



CLIMEMPOWER APPLICATION AND TRIAL SPECIFICATIONS

ClimEmpower Work Package 4, D4.5, v1.1



Project ClimEmpower: User Driven Climate Applications Empowering
Regional Resilience

Work package 4, Deliverable D4.5 v1.1

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Coordinator:	Denis Havlik, Scientist <denis.havlik@ait.ac.at> AIT Austrian Institute of Technology Giefinggasse 4, 1210 Vienna, Austria
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Lead:	Pavone, Venera - Plinivs
Author(s):	Pavone, V. (Plinivs), Italy Vurnek, M. (Faculty of electrical engineering and computing), Croatia Havlik, D. (AIT), Austria

¹ If you wish to reference this template, please reference the latest version thereof at zenodo

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List of Acronyms

Acronym	Definition
AIT	Austrian Institute of Technology GMBH
ANDALUS	Consejería de Sostenibilidad, Medio ambiente y Economía Azul
ANET	Anaptixiaki eteria kinotiton periochis troodoys ltd
AQUA	AQUATEC – Proyectos para la gestión del agua
BINGO	Bringing INnovation to onGOing water management (H2020 program, Grant agreement ID: 641739, 2015-2019; https://cordis.europa.eu/project/id/641739)
CC	Climate Change
CCA	Climate Change Adaptation
CERTH	Ethniko kentro erevnas kai technologikis anaptixis
CET	CETAQUA -
CoP	Community of Practice
CS	Case Study
CSF	Case Study Facilitator
DRIVER+	DRIVER+project - DRiving InnoVation in crisis management for European Resilience, 2014-2020 (FR7 programme, Grant agreement ID: 607798, 2014-2020; https://www.driver-project.eu/driver-project/)
ECMWF	European centre for medium-range weather forecasts
ESPRESSO	ESPRESSO project - Enhancing Synergies for disaster PREvention in the EurOpean Union (H2020 program, Grant agreement ID: 700342, 2016-2018; https://cordis.europa.eu/project/id/700342)
EU	European Union
FAIR	Findable, Accessible, Interoperable and Reusable
FER	Sveuciliste u Zagrebu Fakultet Elektrotehnike i Racunarstva
FRC	Frederick Research Center
FUA	Functional Urban Area
GDPR	General Data Protection
ICARIA	ICARIA - Improving ClimAte Resilience of crltical Assets (HORIZON-MISS-2021 program, Grant agreement ID: 101093806, 2023-2025; https://cordis.europa.eu/project/id/101093806)
IPCC	Intergovernmental Panel on Climate Change
KPI	Key Performance Indicator
OBZ	Osijek-Baranja County (Osjecko-Baranjska Zupanija)
OBZ-AZP	Public Institution Agency for the Management of Protected Natural Values in the Area of Osjensko-Baranja County (Javna Ustanova Agencija Za Upravljanje Zasticenim Prirodnim Vrijednosa na Podrucju Osjensko-Baranjske Zupanije)
PLINIVS	PLINIVS

Acronym	Definition
PSTE	Periferia Stereas Elladas
RAs	Regional Authorities
SHIELD	Framework designed in ESPRESSO project that stand for “Sharing knowledge, Harmonizing capacities, Institutionalizing coordination, Engaging stakeholders and Leveraging investments”
SICILY	Sicily Region
SMART	Specific, Measurable, Achievable, Reasonable and Time-bound
SO	Strategic Objective
SSH	Social Sciences and Humanities
TGM	Trial Guidance Methodology
WCDS	Western Costa del Sol
WP	Work Package

Glossary

Term	Definition
Climate impacts	The consequences of realized risks on natural and human systems, where risks result from the interactions of climate-related hazards (including extreme weather and climate events), exposure, and vulnerability. Impacts generally refer to effects on lives; livelihoods; health and well-being; ecosystems and species; economic, social and cultural assets; services (including ecosystem services); and infrastructure (based on IPCC, 2018)
Climate Resilience	The ability of a system and its component parts to anticipate, absorb, accommodate, or recover from the effects of a hazardous event in a timely and efficient manner, including through ensuring the preservation, restoration, or improvement of its essential basic structures and functions.
Community of Practice	Group of people who share a common interest or concern for a specific activity, practice or topic who engage in a process of collective learning within a shared domain by supporting each other and exchanging information through collaborative activities
Case Study Facilitator	Designated entities in each Case Study that are responsible for maintaining oversight and keeping the WP (Work Package) leaders informed about the progress and development of the CoP (Community of Practice). These entities play a vital role in establishing synergies with other Work Packages and ensure the project activities at local level meet end-users needs.
Exposure	Exposure is the situation of people, infrastructure, housing, production capacities and other tangible (human) assets located in hazard-prone areas.
Hazard	Hazards have the potential to cause loss of life, injury or other health impacts, property damage, social and economic disruption, or environmental degradation.
Indicator	An indicator is a measurement or value which gives you an idea of what something is like.
Vulnerability	Vulnerability refers to the conditions determined by physical, social, economic, and environmental factors or processes which increase the susceptibility of an individual, a community, assets, or systems to the impacts of hazards.

Executive summary (publishable)

Deliverable D4.5 documents the planning and preparation of ClimEmpower trials, designed to validate the project’s tools, services, and resilience strategies across five case-study regions: Andalusia (Spain), Osijek-Baranja (Croatia), Sicily (Italy), Central Greece (Greece), and Troodos (Cyprus). Following the Trial Guidance Methodology (TGM), these trials ensure a structured, transparent, and replicable process combining technical and scientific validation.

This deliverable defines the trial context, gaps, objectives, scenarios, and evaluation methods. The trials test the ClimEmpower platform as an integrated environment bringing together climate data, resilience indicators, hazard and risk maps, recommendations, and educational resources. The goal is to validate its usability, adaptability, and capacity to support evidence-based decision-making for local and regional climate resilience.

Key elements covered in this deliverable include:

- **Trial Context and Preparation:** Identifying gaps, defining objectives and research questions, and establishing roles across trial teams and stakeholders.
- **Platform Testing:** Validating core features like data extraction, indicator visualization, hazard mapping, resilience recommendations, and customizable dashboards.
- **Stakeholder Involvement:** Actively engaging Communities of Practice (CoPs) in trial design and execution to ensure outcomes reflect local needs.
- **Evaluation Approach:** Using pre- and post-workshop surveys, observation, and interviews to assess usability, acceptance, learning effects, and transferability.
- **Mini-Trials:** Developing simplified scenarios to engage follower regions, test replicability, and support sustainability planning.

Ultimately, D4.5 sets the scene for the ClimEmpower trial phase, ensuring results are tested in real-world contexts, validated by stakeholders, and assessed for European scalability. Trial outcomes will provide crucial feedback to improve the platform, refine resilience recommendations, and support long-term policy impact.

Due in month 24 and drafted in September 2025, this deliverable specifies the trials as originally planned. It is deliberately retained in this form; Deliverable D4.6 ("Community testing and validation report") documents the trials as actually conducted and measures outcomes against these established criteria. Updated document version editorially finalises the September 2025 draft without altering its technical content.

1. ClimEmpower summary

ClimEmpower is a Horizon Europe collaborative research project dedicated to addressing the ongoing Climate Crisis in Europe by empowering the regional stakeholders in some of the most vulnerable European regions (Figure 1).

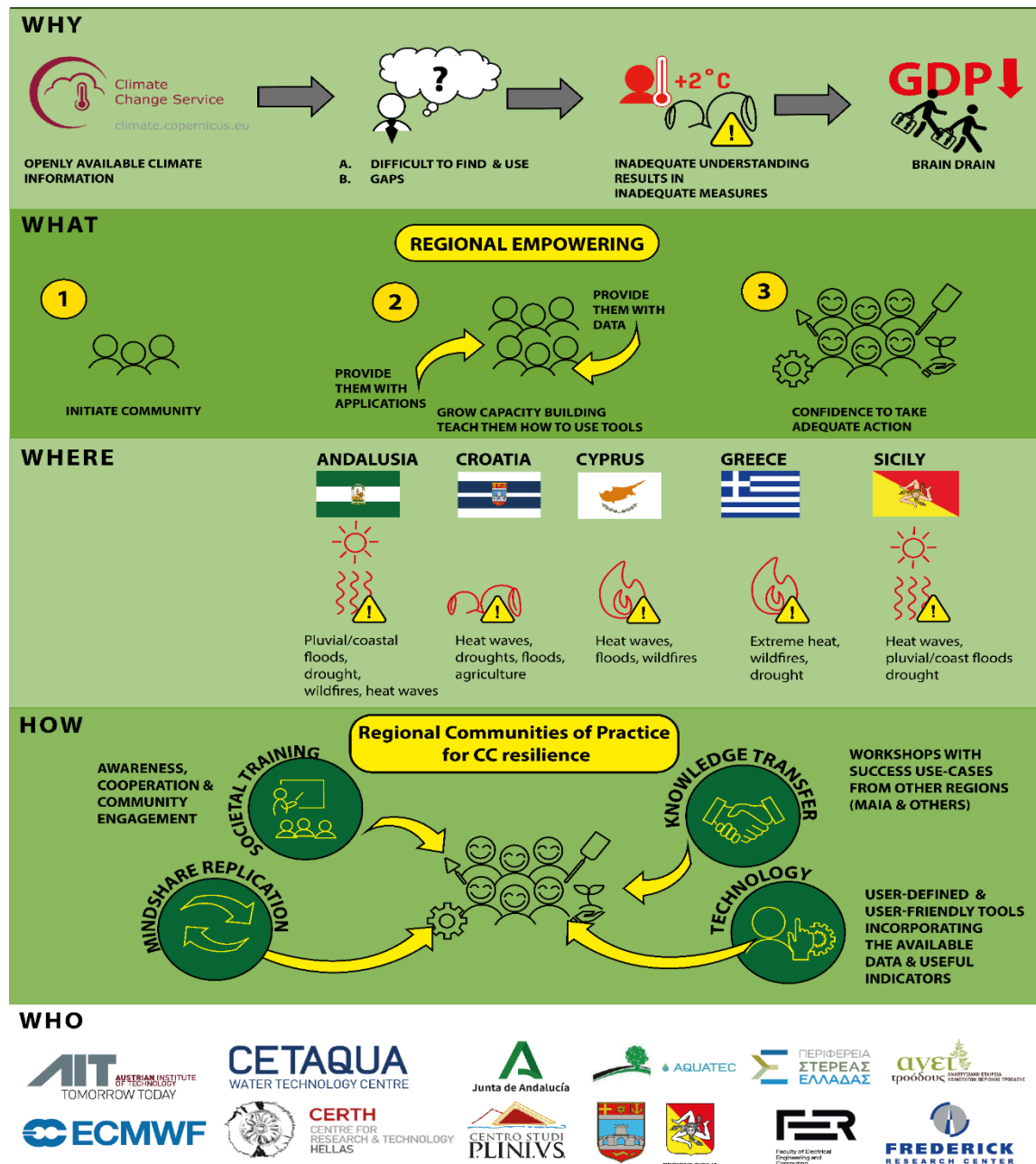
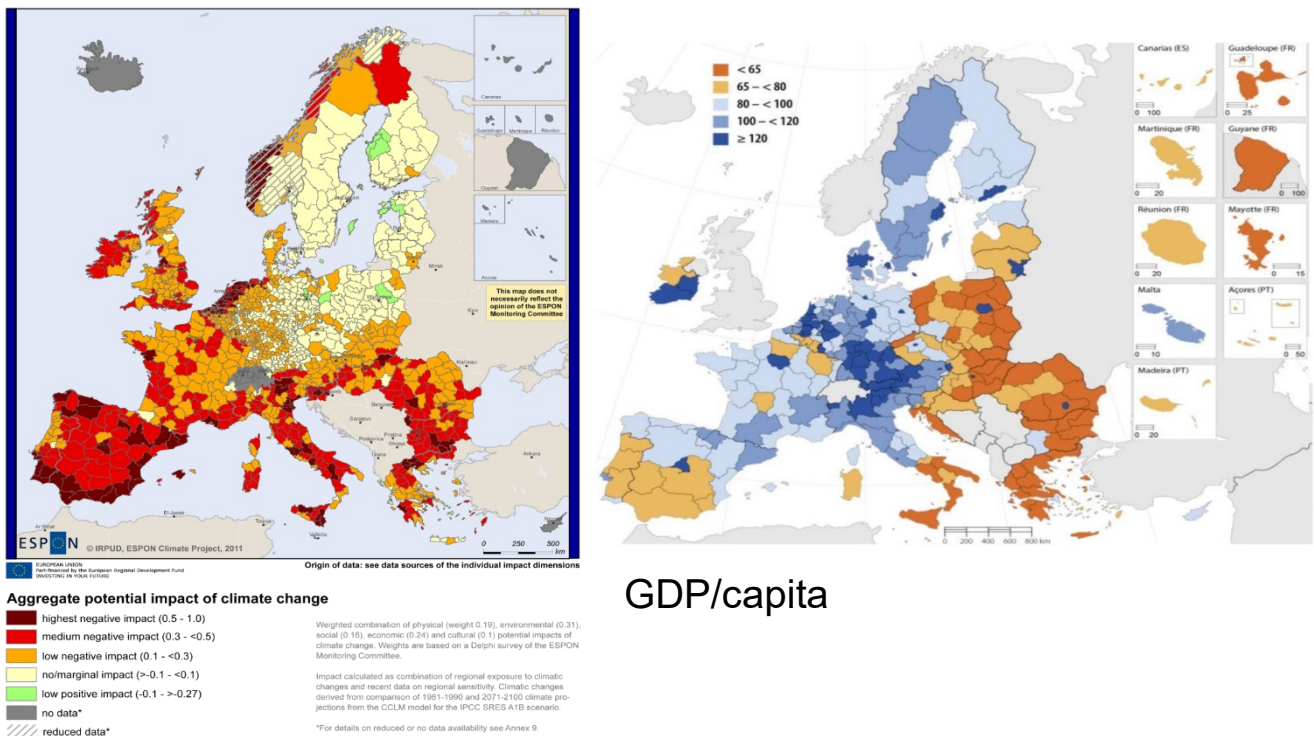


Figure 1: ClimEmpower at a glance: why, what, where, how and who.

