D5.2- Plan for the dissemination and exploitation including communication activities- v1

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Disclaimer

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HISTORY OF CHANGES

Date	Version	Author	Change Description
31.05.2023	1.0	Bianchia Scappatura	First Issue

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1 ABSTRACT

The present document represents the deliverable D5.2 - Plan for the dissemination and exploitation including communication activities - v1 of CENTAUR project and is produced under the Work Package WP5 - Analysis of the integration in the operational set up of Copernicus EMS and SEA, impact and further exploitation.

This document describes the initial version of the exploitation activities performed during and after the project duration; the analysis of project results leads to the identification of key exploitable project results (KERs). The exploitation plan takes also into account different types of industrial partners (Industry, SMEs, new start-ups), as well as other type of stakeholders that are needed in the business ecosystem.

To ensure a final complete version of the Exploitation Plan, the Horizon Results Booster (HRB) service of the European Commission (EC) was activated. The aim of this service is to strengthen the capacity of projects in using their research results enhancing partners' capacity to improve their exploitation strategy.

Initial two Key Exploitable Results (KERs) of the project have been identified and its related information (Risk assessment and priority map, exploitation roadmap, and Use options) were developed by the KERs owners, analyzed by the HRB service expert and shared, discussed and modified during the ESS (HRB Exploitation Strategy Seminar) joined by the Consortium members.

The feedback and conclusions resulting from the exchange and meetings with the service (at this stage they lasted from mid-March to the end of May 2023) are included in this version of the document.

The second version of the document will include additional KERs and any reviews of previous results, whether necessary.

Moreover, a very initial market analysis relevant for the exploitation of CENTAUR has been carried out. However, a detailed one will be provided in the version 2 and refined in version 3.

The final version 3 of the document will include some aspects not thoroughly covered in this initial version:

- Key Exploitable Results (KERs) may evolve during the validation and demonstration phase, and IPR issues will be properly addressed once they are clearly defined and tested.
- A competitive analysis and market share will be included in the final version.
- A more complete user segmentation will be carried out once the final KERs and target markets are clear.
- A Business Model and final Business Plan will be clearly detailed in the final document.

This document is divided into the following sections:

- Section 2: Introduction
- Section 3: Dissemination and Communication Activities
- Section 4: Key Exploitable Results - KERs
- Section 5: Market Analysis
- Section 6: Potential end-users
- Section 7: Annex 1: Additional content

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2 INTRODUCTION

Within HORIZON-CL4-2021-SPACE-01-43 - Copernicus Security and Emergency Services evolution, e-GEOS is the leader of the *COPERNICUS ENHANCED TOOLS FOR ANTICIPATIVE RESPONSE TO CLIMATE CHANGE IN THE EMERGENCY AND SECURITY DOMAIN* project with thirteen partners' consortium.

The overall objective of CENTAUR is to respond to societal challenges deriving from Climate Change threats by developing and demonstrating new service components for the Copernicus Emergency Management Service (CEMS) and Copernicus Service in Support to EU External Action service (SEA), aiming to:

- improving situational awareness and preparedness around climate change and its impact on complex emergencies and multi-dimensional (security) crises.
- anticipating the occurrence and possible knock-on effects of crisis events, in particular those triggered by climatic extremes, thus contributing to resilience and effective adaptation.

In the emergency domain, CENTAUR will address the flood-related threats to population, assets and infrastructures in urban areas. In the Security domain, CENTAUR will address water & food insecurity. The two work streams will be connected via a cross-cutting component focusing on exposure and vulnerability to climate change, as well as resilience and societal capacity for managing environmental risks and social conflict. Across work streams, indicators and models will be validated by different methods.

CENTAUR will integrate data coming from multiple heterogeneous sources, with a specific focus on those generated by other Copernicus services and, in particular, those of the Climate Change Service. It will combine these with meteorological data, socio-economic data, and data coming from new sensors (e.g. traditional and social media). Thus, it will enhance the current capacities to produce composite risk indexes and to perform multi-criteria analyses in the emergency and security domains.

A layered approach is adopted within CENTAUR project:

- **Data in three dimensions (1st layer)**: i) geospatial data including EO as well as thematic data captured from ground sensors and other geospatial datasets (Reference layers, LIDAR, drones, etc.); ii) meteorological data for numerical weather predictions; iii) open data include data lakes from various sources or unconventional "sensors", such as media of various types, documents, social outlets.
- **Indicators (2nd layer)**: thematic information from data time series and simple indexes, obtained by simple combination of data according to models applicable to the phenomena observed or similar levels of processing, including the use of advanced processing methods in the domain of big data analysis and artificial intelligence such as Machine Learning. CENTAUR indicators will describe and characterize urban floods, water and food insecurity and social, political and economic factors. Indicators may well describe a phenomenon alone or used to trigger another one.
- **Crisis Indexes (3rd layer)**: is a result from the integration of urban flood and water & food indicators with Social, Economic and Political indicators, to detect a crisis event and/or its impact. They intend to provide quantitative assessment of statistical risk of occurrence of an event, obtained by simple combination of indicators or applying more innovative AI automatic classification algorithms.

