CLIMAAX
climate ready regions

Deliverable Phase 1 – Climate risk assessment

QCATI (Climate Adaptation Toolbox Implementation)

Spain, Quart de Poblet

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HORIZON-MISS-2021-CLIMA-02-01 - Development of climate change risk assessments in European regions and communities based on a transparent and harmonised Climate Risk Assessment approach

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1. Document Information

Deliverable Title	Phase 1 – Climate risk assessment
Brief Description	This report is the first deliverable submitted by the Municipality of Quart de Poblet as participant of the CLIMAAX Project. The document describes how the climate risk assessment of Phase 1 was carried out using the CLIMAAX framework.
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Country	Spain
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Leading Institution	City Council of Quart de Poblet
Supporting subcontracting Institutions	Sequoia Pro
Author(s)	• Alberto Martínez Reyes (City Council of Quart de Poblet) • David Valdearcos Teruel (City Council of Quart de Poblet) • Aitana Navarro Molina (Sequoia Pro) • Lorena Núñez Iranzo (Sequoia Pro)
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5.0	31/09/2025		Final version to be submitted

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5. Abbreviations and acronyms

Abbreviation / acronym	Description
AEMET	Spanish Meteorological Agency
CHJ	Júcar Hydrographic Confederation
CRA	Climate Risk Assessment
CSIC	Higher Center for Scientific Research
DANA	Isolated high-altitude depression
GCM	Global Climate Model
GDP	Gross Domestic Product
ICV	Valencian Cartographic Institute
INE	National Institute of Statistics
NDVI	Normalized Difference Vegetation Index
QCATI	Climate Adaptation Toolbox Implementation for Quart de Poblet
RCM	Regional Climate Model
RCP	Representative Concentration Pathway
RP	Return Period
SNCZI	National Flood Zone Mapping System

6. Executive summary

Motivation: This report presents the results of the First Phase of the QCATI project, which consisted of a climate risk assessment (CRA) in the municipality of Quart de Poblet (Valencia, Spain) using a harmonized methodology, as part of the CLIMAAX project. To this end, CLIMAAX provides a standardized framework and toolbox for conducting risk analyses. The ultimate objective of this assessment is to improve local adaptive capacity through informed decision-making.

Main results: The work carried out included a CRA for river flood and heatwave risks, which were considered priorities for Quart de Poblet during the Framework's screening phase. To this end, the Workflows developed by CLIMAAX were used as prepared, taking open information from various European and global databases for analysis. Hazard, exposure, and vulnerability variables were incorporated for each risk. Two workshops with project stakeholders were also held during this phase.

- River flooding: The hazard maps represented the floodable areas associated with the Turia River and the Poyo ravine for return periods of 10, 100, and 500 years. As the return periods extends, the floodable areas and depths reached do increase. Under the 500-year return period, the affected areas included the left bank of the Turia River and the edge of the urban area, as well as the industrial and agricultural zones around Poyo, affecting critical infrastructure, with depths exceeding 3.5 m. The hazard analysis under different climate scenarios (RCPs 4.5 and 8.5) provides information on the expected depths for the Turia River, which are decreasing compared to the historical period. Risk outputs estimate maximum damages of around €3 million for extreme flood events (500-year return period).

- Heatwaves: The results show an increasing trend toward the occurrence of heatwaves according to climate projections, with a particularly worrying scenario as the century progresses and under the RCP 8.5 scenario. The calculations were performed using both the EuroHEAT methodology and a combination of different GCM-RCMs under the XCLIM methodology, which calculates the index, frequency, and duration. Epidemiological definitions of heatwaves were used for this purpose. The use of satellite imagery (Landsat8) has made it possible to locate the areas most affected by the urban heat island effect: the residential areas of Quart de Poblet and Barrio del Cristo, and especially the municipality's industrial areas. Older adults and children have been identified as vulnerable groups to this risk.

The knowledge gained from executing the selected workflows is essential for continuing in subsequent phases of work, since the current results provide a basis for incorporating the necessary improvements to refine the analysis at a local level.

Conclusions: The risks analyzed pose a challenge to the municipality's resilience capacity. Although there is less certainty regarding the increase in the risk of river flooding throughout the century, its current impact is well known. In addition, the risk of heatwaves is on the rise, aggravated by the urban heat island effect. To address these problems, local governments require reliable, accessible, and understandable information that facilitates the implementation of appropriate adaptation and preparedness measures. To improve the analysis, the next phase of the project will focus on obtaining and incorporating high-resolution data, refined for the local level, into the Workflows. Likewise, work will continue on stakeholder communication and engagement in the project.

1 Introduction

1.1 Background

The municipality of Quart de Poblet is located in the province of Valencia, in the district of l'Horta Sud, 5 km from the city of Valencia. It covers an area of 19.72 km^2 in the so-called Valencian coastal plain, so the topography is practically flat, interrupted only by the channels of gullies and rivers. The location of the municipality can be seen in Figure S-1 of the Supporting Documentation.

The municipality has a population of 26.304 (INE, 2024), which represents a very high population density per km^2 (>1.000 inhabitants/km^2). Furthermore, Quart de Poblet is home to extensive industrial areas around the A-3 motorway, where a large number of companies and workers are concentrated, as well as strategic facilities such as the UN Communications and Data Center, a military residence, part of Manises Airport, and the Valencia metropolitan area waste treatment plant, among others. All of this emphasizes the importance of good preparation for extreme weather events. Furthermore, the aging rate is very high (157.3%), which is important since the older population is a vulnerable group to certain climatic risks such as extreme heat.

Quart de Poblet has a typical Mediterranean climate (Csa), characterized by hot, dry summers and mild winters. Annual rainfall is usually concentrated in autumn and spring. The variability of this climate type makes it susceptible to climate-related hazards, such as forest fires, droughts, heavy rainfall, river flooding, and heatwaves.

The CLIMAAX project in Quart de Poblet will focus on studying the risk of river flooding and heatwaves, given the current impact of these risks on the population and established land uses. Considering the known impacts, it is important to study the projection of these risks into the future in the context of climate change so that preparedness can be improved.

1.2 Main objectives of the project

The QCATI project aims to assess various climate risks in the municipal context of Quart de Poblet, identifying hazards and vulnerabilities to develop strategies to improve the resilience of the population, the environment, and municipal infrastructure.

The significance of this project lies in its ability to support local adaptation planning, ensuring sustainable development and safeguarding critical infrastructure, natural ecosystems, and community well-being.

The specific objectives of QCATI include:

- Assessing climate risks using the CLIMAAX framework and methodology, established by experts in the field, to identify the areas and communities most susceptible to risk through the generation of visual outputs.
- Identifying the areas of greatest exposure and the most vulnerable groups in Quart de Poblet.
- Providing local authorities with accessible and understandable information on current and expected risks based on various climate scenarios, to support decision-making regarding adaptation and mitigation, as well as emergency preparedness.

- Improving local adaptation capacity by engaging local stakeholders and raising public awareness to improve their risk perception.

By applying the tools provided by the CLIMAAX Handbook, the project benefits from a scientific and standardized approach to climate risk assessment, based on a common methodology that can be adapted to different European regions. This framework will optimize short-, medium-, and long-term decision-making in accordance with European standards and best practices.

1.3 Project team

The QCATI project involves a diverse team, led and coordinated by the European Projects Department of the Quart de Poblet City Council, in collaboration with the Department of Environment. The following people are involved:

- Alberto Martínez Reyes: city council coordinator technician, in charge of managing and evaluating QCATI project, and relationships with external services and the other municipality departments.
- David Valdearcos Teruel: technician from the European projects department in the municipality of Quart de Poblet, in charge of financial follow-up and technical issues.

Thus, the City Council is responsible for overseeing the project objectives and managing stakeholder engagement. Besides, the technical team supporting the City Council on the QCATI project was contracted through a public tender process, which led to the hiring of an environmental consultancy firm. This technical team, responsible for applying the CLIMAAX methodology, includes:

- Aitana Navarro Molina: Environmental and climate consultant, responsible for executing workflows and developing the climate risk assessment.
- Maria Lopez Devesa: Communication officer and consultant, responsible for managing press releases, posts and social media engagement.
- Verónica Sánchez-Ferragut: grapich designer in charge of the project image and the elaboration of all communication products.
- Lorena Núñez Iranzo: European Projects manager, responsible for the internal communication with the city council of Quart de Poblet, about aligning all project outcomes with EU financing initiatives, and to developing stakeholders' engagement strategy and public participation plan.

1.4 Outline of the document's structure

This document presents the work carried out during Phase 1 of the CLIMAAX project in Quart de Poblet. The **introduction** provides a brief description of the municipality to contextualize the project territorially. The main objectives and the project team are also outlined.

The central body of the document contains the **climate risk assessment**. This section first includes the **scope**, defining the objectives, context, and stakeholders for the project. This is followed by **risk exploration**, which leads to the selection of workflows and scenarios of interest. Next, the **risk analysis** is developed, presenting the different steps followed through Workflows to perform an analysis based on hazard, vulnerability, and exposure variables for the different risks. The **preliminary results of the assessment** are described in terms of severity, urgency, and capacity.

The **conclusions** summarize the most relevant aspects of this first phase of work, the key findings, and the challenges addressed and unaddressed. This is followed by a **progress evaluation** and a reflection on the challenges posed for the next phases of the project.

Finally, the **supporting documentation** accompanying this report is listed, along with the **references** used.

2 Climate risk assessment – phase 1

2.1 Scoping

Defining the project scope is a fundamental initial step. The scope establishes the project's objectives, context, and stakeholders, including those responsible for risk management. This step ensures that the risk assessment is conducted at a scale appropriate for the municipality and aligned with its administrative and competency framework.

2.1.1 Objectives

This phase of the project aims to assess two climate risks for Quart de Poblet: river flooding and heatwaves. This assessment aims to achieve several objectives: to understand the future projections of these phenomena in relation to climate change, to identify vulnerable areas and groups, and to evaluate the potential impacts of the analyzed risks on the territory and the population.

The results obtained should provide a reliable and verified source of information for political decision-making in the City Council regarding risk preparedness, mitigation, and adaptation to climate change. Furthermore, the aim will be to improve risk awareness and understanding among various stakeholders and the general public, as a way to enhance local adaptation capacity and resilience.

The limitations that could affect the development of the Climate Risk Assessment are diverse: limitations in European databases due to their resolution, which make it difficult to conduct local-level assessments, which will be addressed in the second phase; achieving active and meaningful stakeholder participation; limitations in technical staff capacity; and uncertainty in the results of climate projections.

2.1.2 Context

Current risk management and assessment: At the regional level, the Valencian Climate Change and Energy Strategy 2030 defines the effects of climate change on the Valencian territory: general increase in temperatures, decrease in rainfall, aridification, rising sea levels, increased intensity of extreme events such as floods and heatwaves, emergence of invasive species and new diseases.

Risk management falls under the responsibility of the Civil Protection System, whose powers are shared among the different administrative levels in Spain (national, regional, and local). The Valencian Community has its own civil protection law, one of its objectives being "To analyze the vulnerability of the territory of the Valencian Community for the preparation of various risk maps [...]." This mapping is included in the Special Risk Plans, which have assessed and determined the risk level for each municipality. Municipalities must also have local civil protection planning. The climate risks addressed by this planning are specifically floods and forest fires. In addition, local authorities can develop programs and action plans to address specific risk situations.

However, no climate risk assessment has been previously conducted at the local level in Quart de Poblet. Current information on the risks to be assessed in this project comes from regional and/or national authorities and institutions.

Official flood risk mapping exists at both the regional and national levels. Furthermore, the Júcar River Basin Authority (CHJ), which includes Quart de Poblet, also has a Flood Risk Management Plan. The risk of heatwaves is managed through the regional health authority, which annually prepares a summer program to prevent and address health problems arising from high temperatures. This program includes communication of the daily risk level assigned to each municipality.

In addition, the Spanish Meteorological Agency (AEMET) provides weather information and forecasts and maintains continuous monitoring of adverse weather events and issues warnings when certain risk thresholds are reached. AEMET is also responsible for developing and updating regionalized climate change scenarios for Spain. Information on climate change projections for the 21st century is disseminated through the AdapteCCa portal, part of the Spanish Climate Change Office.

Problems to address: Extreme weather events linked to temperature and water are a growing concern among society and decision-makers, especially along the Mediterranean coast. In the current context, extreme heat events are becoming more intense (temperature records are being broken) and longer lasting (heatwaves are extending over time). June 2025 was the most anomalously warm month on record in Spain, with an average temperature of 23.7°C, 3.6°C higher than the reference period average, according to AEMET. Furthermore, the region recently experienced one of the most severe flooding events recorded to date: the DANA flood of October 2024, with 215[1] deaths and an estimated loss of more than €17 billion[2] in capital stock in the Valencian Community. This leads to greater concern and risk perception, and demonstrates the need to improve local knowledge about current risks and their evolution under climate change. Therefore, the project seeks to address questions such as how risks can be expected to evolve in the future, what climate events the municipality should prepare for, which areas and groups will be most affected, and how to improve decision-making for risk prevention and management.

Governance context: As previously mentioned, risk governance falls under different administrative levels, primarily through civil protection plans. Local planning is integrated into regional planning through operational emergency response mechanisms.

Regarding risk assessment and climate change adaptation, various legal frameworks, plans, and strategies can be highlighted at the national and regional levels:

- Law 7/2021, of May 20, on climate change and energy transition.
- Spanish National Climate Change Adaptation Plan 2021-2023
- National Integrated Energy and Climate Plan 2023-2030 (PNIEC)
- Law 6/2022, of December 5, of the Generalitat, on climate change and the ecological transition of the Valencian Community
- Valencian Integrated Energy and Climate Change Plan (PVIECC 2030)

[1] https://www.lamoncloa.gob.es/info-dana/paginas/2024/131124-datos-seguimiento-actuaciones-gobierno.aspx

[2] https://www.ivie.es/es_ES/ptproyecto/ivielab-alcance-economico-de-la-dana-del-29-de-octubre-en-la-provincia-de-valencia/

- Valencian Climate Change and Energy Strategy (2030)
- Law 17/2015, of July 9, on the National Civil Protection System.
- Law 13/2010, of November 23, of the Generalitat, on Civil Protection and Emergency Management.
- National Plan for Preventive Actions against the Effects of Excessive Temperatures on Health
- Program for the Prevention and Response to Health Problems Derived from High Temperatures in the Valencian Community
- Special Plan for Flood Risk in the Valencian Community (PEIN)
- Sectoral Territorial Action Plan for Flood Risk Prevention in the Valencian Community
- Flood Risk Management Plan of the Júcar Hydrographic Confederation

At the local level, the following risk management tools stand out:

- Municipal Territorial Emergency Plan
- Municipal Flood Risk Action Plan
- Municipal Prevention Plan for the Risk of Heavy Rainfall
- Environmental Promotion Plan for Climate Change Adaptation

Relevant sectors: Due to their exposure, the sectors considered most susceptible to the consequences of the risks analyzed are the population, urban and transportation facilities and infrastructure, the industrial and agricultural production sectors, and the natural environment. The October 2024 flooding highlighted the exposure of these sectors to risk. Regarding heatwaves, public health is of particular concern.

Outside influences: Beyond the municipal context, there are external influences on the adaptive and resilient capacity that can be achieved in Quart de Poblet. These include regional and national climate change adaptation and mitigation strategies; river authority risk management plans; and European initiatives (CLIMAAX, Covenant of Mayors, Pathways2Resilience, etc.). Specifically, the "Plan Endavant", a strategy promoted by the Generalitat Valenciana, that is currently being developed to adapt a strategy to recover from the effects of the DANA, in which the municipality of Quart de Poblet is also located, and that involves an external influence to be taken into consideration for our QCATI project.

Possible adaptation interventions: These include hydrological interventions in ravines (channeling, diversions), adapted urban planning (green infrastructure, urban flood parks) and improvement of drainage and rainwater harvesting networks, creation of shaded areas in public spaces, adaptation of public buildings as climate shelters, improvement of early warning systems for the population, and increased information and public awareness.

2.1.3 Participation and risk ownership

Regarding participation, the City Council has conducted a preliminary stakeholder mapping of interest to the QCATI project, identifying those of greatest relevance, interest, and urgency for the project. This stakeholder mapping was conducted through a dynamic session with the council's stakeholders involved in the project. Using sticky notes and continuous paper, the mapping will serve as a guide to the next steps in the participatory process. Furthermore, during the second workshop held with City Council representatives to present the results of Phase 1, civil society groups that could be incorporated as stakeholders were identified.

Among the groups and people of interest the following have been considered:

- Municipal areas and local authorities of Quart de Poblet Town Council: departments of European Projects, Town Planning and Environment, Public Safety (Civil Protection/Police) and Social Services.
- Academia and research centres: the Research Group on Climate Change, Meteorological Risks and Inputs to the Hydrological System in the Mediterranean (CLIMAMET) of the University of Valencia has been contacted.
- Institutions: at supra-municipal level, cooperation and knowledge transfer will be sought with the neighbouring municipalities of Aldaia, Manises and Mislata, given the territorial, urban and industrial continuity that exists between these towns and Quart de Poblet. On the other hand, the synergies that can be generated with the Barrio del Cristo, an urban nucleus that also belongs to Quart de Poblet and which is directly affected by the climate risk analysis, will also be actively sought. The collaboration of the Mancomunidad Intermunicipal de l'Horta Sud will also be sought, as an entity committed to sustainability and the environment, of which Quart de Poblet is a member. On the other hand, contact has been established with the Generalitat Valenciana's Subdirectorate General for Epidemiology, Health Surveillance and Environmental Health to consider the threshold temperatures to be used in the definition of heat waves.
- Civil society and organisations: local associations and organisations such as Fundación Limne, Equartlogistes, Quart es Ciencia, or the Municipal Sectoral Council for the Environment.
- Other projects: a strategy has been initiated with the Alicante County Council (the other project funded by the first open call), to share resources, knowledge, good practices and experiences in the implementation and management of the project. There are also plans to carry out joint actions to raise awareness and inform on the status of both projects.

Regarding risk responsibility, as mentioned, the law grants the municipality powers over prevention and management, making it responsible for civil protection and public safety. The City Council is responsible for promoting local policies and actions to improve climate change adaptation and emergency response. Information for risk assessment and management is generally provided by regional and national institutions and entities (research centers, universities, etc.).