1.1 Project Context

Climate risks result from a combination of hazard, exposure, and vulnerability (IPCC, 2022). Addressing all three aspects is crucial for effective increase of regional resilience. However, exposure, vulnerability, and related aspects, such as adaptive capacity, strongly depend on available knowledge and climate literacy. Consequently, global climate crisis frequently has a higher impact on socioeconomically vulnerable regions, thanks to a higher human and economic potential for addressing the issue in more affluent regions. To maximize its impact, ClimEmpower has therefore chosen to address the EU regions featuring a combination of high potential CC impacts and low



and/or stagnant regional GDP/capita. This is mainly the case for regions in South and Southeast Europe (Figure 2).

Figure 2.- aggregated potential impact of climate change (<https://www.espon.eu/climate-2012>); **GDP/capita** (based on <https://ec.europa.eu/eurostat/web/products-eurostat-news/-/ddn-20210303-1>)

The context the project addresses is thus one of an ongoing global warming, high regional vulnerability and low coping capacity of the participating regions, and the **overarching strategic objective of ClimEmpower** is to empower the Regional Authorities (RAs) and other Mission Users (MUs) in five EU-regions featuring a combination of exceptionally high climate hazards and exceptionally low coping capacity by improving their collective understanding of the Climate Change (CC) hazards, risks and resilient development pathways and supporting their knowledge-based regional planning and development through provision of relevant data, knowledge and user-defined and user-friendly decision support applications.

1.2 Project Objectives

To achieve this overarching goal, **ClimEmpower has identified six SMART² Strategic Objectives (SO)**, each one related to one or several work packages. The SOs have also been classified according to different categories: societal, contributing to improved dialogue, awareness, cooperation and community engagement as highlighted by the European Climate Pact (SO1, SO5); scientific, corresponding to research activities for advances beyond the state of the art (SO2, SO3); technological, suggesting and/or developing novel solutions, integrating state-of-the art and digital advances (SO4); and outreach, aimed at sharing ClimEmpower results to a broader scientific and non-scientific audience, including additional regions and communities, to maximize project impact (SO6).

- SO1 Understand regional background, challenges and expectation (WP1, societal)
- SO2 Addressing the gaps in availability and usability of CC data and services (WP2 and WP4, scientific)
- SO3 Identification, definition, estimating, and communication of climate impact/resilience indicators suitable for local end-users (WP2 and WP4, scientific)
- SO4 Simplify access to CC data and development of end user applications (WP3, technological)
- SO5 Empower the regions to activate and enhance their potential for addressing the climate change challenge. (WP4, societal)
- SO6 Ensure the use and impact of the ClimEmpower outputs (WP4 and WP5, scientific and societal)

² Specific (related to WPs), Measurable (by relevant KPIs), Achievable (the WPs in which they will be achieved are listed), Realistic (since they are referred and explained in the methodology section), and Timebound (each KPI is related to a deliverable and a month of achievement).

ClimEmpower’s key ambition is to **prove beyond doubt that CC-resilience should, and can, be an integral part of regional development** everywhere in EU and beyond it. That is, we anticipate that the regional stakeholders will recognise that CC-resilient development pathways offer multiple benefits to them, including but not limited to **higher quality of life and reviving economy**, and that these can be understood using available **data, tools, and services**. Second key ambition of the project is to **help the regions address the CC resilience** in key community systems addressed in five ClimEmpower trials.

Underlying philosophy of the project is to **“help the regions to help themselves”**. This will be achieved through various mechanisms, including co-creation and mediation of the regional “Communities of Practice”, provision of the Climate Change -resilience training materials, as well as in provision and training in use of the user-centric data and services – including those that have already been made available through previous research projects and EU initiatives.

2 Introduction

2.1 Deliverable summary

This Deliverable is part of WP4 [Empowering the regions] and contains specifications of the five regional trials, including the updated scenarios, applications that will be trialed, definitions of procedures and criteria for technical and scientific tests to be conducted during the trial and for the community validation to be conducted at the final trial workshop.

2.2 Results and expected impacts

Deliverable 4.5 defines the detailed specifications of the regional trials to be carried out in the five ClimEmpower case study regions. It describes the trial implementation procedures. It also sets the criteria for scientific/technical assessment and the framework for community validation during final workshops. It provides the operational blueprint for testing ClimEmpower application, tools and recommendations in real regional contexts, ensuring that they meet local needs and can be replicated in other (Follower) regions.

Contribution to Strategic Objectives (SOs)

- **SO2 (Addressing gaps in data and services, WP2 & WP4):** D4.5 operationalizes the datasets, services, and methods produced earlier, testing whether the identified gaps have been effectively addressed in real-life contexts.
- **SO3 (Indicators for local end-users, WP2 & WP4):** the trial specifications embed resilience indicators into trial applications, ensuring they are tested for **relevance, and usability**.
- **SO5 (Empower the regions, WP4):** through co-design with Communities of Practice and trial specifications, this deliverable supports regional actors in **actively validating and shaping solutions**, increasing their ownership and empowerment.
- **SO6 (Ensure use and impact, WP4 & WP5):** the structured methodology in D4.5 (scientific validation + community testing) ensures that project outputs are **credible, transferable, and exploitable**, thereby maximizing their impact and uptake beyond the project.

Deliverable 4.5 contributes to multiple dimensions of impact within ClimEmpower. From a scientific perspective, it serves as a testbed for evaluating methodologies in data integration, resilience indicators, and climate services. On the technological side, it ensures that the technical outputs of Work Package 3 (libraries, application architecture, and GUI components) are tested in real operational environments, which increases their maturity and readiness for use. The societal impact is reflected in the

strong involvement of Communities of Practice in the validation process, which strengthens dialogue, awareness, and co-creation at the regional level, ensuring that solutions are aligned with local needs and enhancing trust in climate resilience strategies. In terms of policy and governance, the trial specifications provide a basis for generating evidence on resilience measures and governance approaches, which can directly inform regional strategies as well as EU-level climate adaptation policies. From an exploitation and sustainability perspective, Deliverable 4.5 lays the foundation for future work in Deliverable 4.7 by ensuring that tested and validated solutions are sustainable, replicable, and scalable across Europe.

2.3 Relation to other work

Deliverable 4.5 builds directly on several earlier project outputs that provided the scientific, technical, and stakeholder-informed foundations for the trial design. It is closely aligned with ongoing activities in WP2 and WP3, as well as with the previous work in WP1 and WP4. Step by step, ClimEmpower partners have put together the building blocks that are now put into practice through the trials.

First, within WP1, the Communities of Practice were set up to bring stakeholders together (D1.1) and define the regional scenarios (D1.2). In WP2, the consortium identified what data and services already exist, where the gaps and barriers are, and which indicators are most useful for assessing resilience (D2.1 and D2.2). This was followed by methodological work on downscaling and combining different datasets (D2.3) and the definition of concrete measures and strategies to improve climate resilience (D2.4).

At the same time, WP3 provided the technical backbone: Deliverable 3.1 defined the ClimEmpower application architecture, and Deliverable 3.2 developed reusable libraries and services for data processing, feature extraction, and indicator building. Those are technical outputs that will be tested during the trials.

In parallel, WP4 prepared the ground for empowerment and validation at the regional level. Educational materials and interactive tools were provided under Task 4.1, while Task 4.2 strengthened and engaged the regional Communities of Practice through workshops and exchanges. Deliverable 4.3 gathered regional recommendations that reflect local priorities and concerns, ensuring that technical tools are matched with real-world needs.

Dissemination and stakeholder engagement strategies were outlined in WP5 deliverables D5.6 and D5.7, ensuring that input from regional stakeholders is fully embedded in the process.

Deliverable 4.5 now brings these strands together by providing the detailed specifications of the regional trials. It outlines the updated scenarios, the application that will be tested, and the procedures and criteria for technical and scientific assessment, as well as for community validation. These specifications are the operational blueprint for conducting regional trials across the five ClimEmpower regions.

Within the project, D4.5 will guide the implementation of Task 4.4 and form the basis for subsequent deliverables:

- D3.3 (HTML5 framework and user-centric applications), which will operationalize the trialed applications,
- D4.6 (Community testing and validation report), which will document the evaluation process, and
- D4.7 (Sustainability and exploitation plan v1), which will assess how trial-tested applications can be sustained and replicated.
- D4.5 offers a structured methodology that can be adapted to different regional contexts. This strengthens the transferability and long-term impact of ClimEmpower results.

2.4 Data, security, and ethics

ClimEmpower observes the following three principles for data-related work:

- KISS: both the data management within the project and discovery, access, and reuse of data during and after the project will be made as simple and as transparent as possible.
- FAIR: data used in the project, as well as the data produced by the project should be easily Findable, Accessible, Interoperable and Reusable.
- Societally Responsible: data produced by the project will be made publicly available unless there is a compelling ethical or commercial reason against such publication. All project outputs (e.g. data, algorithms) will be explicitly checked for Ethics issues.

2.4.1 Data interoperability

Deliverable 4.5 (D4.5) contains specifications of the five regional trials, including the updated scenarios, applications that will be trialed, definitions of procedures and criteria for technical and scientific tests to be conducted during the trial.

Some of the data used to write this deliverable builds upon previous and ongoing EU-funded projects, such as DRIVER+ (DRiving InnoVation in Crisis Management for European Resilience), BINGO (Bringing INnovation to onGOing water management), ESPRESSO (Enhancing Synergies for Disaster Prevention in the European Union), ICARIA (Improving Climate Resilience of Critical Assets), KNOWING (Framework for defining climate mitigation pathways based on understanding and integrated assessment of climate impacts, adaptation strategies and societal transformation), and UP2030 (Urban Planning and design ready for 2030). These projects provided insights, methodologies, and datasets relevant to climate adaptation, resilience planning, and stakeholder engagement.

The tables of outcomes produced in preparation of this deliverable are Excel files with “.xlsx” format that task and work package leaders collaboratively filled based on input from ClimEmpower partners, CoP participants and external experts. Accessing the tables requires either Microsoft Excel or other software capable of displaying “.xlsx” type files, such as Apache OpenOffice or Google Sheets.

2.4.2 Data accessibility and reuse:

Primary data sources used in the preparation of the D4.5 deliverable consist of the ClimEmpower deliverables that are quoted in the Table 1.

Note: All public ClimEmpower deliverables are available on CORDIS, at <https://cordis.europa.eu/project/id/101112728/results> and on the ClimEmpower web site, under <https://climempower.eu/results/>. Sensitive deliverables and other sensitive materials aren’t publicly available.

Table 1: Data used in preparation of ClimEmpower deliverable D4.5

Data set name	Form at	Size	Owner & re-use conditions	Potential Utility within and outside	Unique ID
Deliverable D1.1 Community of Practice organisation and expectations	PDF	10.19 MB	Sensitive	Document is available on Projects’ project-internal document repository, in “Project Outputs” directory. It describes the organisation of the CoPs.	• ClimEmpower D1.1
Deliverable D1.2 ClimEmpower Scenarios	PDF	5 MB	Public	Describes the status at the project start and documents the needs of the regions.	ClimEmpower D1.2
Deliverable D2.1 Climate Change resilience identified data, services, and gaps	PDF	6.02 MB	Public	Lists potentially useful data and services and identifies the gaps.	ClimEmpower D2.1
Deliverable D2.2 Climate Change resilience indicators	PDF	3.73 MB	Public	Defines the methodology for establishing the CC resilience indicators.	ClimEmpower D2.2
Deliverable D2.3 Downscaling and data fusion for Climate Change resilience	PDF	5.24 MB	Public	Document describes various downscaling and data fusion algorithms of interest to the project.	ClimEmpower D2.3
Deliverable D2.4 Measures and strategies for increased Climate Change resilience	PDF	N/A	Public	Connects the methodology for producing risk maps with resilience indicators , adaptation strategies and resilient development recommendations.	ClimEmpower D2.4
Deliverable D3.1 ClimEmpower application architecture	PDF	9.65 MB	Public	Introduces the ClimEmpower implementation architecture.	ClimEmpower D3.1

Data set name	Form at	Size	Owner & re-use conditions	Potential Utility within and outside	Unique ID
Deliverable D3.2 Reusable libraries and services for climate feature extraction, data processing and indicator building	PDF	4.2 MB	Public	Describes the interoperable, open-source libraries and modular data access and pre-processing services, the Indicator Service framework and the Decision support platform	ClimEmpower D3.2
Deliverable D4.1 Educational materials for increased regional CC resilience v1	PDF	7.75 MB	Public	Provides an overview of already existing educational materials that are deemed useful for the ClimEmpower Communities of Practice (CoP) and other regional stakeholders, including the general public.	ClimEmpower D4.1
ClimEmpower Climate Change educational resources (Knowledge hubs and educational materials tables)	Micro soft Excel (.xlsx)	150 KB	Public	Two tables, providing a list of "aggregator pages" with (links to) curated educational materials on climate change adaptation and mitigation and examples of different types of educational materials that are resolving some of the educational needs of the ClimEmpower regional stakeholders.	ZENODO 10.5281/zenodo.13944850
Deliverable D4.3 Regional CC-resilience recommendations v1	PDF	2.38 MB	Public	Presents the intermediate consensus on general and region-specific recommendations for decision-makers within and beyond the five ClimEmpower regions.	ClimEmpower D4.3
Deliverable D5.6 Stakeholder engagement plan and events report v1	PDF	5.29 MB	Sensitive	Introduces strategy for engaging stakeholders, dialogue and knowledge exchange in the project and supports all activities and events related to stakeholder engagement.	ClimEmpower D5.6
Deliverable D5.7 Stakeholder engagement plan and events report v2	PDF	2.50 MB	Sensitive	Evaluates progress made in the first half of the ClimEmpower project and from the last version of Stakeholder engagement plan end events report v1 (28.5.2024.), identifies areas for improvement, and refines strategies for stronger stakeholder involvement in the upcoming months.	ClimEmpower D5.7

2.4.3 Security and Ethics

The work performed in this deliverable and the data used or produced aren't considered sensitive in terms of ethics or security. Deliverable 4.5 specifies the design and procedures of the ClimEmpower regional trials but does not itself include any personal data collection or sensitive information.

