REVEALING THE ROLE OF GEOSS AS THE DEFAULT DIGITAL PORTAL FOR BUILDING CLIMATE CHANGE ADAPTATION & MITIGATION APPLICATIONS

D2.1 EIFFEL personas, co-designed scenarios and user requirements

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Executive Summary

To support Climate Change (CC) adaptation and mitigation measures of the Paris Agreement, practitioners co-designing these measures within their community of practice need ready-to-use climate applications. To offer actionable insights to these practitioners, the EIFFEL project partners will develop several CC adaptation and mitigation applications, covering a set of five different domains, contributing to the GEO Societal Benefit Areas (SBAs). Communities of Practice (CoPs) will test these applications in five pilot studies, corresponding to these SBAs, at various EU geographical and climatic regions. These pilot studies are testing applications: (1) on the climate effect of adaptation measures in SBA Water and Land Use Management (Netherlands/Belgium, regional-cross border), (2) on the new CAP crop carbon accountability in SBA Sustainable Agriculture (Lithuania, national-pan European), (3) on climate impact mitigation of atmospheric emissions by port activity in SBA Transport Management (Spain, regional), (4) on urban CC mitigation in SBA Sustainable Urban Development (Greece, local-regional) and (5) on forest disturbances by CC in SBA multi-hazard risk assessment (Finland, regional-national). The pilots are aimed at testing the value of using explainable AI techniques for improving the credibility and comprehensiveness of such CC applications. EIFFEL will foster the co-design of CC adaptation policies and mitigation strategies and monitor CC effects on the respective regions.

Ensuring that practitioners and their stakeholders are actively participating in the application design, this study reports on the early engagement with stakeholders and their participation in the application design. The aim is to co-develop climate change-related user stories for the respective pilots. For each pilot study, a high-level participation structure is created by inviting both the members of the community of practice and the pilot leads (technical partners responsible for application development) for structured focus group workshops. This is done virtually in online workshops, using Microsoft Teams as the online communication platform sheltering an online visual collaboration tool (MURAL©), used to support the facilitation and for data collection. In a preliminary workshop during the project's kick-off meeting, with all EIFFEL partners involved, the stakeholder heterogeneity was captured to enumerate potential participants at the CoPs.

At the start of each pilot workshop (5 in total; the workshop for pilot 1 consisted of three parts), familiarity with the MURAL tool was cultivated by activating participation through an icebreaker task. During a first round of the workshop, user stories were co-created verbally (user – CC dealt with – goal of user – task of user to achieve goal) and notes were taken by a facilitator. During a second round of the workshop, per user story co-created, participants jointly listed functionalities, including a discussion to categorise the functionalities as necessary or optional. During a third round of the workshop, participants were invited to reflect on the stakeholder categorisation in potential primary (direct user of the application) and secondary (user of the findings from the application use) stakeholders. The data from the focus group workshop on users and user functionalities have been synthesized using Qualitative Research Analysis, in which the codebook is colour-coded in order to compound user stories according the components: User, Climate Change Challenges, Goals, and Core Tasks. The leads of the CoP and pilot were invited to review the compounded user stories.

A total of 15 user stories were co-created by the community of practice in consultation with the leads responsible for the application development. In total all 5 pilots are represented within

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the 6 focus group workshops held, for which we sent 84 invitations to potential focus group members; realising: 74 participants (a mean of 11 to 12 participants per PILOT).

The focus groups resulted in about 4 different user stories per pilot. Across all pilots, various similarities between users and user stories can be distinguished. First of all, each pilot contains a user story concerning a user working for a government institution or involved in policymaking. Furthermore, most pilots also contain a user with a particular economic interest. The diversity of users and their perspectives are an important consideration in the development of the EIFFEL applications. The applications should facilitate decision making within the specific contexts of the separate users, and should furthermore allow users to gain insights on the perspectives of other users. The latter should also contribute to the collaboration between CoP members in the context of CC adaptation. A third similarity between pilot user stories is the lack of stories focussing on (concerned) citizens. Despite citizens being mentioned in multiple workshops, only one actual user story relating to this user was developed. The importance of citizens as users of the applications should be considered and more knowledge is necessary in order to ensure that applications meet the needs of citizens as users.

The co-created user stories helped participants to jointly define functionalities (the application's characteristics, as well as services it can provide) and to list those as necessary or optional.

The objective of opening up Earth Observation data from the GEOSS platform is to be of service to their community of practice in need for ready-to-use climate applications. In the development of the CoPs, it is recommended that EIFFEL involves the concerned citizen to a higher degree, as a secondary stakeholder, in order to grasp their perspectives on the CC challenges, and to fit their needs to spatially explicit CC information by convenient applications. Overall, the co-designing resulted in the denomination of 21 groups of primary stakeholders (initially projected: 11 groups) and 20 groups of secondary stakeholders (initially projected: 14 groups). The functionalities could be classified into 4 groups according to the function of the application in handling geo-referenced data; the majority of the listed functionalities has been classified as necessary. Hence, the positioning of the functionalities on each user story as a process will still have to be analysed by the CoP during future tasks, e.g., on the basis of a prototype application. The compounded user stories, the stakeholder group denomination and the stratification of functionalities provide the EO-based community and the EIFFEL partners with insights on the user requirements needed to develop AI-specifications of EIFFEL tools and Climate Change applications using GEOSS data. For each pilot, the functionalities are grouped according to relevant mapping and non-mapping functionalities. These findings will serve as input on more thorough analysis of EO-tool and application development in the next stage of the study. The results presented herein are used for the specification of the EIFFEL tools and Climate Change applications (Task 2.2).

Acknowledgements: during the process of writing this report, participants of the pilots were given the opportunity to review certain sections related to their respective pilot and workshop. The comments provided by them have therefore contributed to this report. Upon request, and in accordance with the GDPR, an overview can be provided by the Editor.

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List of Acronyms and Abbreviations

Acronym	Meaning
BE	Belgium
CAP	new European Common Agricultural Policy 2023-2027
CC	Climate Change
CdM	Co-design Meeting
CoP	Community of Practice (of each pilot study)
DSA	Decision Support Application
ECV	Essential Climate Variable
ES	Spain
FI	Finland
GA	Grant Agreement
GDPR	General Data Protection Regulation
GEOSS	Global Earth Observation System of Systems
GHG	Greenhouse Gas
GR	Greece
IPTO	Independent Power Transmission Operator (Greece)
KoM	Kick-off Meeting
LT	Lithuania
NbS	Nature-based Solutions
NL	The Netherlands
PPC/PPCR	Public Power Corporation / Public Power Corporation Renewables (Greece)
SBA	Societal Benefit Areas
SDG	Sustainable Development Goal
WFD	Water Framework Directive
WuC	Warm-up Call

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1 Introduction

This report '**EIFFEL personas, co-designed scenarios and user requirements**' presents the results of co-design workshops held within each pilot Community of Practice (CoP), to define potential users (stakeholder) of the EIFFEL applications to be developed in each pilot. It should be noted that, currently, each CoP is in the process of being built in congruence with each PILOT's application development. This report describes the applied methods and the findings, as started from the proposed structure of this task **T2.1 'Co-design of climate-change related user stories/scenarios and project user requirements'** from the EIFFEL project plan as defined in the Grant Agreement (GA) (Table 1) [1]. Resulting from the workshops, the report describes for each of these potential EIFFEL users ('EIFFEL Personas'), their user stories as co-designed by the PILOT's community of practice ('co-designed scenarios') and the necessary and optional functionalities for those applications ('user requirements'). As a project management tool, this report is deliverable **D2.1** of the first task (**T2.1)** of EIFFEL work package 2 on '**Co-Design of Climate Change applications based on GEOSS**'. This deliverable serves as an input for the next task **T2.2** '**Specifications of the EIFFEL tools and Climate change applications**'.

Table 1. Description of Task 2.1 in WP2

Task T2.1 Co-design of climate-change related user stories/scenarios and project user requirements (Leader OUNL, with NOORD-BRABANT, BPA, Attica, NPA, Draxis, SYKE, NOA, IBEC, PRO) [1]
In this task, the EIFFEL user stories and scenarios shall be compiled. The user stories will be inspired by the set of EIFFEL personas, created by the task leader with the respective CoP/Pilot leader- and will be crafted in a two-step approach. The first step will be through a co-design process implemented during and after the focus groups taking place until M3. The focus groups shall consist of small groups of participants, being among 6-10 people and corresponding –in terms of profile, expertise and interest- to the stakeholders of each CC application. The focus groups shall include coordinated brainstorming sessions and hands-on sessions for the creation of user stories facilitated by modern tools for such as Trello or similar. The use of these tools shall allow for a shared shaping and discussion of a user story, giving the flexibility for off-line improvements and additions after the focus groups conclusion. The process will be facilitated by a focus group moderator, and a backlog of exemplary user stories, circulated to participants prior to the focus groups. In the second step, the user stories shall be further elaborated into high-level scenarios. The user stories and high-level scenarios shall be made publicly available, shared in the project wiki or website. This way, the project outputs shall be made visible from an early stage, triggering CoPs and external stakeholders, and allowing for a maximum visibility. When this is completed, this task will collect needs and requirements, based on the scenarios derived; an online survey circulated to the project network of stakeholders will be utilized in order to expand the user base. With the support of the CC applications' task leaders (IHE, IBEC, PRO, NOA, SYKE), the needs will be transformed to requirements using a more formal language and taxonomised appropriately (e.g. with unique id, type, category, persona/scenario they relate to, associated EIFFEL tool or application, functional/non-functional etc.). The formulated list of requirements will be properly framed to assist the design of EIFFEL tools and also applications.

The terminology used in this report with regards to these results is different from the terminology that was initially used in the Grant Agreement. Instead of *personas*, this report refers to ***Users***. The corresponding *co-designed scenarios* are referred to as co-designed ***User Stories*****.** Furthermore, the *user requirements* are referred to as ***Application Functionalities***. It should thus be noted that the remainder of this report utilises this new terminology. Accordingly, the results of the individual pilot workshops constitute a set of ***Users***, ***User Stories***, and ***Application Functionalities*** for each respective pilot.

The scope of **D2.1** is limited to the input of the various partners involved in the respective PILOTs. The results collected during **T2.1**, and subsequently presented in **D2.1** should provide valuable knowledge for the development of the EIFFEL applications. The ***Users***, ***User Stories***, and

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Application Functionalities identified should be considered during the application development stage in order to ensure that the final applications meet the needs and requirements of those that will use the applications.

1.1 Context

1.1.1 Objectives

This deliverable report **D2.1** contributes to the EIFFEL project objectives **O4** and **O5**. The data resulting from the co-design (**O4**) workshops that are part the task corresponding to D2.1 provide input for the co-creation (**O5**) of the CC applications per pilot study (Figure 1).

Figure 1. Location of the five EIFFEL pilot studies (Objective O5) in the European Union.

Legend: Each pilot task (T5.1-T5.5) is described by: pilot number (P1-P5), main CC aim - study area [country], in italic spatial scale of governance.

The EIFFEL project has five **objectives (**O1-O5**, below)** [1], which are indirectly linked to the findings published in this report, due to their relevance for T2.2:

1. (**O1**) EIFFEL will exploit the untapped potential of available GEOSS datasets, i.e., satellite, in-situ, modelling, crowdsources, by creating AI-based cognitive search tools. The tools are applicable to any GEOSS dataset, but in EIFFEL, they will be showcased for the CC adaptation and mitigation applications at hand.

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2. (**O2**) EIFFEL will leverage techniques of Explainable AI to develop tangible indicators for CC impacts; it will also make use of super resolution, data fusion and stochastic modelling techniques to generate spatially and temporally explicit information from the untapped pool of GEOSS.
3. (**O3**) EIFFEL will contribute to GEO's new infrastructural feature, known as the GEO Knowledge Hub, GKH is a digital repository providing access to knowledge needed to build GEOSS-driven applications.
4. (**O4**) EIFFEL will foster the co-design of CC adaptation and mitigation applications, bringing on-board the decision makers, responsible for working towards the PA goals at local, regional, national scales. It follows a user-driven approach from the design of the applications to the pilot based showcasing and impact assessment.
5. (**O5**) EIFFEL will develop, using co-creation (O4), a set of CC adaptation and mitigation applications in different and quite diverse GEO SBAs, in order to demonstrate the project innovations: PILOT1/P1-water/Land Management, PILOT2/P2-Sustainable agriculture, PILOT3/P3-Transport Infrastructure, PILOT4/P4-Sustainable urban development, PILOT5/P5-Disaster Resilience (Figure 1).

1.1.2 Work plan

This report, Deliverable **D2.1** corresponds to **T2.1: Co-design of climate change related user stories/scenarios and project user requirements (M1-M4)**. It is part of **WP2: Co-design of Climate Change applications based on GEOSS**.

The results presented in **D2.1** are used in **T2.2: Specifications of the EIFFEL tools and Climate Change applications (M4-M8) (WP2)**. **D2.1** results are used in **T2.2** to translate the PILOT's views and particularities into system requirements and specifications, as well as a set of features of both the EIFFEL tools and the CC applications [1].

The results presented in **D2.1** also play an important role in other WP's. Results will be used in **WP5: Development of the EIFFEL CC applications based on GEOSS** as well as during **WP7: EIFFEL pilot demonstrations and impact assessment** [1].

1.1.3 Milestones

D2.1 is linked to **MS1** and **MS2** [1]:

- **MS1:** Focus groups for the creation of user stories and scenarios for all EIFFEL CoPs.
  Means of verification: Focus groups realised virtually or physically in all EIFFEL PILOTs, as resulted from Draft D2.1
- **MS2:** Scenarios published in the EIFFEL project wiki or website.
  Means of verification: publication of D2.1 EIFFEL personas, co-designed scenarios and user requirements (this document)

1.1.4 Deliverables

D2.1 provides input for **T2.2**, and is hence connected to **D2.2: Report on EIFFEL specifications** (Lead beneficiary: **DRAXIS**). Given its relevance for **WP5** and **WP7** [1], **D2.1** is also connected to the following deliverables:

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- **D5.1**: Model-based decision support components for testing adaptation measures in the Aa-of-Weerijs river basin, NL.
  - Lead beneficiary: **IHE**
- **D5.2**: Novel AI-enabled services in support of crop carbon accountability and evaluation of CAP measures in a cross-border area.
  - Lead beneficiary: **IBEC**
- **D5.3**: Port activity Climate Impact Assessment Tool.
  - Lead beneficiary: **PRO**
- **D5.4**: Decision Support Application (DSA) for urban CC mitigation measures.
  - Lead beneficiary: **NOA**
- **D5.5**: Multi-hazard risk assessment of forest disturbances in Finland.
  - Lead beneficiary: **SYKE**
- **D7.1**: Report on PILOTs' setup, definition of impact assessment KPIs
  - Lead beneficiary: **SYKE**
- **D7.2**: Initial Report on EIFFEL pilot demonstrations, best practices, lessons learned
  - Lead beneficiary: **NOA**
- **D7.3**: Final Report on pilot impact assessments and recommendations
  - Lead beneficiary: **SYKE**

1.2 Intended Readership and Document Structure

The dissemination level of this report is public. It is specifically intended for partners working on **WP2**, **WP5**, and **WP7**. The section following the introduction provides a description of **T2.1** (Description of Task). This is followed by an explanation of the goals and method employed for this task (Goal and Method of Co-design Process). Next, an overview of the various pilot applications (Pilot Applications) is provided, followed by an overview of each PILOT's CoP (PILOTS: Community of Practice). The results of the respective workshops are presented in the following section (Results per PILOT). The next section presents a synthesis of these results (Synthesis of Workshop Outcomes). A discussion and conclusions (

Discussion & Conclusions) are presented at the end of this report.

2 Description of Task

This task concerns the co-design of climate-change related user stories/scenarios and project user requirements (M1-M4)

- Lead: OUNL
- Participants: NOORD-BRABANT, BPA, ATTICA, NPA, DRAXIS, SYKE, NOA, IBEC, PRO

The user stories are developed through a co-design approach involving the pilot *lead (*technical partner responsible for application development) and the *CoP lead with CoP participants* for the respective pilot (Table 2).

It is the first task of work package **WP2** (lead: DRAXIS, M1-M12) Co-design of Climate Change Applications Based on GEOSS. The findings and results of this task are conditional for the next two tasks in WP2:

Task (T2.2): Specifications of the EIFFEL tools and Climate change applications (lead DRAXIS; M4-M8)

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Task (T2.3): EIFFEL System architecture and integration plan (lead DRAXIS; M4-M12)

Table 2. Planned pilot studies (indicated by number) described by country, title (with EIFFEL Deliverable), Aimed application, Leader institution of the pilot study and Leader of the community of practice (CoP) co-designing the application.

PILOT	Country	Title (Deliverable)	Application	Pilot leader	CoP leader
1	Netherlands (NL)	**Water & Land Use Management (D5.1 report)**	Model-based decision support components for testing adaptation measures in the Aa-of-Weerijs river basin	IHE	NOORD
2	Lithuania (LT)	**Sustainable Agriculture (D5.2 report)**	AI-enabled services in support of crop carbon accountability and evaluation of CAP measures in a cross-border area	IBEC	NPA
3	Spain (ES)	**Infrastructure & Transport Management (D5.3 report)**	Port activity Climate Impact assessment tool	PRO	BPA
4	Greece (GR)	**Sustainable Urban Development (D5.4 report)**	Decision Support Application (DSA) for urban CC mitigation measures	NOA	ATTICA
5	Finland (FI)	**Multi-hazard risk assessment (D5.5 report)**	Multi-hazard risk assessment of forest disturbances (Disaster resilience)	SYKE	SYKE

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3 Goal and Method of Co-design Process

The aim of this process is to co-develop climate change related user stories for the respective PILOTs. The process consists of 4 steps, which are explained in more detail below.

3.1 Step 0: Enumeration of Stakeholder Heterogeneity

In this preliminary step, the goal was to take stock of the stakeholder heterogeneity. This consisted of a Warm-up Call (WuC), a Kick-off Meeting (KoM) Workshop and a Co-design Meeting (CdM) review meeting. The heterogeneity in pilot use scenarios was captured during the KoM workshop.

Table 3. STEP 0 on Design, Stakeholder Heterogeneity and Review of workshop setup.[DR = dissemination report published.]

Workshop	Titel	Invited: WP5 pilot leaders & WP	Date workshop	No. of CoP participants to be invited
WuC	Design T2.1 workshops	all	20210611 PM	20
KoM	Stakeholder heterogeneity	all	20210623 PM	60 (DR)
CdM	Review workplan	all	20210723 PM	20

3.2 Step 1: pilot Workshops

Co-design workshops were organised for every pilot during M2 and M3 (Table 4). Relevant partners were invited to comment and provide feedback on the preliminary results of the respective workshop. This allowed for the co-design process to continue after the workshop, and for the resulting data to be more accurate and relevant.