The results obtained through the CRA will be shared with project stakeholders through internal communications, meetings, and workshops. In turn, raising the profile of the project and raising public awareness of climate risks and change is one of QCATI's objectives. Therefore, the project has a communication plan that includes publications in the press, on the web, and on social media to reach the general public, as shown in the Supporting Documentation (Figures S-19 to S-25), that complies with a holistic impact and outreach strategy of the project's main activities and results.

2.2 Risk Exploration

Risk screening begins the climate risk assessment process. It is essential to examine which risks pose the greatest threat to the municipality and generate the greatest concern among individuals and stakeholders, as well as among citizens, in order to focus the project on local needs and the hazards that may have the greatest impacts.

2.2.1 Screen risks (selection of main hazards)

Two risks have been considered priority for the municipality of Quart de Poblet:

River flooding: This risk is associated with various channels in Quart de Poblet. First, the Turia, a large river (watershed area of 6.143 km^2), next to which the town center is located. Second, the Poyo, Gallego, and Saleta ravines, whose overflow affects the industrial and agricultural areas of the municipality. The ravines of the Valencian region are characterized by being highly dynamic and generating flash floods when torrential rains occur, affecting floodplains that have been heavily occupied (Camarasa and Soriano , 2012).

The most recent flooding incident, caused by the isolated high-altitude depression (DANA) on October 29, 2024, which generated a historic torrential downpour (peaking 771 l/m^2 in 24 hours in Turís, 25 km from Quart), catastrophically affected the municipalities of l'Horta Sud. This event has marked the history of the Valencian Community and has rekindled social concern about the risk of flooding. Although Quart de Poblet was not the area most affected by the DANA, the municipality suffered significant material damage, especially in the industrial area due to the overflowing of the Saleta ravine (2 million m^2 of land affected). The overflowing of the Poyo ravine affected large areas of agricultural land, farms, orchards, and rural roads, while the AP-7 motorway, one of the province's main communication routes, collapsed over the Gallego ravine. The flooding of the Turia River affected the protected Natural Park, as well as garages and ground floors in the town center. The water swept away vehicles and completely flooded some municipal facilities.

It should be noted that, to date, it is not possible to reliably demonstrate a change in the flood regime directly attributable to climate change, due to the scarcity of long-term flood flow records. The strong climate variability in the Mediterranean region also means that trends in precipitation changes that influence flooding are not so clear (MITECO, 2018). However, studies on rainfall events observed in the CHJ in recent decades are highly relevant, such as that by Camarasa *et al*. (2020), which shows a trend towards increasing intensity of episodes, in addition to a reduction in total accumulations.

Heatwaves: The last three years (2022 to 2024) have been extremely warm in Spain, marking the three warmest years since the start of the AEMET series. During the summer of 2022, three heatwaves were recorded in the Iberian Peninsula between June and August; in 2023, four heatwaves occurred (two in July and two in August), exceeding 45°C in some areas of the province of Valencia; and in 2024, another three heatwaves occurred between July and August. Extremely warm temperatures are becoming more frequent in the country, and it is noteworthy that the 10 warmest years in the series since 1961 now belong to the 21st century.

Quart de Poblet is a municipality vulnerable to this risk, which is exacerbated in large areas where urban, industrial, and road expansion favors the urban heat island effect. In this context, it is important to consider the high aging rate of the local population, as people over 65 are a vulnerable group to extreme heat.

The first phase of work consists of an assessment of these risks using the databases provided by the CLIMAAX Toolbox, measuring the level of hazard, exposure, and vulnerability. The objective of the next phase of the project will be to incorporate local data to improve the analysis results,

compare the results obtained, and facilitate better decision-making by policymakers to address risks through adaptation and mitigation strategies.

2.2.2 Workflow selection

This section describes the workflows used for climate risk assessment, selected from the CLIMAAX Toolbox. It also identifies the vulnerable groups and exposed areas relevant to the different risks.

2.2.2.1 Workflow #1: River floods

As mentioned, flooding is a renewed concern in the region due to the historic event that occurred last October (2024). This risk assessment was conducted using JRC flood hazard maps for different return periods. Aqueduct Floods maps were also incorporated to compare future scenarios. The exposure was based on LUISA land-use data, and vulnerability was calculated using damage curves (€/m2) for different land uses.

Exposed areas: Due to the characteristics of the databases, only basins larger than 150 km^2 are represented, so some of the ravines that cause problems in the municipality are excluded from the analysis. The results show greater exposure in the eastern part of the urban center (in contact with the Turia River) and in the westernmost part of the municipality, where the flooding of the Poyo ravine primarily affects agricultural and industrial areas.

Vulnerable groups: The following are considered vulnerable: residences and facilities located in low-lying areas of the urban center, closest to the river; the protected area of the Turia Natural Park; the industrial areas around the A-3 motorway and the road itself; and agricultural holdings located to the west. The vulnerable population includes residents of the low-lying areas of the urban center and workers in the industrial area.

2.2.2.2 Workflow #2: Heatwaves

Heatwaves in Spain are becoming more frequent, intense, and long-lasting, following a growing trend over recent decades. Heatwave hazard assessments were carried out using the EuroHEAT and XCLIM methodologies, both using health-related definitions (EU-wide for EuroHEAT and regional for XCLIM). Risk assessments were conducted using satellite-derived land surface temperature information (Landsat8) combined with estimates of vulnerable populations obtained from Worldpop Hub data. Risk evolution was also analyzed based on climate change for the RCPs 4.5 and 8.5 scenarios for municipalities in the province of Valencia, including Quart de Poblet.

Exposed areas: Considering the urban heat island effect, the areas most at risk are the urban core and the Cristo neighborhood, as well as the industrial areas, especially around the A-3 highway, where densely built-up areas with heavy traffic are concentrated.

Vulnerable groups: The elderly population (over 65 years old) and children (under 5 years old) have been considered vulnerable, mainly concentrated in the urban core of Quart de Poblet.

2.2.3 Choose Scenario

At the local level, decision-makers' capacity to act is typically short (4-year cycles). However, it is necessary to maintain a medium- and long-term vision that allows for variations in estimated risks due to climate change to be taken into account, allowing for improved preparedness and adaptation.

In the short term, knowledge about recent events and current exposure and vulnerability are used to validate workflows.

Regarding future scenarios, two time horizons are proposed:

In the medium term (2040-2060) – a progressive escalation in temperatures will increase the severity of heatwaves and may also favor the occurrence of intense torrential rain events. According to the study by Miró *et al.* (2021), extreme precipitation could increase in the Valencian region in the short to medium term under RCPs 4.5 and 8.5 scenarios, which may lead to more flooding due to river and ravine overflows. However, channeling and diversion interventions (Poyo ravine) can be implemented to reduce the associated risk. Population projections from the National Institute of Statistics predict a population increase (more than 5 million in the next 15 years)[3] if current trends continue, with particular growth in the Valencian Community, in addition to an increase in the population over 65 years of age (from 20,4% to 30,5% by 2055). However, in Quart de Poblet specifically, population growth may be limited, as there is hardly any residential land left to develop, according to current urban planning.

In the long term (2070–2100), the worst-case scenario is proposed under RCP 8.5 for the end of the century, with severe changes in climate risks, especially the risk of heatwaves. There is greater uncertainty in the projections regarding the risk of river flooding, which is closely linked to the behavior of precipitation. By the end of the century, the projections obtained by Miró *et al*. (2021) show a reduction in annual precipitation across the CHJ as a whole (although there are spatial variations), with a more general and drier trend under the RCP 8.5 scenario. It also presents a reduction in extreme precipitation events in the central and coastal areas of the province of Valencia.

The RCP 4.5 and RCP 8.5 scenarios were used in both risk assessments for the medium- and long-term timescales, with RCP 4.5 considered moderately optimistic, compared to RCP 8.5, which is considered pessimistic regarding future greenhouse gas concentrations. The scenarios used in the development of the CLIMAAX workflows were as follows:

Floods:

- Aqueduct Floods: projections for RCP 4.5 and RCP 8.5.
- JRC: Return periods for base scenarios of 10, 100, and 500 years.

Heatwaves:

- EuroHEAT methodology: projections for RCP 4.5 and 8.5 through 2085.
- XCLIM methodology: projections for RCP 4.5 and 8.5 from 2006 to 2070.
- Risk projection under climate change: projections for RCP 4.5 and 8.5 over two time horizons (2045 and 2075).

2.3 Risk Analysis

2.3.1 Workflow #1 River Floods

It has been previously indicated that the flood risk in Quart de Poblet is linked to the presence of the Turia River, as well as various sporadic ravines (Poyo, Gallego, Saleta). Administratively, the basins present in Quart fall under the jurisdiction of the Júcar River Basin Authority (CHJ). As can

[3] https://www.ine.es/dyngs/Prensa/PROP20242074.htm

be seen in the map (Figure 2-1), the final stretch of the Turia River is channeled through a diversion structure that begins in the municipality of Quart. The Saleta ravine is absorbed by the industrial area of the municipality due to poor territorial and urban planning, while the Gallego and Poyo ravines are located in the agricultural area and border the industrial area.

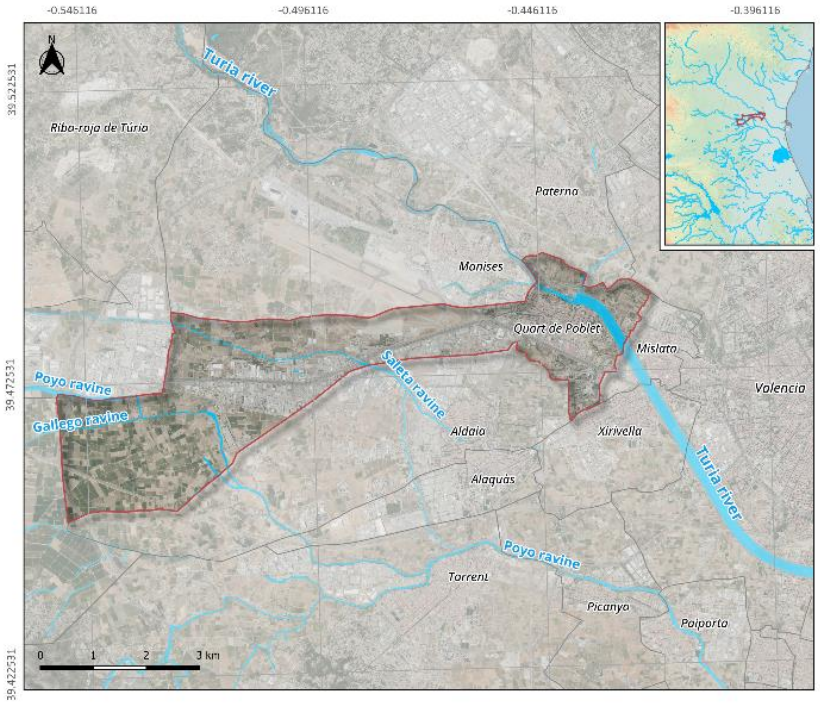

Figure 2 - 1 Map of the rivers and ravines present in the municipality of Quart de Poblet. Prepared by the authors based on maps from the Valencian Cartographic Institute.

Table 2 - 1 Data overview workflow #1

Hazard data	*Vulnerability data*	*Exposure data*	*Risk output*
JRC's high resolution river flood map dataset (present day scenario) *Aqueduct Floods's coarse resolution flood maps (baseline and future scenarios for RCPs 4.5 and 8.5)*	*JRC depth damage curves*	*LUISA (Land Use-based Integrated Sustainability Assessment modelling platform) land use dataset*	*Flood damage maps for different RP (50, 100, 500). The damage is expressed in monetary value (million €)*

2.3.1.1 Hazard assessment

The river flood hazard assessment in Quart de Poblet was carried out using the workflow provided by CLIMAAX, which uses two flood databases (Joint Research Centre and Aqueduct Floods). The study area includes the municipality of Quart de Poblet and its immediate surroundings. First, data obtained from the JRC was used to generate high-resolution flood maps, showing the extent and depth of the water. The dataset allows this information to be represented for different return periods, of which 10, 100, and 500 years were chosen. This RP are also used by the official spanish flood hazard mapping (SNCZI). It should be noted that the JRC dataset presents limitations for a

local assessment, as it does not include basins smaller than 150 km^2, so the Saleta and Gallego ravines are omitted.

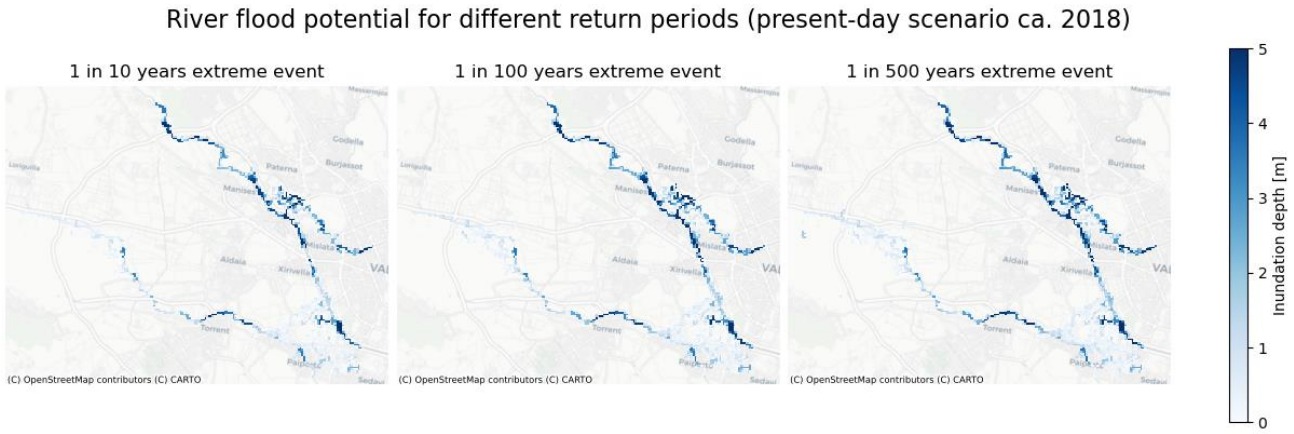

Figure 2 - 2 Flood extent and depth for return periods of 10, 100, and 500 years.

The results show the greatest flood depths in the Turia River, equal to or greater than 5 m (maximum of 7.39 m for a 500-year event). On the left bank of the river, between Quart and Paterna, a flood-prone area is marked, affected by tributary ravines (de la Font, d'en Dolça) from other municipalities. The area of the former Turia riverbed is also considered hazardous. Meanwhile, the urban center of Quart is minimally affected thanks to its higher elevation. Within the municipality, the Poyo ravine is at its deepest near the Valencia Metropolitan Area Waste Treatment Plant (maximum of 3.76 m for a 500-year event). The slick represents an overflow in the agricultural area of the municipality, partially affecting the Valencia 2000 industrial estate (with depths less than 80 cm). It is noteworthy that there is no significant difference between the results for the different return periods. The greatest change is found in the area affected by the Poyo ravine. Furthermore, considering the information available in the ICV on the flooding that occurred in October 2024 (Supporting Documentation, Figure S-3), which exceeded the forecasts for a 500-year PR, the limitations of the dataset used are evident.

The Aqueduct Floods database was used to assess risk in future scenarios related to climate change. The maps generated for a 250-year return period event at different time horizons allow for a comparison between the RCP 4.5 and RCP 8.5 scenarios, as well as the difference with respect to the baseline situation. This dataset only presents results for the Turia River due to the coarse resolution of the data; however, it is useful as an estimate of the potential impact of climate change on flood hazard. The progress made shows minimal variation between the different scenarios, although the expected depth reduction for the 2080 horizon under RCP 8.5 is notable. Additionaly, the outputs show negative values when comparing the projected flood depth with the baseline, indicating that a depth reduction is expected, which could be due to lower river flow. This is consistent with climate change studies conducted for the CHJ area (which includes the Turia basin), such as that of Miró *et al*. (2021), which describe a long-term reduction in rainfall, especially inland in river headwaters, and more markedly under the RCP 8.5 scenario.

However, according to climate projections (Miró *et al*., 2021), the trend in extreme precipitation may increase in the short to medium term (RCPs 4.5 and 8.5) in some areas of the CHJ, including the middle stretch of the Turia, while by the end of the century there is a marked downward trend in the Valencia area, which would affect Quart de Poblet, especially under RCP 8.5. In this sense, the dynamics of ravines and gullies, which are not included in this analysis, play a fundamental role.

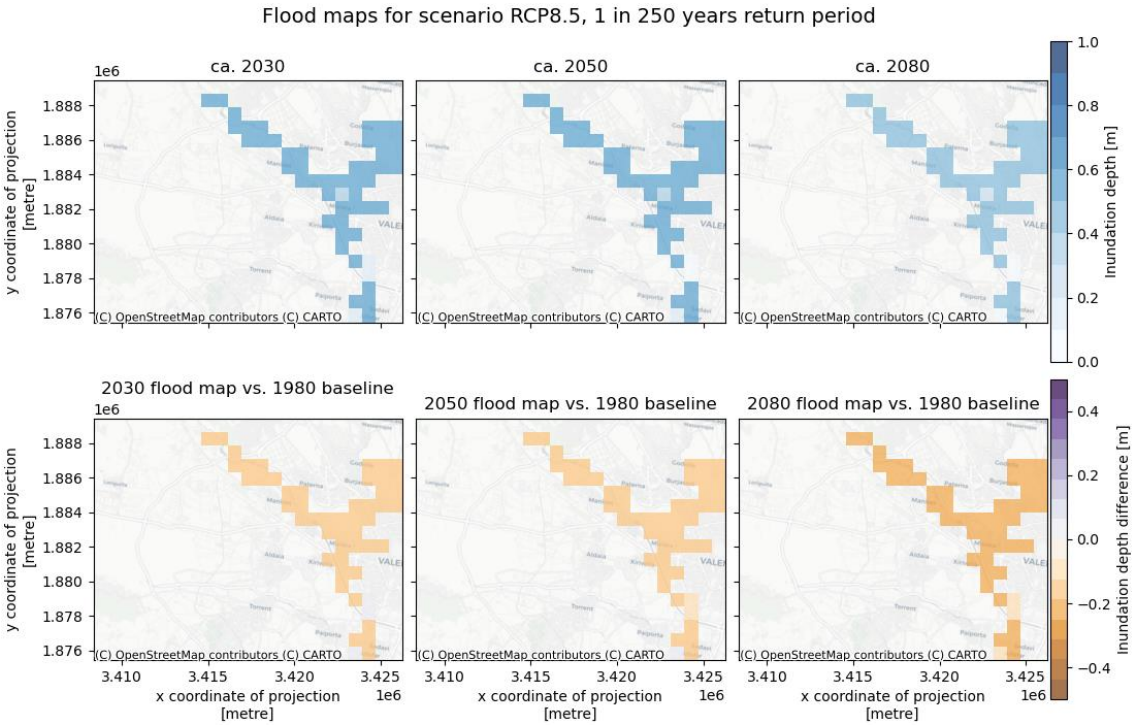

Figure 2 - 3 Comparison of RCP 8.5 scenario with baseline.

