I-CISK

HUMAN CENTRED CLIMATE SERVICES

Deliverable D1.2

Roadmap for the collaboration between the Living Labs (WP1) and Work Packages 2-6

September 2023

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I-CISK

Innovating Climate services through Integrating Scientific and local Knowledge

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Executive Summary

The action-research approach that is taken in the I-CISK project implies that the research and innovation that is developed in the project is done so in close collaboration with the seven Living Labs that have been established in the project. In each of these a close collaboration with the actors and stakeholders that constitute multi-actor platforms (MAPs) have been set up. The collaboration between these living labs and the tasks in the project is essential in co-creating human centred climate services, following the seven steps that have been identified in the prototype co-creation framework. This framework itself is a key output of the project, and through reflection and analysis of how this is applied in the living labs the framework itself will be refined to evolve into a final co-creation framework for human centred climate services.

In this report, a roadmap is developed to outline the co-creative collaboration between the living labs and the research and innovation tasks of the project. This is developed as a generic roadmap for all the living labs, with interactions with the MAPs defined at six-monthly intervals. In a next step, when the roadmap is detailed to each of the living labs these intervals may change. Crucially, the roadmap provides clear linkage to the seven steps of the co-creation framework, and how these link to the different tasks as well as when these form the focus of the process as the climate services co-created in each living lab evolve. Additionally, the report identifies fourteen crucial tasks in the project. These need to be monitored carefully to ensure delays do not occur. The information in this report is intended to guide the efficient and effective collaboration between the living lab and the project partners, and to ensure stakeholder overload and fatigue is avoided.

The needs and desires for climate services within the living labs have been co-explored with stakeholders (deliverable D2.1). That report shows that the climate services that are to be co-delivered to the pre-operational status either cater to decision processes at the (sub) seasonal to decadal time scale, or to the longer climate time scale when considering adaptation options and strategies. Seven research themes that the project addresses in the co-creation of climate services are also identified, and an analysis shows which of these themes is emphasised in each of the living labs. This provides important information to the researchers involved in the project as it allows identification of the living lab(s) in which each of their research objective can be best developed.

This report has been developed primarily to support the details of the collaboration between the work packages, and map this collaboration in time. As the project progresses, these collaborations may be refined. Also, the generic framework described will in a second step be translated into the specific detail of each living lab and how the collaboration is implemented, bearing in mind the general timing of the generic roadmap and the objectives of each step. This also means that this report will be updated as the project evolves and insight is gained on the collaboration between the work package that coordinates the Living Labs, and the other tasks of the project. More generically, the report provides guidance on a process through which the co-creation framework as applied within the I-CISK project can be operationalised. This may be useful in the co-creation of climate-services independent to the living labs in which the research is developed in this project.

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Appendix 1 Glossary

Acronym	Definition
API	Application Programming Interface
C3S	Copernicus Climate Change Service
CDS	Climate Data Store
CEMS	Copernicus Emergency Management Services
CMIP	World Climate Research Programme's Coupled Model Intercomparison Project
CORDEX	Coordinated Regional Climate Downscaling Experiment
CS	Climate Services
CSIS	Climate Services Information Systems
DRR	Disaster Risk Reduction
GEO	Group on Earth Observations
GEOSS	Global Earth Observation System of Systems
GUI	Graphical User Interface
IPCC	Intergovernmental Panel on Climate Change
LL	Climate Services Living Labs
NHMS	National Hydro-meteorological Service
MAP	Multi Actor Platform
MOOC	Massive Open Online Course
OGC	Open Geospatial Consortium
S2S	Sub-seasonal to Seasonal
TRL	Technology Readiness Level
UNCCD	United Nations Convention to Combat Desertification
UNDRR	United Nations Office for Disaster Risk Reduction
UNFCCC	United Nations Framework Convention on Climate Change
WCRP	World Climate Research Programme
WFD	Water Framework Directive
WMO	World Meteorological Organization

1 Introduction

Climate Services (CS) have rapidly developed in recent decades, benefiting from the advances in climate science and rapid increases in availability of climate related data. When used effectively, these are considered to be crucial in empowering users in taking climate smart decisions and helping them define resilient pathways to address the challenges posed by climate change and reduce the impacts of extremes such as floods and droughts (Goddard & Goddard, 2017).

Despite the potential CS provide, there are challenges in bridging the gap between CS that are useful; to CS that are actually used (Raaphorst et al., n.d.; Vincent et al., 2020). Some of these challenges stem from the fact that CS have often been developed through a largely top-down approach (Jacobs & Street, 2020), with the scientific data and methods as the primary knowledge on which services are founded. As a result, the services do not fully consider the social and behavioural factors of the intended users, nor the local knowledge and customs these users have. One of the main objectives of the I-CISK project is to develop a framework through which climate services are co-created with all actors that are involved in the climate services value chain; including data providers, the research community, climate services producers and purveyors, and importantly the users that the climate services intend to serve. Throughout the project, lessons learned from the application of the framework the project is developing in the living labs will be used to adjust the framework. This will help mature the framework, and make it ready to be used to support co-creation of climate services beyond the project.

Figure 1 The I-CISK co-creation framework guiding the process of developing human-centred CS

The process of co-creation entails the joint development of knowledge and services between experts with multiple disciplines, and the diverse sectors the CS are designed to serve (Brandsen, Steen, & Verschuere, 2018; Celliers, Costa, Williams, & Rosendo, 2021). It requires active involvement of all actors, in particular the end-users of the product and services. The high degree of interaction that the co-creation process entails, also means that research undertaken in the project is done in close collaboration with the users of the climate services.