During the trial phase (Task 4.4), data will be collected from stakeholders through questionnaires, structured interviews, and validation workshops. In such cases, all data collection will be conducted in accordance with the relevant EU and national legislation, including the GDPR. Stakeholders will be provided with clear information about the purpose of the data collection and their role in the trial activities. Informed consent will be obtained, and a template consent form will be included as a separate annex to the trial documentation. Only anonymised and aggregated information will be used in analyses to ensure the privacy of participants.

No algorithms with significant ethical or security concerns are introduced in this deliverable. The technical tools and services to be tested in the trials rely on established methodologies and open data sources.

3 Trial Guidance Methodology and CoPs

A **Community of Practice (CoP)** is a group of people who share a common concern or interest and engage in collective learning by exchanging knowledge and supporting one another (Wenger-Trayner, 2015). The concept, introduced by Lave and Wenger in *Situated Learning* (1991) and later expanded in *Communities of Practice* (1998), rests on three main elements (Wenger-Trayner, 2022):

- **Domain** – a shared topic or concern, such as tackling climate change in vulnerable regions.
- **Community** – members who build relationships and learn together.
- **Practice** – the actions, tools, and shared knowledge used to address challenges.

In ClimEmpower, CoPs bring together a **diverse mix of stakeholders**: technical experts from government and civil sectors, researchers, industry professionals, private sector actors, and members of civil society. This diversity ensures solutions are scientifically sound, practically useful, and socially relevant.

The CoPs in each case study region are coordinated by **Case Study Facilitators (CSFs)**, who ensure active participation, keep work package leaders informed, and foster connections with other project activities. CoPs evolve throughout the project, adapting to regional needs and priorities. Meetings are organized face-to-face, in local languages, and with interactive workshops, ensuring participation and ownership of outcomes.

The ClimEmpower consortium has adopted the **Trial Guidance Methodology (TGM)**, originally developed by the DRIVER+ project, as a framework for testing innovative solutions. TGM offers a **structured yet flexible approach** to assess how new solutions can meet societal or organizational needs. It combines principles from **Design Thinking and AGILE development** with step-by-step trial design, clear roles and responsibilities, and systematic evaluation tools (Fonio et al., 2020).

To address the challenges faced by the five case study regions, ClimEmpower will implement and test a variety of solutions using the **Trial Guidance Methodology (TGM; Fonio et al., 2020)**. These trials will cover both technological and societal dimensions, with regional stakeholders playing a central role in shaping, testing, and validating the outcomes.

Each region collected information to identify gaps in existing tools, services, and materials. The next step is to involve stakeholders in testing the risk assessment methodologies and technical solutions developed within the project. Insights gained during this process will feed into the design of “**mini-trials**”, an extension of the TGM approach that strengthens the evaluation of exploitation potential. In the final stage,

results will be transferred to follower regions, ensuring replication and scalability of the proposed solutions.

The methodology for developing and validating the ClimEmpower case studies has been tailored to help stakeholders **systematically assess how innovative solutions address real societal needs**. It builds on principles of **Design Thinking, AGILE development, and the DRIVER+ Trial Guidance methodology**.

Within ClimEmpower, work with CoP's is organised in six phases:

- **Phase 0:** Establishing CoPs in each ClimEmpower case study region, defining the most relevant climate hazards
- **Phase 1:** Collecting information in each case study region to identify needs, gaps, tools, services, datasets and resilience strategies.
- **Phase 2:** Selecting and prioritizing indicators
- **Phase 3:** Trials - testing results and technical solutions with stakeholders to validate their relevance and usability.
- **Phase 4:** Conducting smaller “mini-trials” to refine lessons learned and strengthen exploitation potential.
- **Final step:** Extending results to follower regions to ensure replicability and broader European impact.

By embedding stakeholders in every stage of the process, TGM ensures that ClimEmpower results are **co-created, tested in real contexts, and transferable**. Its balance of strict rules (for comparability and reliability) and flexibility (for adaptation to diverse contexts) makes it a powerful tool for validating both technological and societal innovations.

The first phases in organizing and establishing the CoPs, as well as the outcomes of the first three CoP meetings, are described in more detail in Deliverables **D1.1, D5.6, and D5.7**. Following paragraphs summarize the key findings emerging from these activities.

Stakeholder engagement is a two-way process, where researchers gain valuable insights from stakeholders while providing them with knowledge and tools to enhance their capacity for climate adaptation. They actively participate in co-creating tools and services tailored to address their specific needs and challenges (CoP meetings and workshops) and now will be included in validation process through trials and mini trials.

ClimEmpower focuses on five south-European regions highly vulnerable to climate change due to their low adaptive capacity and significant socio-economic and environmental challenges. These regions—**Andalusia** (Spain), **Osijek-Baranja County** (Croatia), the **Region of Central Greece** (Greece), **Sicily** (Italy), and the **Troodos Mountain Range** (Cyprus)—were selected based on their economic

vulnerabilities, exposure to climate risks and the need for adaptation strategies. A more detailed description of the regions, problems and expectations can be found in D1.1 and in D5.6.

Main objectives of the stakeholder engagement were and are:

- Establishing a basic understanding of existing regional tools, services and strategies, assessing their relevance and reusability for ClimEmpower,
- Encouraging understanding of CC challenges, needs, gaps, barriers and previous experiences, to foster risk perception and awareness,
- Stakeholder participation in data collection and addressing data gaps, including them in final solutions,
- Promoting the co-creation of resilient customization solutions that meet their needs and expectations,
- Incorporating the end-user perspective throughout the design process to improve the usability and effectiveness of tools and methods,
- Designing educational and training materials to empower users, improve their understanding and capacity to effectively address climate change,
- Sharing and exchanging knowledge,
- Networking and building relationships among stakeholders to foster partnerships and joint action.

As previously mentioned, validation of the project's results by stakeholders will be performed by CoPs, following the Trial Guidance Methodology (TGM; Fonio et al., 2020).

Results of Phase 0:

At the start of the project, WP1 engaged regional stakeholders across the five case study regions through Task 1.1 *Activate regional stakeholders* and Task 1.2 *Build a common understanding*. As a result, Communities of Practice (CoPs) were established and their first meetings held to “set the scene,” ensuring that all relevant stakeholders were actively involved from the beginning.

To encourage participation and collaboration, the launch of the CoPs was organized as face-to-face workshops, conducted in local languages and supported by interactive tools. This approach helped improve communication, foster trust, and ensure that outcomes reflected local priorities, needs, and expectations.

Across all regions, common climate hazards were identified, including droughts, heatwaves, storm surges, floods, and forest fires. A major challenge that emerged was data collection, as some regions face difficulties in accessing or sharing relevant

datasets. Another widely recognized need was training and capacity building for users and stakeholders.

The discussions also highlighted the importance of making project results transferable. However, a lack of technical expertise among many users was seen as a barrier, limiting their ability to apply adaptation strategies and planning tools.

Results of Phase 1:

After the establishment and initial development of CoP's in WP1, their further work and development continued in WP4, specifically within task 4.2. Involve and empower regional actors (CoPs). A series of regional CoP meetings and workshops were organized and facilitated by their respective CSFs (*Case Study Facilitators - project partners responsible for coordination, managing and supporting Communities of Practice - PLINIVS; CERTH; AQUATEC; CETAQUA; FER; FRC*).

The main goals of all CoP meetings were:

- to identify gaps and needs, datasets, services, ...
- achieving a better understanding of risk perception and awareness,
- confirming local experiences with potential adaptation solutions, and
- ensuring that project outcomes are in line with local priorities, needs and expectations.

Focusing on local challenges, gaps and obstacles is important because it gives relevance to a specific local community. It addresses the local challenges and priorities, empowers and involves relevant stakeholders, supports policy and decision-making on local level, and contributes to sustainable long-term changes. The organization of the second CoP meetings became a key task for WP4 leaders, in coordination with Case Study Facilitators (CSFs) and Regional Actors (RAs).

The work of Communities of Practice (CoPs) followed a similar structure across all ClimEmpower regions, ensuring consistency in stakeholder engagement and knowledge exchange. Before each CoP meeting or workshop, Case Study Facilitators (CSFs) developed an initial agenda, aligning discussions with project objectives while considering regional priorities. Due to the specific contexts of each region, CSFs had the flexibility to decide on some aspects, such as whether the meeting will be held online or in person, its duration and whether they organize a single large meeting or multiple bilateral sessions.

Detailed results of this phase are described in D5.7 Stakeholder engagement plan and events report, v2. While each region had unique climate-related priorities and adaptation challenges, there were significant similarities in stakeholder concerns, gaps in data availability, and the need for better institutional collaboration and engagement across sectors.

Common Themes Across All Regions:

- High stakeholder awareness of climate risks but gaps in adaptation measures:** across all regions, stakeholders demonstrated strong awareness of climate risks, with specific emphasis on heatwaves, droughts, wildfires, flooding, and extreme weather events. However, despite this awareness, adaptation strategies remain underdeveloped due to gaps in funding, lack of coordinated policies, and insufficient engagement across sectors.
- Lack of access to localized climate data and risk mapping:** all five regions highlighted the need for improved climate data availability, particularly localized risk mapping. Stakeholders frequently noted that existing climate models do not incorporate future projections or account for compound risks (e.g., wildfires increasing due to prolonged drought). In many cases, national-level climate services exist, but their applicability at the regional level is limited due to low resolution, lack of updates, or lack of awareness among local stakeholders.
- Demand for training and educational resources:** every region pointed the importance of educational materials and training programs for decision-makers, public services, and local communities. Stakeholders emphasized the need for practical, easy-to-understand educational resources, workshops, and technical training to improve knowledge on climate risks, adaptation planning, and disaster preparedness. The absence of structured climate change education for policymakers and local administrations was a widely shared concern.
- Challenges in stakeholder engagement,** particularly from the private sector: meetings revealed a lack of engagement from private-sector stakeholders, particularly in sectors such as agriculture, tourism, and infrastructure development. In some regions (e.g., Osijek-Baranja and Troodos), stakeholders from private businesses noted low interest in climate resilience, while in others (e.g., Sicily and Andalusia), the issue was fragmented collaboration between institutions, businesses, and local governments.
- Emphasis on strengthening institutional coordination:** meetings identified poor coordination between government agencies, municipalities, and sectoral institutions as a major barrier to implementing climate adaptation measures. This was particularly evident in Sicily, Andalusia, and the Region of Central Greece, where stakeholders pointed the need for better integration of climate adaptation into planning policies and the development of standardized frameworks for resilience-building.
- Need for enhanced flood management and water security measures:** while all regions identified multiple climate risks, the need for improved flood management strategies and water resilience measures was universal. Andalusia, Central Greece, and Sicily raised concerns about urban flooding, extreme rainfall events, and inadequate stormwater drainage systems. In

contrast, Troodos and Osijek-Baranja emphasized the need for better drought and water resource management. Several stakeholders called for the use of smart monitoring technologies (e.g., satellite observation, AI-based forecasting) to predict and mitigate extreme hydrometeorological events.

Results of Phase 2:

As part of Work Package 2 (WP2 Addressing the CC data and knowledge Gaps), a comprehensive analysis of 531 indicators was carried out, covering 16 sectors defined by ISO 37123:2019, with the addition of a dedicated “Climate Change” sector focusing on climate hazard indicators (e.g., maximum daily rainfall intensity).

The distribution of indicators showed that the **Environmental sector** contains the largest share, almost **24% (around 130 indicators)**, mainly addressing vulnerability and exposure. The **Governance sector** is the second most prominent with approximately **14% (80 indicators)** spread across all categories, followed by the **Economic sector** with about **9% (50 indicators)**, primarily linked to vulnerability.

The ClimEmpower team emphasized that the objective is not to create a single, all-encompassing framework valid for all regions and contexts. Instead, the goal is to empower each region to select **indicator sets tailored to its specific resilience needs and pathways**. WP2 and this deliverable therefore provide the **formal framework** and a **large pool of potentially useful indicators** from which regions can choose, while WP3 and WP4 support their integration into climate services and regional practices.