2.3.1.2 Risk assessment

The risk assessment in this workflow is based on combining the obtained hazard maps with land-use maps as an exposure layer, and damage curves to incorporate an economic vulnerability variable. Information on land uses and damage curves is also provided by the JRC.

The land use database (LUISA) has been incorporated into the assessment at a resolution of 100 m to represent the different land cover found in the municipality (residential, industrial, agricultural, road infrastructure, etc.). The damage curves used assign a damage ratio to the different land uses based on flood depth. Using the LUISA_damage_info_curves.xlsx template, a monetary value is assigned to the land use categories, allowing potential losses in €/m^2 to be calculated. To adapt this template to local conditions, the GDP per capita of the Valencian Community (€26.453 in 2023[4]) has been used.

Finally, the combined data for damage calculations was applied to the different return periods. The following figure shows the maps for the 10, 100, and 500 year events. The results for each available return period can be seen in the Supporting Documentation (Figures S-4 through S-8).

[4] https://www.caixabankresearch.com/es/publicaciones/fichas-comunidades-autonomas/comunitat-valenciana

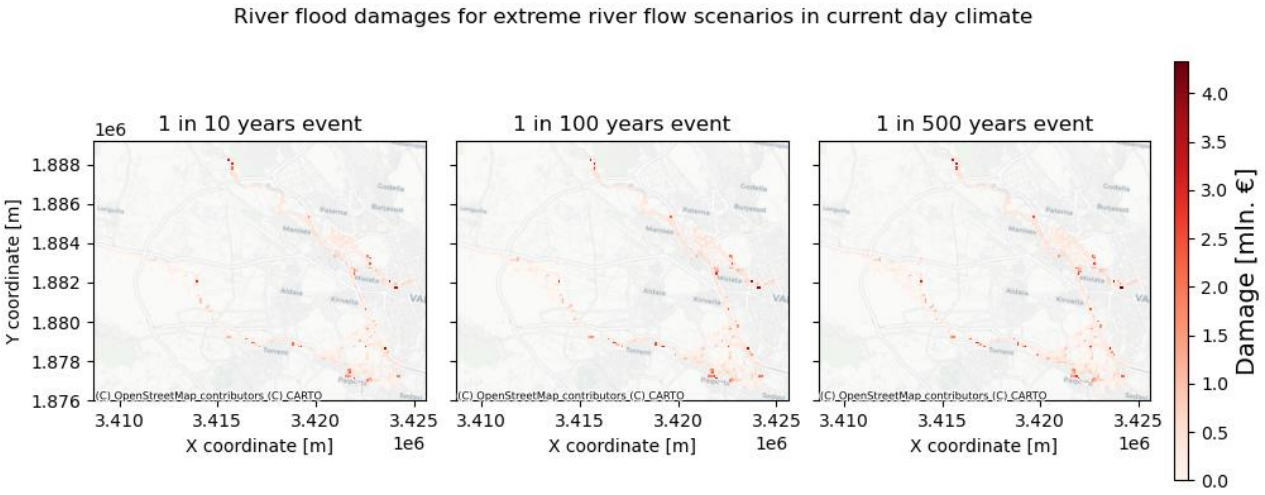

Figure 2 - 4 Economic damages from river flooding for return periods of 10, 100 and 500 years.

Risk analysis is limited by the shortcomings of hazard maps, as previously mentioned, so there are areas potentially affected by river flooding that are not represented. Taking this into account, the results show that the greatest economic damage within the municipality of Quart de Poblet coincides with certain industrial uses to the west due to the impact of the Poyo ravine, the most notable being the Waste Treatment Plant and the Wastewater Treatment Plant. Regarding the Turia River, it has a low impact on the urban center. The greatest damage would be found at the Military Hospital, which borders the urban center of Mislata.

As a first approach to the CLIMAAX toolbox, the results obtained are consistent and provide a basis for risk assessment. Incorporating more representative hazard maps for the analysis, provided by the SNCZI, will be one of the QCATI team's objectives for the second phase of the project.

2.3.2 Workflow #2 Heatwaves

It has been previously established that Spain has experienced an increase in extreme temperatures and heatwaves in recent decades. Figure S-9 of the Supporting Documentation shows the average annual temperature anomaly experienced by mainland Spain between 1961 and 2023. At the regional level, works such as that of Miró *et al.* (2015) reveal the magnitude of temperature change (ºC) experienced in the Valencian Community in recent decades, with a significant warming trend, although more moderate in coastal and pre-coastal areas. The objective of applying this workflow will be, on the one hand, to test its applicability to the case of Quart de Poblet and, on the other hand, to assess future risk under the impact of climate change, knowing the occurrence conferred under the RCP 4.5 and RCP 8.5 scenarios.

Table 2 - 2 Data overview workflow #2

Methodology	*Hazard data*	*Vulnerability data*	*Exposure data*	*Risk output*
Hazard assessment EuroHEAT	*Bias-adjusted EURO-CORDEX dataset: heatwave days*	*…*		*Graph for the evolution of the number of heatwave days from 1985 to*

Methodology	Hazard data	Vulnerability data	Exposure data	Risk output
	per year, RCPs 4.5 and 8.5			*2085, under the scenarios RCP 4.5 and RCP 8.5*
Hazard assessment XCLIM	*EURO-CORDEX dataset: Daily max. and min. air temperature at 2m height for 3 combinations of GCM-RCM models*	*…*		*Graphs for the evolution of 3 variables: heatwave index, heatwave frequency and heatwave total length, for RCPs 4.5 and 8.5 scenarios, from 1971 to 2070*
Risk assessment (satellite-derived data)		*Maps of population distribution from Worldpop Hub for year 2020 (ages ≤5 and ≥65 years)*	*Satellite-derived land surface temperature data based on land surface temperature (LST) calculated from Landsat 8 imagery & Vector layer of vulnerable places (kindergarten, schools, health centre, retirement home, sports centre, squares, parks…)*	*Map of possible heat risk level to vulnerable population*
Risk assessment (climate change)	*EURO-CORDEX dataset: heatwave days per year, RCPs 4.5 and 8.5, for near future (2016-2045) and further future (2046-2075)*	*Maps of population distribution from Worldpop Hub for year 2020 (ages ≤5 and ≥65 years)*		*Maps representing: -Relative change and magnitude of change in heatwave occurrence -Relative change of heatwave risk to vulnerable population groups for the Valencia province municipalities*

2.3.2.1 Hazard assessment

The QCATI team has assessed the hazard of heatwaves using the two methodologies proposed by the CLIMAAX Handbook (EuroHEAT and XCLIM), allowing for comparison of results considering different parameters for defining a heat wave.

First, using the EuroHEAT project methodology, heatwaves were considered under a health-related EU-wide definition. The dataset used provides a series of heat wave days available in a 12x12 km grid for all of Europe and for different climate change scenarios (RCPs 4.5 and 8.5). The resulting

plot (Figure 2-5) corresponds to the Quart de Poblet area and its surroundings, taking into account the dataset resolution. An increase in the number of heatwaves is observed for both scenarios; furthermore, the difference between the two scenarios increases significantly starting in the middle of the century. The number of days triples from 2025 to the end of the century for RCP 4.5 (from 11 to 30 days), while it increases fivefold for RCP 8.5 (from 12 to 62). The option of using national thresholds with this methodology is not available for Spain.

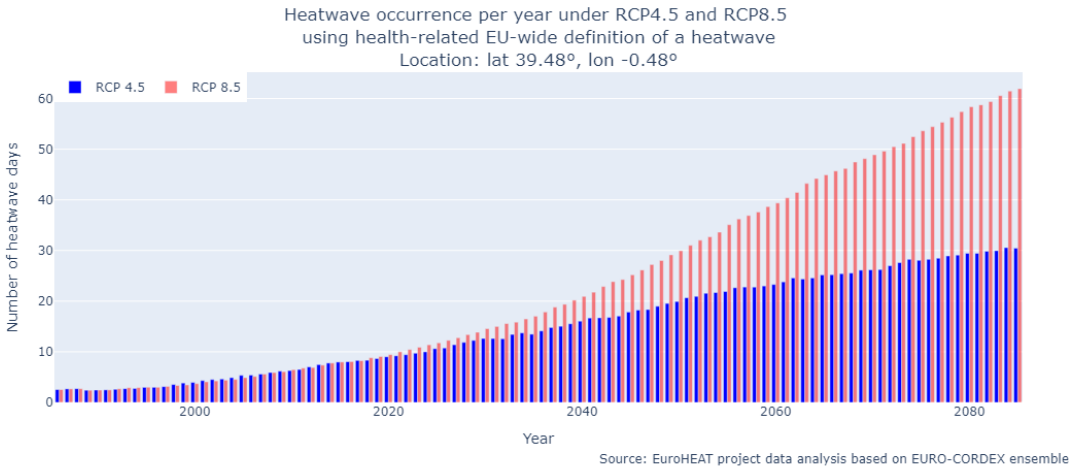

Figure 2 - 5 Occurrence of heatwaves in Quart de Poblet under the RCP 4.5 and RCP 8.5 scenarios using the EuroHEAT methodology, period 1986-2085.

Secondly, for the use of the XCLIM methodology, a definition of heat wave also related to health has been considered, using the thresholds defined by the health authorities in Spain (Figure S-11 of the Supporting Documentation). These thresholds are established for the meteorological zones[5] defined by AEMET. The maximum temperature threshold for the northern coast of Valencia (where Quart is located) is 34.7°C[6], while the minimum threshold of 24°C established by Díaz *et al.* (2015) is used. A heat wave is considered to occur when three or more consecutive days occur under these parameters.

The historical data used correspond to the period 1971–2005, while the period selected for the RCP 4.5 and RCP 8.5 scenarios ranges from 2006 to 2070. To compare different results, the QCATI team carried out the analysis for different GCM-RCM combinations, as shown in the Supporting Documentation (Table S-1). As in the previous case, since the same spatial data resolution is used, the area selected for plotting the information corresponds to the municipality and its immediate surroundings. Finally, the occurrence of heatwaves was calculated using the indicators proposed in the CLIMAAX Handbook: heat wave index, frequency, and total duration.

Despite significant differences between model combinations, the results show an increasing trend toward the end of the century for the different indicators in all cases. As in the case of EuroHEAT, the greatest difference between the RCPs 4.5 and RCP 8.5 scenarios begins mid-century.

[5] Details of municipalities by meteorological zone of the National Plan for the Prediction and Monitoring of Adverse Weather Events. Meteoalerta. (2025). AEMET. Available for consultation at: https://www.aemet.es/documentos/es/eltiempo/prediccion/avisos/plan_meteoalerta/detalle_municipios_zonas_meteorologicas.pdf

[6] National plan for preventive actions against the effects of excessive temperatures on health (2025). Ministry of Health.

2.3.2.2 Risk assessment

The CLIMAAX Handbook proposes two options for assessing heat wave risk: one based on the use of satellite-derived data to identify urban heat islands, and another based on calculating the relative change in heat wave occurrence under climate change.

- **Satellite-derived Data**

First, satellite-derived data analysis allows us to answer two key questions: which areas of the municipality are most at risk, and who or what is at risk. Since this methodology works with historical data (satellite and population estimates) and does not use projections, the CLIMAAX Handbook recommends exploring the information provided by Climate-ADAPT on the future occurrence of hot days to contrast the influence of climate change. The results of this exploration are provided in the Supporting Documentation (Figure S-12). As can be seen, the hot day anomaly graph broadly coincides with Figure S-9 from AEMET (Supporting Documentation), while the upward trend in apparent temperature heatwave days is consistent with the results of the hazard analysis performed in this Workflow.

Land surface temperature data were manually downloaded from the RSLab Portal[7], using Landsat8 images with NDVI-based emissivity (with a resolution of 30x30m) for the months of June, July, and August 2022 to 2024, which have been particularly warm in the municipality. The area comprising the urban center of Quart de Poblet was delimited, also including the residential area of the Cristo neighborhood, as these are areas where the most vulnerable population may be concentrated. Following the methodology, the mean values of those raster bands that are not significantly influenced by clouds are calculated to obtain a scatter plot of the data. Furthermore, the maximum values are reclassified into 10 classes to generate a map of overheated areas in the study area (Supporting Documentation, Figure S-13). Considering that the maximum values obtained were between 41.6 and 54.8 ºC, the defined classes correspond to Very Low (< 42-43 ºC), Low (43-45 ºC), Medium (45-47 ºC), High (47-49 ºC), and Very High (49-50 < ºC). The resulting map shows medium values for residential areas and very high values for industrial areas, due to the urban heat island effect. The lowest values correspond to the Turia River natural area.

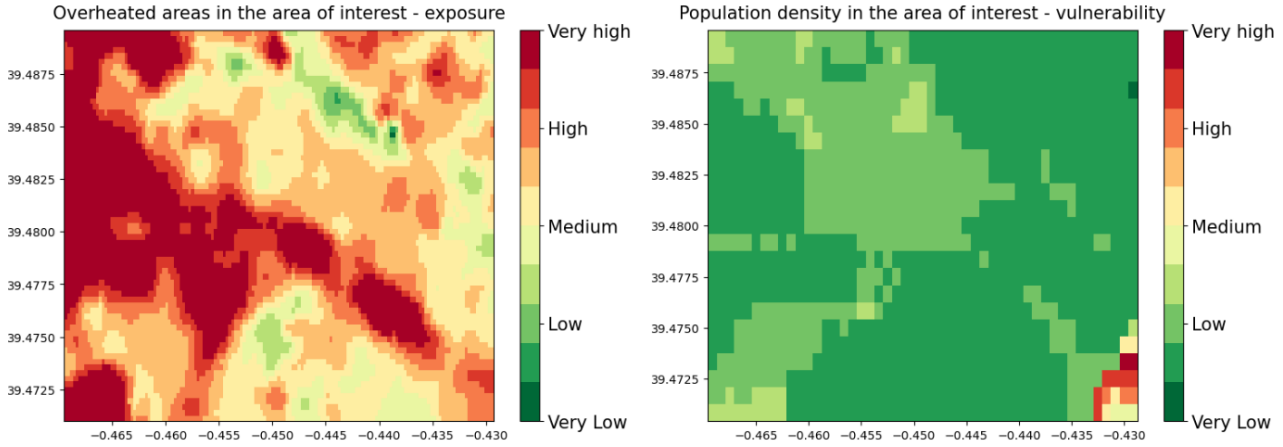

Figure 2 - 6 Representation of exposure and vulnerability variables: overheated areas and distribution of the vulnerable population in the study area.

[7] https://rslab.gr/Landsat_LST.html

Next, the population data provided by Worldpop Hub was processed. Maps for vulnerable population groups (1-5 years old and over 65 years old) were downloaded. The datasets were processed to total the number of vulnerable population per pixel, and reclassified into 10 classes comprising 5 categories (Very Low to Very High). This resulted in a vulnerable population density map (Figure 2-6), which shows low to very low values for the area of interest.

Finally, the exposure and vulnerability data were combined to form the risk map (Figure 2-7, below). The classification of the temperature and population density data into 10 groups allows for the generation of a map based on a 10+10 risk matrix. A vector information layer was also included to locate buildings and public areas that may be considered vulnerable based on their users (daycare centers, schools, health centers, sports centers, residences, squares and parks). The map presents a low-medium risk for the urban core and the Cristo neighborhood, while the industrial areas (P.I. Nou d'Octubre, P.I. Masia d'Espí) present a medium-high risk. The area with the lowest risk corresponds to the Turia River natural area. Thus, this methodology has made it possible to identify areas susceptible to extreme heat, which may require intervention to improve adaptation to climate change. It is important to consider this information alongside the results of climate projections, which show significant upward trends in the occurrence of heatwaves in the future, as well as paying attention to population projections, which show an increase in the elderly population, a vulnerable group.

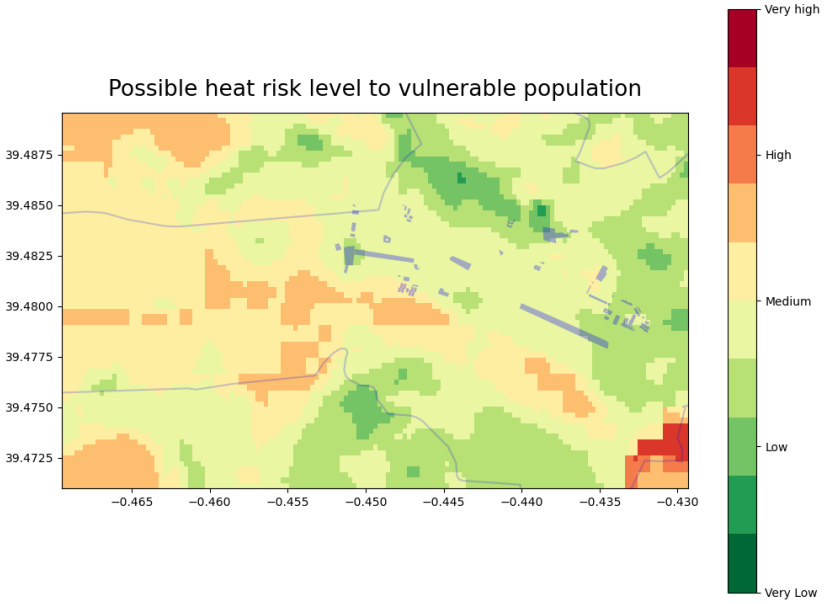

Figure 2 - 7 Heatwave risk map focusing on residential areas of Quart de Poblet.