Table 4. Workshops and dates for every PILOT

PILOT	Country	Title	Pilot leader	CoP leader	Workshop Date planned	No. of participants planned
1	NL	Water & Land Use Management	IHE	NOORD	(P1) 20210726 PM* (P1.5) 20210826 AM (P2) 20210916	8 9 10
2	LT	Sustainable Agriculture	IBEC	NBA	20210802 PM	14
3	ES	Infrastructure & Transport Management	PRO	BPA	20210802 AM	11
4	GR	Sustainable Urban Development	NOA	ATTICA	20210803 AM	20
5	FI	Multi-hazard risk assessment	SYKE	SYKE	20210813 AM	12
total					5 workshops	84 p. (11.4 p/PILOT)

*Note: *The workshop for pilot 1 was split into multiple parts in order to ensure that relevant CoP members could participate (a total of 12 unique participants). It should be noted that the first part of the P1 workshop was used to test the envisioned setup for the various pilot workshops. Based on the experiences during this P1 workshop, and the feedback provided, the setup was altered for the rest of the workshops that were organised as part of the task.*

The workshops took place facilitated in an online environment, and the group of participants per session consisted of 5-15 people. All PILOT-leaders and PILOT-partners received an invitation

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to participate in their respective workshop from OUNL. Because all workshops took place on the same online platform, inter-Pilot exchange was possible. A preliminary setup of the focus groups was developed and tested during Part 1 of the workshop for pilot 1. Based on the feedback, several changes were made to the setup of the workshops. The general setup of the workshops was as follows:

1) **Welcome and Presentation**

At the start of the workshop, participants are welcomed by OUNL and are provided with a short introductory presentation. Participants are then invited to enter the visual collaboration tool (MURAL ©) used to support the facilitation and for data collection

2) **Icebreaker**

Familiarity with the visual collaboration tool is cultivated through participation in the icebreaker

3) **Round 1: Co-creation of User stories for Applications**

During the first round of the workshop, user stories are co-created (3). For this task, 40 minutes are scheduled. OUNL asks participants to define a specific user (or users) and elaborate on the climate change challenge that is being dealt with. Then, participants are asked to specify the goal of the user, as well as the core task that needs to be performed in order to achieve this goal. Contributions of participants are verbal, and OUNL takes notes using the visual collaboration tool.

4) **Round 2: Application Functionalities**

During the second round of the workshop, an inventory of functionalities is co-created (4). For this task, 40 minutes are scheduled. In the first part of this round, participants are invited to suggest functionalities that users may require to perform their core tasks. Participants make written contributions using the visual collaboration tool. Then, a discussion is facilitated in order to categorise the functionalities as necessary or optional. Participants make verbal contributions and OUNL takes notes.

5) **Round 3: Reflection on Stakeholder Categorisation (Grant Agreement)**

During the third round of the workshop, participants are invited to reflect on the stakeholder categorisation presented in the GA (5). Through verbal contributions, participants may comment on this categorisation, and suggest changes if necessary.

6) **Final Thoughts & Feedback based on pre-arranged points of reflection.**

The workshop is concluded with a short opportunity for final thoughts on the user stories and feedback on the workshop itself (6).

Note on pilot 1 workshops.

It should be noted that the workshop for pilot 1 was split into multiple parts in order to ensure that all relevant CoP members could participate. It should furthermore be noted that the P1 workshop was used to test the envisioned setup for the various pilot workshops of this task. Based on the experiences during this P1 workshop, and the feedback provided, the setup was altered for the rest of the workshops that were organised as part of the task. Therefore, the setup of the P1 workshop deviated from the setup as described above.

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3.3 Step 3: Feedback on Preliminary Results

OUNL compiled the results of each workshop into a short report. Participants and other relevant partners were invited to provide feedback and suggestions on its content. These were incorporated into the D2.1 Report.

It should be noted that this step did not apply to the workshop of pilot 1. However, since this workshop consisted of several parts, this was not considered an issue. Furthermore, participants of the pilot 1 workshop were invited to review the user stories developed based on the outcomes of the workshop (see Step 5).

3.4 Step 4: Synthesis of Workshop Outcomes

The **first part** of the synthesis (*Section 7.1)* consisted of taking the outcomes of Round 1 of the workshops in order to develop concrete *Users* and *User Stories* for every pilot. Every user was given an appropriate name that clearly indicates their role in the context of the pilot. If participants identified multiple users for a single user story, an encompassing name reflecting the multiple users was chosen. Next, the climate change challenges, goals, the core tasks identified by participants for each user story were interpreted according to Bloom's taxonomy principles [2]. This was used to develop an instructive story line of core tasks for each user of each CC application –in terms of profile, expertise and interest [3]. The data from the focus group workshop on users and user functionalities were synthesized using Qualitative Research Analysis, in which the codebook is colour-coded in order to compound user stories according the components (legend):

- **The User (brown)**
- **The Climate Change Challenges (red)**
- **The Goals (green)**
- **The Core Tasks (purple)**

During the **second round** of the workshop, per user story co-created, participants jointly listed functionalities, including a discussion to categorise the functionalities as necessary or optional. The data of this session are synthesized (*Section 7.2)* according four main types of functionality in Geo-referenced data science (adapted from [4]). To express the result of this synthesis the codebook is in accordance with definitions of functionality grouping:

- **Georeferencing = Functionality to visualise GEOSS data and geo-referenced data mapping** (like spatial resolution)
- **Context Layers = Functionality which adds context to data** (like attribute layers)
- **Change Detection = Functionality which helps to detect change** (like historic, real time and future modelling)
- **Non-mapping = Functionality to scaffold the user in Non-mapping tasks** (like user queries)

The pilot stakeholder categorisation resulted in a final division between primary (direct user of the application) and secondary (user of the findings from the application use) stakeholders. A synthesis (*Section 7.3*) shows the primary and secondary stakeholders in the whole EIFFEL community of Practice.

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3.5 Step 5: Feedback on User Stories

Participants were invited to review the user stories developed by OUNL as part of the synthesis of the outcomes of each workshop. This gave participants the opportunity to provide feedback and suggestions. These were incorporated in the user stories that are presented in this report.

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4 Pilot Applications

4.1 General: CC Applications & KPIs

Different applications are foreseen to be developed for every pilot (**WP5**) and is used by the respective CoPs (**WP7**), and in particular by the EIFFEL partners. The EIFFEL tools (**WP3: augmenting GEOSS data exploration**, and **WP4: improving temporal, spatial distribution and data quality of CC related datasets**) form the backbone of the applications (Figure 2).

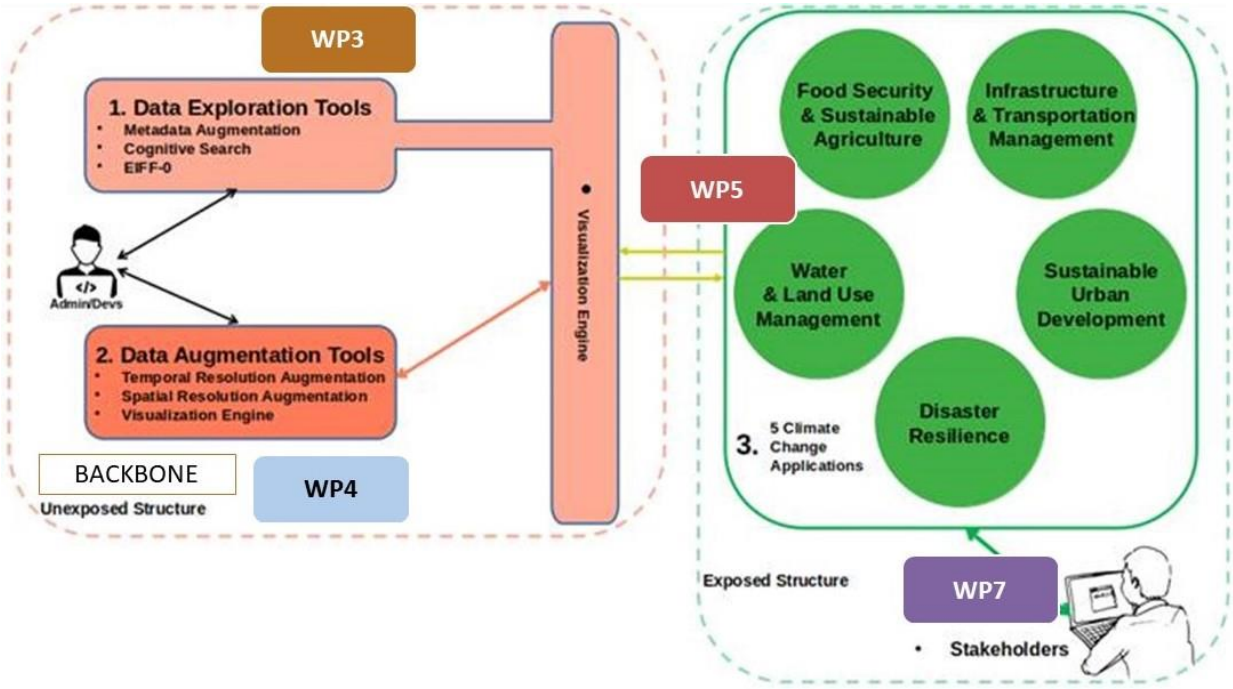

Figure 2. EIFFEL structure showing the Communities of Practice (WP7) co-designing – the user requirements & stories of the pilot applications (WP5), which will be co-designed based on tools (WP3, WP4) to reveal GEOSS data (Adapted from DRAXIS, 2021).

Note: The co-designing by the CoP of the applications is within the T2.1 focus groups workshops, the exposed structure of EIFFEL. The co-designing of the applications based on the EIFFEL tools built on available GEOSS datasets is the backbone, unexposed EIFFEL structure.

The CC applications to be developed consist of a common basis [1]

1) Built on available GEOSS datasets, without having to in new in-situ systems
2) Assessing support to CC adaptation and mitigation measures, using Key Performance Indicators; the KPIs will also attempt to quantify ECVs as well as societal impact and stakeholder acceptance.

To set the quality for the development of the CC adaptation and mitigation applications for the different PILOTS (**O5**) common general key performance indicators (**KPI-5.GEN)** are set [1].

KPI-5.GEN (Validation: **WP5**, **WP7**)

- CC applications for 5 European climatic regions, 5 GEO SBAs;
- Acceptance (at least 90%) of applications in 5 stakeholder workshops;

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- Final number of different types of GEOSS datasets integrated with local datasets

Specific KPIs for the individual applications for every pilot are discussed below in the respective section for each pilot.

4.2 Pilot 1: Water and Land Use Management (NL/BE)

Pilot 1 takes place at a regional (cross-border) scale. The pilot area covers the cross-border (NL/BE) Aa-of-Weerijs brook catchment (Figure 3); the case study concerns the Dutch (NL) downstream basin, located in the province of Noord-Brabant (the Netherlands). The pilot specifically focusses on the impact of co-created nature-based solutions to adapt and mitigate water shortage, drought, and its effect on carbon sequestration. Users require climate effect applications and atlases for the area. The three applications are: (1) a Hydrological / Water management model, (2) a Soil carbon model, and (3) a Decision Support Application.

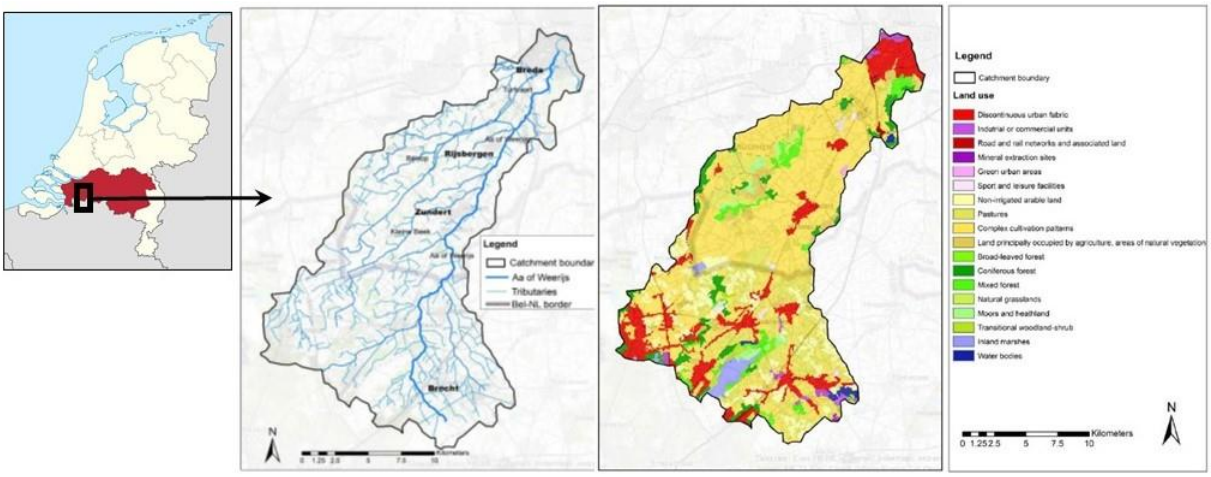

Figure 3. Location of pilot 1: Water and Land Use Management (NL/BE).

Note: maps from left to right: (a) pilot area in province of Noord-*Brabant (NL), (b) cross–border catchment (NL/BE) of Aa-of-Weerijs brook (thick blue line) and its tributaries (thin blue lines) , (c) land use of the catchment, with (d) land use legend for overall colouring: reddish is build-up area, yellowish is agricultural area, greenish is nature, blueish is wetland (IHE, Noord-Brabant, 2021 as cited by [5]).*

D5.1 consists of model-based decision support components that will allow the testing of measures for adaptation in the region [1]

The following Sustainable Development Goals (SDGs) [7] are relevant for pilot 1 [1]:

- **SDG 6**: Ensure availability and sustainable management of water and sanitation for all.
  - **Target 6.4**: By 2030, substantially increase water-use efficiency across all sectors and ensure sustainable withdrawals and supply of freshwater to address water scarcity and substantially reduce the number of people suffering from water scarcity.
  - **Target 6.6:** By 2020, protect and restore water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers and lakes.

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- **SDG 13**: Take urgent action to combat climate change and its impacts
  - **Target 13.1**: Strengthen resilience and adaptive capacity to climate-related hazards and natural disasters in all countries
- **SDG 15**: Protect, restore and promote sustainable use of terrestrial ecosystems, sustainable manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss.
  - **Target 15.3**: By 2030, combat desertification, restore degraded land and soil, including land affected by desertification, drought and floods, and strive to achieve a land degradation-neutral world

The specific KPIs for the development of the CC adaptation and mitigation application for pilot 1 (**O5**) are listed below [1]:

KPI-5.P1 (Validation: **WP5**, **WP7**)

- Development of data-/model-based applications for testing adaptation measures for increased water and efficient usage, and soil organic carbon storage in the Aa-of-Weerijs catchment;
- Validation through established/new indicators:
  - Water Use Efficiency (SDG 6)
  - Land Degradation Neutrality (SDG15.3 incl. Soil Sealing)
  - Topsoil Organic Carbon (SDG15)
- Additional KPIs proposed (cos, implementation potential)

4.3 Pilot 2: Sustainable Agriculture (LT)

Pilot 2 takes place at a national scale. The pilot area covers nation-wide the agricultural area of Lithuania (LT) (Figure 4); the case study concerns a test site located in Western Lithuania supported by 400 local farmers and more than 15 officers from the Lithuanian National Paying Agency.

It specifically focusses on a monitoring system to support crop carbon accountability and crop diversification assessment. This fits under the new European common agricultural policy (CAP) which starts in 2023 and aims to foster a sustainable and competitive agricultural sector.

Users require climate effect applications assisting carbon monitoring purposes as an efficient estimation of soil carbon stock changes with use of novel ensemble models; and to support practices of Climate-Smart Agriculture.

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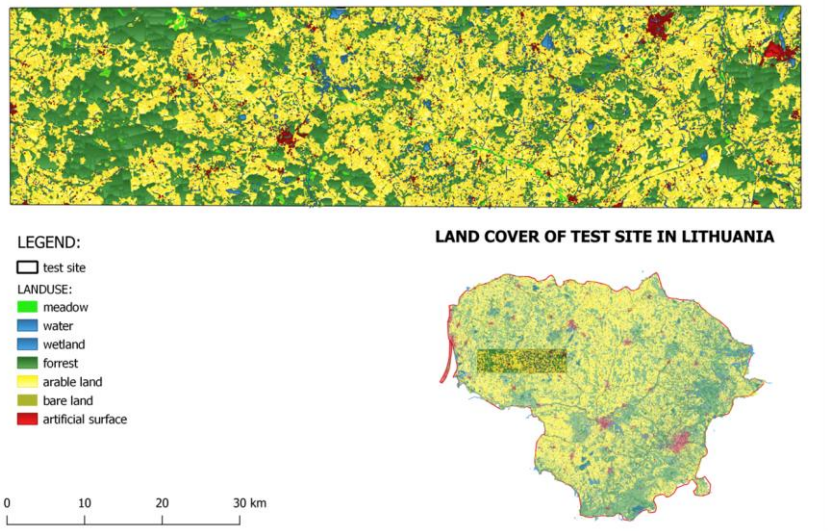

Figure 4. Location of pilot 2: Sustainable Agriculture (LT).

Note: Land cover map of Lithuania, test site in Western Lithuania is highlighted and enlarged above the map; same legend for both maps (i-BEC, NOA & NPA, 2021 as cited by [6]).

The two applications are: (1) Evaluation of the Agricultural Carbon Hybrid Modelling support of national GHG and (2) Full-scale deployment of the future land suitability tool mapping.

D5.2 consists of several AI-enabled services supporting crop carbon accountability and the evolution of CAP measures. The goal is to co-design CAP monitoring and reporting applications [1].

The following Sustainable Development Goals (SDGs) [7] are relevant for pilot 2 [1]:

- **SDG 2**: End hunger, achieve food security and improved nutrition and promote sustainable agriculture
    - **Target 2.4**: By 2040, ensure sustainable food production systems and implement resilient agricultural practices that increase productivity and production, that help maintain ecosystems, that strengthen capacity for adaptation to climate change, extreme weather, drought, flooding and other disasters and that progressively improve land and soil quality.
- **SDG 15**: Protect, restore and promote sustainable use of terrestrial ecosystems, sustainable manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss
    - **Target 15.1**: By 2020, ensure the conservation, restoration and sustainable use of terrestrial and inland freshwater ecosystems and their services, in particular forests, wetlands, mountains and drylands, in line with obligations under international agreements.
    - **Target 15.3**: By 2030, combat desertification, restore degraded land and soil, including land affected by desertification, drought and floods, and strive to achieve a land degradation-neutral world.

The specific KPIs for the development of the CC adaptation and mitigation application for pilot 2 (**O5**) are listed below [1]:

KPI-5.P2 (Validation: **WP5**, **WP7**)

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- Enhanced services for Common Agricultural Policy (CAP) monitoring and LULUCF reporting, on-time arrival of CAP services (>30% improvement from current status)
- Support agricultural domain to offer more climate-friendly land use services (>90% positive evaluation in relevant CoP).

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4.4 Pilot 3: Infrastructure and Transport Management (ES)

Pilot 3 takes place at a regional scale. The pilot area covers the ports and their surroundings of the Balearic Islands (ES); case studies are located in the port and city of Palma and in marine reserve The Freus (Figure 5). It specifically focusses on atmospheric emissions and related atmospheric pollution and air quality. Users require climate effect applications on monitoring and prediction of atmospheric pollution, planning and optimisation of port activities, better decision making by minimising the carbon footprint of the port activity and data analytics services to vessel companies.

Figure 5. Location of pilot 3: Infrastructure & Transport Management (Balearic Isles, Spain).