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2.1 SCOPE OF THE DOCUMENT

The final objective of deliverable D5.2 - Plan for the dissemination and exploitation including communication activities v1 is to present an initial exploitation plan for CENTAUR project, including an overview of the potential products and services to be offered and their position in the market. Two more versions are foreseen to be implemented:

- In the intermediate version (v2), KERs present in the initial version (v1) will be updated and new identified KERs will be presented.
- In the Final version (v3), recommended market strategies for successful commercialization of these products and services will be included.

The task 5.3 of WP5 aims at:

- Identifying results and exploitation activities to be performed during and after the project duration, as well as related to the owner.
- Making a market analysis relevant for the exploitable results, including market segmentation, market dynamics and competitive analysis.
- IPR management.
- Identification of suitable business models including the description of the value proposition and the success factors of the solutions marketable, potential stakeholders, engagement strategies and possible revenue streams.
- Analysis of project results leading to the identification of key exploitable project results (KERs) by also relying on Horizon Results Booster service.

With the aim of identifying correctly and analysing all the necessary issues of the Key Exploitable Results, the Horizon Results Booster (HRB) service of the European Commission has been activated. This service "is a new package of specialised services to maximise the impact of R&I public investment and further amplify the added value of the Framework Programmes (FPs)". In particular, the service requested is the Module C - Assisting projects to improve their existing exploitation strategy, which aims at:

- Reviewing of the key exploitable results of the project.
- Revising, complementing and clarifying the existing exploitation plans of project results and/or outline exploitation paths of results.
- Providing techniques to identify all the relevant stakeholders in the exploitation value chain.
- Providing support to perform a risk analysis related to the exploitation of results.

First bilateral meeting with the service expert:

- 3rd April 2023: Introductory call. In this meeting the service was explained and the Service Delivery Plan was agreed.

Two further meetings and steps with service experts and CB were organized as follows:

- 21st April 2023: discussion with the CB on initial version of two selected KERs and overview of HRB templates required to be submitted to the service (i.e. Characterisation Table, Exploitation intentions summary table, User options, Exploitation roadmap, Risk Assessment and Priority Map):
  - 28th April 2023: initial version of selected KERs were sent to the service expert,
  - 12th May 2023: preliminary report received and shared at CB level.
- 22nd May 2023: the ESS (Exploitation Strategy Seminar) workshop with CENTAUR technical partners.

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2.2 DEFINITION, ABBREVIATIONS AND ACRONYMS

Table 1: Definitions, Abbreviations and Acronyms

Abbreviation/acronym	Definition
AB	Advisory Board
CB	Consortium Board
Copernicus EMS or CEMS	Copernicus Emergency Management Service
DTM	Digital Terrain Model
EC	European Commission
ECMWF	European Centre for Medium-Range Weather Forecasts
EFAS	European Flood Awareness System
EO	Earth Observation
ESS	Exploitation Strategy Seminar
EU	European Union
EW	Early Warning
GIS	Geographic Information System
GLOFAS	Global Flood Awareness System
InSAR	Interferometric Synthetic Aperture Radar
IPR	Internal Property Rights
KER	Key Exploitable Result
MEPs	Members of the European Parliament
ML	Machine Learning
PMP	Project Management Plan
SAR	Synthetic Aperture Radar
SEA	Copernicus Service in Support to EU External Access
SMEs	Small and medium-sized enterprises
(V)HR	(Very) High Resolution
UNISTRA	Université de Strasbourg
VITO	Vlaamse Instelling voor Technologisch Onderzoek

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2.3 APPLICABLE AND REFERENCE DOCUMENTS

ID	Document name
[AD1]	CENTAUR - 101082720 – Grant Agreement
[AD2]	HORIZON-CL4-2021-SPACE-01 - Strategic Autonomy in Developing, Deploying and Using Global Space-based Infrastructures, Services, Application and Data 2021, available at https://ec.europa.eu/info/funding-tenders/opportunities/portal/screen/opportunities/topic-details/horizon-cl4-2021-space-01-12
[AD3]	CENTAUR deliverable D1.1 - Report on Urban Flood and Water&Food security indicators
[AD4]	Exploitation Strategy Seminar (ESS) Final Report for «COPERNICUS ENHANCED TOOLS FOR ANTICIPATIVE RESPONSE TO CLIMATE CHANGE IN THE EMERGENCY AND SECURITY DOMAIN», Project ID Number 101082720, Horizon Results Booster (HRB)

[RD1]	Copernicus Service in Support to EU External Action: https://sea.security.copernicus.eu/
[RD2]	Copernicus Emergency Mapping Service – Rapid Mapping: https://emergency.copernicus.eu/mapping/copernicus-emergency-management-service#zoom=2&lat=17.44093&lon=29.71939&layers=0BT00

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3 DISSEMINATION AND COMMUNICATION ACTIVITIES

CENTAUR includes a series of dissemination and communication activities to be carried out in order to fully harness the potential of the project's scientific findings.