Following Deliverable D2.2, the proposed framework was further validated through **Community of Practice (CoP) discussions and surveys**. Stakeholders across the five case study regions were asked to evaluate indicators and provide feedback on the following aspects:

- The **level of granularity** and spatial extent most useful for their regional context,
- Availability of **local datasets** or additional sources to support indicators,
- The **perceived relevance** of each indicator (rated as low, medium, or high),
- Trade-offs between **spatial resolution and temporal accuracy**.

Regional Participation and Results

- **Costa del Sol (Spain), Osijek-Baranja County (Croatia), and Central Greece:** Stakeholders provided ratings of low (1), medium (2), or high (3) relevance for each indicator.
- **Sicily (Italy):** A prioritized list of selected indicators was provided, without scoring. Indicators chosen were considered of **high priority** only.
- **Troodos (Cyprus):** No structured scoring was collected in this round.

The final indicator relevance scores were calculated as **mean values** of stakeholder responses per region, using a numerical scale (1–3). For Sicily, only two values were applied: **0 (not rated)** and **3 (high relevance)**.

In addition, stakeholders in Costa del Sol and Central Greece were asked to state their preference regarding **resolution trade-offs** for each indicator. They could choose between:

- **High spatial resolution** (marked as “SPATIAL”), or
- **High temporal resolution** (marked as “TEMPORAL”).

This feedback allows the project to adapt the indicator framework to different regional needs and contexts, ensuring practical usability and improved stakeholder ownership.

- The selected and validated indicators will feed into:
 - **WP3** – for integration into climate data services and applications,
 - **WP4** – for CoP-based resilience recommendations and regional trials.

A comprehensive description of the indicator selection, stakeholder feedback, and resulting recommendations is provided in Deliverable D2.4 “Measures and strategies for increased Climate Change resilience.”

Results of Phase 3:

With the indicator framework established and validated through stakeholder engagement, the next major step in ClimEmpower is the **preparation and implementation of regional trials**. These trials are at the core of the project’s methodology, as they provide a structured environment where proposed solutions—ranging from climate services and resilience indicators to educational materials and digital tools—are tested under real conditions in collaboration with local stakeholders.

The trials will be designed and conducted following the Trial Guidance Methodology (TGM; Fonio et al., 2020), which ensures a systematic, transparent, and replicable process. This methodology allows each region to assess the innovative potential of solutions by linking them directly to the local challenges identified in earlier project phases. In practical terms, the trials will connect the outputs from WP2 and WP3 with the societal and governance needs expressed through the Communities of Practice (CoPs) in WP4.

Preparation of the trials involves several parallel activities - the methodology is divided into three phases: **Preparation, Execution, and Evaluation**.

1. Preparation Phase

This phase lays the groundwork and is broken into structured steps:

- Step 0 – Contextualization: identify the gap and the trial context.

- Step 1 – Define trial objectives: formulate SMART objectives based on the gap.
- Step 2 – Formulate research questions: specify questions that the trial should answer.
- Step 3 – Data collection plan: decide what data will be gathered, how, by whom, and when.
- Step 4 – Evaluation approach: select evaluation criteria and metrics for assessing outcomes.
- Step 5 – Scenario building: design realistic trial scenarios that replicate local challenges.
- Step 6 – Solution selection: identify and select the tools, services, or methods to be tested.

2. **Execution Phase**

The trial is carried out in practice. This often starts with a “dry run” to test logistics, followed by the real trial where scenarios are implemented, data is collected, and stakeholders are actively engaged.

3. **Evaluation Phase**

Data collected is verified and analyzed to answer the research questions. Lessons learned are documented, and recommendations are made for improving the tested solutions and their future use.

In the following section, each of these phases of the Trial Guidance Methodology will be elaborated in detail, with a focus on how they are applied within the ClimEmpower regional trials.

4 ClimEmpower Solutions

4.1 Theoretical Background: Resilience Framework and Conceptual Underpinnings

ClimEmpower is grounded in a robust theoretical foundation rooted in the principles of climate resilience, systemic transformation, and participatory governance. The project aligns with key EU and international strategies, including the EU Adaptation Strategy and the UN Sustainable Development Goals (SDGs), aiming to contribute to the mission of creating at least 150 climate-resilient European regions by 2030.

At its core, ClimEmpower operates within the widely accepted climate risk assessment framework, which conceptualizes climate risk as a function of three components: **hazard, exposure, and vulnerability**. These components interact to determine the overall risk a region faces considering current and future climate change scenarios. Effective climate resilience, therefore, requires simultaneous mitigation of hazards, reduction of exposure, and addressing vulnerability, particularly socio-economic and institutional vulnerability.

The resilience concept, as used in ClimEmpower, transcends simple adaptation and instead supports a **systemic and transformative approach** to planning. Rather than responding to individual events, the project aims to foster adaptive systems capable of anticipating, absorbing, recovering from, and transforming in response to long-term climate stressors. In this regard, resilience is treated not only as a technical or infrastructural objective but as a socio-political and institutional capability.

ClimEmpower targets five EU regions that exhibit **exceptionally high climate-related hazards and low socio-economic coping capacity**. These areas were strategically selected based on an analysis combining ESPON climate vulnerability maps and Eurostat GDP/capita data. The rationale is that the effects of climate change are disproportionately severe in less affluent regions due to limited capacity for investment in mitigation and adaptation. ClimEmpower thus focuses on providing **cost-effective, scalable, and user-centric tools** to enhance adaptive governance in regions most in need.

ClimEmpower leverages a multidisciplinary theoretical approach, integrating:

- **Design Thinking:** To facilitate collaborative problem-solving and user-centred design of decision support tools.
- **AGILE Development Methodology:** For iterative development and rapid prototyping of digital services and applications tailored to regional needs.
- **DRIVER+ Trial Guidance Methodology (TGM):** A six-step process for testing and validating innovative crisis management solutions, adapted here for climate resilience trials. - **System Dynamics Modeling:** To simulate the interactions

between climate hazards, governance, socio-economic variables, and adaptation strategies.

- **Participatory and Transdisciplinary Research:** Drawing on SSH disciplines such as behavioural science, governance studies, and risk communication to ensure inclusive and actionable results.

ClimEmpower acknowledges the complexity of measuring climate resilience and therefore integrates a **multi-indicator approach**, combining climate hazard indices (e.g., ETCCDI), socio-economic vulnerability indices (e.g., SoVI), and governance-related metrics. Resilience has become a vital, cross-disciplinary framework for addressing complex challenges like climate change and urban planning. Over time, the concept has shifted from static models to dynamic, adaptive approaches that emphasize transformation, learning, and long-term sustainability. While this flexibility strengthens its relevance, it also creates challenges in defining and measuring resilience consistently. To maintain clarity, ClimEmpower adopts the IPCC’s definition of resilience in all project activities.

To guide regional climate resilience planning, ClimEmpower draws on a comprehensive framework originally developed by Arup and the Rockefeller Foundation. Though designed for cities, this framework is well-suited for regions, recognizing their complex social, environmental, and economic systems. It enables regions to assess vulnerabilities, identify interdependencies, and plan targeted resilience actions.

The framework is structured around four key dimensions:

- 1) Health & Wellbeing
- 2) Economy & Society
- 3) Infrastructure & Environment
- 4) Leadership & Strategy

These are supported by 12 resilience drivers/goals and 52 indicators, all shaped by seven core resilience qualities, offering a practical and scalable method to evaluate and improve regional resilience.

ClimEmpower adopts a holistic and adaptive approach to resilience by integrating seven key qualities identified in leading global frameworks:

- 1) **Reflectiveness** – Learning from past experiences to inform future actions.
- 2) **Resourcefulness** – Finding alternative ways to use resources during crises.
- 3) **Robustness** – Designing systems to withstand shocks without failing.

- 4) **Redundancy** – Ensuring spare capacity and diverse solutions to absorb disruptions.
- 5) **Flexibility** – Adapting strategies to respond to changing conditions.
- 6) **Inclusivity** – Involving all stakeholders, especially vulnerable groups, in decision-making.
- 7) **Integration** – Promoting cross-sectoral collaboration and unified strategies.

These qualities inform the design and selection of **resilience indicators**, which are further shaped by guidance from key organizations like the IPCC, UNFCCC, UNDRR, and the World Bank. Advances in technology—such as data analytics and satellite imaging—have enabled more dynamic, predictive, and context-specific indicators.

ClimEmpower ensures indicators are:

- **Context-specific**
- **Measurable**
- **Comparable**
- **Actionable**
- **Aligned with local/national development goals**

ClimEmpower’s indicator framework reflects several common international themes:

- **Systemic and Intersectoral Perspective:** Workshops, educational materials, and integrated assessment tools promote cross-sector understanding.
- **Measurability and Actionability:** Indicators are evaluated for data availability and discussed with stakeholders to ensure they support practical decisions.
- **Focus on Adaptive Capacity:** Indicators cover governance, education, economy, and society, helping assess a region’s ability to respond to climate impacts.
- **Recognition of Local Diversity:** Indicators are tailored to regional characteristics, based on first-year project findings across diverse pilot regions.
- **Flexibility and Evolution:** While a core indicator framework is developed, the system allows future updates and adjustments through the Climate Services (WP3).

Resilience is also enabled through technological empowerment. ClimEmpower develops a modular, open-source, web-based platform that allows local authorities to:

- Access and manipulate high-resolution climate and socio-economic data.
- Run risk and impact assessments using simplified workflows.
- Compare adaptation strategies based on multi-criteria analysis.
- Receive decision-support tailored to their local context.

The technological framework draws heavily from lessons learned in previous EU projects (e.g., CLARITY, RESCCUE, KNOWING) and offers a scalable architecture for future re-use.

5 Trial Planning: gaps and context

5.1 Trial Regions

The starting point of the Trial Guidance Methodology is the **Preparation Phase**, which begins with what is referred to as **Step Zero**. This step plays a crucial role, as it lays the foundations for the entire trial. Its main purpose is to establish the essential factors that guide both the organisation and the execution of the trial. In particular, Step Zero focuses on two dimensions: defining the **overarching trial goal**, and clarifying the **circumstances and boundaries** within which the trial will take place. These two elements are captured respectively in the **Trial GAPS** and the **Trial Context**.

While the Trial GAPS provide direction by articulating the high-level goals and expected benefits of the trial, the Trial Context addresses the more practical aspects that will shape its organisation. This includes agreeing on the composition of the team, the environment in which the trial will be conducted, and the roles and responsibilities of those involved. For example, roles such as **Trial Owner**, **Technical Coordinator**, **Evaluation Coordinator**, and **Practitioner Coordinator** need to be assigned, either to individuals or to organisations.

In addition, the Trial Context helps establish the main conditions and parameters of the trial. These cover fundamental aspects such as the **location and timing** of the trial, but also extend to initial ideas about the **scenario to be tested**, the **participants to be involved**, and the **tools and procedures** that will be evaluated.

Some of these elements, as well as the solutions to be trialled, are in part already pre-defined by the **ClimEmpower Grant Agreement**. However, they required careful examination and refinement during the implementation of the project. The outcomes of this refinement process are presented in the following sections.

5.1.1 Andalusia

The Western Costa del Sol (WCDS) in Andalusia, Spain, is a highly touristic Mediterranean coastal area with 11 municipalities. The region faces severe climate-related threats, including **water scarcity, extreme heatwaves, wildfires, floods, and coastal erosion**. Seasonal variations in population because of tourism place additional pressure on water and energy infrastructures, worsening existing vulnerabilities. Rapid land-use changes, including urban expansion and increased need for irrigation due to altered climate conditions significantly impact water resources. The region requires integrated climate resilience strategies, including better water management, improved land-use planning, and stronger climate risk policies.

Andalusia, Spain				
Hazard				
	Heat wave	Flood event	Wildfire	Drought
Critical Asset	Built environment, Tourism, Critical Infrastructure, Agriculture, Natural Area			

5.1.2 Sicily

Sicily, Italy's largest island, faces some of the most severe climate threats, including heatwaves, urban flooding, wildfires and biodiversity loss. Urban areas are confronted with severe heatwaves, temperatures reaching record highs (48.8°C in August 2021). Rising temperatures, prolonged droughts, and irregular precipitation patterns severely impact agriculture, biodiversity and urban sustainability. The island's economy, heavily reliant on agriculture and tourism, is increasingly threatened by climate instability. Improving water management, strengthening climate risk policies, climate proofing and integrating nature-based solutions are the most important resilience strategies for the region.

Sicily, Italy				
Hazard				
	Heat wave	Flood event	Wildfire	Drought
Critical Asset	Built environment, Tourism, Critical Infrastructure, Natural Area			

5.1.3 Central Greece

The Region of Central Greece (PSTE) is one of the most mountainous areas in Greece, with a diverse landscape that includes wetlands, agricultural zones, and industrial hubs. Key economic activities include metal production, food processing, and agriculture. The region faces climate challenges such as **wildfires, floods, droughts, heatwaves, and water contamination**, impacting food production and industrial productivity. Limited tourism development, despite regional potential, represents a missed opportunity for sustainable economic growth. The focus in this region is on enhancing resilience through climate-adapted agricultural practices, sustainable water management and fostering climate-smart solutions.

