as it follows.

- Lectures 3 (1-2/discipline)
- Discussions on the challenges, themes, bibliography, methodology of research including C-maps tool and a synoptic table tool
- Discussions on the C-map tool

For the disciplines **Urban Mobility** and **Mobility policies** were involved 44 students, and 25 of them have chosen the theme of **resilience to climate change in Urban Mobility** for their individual research study that is one of the evaluation components for the above-mentioned academic disciplines.

The lectures and discussions focused on:

- The main packages of measures for a green and inclusive transition towards making Europe the first climate-neutral continent by 2050 (as set in the Green Deal EU programmatic document),
- The impact of the current mobility policy and behaviour on GHG emissions,
- The challenges regarding the (re)model of transport systems and mobility planning for the mitigation of their climate change effects and for their adaptation to the climate change effects that cannot be totally avoided.
- A general synoptic framework on the directions of action and measures to be taken for the mobility & transport resilience to climate change, in two main domains: Mobility and Urban Planning: concepts, planning and designing models (as a study tool for the students)
- Complementary, general, measures in other relevant domains that are needed to support the achievement of mobility resilience to climate change demand: Green energy, ITS ("smartification")
- The presentation of the concept maps as a support tool for inter-disciplinary approaches of resilience to climate resilience, in general, and specifically for an interdisciplinary approach to mobility & transport resilience to climate change



Tabel sinoptic – reziliența la schimbări climatice în domeniul mobilității urbane și transporturilor

EFECTE / RISCURI	MOBILITATE - TRANSPORT VULNERABILITĂȚI Mobilitate	PREVENȚIE Tipuri de măsuri	ADAPTARE Tipuri de măsuri	Observații / argumentare
1. RISCURI hidrometeorologice:				
• Inundații		Ex. Mp1..Mpn	ex. Mv3, Msit2	
• Secete				
• Incendii de pădure		Ex. Mp1..Mpn	ex. Msi2	
• Valuri de căldură			ex.Msit4, U1	
• Furtuni			U3	
2. Riscuri geofizice:				
• Alunecări de teren				
• Avalanșe				
• Deșertificare				
• Dispariția unor areale din localitățile costiere, prin creșterea nivelului mării				
3. Riscuri biologice				
• Distrugerea unor ecosisteme și dispariția unor specii				
• Pandemii				
.....				

Fig. 9. Methodology used for the Urban Mobility teaching activities, source: Mihaela Negulescu

The student's studies were aimed at identifying in two fields - Urban mobility and transport (M); Urban planning (U) - the categories of policies, models, technological changes that meet the objective of remodelling a resilient to climate change mobility behaviour for: 1. preventing climate change and 2. adaptation to climate change.

For the students' individual research studies we used a methodology in four steps.

1. Documentation, analyses, classifications
2. Realisation of a Synoptic table in which were identified and correlated the different categories of mitigation and adaptation to climate change measures, both for mobility systems and policies and for urban planning, related to each type of risks (flooding, extreme warming, etc.)
3. Drawing of a Conceptual C-map - used to structure the whole information on a logic and narrative manner
4. Then they made a Report (in which they discussed and concluded on their findings on the topic)

Results – concept maps per discipline

We acknowledged that the general, **integrated strategies for resilience to climate change**, as well as the **thematic** (by domain) strategies for urban resilience to climate change (at national and local levels), are deployed in four **sectors of activities**, the so-called quadruple helix, *through correlated regulations, strategies, projects, measures, action plans*:

- GOVERNANCE – is the main sector designing the framework for resilience to climate change through (institutional framework, regulations, strategies /policies/planning, etc.)

- RESEARCH and ACADEMIA – the sector the most oriented on resilience to climate-change (knowledge and innovation)
- (CIVIL) SOCIETY that needs awareness regarding climate change that need social acceptance for measures that might be unpopular (for instance like those discouraging car-use), that need behavioural & life-style changes
- INDUSTRY / DESIGN the sector that provide design / projects products/services.

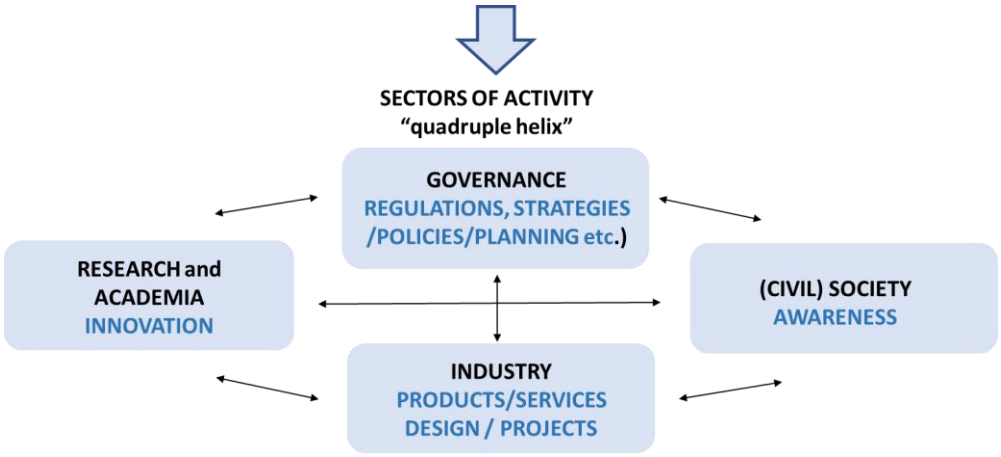


Fig. 10. Quadruple helix approach

For urban mobility we identified a **thematic framework for the study of mobility & transport resilience to climate change**, with the **two main objectives:**

- Mitigation of the environmental footprint (through decarbonisation) of mobility – low carbon mobility
- Adaptation to climate change effects (reducing transport vulnerabilities related to climate change risks)

To achieve these objectives, we identified three main **directions of action:**

- To develop green, robust, adaptive technologies
- To remodel a less car-oriented mobility behaviour
- To achieve a lower need & demand for long-distance (and thus motorized) daily travels

Meeting these objective implies a holistic approach, and projects and measures in different domains:

- TECHNICAL & TECHNOLOGICAL INNOVATION in transport – vehicles, infrastructure, IT-based services
- SUSTAINABLE Mobility POLICIES
- URBAN PLANNING principles and models (re)VALUYING PROXIMITY
- GREEN ENERGY to fuel a greener transportation
- TIC (Technologies of Information and Communication) for the "smartification" of mobility and transport systems, but also for developing the smart city reality, with digitalised, remote activities, reducing the need for travel.