To determine which zones could be prioritized beyond the residential areas, this methodology was also used to observe the results across the entire municipal area. As expected, the most overheated areas correspond to industrial estates (concentrated around the A-3 highway), due to the urban heat island effect. This area is not considered to have a vulnerable population (aged <5 or >65), but there is a large number of working people who may suffer the effects of extreme heat. The maps related to this analysis can be seen in the Supporting Documentation (Figures S-14 and S-15).

- **Climate Projections**

This methodology uses a regional approach, therefore the risk of Quart de Poblet was analyzed within the context of all municipalities in the province of Valencia. Considering that the provincial scale has its own administrative level, which also impacts decision-making for the implementation of climate change mitigation and adaptation strategies and actions, this perspective was considered beneficial.

Risk assessment using this methodology combines hazard variables (EuroHEAT heatwave days) and vulnerability variables (Worldpop Hub) for the current and projected climate under RCPs 4.5

and 8.5 scenarios. As a result, the risk maps show the municipalities most affected by the projected potential increase in heatwave occurrence in the near future (2016-2045) and distant future (2046-2075), and by the concentration of vulnerable population groups.

Following this methodology, the mean temperature data was calculated for each of the selected periods (historical, near future, and distant future). For future scenarios, the relative change with respect to historical data (1976–2015) was calculated, as well as the magnitude of change, which consists of a reclassification of the relative change data into 10 equal class intervals (1 = very low change, 10 = very high change). The results are shown in a series of maps (Supporting Documentation: Figures S-16 and S-17), with the greatest magnitude of change being that expected for the distant future of the RCP 8.5 scenario. From the Worldpop Hub population data, the vulnerable population (<5 years and >65 years) was selected, summing their values on the grid. The mean for each municipality was then calculated (zonal statistics) and the results were classified into 10 equal intervals. In this step, a map was obtained showing the concentration of vulnerable groups by municipality for the province of Valencia (Supporting Documentation: Figure S-18), where the capital (Valencia) and some of the municipalities in its metropolitan area are those with the highest density.

Finally, the reclassification of hazard and vulnerability data into 10 class intervals allowed the application of a 10+10 matrix to calculate risk. The results are shown in the maps below (Figure 2-8, below). Under RCP 4.5, the relative change in risk ranges from very low-low (2016-2045) to medium-low (2046-2075) as the century progresses. The metropolitan area of Valencia stands out, as it is the most populated area in the province. Under RCP 8.5, a greater number of municipalities are affected by the relative change in risk. For the distant future, the high magnitude of change expected for the central and southern areas of the province results in greater localized risk in these areas. Specifically for Quart de Poblet, the risk level is set as very low (near future) and low (distant future) in the RCP 4.5 scenario, and as low (near future) and medium (distant future) in the RCP 8.5 scenario, within the context of the province.

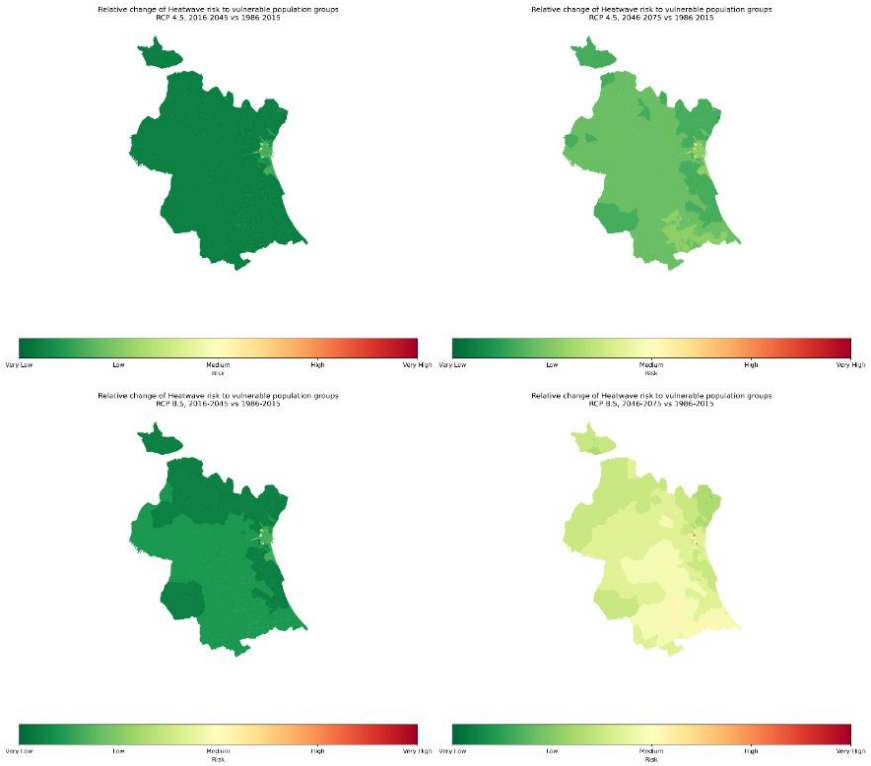

Figure 2 - 8 Relative change in heatwave risk for the vulnerable population in RCP 4.5 and 8.5 scenarios compared to the historical baseline (1986-2015), province of Valencia.

2.4 Preliminary Key Risk Assessment Findings

The analysis carried out using the CLIMAAX Workflows has produced results that provide quantitative information regarding climate risks and their impacts. Based on this information, the risks considered for Quart de Poblet within the project were assessed in terms of severity, urgency, and capacity to cope and adapt. This assessment was conducted through a participatory workshop with City Council stakeholders involved in the project, with the participation of the Departments of the Environment, Local Police, and Senior Citizens.

The results of this participatory exercise are shown in the following table (Table 2-3). The severity, urgency, and capacity aspects considered in assessing the risks are then discussed individually.

Table 2 - 3 Assessment of key risks based on severity, urgency, and manageability. Source: CLIMAAX Handbook.

	Severity		*Urgency*	*Capacity*	*Risk Priority*
	Current	*Future*		*Climate risk management - Resilience*	
River flooding					High
Heatwaves					Very high

Severity	Urgency	Resilience Capacity	Risk Ranking
Critical	Immediate action needed	High	Very high
Substantial	More action needed	Substantial	High
Moderate	Watching brief	Medium	Moderate
Limited	No action needed	Low	Low

2.4.1 Severity

River flooding risk:

- It is associated with the Turia River and the Poyo ravine. For the 500-year return period, depths of 7.39 m are observed in some parts of the Turia, and 3.76 m in Poyo.
- According to modeling, the Turia River's flooding is occurring northward, following its former course. Other ravines and irrigation ditches are also affected in the municipality of Paterna. Thus, the urban area bordering the river is affected to a lesser extent.
- The overflow of the Poyo ravine affects the Valencia 2000 industrial area, strategic facilities such as the municipal Wastewater treatment plant and the Metropolitan waste treatment plant, as well as cultivated areas, especially fruit trees (citrus).
- Climate change projections are inconclusive but suggest the possibility of a reduction in the flood depth of the Turia River.

Heatwaves risk:

- Heat wave projections show an increase in extremely hot days, frequency, and duration of heatwaves.
- There are overheated areas in the municipality affected by the urban heat island effect, including the urban center and, especially, industrial areas, which account for approximately 17% of the municipal area[8].

[8] According to data from the Valencian Institute of Statistics (IVE) and the Valencian Institute of Business Competitiveness (IVACE).

- The risk analysis for the vulnerable population yields results that appear inappropriate for Quart de Poblet and its neighboring municipalities, as very unequal density values are assigned between municipalities that share a similar population structure.

2.4.2 Urgency

Regarding **river flooding**, it was observed that the different return periods showed few differences between them. Furthermore, risk projections under climate change do not show great variation between climate scenarios (RCP 4.5 and RCP 8.5) or between time horizons (2030, 2050, and 2080). The greatest difference occurs in RCP 8.5 for the year 2080, due to a reduction in the expected flood depth. In this case, the analysis of current hazard needs to be improved by incorporating local data. Furthermore, it is worth considering the regional scientific literature, since works such as that of Camarasa *et al*. (2020) have shown a growing trend toward increased intensity of rainfall episodes in recent decades, which has a direct impact on flooding, especially in ephemeral streams (ravines). Therefore, for the second phase of project development, the possibility of also assessing the risk of heavy rainfall will be studied, given its effect on runoff from the municipality's ravines.

In respect of heatwaves, climate projections indicate their greatest change starting mid-century, that is, in the medium term, and their most significant impact will occur toward the end of the century, with a progressive rise in temperatures. However, the effects of these increases in extreme temperatures, intensity, and duration of heatwaves are already being experienced, so action is needed as soon as possible to minimize potential damage.

2.4.3 Capacity

The climate risk management measures currently implemented include:

Natural: The NaTURTURia Project, for environmental and hydromorphological restoration of the natural section of the Turia River as it passes through Quart de Poblet, aims to mitigate the impacts of climate change and improve the resilience of the natural environment.

Physical: Regarding flood risk, the structural diversion of the Turia River channel (Plan Sur de Valencia, 1965-1973), which begins in the municipality of Quart de Poblet, is key, as it gives the last stretch of the river a drainage capacity of approximately 4.300 m^3. There is a project yet to be implemented to reduce risk in the Poyo ravine, which is under the jurisdiction of the Júcar Hydrographic Confederation (basin authority) and the Ministry of the Environment. The risk is also monitored through a network of rainfall and flow sensors (Automatic Hydrological Information System, CHJ) and is prevented through riverbed cleaning and maintenance. Furthermore, to reduce the impact of heatwaves on the elderly population, the Municipal Senior Living Center is used as a climate shelter.

Social-institutional: Local planning for flood risk management (Municipal Territorial Emergency Plan, Municipal Flood Risk Action Plan, Municipal Prevention Plan for the Risk of Heavy Rainfall) and regional planning for heatwave risk management (Program for the prevention and response to health problems arising from high temperatures in the Valencian Community), in addition to warnings to the population by the City Council when temperature alert levels are reached.

Opportunities to reduce and manage risk include:

Financial: There are funding opportunities at the European, national, and regional levels to support flood risk prevention measures (river restoration or renaturation projects, riverbed clearance,

implementation of sustainable drainage systems, etc.); as well as funds to promote environmental conservation, energy efficiency, and building renovation, which can help combat the effects of heatwaves.

Physical: The ability to act at the physical level is determined by the City Council's financial capacity and its administrative powers over other institutions such as the CHJ, which determines what actions can be taken on rivers.

Social-institutional: Work can be done to improve social perception of risks through reliable and understandable information; strengthen collaboration between the City Council, academic groups, and civil society; promote community resilience and governance in decision-making regarding the impacts of climate change; and even developing new plans for risk management (Local Action Plan for High Temperatures).

2.5 Preliminary Monitoring and Evaluation

The first phase of the CLIMAAX project, developed by the QCATI team, has provided **valuable insights** into flood and heatwave risks in Quart de Poblet, by running the Workflows with data provided by the Handbook.

First, the **CLIMAAX Workflows' functionality** for conducting risk analysis incorporating various hazard, exposure, and vulnerability variables has been demonstrated. The visual outputs obtained facilitate understanding and communication of information to stakeholders and the general public.

However, the lessons learned also highlight the **limitations of certain databases** used, which have served as a framework for an introduction to risk assessment, but will need to be improved in the next phase of the project to obtain results better adapted to local realities.

Using the River Floods Workflow, it has been found that the datasets used to incorporate hazard data are insufficient. The JRC dataset does not include the municipality's smallest watersheds (Saleta and Gallego ravines), and Aqueduct Floods only provides very coarse-grained information for the Turia River.

Using the Heatwaves Workflow, analysis using Worldpop Hub shows that this dataset is poorly suited to representing the reality of Quart de Poblet, as it presents some inconsistencies. The maps show exacerbated inequality between Quart de Poblet and its neighboring municipalities (Mislata, Xirivella). However, a consultation of official Census statistics (INE, 2024) shows that the difference in population values for vulnerable groups is, in fact, small.

The results obtained were presented to stakeholders during a participatory workshop at City Hall, during which the risk assessment table (Table 2-3) was completed. Those involved emphasized the importance of obtaining and working with more precise information in terms of spatial resolution, which more validly and reliably reflects the local reality. They also considered it beneficial to incorporate new stakeholders during the second phase of work to broaden their perspectives, concerns, and needs, and to identify other possible sources of data, such us local associations and civil society organisations from Quart de Poblet, and also amplifying the scope of the project to the research and academia field. They also considered it beneficial to carry out specific communication and awareness-raising efforts aimed at vulnerable groups such as the elderly, to develop a climate risk awareness communication outputs adapted to vulnerable people. Hence, **next steps regarding stakeholders' engagement** will be planned for Phase 2 as follows:

- Local associations and organisations such as the Limne Foundation, Equartlogistes, Quart es Ciencia and the Municipal Environmental Council will be invited to a meeting. The aim is to present the project and encourage civil society groups to lead adaptation and resilience initiatives in their respective areas of influence.
- A specific event will be organised for elderly people over 65 in the municipality to raise awareness among vulnerable population in Quart de Poblet. During the event, they will be provided with information about their vulnerability to floods and heat waves and taught prevention measures to protect themselves from these risks.
- A commemorative event will be held on the anniversary of the DANA bringing together key players in climate resilience. This event will bring together various mapped stakeholders, such as representatives from other municipalities, universities and research centres, to share the results of the project and encourage collaboration in the field of climate resilience.

To **improve the risk assessment process** in the next work phase, the possibility of incorporating new datasets is proposed, such as:

- Official digital mapping of river flood hazards in Spain (SNCZI, for 10-, 100-, and 500-year return periods).
- Mapping of the extent and depth of flooding that occurred during the 2024 DANA (prepared and provided by the ICV).
- Updated land-use mapping (prepared and provided by the ICV).
- Regionalized gridded climate projections, developed using ensembles by AEMET and the CSIC for maximum temperature and maximum duration of heatwaves, for different scenarios (SSP2-4.5 and SSP5-8.5).
- Actual demographic data of the vulnerable population, from the 2021 Population and Housing Census (translated into geotiff by Eurostat Census Grid), data from the Annual Population Census (INE, 2024), and, if possible, data disaggregated by neighborhood or block from the Municipal Population Register.

For the Phase 2 of the project, the possibility of assessing the risk of heavy rainfall using the Heavy Rainfall Workflow will also be considered, given its effect on flooding in the municipality.

3 Conclusions Phase 1- Climate risk assessment

The Climate Risk Assessment carried out during the first phase of the QCATI project involved the execution of two CLIMAAX workflows: river flooding and heatwaves. These workflows were developed using the available data provided by the CLIMAAX framework. This report presents the processes implemented and the results obtained.

As demonstrated, vulnerable areas in the municipality to flood risk have been identified, and damage levels have been calculated based on land use and return periods. A future risk trend has been identified for the Turia River, although not for the rest of the municipality's watersheds.

For the heatwave risk assessment, it is concluded that this is an increasing risk under climate change, with increasing frequency and duration, as demonstrated by the EuroHEAT project and various GCM-RCM combinations. Using satellite-derived imagery, the most overheated areas of the municipality due to the urban heat island effect have been identified. Also, the distribution of vulnerable population groups has been determined.

These risks have been assessed by the stakeholders involved in the project, taking into account the results obtained and local knowledge, based on their severity, urgency, and resilience.

The key findings that will guide the next phase of work are:

1. Regarding river flooding:

- Hazard maps show floodable areas for different return periods (10, 100, and 500 years). Not all basins are included in the analysis due to the characteristics of the dataset.
- Flood extent and depth increase with the RP, which influences the damage generated.
- The risk exposure of critical infrastructure and industries is confirmed.

2. Regarding heatwaves:

- The trend under climate change points to a clear increase in the occurrence of heatwaves, more pronounced in the high-emissions scenario RCP 8.5.
- The urban heat island effect is particularly noticeable in the urban center and especially in the municipality's industrial areas, increasing the risk.
- It is considered that there are problems with the data on the vulnerable population, so efforts will be made to improve the data used during the next phase of work.

3. Stakeholder Engagement:

- It is considered necessary to expand stakeholder engagement in the next phase of work to identify concerns, needs, ways to improve and recommendations, in addition to increasing risk perception, awareness, and acceptance of adaptation strategies.
- It is necessary to adress vulnerable groups, and to align QCATI impact with other initiatives and projects to generate positive sinergies in the field of climate risk analysis.

Unaddressed challenges include:

The impact of river flooding on vulnerable population groups has not been considered, as they have not been identified through available data or through local and stakeholder knowledge.

Heatwave risk has been assessed using a health-related (epidemiological) definition, but not the climatological definition offered by the State Meteorological Agency. This may be an option for the next phase of work, as it would be interesting to compare results.

Finally, considering the problems detected during the first phase of work, the following recommendations are proposed:

- Incorporating refined, high-resolution databases that address local specificities to improve sources of analysis on hazards, exposure, and vulnerability.
- Conducting a comparison of the results to assess the suitability of the new datasets used.
- Expanding and promoting stakeholder participation, also involving groups that make up Quart de Poblet's civil society. This includes groups that are part of the vulnerable population and local action groups that promote environmental awareness, science, the fight against climate change, etc.
- Strengthening resilience capacity through knowledge transfer, improving decision-making.
- Evaluating local risk prevention and management tools and providing input to improve local adaptation strategies and risk management plans.
- Implement a communication event to maximise the outreach and dissemination of the project to the whole region.

4 Progress evaluation and contribution to future phases

This section describes the progress made during Phase 1 of the QCATI project and its connection to subsequent work phases.

In this first phase, the methodology and tools provided by CLIMAAX for assessing river flood and heatwaves risks have been successfully implemented. The knowledge gained is essential for continuing in subsequent work phases. Furthermore, the results of the first phase provide a basis for incorporating the necessary improvements to refine the analysis at the local level.

Stakeholder engagement took place through two workshops. The first, held on May 30th, served to conduct risk scoping and stakeholder mapping, with the participation of the municipal departments of European Projects and Environment in collaboration with the consulting firm in charge of the project. The second workshop, held on July 21st, served to present the results of the First Phase and jointly assess the severity, urgency, and capacity to address the risk, along with representatives from the departments of Environment, Local Police, and Social Services. The future participation of new stakeholders was also discussed.