Central Greece, Greece					
Hazard					
	Heat wave	Flood event	Wildfire	Drought	Water contamination
Critical Asset	Built environment, Tourism, Agriculture, Natural Area				

5.1.4 Osijek-Baranja

Located in eastern Croatia, Osijek-Baranja County is the most important agricultural area with extensive fertile lands, rich biodiversity, and significant wetlands. Climate change threatens its agricultural productivity, ecosystems, and water resources. The county has experienced extreme weather conditions, including **floods, prolonged droughts, heat waves and temperature fluctuations**, impacting both biodiversity and food production. The County faces demographic decline and economic stagnation which presents strong socio-economic challenges. Addressing these risks requires sustainable water management, improved flood defences and climate-smart agricultural practices.

Osijek-Baranja, Croatia			
Hazard			
	Heat wave	Flood event	Drought
Critical Asset	Agriculture, Natural Area		

5.1.5 Cyprus

The Troodos Mountain Range in Cyprus covers 15% of the island's landmass, featuring high-altitude forests, natural springs, and a complex hydrological system. The region **experiences extreme temperature variations**, ranging from **very hot summers to very cold winters**. Climate change impacts include decreased water availability, changing precipitation patterns, and biodiversity loss. Since Troodos is an ecologically sensitive region, climate resilience efforts will focus on forest conservation, water resource management, and climate-smart rural development.

Troodos Mountain Range, Cyprus				
Hazard				
	Heat wave	Flood event	Drought	Wildfire
Critical Asset	Tourism, Agriculture, Natural Area			

5.2 Trial Team

The roles within TGM and their naming conventions in both the TGM and ClimEmpower contexts are summarised in Table 2.

Considering the requirements for CoP members as well as the organisational capacities of the partners, most of the trial-related activities will be carried out jointly by the problem owners together with the designated regional technical partners.

Event organisation is delegated to the regional technical partners, with oversight provided by the Trial Owners/Problem Owners

Table 2. TGM and ClimEmpower roles

TGM Role	ClimEmpower role	Organisation	Objective
Trial Owner	Problem Owner	Sicily Region (IT), Osi-jek-Baranja County (HR), Andalusia Region (SP) Troodos Mountain Range (CY), Region of central Greece (GR)	It is responsible for the trial guides and hosting the whole process. It also means having a clear vision of its goals, written in a scenario to show gaps and needs.
Technical Coordinator	Technical and cross cutting partner (TSCC) and Social Sciences and Hu-manities (SSH)	AIT (AT), AQUA (ES), CET (ES), PLINIVS (IT), FER (HR), ECMWF (INT), CERTH (GR), FRC (CY)	Ensures that the solutions developed by Cliempower team are well understood and adequately positioned in the Trial. Coordinates the technical integration, training and trial execution. In this project, The Technical Coordinator will also be responsible for scenario definition, hosting and directing of the trial, including the related event management; despite these tasks are often developed by the trial owner
Evaluation Coordinator	Evaluation Coordinator	AIT (AT) & Plinivs (IT)	Ensures that the evaluation of the trials is adequately designed in the trial preparation phase and that the necessary data is correctly collected during the trials and interpreted afterwards.

TGM Role	ClimEmpower role	Organisation	Objective
Practitioner Coordinator	Case Study Facilitator	CET (ES), PLINIVS (IT), FER (HR), CERT (GR), FRC (CY)	Manages the relationship between the core trial Team and the CoP members. Ensures adequate participation of the CoP members in trial preparation (co-design) and execution phase of the trials.
CM actioners	PR Community of Practice	Five Regional COPs	Represent the needs of regional stakeholders beyond those of the five problem owner organisations. CoP members thus need to be involved in trial design as well as in the trial execution phase. Their feedback is collected through interviews or questionnaires as a part of the trial execution.
Core Team	Core Team	Sicily Region (IT), Osi-jek-Baranja County (HR), Andalusia Region (SP) Troodos Mountain Range (CY), Region of central Greece (GR) AIT (AT), AQUA (ES), CET (ES), PLINIVS (IT), FER (HR), ECMWF (INT), CERTH (GR), FRC (CY)	The core team includes Trial Owner (Problem Owner), Technical Coordinator, Evaluation Coordinator and Practitioner Coordinator (Case Study Facilitator).
Solution Providers	Technical and cross cutting partner (TSCC) and Social Sciences and Humanities (SSH)	AIT (AT), AQUA (ES), CET (ES), PLINIVS (IT), FER (HR), ECMWF (INT), CERTH (GR), FRC (CY)	They present potential solutions, gathering initial feedback and impressions, analysing to conclude which solutions can address the gaps.

5.3 Trial Gaps

The overarching aim of every trial is to identify and assess innovative socio-technological solutions that can address the challenges stakeholders face in adapting to climate change within their region. The first step in preparing a trial is therefore to define the gaps that will be targeted. These gaps are generally specific to stakeholder organisations, the roles and responsibilities of individuals within them, and the climatic as well as socioeconomic conditions of the region.

Within ClimEmpower, the initial identification of gaps was carried out during the project preparation phase and in the implementation of WP1, WP2 and WP4. The preliminary gap definitions, outlined in the Grant Agreement, were later reviewed during the CoP meetings (see D1.2, D2.1, and D5.6, D5.7) through discussions between the Trial Owners (problem owners), the CoP members (stakeholders and practitioners), and the platform technicians. The

Table 3 below shows the gaps that are relevant across all five trial regions, as well as those that are region-specific.

Table 3. Trial gaps

Gap No.	GAP	IT	HR	SP	CY	GR
1.	Insufficient high-resolution spatial data for local climate assessments.	+	+	+	+	+
2.	Limited technical support to improve climate modelling tools.	+	+	+	+	+
3.	Fragmented data-sharing among municipalities/regions	+	+	+	+	+
4.	Weak policy coordination, with limited integration of climate resilience into decision-making at all levels.	+	+	+	+	+
5.	Inadequate asset-level models for assessing impacts of climate hazards and adaptation options.	+	+	+	+	+
6.	Absence of thorough analysis focused on historic climate data and its impact on agriculture and protected areas.		+		+	+
7.	Deficiency in studies examining the impact of climate change on tourism and health sector				+	
8.	Unavailability of practical tools to support climate-proofing procedures	+				
9.	Pluvial Flood models, including detailed assessments and comprehensive flood risk evaluations to support evidence-based planning and decision-making	+		+		

5.4 Trial Context

In ClimEmpower, the trial context is partly predefined by the project objectives, which are to empower European regions to strengthen their climate change resilience by co-developing and testing data-driven tools, indicators, and strategies with local stakeholders through Communities of Practice.

The same applies to the trial locations, which correspond to the five regions: Sicily, Andalusia, Central Greece, the Troodos Mountains, and Osijek-Baranja. The Trial Teams are likewise predefined, consisting of project consortium members selected based on their skills and expertise. However, specific aspects such as the practical organisation of the trials, the expectations regarding the type of information to be generated, and the timing and duration of the “trial run” events still needed to be discussed and agreed upon. These elements formed an essential part of the collaborative work leading to the present deliverable.

At the beginning of Task 4.3, the trial teams confirmed that the TGM is an appropriate approach for validating the outcomes of ClimEmpower. They agreed to organise the trial run events and mini-trials as computer-assisted desktop exercises and to evaluate the project’s outputs primarily through direct observation and questionnaires completed by CoP members participating in the trials. This decision is already recorded in D5.7, section 4.3., along with the period for the two events:

- WS3 (m26-m28) Trial Implementation – Implementation of trial scenarios and collecting data necessary for their evaluation. WS will start with an overview of the trial, objectives, research questions and scenarios, while informing stakeholders of their roles and responsibilities during the trial. The main part of

the workshop will involve scenario execution, followed by a discussion on which aspects of the trial were relevant and successful for stakeholders and to what extent. Stakeholder feedback and collected data will be used to validate the project outcomes, to decide what and how to present on “mini-trial” WS, and to contribute to the ClimEmpower sustainability and exploitation strategy. The workshop will validate all the functions of the platform that is developed by the technical team in the region-specific trial context (section 4.2). In addition, **region-specific preparation activities** will be carried out prior to the trial. These include the generation of region-specific data and models, the plausibility check of results against historical events by the scientific team, and the validation of these results against the needs and expectations of CoP members during the trial run events.

- **WS4 Mini Trial (m30)** Each of the ClimEmpower trial regions will develop a simplified version of the trials as a demonstrator to engage follower regions and determine the level of replicability in a broader context at EU level. Mini-trials will be held as a workshops for (stakeholders of) the follower regions with the aim of presenting the results achieved by the trial and validation process and the results of the participatory co-creation process in order to assess their relevance and usability. => input to sustainability and exploitation planning.

Crucially, the trial will also assess the quality of the training materials provided to stakeholders. This ensures that the resources are not only suitable for their intended purpose but also effectively help stakeholders navigate and use the platform with confidence.

All five trial teams agreed that the focus of the trial run events is to test the **usability of the platform**, rather than to evaluate the quality of the data or model predictions. Scientific or statistical assessment of data and model outputs will instead be carried out by the scientific team during the trial preparation phase. The outcomes of this assessment will be provided as supporting information for the final trial evaluation and shared with CoP members during the trial run events to ensure that the data and model outputs meet their needs and expectations.

Drawing from this premise, the trial context for ClimEmpower was defined as follows:

- **Format of Trials:** Trial run events (and mini-trials) will be conducted as live computer-assisted desktop exercises.
- **Focus on Resilience Tool-box:** Trials and mini-trials will address 1–2 types of situation to test toolbox functions and how this can improve resilience of each trial region.
- Where possible, both historical events familiar to stakeholders and synthetic future events based on climate change projections will be considered.

- Region-specific data and modelling necessary for the trials will be carried out during the trial execution phase. The scientific team will assess the quality of these results, and CoP members will validate them during the trial run events.
- Mini-trials will additionally test the transferability of ClimEmpower results to new regions, under conditions of limited data availability and restricted resources for addressing data gaps and adjusting hazard and impact models.
- **Duration:** Each trial and mini-trial will last two days.
- **Assessment Tools:**
- Each trial will evaluate the core tools developed by the project.
- The tools will be presented by dedicated team members and validated by CoP members.
- Stakeholders will be trained to use the tools independently during the trial events.
- **Feedback Collection:** Feedback during the trial will be gathered through a combination of direct observation, pre- and post-workshop surveys, and retrospective discussions, focusing on three main aspects: a) Participant understanding of the ClimEmpower tools; Effectiveness and usability of the platform; Suggestions for improvement. This structured approach ensures that feedback captures both the usability of the platform and the learning impact on participants, while also identifying actionable improvements for future iterations of the tools. The approach will be further specified in sections 6.3 and 6.4

6 Trial Planning: six step approach

As outlined in Section 3, *Trial Guidance Methodology and CoPs*, the trial planning phase is structured into two stages: “step zero” and “trial preparation.” The trial preparation stage involves the iterative design of six key elements: objectives, research questions, data collection, evaluation methods and metrics, the trial scenario, and the selection of solutions.

6.1 Objectives

The objectives of a trial express the overarching goals and ambitions of the trial team. They are directly linked to identified trial gaps and must be defined according to the SMART principle—Specific, Measurable, Achievable, Reasonable, and Time-bound. Typically, objectives are formulated during a brainstorming session, where participants address the following guiding questions:

- **SPECIFIC:** What are the main challenges or problems you aim to address through this trial? These problems must align with the identified trial gaps; otherwise, the team must revisit step zero to refine the gaps and context.
- **MEASURABLE:** What measurable results should be achieved to tackle these problems? Do you need greater speed? Improved accuracy? Or the ability to perform tasks that are currently not possible?
- **ACHIEVABLE:** Can these objectives realistically be achieved within the trial context? In later iterations, this becomes: “Can this be achieved within the planned scenario and with the solutions being trialled?”
- **REASONABLE:** Can these objectives be achieved with the resources available for the trial? Here, it is important to consider whether the organisations involved would realistically be able to implement the trialled solutions, given legal, organisational, or financial constraints.
- **TIMELY:** Can this objective be achieved within the time frame of the trial? For instance, *Climempower* is a three-year project. Even if resources and interest are dedicated to implementing recommendations for climate change adaptation within the trial, the project duration is too short to monitor the long-term effects of such measures.

Each trial is required to define at least one SMART overarching objective, often referred to as the “trial slogan.” This primary objective can be complemented by a limited number of secondary objectives. All five trial teams agreed on the following overarching objective (slogan) for their trials:

Simplify access to climate data and deliver user-driven decision-support tools that empower local and regional authorities to design tailored climate adaptation measures that enhance co-benefits for resilience, sustainability, and emission reduction.

Table 4. Trials objectives

Obj no.	Objective
O1	Validate the usability and plausibility of ClimEmpower platform outputs, including hazard maps, climate and resilience indicators, and resilience recommendations.
O2	Validate the ability of ClimEmpower tools, models, and services to simulate impacts of long-term climate change on regional vulnerabilities, including hazards such as heatwaves, droughts, floods, and compound events.
O3	Assess to what extent ClimEmpower data, indicators, and services can support regional and local authorities, and other stakeholders, in evaluating climate vulnerability and resilience, identifying strengths and weaknesses at multiple spatial scales
O4	Assess how ClimEmpower platform functionalities (e.g., micro-services, customizable dashboards, educational resources) can help regional stakeholders improve climate adaptation planning and decision-making processes in operational contexts.
O5	Assess the extent to which ClimEmpower educational resources enhance the capacity of Communities of Practice (CoPs) to interpret climate data, understand risks, and identify feasible adaptation options
O6	Assess the platform's ability to facilitate stakeholder collaboration, knowledge-sharing, and joint decision-making for climate resilience planning

The objective must be understood within the specific context of each trial and the regional needs described in Section 5.1. Moreover, Objective 6 is highly relevant to the overall purpose of the project. At the same time, the Trial Team is still in the process of defining which additional platform features may contribute to achieving this objective.