Note: Balearic Islands (ES); Upper map (a): physical map; legend: blueish: sea depth (location of marine reserve The Freus), green: vegetated land use, beige: mountainous LU (Google maps, 2021, as cited in [8]) ; lower map (b): Contour map indicating the coastline of mainland Spain with the City of Valencia and the shores of the Balearic Islands: red dots: main ports (PdB, 2021, as cited in [8]).

The three application**s** are: (1) analysis of atmospheric pollution in Palma: correlation between the port activity and air quality in the city of Palma, (2) atmospheric emissions study in marine reserve The Freus (Formentera): monitoring of emissions from vessels-line to detect pollution's episode, (3) berths allocation optimization based on experience (monitoring + prediction), both for the emissions of the vessel and the vehicles on board.

D5.3 consists of a Port Activity Climate Impact Assessment tool to support these three applications [1].

The following Sustainable Development Goals (SDGs) [7] are relevant for pilot 3 [1]:

- **SDG 9**: Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation.

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  - **Target 9.3**: increase the access of small-scale industrial and other enterprises, in particular in developing countries, to financial services, including affordable credit, and their integration into value chains and markets.
  - **Target 9.4**: by 2030, upgrade infrastructure and retrofit industries to make them sustainable, with increased resource-use efficiency and greater adoption of clean and environmentally sound technologies and industrial processes with all countries taking action in accordance with their respective capabilities.
- **SDG 11**: Make cities and human settlements inclusive, safe, resilient and sustainable
  - **Target 11.5**: By 2030, significantly reduce the number of deaths and the number of people affected and substantially decrease the direct economic losses relative to global gross domestic product caused by disasters, including water-related disasters, with a focus on protecting the poor and people in vulnerable situations.
- **SDG 13**: Take urgent action to combat climate change and its impacts.
  - **Target 13.3**: Improve education, awareness-raising and human and institutional capacity on climate change mitigation, adaptation, impact reduction and early warning.
- **SDG 14:** Conserve and sustainably use the oceans, seas and marine resources for sustainable development.
  - **Target 14.1**: By 2025, prevent and significantly reduce marine pollution of all kinds, in particular from land-based activities, including marine debris and nutrient pollution.

The specific KPIs for the development of the CC adaptation and mitigation application for pilot 3 (**O5**) are listed below [1]:

KPI-5.P3 (Validation: **WP5**, **WP7**)

- Alert service for average temperature deviations >1.5 ºC and when anomaly GHG emissions are predicted (>=1) (SDG 13, 14);
- Methodology for detecting vessels with high GHG emissions via AI models from O2;
- Service for vessel companies and cities nearby offering pollution KPIs (SDG 9, 11);
- Service for optimising vessel traffic operations from and to the port area based on spatiotemporal analysis of pollution patterns and vessel traffic configuration to reduce emissions;
- At least 5 scenarios (SDG 9, 11, 13, 14).

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4.5 Pilot 4: Sustainable Urban Development (GR)

Pilot 4 takes place at a local/regional scale. The pilot area covers the Attica Region and the case studies are located in Athens, the Greek capital, which hosts a population of ~4 million and ~40% GDP (Figure 6).

It specifically focusses on the development of a Decision Support Application (DSA). Users require climate effect applications to enable inspection of GHG mitigation scenarios, in three urban-critical sectors. The applications are directed to three urban-critical sectors: (1) building energy efficiency, (2) photovoltaic penetration in urban environments and (3) vehicle fleet emissions+ intra-urban air quality.

Figure 6. Location of pilot 4: Sustainable Urban Development (Attica, Greece).

Note: Clockwise from upper: (a) view on the pilot area: the city of Athens in the Attica region [9]. (b) aerial view (left) and physical map (right) of the Attica Region (NOA, 2021 as cited by [10]), and (c) location of the Attica Region in Europe (NOA, 2021 as cited by [10]).

D5.4 consists of a Decision Support Application (DSA) for urban CC mitigation measures [1]. The following Sustainable Development Goals (SDGs) [7] are relevant for pilot 4 [1]:

- **SDG 3**: Ensure healthy lives and promote well-being for all at all ages
  - **Target 3.4**: By 2030, reduce by one third premature mortality from non-communicable diseases through prevention and treatment and promote mental health and well-being.
    - **Indicator 3.4.1**: Mortality rate attributed to cardiovascular disease, cancer, diabetes or chronic respiratory disease [11].
  - **Target 3.9**: By 2030, substantially reduce the number of deaths and illnesses from hazardous chemicals and air, water and soil pollution and contamination.

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        - **Indicator 3.9.1**: Mortality rate attributed to household and ambient air pollution [11].
- **SDG 7**: Ensure access to affordable, reliable, sustainable and modern energy for all
    - **Target 7.1**: By 2030, ensure universal access to affordable, reliable and modern energy services.
        - **Indicator 7.1.2**: Proportion of population with primary reliance on clean fuels and technology [11].
    - **Target 7.2**: By 2030, increase substantially the share of renewable energy in the global energy mix.
        - **Indicator 7.2.1**: Renewable energy share in the total final energy consumption [11].
    - **Target 7.b**: By 2030, expand infrastructure and upgrade technology for supplying modern and sustainable energy services for all in developing countries, in particular least developed countries, small island developing States, and landlocked developing countries, in accordance with their respective programmes of support.
        - **Indicator 7.b.1**: Investments in energy efficiency as a percentage of GDP and the amount of foreign direct investment in financial transfer for infrastructure and technology to sustainable development services [11].
- **SDG 11**: Make cities and human settlements inclusive, safe, resilient and sustainable
    - **Target 11.1**: by 2030, ensure access for all to adequate, safe and affordable housing and basic services and upgrade slums
        - **Indicator 11.1.1**: Proportion of urban population living in slums, informal settlements or inadequate housing [11].
- **SDG 12**: Ensure sustainable consumption and production patterns
    - **Target 12.a**: Support developing countries to strengthen their scientific and technological capacity to move towards more sustainable patterns of consumption and production.
        - **Indicator 12.a.1**: Amount of support to developing countries on research and development for sustainable consumption and production and environmentally sound technologies [11].
    - **Target 12.c**: Rationalize inefficient fossil-fuel subsidies that encourage wasteful consumption by removing market distortions, in accordance with national circumstances, including by restructuring taxation and phasing out those harmful subsidies, where they exist, to reflect their environmental impacts, taking fully into account the specific needs and conditions of developing countries and minimizing the possible adverse impacts on their development in a manner that protects the poor and the affected communities.
        - **Indicator 12.c.1**: The amount of fossil-fuel subsidies per unit of GDP (production and consumption) and as a proportion of total national expenditure on fossil fuels [11].

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- **SDG 13**: Take urgent action to combat climate change and its impacts
  - **Target 13.2**: Integrate climate change measures into national policies, strategies and planning.
    - **Indicator 13.2.2**: Total greenhouse gas emissions per year [12]

The specific KPIs for the development of the CC adaptation and mitigation application for pilot 4 (**O5**) are listed below [1]:

KPI-5.P4 (Validation: **WP5**, **WP7**)

- Design of >10 GHG urban mitigation scenarios to support carbon neutrality (SDG 13); in sectors: building energy efficiency (SDG 7), photovoltaic penetration (SDG 7), vehicle fleet emissions (SDG 3);
- Estimated benefits in the intra-urban concentration fields of air pollutants and citizen exposure (SDG3, 11).

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4.6 Pilot 5: Multi-hazard risk assessment (FI)

Pilot 5 takes place at a national scale. The pilot area covers Finland as a whole as the most forested country in Europe; case studies focus on multi-hazard risks for forests in SW Finland (Figure 7). It specifically focusses on a risk assessment framework for forest disturbances: droughts, forest fires and pests (invasive insects). Climate change risks for boreal forests [13] are drought (despite an increase in precipitation), risk of forest fire, eruptive forest pest species, and damage by storm and snow. Users require climate effect applications for existing national portals on water resources (Vesi.fi [14]) and climate change (Climateguide.fi [15]), based on previous drought study in SW Finland (focus on agriculture) and drought mitigation plans for some municipalities. The three applications are: (1) National-scale hydrological model (on drought) (2) phenological modelling of forest pest species and (3) forest fire indices.

D5.5 consists of a multi-hazard risk assessment of forest disturbances in Finland [1].

The following Sustainable Development Goals (SDGs) [7] are relevant for pilot 5 [1]:

- **SDG 6:** Ensure availability and sustainable management of water and sanitation for all
  - **Target 6.4**: By 2030, substantially increase water-use efficiency across all sectors and ensure sustainable withdrawals and supply of freshwater to address water scarcity and substantially reduce the number of people suffering from water scarcity
- **SDG 11:** Make cities and human settlements inclusive, safe, resilient and sustainable
  - **Target 11.5**: by 2030, significantly reduce the number of deaths and the number of people affected and substantially decrease the direct economic losses relative to global gross domestic product caused by disasters, including water-related disasters, including water-related disasters, with a focus on protecting the poor and people in vulnerable situations.
- **SDG 13**: Take urgent action to combat climate change and its impacts
  - **Target 13.1**: Strengthen resilience and adaptive capacity to climate-related hazards and natural disasters in all countries.
- **SDG 15**: Protect, restore and promote sustainable use of terrestrial ecosystems, sustainable manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss.
  - **Target 15.1**: By 2020, ensure the conservation, restoration and sustainable use of terrestrial and inland freshwater ecosystems and their services, in particular forests, wetlands, mountains and drylands, in line with obligations under international agreements.
  - **Target 15.2**: By 2020, promote the implementation of sustainable management of all types of forests, halt deforestation, restore degraded forests and substantially increase afforestation and reforestation globally.

The specific KPIs for the development of the CC adaptation and mitigation application for pilot 5 (**O5**) are listed below[1]:

KPI-5.P5 (Validation: **WP5**, **WP7**)

[1] Grant Agreement No 101003518, Part B, pp. 7-8

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- Enhanced/new risk mapping services (>=2) for drought, forest fires and pests in national portals (SFDRR; SDG 6, 13, 15);
- Number of GEOSS datasets integrated in modelling framework;
- List of priority actions at national/regional level to maintain resilience to drought/forest fires (SFDRR; SDG 6, 13).

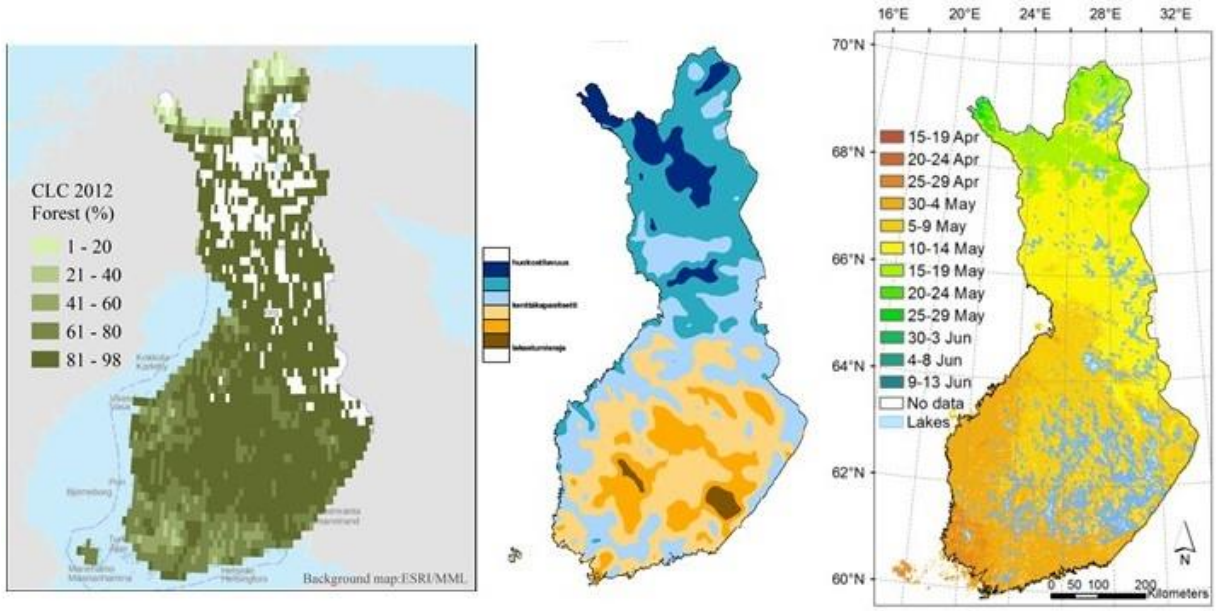

Figure 7. Location of pilot 5: Multi-hazard risk assessment (FI).

Note: Maps of Finland on (from left to right): (a) forests, from CORINE data (map by A. Viinikka, n.d. as cited by [16]) (b) soil moisture, monthly forecast (SYKE, 2021 as cited by [16]), and (c) Peak flight of moth Orthosia gothica (forest pest) from snow melt, mean 2001-2013 (Pöyry et al. 2018, as cited by [16])

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4.7 Essential Climate Variables

A total of 30 Essential Climate Variables (ECVs) [17] are relevant for the various PILOTs. Discussion of these ECV's during the workshops was not deemed as necessary for this task, but the categorised overview (Table 5) could be added as user requirements during the development phase of the applications.

Table 5. Essential Climate Variables (ECVs) relevant for each PILOT, categorised in accordance *with the relevant climate system (Atmosphere, Land, Ocean).*

ECV cat.	Essential Climate Variable	Pilot 1	Pilot 2	Pilot 3	Pilot 4	Pilot 5
Atmosphere	Clouds					X
	Earth radiation budget			X	X	
	Precipitation	X	X	X		X
	Pressure					X
	Radiation budget			X	X	X
	Temperature	X		X		X
	Water vapour					
	Wind speed and direction			X		X
	Carbon dioxide, methane and other greenhouse gases			X	X	
	Above ground biomass		X			
	Aerosols			X	X	
Land	Albedo				X	
	Anthropogenic water use	X	X			
	Evaporation from land	X				X
	Fire					X
	Groundwater	X				
	Leaf area index	X	X			X
	Land cover	X	X		X	
	Land surface temperature		X			X
	Soil carbon	X	X			
	Soil moisture	X				X
	Snow					X
	River discharge	X				
	Anthropogenic greenhouse gas fluxes				X	
Ocean	Ocean colour			X		
	Ocean surface heat flux			X		
	Sea ice			X		
	Sea level			X		
	Sea state			X		
	Sea surface temperature			X		

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5 PILOTS: Community of Practice

A multi-stakeholder Community of Practice (CoP) has been implemented locally for every PILOT [1] (Table 6). CoP members will use the applications developed in their respective PILOTs. Consideration of the needs of members of the CoP is therefore essential during the development of the applications. For each PILOT, **WP7** partners are the CoP leaders.

A preliminary overview and categorisation of the stakeholders (primary and secondary) for each respective pilot was considered during the writing stage of this project's proposal (summer 2020). The primary and secondary stakeholders that were presented in that stage [1] are displayed in Table 6. It should be noted that participants were given the opportunity to reflect on this preliminary categorisation during the pilot workshops; the results of this reflection are discussed later in this report.

Table 6. Stakeholders for each PILOT: A preliminary overview and categorisation.

PILOT	Title	CoP leader	Primary Stakeholder	Secondary Stakeholder
1	Water & Land Use Management (NL/BE)	NOORD	Regional Authorities & Municipalities; Water Management Boards	Land and Nature Managers; Agricultural Organisations; Citizen Councils
2	Sustainable Agriculture (LT)	NBA	Paying Agencies; Agricultural policy makers	Farmers; Agri-consultants; Agricultural Cooperatives
3	Infrastructure & Transport Management (ES)	BPA	Port Authority; Vessel Companies	City Councils; Citizens
4	Sustainable Urban Development (GR)	ATTICA	Ministry of Environment & Energy; Ministry of Health; Ministry of Development & Investments; Ministry of Infrastructure	Administrative Authorities (i.e., prefectures, municipalities); Urban Planners; Industry (e.g. renewables, building construction); Energy providers/distributors (i.e., PPC/PPCR, IPTO)
5	Multi-hazard risk assessment (FI)	SYKE	Ministry of Agriculture and Forestry; Forest Centres and management companies	Regional Authority for water resources governance; Rescue Services
Total			**11 groups of primary stakeholders**	**14 groups of secondary stakeholders**

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6 Results per PILOT

The raw data for the workshop was collected through the visual collaboration tool MURAL. OUNL compiled this data in preliminary reports for every workshop. The data as presented in those reports was subjected to minor changes (e.g., spelling) and elaborations/clarifications by OUNL. The reports and an invitation for review were then sent to participants of the workshops, as well as to important partners that were unable to participate in the workshop. By means of this review round, participants were given the opportunity to comment on the results. It also allowed for those that had not been able to participate to still make a contribution to the co-creation process.

This section of the report presents the results of the workshops, realised a little ahead of the planned timeline (Figure 8).

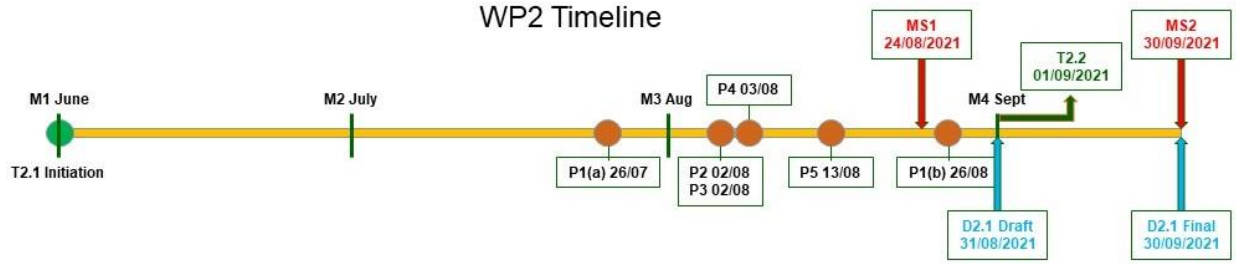

Figure 8. Timeline that represents the realized workflow of Task T2.1 to Deliverable D2.1 (report, public) by Milestones MS1 and MS2.

Legend: yellow arrow is workflow process, green dot is start, orange dot is pilot focus group workshop, red arrow is milestone, blue arrow is deadline D2.1, green arrow is connection to T2.2 (and T2.3). (by Draxis)

All 5 PILOTs are represented within the 5 focus group workshops held, for which we sent 84 invitations to potential focus group members; realized: 74 participants (Table 7).The changes and comments made by OUNL and partners have been incorporated. For every pilot workshop, the results are listed per workshop round.

Table 7. Focus groups workshops realised with the CoP per pilot. (indicated by number).

PILOT	Country	Title	Pilot leader	CoP leader	Workshop Date	No. of participants invited (real)
1	NL	Water & Land Use Management	IHE	NOORD	(P1) 20210726 PM (P1.5) 20210826 AM (P2) 20210916	8 (5) 9 (6) 10(7)
2	LT	Sustainable Agriculture	IBEC	NBA	20210802 PM	14 (10)
3	ES	Infrastructure & Transport Management	PRO	BPA	20210802 AM	11 (12)
4	GR	Sustainable Urban Development	NOA	ATTICA	20210803 AM	20 (14)
5	FI	Multi-hazard risk assessment	SYKE	SYKE	20210813 AM	12 (9)
total					Realized: 5 workshops	Realized: 84 p. invited, (74 p. participated)

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Note: Number of participants invited and realized indicated per pilot and in total. PILOTs described by country, title (with EIFFEL Deliverable), Aimed application, Leader institution of the pilot study and Leader of the community of practice (CoP) co-designing the application. The No. of participants invited and real are overlapping per pilot (total count is not indicating the No. of unique participants, because leads WP2/WP5/WP7 attended the workshops as well).