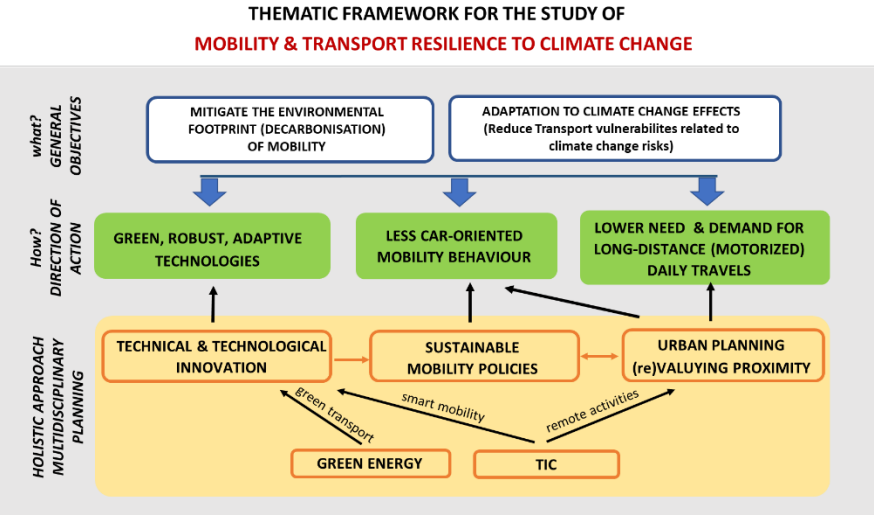


Fig. 11. Quadruple helix approach, source: Mihaela Negulescu

Conclusions - assessment

The students identified specific transport measures for the different components of the transport systems (infrastructure, vehicles, services, routes). Also, the students acknowledged that urban planning can and has to contribute to mobility and transport resilience to climate change, planning and implementing models valuing proximity or generating shadow like: compact development, polycentric development, Transit Oriented Development, Functional mix, walkable eco-neighbourhoods, 15 minutes city, green corridors / infrastructure, streets.

The students designed C-maps for the topic of mobility resilience to climate change. Based on these, a complex scheme was finally drawn, detailing the models of planning and technology, to be developed and implemented in the different domains previously mentioned: Transport, Urban Planning, Green Energy, ICT, Buildings (Green architecture)

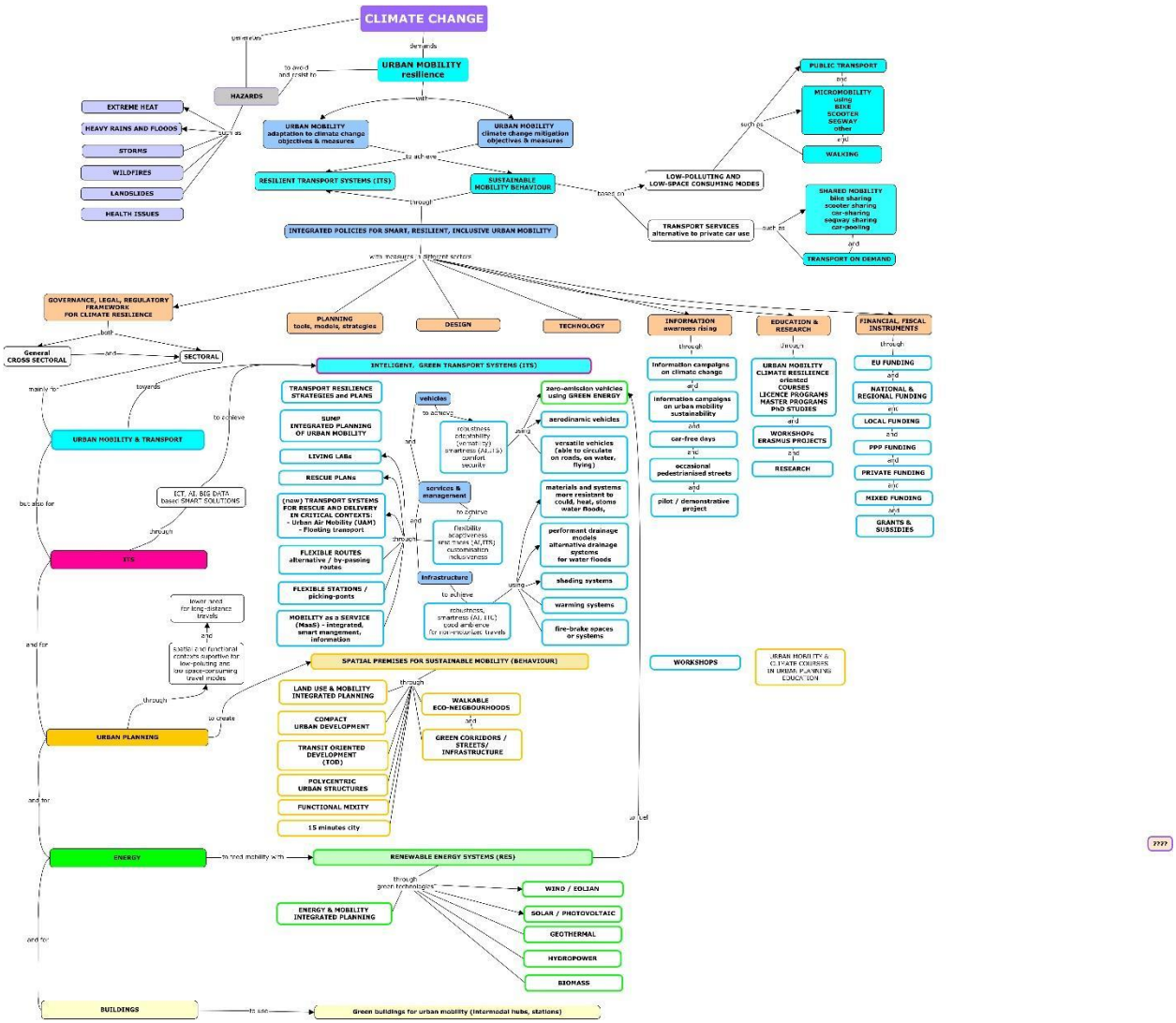


Fig. 12. Climate Resilience Integrated Concept Map – Urban Mobility, source: Mihaela Negulescu

2.4.5. Public services and technical equipment

Local teaching activities

Public services and network utilities is a seminar that presents the Romanian different networks typologies, their functionality, their equipment and their deficiencies etc. The main focus is on the sewage network system and how it can be improved by adopting new concepts that are meant to adapt and mitigate climate change: smart growth, nature-based solutions etc.

20 students participated at this seminar and all of them were 2nd year students (the final year) of the Master for Urban Management for Competitive Cities. All of the students were aware of the climate change effects and the actual severity of this problem, but few of them knew what types of measures are suitable to mitigate climate change. In this respect, preliminary presentations were prepared in order to provide a context of the seminar exercises.

Organization of InCLIMATE teaching activities

The seminar was organized as follows:

- Three meetings for preliminary lecturers (a general presentation of all the network utilities, a detailed presentation of actual concepts used to mitigate climate change and a final presentation to exemplify nature-based solutions among the rivers – the river restauration);
- Two meetings to present the exercises (there were two exercises);
- Two meetings to discuss the results of the exercises (one for the first exercise and one for the second one);
- A final meeting to create the concept map. Thus, the map was a result of all the findings and accumulated knowledge during the seminar.

The seminar had two deliverables, one for each exercise. The first exercise had a small component that was addressed to climate change while the second exercise had the main objective to find solutions to reduce climate change effects. Both exercises were developed in small groups (2-3 students).

Results – concept maps per discipline

The concept map, as the final exercise of the seminar, was mainly focused on providing detailed solutions for adaptation / mitigation strategies for climate change, in particular for built environment resilience. The approach for the integrated concept map was to apply all the findings from the research conducted during the seminar exercises. Therefore, the map is presenting both the general concepts and the detailed solutions for alternative collection of runoffs.

Conclusions - assessment

The concept map turned out to be a very good tool to organize the information accumulated during the didactic activities. Not only the students could present what they have learned but they had a change to correlated with other colleagues' findings and thus, to learn more.

The feedback from the students was positive and the concept map seminar was very dynamic and attractive. They really enjoyed it as the student's involvement lasted more than was expected.