In the I-CISK project this close collaboration is ensured through an action-research approach. All research is developed within 'Living Labs' (LLs). LLs are real-life environments within which multiple stakeholders and researchers interact and where innovation and development activities can be jointly conducted (Fuglsang & Hansen, 2022). Within the I-CISK project, seven LLs have been established, located in climate change hotspots across Europe and Africa, each with specific geographical and climatic settings. These LLs have been designed to provide the space where CS will be co-created with stakeholders from multiple sectors to meet their climate information needs. The LLs that have been established in the project are located in The Netherlands, Spain, Italy, Hungary, Greece, Georgia and Lesotho. A first work package (WP1) of the project has been designed to

coordinate the activities of these seven LLs, and has already established a detailed characterisation of each. This can be found in deliverable D1.1: "*Characterization of the I-CISK Living labs*"[1].

Work Package 2 (WP2) focuses on conceptualising the co-creation framework and learning from its application and refining the framework through an iterative process of co-evaluation. The co-creation framework that is under development in the project comprises of several steps as shown in Figure 1. This prototype co-creation framework has been developed as project milestone[2] in the early stages of the project to guide the process with the living labs. Through the course of the project this prototype framework will be developed and matured, and will be fully described in project deliverable D2.5: "I-CISK framework for co-creating user-centred climate services".

As can be seen in Figure 1, three of the steps in the co-creation framework include; (i) co-exploring user needs, (ii) co-identifying relevant local knowledge, perceptions and concerns and (iii) co-identifying the climatic parameters and thresholds, and the spatial and temporal scales of climate information that match with the envisioned climate actions to be supported by the CS. For this, a survey of climate services needs and gaps in each of the living labs has been developed and is available in a deliverable[3]. Co-creation also entails the co-exploration of the behavioural factors, drivers, and barriers that influence how climate information is used in short to medium term decisions (sub-seasonal and seasonal). These are key entries into the co-design of tailored CS that are not only useful, but are also used to inform the identified decision processes in a trusted, understandable, reproducible and effective way. The following steps in co-creating is the co-design of climate information (products) that integrate both local and scientific datasets. Depending on needs, these can span time-scales from sub-seasonal to seasonal, through to the decadal and climate projection time scales. Research to advance the methods and tools required for the transformation, visualisation and quality assurance; and the integration with local knowledge with scientific data is the focus of Work Package 3 (WP3) of the project. In Work Package 4 (WP4) an understanding of the bi-directional and multiple feedbacks between the human and the climate system is explored.

In Work Package 5 (WP5), CS are co-designed to the pre-operational stage through a climate services platform, or climate services information system (CSIS). The development of these pre-operational CS will allow these to be available to users and to be co-evaluated within their real-world context . WP5 additionally explores the co-delivery of the CSIS. This includes ensuring users have the necessary capacities and that there is an enabling environment for the adoption of CS. It also requires to explore business models and institutional settings within the climate service sector in each of the LL, including public and private entities. This is essential for the sustainability of these services that have been developed. Work package 6 (WP6) finally focusses on communication, dissemination and outreach.

The action-research approach that is essential achieving the objectives of the I-CISK project, means that the with the research is very much grounded within the context of the seven LLs. This also means a close interaction and iterative process with the diverse stakeholders that have been identified in each of these LLs. To enable this close interaction, a roadmap has been developed that details this collaboration between the LLs and the other work packages and tasks of the project. This roadmap is developed from the perspective of the LLs and outlines the interactions with the multiple stakeholders in each LL. The roadmap also outlines the

[1] https://icisk.eu/wp-content/uploads/2022/07/D1.1-Characterization-of-the-I-CISK-Living-Labs-Final.pdf
[2] https://icisk.eu/wp-content/uploads/2023/03/Milestone-MS10-A-prototype-framework-on-co-creating-end-user-centred-climate-services.pdf
[3] https://icisk.eu/wp-content/uploads/2022/07/D2.1-I-CISK-Information-on-climate-service-needs-and-gaps-Final.pdf

objectives of each these interactions and how the research developed in the tasks defined within the WP2 through WP6 contributes to achieving these objectives.

In this report the roadmap for the collaboration between the Living Labs (WP1) is described. A generic roadmap is first outlined in Chapter 2, which sets out the main interactions and the connection to the various tasks in the remaining work packages. As each LL is different, as well as the stakeholders, it is clear that the context and specific goals of each of the LLs differs. This means that this generic roadmap may not be fully applicable in all cases. In Chapter 3 further details of how the roadmap is defined for each of the seven living labs. Chapter 4 describes how the implementation of the roadmap is monitored through the course of the project and how this may be adapted and updated. Chapter 5 provides a short summary and conclusions.

Guide to the Reader

The roadmap that is presented in this document has been developed to serve two purposes. This also means that how the document can be best used will depend on which of these purposes is relevant to the reader.

For the reader that is involved in one of the living lab teams, the roadmap can be used to provide guidance on how the process and interactions can be organised and planned within the context of the living lab. The guidance provided is generic, and so will need to be adapted and adjusted to the specific context, to develop the roadmap adjusted to that living lab. This can guide the interaction between the researchers and the stakeholders in the living lab, and help set expectations. Additionally, the roadmap can also be used to identify when the different the tasks in the project seek to engage with the living lab and the stakeholders therein. This is important to allow the living lab teams to facilitate these interactions, and make sure that efforts are combined. This includes for example the combining of questionnaires or workshops with the stakeholders, to ensure the project makes an efficient use of their valuable time, and to avoid what can be referred to as stakeholder fatigue.