Dissemination activities refer to publishing scientific results or presenting them in scientific congresses or technical gatherings. These activities aim to share the findings and outcomes of the CENTAUR project with a broader but specialised audience. The outcomes can include new technical improvements achieved by partners, new improved products/services available for end-users, and other results that stem from the project activities. The objective of dissemination activities is to maximise the impact and benefits of the project by sharing the results with as many people as possible, who will be able to use these results and amplify the overall reach and impact of the CENTAUR project.

Communication activities refer to presenting the project outside of its community to a wide range of stakeholder groups. These activities include creating a project website, social media accounts (Twitter and LinkedIn), a newsletter, and a flyer. The goal of these activities is to showcase the benefits and impacts that the CENTAUR project brings to the various stakeholder groups. By doing so, the project consortium hopes to engage and inform a wider audience about its activities and outcomes.

The dissemination and communication activities aim to promote **three high-level messages** about the impact of climate change, CENTAUR's objectives, and its benefits.

The first message highlights the significant impact of climate change on human livelihoods, making climate and weather extremes more likely and therefore resulting in a higher number of disasters. Climate change is also one of the drivers of environmental degradation, which is a threat multiplier and an aggravating factor for political instability, with implications in terms of peace and security across the world.

The second message focuses on CENTAUR's objective to improve situational awareness and preparedness, anticipate crisis events, and contribute to resilience and effective adaptation. The project aims to achieve these objectives by developing and demonstrating new service components for CEMS and CSS-SEA.

The third message emphasises the benefits of CENTAUR, such as its ability to generate information over wide areas and then trigger alerts corresponding to significant changes in the normal patterns of indicators. This feature allows to improve situational awareness and decision-making during complex emergencies and multidimensional crises.

To ensure appropriate and effective measures are planned and executed to maximise engagement and exchanges of information between CENTAUR partners and stakeholders. A Communication Strategy and Action Plan is also delivered within the D6.1 report, on the 31st May. This plan analyses in detail the stakeholder groups identified, including CEMS Users, CSS-SEA Users and other potential beneficiaries. Each group will be targeted with specific communication and dissemination activities that best suit their needs and interests. Measures to expand the circle of information sharing to other stakeholders such as MEPs, Member States or the public at large will also be planned.

At this stage, the focus of the communication and dissemination activities is primarily on building the network and engaging stakeholders. As the project progresses and tangible results begin to emerge, the focus will shift towards dissemination and communication activities, including additional events, publications, and other measures to share the findings and outcomes of the project with a broader audience.

Overall, CENTAUR team is committed to engaging with stakeholders and Advisory Board members in order to maximise the impact of the project. Through a wide variety of dissemination and communication activities, the project team aims to build a strong network of stakeholders who are committed to the project's success and can help amplify its impact.

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The CENTAUR project team has already implemented several measures to engage with its target audience.

- The CENTAUR website has been developed. It provides stakeholders with a single point of access to information on the project's objectives, activities, outcomes, and engagement opportunities.
- An initial informative **flyer** has been produced to raise awareness of the project among target stakeholders and potential Advisory Board members.
- The project team has also established a **social media presence** on Twitter and LinkedIn, engaging already with a range of relevant accounts such as: the official accounts of the European Health and Digital Executive Agency (HaDEA) and EU Commission's Directorate-General for Climate Action (DG CLIMA).
- To further engage with stakeholders, the CENTAUR project team is currently working on the development of a **newsletter** to be distributed on a regular basis, every six months. The newsletter will include a summary of the most important updates on the project's activities, such as the results achieved and milestones reached, the project's scientific publications, suggested readings in line with the project's themes, and upcoming events.

In addition to the above activities, the project consortium will **leverage the tools provided by the European Commission** to ensure that the project results reach the widest possible audience. A more complete description can be found in D6.1, however, a non-exhaustive and preliminary list includes:

- For dissemination purposes: the Community Research and Development Information Service (CORDIS), the Horizon Results Booster (HRB), and the Horizon Results Platform (HRP).
- For communication purposes: the Horizon Magazine and the Research and Innovation Success Stories portal.

Furthermore, the dissemination and communication activities will also consist of interactive activities: participation in events/conferences and organisation of workshops with key stakeholders.