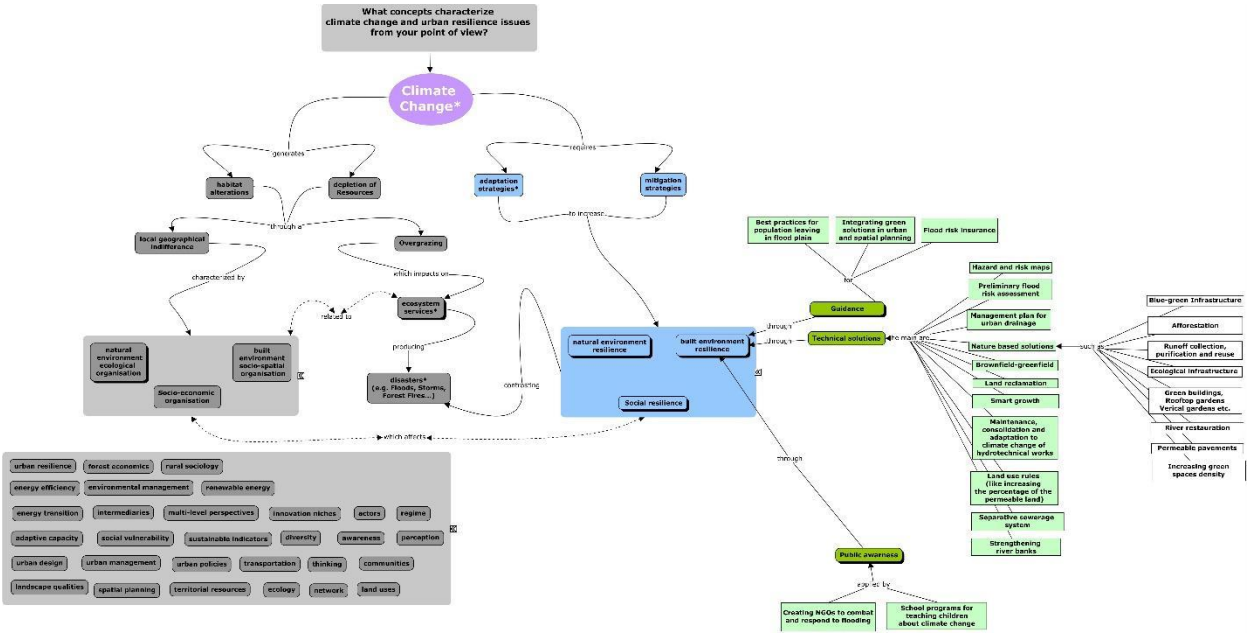


Fig. 13. Cmap – Public services and technical equipment

2.4.6. Explanatory note on the integrated concept map of UAUIM

There is an obvious continuation of the previous conceptual map - in the sense that the various concepts that were placed in the "parking lot" of the original scheme were basically organised around the core area of the new scheme - giving the general frame in which professional input is integrated in the effort to improve the physical reality.

The variety of disciplines in which UAUIM team has applied the InCLIMATE project conceptual mapping approach has allowed them to define several ways of developing parts of the initial scheme and also to place/allocate the key words from the grey "parking" box into different sections.

One important aspect is that the disciplines taught to the bachelor students in their first or second year of studies have produced schemes that are focused on notions definitions (introduction to urban planning, urban geography and ecology), while students in their 4th year of the bachelor program or master students went into details on specific methods in order to increase resilience: sustainable mobility, public utilities, and also various urban design solutions that were documented in case studies analysis.

But no matter the specific focus of the discipline, in all five cases, the questions related to the general frame for various processes (legislation, planning system instruments, but also financing programs in relation to local, national or European policies) have been discussed somehow separately from the somewhat technical know-how that is forming the main core of the professional training in the urban planning faculty. Hence, the integrated map from UAUIM (Figure 14) shows an attempt to organize the processes that would lead to more resilience in three major parts:

-support for resilience from policies and programmes based on principles, but also from research and innovation, as well as from public awareness;

-defining solutions for more resilience through specific instruments of planning, design, management;

-identifying more resilience at different scales of physical reality in various types of infrastructure.

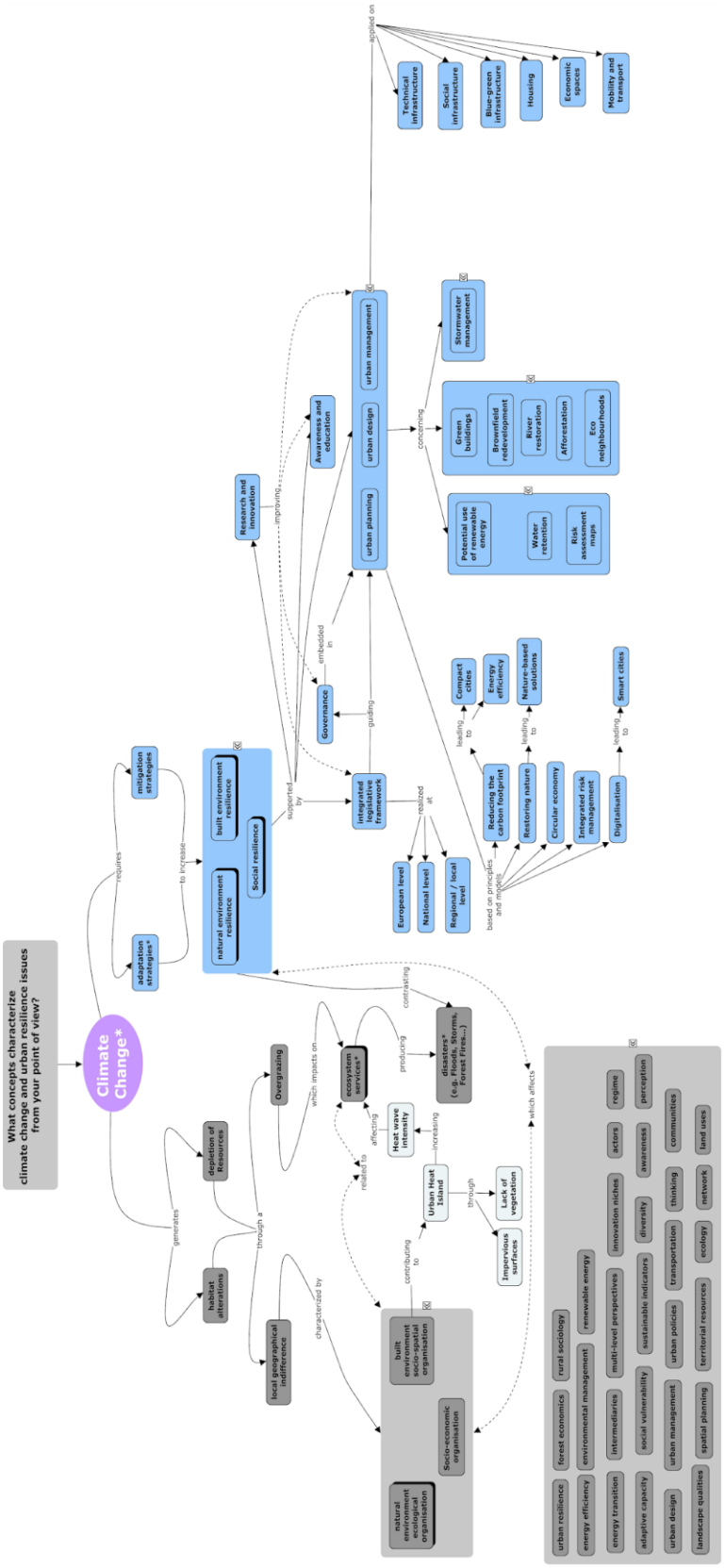


Fig. 14. UAUIM integrated C-map

2.5. UPO

2.5.1. UPO Local teaching activities

In order to develop and customise the POCS a set of diverse teaching activities was conducted. These teaching activities were developed involving the following students belonging to different programmes and events:

- No. 10 students were engaged (20 registrations), from different degrees (Degree in Geography and History, Degree in Biology, Degree in Sociocultural Anthropology and postgraduate and Degree in Chemical engineering) and postgraduate (Master's degree in social sciences applied to the environment and Doctoral Programme in Environment and society). A day workshop (16 pm-20 pm) was held on 1st March 2022. Module leader: Dr Jesús Vargas.