Additional comments made during the workshop are presented in APPENDIX A. The changes and comments made by OUNL and partners regarding these additional comments have also been incorporated.

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6.1 Results for Workshop pilot 1

The workshop aimed to facilitate interaction between partners from WP5 and WP7 (Table 8). OUNL therefore invited representatives from **IHE** and **NOORD-BRABANT**. It should be noted that OUNL is also involved in pilot 1, which allowed for additional input during the co-design process. Additionally, it should be noted that IHE is the lead partner of WP5. The lead partners of WP7 (SYKE) and WP2 (DRAXIS) were also invited.

Due to the fact that it was not possible to have all relevant representatives of each partner present during a single workshop, it was necessary to conduct the workshop in two parts. During the second part of the workshop, participants were invited to comment and expand upon the results of the first part of the workshop.

Table 8. Partners of WP5, WP7, WP2 participating in the pilot 2 workshop.

Pilot Title	Country	Workshop date	WP5	WP7	WP2	No. of participants invited (**present**)
Water & Land Use Management	NL & BE	20210726 PM	**IHE** (1)	(0)	DRAXIS (1) OUNL (3)	8(**5**)
Water & Land Use Management	NL & BE	20210916	**IHE** (2)	**NOORD-BRABANT** (1)	DRAXIS (1) OUNL (2)	10(**7**)*

*Note: Partners noted by their acronym followed by the number of participants in parentheses; pilot lead (WP5) and CoP lead (WP7) **bold**, leads of WPs and T2.1 underlined. *One member from NPA was also present during Part 2 of the workshop*

6.1.1 Results of Round 1: Co-creation of User Stories for Applications

Table 9. Partners of WP5, WP7, WP2 participating in the pilot 1 workshop.

User	Climate Change Challenge	Goal	Core Task
Water board (authority) - water managers of the system - On water part of the system, but affects land part of the system - Water board hydrologist; water board data scientist	- Extreme flood events - Water drought by CC/nature - Water droughts by (agricultural) use - Crossboundary catchment-integrative water gov - Increased by CC, but also active agricultural activity – export tree nurseries - Diff data systems, data needs - Interaction agricultural – nature (not WB gov) - Interact - Integrative approach - To little water effects chemical and ecological quality (= WFD) - Not much flooding problems from river, but from rainfall	- Water retention in flooding periods and use in drought - To discuss potential solutions / knowledge in apps - Carbon storage by using NbS - To manage water; positioned in the middle - Could BE&NL be represented in apps; as example of cross border EU - Goal and - Main action is by land owners & land managers - Nice balance between need and supply of water - Demand side cannot be regulated (only by allowances for pumping)	- Identify solutions, to be checked by stakeholders (web/apps) - Negotiate plan of actions - Two-way communications and visualisation of CC problems and actions - PLAN to use such app in co-create processes - Trying to work with land owners / farmers - To align the different users on land use (earning money connecting with CC challenge)

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User	Climate Change Challenge	Goal	Core Task
	- Natural supply - Citizens: to be aware of the water/landscape - Balance between supply and demand; demand is enhancing (nurseries) - Information for concerned citizens = climate proof (transforming land)	- Demand side balancing by storing water / water retention	
Regional Authorities & Municipalities - Municipalities: only on the urban system; the sewage	- Soil carbon sequestration from water change view - Ongoing projects connection with others - What is already known; what are the gaps	- What is used in the climate atlases by the USER organisations - Role of climate atlases in NL, but how cross border	- Interaction with EIFFEL tool developers - Role of community of practice of pilot 1
Land Users (agriculture) - Farmers (economic activity spills of nature) - Tree nursery farmers (specific needs)	- Soil carbon sequestration from water change view	- Main action is by land owners & land managers	
Nature Managers	- Soil carbon sequestration from water change view	- Main action is by land owners & land managers	
Province - glue between users - giving information		- Province is 'master-level' of scale; details more on water board; municipality; end users	- 'Information broker': giving information, detecting gaps; connecting those users - Pre- & post evaluation (also by maps and measurements (satellite & pipes) - Province does 'frameworking'; the end users are working with these goals & information - The province monitors the end-users interventions: does it affect CC goals? - Feedback loop between monitoring and planning measures
General / Context - Complete system for all users	- Aa-Weerijs = pilot area in climate proof plan	- Providing interconnected information and data for end users - Not only maps because of uncertainties: are we doing it right, can we approve for next regions - Information: potentials for water retention; climate proof = how to define/how to measure - Does the policy making work; should we adapt those; being coherent for overall solution (dynamics)	- Grey area – who does what? - Complex and interconnected with all users; look at whole system - Links between different users and between quality and quantity, but same type of data are needed - Interlining data of the physical system/depending - Important to look from the 'data-side' - Monitor the right indicators

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User	Climate Change Challenge	Goal	Core Task
			- Monitor your actions/effects - More difficult who is in charge; lower authorities are in charge, province; end users are on details, in the masterplan

6.1.2 Results of Round 2: Application Functionalities

Table 10. pilot 1 Workshop: Round 1 Results

User	Functionalities
- **Water boards manager** - **Water board (authority)** - **Province**	- Test effects of NbS: 1) in planning stage, 2) calculate actual effect, 3) real world measuring / effect on overall system (feasibility?) - Indicators for water availability - Effect of NbS in the catchment - Land use change is indicator of Nbs - Indicator for diff stakeholders are different? - What visualisation, pref. to each stakeholder aim - Prioritisation by stakeholders of NbS - UK app - Parcel level - Province => policy making. Land users: making business
- **Regional Authorities & Municipalities** - **Land and Nature managers** - **Province**	- More integrated the water and soil carbon effect - Study application (existing) in NL and UK - Supporting discussion & selecting NbS – to be used by others in negotiation - Biggest interest province is how do different interventions into the system; interaction in whole province - First the indicators, then the measures and other way around - Different options at different locations
- **Land users (agriculture) = farmers** - **Specific in needs: tree nursery farmers** - **Image climate proof can be leverage for taking measures (if it is important/market)** - **More willing to reduce their risks; to be more climate proof** - **Nature managers**	- Get a better idea of extreme events on the overall and measures system (real time) - Comparing modelling effects with real time data (like data mining from social media and satellite) - To better understand how the system is working in real time - Real time monitoring for the demand side of water (agriculture) - Real time monitoring to optimize water balance (demand & supply) - Nature manager: monitor quality of vegetation and effect of measures (climate robust forest)
- **Province = glue between users = giving information**	- Bigger need for details, real time information (more $ risks) - More precise data/information - What kind of NbS for each user groups/ & effects (transforming land use; affect other users)

Table 11. pilot 1 Workshop: Round 2, Part 2 Results

Necessary Functionalities	Optional Functionalities
- indicators at regional and on local (parcel) scale - Connect to CC atlas NL - Study application (existing) in NL and UK - Indicators and demonstration of change in indicators	- Negotiation; collaboration - WP3 and WP4 functionalities - Nature manager: monitor quality of vegetation and effect of measures (climate robust forest) CROSS PROJECT (FINLAND)

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Necessary Functionalities	Optional Functionalities
- Get a better idea of extreme events on the overall and measures system (real time) - Comparing modelling effects with real time data (like data mining from social media and satellites) - Real time monitoring for the demand side of water (agriculture) - Real time monitoring to optimize water balance (demand & supply) - More precise data/information - What kind of NbS for each user groups/ & effects (transforming land use; affect other users) - Test effects of NbS; 1) in planning stage, 2) calculate actual effect, 3) in teal world measuring / effect on overall system (feasibility?) - Biggest interest province Is how do different interventions into the system; interaction in whole province - To better understand how the system is working in real time	- Bigger need for details, real time information (more $ risks) WHAT IS ALREADY AVAILABLE

6.1.3 Results of Round 3: Reflection on Stakeholder Categorisation

Numerous changes were made to the stakeholder categorisation that was initially presented in the Grant Agreement[2]. The *regional authority* in the area remains a primary stakeholder, but is now referred to as the *Province.* The *regional authority* in BE is a secondary stakeholder, and is referred to as the *Province of Antwerp*. The municipality of the region and the local and water (management) board remain a primary stakeholder. Other water boards in the province are a secondary stakeholder; lessons learned from the pilot are communicated to them. While *land and nature managers* were initially categorized as secondary stakeholders, the *land users* and *nature manager* are now categorized as primary stakeholders. Agricultural organisations remain a secondary stakeholder. The initially identified *citizen councils*, a secondary stakeholder, have been exchanged for *concerned citizens & affected business.* Tourism businesses are an example of the latter.

Table 12. pilot 1 Workshop: Round 3 Results

Primary Stakeholders	Secondary Stakeholders
- Municipality - Water Board - Province - Land users (agriculture) = farmers (tree nursery farmers have specific needs) - Nature managers	- Agricultural Organisations - Other water boards in province (lessons learned/dissemination) - Province of Antwerp (Cross-border) - Concerned citizens & affected business (e.g., tourism)

[2] Grant Agreement No 101003518, Part B, 14

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6.2 Results for Workshop pilot 2

6.2.1 Pilot 2 Workshop Participants

The workshop aimed to facilitate interaction between partners from WP5 and WP7 (Table 13). OUNL therefore invited representatives from **IBEC** as well as from **NPA**. The lead partners of WP5 (IHE), WP7 (SYKE) and WP2 (DRAXIS) were also invited.

Table 13. Partners of WP5, WP7, WP2 participating in the pilot 2 workshop.

Pilot Title	Country	Workshop date	WP5	WP7	WP2	No. of participants invited (**present**)
Sustainable Agriculture	LT	20210802 PM	**IBEC** (1) IHE (1)	**NPA** (5)	DRAXIS (1) OUNL (2)	14 (**10**)

*Note: Partners noted by their acronym followed by the number of participants in parentheses; pilot lead (WP5) and CoP lead (WP7) **bold**, leads of WPs and T2.1 underlined.*

6.2.2 Results of Round 1: Co-creation of User Stories for Applications

Table 14. pilot 2 Workshop: Round 1 Results

User	Climate Change Challenge	Goal	Core Task
Agricultural Policy Makers	- Biodiversity enhancement - CO_2 sequestration - Carbon sequestration	- Diversification - Crop rotation - Reach European greening policy goals efficiently - Because of new CAP - To monitor the effect of policy measures - To validate effects on aims	- Monitoring crop rotation; to see yearly changes in area, per parcel. - Monitoring crop diversification, to plant and declare in the same area - Monitoring Thresholds, predicting if thresholds might change are under changing per year etc. - For the whole country – national scale - Seasonal basis; one yield per crop - To boost changes in effect of policy faster
Agri-Consultants **Farmers**	- Soil carbon sequestration - Hybrid modelling: soil erosion - Soil biodiversity (secondary) - Enhancing water storage capacity (secondary)	- How can select farmers to enhance soil carbon - To provide farmers with enhanced spatial indicators - To provide farmers with services to support climate smart agriculture (pref. than precision agriculture)	- Understanding based on Explainable information to support the services and information to farmers - Performed at parcel level - Estimation of properties (at least yearly)
Paying Agencies **Environmental Agencies**	- Biodiversity	- Area detection; burned grassland detection. Ploughed NATURA 2000 areas (permanent grasslands) detection - To reduce the burned area	- Fast detection: to be able to detect areas of burned grassland immediately - To detect diversity of changing land use, bound up with new CAP - To detect bare soil

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User	Climate Change Challenge	Goal	Core Task
		- To prevent burned areas and emissions - To be able to give out fines for burned grassland	

6.2.3 Results of Round 2: Application Functionalities

Table 15. pilot 2 Workshop: Round 2, Part 1 Results

User	Functionalities
Agricultural Policy Makers	- Scale: whole country; Output: layers/numeric data; once per year for different crop type group (winter/summer grain), connected with LPIS data - Real time for some crop groups (existing data); once per year for other crop groups - Use of spatial explicit and use data for LULUCF accounting in their National GHGs inventories - For the whole country: national scale - Seasonal basis; one yield per crop
Agri-Consultants **Farmers**	- Scale: whole country; Output: once or twice per year; uploaded to user friendly environment (to reach farmers easily) - CAP indicators in common language (farmer services) - Common legend; simple query - At parcel level - At least yearly, estimation of properties
Paying Agencies **Environmental Agencies**	- Ability to use data for monitoring the achievement of indicators - At parcel level - Temporal scale – immediate alert when thresholds are passed

Table 16. pilot 2 Workshop: Round 2, Part 2 Results

Necessary Functionalities	Optional Functionalities
- Scale: whole country; Output: layers/numeric data; once per year for different crop type group (winter/summer grain), connected with LPIS data - Scale: whole country; Output: once or twice per year; uploaded to user friendly environment (to reach farmers easily) - Common legend; simple query - Real time for some crop groups (existing data); once per year for other crop groups - Seasonal basis; one yield per crop - At parcel level - Use of spatial explicit and use data for LULUCF accounting in their National GHGs inventories - Ability to use data for monitoring the achievement of indicators (to be discussed: to what extent) - Temporal scale – immediate alert when thresholds are passed - Different users, different platform application, different versions (phone, computer; layers per user groups) to be decided upon in next EIFFEL stages	- If open data are used, upscaling might be possible to other EU CAP regions; but other data is restricted / publicly - Farmer user GUI. CAP indicators in common language (farmer services)

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6.2.4 Results of Round 3: Reflection on Stakeholder Categorisation

The stakeholder categorisation that was initially presented in the Grant Agreement [1] was left mostly unaltered. The only change that was made was the addition of *municipalities* as a secondary stakeholder.

Table 17. pilot 2 Workshop: Round 3 Results

Primary Stakeholders	Secondary Stakeholders
- Agricultural Policy Makers - Paying Agencies	- Agricultural cooperatives - Agri-consultants - Farmers - Municipalities – rural areas for declarations for payments

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6.3 Results for Workshop pilot 3

The workshop aimed to facilitate interaction between partners from WP5 and WP7 (Table 18). OUNL therefore invited representatives from **PRO** as well as from **BPA**. The lead partners of WP5 (IHE), WP7 (SYKE) and WP2 (DRAXIS) were also invited.

Table 18. Partners of WP5, WP7, WP2 participating in the pilot 3 workshop.

Pilot Title	Country	Workshop date	WP5	WP7	WP2	No. of participants invited (**present**)
Infrastructure & Transport Management	ES	20210802 AM	**PRO** (2) IHE (1)	**BPA** (2)	DRAXIS (1) OUNL (3)	11 (**12**)*

*Note: Partners noted by their acronym followed by the number of participants in parentheses; pilot lead (WP5) and CoP lead (WP7) **bold**, leads of WPs and T2.1 underlined. * Three participants from NPA were partially present during the meeting.*

It should also be noted that PRO and BPA prepared an overview of users for the various use cases in pilot 3, as well as a list of relevant KPIs. The most up-to-date overview incorporates comments from the workshop, and can be found in APPENDIX B.

6.3.1 Results of Round 1: Co-creation of User Stories for Applications

Table 19. pilot 3 Workshop: Round 1 Results

User	Climate Change Challenge	Goal	Core Task
(1st) - Port Authority (Environmental & Operational)	- Lower Emissions - Pollution and accidental pollution -> connection with emissions - Thresholds exist; alert managed by port, not an accident	- Emission periods - Focus is on air quality - Minimize the impact - To correlate information sensors with other sources of information - Origin of emissions (of which vessels; installation) - To validate / extrapolate to areas without sensors - Specific source of emission period - As soon as possible, action, after monitoring - Not to affect the city with emission periods - Also accidental pollution can be monitored - To predict to detect pathways to control pollution episodes (FUTURE) - Use case 3 = pathways/patterns for future regulations - Future recommendations at regional level	- Monitoring - To take actions / operations to minimize impact - Port authority cannot do inspection on vessels - To make it possible to detect the origin to specific vessels - To take measures from the 25 in-situ environmental stations (25) - Tool to plan the vessel actions - Berths allocation optimisation within short term (2-3 hours): to organize actions (dock; delay berth) one day before arriving

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User	Climate Change Challenge	Goal	Core Task
(2nd) - City Councils - Administration, regional government – environmental department - Inspectors; different from port authority (navigation authority)	- Lower emissions (overall) - Mitigation and adaptation actions in policy plans	- Monitoring the pollution; origin from port or from another source (industry?) - (AP&CA)	- Different users take different actions - To verify if the port users are complying with the air quality policy plans
(3rd) - Citizens - Tourist companies		- Low pollution level - Being informed about pollution levels / pollution episodes / pollution patterns	- To check at an open website
(4th) - Vessel Companies - Managers - Global Managers		- To comply with regulations - To lower emissions - To validate if their own mitigation measures are working - Promotion of their GREEN level of the company – if they are improving - To be sure that emissions are from other sources, and not their vessels.	- To check if measures are working

6.3.2 Results of Round 2: Application Functionalities

Table 20. pilot 3 Workshop: Round 2, Part 1 Results

User	Functionalities
Port Authority	- Monitor pollution and detect episodes over the TLV - Correlate in-situ data to GEOSS data - Calculate the source of the possible origin of a pollution episode - Decision support - Alerts emission - Pollution episodes prediction - Historical data - To identify the origin of the pollution episodes - Recommendations based on the predictions - Identify any possible seasonal pollution pattern - Send alert if a high emission is predicted - Send alert if a high emission is detected - Backtracking pollution - Statistical pollution data by vessel/company - To set the pollution prediction at a feasible interval for a reasonable timeframe (e.g. next XX days), considering that prediction accuracy diminishes as the predicted timeframe increases - Send alert when high emission is predicted and the area affected might have high density of population
City Councils	- Monitor pollution and detect episodes over the TLV - Link pollution episodes to its right source - Alert emission - Pollution episodes prediction - Web based, open site - Simple query, clear legend - Congruent with authority symbols and alerts, like red-yellow-green level of risk - Dashboard
Citizens	- Dashboard

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	- Web based, open site - Simple query, clear legend - Congruent with authority symbols and alerts, like red-yellow0green level of risk
Vessel Companies	- To identify the origin of the pollution episodes, if it is possible identify the vessel/s which originated the episode - Determine the environmental impact of each vessel - To know the berth allocation and planning, which may change depending on the estimated pollution predicted - LEGEND based on GREEN labelling: (international sustainability level??) - Web based, open site

Table 21. pilot 3 Workshop: Round 2, Part 2 Results

Necessary Functionalities	Optional Functionalities
- Calculate the source of the possible origin of a pollution episode - Pollution episodes prediction - Recommendations based on the predictions - Backtracking pollution - Statistical pollution data by vessel/company - Methodology for detecting vessels with high emissions - To identify the origin of the pollution episodes - Monitor pollution and detect episodes over the TLV - Decision support - Historical data - Identify any possible seasonal pollution pattern - Specific user; specific access (restriction to own vessel) - Maybe more than TWO levels of access - TWO level of access – open and restricted - Determine the environmental impact of each vessel - Correlate in-situ data to GEOSS data - To correlate with extra areas (not yet known which data from GEOSS) - SDG indicators – KPI's (grant agreement) - Alerts emission - Alerts KPI's (see doc) - Send alert if a high emission is predicted - Send alert if a high emission is detected - Dashboard - Simple query, clear legend	- Congruent with authority symbols and alerts, like red-yellow-green level of risk - Legal thresholds change each year; comply the legal limits and air quality index - Berth allocation and planning - LEGEND based on GREEN labelling: (international sustainability level)

6.3.3 Results of Round 3: Reflection on Stakeholder Categorisation

Several changes were made to the stakeholder categorisation that was initially presented in the Grant Agreement [1]. The *Port Authority* remains a primary stakeholder. The *cruise companies* and *shipping companies*, both primary stakeholders, are now merged and defined as *vessel companies*. *City councils* had initially been categorized as a secondary stakeholder; they are now referred to as the *city councils and environmental regional government*, and are categorized as a primary stakeholder. *Citizens* remain a secondary stakeholder. Several new secondary stakeholders are incorporated: (1) *industry in port area*, (2) *port community (not presented by port authority)*, and the (3) *association of vessel companies*.