6.2 Research Questions

Research questions are specific points of interest for the trial team. They should always be formulated as questions that can be answered in a straightforward way (e.g., yes/no, rating scales, or simple qualitative judgments). Research questions serve as a bridge between trial gaps and objectives, ensuring that they can be addressed in an objective, verifiable manner during the trial. To be effective, research questions must be clearly formulated, easy to understand, and agreed upon by all trial stakeholders.

For ClimEmpower, trial research questions are grouped into the following dimensions:

- **[Sci]** Science and technology – e.g., “How accurate and reliable are the platform outputs such as indicators, maps, and recommendations?”, “How well does the ClimEmpower toolbox integrate and operationalize climate data?”
- **[UX]** User experience – e.g., “How intuitive and usable is the ClimEmpower interface?”, “How much training do end users need to effectively use the platform?”
- **[Acc]** User acceptance and sustainability – e.g., “Do stakeholders find value in using ClimEmpower for their work?”, “How well do the services support decision-making in real operational contexts?”

- **[Soc]** Socio-economic impacts and ethics – e.g., “What socio-economic impacts do stakeholders foresee from adopting the platform?”, “How do recommended adaptation measures support a just and equitable transition?”

Table 5. Research questions

Dimension	Question	Relevance
[Sci]	How accurate are the ClimEmpower indicators and recommendations compared to established climate datasets?	The question is critical because it assesses the scientific validity of the platform. If ClimEmpower outputs align with trusted climate datasets, users can rely on the platform as a credible tool for decision-making.
[Sci]	Are the maps and outputs generated by the platform reliable for local decision-making?	This question ensures that outputs are not only technically sound but also context-sensitive, supporting stakeholders in applying the information in their specific regional settings.
[Sci]	How effectively does the ClimEmpower toolbox integrate different sources of climate data?	Evaluating integration capacity highlights whether ClimEmpower can serve as a unified entry point, reducing complexity for users and improving efficiency.
[Sci]	How consistent are platform outputs when applied to the same data multiple times?	This question tests the reproducibility of platform results, a fundamental requirement for building trust among researchers, policymakers, and practitioners.
[Sci]	Can the platform handle large datasets without performance issues?	This question helps identify potential technical bottlenecks that could limit adoption in data-intensive applications
[Sci]	Are the platform's recommendations actionable and technically feasible?	this question checks whether outputs can realistically guide adaptation strategies, bridging the gap between climate science and applied decision-making.
[UX]	How intuitive and easy to navigate is the ClimEmpower interface?	This question assesses the user friendliness of the design to avoid underutilization
[UX]	How long does it take new users to become proficient in using the platform?	Learning time is an indicator of accessibility and inclusiveness. This question captures the platform's ability to onboard diverse users, including those without advanced technical expertise
[UX]	How satisfied are users with the clarity of visualizations and reports?	well-designed outputs are crucial for communicating complex climate information. This question ensures that visualizations do not just exist, but genuinely support decision-making by making results understandable.
[UX]	Which features are most helpful or challenging according to user feedback?	Understanding which functions add the most value and which create difficulties allows targeted improvements in future iterations
[UX]	How easily can users customize the platform to their specific needs?	This question measures the flexibility and adaptability of the platform, determining whether it can be meaningfully applied in different contexts.
[UX]	How confident do users feel in interpreting outputs independently?	User confidence reflects both the clarity of information and the empowerment of stakeholders. If users can interpret outputs

		without external support, the platform has greater potential for sustainable, long-term use.
[Acc]	Do stakeholders perceive the platform as valuable for their work?	This question measures whether ClimEmpower meets stakeholders' practical needs and adds clear benefits to their professional activities
[Acc]	How effectively do the platform's outputs support real-world decision-making?	This question assesses the platform's applicability to real-world contexts, ensuring that results are decision-oriented rather than purely academic.
[Acc]	Are stakeholders likely to continue using ClimEmpower after the trial period?	This question helps gauge the potential for lasting adoption and whether the platform will remain relevant without external facilitation.
[Acc]	What factors influence stakeholders' willingness to adopt ClimEmpower in their workflow?	Adoption is often influenced by barriers and enablers. This question explores those drivers to inform strategies for wider uptake.
[Acc]	How compatible is the platform with existing tools and procedures used by stakeholders?	This question examines the interoperability and complementarity of ClimEmpower, determining whether stakeholders can embed it without disruption.
[Soc]	What socio-economic benefits or challenges do stakeholders anticipate from using ClimEmpower?	This question captures the perceived added value and risks of adopting the platform. Understanding both benefits and challenges helps to evaluate the broader impact on communities and institutions. Collecting these perspectives provides insight into how ClimEmpower may influence both short-term decision-making and long-term socio-economic development, ensuring that the platform's design and implementation
[Soc]	How do stakeholders view the ethical implications of relying on ClimEmpower recommendations?	Adaptation measures can affect groups differently. This question assesses whether the platform's outputs contribute to fair and inclusive outcomes, ensuring that no community is disadvantaged.
[Soc]	Could adoption of ClimEmpower influence local economic planning and resource allocation?	This question explores the platform's potential to shape economic planning processes and influence investment decisions
[Soc]	How the use of platform could trigger a shift in institutional practices?	this question considers the longer-term socio-economic consequences of platform use, such as changes in resilience capacity, cost savings, or shifts in institutional practices.

In order to assess in a measurable and objective way whether the research questions have been addressed, the trial foresees the use of a set of tools for data collection before, during, and after the trial. These tools are described in detail in Section 6.3.1, and the section 6.3.4 concludes with a table that maps each research question to the corresponding instruments designed to provide relevant answers.

6.3 Data collection plan, tool and evaluation approach

In line with the Trial Guidance Methodology (TGM), the evaluation of the TRIAL workshop will focus on assessing the usability, relevance, and overall impact of the platform and its associated services. Well-defined trial questions must be answerable

in a clear and unambiguous way, requiring the collection of specific data during the trial and its systematic assessment afterward. The type of data collected, as well as the collection method, depend on the trial objectives, research questions, characteristics of the solutions, and the overall trial context.

Some data will be collected automatically using technical tools or sensors (e.g., measuring the time required to complete a task), while other data will be gathered through interactive methods. The evaluation will adopt a mixed-methods approach, integrating both quantitative and qualitative feedback. Data collection will be structured around three main instruments: pre-workshop surveys, a self-recorded task log template and an observer workshop log template, complemented by follow-up interviews. Most of the data will be collected directly from trial participants (CoP members) using dedicated questionnaires, which participants will complete individually and submit digitally via e-mail or a specialized questionnaire platform. This approach minimizes peer influence and allows participants to provide honest, independent responses.

While surveys offer many advantages, potential limitations, such as respondent fatigue or misinterpretation of questions, will be carefully considered. For this reason, particular attention will be given to using very simple and clear language, avoiding technical jargon, and structuring questions in a concise and straightforward manner to facilitate accurate and complete responses from participants. When designing the questionnaires, attention will be paid to the expected attention span of CoP members and the clarity of the questions to ensure reliable responses. The questionnaires will primarily address the defined research questions, but they will also include profiling questions (e.g., organization, role, education, professional background, and potentially nationality, gender, or age) as well as questions regarding event organization. Profiling data will be handled with strict adherence to privacy regulations (GDPR). Finally, questionnaires will allow participants to select “cannot assess” as an explicit response option. This distinction will enable the evaluation team to differentiate between cases where participants are unable to answer due to questionnaire length or complexity, and situations where the trial did not provide sufficient information for an informed response. All data collected during the trial, will generate valuable insights into user experience, platform usability, and practical application. These insights will directly inform the ClimEmpower exploitation and sustainability strategy v.2 (D4.8), supporting evidence-based decisions for the platform’s further development, adoption, and long-term impact. All tools and instruments used during the trial will be completed digitally. This approach ensures that data are captured accurately and consistently, reducing the risk of misinterpretation or transcription errors. Digital collection also facilitates immediate storage, organization, and analysis of responses, enabling the evaluation team to efficiently process both quantitative and qualitative feedback. Moreover, it allows participants to submit their inputs in a standardized format, supporting comparability across sessions and participants while maintaining the integrity and reliability of the trial data.

6.3.1 Pre-workshop survey

Participating stakeholders are invited to complete a **pre-workshop survey** prior to the start of the trial events. This survey serves as a **baseline assessment**, enabling the evaluation team to better understand participants' backgrounds, current practices, and expectations.

The survey includes a combination of **Likert-scale questions, multiple-choice items, and open-ended responses**.

Key areas of focus include:

- Familiarity with **climate data** and **resilience indicators**.
- Current **use of digital tools** for adaptation planning.
- Identification of **priority hazards** and **adaptation gaps** in regional contexts.
- Initial **expectations and desired outcomes** from participation in the trial.

By establishing a clear reference point, the pre-workshop survey will support the evaluation of learning outcomes and changes in perception over the course of the trial and beyond. Completing the survey should take approximately 10–15 minutes. The structure and contents of the questionnaire are the follow:

Table 6. Pre-workshop questionnaire

Dear Participant, Thank you for joining the ClimEmpower trial. This survey aims to capture your baseline understanding of climate resilience, current practices in adaptation planning, and expectations for the platform. Your responses will remain confidential and will help us evaluate the impact and usability of ClimEmpower. The survey should take approximately 10–15 minutes to complete.				
Section 1.				
Name/ organisation				
Role/Function in your organization		☐ Policymaker / Planner ☐ Researcher / Scientist ☐ Technical Specialist / Analyst ☐ NGO / Community Representative ☐ Other: _____		
Years of experience in climate adaptation or resilience planning		☐ 0–2 years ☐ 3–5 years ☐ 6–10 years ☐ 10+ years		
Section 2: Baseline Knowledge				
How familiar are you with climate resilience concepts?				
1	2	3	4	5

Not familiar at all	Slightly familiar	Moderately familiar	Very familiar	Extremely familiar
How familiar are you with climate and resilience indicators?				
1	2	3	4	5
Not familiar at all	Slightly familiar	Moderately familiar	Very familiar	Extremely familiar
Have you previously used digital tools or platforms for adaptation planning?		☐ No ☐ Yes (please specify):		
Which types of climate hazards are most relevant in your region?		☐ Floods ☐ Droughts ☐ Heatwaves ☐ Storms/ Extreme winds ☐ Other: _____		
What are the main adaptation gaps or challenges in your region?				
Section 3: Current Practices				
How do you currently access and use climate data? (Select all that apply)		☐ National or regional climate services ☐ Scientific publications / datasets ☐ Internal monitoring and reports ☐ Consultancy or expert advice ☐ Other: _____		
How frequently do you use climate data for planning or decision-making?		☐ Daily ☐ Weekly ☐ Monthly ☐ Rarely/ Occasionally ☐ Never		
Which adaptation planning tools do you currently use? (Multiple choice with optional open-ended)		☐ ☐ ☐ ☐ ☐ Other: _____		
Do you face challenges in integrating data from multiple sources?		☐ No ☐ Yes (please specify): _____		
Section 4: Expectations for ClimEmpower				
What functionalities do you expect from the ClimEmpower platform? (Select all that apply)		☐ Data access and integration from global services ☐ Visualization of climate and resilience indicators ☐ Risk and hazard mapping ☐ Tailored resilience recommendations ☐ Educational resources / guidance ☐ Other: _____		
Which outcomes are most important to you from this trial? (Open-ended)				

How confident are you in using a digital platform to support decision-making?				
1	2	3	4	5
Not confident at all	Slightly confident	Moderately confident	Very confident	Extremely confident
Do you anticipate any barriers to adopting ClimEmpower in your work? (Open-ended)				
Any additional comments or expectations you would like to share before the trial? (Open-ended)				

6.3.2 Participant and Observer Task log

The **Participant and Observer Task Log Templates** are designed as essential instruments for collecting data **during the execution of the trial**, capturing both real-time interactions and observed behaviors.

The **Participant Task Log** is structured to be **concise and easy to complete**, enabling participants who are directly performing trial tasks—often without specialized evaluation experience—to record their actions, task duration, encountered challenges, and overall impressions with minimal effort. In contrast, the **Observer Task Log** is designed for individuals present specifically to **monitor and analyze trial execution**, requiring a **higher level of precision and detail** in documenting task completion, participant behaviors, errors, and points of confusion.

By providing templates with **different levels of complexity tailored to their respective roles**, the two logs together ensure a **comprehensive and multi-perspective data collection**, supporting the evaluation team in understanding both the direct user experience and the practical dynamics of task execution throughout the trial.