2.5.2. Organization of the session

The session was divided into three parts.

- Part 1. Theoretical introduction on meaningful learning and urban resilience to climate change. (16 pm -17 pm).

  The objective of this first part was to make a theoretical approach to the concept of meaningful learning and its usefulness from the point of view of research, as well as its potential to collaboratively build knowledge, incorporating the knowledge of different disciplines. Something fundamental to address the debate on urban resilience to climate change that would go in the following parts of the session. This theoretical session was completed with a brief approach to the concept of urban climate resilience.

- Part 2. Work in groups. Approach to campstools software and first conceptual maps on urban resilience. (17 pm -18 pm)

  An introduction to Camptools software was. Main tools and work possibilities of the software were presented. For this, a first group work session was held (initially 4 groups were planned, finally 2 were made due to the number of students who attended the session). Each group worked on a first concept map on urban resilience to climate change. As a result, two camps were developed by students (see Figures 15 and 16).

- Part 3. Collaborative work session on urban climate resilience (17 pm -20 pm).

  Finally, a collaborative work session was held, taking advantage of the possibilities of synchronous work offered by the software. As a result, a final Cmap was developed. (see Figure 17).

In order to develop and customize the POCS a set of diverse teaching activities was conducted. These teaching activities were developed involving the following students belonging to different programs and events:

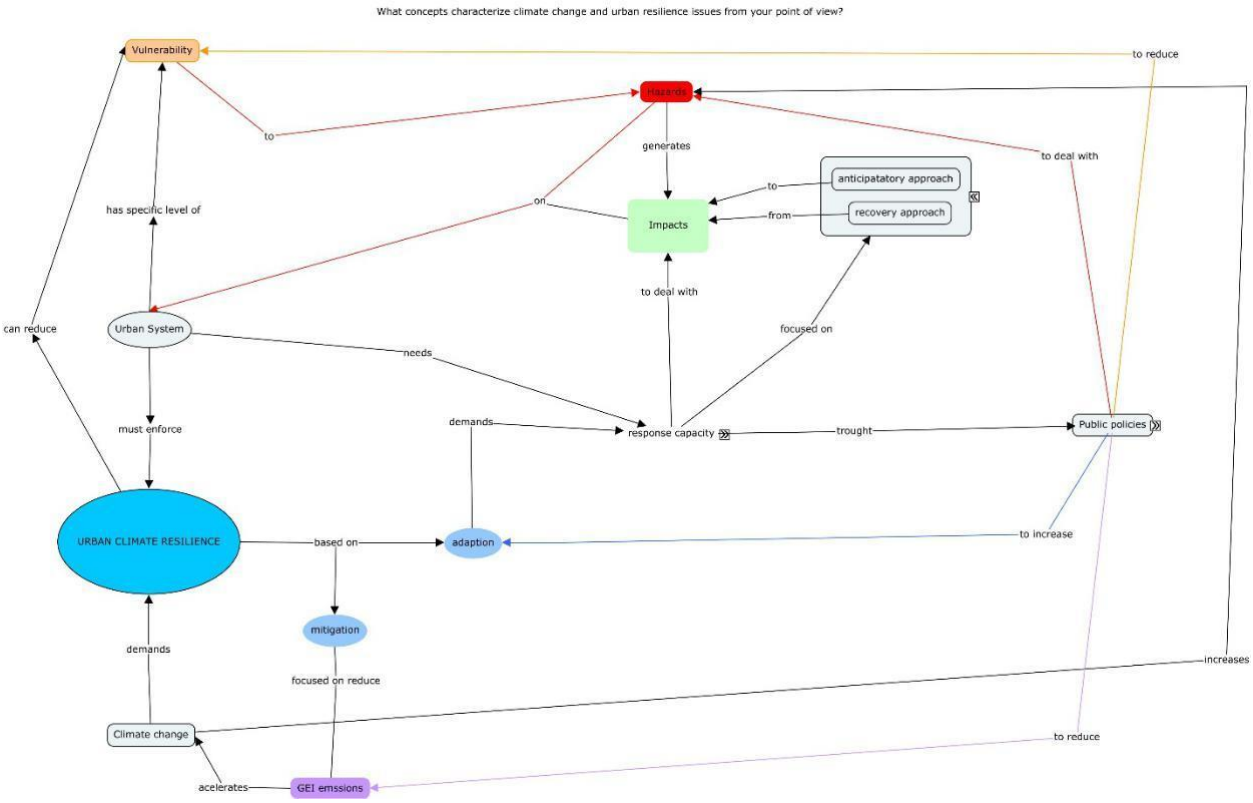


Fig. 15. Cmap developed by group 1

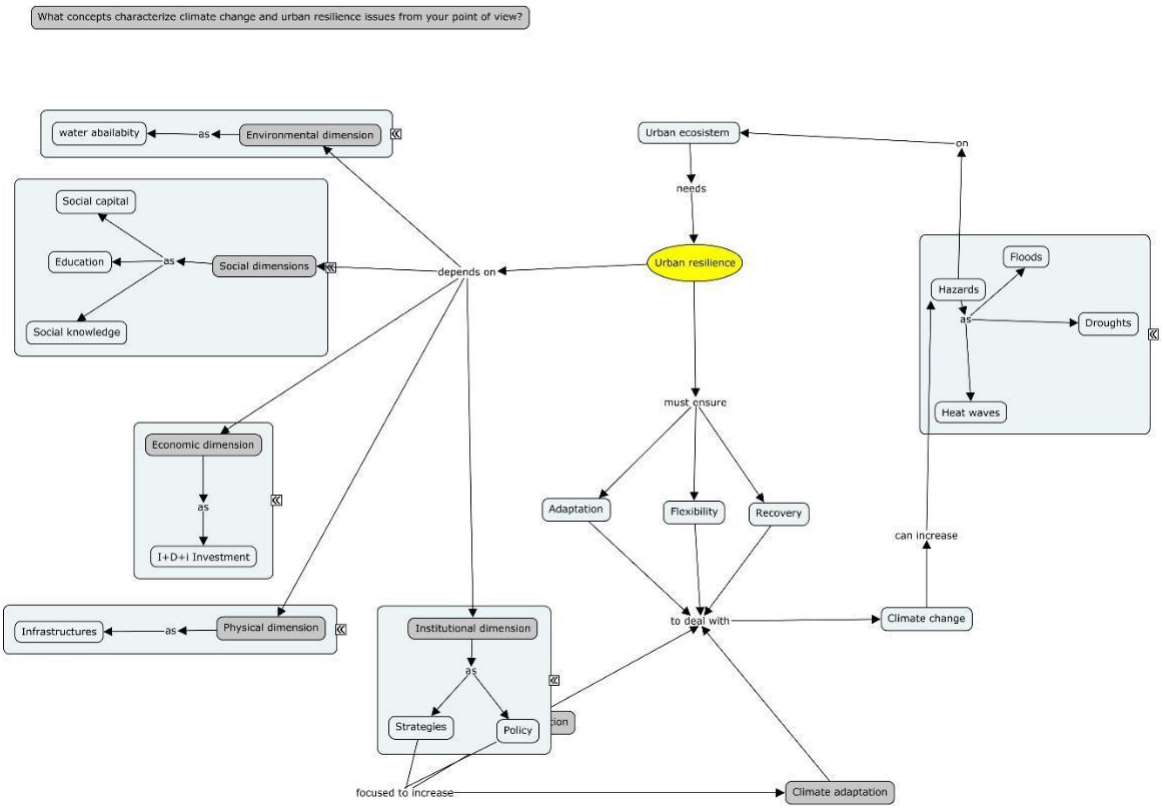


Fig.16. Cmap developed by group 2

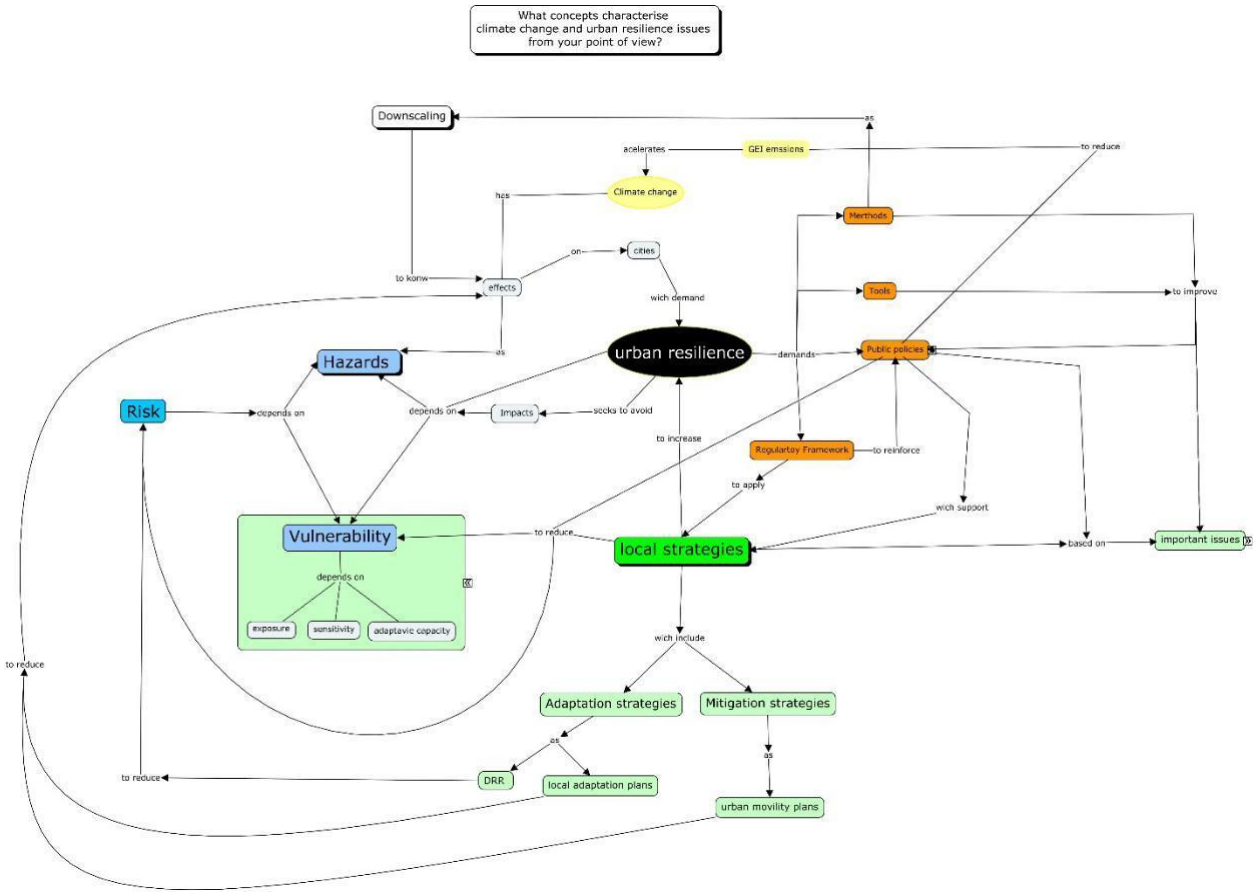


Fig. 17. Cmap collaboratively developed

3. Methodological aspects – designing the Climate Resilience Integrated Concept Map

3.1. Different approaches within the InCLIMATE consortium

InCLIMATE project brings together various institutions that share the same objective of producing and sharing knowledge, acting according to this knowledge in order to improve the physical reality at different scales and on various topics. The original map was extended towards the REQUIREMENTS in order to make efforts for both adaptation and mitigation to climate change

There are four zones in the new scheme from which to define the frame (left and top) and one is dedicated to the impact in physical reality spaces of various sorts (right), so that the core area of the scheme is the place for introducing input from each partner in this given frame.

on the left: the grouping of principles are taken from various documents (e.g. Charter of Leipzig - 2007, the New Charter of Leipzig - 2020, Territorial Agenda - 2020, …) - they indicate already adopted principles which influence not just the legal and programmatic frames, but also the current professional input that is taught in universities

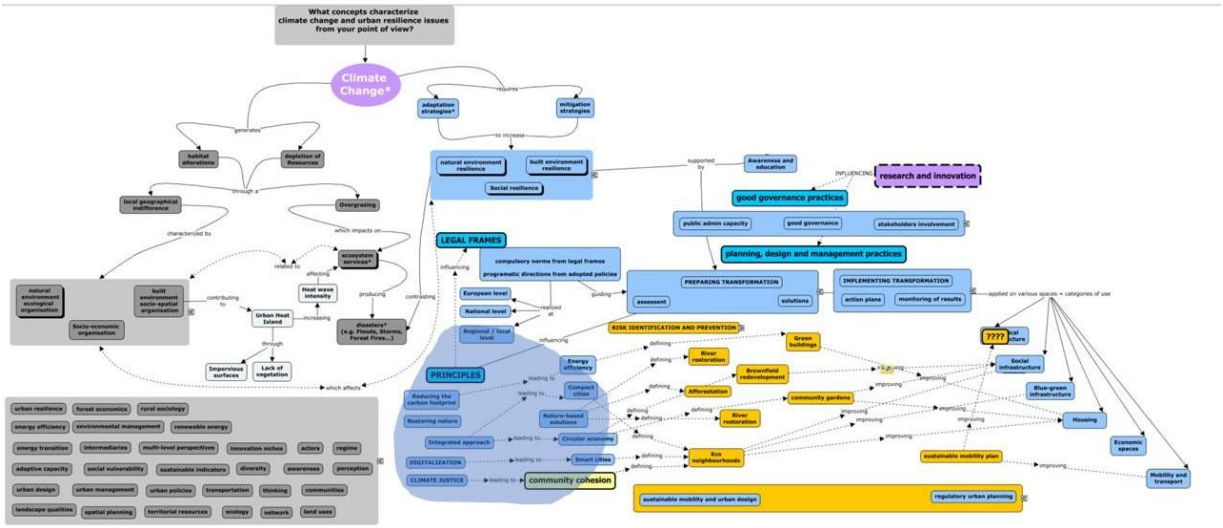


Fig. 18. CRIC-map - Principles

on the top-left

Existing regulations and programs (strategies) are based on the principles mentioned above, and they are the legal (normative) and operational frames for the transformation processes.