For the reader that is working on the development of one of the tasks within work packages WP2 through to WP6, and not directly connected to a specific lab, the roadmap is also useful to identify the interactions with the stakeholders in the living labs. This again to ensure the opportunities of engagement with the stakeholders are realised and the information required to progress the scientific goals are obtained efficiently. The document also provides a mapping between the main scientific themes that are addressed in each living lab. This is important information to identify with which roadmap team the reader should engage, depending on the scientific theme of the task in hand. This then allows the reader to become a part of that roadmap team, and also explore with that team the specific details of the living lab specific roadmap.

A second, more general purpose is that the approach taken in the roadmap as it is laid out here, and how this aligns with the co-creation process. This can be easily adapted to suit a climate service co-creation process in another context than the seven living labs of this project.

2 A generic road-map for collaboration

In this chapter we outline a generic roadmap for the collaboration between the seven LLs defined in the I-CISK project (conceptualised in WP2 and coordinated in WP1) and the remaining work packages (WPs). The generic roadmap is embedded in the co-creation framework for human centred climate services. This prototype, which provides guidelines for the co-creation process, comprises of a highly iterative sequence of steps. These include; co-exploration of CS needs and desires; the co-identification of adaptation and DRR strategies; the co-development of climate data and knowledge; the and co-design of user-centred climate services. Knowledge and services developed are co-evaluated throughout; with the process culminating in the co-delivery of (pre) operational climate services.

This roadmap serves two purposes. First, it defines the envisaged interactions with the multiple stakeholders conformed in the multi-stakeholder platforms established in each of the LLs. This can be used to set expectations with those stakeholders, helping clarify how and how often they will be interacting with the researchers in the project. We recognise that the co-creative action-research approach taken by the project means that interaction may be sought by many researchers in the project, including but not limited to the development of surveys; focus-group discussions; participatory modelling activities; and user feedback and reflection sessions. The goal of the roadmap is to streamline and combine these interactions to the extent possible. Second, the roadmap sets out the research objectives of these interactions, thus defining when the research activities in the various WPs and the tasks therein are developed. This will be used by the research team to design the research process.

Figure 2 presents a generic roadmap, which has been established from the perspective of the interactions with the multi-stakeholder platforms, and designed to represent the steps in the co-creation process. Interactions are designed at intervals of around six months, starting with the operationalisation of the MAP in each of the LL in the first six months of the project, which itself started in November 2021. Each of these interactions, has a specific set objectives and links to other work-packages and the tasks therein. Interactions can be organised in the form of a workshop or meeting with the MAP, but may also be indirect interactions such as questionnaires or interviews, depending on what best suits the context. It should also be noted that the six-months intervals should be considered as staging posts, rather than strict deadlines, and should be refined to the LL context. The overall goals of the six-monthly interactions, or staging posts, are outlined in the following list, while the details are presented in the following sections (see also Figure 1 for the steps in the co-creation framework).

- Jan-April 2022. As part of Co-creation step 0 (Building continuous engagement in the Living labs): Operationalising the Living Labs and establishing Multi Actor Platforms, starting with a first contact with the Living Labs and as part of Co-creation step A (Co-exploring climate information needs and desires): Survey to the LL on existing climate services, gaps and needs
- September-November 2022. As part of Co-creation step B (Co-identifying adaptation and DRR plans to be supported) and C (co-developing climate data and climate knowledge): Uncovering local knowledges, expected impacts of CS and identifying adaptation options.
- February-April 2023. As part of Co-creation step B (Co-identifying adaptation and DRR plans to be supported) and C (co-developing climate data and climate knowledge): Validation of multiple knowledges, adaptation options and feedbacks
- September-November 2023. As part of Co-creation step C (Co-developing climate data and climate knowledge) and D (Co-designing climate services providing climate information): Prototyping CS and Knowledge Integration
- February-April 2024. As part of Co-creation step E (Co-evaluating the prototype climate services): Prototype reflection; participatory modelling to explore adaptation options

- September-November 2024: As part of Co-creation step F (Co-delivering pre-operational climate services information systems): Pre-operational testing of pilot CS in each of the LL; reflection on expected impacts
- February-April 2025. As part of Co-creation step E (Co-evaluating the prototype climate services): Final interactive workshops, with focus on reflections on the co-creation process itself and its resulting of pre-operation CS tested in the LLs, impact stories and upscaling
- June-July 2025: Project end workshops, with focus on policy implications, communication and dissemination and sustainability

As the project closes at the end of October 2025, it is envisaged that final interactions with the MAP in each of the LL is held during July-September of 2025.

Within each of the LLs the frequency of interactions, as well as the objectives of each may differ, depending on the context as well as the specific objectives in the LL. The specific context and details of how this generic roadmap is established in each LL are provided in the next chapter.

Figure 2 also shows how these interactions align with the co-creation process. This alignment is also described in the text below (with reference to the steps of the co-creation framework as shown in Figure 1 provided in italics). More complete information on the objectives of each of the steps of the co-creation process are provided in the (prototype) co-creation framework (See project milestone MS10). This also provides key performance indicators used to monitor the step, actions undertaken, some guidance on techniques and tools that can be applied, as well as enablers to the success of the step. A set of questions is also provided to serve as a form of checklist. As a result, this roadmap which focusses on opportunities for interactions and provides an outline of the timing and *when* steps are taken, the co-creation framework provides information on *what* the objective of the steps are and *how* these can be done.

It should be emphasised that the co-creation process also is a very iterative one, with many of the steps such as the co-exploration of climate information needs and climate services desires repeating and being validated and refined over multiple interactions with the stakeholders in the living lab. This is not fully represented in the figure as the steps are here represented in a more linear fashion. The figure does show, however, at what stage there may be more emphasis on a particular step in the process. Note also that several steps may also happen concurrently.