The results of the CRA and stakeholder engagement reflected in this report should guide the work carried out in subsequent phases by highlighting the identified needs. Thus, the next phase will focus on collecting and integrating higher-resolution data for analysis, adapting workflows as needed to improve the accuracy of the risk assessments and ensure more appropriate decision-making in risk preparedness and management.

The third phase of the project, meanwhile, will use the lessons learned from the CRA to determine which adaptation measures should be prioritized in Quart de Poblet, as they are considered most effective in addressing the challenges posed by climate change and its impact on risks.

Finally, to be mentioned, the QCATI project team had to activate the Recovery Plan, being necessary to make an adjustment in the date of the first deliverable, postponed to 30 September 2025, as well as a reduction in the number of risks to be analysed, from initially 3 risks, to only 2.

Table 4 - 1 Overview key performance indicators

Key performance indicators	*Progress*
Number of stakeholders involved in the activities of the project (at least 5: other municipalities, supramunicipal entities, local organisations, Universities, research centres, etc.)	Completed in phase 1, with at least we have 5 stakeholders mapped (University of Valencia and Polythecnic University of Valencia, municipality of Manises, municipality of Aldaia, municipality of Mislata and Mancomunidad Horta Sud). Then, we have involved 3 key areas from the municipality: local police and emergencies, environment and senior citizens.
Number of local and european data collection sources (at least 3 different sources)	At least 3 completed: Joint Research Centre, Aqueduct Floods, EuroHEAT and XCLIM (EURO-CORDEX), RSLab, Worldpop Hub, Climate-ADAPT. And then from Spain: AEMET and Ministry of Health
Number of complementary actions useful for the municipality climate	Not yet started, will start in Phase 3

Key performance indicators	*Progress*
plans (at least useful for two local mentioned policies, paragraph 3.1)	
Number of communication actions taken to share results with the stakeholders (at least 1 per project phase).	1 communication action succesfully completed in Phase 1: website implementation and presentation.
Number of publications and dissemination actions (at least 1 per month): social media publications, website, explanatory video. Correction: number of publications and dissemination actions in social media (1 per project month: total 22 publications). For reaching that amount of publications, we will ellaborate a dissemination plan where we will publicate on a scheduled basis the progress of the project (meetings, information about CLIMAAX, implementation of actions, good practices, etc.). On the other side, we will have dissemination actions (1 per month: website Phase 1; infographics Phase 2; Explanatory video Phase 3)	5 publication and dissemination actions in Phase 1 completed: kick off meeting, press release, 4 social media posts.
Number of articles in regional media mentioning the project: 2 press releases (minimum).	In Phase 1: one press release published.
Number of workflows successfully applien on Deliverable 1 (at least 2 workflows, to ensure flexibility but to obtain a full vision about the most important risks for Quart de Poblet)	2 workflows applied succesfully in D1: heatwades and floods.
Number of workflows successfully applien on Deliverable 2 (3 to ensure a full risk assessment and that all relevant hazards are addressed)	Not yet started (phase 2)

Table 4 - 2 Overview milestones

Milestones	*Progress*
M1: External services hired	Completed

Milestones	*Progress*
M2: Test of the workflow Phase 1 made	Completed
M3: Workflow Phase 2 successfully applied	Not yet
M4: Stakeholders meeting done	Completed
M5: Attend the CLIMAAX workshop held in Barcelona	Completed
M6: Correct Assessment of the Workflow Phase 3	Not yet
M7: Publication of the press releases (1 at Phase 1: beginning of the project; 1 at Phase 3: end of the project)	Completed publication of phase 1 press release
M8: Publication of graphic material (Phase 2)	Not yet
M9: Video Upload to the website (Phase 3)	Not yet
M10: Presentation of the results to policy and decision makers in the municipality of Quart the Poblet (Phase 3)	Not yet
M11: Attend the CLIMAAX workshop held in Brussels	Not yet

5 Supporting documentation

The results generated during this phase of the project include:

1. Main report.

2. Supporting documentation: a document that contains supplementary workflow material (visual outputs not included in the Main report) and Communication outputs.

6 References

Camarasa-Belmonte, A.M.; Soriano García, J. Flood risk assessment and mapping in peri-urban Mediterranean environments using hydrogeomorphology. Application to ephemeral streams in the Valencia region (eastern Spain). Landscape and Urban Planning 2012, 104, pp. 189-200. DOI: 10.1016/j.landurbplan.2011.10.009

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CLIMAAX
climate ready regions

Deliverable Phase 1 – Supporting Documentation

QCATI (Climate Adaptation Toolbox Implementation)

Spain, Quart de Poblet

Version 1.0 | August 2025

HORIZON-MISS-2021-CLIMA-02-01 - Development of climate change risk assessments in European regions and communities based on a transparent and harmonised Climate Risk Assessment approach

Funded by the European Union

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101093864. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Climate, Infrastructure and Environment Executive Agency (CINEA). Neither the European Union nor the granting authority can be held responsible for them.

Supporting Documentation

1. List of figures

2. List of tables

SPATIAL CONTEXTUALIZATION

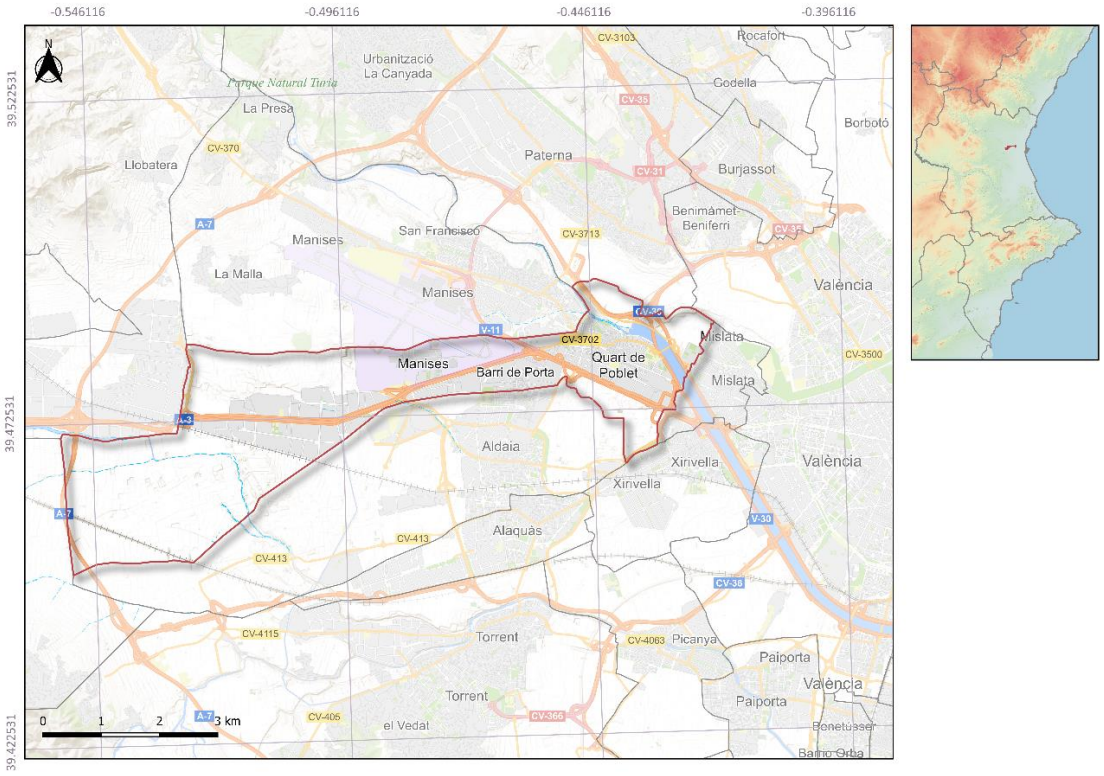


Figure S - 1 Location of Quart de Poblet in the Valencian region (Spain).

FLUVIAL FLOODS RISK ASSESSMENT RELATED

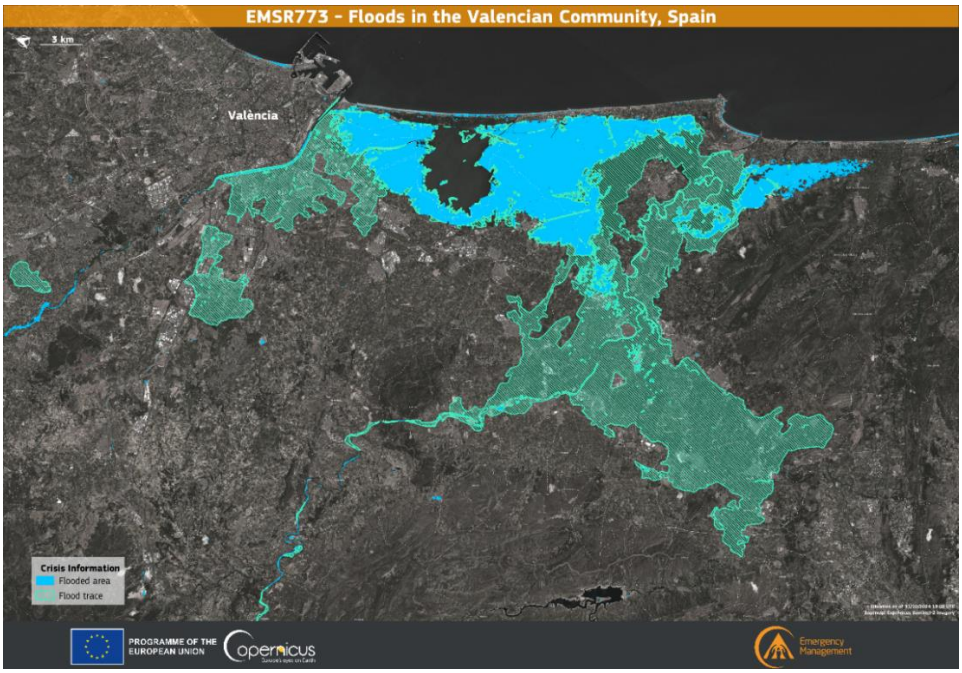


Figure S - 2 Flood trace and flooded area after the DANA event of 29th October 2024. Source: European Union, Copernicus Sentinel-2 imagery.

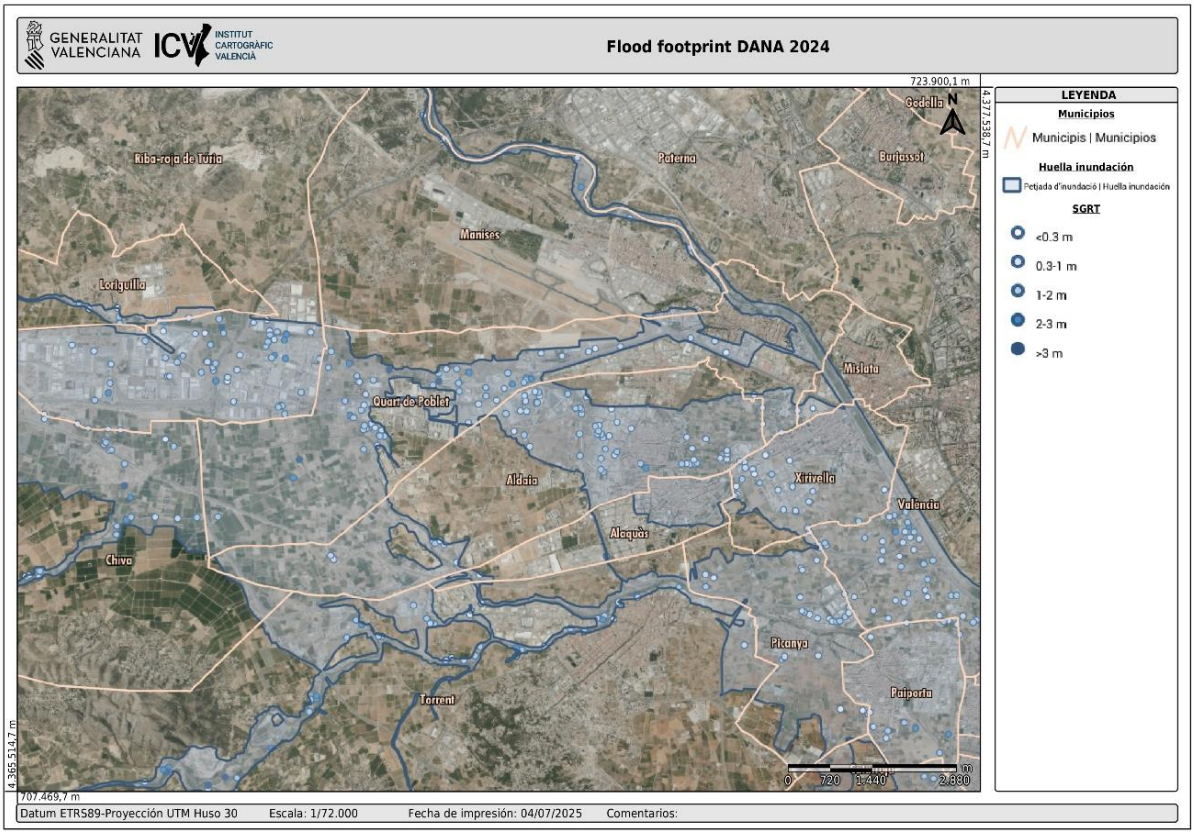


Figure S - 3 Flood footprint and observed depth after the DANA event of 29th October 2024 in Quart de Poblet. Source: Valencian Cartographic Institute (ICV).

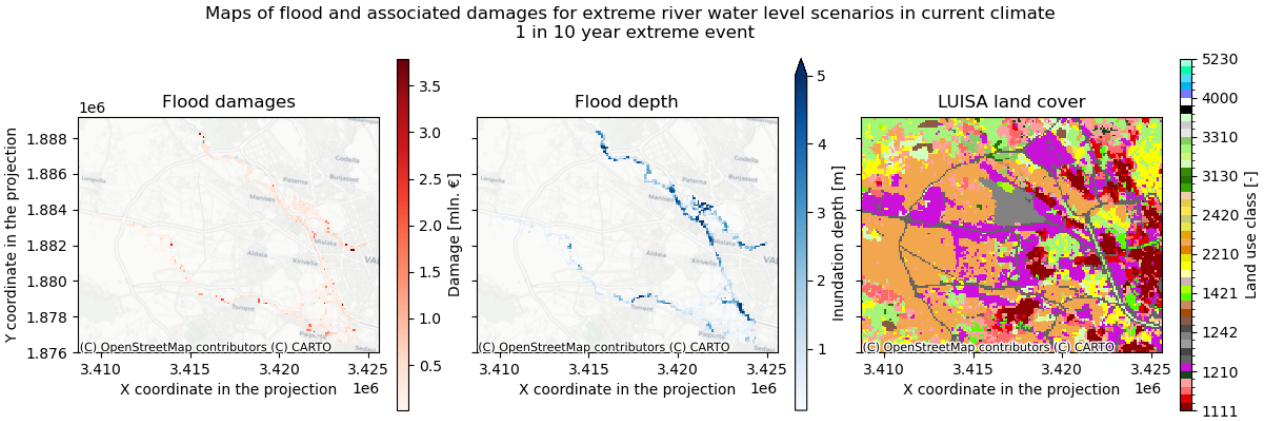


Figure S - 4 Flood damages in Quart de Poblet for a 10 year return period.

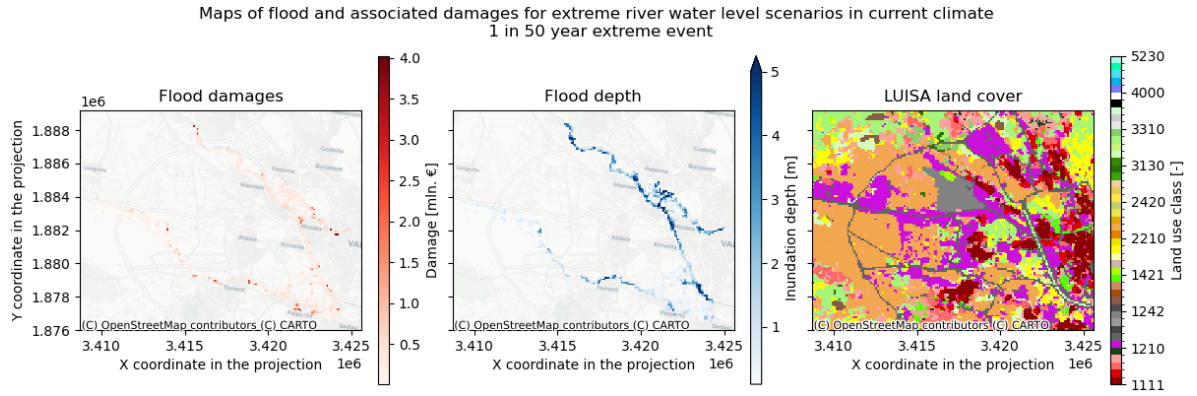


Figure S - 5 Flood damages in Quart de Poblet for a 50 year return period.

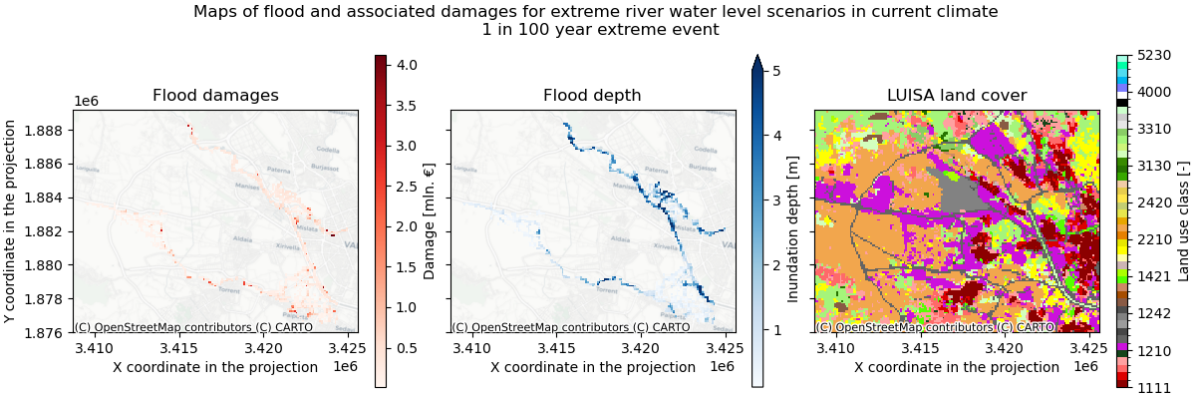


Figure S - 6 Flood damages in Quart de Poblet for a 100 year return period.