Table 7. Participant Task Log Template

ClimEmpower Trial – Participant Task Log Template									
Participant Name / ID:					10. 11.				
Date:									
Session / Location:									
Instructions for Participants: Complete the log immediately after each task. Record your start and end times, task success, and any issues encountered. Provide feedback on confidence, satisfaction, and comments.									
Task ID	Task Description	Expected Outcome	Start Time	End Time	Task Completed? (Yes / Partial / No)	Issues / Errors Encountered	Confidence (1–5)	Satisfaction (1–5)	Comments / Suggestions
1.	Example: Access climate data from Copernicus Climate Data Store	Retrieve regional temperature dataset							
2.	Example: Visualize climate indicators	Display selected indicators on dashboard							

3.	Example: Generate hazard map	Map showing flood-prone areas							
4.	Example: Generate resilience recommendation	Receive tailored adaptation actions							
5.	Example: Customize dashboard	Add/remove charts or indicators							

Table 8. Observer Task Log Template

ClimEmpower Trial – Observer Task Log Template		
Observer Name / ID:	6. 7.	
Date:		
Session / Location:		
Trial Phase / Module Observed:		
Section 1: Session Overview		
Item	Description	
Number of Participants		
Roles of Participants		
Session Objective		
Duration		
Section 2: General participant engagement		
Observation area	Notes/ examples	Rating (1 – 5)
Participant attention / focus	e.g., engaged, distracted, asking questions	

Interaction with platform	e.g., independent, required assistance, collaborative			
Ease of following instructions	e.g., clear, confusing, needed clarification			
Level of collaboration / discussion	e.g., high, medium, low			
Section 3: Platform usability				
Feature / Module Observed	Observed Issues	Severity (Low/Medium/High)	Notes / Suggestions	
Data extraction / integration	e.g., slow loading, errors			
Indicator visualization	e.g., charts confusing, misaligned			
Hazard / risk mapping	e.g., map overlays unclear			
Dashboard customization	e.g., drag-and-drop intuitive			
Resilience recommendations	e.g., unclear links to indicators			
Educational resources	e.g., easy to access, informative			
Section 4: Task Completion Observations				
Task ID / Description	Participant Success (Y/N/Partial)	Errors / Challenges Observed	Approx. Time Taken	Notes on Behavior
1.				
2.				
3.				
Section 5: Technical / Environmental Observations				
Platform performance: e.g., lag, crashes, responsiveness				
Environmental factors: e.g., network issues, room setup, distractions				
Technical assistance required: yes/no, details				
Section 6: General observations & Insights				
Positive aspects:				
Challenges / barriers:				

Participant feedback (verbal or informal comments):	
Opportunities for improvement:	

6.3.3 Follow up interviews

The **Follow-Up Questionnaire** is designed as a structured tool to collect **post-trial feedback** from participants, capturing their reflections, experiences, and perceived outcomes after completing the ClimEmpower trial activities. This instrument complements pre-workshop surveys and task logs by providing **systematic insights on changes in knowledge, attitudes, and practical use of the platform**.

The main objectives of the follow-up questionnaire are to:

- Assess **learning outcomes** and changes in participants' understanding of climate resilience concepts.
- Evaluate participants' **experience with the platform**, including usability, functionality, and relevance to their professional activities.
- Identify **challenges, barriers, or unmet needs** in adopting and applying the platform in practice.
- Collect **suggestions for improvement** and recommendations for future trials.

The questionnaire is intended to be **completed individually and digitally**, typically **shortly after the trial sessions** to ensure that participants' experiences are still recent and relevant. It is designed to be **concise and user-friendly**, with a combination of Likert-scale, multiple-choice, ranking, and open-ended questions to capture both **quantitative and qualitative feedback**.

Table 9. Follow up questionnaire

Dear Participant, This questionnaire aims to gather your feedback after a month since the ClimEmpower trial. Your insights will help evaluate the platform's usability, usefulness, and impact in real-world decision-making. The survey should take about 10 minutes to complete.	
4. Section 1.	
Have you used the ClimEmpower platform since the trial?	☐ Yes, regularly ☐ Yes, occasionally ☐ No
If yes, which modules/features have you used? (Select all that apply)	☐ Data extraction / global climate datasets ☐ Indicator visualization ☐ Hazard / risk mapping ☐ Resilience recommendations ☐ Dashboard customization ☐ Educational resources
How frequently have you used the platform since the trial?	☐ Daily ☐ Weekly ☐ Monthly ☐ Rare ☐ Not at all

5. Section 2. Usability and User Experience				
How easy was it to navigate and use the platform after the trial?				
1	2	3	4	5
Very difficult	Slightly difficult	Moderately difficult	Very easy	Extremely easy
Did you encounter any technical issues while using the platform?		☐ No ☐ Yes (please specify):		
How intuitive did you find the platform's visualizations and reports?				
1	2	3	4	5
Not intuitive at all	Slightly intuitive	Moderately intuitive	Very intuitive	Extremely intuitive
How confident do you feel interpreting outputs independently?				
1	2	3	4	5
Not confident at all	Slightly confident	Moderately confident	Very confident	Extremely confident
Which features did you find most helpful? (Open-ended)				
Which features were challenging or require improvement? (Open-ended)				
Section 3: Impact and Usefulness				
Have you used the ClimEmpower platform since the trial?		☐ Yes, for strategic planning ☐ Yes, for operational decisions ☐ No		
How valuable do you perceive the platform to be for your work?				
1	2	3	4	5
Not valuable at all	Slightly valuable	Moderately valuable	Very valuable	Extremely valuable
Do you trust the outputs and recommendations enough to use them for decisions?				
1	2	3	4	5
Not at all	Slightly	Moderately	Very	Fully
Have you observed any changes in your workflow or approach to climate adaptation since the trial?		☐ No ☐ Yes (please specify):		
How frequently have you used the platform since the trial?		☐ Definitely ☐ Probably ☐ Unsure ☐ Unlikely ☐ Definitely not		
Section 4: Socio-Economic & Ethical Considerations				

Have you noticed any socio-economic benefits or challenges from using the platform? (Open-ended)				
Do you believe ClimEmpower supports equitable and informed decision-making?				
1	2	3	4	5
Strongly disagree	Slightly disagree	Moderately disagree	Very agree	Strongly agree
Do you have any ethical concerns about relying on the platform's recommendations? (Open-ended)				
Section 5: General feedback				
What would you improve in ClimEmpower platform to better support your work? (Open-ended)				
Any additional comments or experiences you would like to share? (Open-ended)				

6.3.4 Evaluation, Data Processing and Metrics Analysis

All data collected during the ClimEmpower trial will be processed and analyzed using a structured, multi-method approach to answer research question and generate actionable insights. The evaluation process begins with a **data quality check**, coordinated by the evaluation coordinator. Working closely with the technical coordinator, the evaluation coordinator ensures that all planned data has been collected, is complete, correctly formatted, and accessible. This includes checking digital and paper-based files, verifying timestamps, task completion logs, observer notes, qualitative feedback, and graphical outputs from applied tools. Any missing or corrupted data will be addressed where possible, or documented if it cannot be recovered, to maintain transparency in the evaluation process. The outcome of this step is a **complete, clean, and pre-structured dataset** ready for detailed analysis.

Quantitative data from surveys and task logs will be cleaned, coded, and analyzed using descriptive statistics, frequency analysis, cross-tabulations, and Likert-scale scoring. These metrics provide **objective measures** of participant performance, engagement, and perceptions of the platform. Task completion time is recorded for each participant task, measuring the elapsed time required to complete activities within the platform, which allows the evaluation team to assess **efficiency** and identify tasks that may be overly complex or time-consuming. Task success rate is determined as the proportion of tasks completed correctly or fully according to predefined criteria, capturing both the **accuracy and completeness** of task execution. This measure is derived from both participant self-reports and observer verification, enabling a comparison between **perceived and actual performance**.

The frequency of errors or challenges encountered during task execution tracks both the **number and type of obstacles** participants face, such as navigation difficulties, data entry mistakes, or misinterpretation of outputs. Likert-scale ratings collected through surveys provide additional quantitative insight into participants' **subjective experiences**, measuring self-reported familiarity with climate resilience concepts, confidence in using digital tools, and perceptions of platform usability. These ratings allow for comparisons across participants and evaluation of **changes in knowledge or confidence** before and after the trial. Metrics related to **tool usage and adoption** capture participants' current practices in climate adaptation planning, including the digital tools and data sources they use and the frequency of their use. This information helps identify changes in reliance on the ClimEmpower platform and its integration into existing workflows. Finally, the ranking of **priority hazards and adaptation gaps** provides context-specific insights, highlighting the most relevant challenges in participants' regional settings and informing the tailoring of platform recommendations.

Qualitative data are analysed using a combination of **deductive and inductive coding**. Deductive coding captures themes directly related to the trial's research questions and predefined evaluation objectives, such as perceived barriers to adoption, usability challenges, or the usefulness of specific platform functionalities. Inductive coding is used to identify **emerging themes** not anticipated in the trial design, allowing novel insights to surface from participant feedback. For observer logs, **structured behavioral coding** documents task sequences, errors, and participant strategies, providing an **objective perspective** on task execution and engagement patterns.

Thematic analysis organizes coded qualitative data into meaningful categories and subcategories, highlighting patterns across participants and trial contexts. This process enables the identification of recurring issues, best practices, and suggestions for platform improvement. Additionally, **content analysis** quantifies the frequency of specific qualitative responses, such as common challenges or frequently mentioned platform features, facilitating **integration with quantitative metrics**.

Table 10. Overview of research questions and related tools

Dimension	Question	Expert knowledge	Pre-trial survey	Observer task log	Participant task log	Post-trial log
[Sci]	How accurate are the ClimEmpower indicators and recommendations compared to established climate datasets?	X				
[Sci]	Are the maps and outputs generated by the platform reliable for local decision-making?					x
[Sci]	How effectively does the ClimEmpower toolbox integrate different sources of climate data?	X				

[Sci]	How consistent are platform outputs when applied to the same data multiple times?	X				
[Sci]	Can the platform handle large datasets without performance issues?	X		X	X	
[Sci]	Are the platform's recommendations actionable and technically feasible?	X				X
[UX]	How intuitive and easy to navigate is the ClimEmpower interface?			X	X	
[UX]	How long does it take new users to become proficient in using the platform?			X	X	
[UX]	How satisfied are users with the clarity of visualizations and reports?			X	X	X
[UX]	Which features are most helpful or challenging according to user feedback?			X	X	X
[UX]	How easily can users customize the platform to their specific needs?			X	X	
[UX]	How confident do users feel in interpreting outputs independently?			X	X	X
[Acc]	Do stakeholders perceive the platform as valuable for their work?		X			X
[Acc]	How effectively do the platform's outputs support real-world decision-making?		X			X
[Acc]	Are stakeholders likely to continue using ClimEmpower after the trial period?		X			X
[Acc]	What factors influence stakeholders' willingness to adopt ClimEmpower in their workflow?		X			X
[Acc]	How compatible is the platform with existing tools and procedures used by stakeholders?		X			X
[Soc]	What socio-economic benefits or challenges do stakeholders anticipate from using ClimEmpower?					X
[Soc]	How do stakeholders view the ethical implications of relying on ClimEmpower recommendations?					X
[Soc]	Could adoption of ClimEmpower influence local economic planning and resource allocation?					X
[Soc]	How the use of platform could trigger a shift in institutional practices?					X

By triangulating quantitative and qualitative data, the evaluation team achieves a **comprehensive, multi-dimensional understanding** of user experience, platform usability, and practical application. The insights derived from this integrated analysis form the basis for extracting **lessons learned**, guiding platform refinement, improving

trial methodology, and providing evidence-based recommendations to support the **ClimEmpower exploitation and sustainability strategy v. 2 (D4.8)**.

6.3.5 Scientific Data collection

A fundamental component of the ClimEmpower trial evaluation is the scientific assessment of the platform’s data and model outputs. Before the trial sessions, the ClimEmpower scientific team will analyze the quality, reliability, and consistency of the data and model results. The findings from this preliminary assessment will be summarized and presented to the Communities of Practice (CoP) members, who will provide expert feedback on the plausibility of the results and evaluate whether the outputs are robust enough to support regional planning and decision-making. The specific methods for analyzing scientific data will depend on the type and source of the data. In cases where direct validation is not possible, such as estimating the impacts of adaptation options, expert judgment and scenario-based evaluation will be used. The detailed analytical approaches will be collaboratively defined by the trial teams and scientific experts to ensure that the assessment is both rigorous and relevant to real-world decision-making contexts. The scientific assessment of data and model outputs will be closely linked to the broader evaluation of the ClimEmpower platform, including user experience, stakeholder acceptance, and socio-economic impacts. Insights from the scientific analysis will inform the design of hands-on tasks and scenario exercises during the trial, allowing participants to engage with outputs that are verified for plausibility and relevance. Participant feedback, collected through surveys, task logs, and discussion sessions, will complement the technical assessment by capturing perceptions of clarity, usability, and trust in the outputs. By triangulating these sources of evidence, the evaluation will provide a comprehensive view of the platform’s performance: scientific rigor ensures that outputs are credible, while user experience and acceptance metrics indicate whether the platform is practical, interpretable, and likely to be adopted in regional decision-making.

6.4 Trial Scenario Formulation

Once the fundamental questions of *what needs to be measured, why, and how* have been addressed, the trial team is responsible for designing specific activities and situations in which the required data can be collected. A **trial scenario** therefore provides a detailed description of the context, including clear definitions of the roles involved, their activities, and the information to be exchanged.

The workshop agenda has been carefully structured to balance **training, hands-on practice, reflection, and rest**, to maximize both participant learning and the robustness of usability testing outcomes. Each solution of the ClimEmpower platform is allocated a dedicated one-hour block organized into four components:

- **Training (15 minutes):** A guided introduction ensures that participants understand the purpose, functionality, and expected outputs of each platform

component. This establishes a common baseline of knowledge across all participants.

- **Self-conducted trial (30 minutes):** Participants independently interact with the platform, testing functionalities under conditions that mirror real operational contexts. This direct engagement is essential for evaluating usability, flexibility, and alignment with stakeholder workflows.
- **Task log completion (15 minutes):** Participants record their impressions, challenges, and suggestions in structured task logs. This immediate feedback process captures qualitative insights while experiences are still fresh.
- **Pause (10 minutes):** A short break between sessions prevents cognitive fatigue, sustains engagement, and facilitates smooth transitions to the next component.