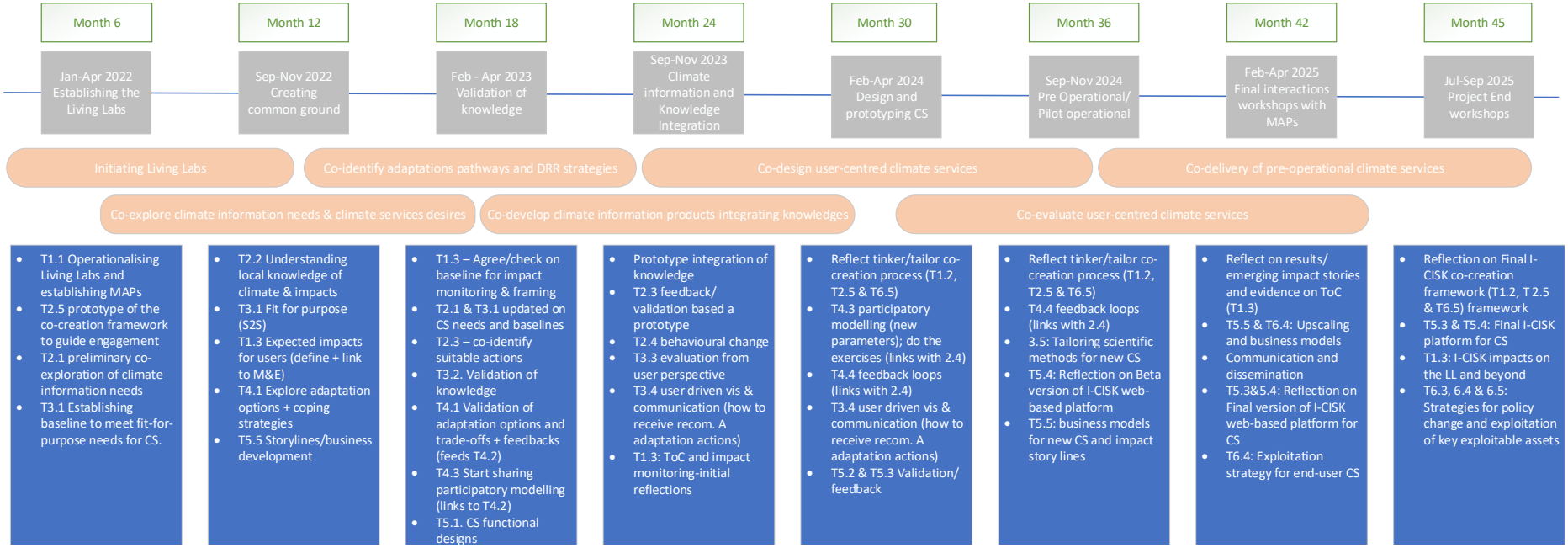

Figure 2 I-CISK roadmap highlighting the interactions with Multi Actor Platforms in the Living labs and linkages to different tasks to be focused on during co-creation sessions with MAP.

2.1 Jan-Apr 2022: Establishing the living labs

The interactions and workshops organised in the first months up to April 2022, and constitute the first engagement with the living labs. This also aligns with the *building a continuous engagement with the Living Labs* (step 0, Figure 1) of the co-creation framework, in which the key actors are identified and partnerships formed, expectations are established, and plans are made. Additionally, initial steps in *co-exploring climate information needs and climate services desires* (Step 1) are taken at this early stage, which are consolidated and validated in later interactions.

Table 1 Objectives of the specific work-package tasks in the January-April 2022 interactions

Task	Description
Task 1.1	This is a very operational task in which the LL is established and the multi-actor platform in each operationalised. This includes identifying the key stakeholders and establishing with them mutual expectations, reaching agreements (at times formal), and outlining the planning of the research and setting expectations for the project.
Task 2.5	This task comprises the co-creation framework itself. While the task culminates toward the end of the project, a prototype of the co-creation framework is already established/adopted as a first step of this initial stage. Although this does not require interaction with the living labs as do other tasks, the context of the living labs is important to the initial design of the co-creation framework, also as the framework guides the design of the interactions with the living labs throughout this project.
Task 2.1	At this stage this task develops a first step in the co-exploration of the climate services needs and desires among the multi-actor platforms. Existing climate services that are in available and perhaps in use are summarised.
Task 3.1	This task concerns the developing of fit for purpose methodologies to meet local climate information needs. This has developed baseline scientific data, including downscaled and bias-corrected seasonal forecast data at the scale of the LLs. Initial results from this task can be presented. Feedback on these baselines from stakeholders in the LL will provide essential input to the further development of this task and refinement of the fit-for purpose methodologies, as well as an important input to Task 3.2. At this first step, the focus is on establishing the geographic extent of the living lab and what are the key hydrometeorological variables and at what space and time scales these are relevant in the LL context

2.2 Sep-Nov 2022: Uncovering local knowledges, expected impacts of CS and adaptation options.

The focus of interactions and workshops organised around November 2022 are to re-engage with the multi-stakeholder platforms that were established within each of the LL. Within this workshop, an important aspect is to reflect and confirm the expectations of the stakeholders involved, as well as to co-evaluate and co-design the implementation of the roadmap within the specific LL context. This is also a validation of the first step of the co-creation process, *Initiating living labs*. Gradually more emphasis is on subsequent steps of the framework, validating and expanding the *co-exploring of climate information needs and climate services desires*. Linked to that, initial steps in *co-identifying adaptation pathways and DRR strategies that will be supported by climate services* can be taken.