Table 22. pilot 3 Workshop: Round 3 Results

Primary Stakeholders	Secondary Stakeholders

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- Port authority (Operation managers; Environmental Managers) - City councils and Environmental regional government - Vessel Companies	- Citizens - Industry in port area. There are industries that are operating at the port, producing emissions - Port community, not represented by port authority: Other entities that produce emissions, like logistic companies - Association of vessel companies / CLIA

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6.4 Results for Workshop pilot 4

6.4.1 Pilot 4 Workshop Participants

The workshop aimed to facilitate interaction between partners from WP5 and WP7. OUNL therefore invited representatives from **NOA** as well as from **ATTICA**. The lead partners of WP5 (IHE), WP7 (SYKE) and WP2 (DRAXIS) were also been invited.

Table 23. Partners of WP5, WP7, WP2 participating in the pilot 4 workshop.

Pilot Title	Country	Workshop date	WP5	WP7	WP2	No. of participants invited (**present**)
Infrastructure & Transport Management	GR	20210803 AM	**NOA** (4) IHE (1)	**ATTICA** (3) SYKE (1)	DRAXIS (3) OUNL (2)	20 (**14**)

*Note: Partners noted by their acronym followed by the number of participants in parentheses; pilot lead (WP5) and CoP lead (WP7) **bold**, leads of WPs and T2.1 underlined.*

6.4.2 Results of Round 1: Co-creation of User Stories for Applications

Table 24. pilot 4 Workshop: Round 1 Results

User	Climate Change Challenge	Goal	Core Task
(1st) - Urban planners - Contracting depends on scale; national – regional – urban; different scales – different plants – coordinates objectives - Administrative authorities (i.e., prefectures, municipalities)	- Intense phenomena like rain, flooding - Tool is more on CC mitigation, so blue-green infrastructure and connection to adaptation measures - Photovoltaic penetration, urban mobility, air quality connected with green parks - Extreme weather events: heat waves, high temp.	- co-benefits of adaptation and mitigation actions, demonstrate co-benefits - air quality application is co-benefit demonstration - greening Attica by parks gives co-benefits (CC adaptation / mitigation effects) - to demonstrate how important is to combine levels from national to urban level - to demonstrate regional/urban planning to showcase to national measures - awareness, action on adaptation linked to mitigation	- To develop urban structures, green infrastructures, green roods, walls - Collect data for common use places / green places - Coordinate plans at different scales - Citizens will be having power in energy producing – so demonstrate scenarios, possible conflicts
(2nd) - Energy providers / distributors (i.e., PPC/PPCR, IPTO) - Financial institutions, potential - Ministry of Environment & Energy	- Decarbonising - Is it not cheaper to focus on rural and on importing energy?	- potential of the city of sustainable sources, to measure/ to provide data sets and parameters on effect - To enlarge e-mobility - New dimension is the citizen as producer of energy, complicated the market operation – new market	- To develop scenarios that could cover the larger need on energy by e-mobility - Proximity is also important to minimize transmission costs - To develop totally new concepts as smart grids - Transmission and spatial distribution had to be more efficient on small scale

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User	Climate Change Challenge	Goal	Core Task
			- To demonstrate citizens as both users and producers of (new) energy - To co-design the use of land for PV, competitive use (rural areas) - 2nd level
(3rd) - Citizens as energy providers - Citizen as user of public spaces, transport system, health			
(4th) - Ministry of Health (Air quality – at national level) - Ministry of Environment & Energy	- Air quality change / accidents - Heat waves; mitigation co-benefit air quality	- Monetarisation: financial benefit and investments Cost Benefit Analysis	- Monitoring and alerting by threshold of air quality (accidents, base level) - Scenario analysis to plan ahead (prediction); spatial and temporal - Scenario analysis / land use analysis - Spatial scale in line with national/regional scales, target measures in locations (MAP above NUMBER)

6.4.3 Results of Round 2: Application Functionalities

Table 25. pilot 4 Workshop: Round 2, Part 1 Results

User	Functionalities
Urban Planners	- Support policy decision - Comparison between municipalities - Database / mapping - Scenario planning for emissions reduction - Adaptation synergies with green infra - Screening for feasibility, space usage - Decarbonisation effectiveness to meet targets - How can I optimize transportation and mobility in my region/municipality to serve the citizens while at the same time cutting down on emissions? - Use the DSA or the tools to prove that I am taking steps towards greening my region/municipality and complying with zero carbon cities - Scale? National <-> regional <-> local
Energy Providers (Infrastructure)	- Solar energy potential information - Definition of the supply and demand equilibriums - Assessing energy savings - Support the continuous intraday energy trading - Is the energy from solar panels (at the building or neighbourhood level) adequate to cover part of the energy needed for electric cars? - Feasibility? Cost? - Create high impact examples. Buildings of high visibility. How good do they perform? - Harmonization with the new European Energy Target Model
Citizens as energy providers (Smart grid)	- Easy to understand, direct information. What is the situation at my home? - How much money I can save through the introduction of the measures - Co-benefits: health related, amenity, travel time, cost etc. - Economic benefit for energy market operations

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	- Will my investment by of benefit for me and at which time horizon? - Simple queries, simple mapping
Air quality officials	- Be able to identify the impact of interventions in the 3 domains and measures to mitigate CC on air quality and exposure - Identification and analysis of top polluters and top hot-spots. How to deal with these top issues first? - Visualize emissions per sector (buildings, transport) - Identify hot spots where more interventions are needed – pursue environmental justice and confront inequities - Which measures get my area of interest within the EU/WHO AQ limits? - Multiple levels of data access and data analysis

Table 26. pilot 4 Workshop: Round 2, Part 2 Results

Necessary Functionalities	Optional Functionalities
- Be able to identify the impact of interventions in the 3 domains and measures to mitigate CC on air quality and exposure - Visualize emissions per sector (buildings, transport) - Decarbonisation effectiveness to meet targets - Multiple levels of data access and data analysis - Simple queries, simple mapping - Database / mapping - How much money I can save through the introduction of the measures - Economic benefit for energy market operations - Will my investment by of benefit for me and at which time horizon? - Assessing energy savings - Solar energy potential information - Definition of the supply and demand equilibriums - Is the energy from solar panels (at the building or neighbourhood level adequate to cover part of the energy needed for electric cars? - Create high impact examples, buildings of high visibility. How good do they perform? - Support policy decision - Comparison between municipalities - Use the DSA or the tools to prove that I am taking steps towards greening my region/municipality and complying with zero carbon cities - Scenario planning for emissions reduction - Scale? National <-> regional <-> local - Easy to understand, direct information. What is the situation at my home?	- Which measures get my area of interest within the EU/WHO AQ limits? - Harmonization with the new European Energy Target Model - Identification and analysis of top polluters and top hot-spots. How to deal with these top issues first? - Identify hot spots where more interventions are needed – pursue environmental justice and confront inequities - Co-benefits: health related, amenity, travel, time, cost etc. - Support the continuous intraday energy trading - Feasibility? Cost? - Screening for feasibility, space usage - Adaptation synergies with green infra - How can I optimize transportation and mobility in my region/municipality to serve the citizens while at the same time cutting down on emissions? - Easy to understand, direct information. What is the situation at my home?

6.4.4 Results of Round 3: Reflection on Stakeholder Categorisation

A range of changes was made to the stakeholder categorisation that was initially presented in the Grant Agreement [1]. The *Ministry of Environment & Energy* remains a categorized as a primary stakeholder, whereas the *Ministry of Health*, the *Ministry of Developments and Investments*, as well as the *Ministry of Infrastructure* are now categorized as secondary stakeholders. *Administrative authorities,* initially categorized as a secondary stakeholder, is now a primary stakeholder. Similarly, *urban planners* and *energy providers / distributors* are also categorized as primary stakeholders. *Industry* remains a primary stakeholder. Two additional primary stakeholders are identified: the *region* as well as *citizens*.

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Table 27. pilot 4 Workshop: Round 4 Results

Primary Stakeholders	Secondary Stakeholders
- Administrative authorities (i.e., prefectures, municipalities) - Ministry of Environment & Energy - Urban planners - Region = partner - Energy providers / distributors (i.e., PPC/PPCR, IPTO) - Citizens (energy) - Ministry of Infrastructure	- Industry (e.g., renewables, building construction) - Ministry of Health - Ministry of Development and Investments - Ministry of Infrastructure

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6.5 Results for Workshop pilot 5

6.5.1 Pilot 5 Workshop Participants

The workshop aimed to facilitate interaction between partners from **WP5** and **WP7** (Table 28). OUNL therefore invited representatives from **SYKE**. SYKE is also the lead partner of **WP7**. The lead partners of WP5 (IHE) and WP2 (DRAXIS) were also invited.

Table 28. Partners of WP5, WP7, WP2 participating in the pilot 5 workshop.

Pilot Title	Country	Workshop date	WP5	WP7	WP8	WP2	No. of participants invited (**present**)
Multi-hazard risk assessment	FI	20210813 AM	**SYKE** (4)	**SYKE** (1)	SYKE (1)	DRAXIS (1) OUNL (2)	12 (**9**)

*Note: Partners noted by their acronym followed by the number of participants in parentheses; pilot lead (WP5) and CoP lead (WP7) **bold**, leads of WPs and T2.1 underlined.*

6.5.2 Results of Round 1: Co-creation of User Stories for Applications

Table 29. pilot 5 Workshop: Round 1 Results

User	Climate Change Challenge	Goal	Core Task
(1st) Water professionals at regional authority Regional users - hydrology	- Changes in water resources - Drought - Forest fires due to drought - Longer and hotter summers - Soils sulphating / water quality issues due to severe rain / drainage - Water resources depleted – regional problems - Water use type can be changed - irrigation	- Being prepared for water problems / advance warnings - To be prepared for different water use - To adjust the water management to future water uses and climate conditions	- To take CC and drought into consideration - Better prepared for drought which is a relatively new challenge in FI - To discuss with others the specific measures - Incentives for utility companies to be prepared for drought / pipe lines etc. - Drought mitigation plans by municipalities - 1 plan developed, but more to come (at most prone areas)
(2nd) SYKE (researchers & experts)	- Rapid climate warming and increasing risk of multiple hazards - Northward shifts of forest pest species in warming climate - Likely increase in summer droughts and increase in large-scale forest fires/frequency of fires - Probability of cascading effects and simultaneous occurrence of multiple hazards - Positive effect of CC on forest growth might be offset by forest damages	- Conducting new research on moths as forest pest species - Develop new functionality & content to SYKE's water and climate change portals - Improve drought forecast in Finland - Consideration of multiple forest disturbances and assessment of combined effect of drought/fires and forest pests - Forecast of occurrence and abundance of forest pests	- Warning to citizens and specific authorities - Researching and implementing in warning systems - Monitoring of the environment - Maintains climate and water portal together with other partners - Provides flood and drought warnings - Responsible for reporting on environment related SDG (e.g. level of water stress, SDG indicator 6.4.2)

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User	Climate Change Challenge	Goal	Core Task
(3rd) Forest centres and management companies	- Drought - Longer droughts, peat fires / forest fires increasing - Pest species - Pest species more abundant in milder winters - Increasing likelihood of forest fires - Interplay between drought and pest effects - Forest fire risk increases if forest is sick	- Improving the warnings for forest fires - Way of forest management: biodiversity vs economic and how CC affects these type of FM - Provide information on pest species per forest / tree type - Improved management information - To maximize forest growth, to make decision in forest management cycle - To have less economic loss - Biodiversity goals, support in interpretation in multilevel situations and projections - Interplay between forest species (spruce is not eaten by moose) - Some forest owners emphasize the ecological and recreational value	- To update their instructions taken CC into account - Pest control to enhance including CC future - To grow forests in a CC perspective - Revising national forestry guidelines including CC future - National guidelines is policy-wise complex - Advise on sustainable management of forests; recommendations for cultivation of species
(4th) Ministry of agriculture and forestry	- The climate change challenges for this user story are the same as above (both forestry and hydrology), but the point of view of the user is different	- Developing strategies and plans on these issues - Responsible for CC adaptation plans (leading, 10y) - Adaptation workgroup, regional groups are involved (lead by Ministry) - To discuss and analyse info to be included in measures - In cooperation with regional authorities and companies	- Coordinating the monitoring; instruct diff partners to use - Collaboration to regional centres (finance; yearly achievements) - CC adaptation strategy (to update) - Updating the legislation - Forecasting impact assessment - Coordination of climate change adaptation in Finland

6.5.3 Results of Round 2: Application Functionalities

Table 30. pilot 5 Workshop: Round 2, Part 1 Results.

User	Functionalities
- Water professionals at regional authority	- At least at a scale of the water system
- SYKE	- Provide improver information on drought risks on the vesi.fi portal - Provide improved information on multi-hazard CC risks on the climateguide.fi portal - Improved warnings with new variables, time scales etc. - Models using new information, e.g. soil moisture from satellites - To develop simple query systems for different user groups
- Forest centres and management companies	- National scale maps of forest pest risks (e.g. seasonal forecast) - Predictions of pest species distributions? - Risk maps for drought and forest fires - If a new pest species arrives, to see directly what might be the spatial impact
- Ministry of agriculture and forestry	- National, scalable maps?

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Table 31. pilot 5 Workshop: Round 2, Part 2 Results

Necessary Functionalities	Optional Functionalities
- Improved warnings with new variables, time scales etc. - Provide improved information on Multi-hazard CC risks on the climateguide.fi portal (Portal Climate) - To build a link between the data of the portals - Risk maps for drought and forest fires - More on long term; what is predicted to happen - Provide improved information on drought risks on the vesi.fi portal (Portal Water) - Two months ahead is more general, not local - To be able to show how big is the risk including uncertainties - Models using new information, e.g., soil moisture from satellites - Predictions of pest species distributions? - To develop simple query systems for different user groups - To the general public - National, scalable maps? National scale maps	- National scale maps of forest pest risks (e.g., seasonal forecast) - If a new pest species arrives, to see directly what the spatial impact might be - Normal maps are 2 weeks ahead; forecast more in advance 2 months ahead (improved) - Not always useful to go into detail, because of data resolution (uncertainty) - Under discussion = at which governance level CC impact has to be analysed / shown

6.5.4 Results of Round 3: Reflection on Stakeholder Categorisation

Various changes were made to the stakeholder categorisation that was initially presented in the Grant Agreement [1]. The *Ministry of Agriculture and Forestry*, as well as the *forest centres and management companies*, remain primary stakeholders. The *Regional authority for water resources governance* was initially categorized as a secondary stakeholder, but is now considered a primary stakeholder. *Rescue services* remain a secondary stakeholder. *Research organisations*, such as SYKE and the Finnish meteorological service, are an additional primary stakeholder. Numerous additional secondary stakeholders are identified: (1) the *general public*, (2) *municipalities*, as well as (3) regional planners involved in CC related issues.

Table 32. pilot 5 Workshop: Round 3 Results

Primary Stakeholders	Secondary Stakeholders
- Forest centres and management companies - Ministry of agriculture and forestry - Regional authority for water resources governance - Research organisations as SYKE, Finnish meteorological service	- General public - Municipalities, depending on scale of institution - Regional planners CC, depending on sector - Rescue services

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7 Synthesis of Workshop Outcomes

This section presents a synthesis of the outcomes of the workshops that were conducted. *Section 7.1* presents the *Users* and *User Stories* that were identified and developed for each respective pilot. This is followed by a synthesis of the *Functionalities* (*Section 7.2)* and an overview of the Stakeholder Categories (*Section 7.3)*.

7.1 User Stories

The user stories resulting from the synthesis of the workshop outcomes are presented in this section. The following components are incorporated into the user stories:

- The **user**
- The **stakeholder category**
- The **climate change challenges**
- The **goals**
- The **core tasks + Bloom's taxonomy [2]**

7.1.1 Pilot 1 User Stories

User Story P1.1: The Policy Officer at the Regional Authority

The central user in **User Story P1.1** is the **Policy Officer at the Regional Authority**, working within the spatial and environmental domains. This concerns government employees working for the *province* (*regional authority*), a **primary stakeholder** in pilot 1. The user plays a central role in the region, and could be described as the 'glue' between the various users in the region, from the local to the national level.

The main climate change challenge faced by this user is **drought**, because of its spatial distribution over a major part of the region. The main cause of this issue is the **lack of balance between the demand and (natural) supply of water** in the region. Demand generated by **agricultural use (irrigation) contributes to the drought issue**. The **demand for water has been increasing** due to changing land use activities such as tree nursery activities. The issue is worsened by **drought resulting from climate change** (e. g. evapotranspiration). Occasional **extreme flood events** resulting from excessive rainfall are another issue. Flooding of the river is less common. The main goals of the user is therefore to **manage the water supply effectively** and to **achieve balance between the demand and supply of water**.

The **Policy Officer at the Regional Authority** needs to **fulfil the 'information broker' role**. The user must **provide information**, **detect gaps in data**, and **connect the various other users** of pilot 1. The user also needs to **fulfil a 'framework' role**, meaning that they **envision and provide the goals and information that other users must work with**. Furthermore, this user must **monitor the interventions of the end users**, and **determine whether or not these affect climate change goals**. The user also needs to **conduct ex-ante and ex-post impact assessments of policies and measures** through the means maps, measurements, and other decision support applications and tools. This helps the user to **facilitate the feedback loop between the monitoring and planning of measures.** Engaging in discussions with the other users is essential for the 'information broker'.

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Existing tools and applications, such as the climate atlases, help the user to fulfil the role of 'information broker'. However, additional tools and applications are needed. In particular, the user needs support that allow this user to **bring together the complete range of stakeholders in order to investigate, analyse, and evaluate the different adaptation measures in a collaborative and transparent manner**.

The role of the **Policy Officer at the Regional Authority** is of vital importance due to the complex system of interconnected users in the region. A 'system perspective' that provides a clear overview is therefore required in order to **make the Aa-Weerijs area climate proof**. Maps and other tools/resources are required as means **spatially visualise measures and to determine their effectiveness**. This includes information needed to **analyse the potentials for water retention**, as well as means to **define and measure how 'climate proof' the potential area is**. Questions surrounding the effectiveness of policy and the potential need for adaptation of policy are important. The diverse range of users in the region creates a grey area; there is uncertainty and at times confusion surrounding who is in charge of what. Despite the different roles these users play, the type of data required by these users is generally similar. It is therefore important to look at the 'data side' and to monitor actions and effects using appropriate indicators.