The previous effort within the InCLIMATE consortium to evaluate them has shown that each national context has its specificity including the ways in which the European programmatic documents (not the directives) are used.

The legal and operational context in each country is explained in the training programmes, and sometimes its dynamics is influenced by new ideas coming from the university through advocacy approaches, consultative bodies in which academia is invited, etc.

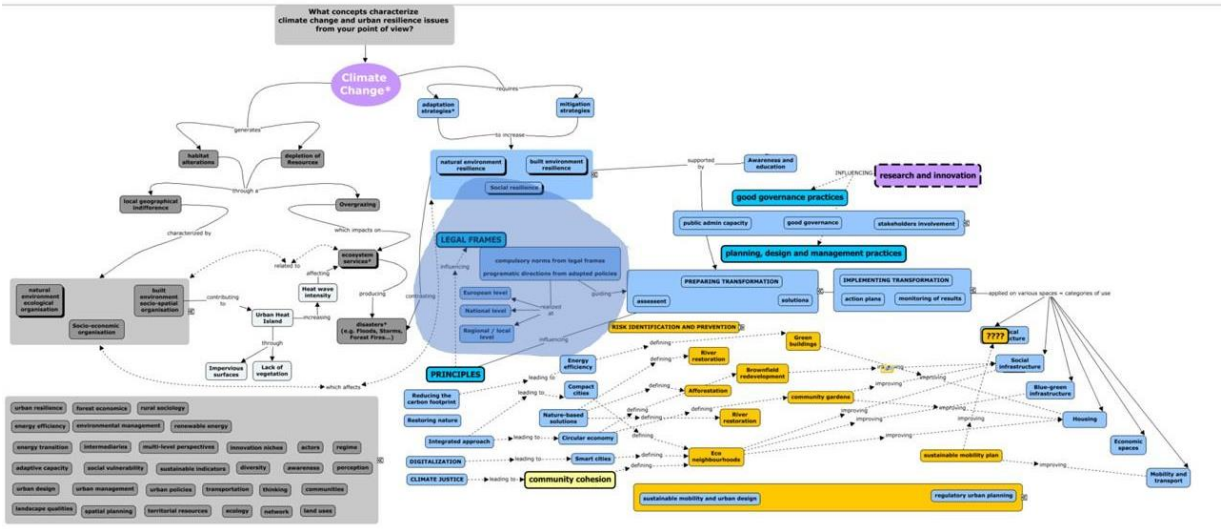


Fig. 19. CRIC-map -existing regulations and programs (strategies)

on the top-center

Processes and practices for transformation are included here - bringing together various actors with their perspective that is influenced by awareness level - also, both the good governance practices and the planning and implementation ones are influenced by innovation (both technical and on management mechanisms).

These practices are explained in the training programmes, but they are also influenced by new ideas coming from the university through the new generations of professionals.

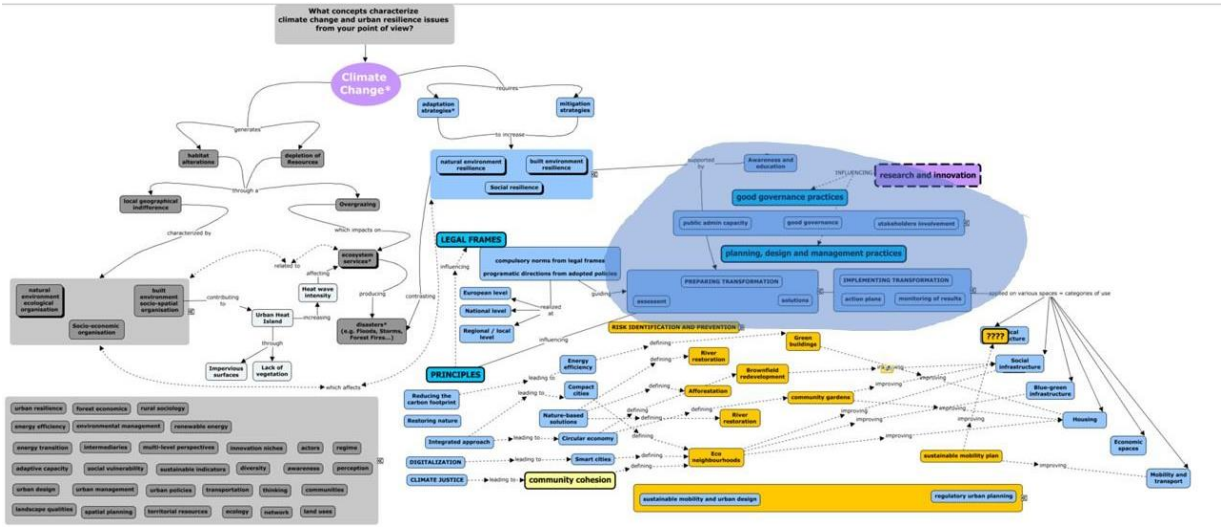


Fig. 20. CRIC-map – processes and practices for transformation

on the right side: space to be transformed in better ways

The spaces that are to be transformed so that more resilience could be achieved were defined by considering space allocation for all the necessary uses (an interpretation of the functional areas in the Charter of Athens - but without any zoning intentions).

Mobility and transport categories are somehow different: although they both take space, the spaces for mobility connect the other spaces, and the functioning of the other spaces also generates mobility needs.

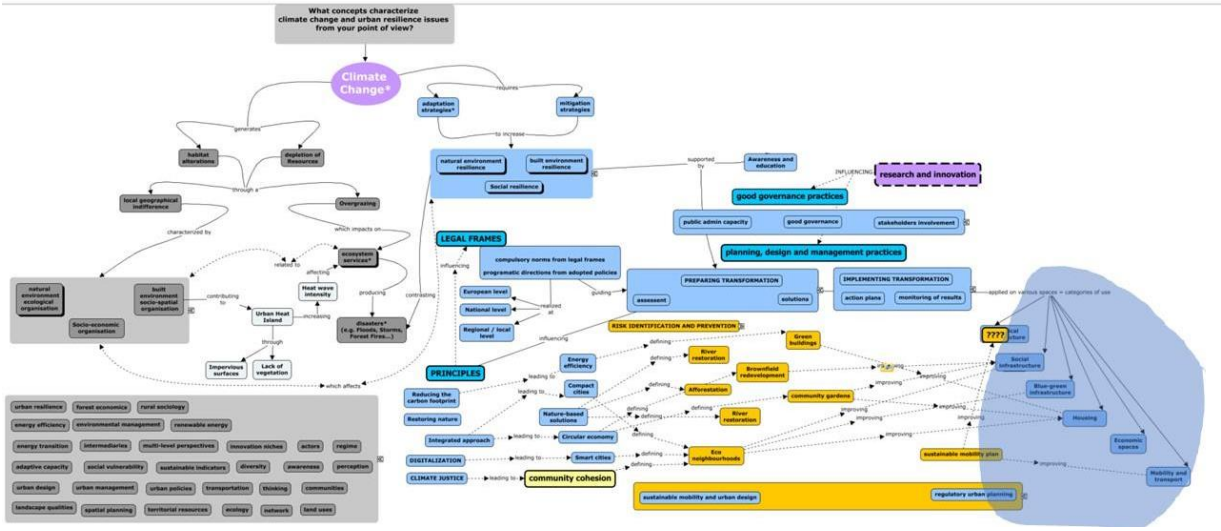


Fig. 21. CRIC-map – the various uses / categories of space

THE CORE AREA:

This is the area of the conceptual map where the applications done on the initial scheme with UAUIM students, within various disciplines, has led to the emergence of various topics depending on the teaching objectives, at various scales:

a. architecture scale: green roofs, green facades.
b. neighbourhood planning and design scale: eco-neighbourhood, brownfield redevelopment,
c. city planning scale: sustainable urban mobility logic, green systems, water management, waste management, etc.
d. territorial planning scale: afforestations, river restoration, flood management, risk assessment maps, etc.

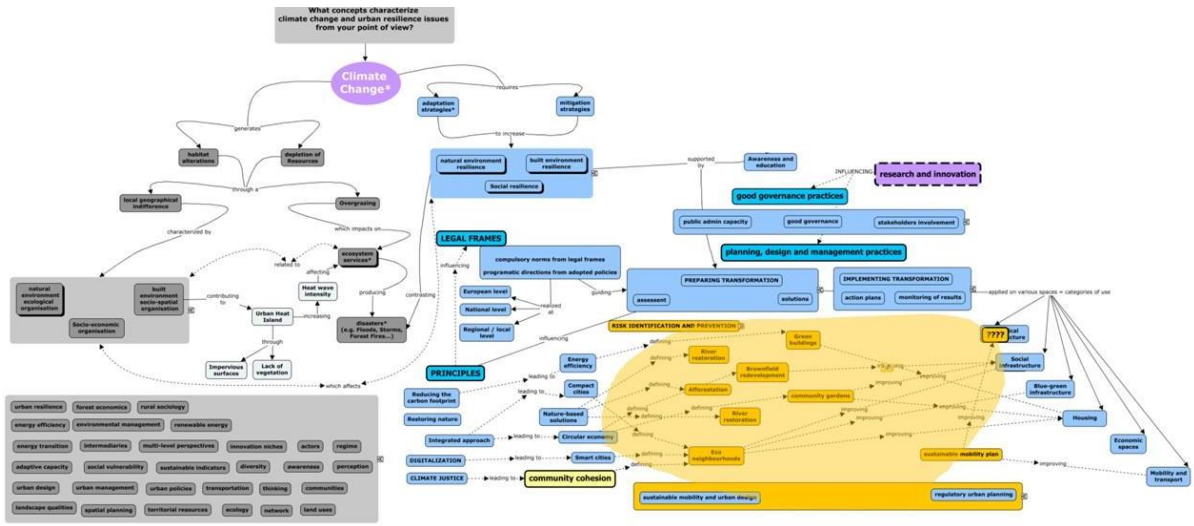


Fig. 22. CRIC-map – The Core Area

There are numerous connections to be made through this middle area of the scheme - teaching students various topics in different training institutions will help the consortium gather a collection of key-words that could be then coloured in a different way depending on the scale they best apply to (building / neighbourhood / settlement / territory of a county or region / national territory / European one).

Each key-word could be linked to an online descriptive file (Open Educational Resource) that could briefly explain how the concept is defined, how it is used, and include some literature references from the common open access bibliography archive of the InCLIMATE project.

Also, by bringing them together in the same area of the conceptual map, the InCLIMATE project may contribute to a more integrated approach of climate change adaptation and mitigation action: very often, different universities focus on their own specific topics and instruments and connections among professionals only happen occasionally.

3.2. Malta workshop

The workshop took place in Malta on 23-26 of May 2022 and it was structured into two types of sessions: lectures from the facilitators and collaborative sessions of work with students. It was the first time when the students had the chance to test the CmapTools software together and to have feedback from other professors from the partner schools. The guiding theme of the lectures was Multi-Level perspectives on Climate Change and Urban Resilience and the main theme of the exercises for students in Cmap was resilience.

The 1st day comprised of introductory lectures: the presentation of the INCLIMATE project and the Climate resilience database (ARISTOTELIO PANEPISTIMIO THESSALONIKIS – MIEMA), the presentation of the course, objectives and agenda, course activities (OXFORD BROOKES UNIVERSITY) and followed by an introduction to the Cmap Tools software (ROMA TRE).

The 2nd day focused on the main theme, the Multi-Level perspectives on Climate Change and Urban Resilience with some concrete examples from the national experience of the partners, touching on subjects like: green infrastructure, adaptation to extreme heat, climate resilience policies, climate resilience approaches in urban planning education, reducing the carbon footprint, renewable energy technologies. The second part of the day was designated for the Meaningful learning workshop with students and was designed in a more interactive way with group exercises and brainstorming sessions for students. The Meaningful learning workshop had 4 parts comprising Day 2, Day 3, and Day 4 and there were 4 different types of exercises:

(1) Brainstorming sessions on the theme of urban resilience: The students had to search for concepts that integrate within the theme where they learned how to elaborate a list of meaningful concepts, present the list and make a customized map presentation;

(2) Mixed teams between students from different universities: The students had to make mixed teams and choose one concept from the list of meaningful concepts to exercise and customize the Pre-Ordinated Cognitive Structure on Climate Change and Urban Resilience, integrate a customized map into the POCS, and integrate new pieces of information into the Pre-Ordinated Cognitive Structure;

(3) Individual exercises: It was a final exercise where each student learned how to map a scientific paper;

(4) Teams with students from the same university: The students had to build the research question for the existing concept and then build their own Cmap around it, learning to integrate new concepts into the Cmap elaborated;

The results of the workshops were new Cmaps on the topic of climate resilience constructed by students in different teams, representing their understanding of the domain of knowledge, and new links with other maps. Also, within the brainstorming sessions, new knowledge and new innovative concepts were created.

The feedback of the participants was that this meeting was very useful, especially for the methodological aspects, main takeaways for the students were:

(1) a better understanding of the climate change phenomenon, new innovative solutions regarding climate change resilience; For example: Distributed, renewable, and interactive energy systems from the presentation done by OBU; Therefore, concrete examples like the Bologna Local Urban Environment

Adaptation Plan for a Resilient City from the presentation done by ROMA TRE which focused on adaptation to heat waves helped students link theory with practice;

Fig. 23. Malta Workshop

(2) a better understanding of different impacts considering the examples given by lecturers, at the local scale, in different geographical contexts;

(3) the concept mapping tool and the narrative aspect of it.

For the educational aspects, UAUIM had a presentation about how courses and lectures incorporate the climate change resilience concept, together with projects and results done by students.

Other positive gains of the workshop were: interdisciplinarity and teamwork. The fact that there was an exercise with mixed teams with students from different universities and also having different backgrounds and specializations, helped them enrich their view on the subject, and learn from each other's experiences.

Some constructive feedback to be improved could be considered regarding the length of the lectures. Participants underlined the fact that they could have been shorter, leaving more room for interactions, brainstorm sessions, and more collaborative work between students, in mixed teams.