Table 2 Objectives of the specific work-package tasks in the November 2022 interaction

Task	Description
Task 2.2	Local knowledge and understanding of climate, climatic patterns and impacts will be explored. This will consider the multiple dimensions these knowledges may

	take within the different livelihoods and different sectors in each LL. Results from this identification provide an important input into Task 3.2, which considers the merging of local and scientific knowledges.
Task 3.1	This task concerns the developing of fit for purpose methodologies to meet local climate information needs. This has developed baseline scientific data, including downscaled and bias-corrected seasonal forecast data at the scale of the LLs. Initial results from this task can be presented. Feedback on these baselines from stakeholders in the LL will provide essential input to the further development of this task and refinement of the fit-for purpose methodologies, as well as an important input to Task 3.2.
Task 1.3	The objective of this task is to develop a systematic monitoring and evaluation of the impacts of research in the project and the pre-operational CS in each LL. At this stage, theory of change for each LL is finalized and a baseline of the expected impacts is co-defined.
Task 4.1	This task aims at identifying and unpacking the causal mechanisms explaining the emergence of different feedbacks between climate change, climate service data, socio-economic behaviour, and adaptation measures in each LL. Adaptation options and coping strategies available to the multiple stakeholders and multiple sectors will be co-explored.

2.3 Feb-Apr 2023: Validation of multiple knowledges, adaptation options and feedbacks

The objectives of interactions and workshops organised around April 2023 are largely to reflect and validate with the multiple stakeholders and multiple sectors the information uncovered, as well as advances in the research in combining local and scientific knowledges. At this stage, there is a strong focus on the validation of the *co-exploring of climate information needs & climate services desires,* as well as the *co-identifying of pathways and DRR strategies*. The knowledge established and validated in these steps provide important starting points for the *co-development of climate information products integrating knowledges* in each of the LL, which is primarily undertaken in subsequent interactions but initiated at this stage.

Table 3 Objectives of the specific work-package tasks in the April 2023 interaction

Task	Description
Task 3.2	Feedback and reflection from the MAP will be sought on the initial steps in merging local knowledges (uncovered in Task 2.2) and large-scale climate services and fit-for purpose methodologies established in Task 3.1.
Task 2.1	The initial exploration of the user needs for climate services identified and compiled in deliverable 2.1 will be reflected on and updated, as these needs may have changed, in part through interaction with the project and its researchers.
Task 2.3	At this stage, an initial exploration of suitable actions will be explored from a conceptual perspective. The initial exploration of how information is used to inform decisions will provide important inputs to Task 3.4, which considers the user-driven visualisation within CS.
Task 4.2 / Task 4.3	Participatory methods, including modelling, that will be used to uncover knowledge on the human-climate feedbacks will be co-explored
Task 1.3	The baseline of expected impacts of CS in each of the LL will be further checked and refined and agreed on with the MAP.
Task 5.1	Feedback on the CS functional design will be sought, in particular related to the front end (Task 5.3) and the data and data transformation methods (Task 5.2).

2.4 Sep-Nov 2023: Climate information and knowledge Integration

In November 2023, climate information products, integrating local data and knowledge as well as scientific datasets will be prototyped. The *co-developing climate information products that integrate tailored local knowledge and state-of-the-art climate data and knowledge* step of the co-creation framework is central to the interactions in this timeframe. Validation of the previous steps will also happen as a part of this process, and as these will also include prototyping of products where possible, this also contributes to the *Co-design user-centred climate service system providing tailored climate information* step.

Table 4 Objectives of the specific work-package tasks in the November 2023 interaction

Task	Description
Task 3.3	The initial designing and prototyping, and evaluation of prototype CS will establish key inputs to the user driven evaluation of the CS. Unpacking the dimensions of the CS relevant to multiple users and stakeholders will help identify suitable metrics to support the evaluation
Task 2.3	The prototype CS, including information contained on suitable actions as identified in the previous interaction, will be used to gain feedback and reflection, and refine these where required. This will provide further input to Task 3.4
Task 2.4	The prototype CS will additionally support identification of behavioural change in the LL. This provides key inputs to Tasks 4.3 and Task 4.4.
Task 3.4	The prototype CS will help further develop the understanding of user-driven communication practices and needs. This includes how the adaptation options uncovered in Task 2.3 are presented and visualised. These are important inputs to the CSIS front-end components (Task 5.2)
Task 1.3	The expected impacts of CS in each of the LL will be monitored using the pre-defined KPIs, and will be checked against the baseline data.

2.5 Feb-Apr 2024: Climate Service Prototyping participatory modelling of adaptation options

The April 2024 interactions and workshop focus on further development of CS prototypes to carry climate information products. The *Co-design user-centred climate service system providing tailored climate information* step of the co-creation framework is the emphasis of the interaction in this phase, while also providing opportunity to validate the climate information products developed in the previous step, as well as initial evaluation of these products. Important feedback and updates to the specification of the I-CISK web-based CS platform are obtained. Additionally, participatory modelling will be undertaken to explore human-climate feedbacks and adaptation options, supported by the CS prototypes.

Table 5 Objectives of the specific work-package tasks in the April 2024 interaction

Task	Description
Task 3.4 / Task 5.2 & 5.3	Further validation and feedback of users will help refine and innovate visualization of climate information products within the CS, including uncertainties. This is also important to the updating and validating of the specifications I-CISK web based CS platform back-end and data (Task 5.2) and front-end (Task 5.3)
Task 4.3 / Task 4.4	Participatory modelling and serious gaming will be applied within the LL context. These will be developed based on the of the behavioural change instigated by CS as co-identified in Task 2.4, as well as the adaptation options co-identified in Task 2.3.
Task 1.2, Task 2.5 and Task 6.5	Discuss with MAP about the co-creation process and adapt the I-CISK protype co-creation framework as required in different LL. This is linked to task 1.2 (effective contribution of MAP in the co-creation process); task 2.5 (guidelines on co-design of climate services, and task 6.5 (I-CISK co-production framework for human-centred CS).