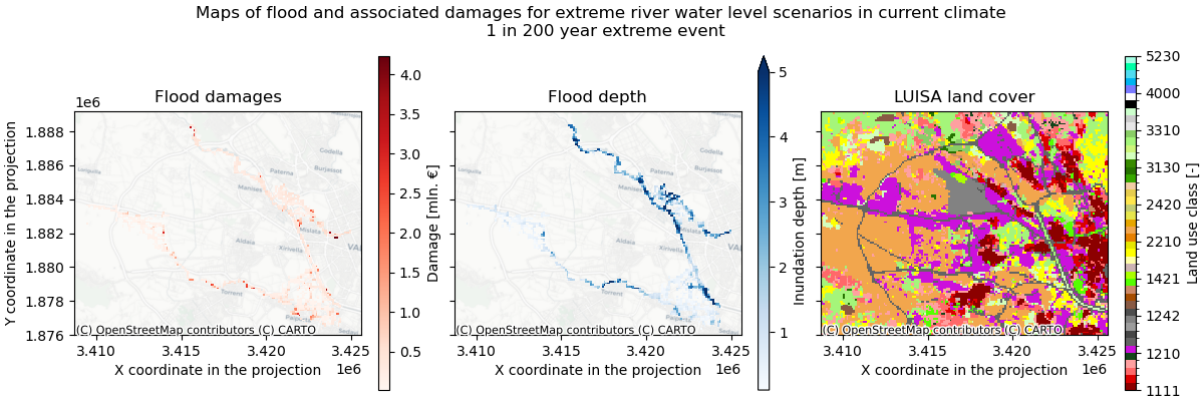


Figure S - 7 Flood damages in Quart de Poblet for a 200 year return period.

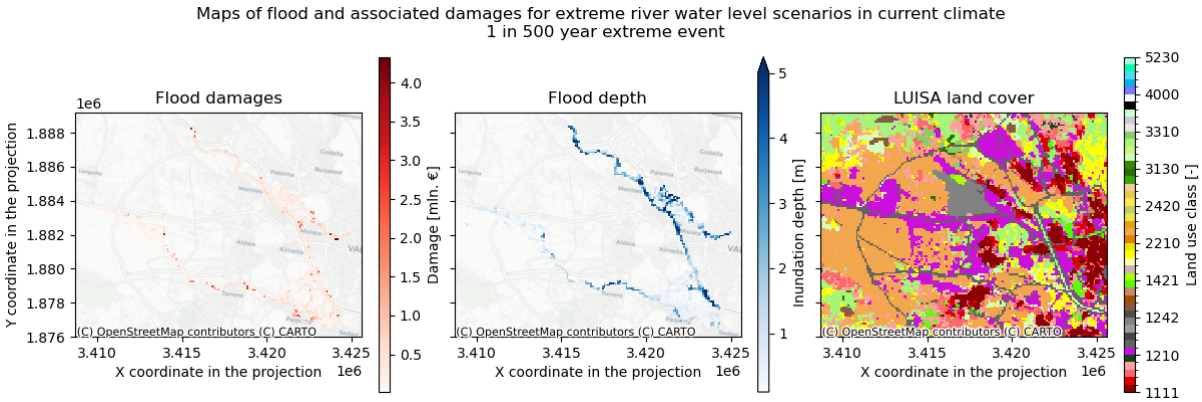


Figure S - 8 Flood damages in Quart de Poblet for a 500 year return period.

HEATWAVES RISK ASSESSMENT RELATED

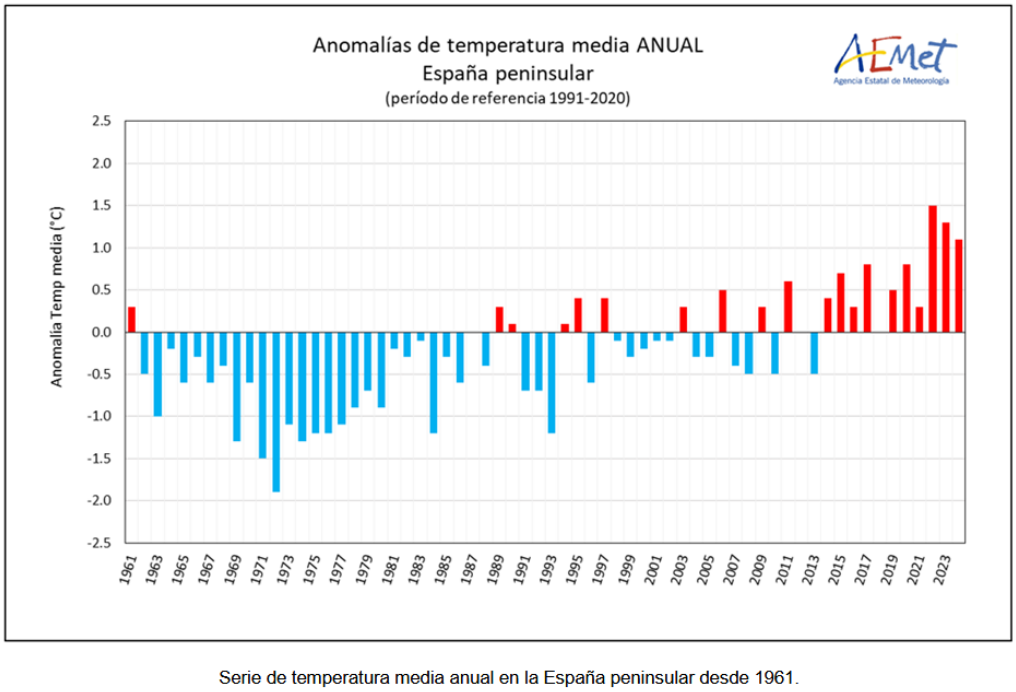


Figure S - 9 Average annual temperature anomalies for peninsular Spain (reference period 1991-2020). Source: AEMET.

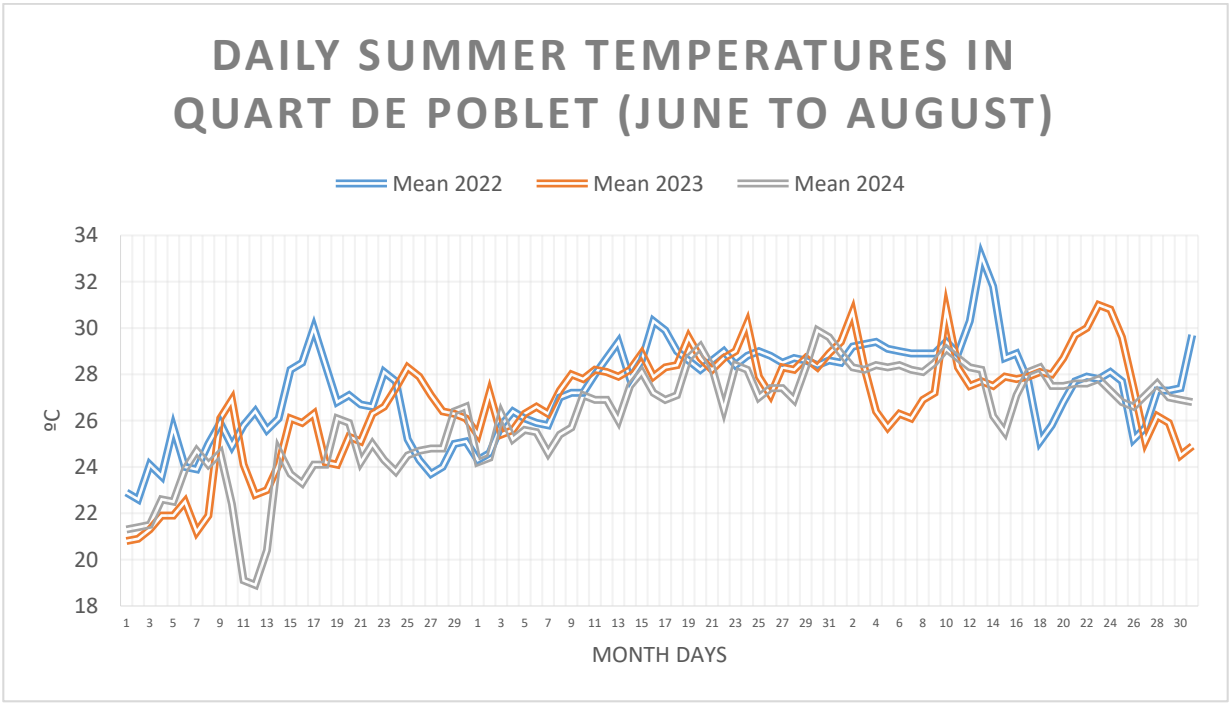
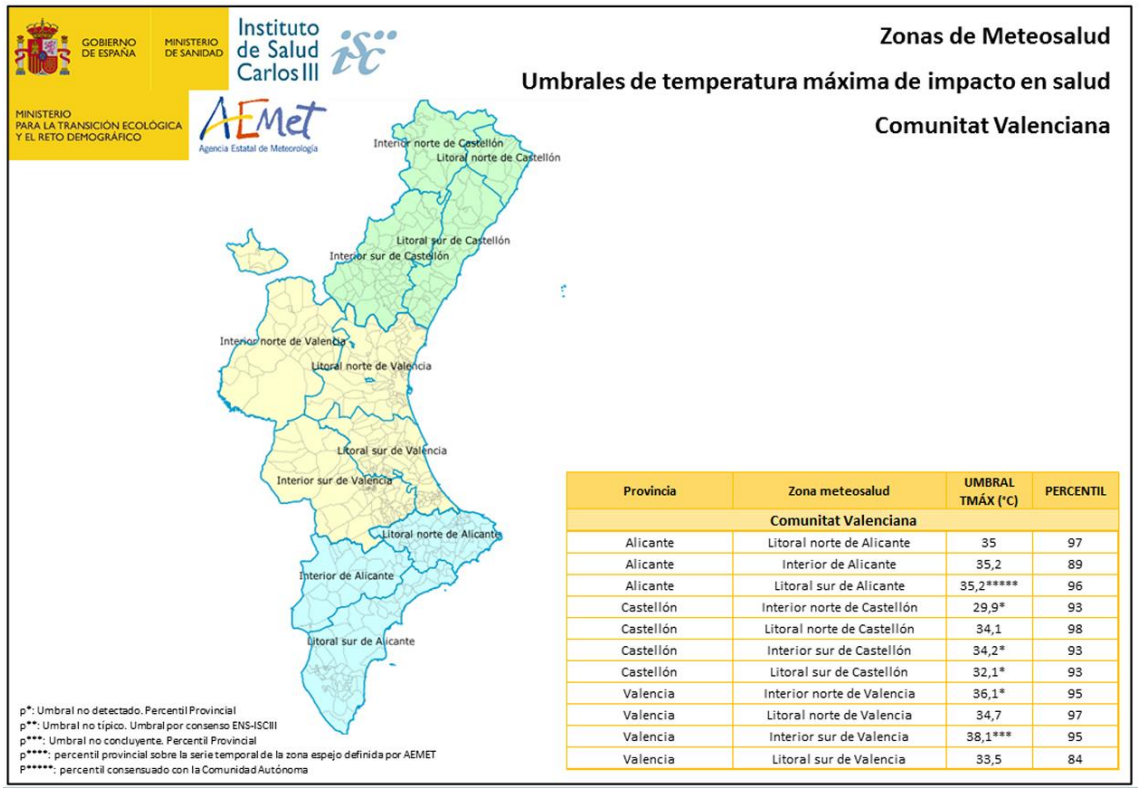


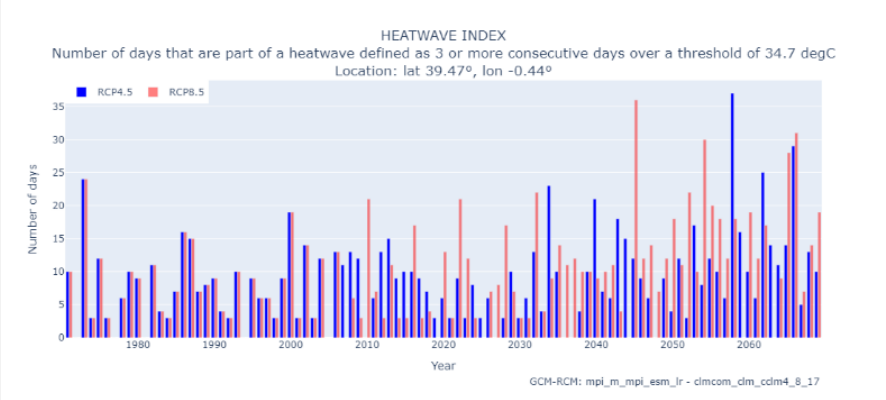
Figure S - 10 Daily mean temperature for the summer months in Quart the Poblet, years 2022 to 2024. Source: Prepared using data from Quart de Poblet wather station - Valencian Meteorological Association (AVAMET).

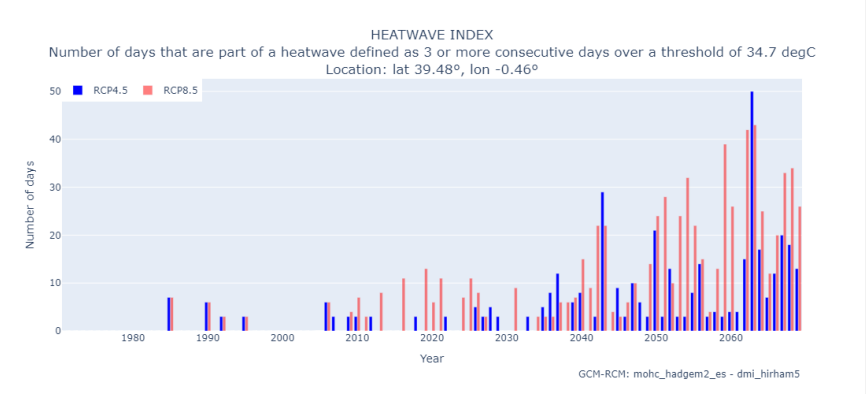
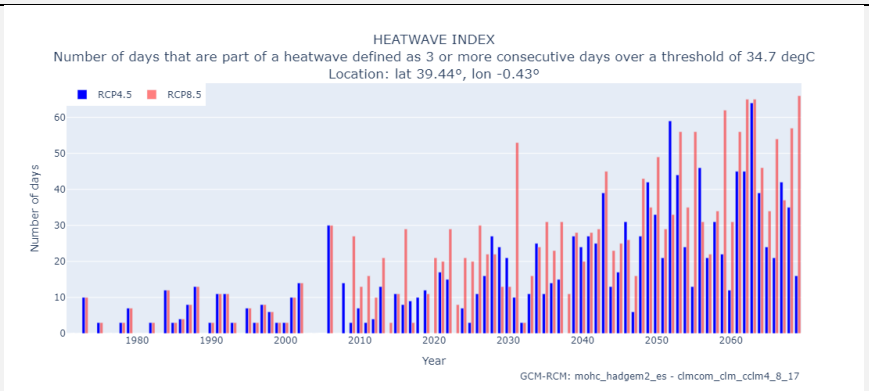
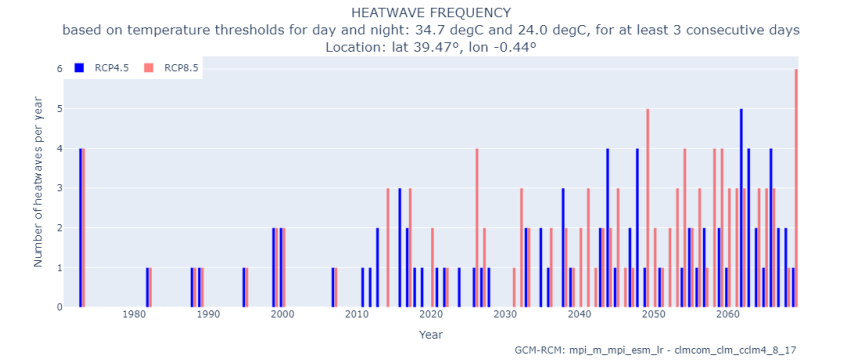
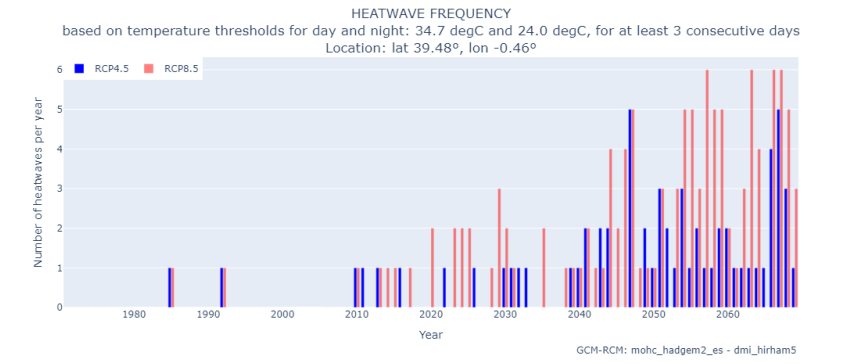