4. The Climate Resilience Integrated Concept Map explained

The Climate Resilience Integrated Concept Map reviewed all the partner's Cmaps and integrated all the aspects related to **CLIMATE CHANGE ADAPTATION AND MITIGATION STRATEGIES**. These instruments / strategies have the purpose to increase **RESILIENCE** of the following fields: natural environment, built environment, social and economic. Increasing resilience can be supported by the **LEGISLATIVE FRAMEWORK** as rules and regulations[1] and policies and programmes[2] which can be applied by Financing Instruments. The funds that can be used for climate change resilience are European, national or regional funds, applied by different programmes such as: LIFE+ programme, Horizon Europe, INTERREG etc. The diversity of funds and the interests in funding the challenges of climate change adaptation and mitigation should encourage the application of various **PRINCIPLES AND MODELS** as: reducing the carbon footprint, restoring nature, circular economy, integrated risk management, digitalization etc.

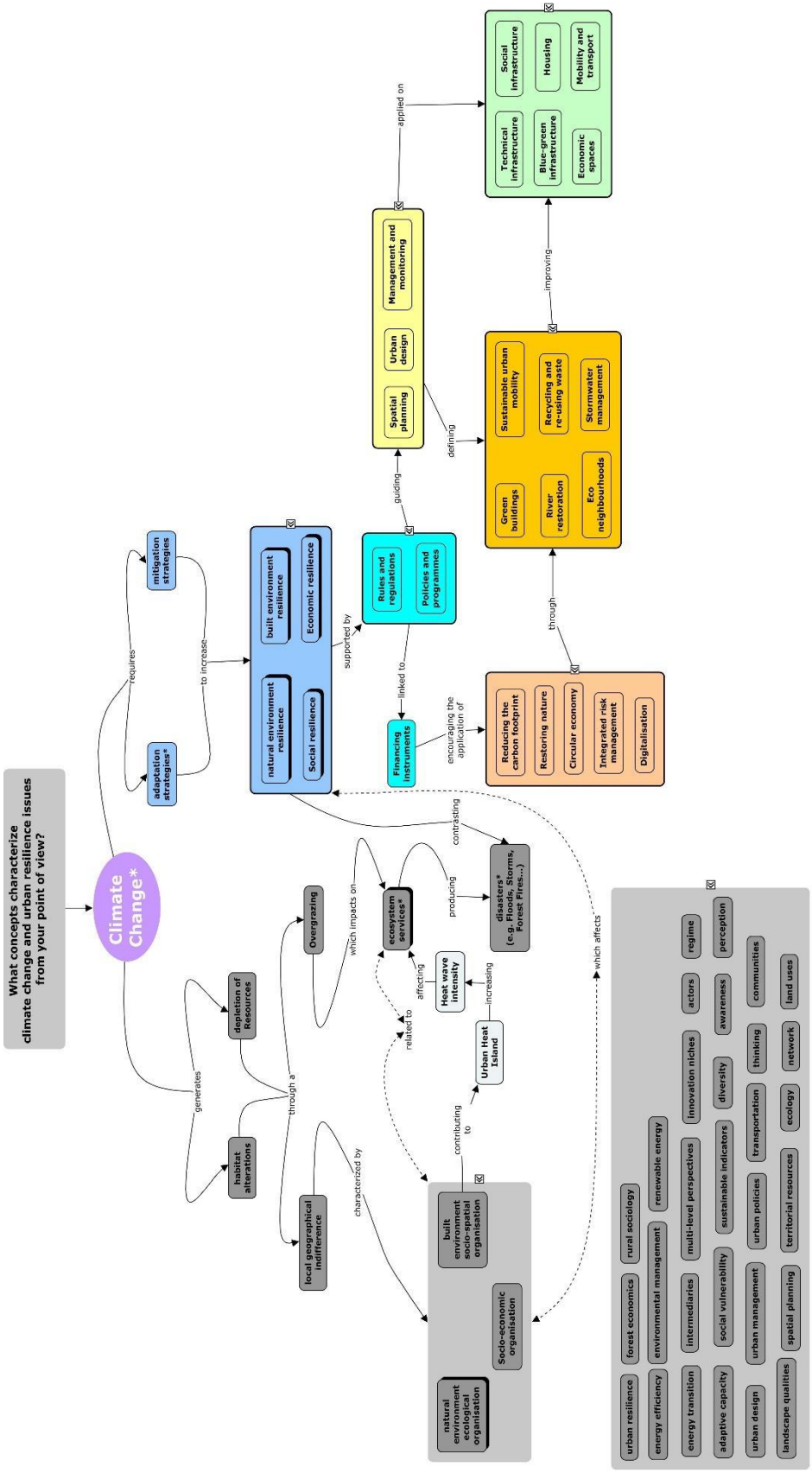
All of these are guiding the **PLANNING, DESIGN AND MANAGEMENT PRACTICES**, namely the spatial planning, urban design and management monitoring. These practices refer to instruments and practices at different spatial scales, containing the specific planning documents and documentations specific to each national planning system.

Moreover, to increase resilience, the **SPATIAL DIMENSIONS** should be approached in detail by adopting technical infrastructure, social infrastructure, blue-green infrastructure, housing, economic spaces and mobility and transport.

Nevertheless, all of the already well studied concepts and well-known instruments should improve and encourage adopting various **TECHNICAL SOLUTIONS** as: green buildings, sustainable urban mobility, river restoration, eco neighbourhoods, recycling and re-using waste, stormwater management etc.

[1] EU Directives, National norms regarding climate change, Regional / local norms

[2] At international level, e.g. UN Framework Convention on Climate Change (1992); At EU level, e.g. European Green Deal (2019), Forging a climate-resilient Europe - a new EU strategy on adaptation to climate change (2021); At national or regional level, e.g. National Strategies on Climate Change, Operational Programmes within the 2021-2027 EU programming period


What concepts characterize climate change and urban resilience issues from your point of view?
Climate Change*
generates
through a
Overgrazing
depletion of Resources
habitat alterations
local geographical indifference
which impacts on
ecosystem services*
producing
disasters* (e.g. Floods, Storms, Forest Fires...)
affecting
Heat wave intensity
increasing
related to
Urban Heat Island
contributing to
characterized by
built environment socio-spatial organisation
Socio-economic organisation
natural environment ecological organisation
which affects
urban resilience
energy efficiency
energy transition
adaptive capacity
urban design
landscape qualities
forest economics
environmental management
intermediaries
social vulnerability
urban management
spatial planning
rural sociology
renewable energy
multi-level perspectives
sustainable indicators
urban policies
territorial resources
innovation niches
diversity
transportation
ecology
actors
awareness
thinking
network
regime
perception
communities
land uses
requires
mitigation strategies
adaptation strategies*
to increase
natural environment resilience
built environment resilience
Social resilience
Economic resilience
supported by
Rules and regulations
Policies and programmes
guiding
linked to
Financing instruments
encouraging the application of
Reducing the carbon footprint
Restoring nature
Circular economy
Integrated risk management
Digitalisation
through
contrasting
Spatial planning
Urban design
Management and monitoring
defining
Green buildings
River restoration
Eco neighbourhoods
Sustainable urban mobility
Recycling and re-using waste
Stormwater management
improving
applied on
Technical infrastructure
Blue-green infrastructure
Economic spaces
Social infrastructure
Housing
Mobility and transport