2.6 Sep-Nov 2024: Pre-operational testing of pilot CS in each of the LL

This workshop will focus on the testing, feedback and reflection on the pre-operational CS. At this stage the focus in the co-creation process is on the *Co-evaluation of user-centred climate services*, and validation and refinement of the co-design of these. Additionally, initial steps towards the *Co-delivery of pre-operational climate services* are developed through exploring business models.

Table 6 Objectives of the specific work-package tasks in the November 2024 interaction

Task	Description
Task 1.2, Task 2.5 and Task 6.5	Discuss with MAP about the co-creation process and adapt the I-CISK protype co-creation framework as required in different LL. This is linked to task 1.2 (effective contribution of MAP in the co-creation process); task 2.5 (guidelines on co-design of climate services, and task 6.5 (I-CISK co-production framework for human-centred CS).
Task 4.4	The outcomes of the analysis of long-term feedbacks between human and climate systems are discussed with MAP. This contributes to the selection of most suitable adaptation actions that address climate change impacts while avoiding maladaptation in the LL contexts
Task 3.5	The concept of next generation of CS developed by integration of local and scientific knowledges, data, tools and methods will be discussed with MAP. This provides important input to develop protype CS and I-CISK CS platform (linked to task 5.4)
Task 5.4	The first (beta) version of I-CISK CS platform is discussed with MAP to receive feedback on customizing it to local needs of different LL.
T5.5	The initial ideas on business models for the pre-operation CS will be discussed and refined by the I-CISK partners and MAP members. The methods to document impact stories resulting from the pilot testing of new CS will be co-developed.

2.7 Feb-Apr 2025: Final interactions and workshops in LL context

The events in the second quarter of 2025 (e.g., April 2025) provide opportunities to reflect on the experience of end-users and impacts of using the pre-operational CS and I-CISK platform'; the *co-evaluation of user-centred climate services* step of the co-creation framework. The interactions will provide evidence on successes and failures, and way forward on documenting impact stories and outlining the exploitation and upscaling strategy. Additionally, there is an increasing emphasis on the *co-delivery of pre-operational climate services* as these progress towards the pre-operational stage in each of the LL

Table 7 Objectives of the specific work-package tasks in the April 2025 interaction

Task	Description
Task 1.3	The interactions during this phase will provide evidence of behavioural change and impacts resulting from the pilot testing of the pre-operational CS and I-CISK platform in the LL. The KPIs will be updated and discussed with the MAP, and selected impact stories will be documented (e.g., in text and short video formats).
Tasks 5.5 & T6.4	The exploitation and upscaling strategy for the successfully developed CS under I-CISK will be discussed within and beyond the LL. The business strategy will be outlined with discussion on the IPR issues (if applicable).
Task 5.3 & 5.4	These final interaction moments with the MAP will provide opportunity to received feedback on (near) final version of the I-CISK CS platform

2.8 Jun-Jul 2025: Project end workshops in the LL

These project end events in the LL will be conducted during last three months of the project (e.g., July to September, 2025) before the project ends in October 2025. These final interactions will ensure critical reflections on the key exploitable assets co-developed under I-CISK (e.g., co-creation framework, I-CISK platform, Pre-operational CS, education and training materials such as a Massive Online Open Course on human centred CS). The exploitation and upscaling strategy will be co-developed with the key actors in the LL (MAP members and other relevant actors within and beyond the LL). The way forward on further development, application and sustainability of the exploitable assets will be outlined. The final workshops will also share the policy recommendations relevant for local, EU and international contexts.

Table 8 Objectives of the specific work-package tasks in the July 2025 interaction

Task	Description
Task 1.2, Task 2.5 and Task 6.5	During these final interaction events (e.g., project end workshops in the LL), a final version of I-CISK co-creation framework and guiding document will be discussed with the MAP, and refined if needed. The role of the MAP/LL in the co-creation process will be co-evaluated, and lessons learned during the co-creation process will be identified and discussed
Task 1.3	The final observations on the theory of change and impacts within the I-CISK LL and beyond will be presented to MAP and other relevant actors.
Task 6.3, 6.4 & 6.5	Building on the key exploitable assets developed under I-CISK (e.g.co-creation framework, I-CISK platform, Pre-operational CS, education and training materials such as a Massive Online Open Course on human centred CS). the project team will share with internal and external actors how to upscale and sustain the exploitable assets generated by I-CISK. The final workshops will provide a forum to share the key policy recommendations emerging from the innovative research carried out under the I-CISK project with relevant actors across local, national, EU and international levels.

2.9 Mapping research themes across the LL

The action-based research approach of the I-CISK project entails that research in the project is developed primarily from within the context of the LLs, in collaboration with the stakeholders. At the same time, the characterisation of the LL, as described in Deliverable D1.1 and the user needs of the different sectors and stakeholders in each LL as detailed in Deliverable D2.1, shows that these LL are diverse, as are the objectives within the scope of this project that have been co-identified in each. As a result, all activities and tasks outlined in the generic roadmap and interactions with the MAP may not be equally relevant in all LL. Additionally, not all tasks developed in the project are developed through interaction with the MAP, as there are also tasks that are project internal tasks.

Based on the initial climate information needs and the processes that the CS are intended to support in each LL, two core groups of information needs were generated, supported by Deliverables D1.1 and D2.1. The two main thematic groups identified are (i) Climate Services that serve climate information needs primarily related to long-term adaptation, and (ii) climate information needs primarily related to short term adaptation and disaster risks reduction at the sub-seasonal to decadal scales. Within these two core groups of climate information needs, eight scientific themes are identified based on the co-creation process and the related research that will be developed in each LL.