User Story P1.2: The Water Management Professional

The central user in **User Story P2.1** is the **Water Management Professional**. This concerns water professional working for *municipalities* as well as those working for the region's *water board*; both are **primary stakeholders** in pilot 1. It should be noted that several **secondary stakeholders**, such as professionals working for *water boards outside the region* as well as those working for the *province of Antwerp*, are also relevant here. The **Water Management Professional** is in charge of the system's water-component, but water management ultimately also affects the land-component of the system including the urban and built-up area, in which municipalities are in charge, including urban flooding by their urban drainage and sewage networks. Both authorities operate in close (democratic voted) contact with citizens.

This user must deal with challenges such as **drought resulting from climate change and agricultural use**, as well as **extreme flood events**. The latter are usually the result of rainfall; river flooding is less common. With regards to drought, the lack of water has **negative effects on the chemical and ecological quality of the water**. Land use activities such as those conducted by tree nurseries are generating **increases in drought**. The **interaction between nature and agriculture**, and the issue of **balancing the (natural) supply with the increasing demand**, are major challenges. On a governance level, **integrated water governance** presents another challenge, due to the cross-boundary catchment. Climate mitigation by soil carbon sequestration as an effect of adaptation measures is interesting from water change view. There are ongoing collaboration projects connection on this, focussing on what is already known and what are the gaps.

The user aims for **water retention during flooding periods** and the **use of retained water during droughts**. Furthermore, the user wants to **achieve balance between demand and supply of water**, with **water retention** as an important means in the balancing process. It should be noted that, besides allowances for pumping, this user cannot regulate the demand side. Another goal is to **store carbon through nature-based solutions**. To discuss potential solutions / knowledge supported by apps, to manage water; with the data positioned in the middle. Could BE&NL be represented in apps; as example of cross border EU? Questions of water professionals

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are what might be main actions by land owners & land managers; what is used in the climate atlases by the user organisations, what are the Role of climate atlases in a cross border context?

In order to achieve these goals, the user must **identify solutions**, **review solutions with stakeholders**, and **negotiate a plan of actions**. This requires two-way communication and visualisation of climate change problems and actions. The user must **work together with land owners and users**, and **use the EIFFEL applications to support co-creation processes.** A central task is to **align the different users** in terms of land use, by connecting economic interests with the climate change challenges.

With regards to the data needs of this user: a lot of local data is already available, but further understanding must be fostered with regards to the value of using GEOSS data and whether or not such data can be helpful for the analyses that need to be conducted. The main **challenges with regards to the GEOSS data** are (1**) the identification of said data**, (2) **access to said data**, (3) **the quality of said data**, and (4) **the overall usability of said data**. This data must either be compared to local data, or must be used in conjunction with local data in order to build models. These models must be of sufficient quality to assure that climate adaptation measures can be assessed properly. What complicates matters is the cross-boundary nature of the region; it must be considered to what extent GEOSS data can be used to deal with the challenges of data sharing and the differing data systems and formats. In order to perform tasks effectively, the used needs to have data and models of the entire catchment, including indications of the BE and NL parts. This would make testing the joint assessment of climate adaptation measures (policy) possible.

The hydrological/hydraulic models that this user is currently working with are built with existing data. However, the user constantly aims **to improve models**. This particularly concerns models that allow for the testing of adaptation measures. This user is therefore expected to be interested in the models that are developed in EIFFEL, even without components of a decision support system. However, the decision support applications will provide additional benefits by allowing this user to see the effects of interventions and to analyse alternatives under different climate change scenarios. However, since the implementation of measures is done by various users, the applications must naturally meet the needs of these various users.

User Story P1.3: The Land User

The central user in **User Story P1.3** is the **Land User**. This concerns *farmers*, a **primary stakeholder** in pilot 1. Even though general requirements of land users are similar, it should be noted that in certain cases specific needs may differ. This is particularly the case for professionals working in the tree nursery sector, which comprises a large and important share of the land use in the region. Economic interest is an important characteristic of this user.

This user faces the challenge of **water requirements for agricultural activities**. The issue of **drought**, as mentioned in previous user stories, is therefore highly relevant. The issue of **soil carbon sequestration** comprises another challenge. The main goal of this user is to **secure adequate amounts of water** in order to successfully perform agricultural activities and **generate economic returns**. Furthermore, the user aims to **improve the soil carbon sequestration capacity** of the land.

The central task of this user is to **perform agricultural activities**. It should be noted that the actions of this user concern the demand-side of the system, and are therefore highly important in the context of the water supply. The user can **use data to perform actions in an informed**

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manner. With regards to this data, the tree nursery sector has specific needs that differ from those of other farmers.

In terms of measures performed by this user on the land, the applications must meet certain needs. The user must be able to receive insights with regards to the potential costs of the measures. Besides the overall effects in the catchment, it should also be possible for the user to see how the user's interests are affected. As with all users, the decision support applications must be customized to meet the particular needs of this user.

User Story P1.4: The Nature Manager

The central user in **User Story P1.4** is the **Nature Manager**. *Nature Managers* are a **primary stakeholder** in pilot 1. The user faces the challenge of **drought** as a major challenge. Contrary to the farmers and other land users, the **Nature Manager** does not have economic interests. Instead, this user's main aim is to **ensure that the land is climate proof**. The core task of this user is **to increase the managed area's resilience to drought**, and **in future agricultural policy including soil carbon sequestration (circular farming).** Similarly to farmers, the actions of this user are highly important in the context of the region's water supply. More generally speaking, the role of the nature manager with regards to measures should not be underestimated. Nature areas are likely to be targets for several measures. Examples include: increasing forests, wetlands, buffer ponds, and enabling upstream recharge areas for aquifers.

In order to perform the necessary tasks, this user must be able to clearly see the effects of potential climate adaptation measures. The user must also be able to use the decision support applications in order to participate in negotiations with other users.

7.1.2 Pilot 2 User Stories

User Story P2.1: The Agricultural Policy Maker

The central user in **User Story P2.1** is the **Agricultural Policy Maker**, who is a **primary stakeholder** in pilot 2. The main challenge faced by this user is **carbon sequestration**. A secondary challenge is the **preservation of biodiversity**. The user aims for **diversification** as well as **rotation of crops**. The user furthermore wants to **comply with the new Common Agricultural Policy (CAP)** and to **efficiently reach the European policy goals with regards to greening**. The user also wants to **monitor the effects of policy measures**, and to **validate the effects on the aims**.

The user needs to **monitor crop rotation**. In particular, it is necessary to **see yearly changes in the area at the level of individual parcels**. The user also needs to **monitor crops on a seasonal/yearly basis** and to **cross-check if the crop type declared by farmers are in line with the crop type detected from Remote Sensing** (Earth Observation Data). The user must furthermore **monitor thresholds**, and be able to **predict possible changes in thresholds**. Monitoring activities must be done at a national scale and on a seasonal basis. It should be noted that doing so constitutes a challenging and complex procedure that requires a large amount of data to be available. The user also needs to **boost changes in policy effects faster**.

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User Story P2.2: The Agricultural Professional

The central user in **User Story P2.2** is the **Agricultural Professional**. This mainly concerns *agricultural consultants,* but *farmers* are also relevant. Both are **secondary stakeholders** in pilot 2. This user first of all faces the issue of **soil carbon sequestration**. Another challenge is that of **soil fertility**. Secondary challenges are issues surrounding **soil biodiversity** and the **water storage capacity**, the latter of which requires enhancement.

The user aims to **provide farmers with enhanced spatial indicators** to be able to reflect their novel practices to enhance soil carbon, and to **provide farmers with services to support 'climate smart' agriculture.** The user must **understand and use the information in support of resilient farming practices.** This must be done at the parcel level. The user must also **conduct estimations of properties** at least once a year.

User Story P2.3: The Paying Agency Official

The central user in **User Story P2.3** is the **Paying Agency Official**. This concerns those working for *paying agencies* as well as those working for *environmental agencies*. The former is a **primary stakeholder** in pilot 2. The main challenge faced by this user are **biodiversity issues**. The user aims to **prevent the burning of cropland areas** and **reduce emissions associated with burned grassland areas**. The user also aims to **reduce the amount of grassland area being burned**. In order to do so, the user aims to **utilize area detection as a means to detect burned grassland**. In particular, **detection in ploughed NATURA 2000 areas (permanent grasslands)** is important. Furthermore, the user aims to **be able to give out fines to those that burn grassland**.

In order to achieve these goals, the user must **detect burning areas immediately**, which is related to the new CAP 2021-2027 Good Agricultural and Environmental Conditions. Furthermore, the user needs to **detect bare soil**.

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7.1.3 Pilot 3 User Stories

User Story P3.1: The Port Authority Professional

The central user in **User Story P3.1** is the **Port Authority Professional.** In particular, this concerns *operations managers* and *environmental* managers working for the port. These are **primary stakeholders** in pilot 3. The main challenge that this user is facing is atmospheric **emissions** originating from vessels as well as from activities within and around the port. Connected to this challenge are **pollution** as well as **accidental pollution**. It should however be noted that the role of accidental pollution with regards to emissions is small. Thresholds for emissions exist, and alerts are managed by the port.

The user is **focused on air quality** and aims to **reduce effects of emission periods on the city**. The user wants to **identify emission periods** and to **minimize the impact**. The user wishes to **locate the origin of the emissions** in terms of vessels and installations. Similarly, the user also wants to **know the specific source of a particular emission period**. The user wants to **monitor emissions**, and **take actions as soon as possible**. The user also aims to **monitor accidental pollution**. Another goal is to **correlate information sensors with other sources of information** to **extrapolate findings to areas without sensors**. Examples of other sources of information are the regional government's atmospheric stations (2 in Palma, 1 in Alcudia), as well as the consumption reports that the regional government requests and receives regarding various emission activities in and outside the ports.

The user also wants to **predict and detect pathways of future pollution episodes in order to control them**. The user furthermore aims for **future recommendations at a regional level**, as well as for **pathways for future regulations**.

Important core tasks for this user are **to monitor** and to **take actions in order to minimize impact**. The user also must **make it possible to detect the specific source of emissions**. The origins of the emissions may be a specific vessel from the port area, but could also be related to activities taking place outside the port, such as those of thermal power plants. It should furthermore be noted that the port authority is unable to do inspections on vessels. The user must **take measures from the 25 in-situ environmental stations**. The user also needs to **use tools to plan the actions of vessels**. The user furthermore must **optimise the allocation of berths within a short time frame (2/3 hours)**, and **organize actions at least one day before the arrival of the vessel**.

User Story P3.2: The City Council Official

The central user in **User Story P3.2** is the **City Council Official**. In particular, this concerns those working for the *city councils* and the *environmental regional government***,** who are **primary stakeholders** in pilot 3. It also concerns *inspectors working for the navigation authority*. The main challenge the user is facing is that of **overall emissions** as well as the **mitigation and adaptation actions in policy plans**.

This user aims to **monitor pollution**. Furthermore, the user wishes to **identify the origin of the pollution**, and to **be able to distinguish between the port and other sources, such as industry**. In order to achieve goals, the user must **verify if the port users are complying with the air quality policy plans**. The regional government is responsible for overall emission controls and

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policy making. It should however be noted that only the navigation authority is allowed to inspect a vessel's fuel and machinery.

User Story P3.3: The Concerned Citizen

The central user in **User Story P3.3** is the **Concerned Citizen**. This includes *citizens*, who are a **secondary stakeholder** in pilot 3. It also includes *tourist companies*. This user wants a **low level of pollution**, and to **be informed about pollution levels, pollution episodes, and pollution patterns.** In order to find the relevant information, this user needs to **utilize an open website**.

User Story P3.4: The Vessel Company Professional

The central user in **User Story P3.4** is the **Vessel Company Professional**. This concerns *vessel companies* and their *(global) managers,* who are a **primary stakeholder** in pilot 3. The various vessel associations are a **secondary stakeholder** for pilot 3, and are also relevant for this user story. This user wishes to **lower emissions** and to **comply with regulations**. The user also requires **means to validate if their mitigation measures are effective**. Furthermore, the user wishes to **promote the environmentally friendly side of their company**, and **be able to show improvements**. The user wishes to **be sure that emissions are not from their vessels, but from other sources** and therefore also requires **certainty regarding the source of emissions**. The main task this user needs to fulfil in to **check if imposed measures are effective**.

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7.1.4 Pilot 4 User Stories

User Story P4.1: The Urban Planner

The central user in **User Story P4.1** is the **Urban Planner**. This concerns either *contracted urban planners* or *administrative authorities* (i.e., prefectures, municipalities), who are both **primary stakeholders** in pilot 4. The climate change challenges that the user faces are primarily various **extreme climate related phenomena**, such as **rain and flooding**, as well **as high temperatures and heat waves**.

The user desires to **incorporate climate mitigation actions into urban planning**. Actions may include the use of renewable energy. A more specific goal is increased **market penetration of photovoltaic services (solar panels)**. Other goals are to **improve urban mobility** and to **improve air quality**. A further aim is to **mitigate building sector emissions (due to cooling/heating energy) through retrofitting or relevant fiscal measures**. These issues are connected to other goals that are critical in the context of the urban planner in the city: to achieve an **increased amount of green spaces**, as well as associated **improvements in well-being**.

Despite the focus on climate mitigation, one goal of the user is to **achieve and demonstrate co-benefits of adaptation and mitigation actions**. Achieving the goals of **increased greening of Attica's urban areas** and **climate-proofing of buildings** brings co-benefits to air quality, while mitigation measures have a more direct effect. For the demonstration of these co-benefits, city-scale models are of high value to the user. The user also aims to **demonstrate how national planning is brought to the urban level**, and to **demonstrate how, in turn, regional/urban planning provides feedback to national measures and policies.** The user must take into account the constrained land resources of the urban environment that have to be balanced between sectors (such as high productivity peri-urban agricultural land pitted against renewables or urban sprawl).

The user has the core task to **make urban planning compatible to the above issues**. The users must **have access to data regarding the impacts of such interventions** and **coordinate plans at different scales**. As these interventions are more strategic in nature, long-term planning would benefit from a capacity to simulate different scenarios. It is likely that citizens will have an increased role when it comes to the production of energy, and that they will generally be more climate science literate. The user must **demonstrate the various scenarios**, **offer scientific transparency**, and **enable meaningful discussions to ameliorate possible conflicts that may arise** in this context.

User Story P4.2: The Energy Provider Professional

The central user in **User Story P4.2** is the **Energy Provider Professional**. This concerns those working for *organisations that provide and distribute energy* (i.e., PPC/PPCR, IPTO), as well as officials working for the *Ministry of Environment & Energy.* Both are **primary stakeholders** in pilot 4. It should be noted that those working for *financial institutions* are also relevant in this user story.

The main challenge that the **Energy Provider Professional** is facing is that of **decarbonisation**, which offsets traditional energy production through coal burning and demands for an ever-increasing penetration of renewals. The infrastructure of the latter is either new or not yet

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constructed. At the same time, a constant maxim is set: the minimization of energy costs. The user must **balance actions towards decarbonisation with competitiveness issues.** The question of why one would produce locally when, in certain instances, importing cheaper energy may reduce costs is an important example in this context.

The user aims to **explore the potential of sustainable energy sources for the city**, and to **measure and provide quantified impacts of such implementations**. The user also aims to **support the needs arising from increased e-mobility**.

Furthermore, the user has to **consider the new dimension on citizens as energy producers and the effects that this will bring to the operation of the energy market as a whole**. In order to achieve the goals, the user needs to **have a solid understanding of the photovoltaic potential** and **map it against the parallel need for smart grids (or lack thereof)** in order to **efficiently tap the potential of small-scale production, transmission, and spatial distribution of energy**. It is important to **consider proximity as a means to minimize transmission costs**. The user also needs to **explore scenarios that could cover the increased energy needs for e-mobility**. Furthermore, the user needs to **consider citizens as both users and products of (new) energy)**. Similarly, to the urban planner, the user needs to **co-design the use of land for photovoltaics**, taking into account other groups' interests.

User Story P4.3: The Environmental Official

The central user in **User Story 4.3** is the **Environmental Official**. This first of all relates to officials working for the *Ministry of Environment & Energy,* a **primary stakeholder** in pilot 4. It also concerns officials working for the *Ministry of Health*, particular those that are focused on air quality impacts on citizens' health at the national level. They are a **secondary stakeholder** in pilot 4. This user faces the challenges of **heat waves** and **poor air quality**. This user furthermore faces the issue of **understanding, quantifying, and communicating the co-benefits that climate mitigation measures bring to air quality**. The user aims to **analyse the direct impacts of mitigation measures** and **pave the way for future cost and benefits analyses regarding financial investments** to tackle urban environmental issues**.**

The user must **monitor air quality** and **send out alerts when thresholds are exceeded**. The user also needs to **conduct scenario analyses** in order to plan ahead and be able to **identify hot-spots for prompt and targeted actions**. Similarly, the user needs to be able to **weigh in other relevant factors such as land cover and land use that directly or indirectly affect the aforementioned challenges**.

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7.1.5 Pilot 5 User Stories

User Story P5.1: The Water Professional

The central user in **User Story P5.1** is the **Water Professional**. This concerns *professionals working for the regional authority*, as well as *hydrologists*. Both are **primary stakeholders** in pilot 5. This user is dealing with various challenges related to **changing water resources**, with **drought** being the most important one. These challenges are also associated with **longer and hotter summers**. At the regional level, issues surrounding **depleted water resources** are experienced. Other challenges include **over-sulphated soils** and **water quality issues due to severe rain and drainage**. A challenge related to these issues is the **changing of water use types** (e.g., irrigation).

The user strives for **advance warnings** and to **be prepared for water problems**. Furthermore, the user wishes to **be prepared for changes in water use** that will inevitably result from the climate change challenges. More generally speaking, the user aims to **adjust the water management to future water uses and climate conditions**.

In order to achieve these goals, the user must **take climate change and drought into consideration** and **take steps to be better prepared for drought,** which is a relatively new challenge in Finland. The user must also **discuss with other parties what specific measures must be taken**. The user furthermore needs to **incentivize utility companies to prepare for drought**, including measures that these companies must take with regards to their pipe lines. The user must also **consider drought mitigation plans of municipalities**. As of yet, only one municipal plan exists, but more will be developed for the areas that are most prone to the climate change challenges.

User Story P5.2: The Researcher

The central user in **User Story P5.2** is the **Researcher**. This concerns *researchers* as well as *experts* working at SYKE, who are **primary stakeholders** in pilot 5. This user is facing the challenges of **rapid climate warming** and the **increasing risk of multiple hazards**. First of all, the warming climate will likely result in **northward shifts of forest pest species**. Furthermore, an **increase in summer droughts** as well as an **increase in large scale forest fires** is likely. A **higher frequency of fires** is also expected. The possibility of **cascading effects and simultaneous occurrence of multiple hazards** form a probable challenge. It should however be noted that **forest damages** may be offset by the positive effect of climate change on forest growth.

The aim of this user is to **conduct new research on moths as forest pest species**, and to be able to **forecast the occurrence and abundance of forest pests**. The user also wants **improve drought forecast** and aims to **develop new functionalities and content for the water and climate change portals** that are run by SYKE. A general goal is to **consider the multiple forest disturbances and to assess the combined effects of drought and fires, as well as forest pests**.