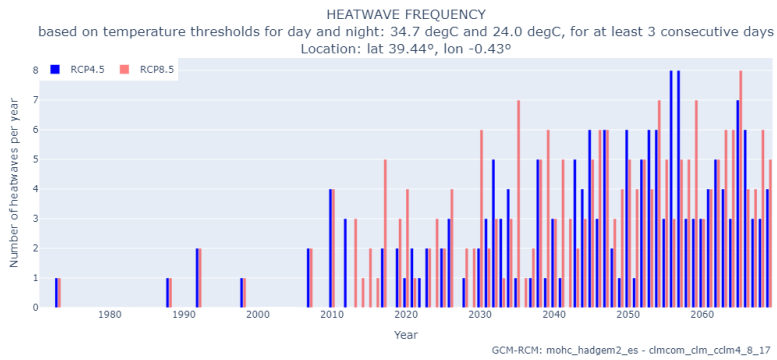
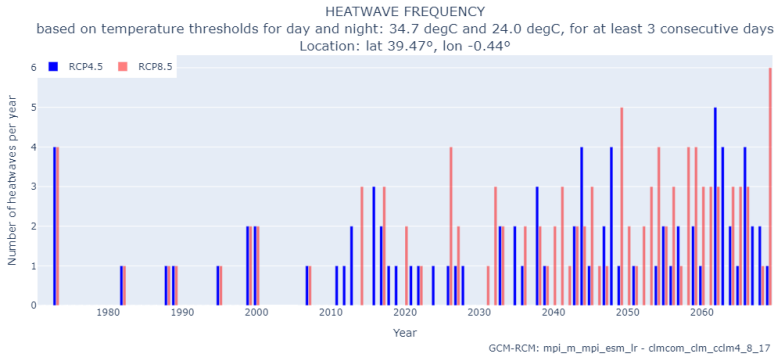
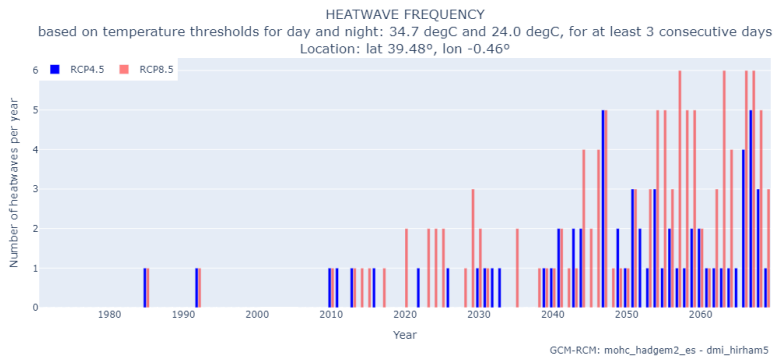
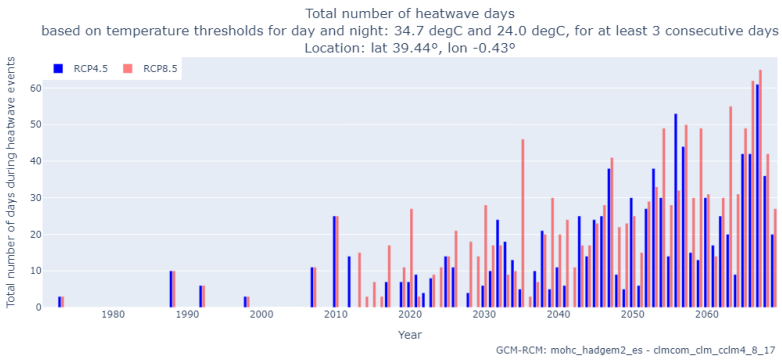
Provincia	Zona meteosalud	UMBRAL TMÁX (°C)	PERCENTIL
Comunitat Valenciana			
Alicante	Litoral norte de Alicante	35	97
Alicante	Interior de Alicante	35,2	89
Alicante	Litoral sur de Alicante	35,2*****	96
Castellón	Interior norte de Castellón	29,9*	93
Castellón	Litoral norte de Castellón	34,1	98
Castellón	Interior sur de Castellón	34,2*	93
Castellón	Litoral sur de Castellón	32,1*	93
Valencia	Interior norte de Valencia	36,1*	95
Valencia	Litoral norte de Valencia	34,7	97
Valencia	Interior sur de Valencia	38,1***	95
Valencia	Litoral sur de Valencia	33,5	84

Figure S - 11 Maximum temperature threshold impacting health by zone in the Valencian Community. Source: National Plan for preventive actions to respond to the health effects of excessive temperatures (2025). Ministry of Health, Carlos III Health Institute and AEMET.

Table S - 1 Comparison of results obtained under XCLIM methodology for heatwaves hazard assessment.

COMPARISON OF RESULTS OBTAINED WITH DIFFERENT GCM-RCM COMBINATIONS	
Combinations used: mpi_m_mpi_esm_lr - clmcom_clm_cclm4_8_17 mohc_hadgem2_es - dmi_hirham5 mohc_hadgem2_es - clmcom_clm_cclm4_8_17	
Heatwave index	

COMPARISON OF RESULTS OBTAINED WITH DIFFERENT GCM-RCM COMBINATIONS	
	
	
Heatwave frequency	
	

COMPARISON OF RESULTS OBTAINED WITH DIFFERENT GCM-RCM COMBINATIONS	
Heatwave total lenght	
	
	
	

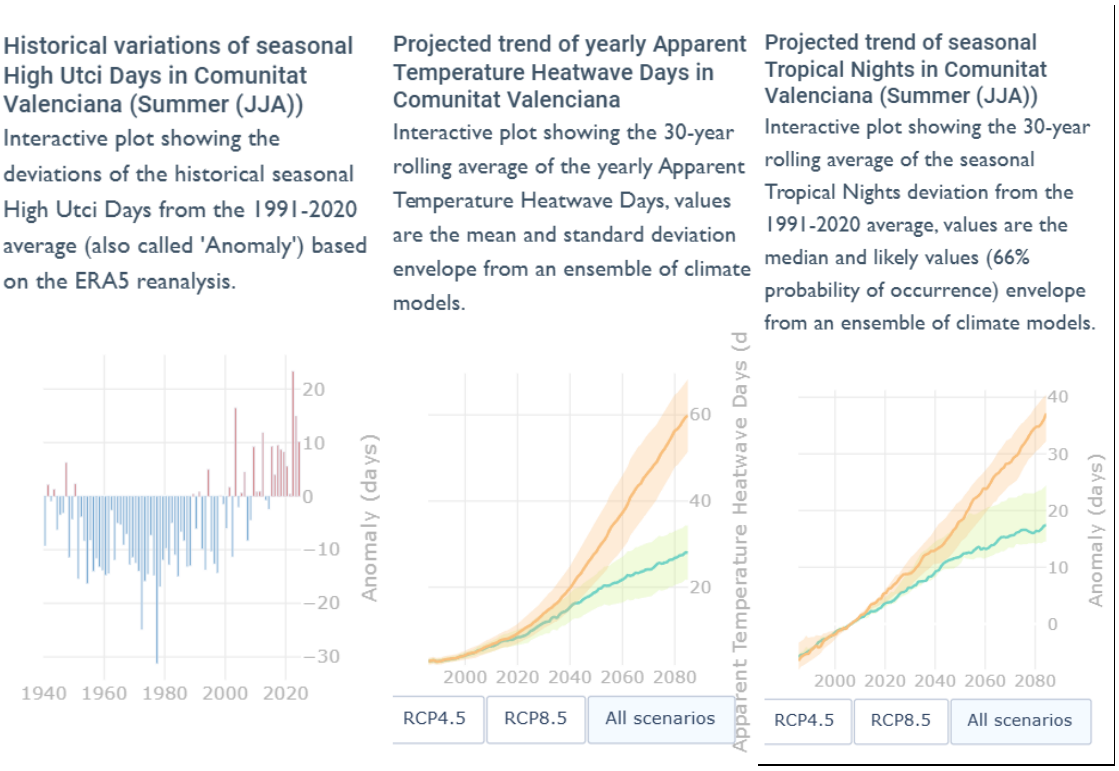


Figure S - 12 Exploration of the Climate-ADAPT data (Copernicus Climate Change Service, ECMWF) for heat days occurrence in the past and projections on apparent temperature heatwave days and tropical nights in the Valencian Community.

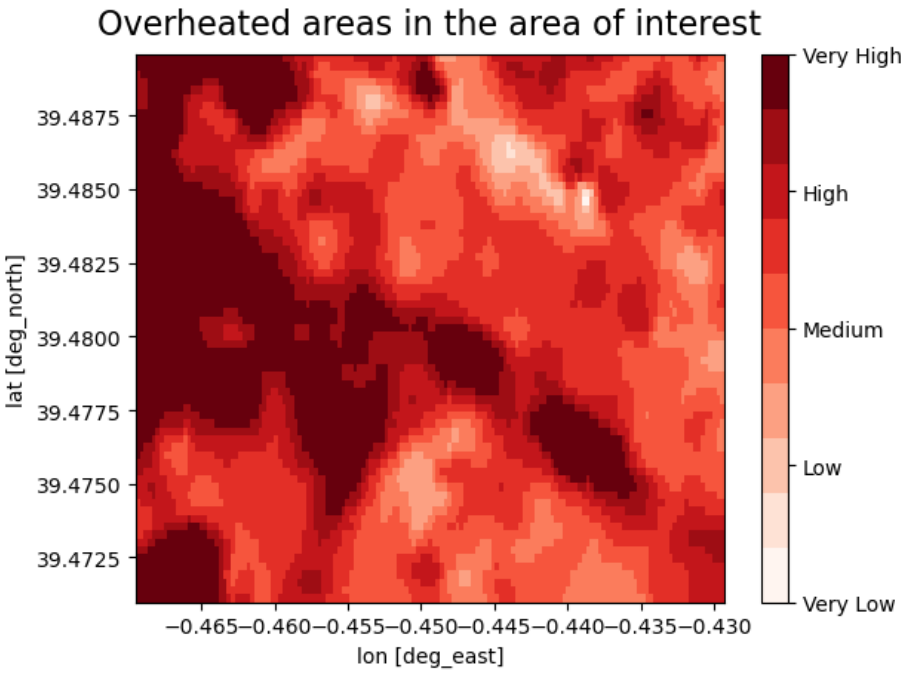


Figure S - 13 Overheated areas in the residential spaces of Quart de Poblet.

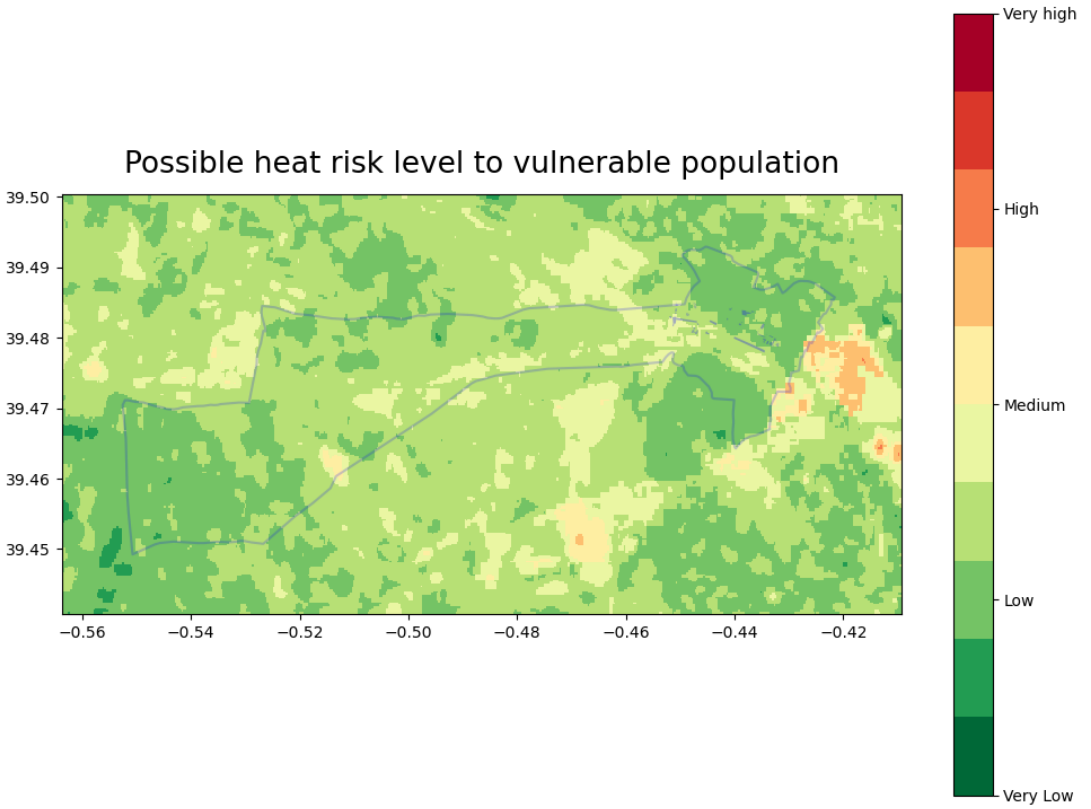


Figure S - 14 Result for the satellite-derived data methodology applied to the municipal territory of Quart de Poblet.

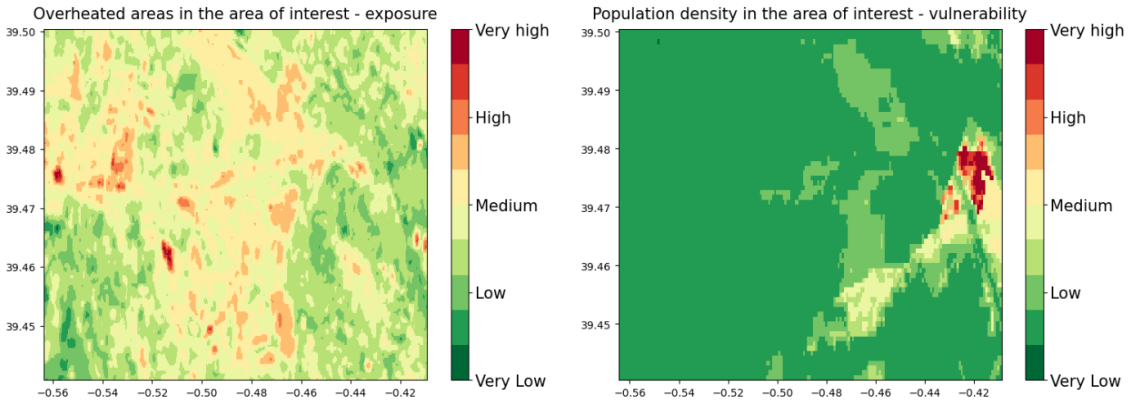


Figure S - 15 Overheated areas and vulnerable population distribution in the municipal territory of Quart de Poblet.

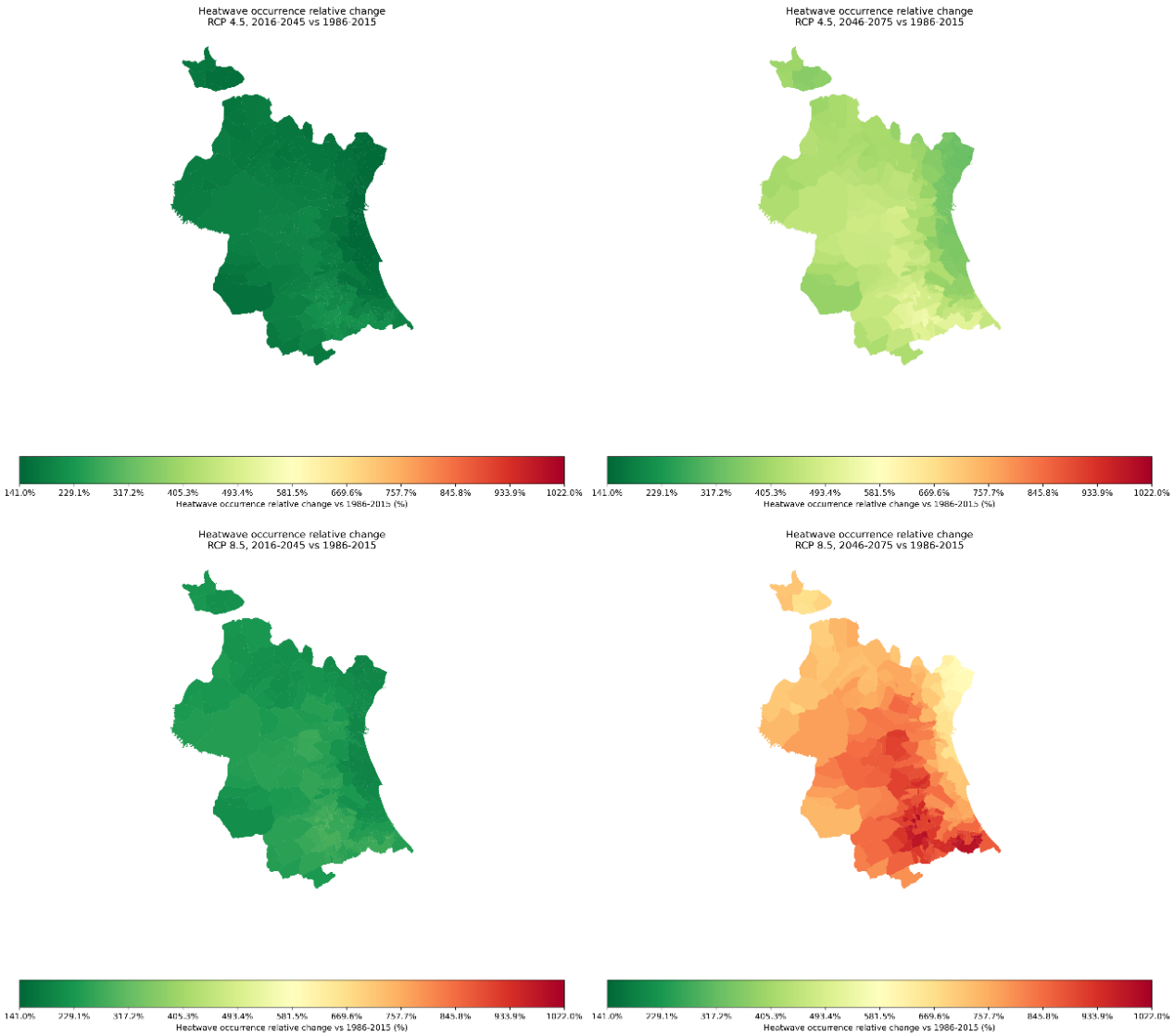


Figure S - 16 Heatwave occurrence relative change versus baseline scenario (1986-2015), for scenarios RCP 4.5 and RCP 8.5, time periods 2016-2045 and 2046-2075, Valencia province.