To unravel the interaction between tasks as defined in the WPs, and specific LLs, Figure 3 provides an overview of these identified research themes, and the tasks within which these themes are developed. The extent to which each research theme is important to a specific living lab differs, and depends on the context, objectives and characteristics of each LL. In some cases, a theme may be very active within a Living Lab context (high contribution), while in another there may be less of an emphasis (low contribution). High contribution implies that, based on the LL characteristics and needs, the LL provides a rich environment for that scientific theme to be explored in detail. This also implies that researchers involved in tasks relating to the theme will actively contribute within the LL context and work together with the LL teams. Low contribution, on the other hand, does not imply that these climate service information needs or scientific themes are not relevant in that LL context, but rather that the focus is on application of the steps (where relevant) in the LL and not explored in depth. Additionally, tasks that are less connected to research and innovation in the LL context, and where the consortium will drive the activities, are indicated.

Living Lab	Climate service serving:	Themes and related I-CISK tasks								Overall I-CISK related tasks in the LL based on high contribution tasks	
		A1: Behavioural change	A2: Co-creation process	A3: Local and scientific knowledge integration	A4: Feedbacks human-climate systems	A5: Co-exploration of Climate Service needs	A6: Co-evaluation of Climate Service	A7: Business development	A8: Policy context local/ EU/International	Living Lab driven	Consortium driven
		T2.4 T4.3 T6.3	T2.1-T2.5 T6.5	T2.2 T3.2	T2.3; T3.3; T3.4 T4.1; 4.3	T2.1; T2.3 T3.1	T3.1; T3.3; T3.4 T5.2 - T5.4	T5.5 T6.4	T3.1 T6.3		
LL01 Rijnland	Long term adaptation needs									T2.2; T3.3; T3.4; T4.3; T6.4	T3.1; T3.2; T4.1; T5.2 - T5.5; T6.3
	Sub-seasonal to decadal adaptation needs										
LL02 Spain	Long term adaptation needs									T2.1- T2.5; T3.3; T3.4; T4.3; T6.4; T6.5	T3.1; T3.2;T4.1; T5.2 - T5.5; T6.3
	Subseasonal to decadal adaptation needs										
LL03 Italy	Long term adaptation needs									T2.4; T2.1 -T2.5; T3.3; T3.4; T4.3; T6.5	T3.1; T5.2 - T5.4; T6.3
	Sub-seasonal to decadal adaptation needs										
LL04 Budapest	Long term adaptation needs									T2.1- T2.3; T3.3; T3.4; T4.3; T6.4	T3.1; T3.2; T4.1; T5.2 - T5.5; T6.3
	Sub-seasonal to decadal adaptation needs										
LL05 Crete	Long term adaptation needs									T2.1; T2.3	T3.1; T6.3
	Sub-seasonal to decadal adaptation needs										
LL06 Georgia	Long term adaptation needs									T2.1 -T2.5; T3.3; T3.4; T6.5	T3.1; T3.2; T5.2 - T5.5
	Sub-seasonal to decadal adaptation needs										
LL07 Lesotho	Long term adaptation needs									T2.4; T6.3; T2.1 - T2.5; T3.3; T3.4; T4.3; T6.5	T3.1; T3.2; T5.2 - T5.5
	Sub-seasonal to decadal adaptation needs										

Contribution key	
High	
Low	

Figure 3 Matrix to identify research themes and which of the seven living labs have an emphasis on a specific theme

3 Towards a roadmap per living lab

Chapter 2 provides a generic roadmap for collaboration within the seven LLs and the other WPs in the project. As this roadmap is generic , it offers guidance to the project implementation, the managing of expectations, and importantly to the interactions of the project with the users in the LLs.

Going forward, this generic roadmap (see Figure 2) will need to be adapted to the context of each LL. This translation to a more local-context should be done keeping in mind few key considerations.

When adapting the roadmap, the LL teams can provide a more detailed description of the interaction moments (e.g., actors involved and the methods through which interactions are developed, including workshops, interviews, questionnaires etc) and the stages of the co-creation framework that will be operationalized and implemented during these interaction moments. The recommendation is that the LL teams detail the process and interactions iteratively, starting with more detail for the first twelve months of the project (Nov 22 - Nov 23, months 12 to 24 in Figure 2). To ensure fruitful collaboration with the WPs and high quality of scientific output, the roadmap should also reflect on Figure 3 from the LL's perspective, highlighting in detail the synergies and contributions to WP2 - WP6. This exercise is to help understand which LLs are most suited to investigate which scientific theme in detail (being mindful of the fact that each LL has its own focus). Finally, the LL roadmap should highlight any risks related with, for example, the interaction moments, capacity of the MAP as well as of the research team etc that the LL teams foresee and measures to mitigate that risk.

4 Critical path network for I-CISK

The I-CISK project implementation is outlined in 31 tasks distributed over seven work packages. The outcomes of specific tasks can be linked directly to the six main objectives of the project. In many cases these are the final tasks of the respective work-packages, with other tasks in the work package providing specific inputs and insights. This means that all tasks that have been defined in the project contribute to the achieving of the I-CISK objectives. However, some of the tasks are primarily driven by the researchers in the consortium and have limited contribution from the LL. In other tasks, there is a significant role of the key actors participating through the MAPs that have been established in the LL. These tasks can be considered critical from the perspective of the collaboration between the living labs and the researchers from the consortium. It is important to map these critical tasks, as these have a pivotal role in the successful implementation of the project. Identifying these tasks also helps understand where delays or difficulties with establishing the collaboration with the MAPs will have implications on the quality of resulting outputs, which in turn may have implications on the successful delivery of the intended outcomes and objectives of the project. The progress of these critical tasks will therefore need to be carefully monitored, as delay in their implementation will impact project implementation.