The user must **monitor the environment**, and **maintain the climate portal and water portal together with partners**. The user also has the responsibility to **report on environment related SDGs**, such as the level of water stress (indicator 6.4.2). Furthermore, the user needs to **provide warnings for floods and drought**. In order to do so, the user must **conduct research to incorporate in the warning systems**. This will be beneficial means to **provide warnings to citizens and specific authorities**.

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User Story P5.3: The Forest Manager

The central user in **User Story P5.3** is the **Forest Manager**. This concerns those working for *forest centres* and for *forest management companies*, who are **primary stakeholders** in pilot 5. This user first of all faces the challenge of **droughts**. These **droughts are longer**, and there is an **increasing amount of peat- and forest fires**. **Pest species** pose an additional challenge; these **pest species are more abundant in years with milder winters.** The various climate change challenges are connected because of the **interplay between drought and pest effects**. The **risk of forest fires increases when a forest is sick**, contributing to an **increasing likelihood of forest fires**.

The user first of all aims to **maximize forest growth** and to **make decisions in the forest management cycle**. The user therefore requires **improved management information**. The user also wants **to know how climate change affects the various types of forest management (biodiversity vs economic)**. Some forest managers may **emphasize the ecological and recreational value** of the forest. Nevertheless, an important goal is to **reduce economic losses**. Furthermore, **biodiversity goals should be considered to support the interpretation of multilevel situations and projects**.

More specifically, the user wants **improved warnings for forest fires.** The user also wants to **provide information on pest species per forest type or tree type**. It is also necessary to **consider the interplay between forest species**. For example, it is important to consider which plants are eaten by various animals (e.g., moose do not eat spruce).

The user must **update the forest management instructions so that climate change is taken into account**, and furthermore needs to **revise the national forestry guidelines with regards to the future of climate change.** It should however be noted that these national guidelines are complex in terms of policy. The user must take climate change and its effects into consideration, and hence **grow forests from a 'climate change perspective'.** The user must also **enhance pest control in the context of the future of climate change**. Finally, the user should also **provide advice on sustainable management of forests**, and **provide recommendations for the cultivation of species**.

User Story P5.4: The Ministry of Agriculture & Forestry Official

The central user in **User Story P5.4** is the **Ministry of Agriculture & Forestry Official**. This concerns those working for the *Ministry of Agriculture & Forestry*, which is a **primary stakeholder** in pilot 5. This user faces **the same climate change challenges as other users (forestry, hydrology), but from a different point of view**.

The user aims to **develop strategies and plans for these issues**, as the user is **responsible for the national climate change adaptation plans**. With regards to the adaptation workgroup, the user leads the regional groups that are involved. The user wants to **discuss and analyse the information that is to be included in the measures**, and to **cooperate with regional authorities and companies** during this process.

The user must **coordinate and instruct partners to monitor the challenges.** **Forecasting** and **conducting impact assessments** are also important tasks. The user must furthermore **update the climate change adaptation strategy** and **update legislation**. Furthermore, the user must

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coordinate the climate change adaptation processes in Finland. It is also necessary to **foster collaboration with regional centres**, for example in terms of finance and yearly achievements.

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7.2 Functionalities

During the second round of the workshop, per co-created user story, participants jointly listed functionalities. This round also included a discussion to categorise the functionalities as necessary or optional. With the support of the CC applications' task leaders, the needs have been transformed to requirements using a more formal language and taxonomised appropriately. The formulated list of requirements will be properly framed to assist the design of EIFFEL tools and also applications. The data of this functionality session have been synthesised according to four main types of functionality in geo-referenced data science (adapted from [4]). To express the result of this synthesis the codebook is in accordance with definitions of functionality grouping:

- **Georeferencing = Functionality to visualise GEOSS data and geo-referenced data mapping** (like spatial resolution)
- **Context Layers = Functionality which adds context to data** (like attribute layers)
- **Change Detection = Functionality which helps to detect change** (like historic, real time and future modelling)
- **Non-mapping = Functionality to scaffold the user in Non-mapping tasks** (like user queries)

7.2.1 Synthesis of Functionalities for pilot 1

Table 33. Synthesis of Functionalities for pilot 1

Functionality grouping	Necessary Functionalities	Optional Functionalities
Georeferencing	- indicators at regional and on local (parcel) scale - Connect to CC atlas NL - Biggest interest province Is how do different interventions into the system; interaction in whole province	- WP3 and WP4 functionalities
Context Layers	- Get a better idea of extreme events on the overall and measured system (real time) - More precise data/information - Land use; Land use and users	- Bigger need for details, real time information (more financial risks) - What is already available in existing data portals?
Change Detection	- Indicators and demonstration of change in indicators - Get a better idea of extreme events (real time) - Comparing modelling effects with real time data (like data mining from social media and satellites) - Real time monitoring for the demand side of water (agriculture) - Real time monitoring to optimize water balance (demand & supply) - What kind of NbS for each user groups & their effects (transforming land use; affect other users) - Test effects of NbS; 1) in planning stage, 2) calculate actual effect, 3) in teal world measuring / effect on overall system (feasibility?)	- Nature manager: monitor quality of vegetation and effect of measures (climate robust forest): possibility for joint collaboration cross-EIFFEL PILOTs (FINLAND)
Non-mapping	- Study (existing) applications in NL and UK	- Negotiation; collaboration tool

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Functionality grouping	Necessary Functionalities	Optional Functionalities
	- To better understand how the system is working in real time	

7.2.2 Synthesis of Functionalities for pilot 2

Table 34. Synthesis of Functionalities for pilot 2

Functionality grouping	Necessary Functionalities	Optional Functionalities
Georeferencing	- Scale: whole country; Output: layers/numeric data; once per year for different crop type group (winter/summer grain), connected with LPIS data - At parcel level - Use of spatial explicit and use data for LULUCF accounting in their National GHGs inventories	-
Context Layers	- Common legend; simple query -	- If open data are used, upscaling might be possible to other EU CAP regions; but other data is restricted / publicly
Change Detection	- Real time for some crop groups (existing data); once per year for other crop groups - Seasonal basis; one yield per crop - Temporal scale – immediate alert when thresholds are passed - Monitoring the achievement of indicators	- Ability to use data for monitoring has to be discussed: to what extent
Non-mapping	- Different users, different platform application, different versions (phone, computer; layers per user groups) to be decided upon in next EIFFEL stages	- Farmer user GUI. CAP indicators in common language (farmer services)

7.2.3 Synthesis of Functionalities for pilot 3

Table 35. Synthesis of Functionalities for pilot 3

Functionality grouping	Necessary Functionalities	Optional Functionalities
Georeferencing	- Identify any possible seasonal pollution pattern	-
Context Layers	- Statistical pollution data by vessel/company - Specific user; specific access (restriction to own vessel) - Maybe more than TWO levels of access - TWO level of access – open and restricted - Determine the environmental impact of each vessel - Correlate in-situ data to GEOSS data - To correlate with extra areas (not yet known which data from GEOSS) - SDG indicators – KPI's (grant agreement) - Dashboard directed to simple query, clear legend	- Congruent with authority symbols and alerts, like red-yellow-green level of risk - LEGEND based on GREEN labelling: (international sustainability level)
Change Detection	- Calculate the source of the possible origin of a pollution episode - Pollution episodes prediction - Recommendations based on the predictions - Backtracking pollution - Alerts emission: Send alerts if a high emission is is predicted / is detected	- Legal thresholds change each year; comply the legal limits and air quality index

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Functionality grouping	Necessary Functionalities	Optional Functionalities
	- Alerts KPI's (see doc)	
Non-mapping	- Methodology for detecting vessels with high emissions - Monitoring and detecting episodes over the TLV - Monitoring to identify the origin of the episodes of high emission levels - Decision support system - Historical data retrieval	- Berth allocation and planning

7.2.4 Synthesis of Functionalities for pilot 4

Table 36. Synthesis of Functionalities for pilot 4

Functionality grouping	Necessary Functionalities	Optional Functionalities
Georeferencing	- Scale? National <-> regional <-> local	- Identification and analysis of top polluters and top hot-spots. How to deal with these top issues first? - Identify hot spots where more interventions are needed – pursue environmental justice and confront inequities
Context Layers	- Visualize emissions per sector (buildings, transport) - Decarbonisation effectiveness to meet targets - Multiple levels of data access and data analysis - Definition of the supply and demand equilibriums - Simple queries, simple mapping - Database / mapping - Create high impact examples, buildings of high visibility. How good do they perform?	- Easy to understand, direct information. What is the situation at my home?
Change Detection	- Be able to identify the impact of interventions in the 3 domains and measures to mitigate CC on air quality and exposure - How much money I can save through the introduction of the measures - Economic benefit for energy market operations - Will my investment by of benefit for me and at which time horizon? - Assessing energy savings - Solar energy potential information - Is the energy from solar panels (at the building or neighbourhood level adequate to cover part of the energy needed for electric cars?	- How can I optimize transportation and mobility in my region/municipality to serve the citizens while at the same time cutting down on emissions?
Non-mapping	- Support policy decision - Comparison between municipalities - Use the DSA or the tools to prove that I am taking steps towards greening my region/municipality and complying with zero carbon cities - Scenario planning for emissions reduction	- Which measures get my area of interest within the EU/WHO AQ limits? - Harmonization with the new European Energy Target Model - Co-benefits: health related, amenity, travel, time, cost etc. - Support the continuous intraday energy trading - Feasibility? Cost? - Screening for feasibility, space usage

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Functionality grouping	Necessary Functionalities	Optional Functionalities
		- Adaptation synergies with green infra

7.2.5 Synthesis of Functionalities for pilot 5

Table 37. Synthesis of Functionalities for pilot 5

Functionality grouping	Necessary Functionalities	Optional Functionalities
Georeferencing	- Two months ahead is more general, not local - National, scalable maps? National scale maps	- National scale maps of forest pest risks (e.g., seasonal forecast)
Context Layers	- Provide improved information on Multi-hazard CC risks on the climateguide.fi portal (Portal Climate)	
Change Detection	- Improved warnings with new variables, time scales etc. - Risk maps for drought and forest fires - More on long term; what is predicted to happen - Provide improved information on drought risks on the vesi.fi portal (Portal Water) - To be able to show how big is the risk including uncertainties - Models using new information, e.g., soil moisture from satellites - Predictions of pest species distributions?	- If a new pest species arrives, to see directly what the spatial impact might be - Normal maps are 2 weeks ahead; forecast more in advance 2 months ahead (improved)
Non-mapping	- To build a link between the data of the portals - To develop simple query systems for different user groups - To the general public	- Not always useful to go into detail, because of data resolution (uncertainty) - Under discussion = at which governance level CC impact has to be analysed / shown

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7.3 Stakeholder Categories

Each CoP determined in the pilot workshops the relevant stakeholders and their categorisation as being primary stakeholder (direct user of the application) or secondary stakeholder (user of the findings from the application use) (Table 38). Starting point for these workshop discussions have been the preliminary overview of relevant stakeholders and their categorisation as being primary stakeholder [1].

Table 38. Stakeholders of each PILOT, and their categorisation, as determined by CoP in pilot workshop.

PILOT	Title	CoP leader	Primary Stakeholder	Secondary Stakeholder
1	Water & Land Use Management (NL/BE)	NOORD	- Municipality - Water Board - Province (NL) - Land users (agr); farmers and tree nursery farmers (latter have specific needs) - Nature managers	- Agricultural Organisations - Other water boards in province (lessons learned/dissemination) - Cross-border regional authority (BE province) - Concerned citizens & affected business (e.g., tourism)
2	Sustainable Agriculture (LT)	NBA	- Agricultural Policy Makers - Paying Agencies	- Agricultural cooperatives - Agri-consultants - Farmers - Municipalities at rural areas for declarations for payments
3	Infrastructure & Transport Management (ES)	BPA	- Port authority (Operation managers; Environmental Managers) - City councils and Environmental regional government - Vessel Companies	- Citizens - Emission producing Industry in port area - Emission producing companies, like logistics services - Association of vessel companies
4	Sustainable Urban Development (GR)	ATTICA	- Administrative authorities (i.e., prefectures, municipalities) - Ministry of Environment & Energy - Urban planners - Regional authority - Energy providers / distributors - Citizens (energy) - Ministry of Infrastructure	- Industry (e.g., renewables, building construction) - Ministry of Health - Ministry of Development and Investments - Ministry of Infrastructure
5	Multi-hazard risk assessment (FI)	SYKE	- Forest centres and management companies - Ministry of agriculture and forestry - Regional authority for water resources governance - Research organisations as SYKE, Finnish meteorological service	- General public (citizens) - Municipalities, depending on scale of institution - Regional planning CC, depending on sector - Rescue services
total			21 groups of primary stakeholders (in GA: 11 groups)	20 groups of secondary stakeholders (in GA: 14 groups)

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8 Discussion & Conclusions

The co-created *Users*, *User Stories*, and *Application Functionalities* presented in this report provide important input for the development of the EIFFEL applications. Incorporation of the findings from this report during application development process ensures that the final applications meet the needs of its potential users. Meeting the needs of users is essential for the EIFFEL project, since doing so allows for the applications to be used for climate adaptation purposes that are required in every pilot. With regards to the co-creation process and its outcome, some general conclusions can be drawn.

On partners involved in each PILOT: In conclusion: for each of the workshop, inviting potential participants actively by leads, resulted in a clearly more defined Community of Practice for each PILOT, and more sharply defined role of each of the partners and their CoP participants. These 61 participants are represented in ANNEX X, which might be valued for the next stages of the EIFFEL project.

On stakeholders, stakeholder participation and co-designing in CoPs: In conclusion: In Table 38 for each pilot the stakeholders are more precisely defined in more detail, focusing on the actual user of the application, as in the GA, Table 6). In future research, imaging the findings of the stakeholder categorisation and the user stories with the Framework of stakeholder analysis and the Participation Pyramid could help to indicate gaps in this analysis.

On functionalities: In conclusion: In Section 7.2 for each pilot the functionalities grouped according relevant mapping and non-mapping functionalities. These findings will serve as input on more thorough analysis of EO- tool and application development in the next stage of the study.

With regards to the outcomes of the workshop, some general findings are worth mentioning. Distinct *User Stories* were developed for each PILOT, but a number of similarities can be identified. First of all, each pilot contains a user story that concerns a user that works for a government institution or is involved in policymaking. These include: the Policy Officer at the Regional Authority (P1.1), the Agricultural Policymaker (P2.1), the City Council Official (P3.2), the Environmental Official (P4.3), and the Ministry of Agriculture & Forestry Official (P5.4). It can furthermore be noted that most PILOTs contain a user story that concerns a user with a particular economic interest. These include: the Land User (P1.3), the Agricultural Professional (P2.2), the Vessel Company Professional (P3.4), the Energy Provider Professional (P4.2). Interestingly, pilot 5 does not contain a user with a mainly economic interest. A third similarity relates to the fact that most PILOTs do not contain the (Concerned) Citizen as a user with a user story. Citizens were mentioned during multiple workshops, but for the most part no full user stories were developed. pilot 3 does contain user story for the Concerned Citizen, but even in that case the user story is limited in content and detail.

The various similarities between users identified for each pilot provide some useful lessons that should be considered in the application development process. First of all, the diversity of stakeholders and their perspectives on CC challenges should be considered. Whereas some users consider these challenges within the context of policymaking, others may consider them within an economic context. The EIFFEL applications should therefore facilitate decision making within this specific context. Since communication and collaboration within the CoP is of high importance for the success of adaptation measures, the EIFFEL applications should also allow users to gain

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insights on the perspectives of other users; e.g., those with a predominantly economic interest should be able to use the applications to increase understanding of the policy-side of the issue. This way the EIFFEL applications could positively contribute to collaborative climate adaptation efforts. Finally, the importance of citizens as users of the applications should be considered. The fact across all PILOTS only one (limited) user story was developed for citizens as users of the applications, indicates that the needs of this user may be unclear and/or underestimated. More knowledge is therefore needed with regards to (1) the importance of citizens as users of the EIFFEL applications, (2) the goals that citizens may have in the context of CC adaptation, and (3) the needs of citizens as users with regards to the EIFFEL applications.

By co-creation in the 6 online focus group workshops, 15 user stories were co-created by the community of practice in consultation with the leads responsible for the application development. In total all 5 PILOTs are represented within the 5 focus group workshops held, for which we have sent 67 invitations to potential focus group members; realizing 56 participants (a mean of 11 participants per PILOT). The focus groups resulted in about 4 different user stories per pilot. On all PILOTs, three main categories of user stories could be distinguished. The first kind of user stories describes the dedicated professionals within the GEO's domain of the pilot study (the professionals on water, agriculture, vessels, energy provision, and forestry); the second kind of user stories are focusing on the governing of managing officials involved (officials or planners at an emission paying agency, port authority, city council and ministries). A third category of users, the concerned citizen, was only described in two PILOTs as a user story. Hence, the objective of opening up GEOSS is to be of service to their community of practice in need for ready-to-use climate applications. In the development of the CoPs, It is recommended by OUNL that EIFFEL involves these secondary stakeholders and their perspectives on the CC challenges, in order to fit their needs to spatially explicit CC information through applications. Overall, the co-designing resulted in the denomination of 17 groups of primary stakeholders (direct users of the application; initially projected: 11 groups) and 15 groups of secondary stakeholders (user of the findings from the application use; initially projected: 14 groups). The compound user stories, the stakeholder group denomination and the stratification of functionalities provide the EO-based community in EIFFEL on the user requirements needed to develop AI specifications of EIFFEL tools and Climate Change applications on GEOSS data.

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9 References

[1] GA (2020). Grant Agreement EIFFEL: Revealing the Role of GEOSS as the Default Digital Portal for Building Climate Change Adaptation & Mitigation Applications, number: 101003518 - EIFFEL - H2020-LC-CLA-2018-2019-2020 / H2020-LC-CLA-2020-2.

[2] Bloom, B. S., Krathwohl D. R., Masia B. B. (1956). Taxonomy of educational objectives: The classification of educational goals. New York: McKay.

[3] Pappas, Eric, Pierrakos, Olga, & Nagel, Robert (2013). Using Bloom's Taxonomy to teach sustainability in multiple contexts. *Journal of cleaner production*, 48, 54-64.

[4] Pattnaik, Anubhav. (2020, May 3). Map Layers: Types and Use Cases. *Towards Data Science*. https://towardsdatascience.com/map-layer-types-and-use-cases-d22a2a788b0e.

[5] Jonoski, Andreja. (2021). T5.1 Assess the impact of CC adaptation measures for the Aa-river basin. WP5 - Development of the EIFFEL CC applications based on GEOSS. EIFFEL-2021062223-KICKOFF.

[6] Tziolas, N., Kalopesa, E., Lorilla, R.S. & Sitokonstantinou, V., Šimkus, Liutauras & Rimgaila, Martynas. (2021). T5.2: Develop a monitoring system to support crop carbon accountability and crop diversification assessment. (i-BEC, NOA & NPA). EIFFEL-2021062223-KICKOFF.

[7] UN (2015). Transforming Our World: The 2030 Agenda for Sustainable Development. *New York: United Nations. Department of Economic and Social Affairs. Sustainable Development.* A/RES/70/1, 25 September 2015. https://sustainabledevelopment.un.org/content/documents/21252030%20Agenda%20for%20Sustainable%20Development%20web.pdf

[8] del Rey, Amelia. (2021). T7.4:Pilot 3: Infrastructure and Transport Management, Regional scale (BPA). T5.3: Assess the CC impact of port activity by correlating the cruise and vessel traffic to the atmospheric quality of the Balearic island. EIFFEL-2021062223-KICKOFF.