The day concludes with a **real case study simulation**, during which participants apply all tested functionalities in an integrated, context-specific scenario. This collaborative exercise demonstrates the end-to-end potential of the platform to support evidence-based climate resilience planning. Routine elements—such as registration, breaks, and reflection moments—are strategically embedded throughout the day to maintain participant energy, encourage informal exchange, and ensure systematic feedback collection. Detailed scripts for each of the time slots need to be prepared and tested by the core trial team on “dry run” meetings and the timings adjusted depending on the needs / complexity of the topics.

Table 11. Trial scenario formulation

Time Slot	Duration	Session	Explicative Comment
08:30 – 09:00	30 min	Registration & Welcome Coffee	Organizational session. Participants register, receive workshop materials, and engage in informal networking. This creates a relaxed atmosphere before the formal start.
09:00 – 09:20	20 min	Opening Session	Plenary introduction led by facilitators: overview of objectives, agenda, and methods. Aligns expectations and establishes a shared understanding of the day.
09:20 – 10:30	1:10 h	Visualization of Indicators	Follows the training–trial–log structure: participants first receive a guided introduction, then test visualization and customization of indicators independently, and finally document feedback in task logs. Ends with a 10-min pause.
10:30 – 11:40	1:10 h	Risk and Hazard Maps	Same structure: training (intro to hazard/risk maps), self-trial (exploration under different scenarios), and task log (reflection on clarity and usability). Closes with a 10-min pause.
11:40 – 12:50	1:10 h	Resilience Recommendations	Organized in the same three phases: training (generation of recommendations), trial (participants apply them at different scales), and task log (recording perceived usefulness and feasibility). Ends with a pause before lunch.
12:50 – 14:00	1:10 h	Lunch Break	Extended pause for rest and informal exchanges among participants. No structured activity.
14:00 – 15:10	1:10 h	Dashboard Customization	Structured cycle: training (intro to modular dashboard), self-trial (participants build customized dashboards), and task log (feedback on usability and adaptability). Ends with a 10-min pause.
15:10 – 16:20	1:10 h	Real Case Study Simulation	Group-based session. Instead of individual logs, participants apply all platform solutions together in a realistic regional scenario. Structured as <i>group trial</i> followed by a short facilitated discussion.
16:20 – 16:40	20 min	Collective Reflection	Plenary discussion guided by facilitators. Participants share experiences, insights, and lessons learned from the day. This replaces individual surveys and fosters shared evaluation.
16:40 – 16:50	10 min	Closing Remarks	Facilitators summarize key outcomes, outline next steps for the trial, and thank participants. Provides closure and continuity.

6.5 Solution Selection

In the ClimEmpower trials, “Solution Selection” has a different meaning from the one envisaged in the DRIVER+ Trial Guidance methodology. Rather than choosing which solutions to test from a pool of solutions, the project’s DoA clearly indicates that the ClimEmpower online platform will be tested as an integrated environment that delivers the modular “CC-resilience toolbox”, through a suite of interconnected functionalities.

Moreover, the platform development will continue in parallel with trial preparation. The objective of the trial is therefore not only to **evaluate the usability of this platform and validate how well it meets stakeholders’ needs and expectations**, but also to utilise the trial preparation to maximise the final results, with particular emphasis on its capacity for regional customization and its ability to facilitate navigation across data, indicators, and services that enhance regional climate resilience.

From a technical perspective, ClimEmpower platform will provide a set of reusable micro-services capable of calculating, visualizing, and exporting indicators and

recommendations, ensuring reusability across different use cases. The following **aspects of the platform will be tested during the trial**:

- **Visualization of Indicators:** A suite of climate and resilience indicators, developed in WP2, will be embedded into the platform. These indicators form the basis for constructing macro-indicators that support the assessment of vulnerabilities, the comparison of adaptation scenarios, and the prioritization of strategies. Users will be able to customize the weighting and relevance of indicators, ensuring alignment with local and regional needs while maintaining consistency across trial regions.
- **Risk and Hazard Maps:** The platform will provide advanced visualization of hazard and risk maps, integrating global datasets with regional models. These maps will represent climate-related threats such as heatwaves, droughts, floods, and compound events under different climate change scenarios. Designed for replication at the European scale, this functionality also accounts for regional risk receptors and generates geospatial outputs to directly support evidence-based decision-making.
- **Educational Resources:** To complement the technical components, the platform will include educational resources designed to strengthen the knowledge base of regional stakeholders. These resources will enhance the capacity of Communities of Practice (CoPs) to understand climate risks, interpret model outputs, and identify feasible adaptation options.
- **Resilience Recommendations:** Building on the indicators and risk mapping outputs, the platform will generate resilience recommendations. This service links macro- and sub-indicators with adaptation actions, producing tailored recommendations at different spatial scales (e.g., regional to municipal). The recommendations will be tested for their capacity to support both strategic planning and operational decision-making in diverse regional contexts.
- The **graphical user interface (GUI)** is designed to be modular and user-composable, allowing end-users to create and customize dynamic dashboards by selecting and arranging components from a reusable library (e.g., indicators, maps, charts, recommendations). This approach ensures that the platform can be adapted to better align with the specific needs, workflows, and expertise levels of different stakeholders. Importantly, the GUI itself will be tested during the trial, with a focus on its usability, flexibility, and capacity to support co-design by regional end-users.

The trial will therefore also serve as a validation of the ClimEmpower platform architecture, assessing the interoperability of components, their efficiency in accessing and processing climate data, and their configurability across case-study regions without requiring modification at source-code level. By engaging stakeholders in real operational settings, the trial will provide robust evidence of the scalability, transferability, and resilience-enhancing potential of the ClimEmpower solution across Europe.

One of the key features of the platform is the **Data Extraction Library**, a powerful tool that integrates a dedicated data access and transformation service connected to global climate data providers, most notably the Copernicus Climate Data Store (C3S). This component enables users to selectively retrieve datasets that are directly relevant to their regional context, thereby avoiding complex local pre-processing. The service will be available both as a Python library and as a REST API, ensuring flexibility, reusability, and interoperability with external workflows. Due to its technical specificity, this feature is not intended for a broad audience. For this reason, the Trial Team has decided to dedicate a focused session to the Data Extraction Library, involving a restricted number of experts in the field.

7 Trial Planning: Execution

The ClimEmpower trial is designed to ensure that the platform is thoroughly tested, participants are fully prepared, and the trial scenario can be executed smoothly. While the final trial run is the main event where data will be collected and stakeholder interactions observed, reaching this stage requires careful preparation and coordination. To support this, the trial includes a **dry run meeting** with the technical team and case study facilitators, followed by a **trial integration meeting** with regional authorities before the final run. The **trial integration meeting**, scheduled for **October 2025**, involves the technical team and case study facilitators. Its purpose is to validate the technical setup, rehearse workflows, and identify any potential issues in advance. During this session, the technical team verifies platform readiness, including data access, computation, and visualization capabilities, while the facilitators rehearse participant tasks, coordinate timing, and provide feedback on usability.

The **TRIAL kickoff**, scheduled for **November 2025**, brings together the trial core team, solution developers, scientific experts, and regional authorities. This meeting focuses on aligning expectations, reviewing the trial plan, demonstrating platform functionalities, and confirming that outputs are relevant for regional decision-making. The trial core team coordinates the overall agenda, ensures contingency procedures are in place, and clarifies responsibilities. Solution developers present tools and workflows, scientific experts validate data and provide interpretation guidance, and regional authorities assess the relevance, clarity, and usability of the platform outputs.

Following the kickoff, two or more **online dry runs** will be conducted with participation of the technical team, case study facilitators, and regional authorities. These rehearsals will test the full trial workflow in a controlled setting, identify potential technical or procedural issues, and ensure that all participants understand their roles. The technical team will confirm platform functionality, while facilitators will practice coordinating participant activities and providing feedback on usability.

The **final trial run**, scheduled for **mid 2026**, will include all participants: technical team, case study facilitators, regional authorities, the core trial team and CoP members. The purpose is to execute the complete trial scenario, test all platform components in practice, collect observations, and gather stakeholder feedback. The technical team will support live operations, facilitators will guide participant activities, regional authorities and other CoP members will engage with the platform and provide feedback on its usability and applicability, and the trial core team will coordinate the process and collect data for evaluation.

Table 12. Trial execution

Trial Stage	Schedule	Participants	Key Responsibilities
Trial Integration Meetings (online)	October 2025	Technical team, Case study facilitators	Test technical setup, rehearse workflows, identify and resolve issues, adjust scripts
Kick off meeting	November 2025	Trial core team, Solution developers, Scientific	Align expectations, review trial plan, demonstrate platform

		experts, regional authorities	functionalities, validate outputs, clarify roles and responsibilities
Dry Runs	March 2026	Trial core team, Solution developers, Scientific experts, regional authorities	Simulate the real trial in a controlled setting, rehearse the end-to-end workflow, test data collection instruments, validate timing and logistics, and anticipate potential challenges to ensure smooth execution during the final trial
Trial Run (Final Execution)	Mid 2026	Technical team, Case study facilitators, cop,	Execute trial scenario, engage with platform, support participants, collect observations and feedback, evaluate usability and performance

8 Mini-trials and Demos

In the final stage of the project, ClimEmpower will concentrate on investigating the transferability of results achieved in one region to the others and assessing socioeconomic effects of climate change and regional CC-resilience strategies. Each of the trial regions will develop a simplified version of the trials as a demonstrator to engage with (at least) one follower region and determine the level of replicability in a broader context at EU level. Follower regions and their primary partner regions are summarised in Table 13.

Table 13. ClimEmpower regions and their follower regions (Status 05/2024)

ClimEmpower region	Follower region
Andalusia (Spain)	Metropolitan Area of Granada (Spain)
Osijek-Baranja County (Croatia)	Vukovar-Syrmia County (Croatia)
Sicily (Italy)	Naples, Metropolitan City of Naples, Campania Region (Italy)
Region of Central Greece (Greece)	Region of Western Greece (Greece)
Troodos mountain area (Cyprus)	Crete (Greece)

Main goal of interaction with the follower regions is to validate the implementation replicability and exploitation plans of the projects by extending the project's participatory process beyond the borders of the five case study regions.

To achieve these goals, follower regions will be integrated in the work of the CoPs, mainly as observers of trial preparation and execution. In addition, each of the trial regions will develop a simplified version of the trial scenarios as “mini trials”, to enable exchanges with follower regions and validate the replication potential of the proposed solutions.

The methodology for the ClimEmpower mini-trials will follow the general Trial Guidance Methodology (TGM), but in a simplified form to specifically test the replicability of results from each case-study region in its corresponding follower region.

The ClimEmpower mini-trials will be designed as short, computer-assisted desktop exercises with the purpose of verifying that the toolbox can be configured with minimal data and setup effort, checking whether stakeholders are able to use it to understand risk and compare adaptation options, and identifying what kind of support will be needed to scale the approach more widely across the EU.

Two to four weeks before the mini-trials, the trial teams will select one or two realistic scenarios—typically a historical event familiar to stakeholders and/or a synthetic future event based on climate projections. A lightweight “minimum viable” data package (e.g., hazard layers, administrative boundaries, a baseline set of indicators) will be assembled, ready-to-use dashboards configured, and concise training assets prepared. At the same time, the evaluation kit (pre- and post-workshop surveys, observation templates, task scripts, and consent forms) will be finalized.

Each mini-trial will run for two days, either in person or in hybrid form, and in the local language.

- Day one will focus on onboarding and core workflows. After a briefing on objectives, roles, and the scenario, facilitators will guide participants through the platform and practical tasks. A structured debrief will then capture usability issues, data gaps, and immediate improvement ideas.
- Day two will emphasize decision support and transferability. Participants will use the recommendations service to compare adaptation options (nature-based, gray, and organizational measures), assemble a simple portfolio, and rank alternatives with a multi-criteria lens. They will then co-author a short “decision memo” summarizing the problem, the evidence considered, preferred options, and trade-offs. The session will conclude with a reflection on institutional fit, adoption barriers, enablers, and next steps.

Evaluation will be integrated throughout the process. A short pre-workshop survey will establish participants’ baseline skills, current tools, and expectations. During the sessions, observers will record time-on-task, completion rates, facilitator interventions, and common error types. The post-workshop survey will capture usability scores, clarity and usefulness of outputs, confidence in independent use, and willingness to adopt the platform in practice. Retrospective discussions will identify top improvements, while follow-up interviews conducted four to six weeks later will assess whether elements have been applied in practice, what barriers remain, and what further support or training may be required.

To ensure comparability across regions, a set of headline metrics will be tracked: completion rates of core tasks and time-on-task; usability scores; reported improvements in understanding risk and options; and signals of adoption intent.

Each region will prepare a concise mini-trial report, documenting the scenario, participants, tasks, metrics, and findings, and a prioritized backlog of change requests for data, services, GUI, and training materials. All activities will be carried out in compliance with GDPR.

In practical terms, the mini-trials will be considered successful when stakeholders in follower regions are able to complete the full workflow—from viewing hazard maps to generating recommendations and drafting a decision memo—with limited facilitator support; when a clear, region-tailored replication recipe is produced; and when participants express trust in the outputs, a realistic intent to adopt the tools, and a feasible pathway for training and maintenance.

9 References

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