The fourteen tasks indicated in Figure 4 have been identified as being critical to the successful implementation of the I-CISK project, with the tasks that are directly related to the project objectives shown along the central horizontal axis of Figure 4 (darker colour). The other tasks (lighter colour) identified are those where the successful collaboration and contribution of the MAPs is essential, as their outputs are an important input to other tasks. Although this figure helps identify these important collaborations with the LL, it does not fully do justice to the interdependency between tasks and work-packages. This is interaction is schematically shown by the background horizontal bar. Additional detail on the interlinkages between tasks across work-packages can be obtained from the project PERTT diagram.

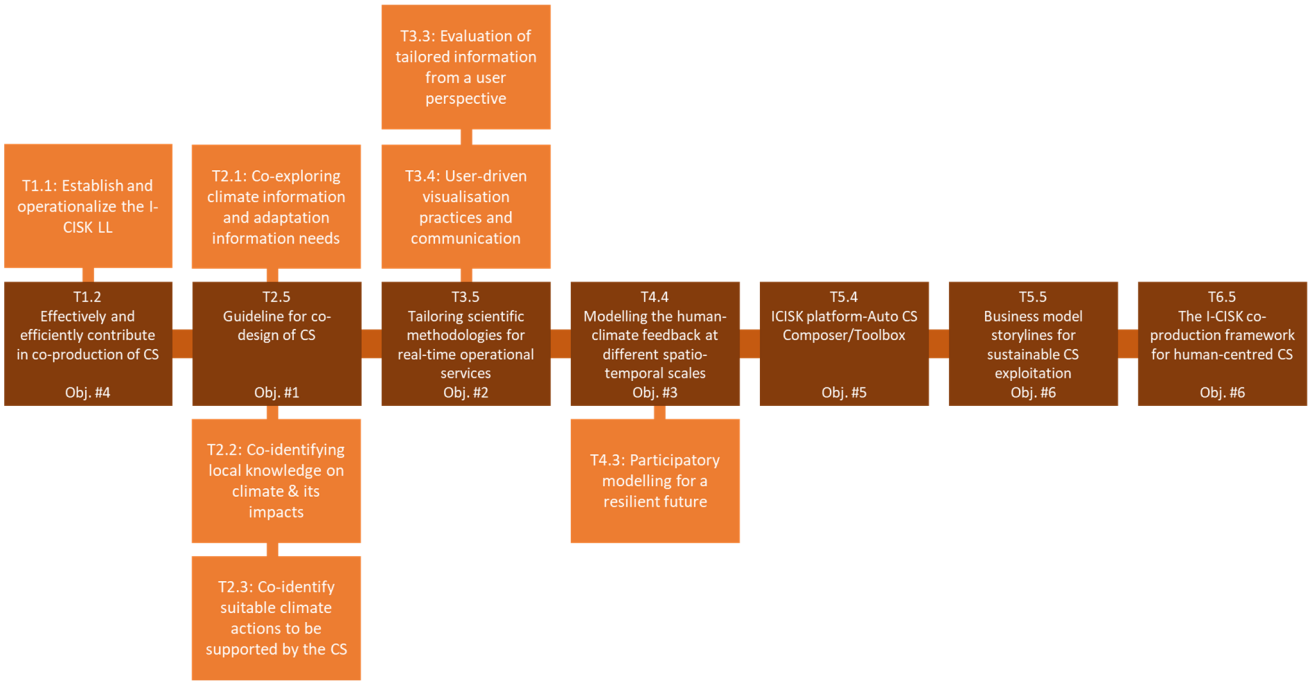

Figure 4 The most critical tasks for the successful implementation of the I-CISK project

5 Conclusions

The roadmap that is outlined in this report has been developed to help develop a detailed plan of the the interactions and connections between the stakeholders and activities taking place in the seven Living Labs (LL) of the project, and the tasks defined to achieve the objectives of the the project..

Establishing a strong connection between the LL and these tasks is essential for the action-research approach that underpins the co-creative character of project. The roadmap is embedded within the co-creation framework, a prototype of which has been developed early in the I-CISK project, and which will be refined as a part of the research. The framing of the roadmap activities within the seven co-creation steps is essential as the roadmap outlines *when* these steps are taken, while the framework provides guidance on *what* and *how* human centred climate services in each living lab are co-created.

The roadmap that has been developed in this report also identifies the research themes that are emphasized in each of the living labs. Overall, climate services that have been identified to be established in each of the living labs focus on decisions processes at the sub-seasonal through to decadal time scale, or at the longer climate adaptation time scale. Additional to these two time-scales, seven research themes have been identified. Although in all living labs both time scales and several research themes will be addressed to some extent, identifying which of these has a stronger emphasis helps understand which living lab(s) provide a richer environment to develop research in a specific theme. These cross-linkages are an important step in identifying the interactions with the living labs from the perspective of the (research) tasks defined in the project, and help design the combined research-living lab teams.

Although the roadmap presented in this report is generic, it provides a blueprint for the collaboration between the stakeholders in the living labs and the project partners involved with the work-packages. In a next iteration this roadmap will be detailed within the specific context of each of the living labs. This also implies that this document is a ‘living document’, and that it will be updated to include these specific roadmaps as these are developed and evolve through the project.

Finally, in this report the tasks that are essential to the realising of the objectives of the I-CISK project are identified. Fourteen ‘critical’ tasks are identified where the collaboration and interaction between the actors of the Multi Actor Platforms (MAPs) established in each of the living labs is essential. If these tasks are delayed or not fully developed, there may be implications for the project achieving its main objectives. Progress and the outputs of these fourteen critical tasks must therefore be monitored carefully.

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I-CISK

HUMAN CENTRED CLIMATE SERVICES

Colophon:

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