[9] Tango7174 (2011, May 18). Athens, Greece. Panorama from the top of Mount Lycabettus, looking southwest. https://commons.wikimedia.org/w/index.php?curid=15746105 - Own work, CC BY-SA 4.0.

[10] Speyer, Orestis. (2021). T5.4 & T7.5 pilot 4 on Sustainable Urban Development: Impact of urban GHG mitigation scenarios in buildings energy efficiency, photovoltaic penetration and adoption of e-mobility in the Attica region. Local to regional scale. National Observatory of Athens (NOA) EIFFEL-2021062223-KICKOFF.

[11] UN (2015). The 17 Goals. 17 SDGs adopted at the UN Sustainable Development Summit in New York in September 2015. *New York: United Nations. Department of Economic and Social Affairs. Sustainable Development. Division of Sustainable Goals.* https://sdgs.un.org/goals

[12] UN (2021, August). SDG Indicators. *Metadata repository*. Goal 13. *New York: United Nations. Department of Economic and Social Affairs. Statistics Division.* https://unstats.un.org/sdgs/metadata/?Text=&Goal=13&Target

[13] Venäläinen, A., Lehtonen, I., Laapas, M., Ruosteenoja, K., Tikkanen, O. P., Viiri, H., ... & Peltola, H. (2020). Climate change induces multiple risks to boreal forests and forestry in

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Finland: A literature review. *Global change biology*, 26(8), 4178-4196.

[14] Vesi.fi (2021). *Suomen tarkinta ja ajantasaisinta vesitietoa.* [Finland's most accurate and up-to-date water information. Joint service in co-operation with expert organizations in the water sector, produced by SYKE Finnish Environment Institute, the Finnish Meteorological Institute and the Flood Center.] www.vesi.fi

[15] Climateguide.fi (2021). Climateguide.fi: Climate Guide Finland. Finnish Meteorological Institute, the Finnish Environment Institute (SYKE) and Aalto University https://ilmasto-opas.fi/en/

[16] Fronzek, Stefan, Böttcher, Kristin, Carter, Tim, Jakkila, Juho, Pöyry, Juha, Saarela, Sanna-Riikka & Veijalainen, Noora. (2021). Risk assessment framework for droughts, forest fires and pests in Finland. Finnish Environment Institute (SYKE). EIFFEL-2021062223-KICKOFF.

[17] GCOS (2016). *Essential Climate Variables [Table].* GCOS 2016 Implementation Plan, Annex 1. The Global Climate Observing System (GCOS). https://gcos.wmo.int/en/essential-climate-variables/table. (CC BY-NC-ND 4.0)

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Appendix A. Additional Comments for Pilot Workshops

Pilot 1

This workshop consisted of three parts, and comments were discussed during this workshop. However, no additional comments have been written down.

Pilot 2

Additional comments for Round 1:

- CAP goals, working together with NOA, to be invited in pilot 2.
- CAP is still under consultation. Question: what is the timeline for setting thresholds?
- In CAP, Lithuania is one region.

Other comments:

- Another user story should be added during the review stage (next to burned land areas)
- Input from NOA is expected
- Input from Lead WP7 CoP is expected
- Future users of future applications could be defined better in next stage
- Preliminary results from the Workshop were clear enough but in general they diverge on what was written and planned at proposal stage. Specifically:
    1. Climate Change Challenges are missing or/not evident enough;
    2. EIFFEL's PILOTs need to include Research activities and thus contradicts with what it is requested and written on the "core tasks", as they are looking more as operational services (e.g. Fast detection of burned area/ bare soil);
    3. The baseline should be on what has been proposed and then to extend if possible to additional research topics to be analysed or additional services that can be provided;
- For your information, the initial idea behind NOA's activities was to support and provide inputs to NPA in order to assist them draft the Strategic Plans (New CAP requirement) that each MS needs to define, including evaluation of where, how and how much the "defined" practices will be applied and thus assist to develop the needed eco-schemes + diversity of crops.
- Hence, the preliminary feedback was useful but on the other hand we need to frame the needs around requirements of the call and also the signed GA. Then we can list all the needed needs and agree on where to focus according to the available resources.

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Pilot 3

Additional comments for Round 1:

- The excel document should be considered for this round.
- With regards to the 1st *User Story*
  - The user story of the **Port Authority** concerns Use Case 1, 2, and Use Case 3 (=future). More information can be found in the excel document that was made in preparation for this workshop.
  - For the climate change challenge: what is measured? Only air quality or also other compartments? This project is focused only on air quality parameters.
- With regards to the 2nd *User Story*
  - The city council should be asked for more detail on the specific user.
- With regards to the 4th *User Story*
  - It is preferred to refer to 'vessel companies' instead of 'shipping companies'.
  - The specific term 'cruise companies' should be avoided
  - More specific; preferably to take generic: Vessel companies. There is a mistake, it should be appeared "vessel companies".

Additional comments for Round 2:

- The optional functionality of 'berth allocation planification' depends on the technical advances and possibilities in the future

Additional comments for Round 3:

- '*Vessel Companies*' has been added as stakeholder; '*Cruise Companies*' was left out as a separate stakeholder category
- Question: are vessel companies impacted by the Paris Agreement decisions?

Pilot 4

Additional comments for Round 1:

- 40% of population of Greece is in Attica. More than 35% of Greek population resides in ATTICA
- All cases are related to energy
- With regards to 1st *User Story*
  - It should be discussed whether or not to included contracted urban planners.
    - I don't understand the term "contracted". I don't see why we should exclude any urban planner. At least in Athens, a lot of the activities of the municipalities is outsourced (even basic ones) (OS)
  - What to prioritise to set goals in planning?
    - Regarding goal prioritization, I would put showcasing co-benefits first, use the Region to provide a national reference point for the mitigation measures second, clearly show the different levels geographical scales involved, show the individual municipality and how the impact of the mitigation measures upscales to the Region and the whole of the country third, awareness, action on

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adaptation linked to mitigation last. I think will derive from the rest. In general, I would give the priorities of the Region of Attica a bigger weight (OS)
    - Programme exist on early warning / urban flooding system (not in EIFFEL)
    - I don't understand goal "to demonstrate regional/urban planning to showcase to national measures" (OS)
- With regards to 2nd *User Story*
    - Is proximity important for energy providers, producing directly at the place?
    - Example of application in city of France
    - Regarding the challenge "Is it not cheaper to focus on rural and on importing energy?", I introduced it a concern/open question. Why would a "pragmatic" urban planner bother with photovoltaic penetration if getting energy from outside the city is "cheaper" ? I am not supporting this opinion but we should be prepared for it (OS)
- With regards to 3rd *User Story*
    - Is the app being public; open app might be run into?
    - It should be studied if data are public or restricted, should limit privacy issues limit the tools
    - Different demonstration levels, depending on the user and the privacy regulations
    - Regarding the 3rd User Story, like I commented during the workshop, I think we will run into trouble if we divulge data on specific buildings that will affect property value. I don't think that this is the purpose of the pilot which has a more policy-oriented character. If we are really sure on the results of the photovoltaic or BSM application, perhaps we can consider sth of a disclaimer etc. (OS)

Additional comments for Round 2:

- The optional functionalities concern relevant side effects of the EIFFEL pilot.
    - I don't understand the phrase: "The optional functionalities concern relevant side effects of the EIFFEL PILOT". Probably rephrase the term side effects (OS)

Other comments:

- The building sector application, although primarily conceived as serving the mitigation aspect of urban planning regarding building emissions, also looks towards adaptation as it provides prerequisite information of the building stock.
- Green spaces are not explicitly meant in EIFFEL PILOT

Other comments by (OS)

- The "Tool is more on CC mitigation, so blue-green infrastructure and connection to adaptation measures " does not read as a Climate Change Challenge.
- Just a comment on "Modernisation: fin benefit and investments CBA". Instead of abbreviations, better to use financial benefit and Cost Benefit Analysis. Altogether it doesn't seem like a goal. What does modernisation mean in this context. Do we want to set as a goal the new knowledge on financial benefits of improving AQ that will be produced by a cost benefit analysis?
- Example of an application in city of France: https://www.uia-initiative.eu/en/uia-cities/paris

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Pilot 5

Additional comments for Round 1:

- With regards to the 2nd *User Story*
  - The expert on pest species did not participate in the workshop.
  - We didn't have time to discuss this during the workshop, but researchers and experts at SYKE, including us who are involved in EIFFEL, could be defined as users of the pilot 5 applications. This could also be through conducting research in addition to the warning systems already mentioned. Outcomes could then include a research paper on moth species that damage trees and expanding the services of two existing web portals, one on water resources and the other on climate change.

Additional comments for Round 2:

- Clarification of the EIFFEL applications
  - The visualisation of WP3-WP5-WP7 (developed by Giannis)
  - Information on water resources, to expand on drought, forest pest species, forest fires interplay
- Rescue services and Ministry of interior are partners (i.e the rescue services are guided by the Min of Int)
  - Their information need is similar, but their goal is different
  - Emergency strategies by CC risks
- Most functionalities are about SYKE as user. Further discussion with CoP is necessary.
- Functionalities have to be tested among users (if it works); tested 10y ago, to be improved?
- Regarding the categorisation of the functionality: "*at least at a scale of the water system*"
  - CoP should be asked, since it is too early now
- Regarding the functionality "*improved warnings with new variables, time scales etc.*"
  - This has to be elaborated upon with CoP
- Regarding the functionality "*Models using new information, e.g. soil moisture from satellites*"
  - Testing of this functionality is necessary, the implementation of the functionality is optional
- Regarding the functionality "*National scale maps of forest pest risks (e.g. seasonal forecast)*"
  - Depends on models to be developed (if they will work on forecasting; research)

Additional comments for Round 3:

- With regards to *Rescue Services*
  - Could be changed during project (depending on topic / risk)

Other comments:

- Should another user story be added for the Rescue Services and/ or the Ministry of interior?
  - Maybe it would better to leave this for later and do this with stakeholders from the Rescue services and Ministry of the Interior.

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Appendix B. Pilot 3 Detailed Overview of Users

APPENDIX B contains the overview of users for the various use cases in pilot 3, as well as a list of relevant KPIs, initially prepared by PRO and BPA. It should be noted that the overview as presented in here is the most up-to-date version, and incorporates comments from the workshop and other changes.

KPI Proposal

KPI proposal	Description	Related SDGs
KP3.1	Alert service for average temperature deviations >1.5 ºC and when anomaly GHG emissions are predicted (>=1)	13, 14
KP3.2	Methodology for detecting vessels with high GHG emissions via AI models from O2	9, 11
KP3.3	Service for vessels and cities nearby offering pollution KPIs	9, 11
KP3.4	Service for optimising vessel traffic operations from and to the port area based on spatiotemporal analysis of pollutionpatterns and vessel traffic configuratio n to reduce emissions; at least 5 scenarios	11, 13, 14

Overview of use cases

nº	Title	Description	KPIs	Operative KPIS to be obtained	Users	Geospatial area	Data needs	GEOSS data
1	Analysis of atmospheric pollution in Palma	Study of the correlation between the port activity and air quality in the city of Palma. Once a pollution episode has been detected, its origin will be analysed (city/port/other). Identify which vessels and/or berths should change their propulsion system (fuel) to reduce their impact on the city	KP3.1 KP3.2 KP3.3 KP3.4	KP1.a) emissions/city zone KP1.b) emissions/harbour area (ships + traffic) KP1.c) SO2 emissions at 2 miles from coastline KP1.d) SO2 emissions from vessels at berth KP1.e) % contribution of pollutant sources in each zone of the city KP1.f) emissions/person registered. Relating to KP3.b)	1.-Port Environmental Manager 2.- City Environmental Manager 3.-Port Operations Manager 4.-Citizens (Tourists + Residents) 5.-Environmental Manager at shipping companies 6.- RegionalEnvironmental Manager (GOIB)	Regional scale: The 5 ports and the City of Palma and nearby.	Wind data of the port and within the Port; PMS- Posidonia Operations data; In-situ environmental stations (25); AEMET data; SAMOA (State Ports) (3-day forecast); Traffic - City Council: Traffic intensity map (IMD). GOIB data: Industries, Thermal Power Plants; Population registered in the different areas and the influx of pedestrians (WiFi network) in	

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		according to the necessary investment.					the different areas of the city. (Palma), discriminating only from those pedestrians who are not residents. Translated with www.DeepL.com/Translator (free version)	
2	Atmospheric Emissions study in The Freus	Monitoring of emissions from vessels in the Freus area (Formentera). Focus on the traffic of the line Eivissa-La Savina (Formentera) to detect pollution's episode.	KP3.2 KP3.3 KP3.4	KP2.1. a) emissions/passengers (there are empty cruises/ferries, particular boats)	1.-Port Environmental Manager 3.-Port Operations Manager 5.-Environmental Manager at vessel companies 6.- RegionalEnvironmental Manager (GOIB)	Freus area (Formentera). Line traffic Eivissa-La Savina (Formentera)	Wind data for the port and within the port; PMS-Posidonia Operations data; On-site environmental stations (25); AEMET data; SAMOA (State Ports) (3-day forecast). Data on the number of passengers, vehicles, lorries carried by ships and the percentage of occupation per vessel.	
3	Berths allocation optimisation	Offering advice on the assignment of berths based on the experience acquired (monitoring + prediction), both for the emissions of the vessel and the vehicles on board. Offering advice to the berth scheduling service on the optimum berth to affect the least number of people. In addition, it would be possible to identify which vessels and/or berths should change their propulsion system (fuel) to reduce their impact on	KP3.4	KP1.1.a) cruise/vessel emissions/ passengers KP3. a) cruise/vessel emissions/ boarded vehicles KP3.b) Emissions/inhabitants (still unclear). Not only mitigation, but also adpatation. KP3.c) Number of cruises/vessels and/or berths exceed the pollution limit KP3.d) Cruise/vessel emissions/route path KP3.e) Prediction of pollution episodes/ prediction alerts (unclear whether this is a KPI or a result)	1.-Port Environmental Manager 3.-Port Operations Manager	5 ports	Wind data for the port and within the port; PMS-Posidonia Operations data; On-site environmental stations (25); AEMET data; SAMOA (State Ports) (3-day forecast).	

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		the city depending on the investment required. Advise the berth scheduling service on the optimum berth to affect the least number of people.						

Users for Case 1

User	Type stakeholder	I want to …	So that..
1.-Port Environmental Manager	Primary Stakeholder	Monitor and detect pollution episodes	So that I can track, predict and act when limit values are prone to be reached, and react proactively and/or reactively
		Identify whether the possible origin of a pollution episode is in the port area (back-trajectory).	1) I could carry out inspections on the possible polluting actors to confirm the results and establish the corresponding actions: sanctions, promotion of corrective measures, etc. 2) I could manage or send customised alerts to trigger the relevant actions according to the established environmental protocol, if any, or define specific actions: email to responsible persons, notifications in other applications, etc.)

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		Analyse whether it is possible to link the origin of a pollution episode to a specific vessel	I could identify if there are vessels and/or berths that should change their propulsion system (fuel) to reduce their impact on the city in terms of the investment required.
2.- City Environmental Manager	Primary Stakeholder	Monitor and detect pollution episodes	So that I can track, predict and act when limit values are prone to be reached, and react proactively and/or reactively
		Identify the external area to the Port as the origin of a pollution episode	1) I could carry out inspections on the possible polluting actors to confirm the results and establish the corresponding actions: sanctions, promotion of corrective measures, etc. 2) I could prioritise mitigation/adaption actions in the most densely populated places. 3) I could promote mitigation/adaption environmental policies
3.-Port Operations Manager	Primary Stakeholder	Analyse whether it is possible to link the origin of a pollution episode to a specific vessel	1) I could establish mitigation/ corrective measures to that vessel or to the port management. For instance: to change fuel type once the vessel is 2 miles away from the coast, to change fuel during berthing, or to decrease the maximum speed allowed inside the port.
4.-Citizens (Tourists + Residents)	Secondary Stakeholder	Be informed about pollution levels	1) I could be aware of the environmental status of the area by consulting the indices. 2) I would be able to consult updated maps of pollution levels.
5.-Environmental Manager at vessel companies	Primary Stakeholder	Be informed about the emissions produced by a specific vessel	1) I could promote measures to mitigate pollution 2) I could validate the effectiveness of the implemented corrective measures
6.- Regional Environmental Manager (GOIB)	Primary Stakeholder	Monitor and detect pollution episodes	I could monitor and analyse the pollution episodes with values above the permitted values.
		Identify the external area to the Port as the origin of a pollution episode	1) I could carry out inspections on the possible polluting actors to corroborate the results and establish the corresponding actions: sanctions, promotion of corrective measures, etc. 2) I could prioritise mitigation/adaption actions in the most densely populated places. 3) I could promote mitigation/adaption environmental policies

Users for Case 2

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User	Type stakeholder	I want to …	So that..
1.-Port Environmental Manager	Primary Stakeholder	Monitor and detect pollution episodes	1) I could carry out inspections on the possible polluting actors to confirm the results and establish the corresponding actions: sanctions, promotion of corrective measures, etc. 2) I could manage or send customised alerts to trigger the relevant actions according to the established environmental protocol, if any, or define specific actions: email to responsible persons, notifications in other applications, etc.)
		Detect if there is an excess of empty vessels	I could detect areas / lines where a change in fuel type or use of an electric shuttle would be appropriate, or modify route management.
3.-Port Operations Manager	Primary Stakeholder	Detect if there are pollution patterns linked to a specific time frame (diurnal, weekly, seasonal).	I could provide recommendations to avoid saturations, thus avoiding pollution episodes
5.-Environmental Manager at vessel companies	Primary Stakeholder	Be informed about the emissions produced by a specific vessel	1) I could promote measures to mitigate pollution 2) I could validate the effectiveness of the implemented corrective measures
6.- Regional Environmental Manager (GOIB)	Primary Stakeholder	Monitor and detect pollution episodes	I could monitor and analyse the pollution episodes with values above the permitted values.
		Detect if there are pollution patterns linked to a specific time frame (diurnal, weekly, seasonal).	1) I could promote environmental adoption/ mitigation policies

Users for Case 3

User	Type stakeholder	I want to …	So that..

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1.-Port Environmental Manager	Primary Stakeholder	Monitor and detect pollution episodes	1) I could anticipate pollution episodes with values higher than those allowed. 2) I could manage or send customised alerts to trigger the relevant actions according to the established environmental protocol, if any, or define specific actions: email to responsible persons, notifications in other applications, etc.)
3.-Port Operations Manager	Primary Stakeholder	Perform berth assignments based on the experience gained, both in terms of the vessel's emissions and the vehicles on board.	I could have an allocation advice tool to help mitigate the pollution generated so that as few people as possible are affected.
		Analyse whether it is possible to link the origin of a pollution episode to a specific vessel	I could identify if there are vessels and/or berths that should change their propulsion system (fuel) to reduce their impact on the city in terms of the investment required.

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Annex A. Overview of Participants

Overview of all leads, partners and participants, involved in the focus group workshops. On request to the Editor, in accordance with the GDPR.

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