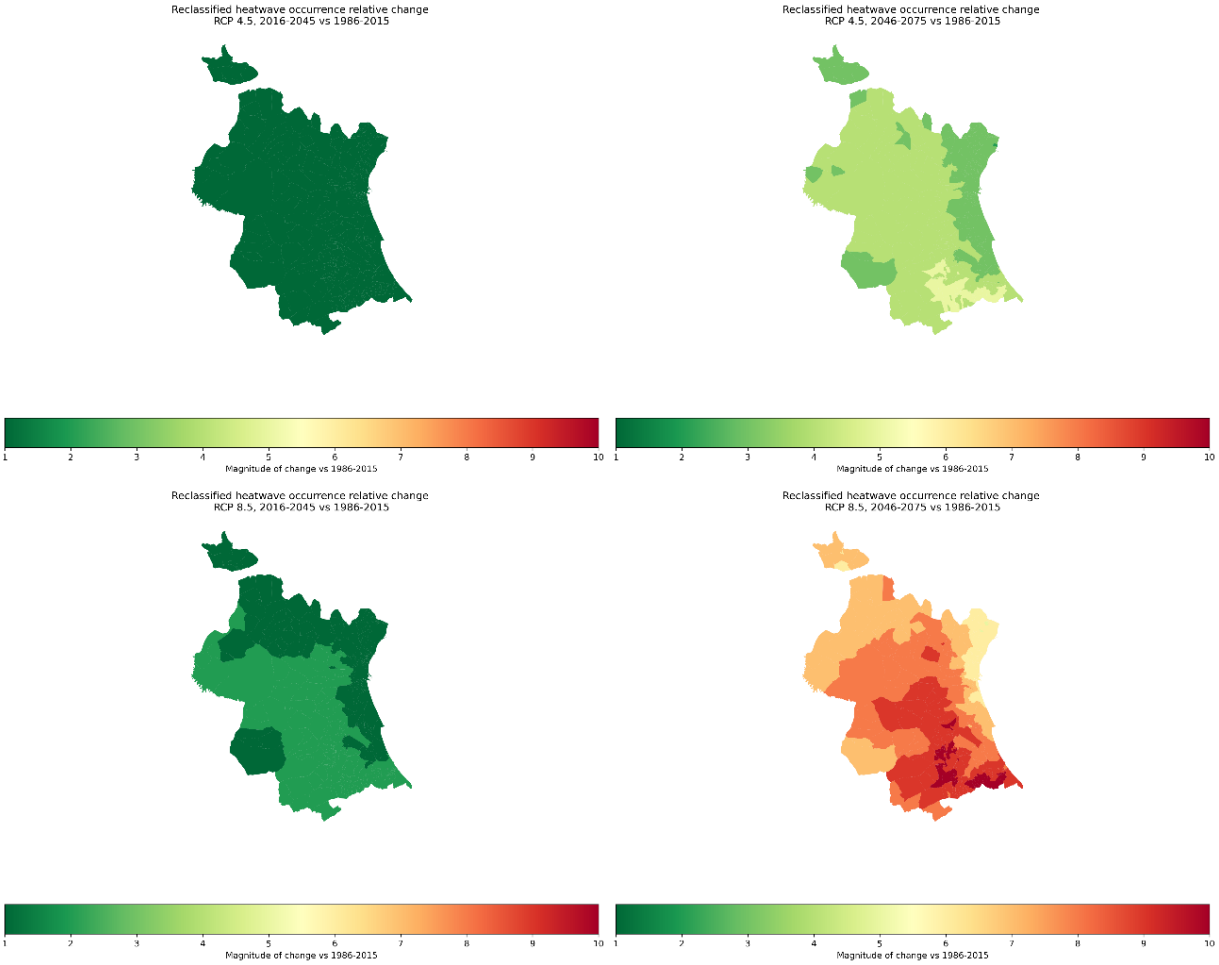


Figure S - 17 Heatwave magnitude of change versus baseline scenario (1986-2015), for scenarios RCP 4.5 and RCP 8.5, time periods 2016-2045 and 2046-2075, Valencia province.

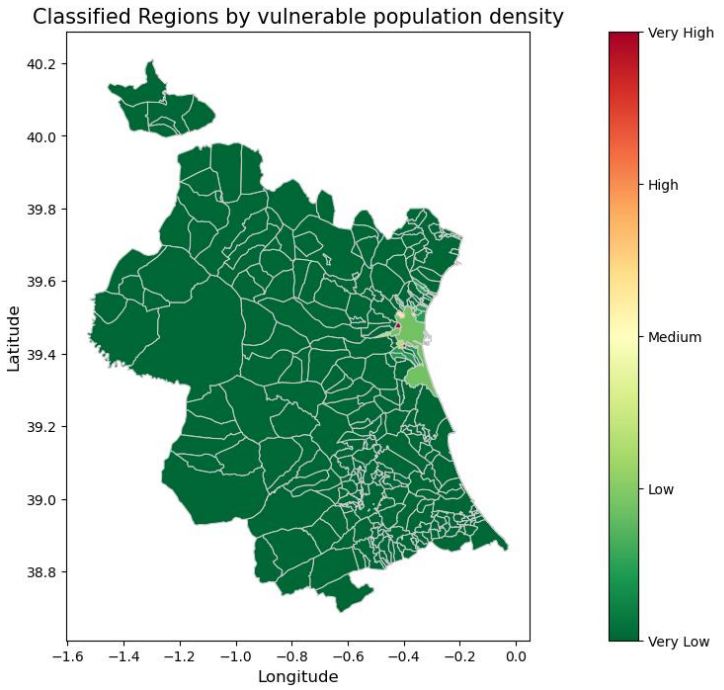


Figure S - 18 Vulnerable population density for the Valencia province municipalities, based on Worldpop Hub data.

COMMUNICATION OUTPUTS

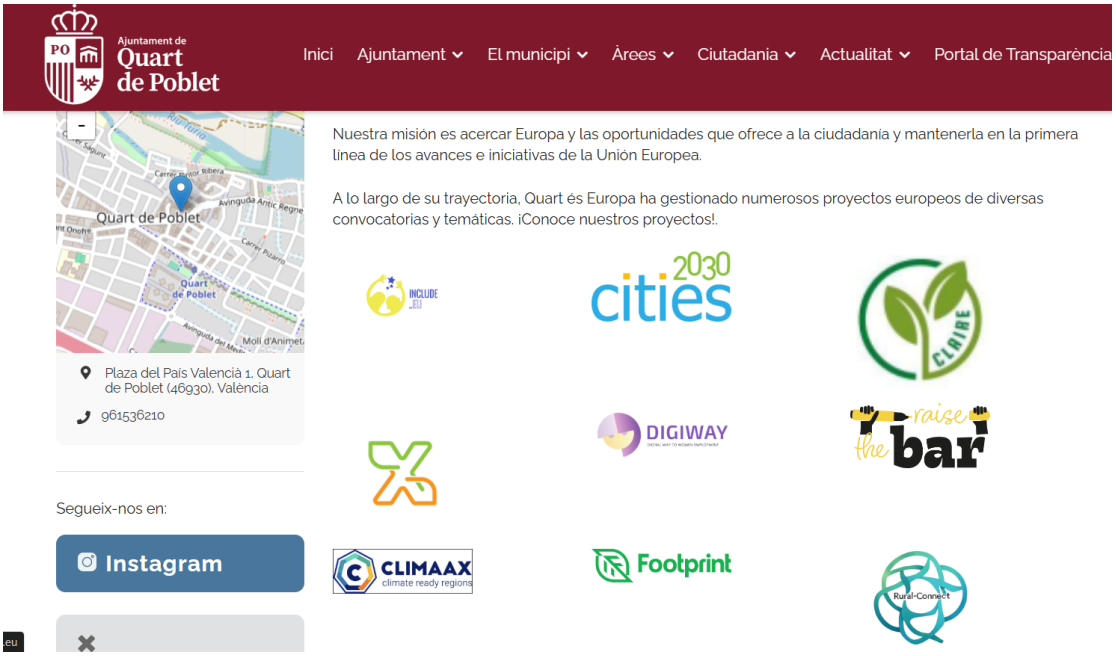


Figure S - 19 Access to the project's web portal from the City Council's website. Available at: https://www.quartdepoblet.es/area/proyectos-europeos

Figure S - 20 QCATI Website. Available at: https://www.quartclimaax.eu/

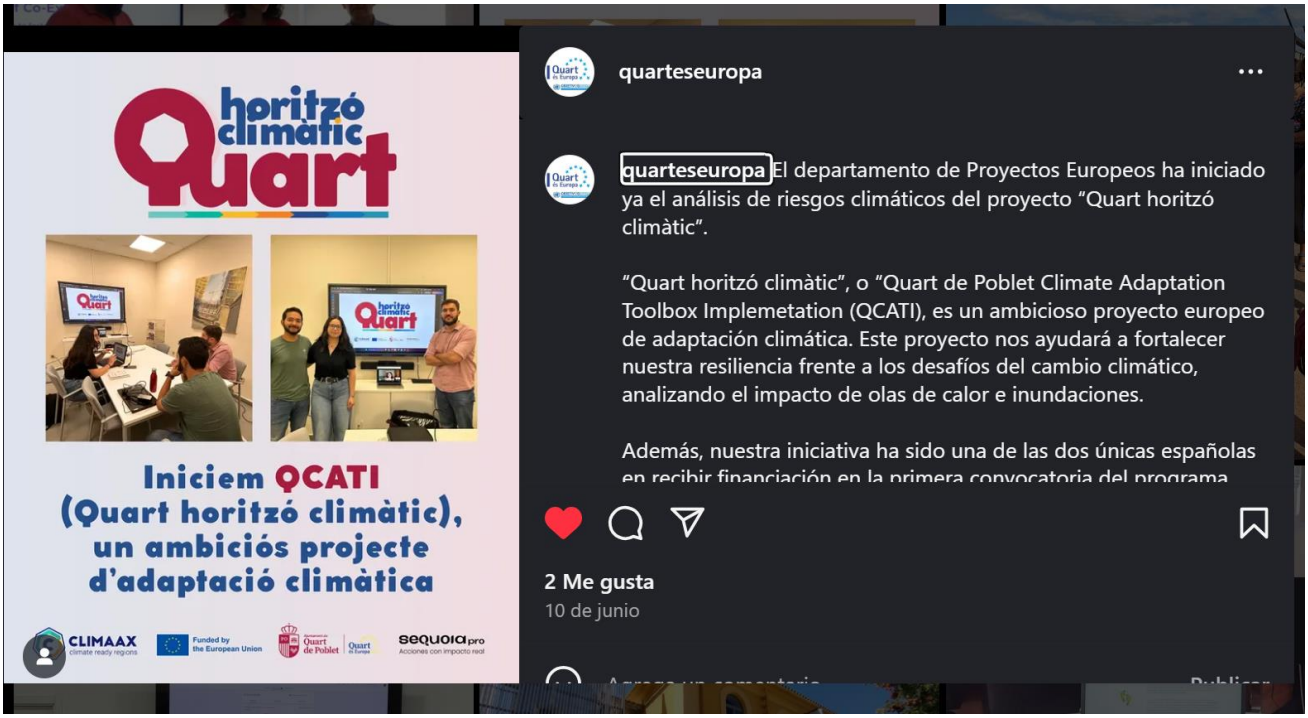


Figure S - 21 Social media: Post 1. Introduction to QCATI project and kick-off meeting

Translated text:
The European Projects department has already started the climate risk analysis of the project 'Quart horitzó climàtic'.

'Quart horitzó climàtic', or "Quart de Poblet Climate Adaptation Toolbox Implemetation (QCATI), is an ambitious European climate adaptation project. This project will help us to strengthen our resilience to the challenges of climate change by analysing the impact of heat waves and floods.

In addition, our initiative has been one of only two Spanish initiatives to receive funding in the first call of the CLIMAAX programme, a recognition that highlights our commitment to sustainability.

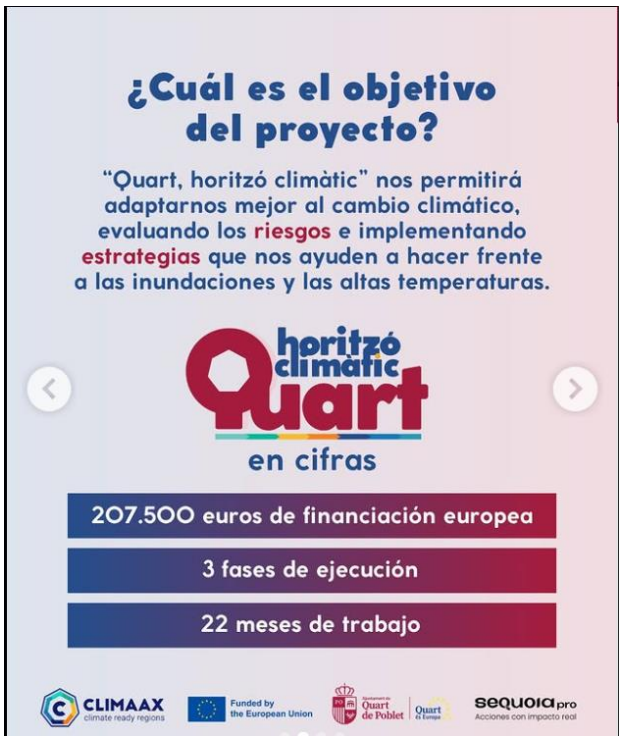


Figure S - 22 Social media: Post 2. Introduction to CLIMAAX and risk analysis

Translated text:
Get to know 'Quart horitzó climàtic', the QdP project funded by CLIMAAX, a European initiative of the Horizon Europe programme, which belongs to the EU Mission for adaptation to climate change.

'Quart horitzó climàtic' will help us to face the risks of floods and high temperatures, implementing key strategies for the security of our municipality.

These are the keys to the project!

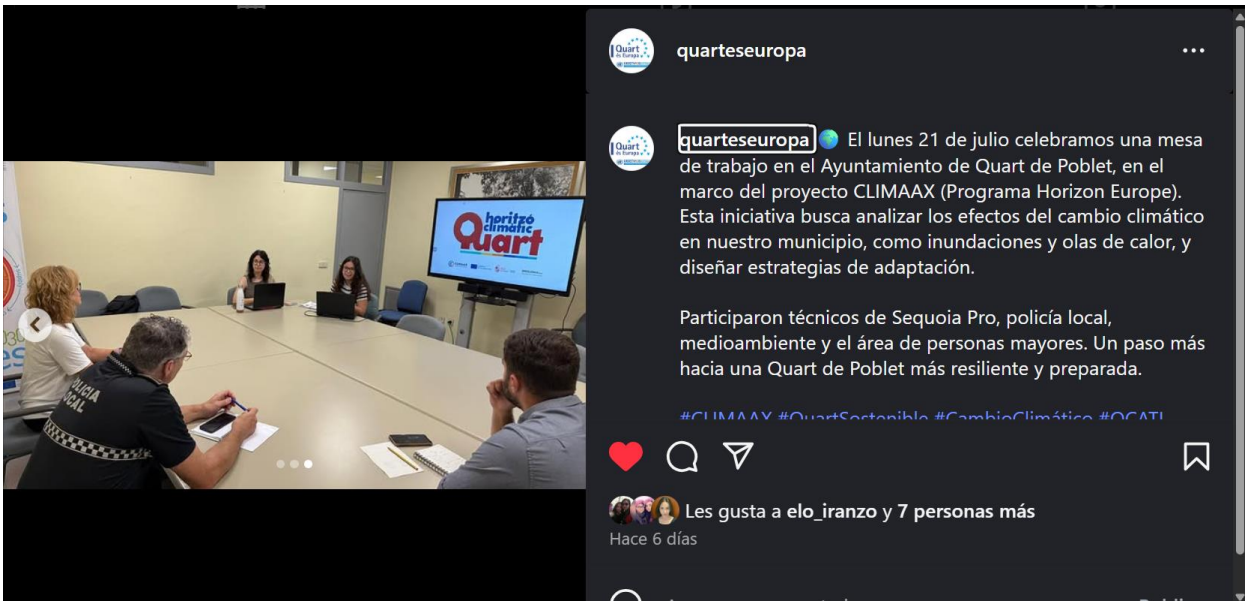


Figure S - 23 Social media: Post 3. Stakeholders workshop with the municipal areas of local police, senior citizens, and environment.

Translated text:
On Monday 21st July we held a working group at the Town Hall of Quart de Poblet, in the framework of the CLIMAAX project (Horizon Europe Programme). This initiative aims to analyse the effects of climate change in our municipality, such as floods and heat waves, and to design adaptation strategies.

Technicians from Sequoia Pro, local police, environment and the area of elderly people participated. One more step towards a more resilient and prepared Quart de Poblet.

#CLIMAAX #QuartSostenible #ClimateChange #QCATI #ClimateAdaptation #EuropeanProjects #EU #Horizon.

Figure S - 24 Press release. Barcelona Workshop. Available at: https://www.quartdepoblet.es/areas/proyectos-europeos/actualidad/articulo/el-area-de-proyectos-europeos-de-quart-de-poblet-viaja-hasta-barcelona-para-presentar-quart-horitzo-climatic

Translated text:

Quart de Poblet Town Council, through its initiative 'Quart horitzó climàtic', participated in the European CLIMAAX Workshop, held at the Cosmocaixa Science Museum in Barcelona on 10 and 11 June. This workshop allowed the City Council's European projects area to present its advances in climate resilience, learn about other projects and discuss the challenges of European funding in the medium and long term.

This international conference of CLIMAAX, a project within the framework of the European Union's Mission for Adaptation to Climate Change and funded by the Horizon Europe programme, was attended by members of the Government of Catalonia and the European Commission, as well as the other representatives of the consortium. The event, organised by the Centre for Applied Research in Hydrometeorology (CRAHI) and Deltares, brought together more than 200 delegations from the 69 CLIMAAX beneficiary regions and municipalities from all over Europe.

The Quart és Europa team, at the cost of Sequoia Pro, had the opportunity to present the progress of the project 'Quart horitzó climàtic', which is the only project of a Spanish municipality of CLIMAAX funded in the first call. During the conference, the Quart de Poblet delegation was able to meet and exchange experiences with representatives of other business projects from the first and second call, such as the Diputación de Alicante, the Region of Murcia and the Municipality of Huércal-Overa (Almería).

Quart de Poblet's participation in this international forum underlines the municipality's commitment to position itself as a benchmark in sustainable management and preparedness for the impacts of climate change. 'Quart, horitzó climàtic' will allow Quart de Poblet not only to remain at the forefront of climate policies, but also to establish and foster collaboration on future projects that contribute to a safer and more sustainable future for the city.

Figure S - 25 1st report: stakeholder mapping