The CENTAUR consortium will participate in a series of events to build a strong network by presenting the project to different stakeholders. Participating in **events and conferences** of complementary EU-funded projects is a highly beneficial opportunity to promote our project activities and achievements. These gatherings are often attended by sector experts and offer a chance to showcase what the CENTAUR project has to offer, as well as establish connections with potential new Advisory Board members. Attending such conferences will also allow us to learn from other EU-funded projects, exchanging knowledge and ideas, and collaborating on matters that can result in greater visibility and impact for our activities. A detailed list of suggested events can be found in D6.1.

Likewise, as part of the CENTAUR project's dissemination and user consultation activities, the project team will be organising a series of user **workshops** to engage with the project's Advisory Board, key stakeholders and representatives of other EU-funded projects. These workshops will provide an opportunity for the project team to share their progress and results, and to gather feedback on how the project outcomes can be improved.

The objective of these workshops is to foster a productive dialogue between the project team and stakeholders, including end-users, practitioners, and other experts. Through this engagement, the project team hopes to receive valuable input from stakeholders, which can help to refine the project's objectives, approach, and outcomes.

The workshops will be designed to encourage participation and interaction, with a focus on creating a collaborative and productive environment. Through these user workshops, the project team aims to maximise the impact of its work and ensure that the CENTAUR project is delivering value to its stakeholders and evaluating user satisfaction.

Figure 1 shows an **overview of the workshops and other user engagement meetings** that are planned over the 3-year project period.

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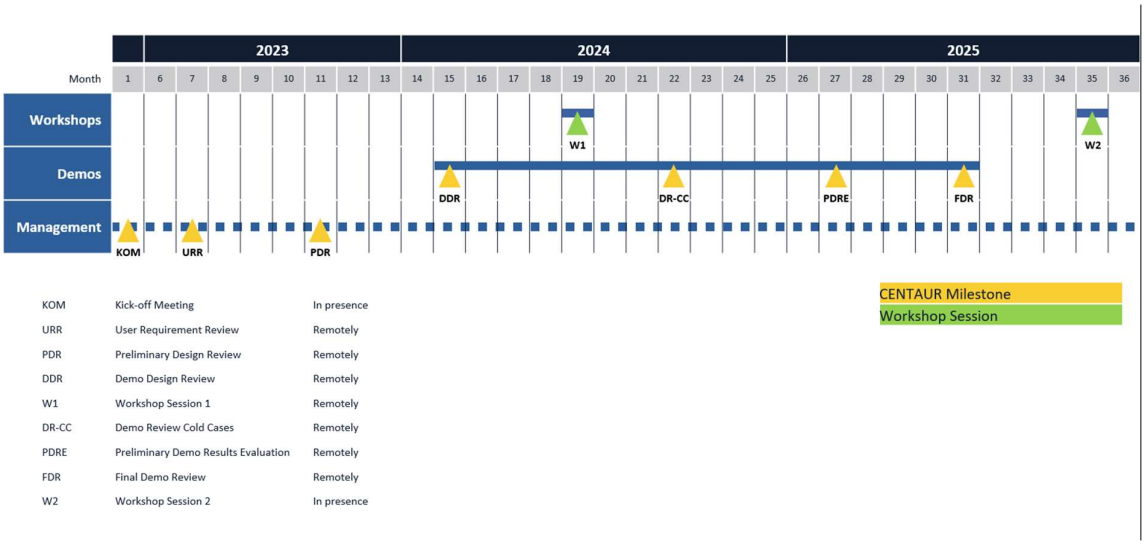
Following the natural development of the project, there will be a greater concentration of meetings in the second and third year, coinciding with various project milestones.

In the first year, two workshops are planned, at M10 and M12, in order to present the planned activities and the ones already carried out in a more targeted manner to the two stakeholder groups most relevant to the success of the project: CEMS Users and CSS-SEA Users.

The second round of workshops will be concentrated at the turn of the second and third project year, so as to include in the events all the insights and updates that will follow the two planned demo reviews for M15 and M21.

A further round of workshops is planned to follow the Preliminary Demo Results Evaluation (M27) and finally, after the Final Demo Review (M32) a final workshop will be organised in order to involve all the stakeholders who contributed to the success of the project, and the users of the two services to whom the results and potential of the services developed by CENTAUR will be presented.



KOM	Kick-off Meeting	In presence
URR	User Requirement Review	Remotely
PDR	Preliminary Design Review	Remotely
DDR	Demo Design Review	Remotely
W1	Workshop Session 1	Remotely
DR-CC	Demo Review Cold Cases	Remotely
PDRE	Preliminary Demo Results Evaluation	Remotely
FDR	Final Demo Review	Remotely
W2	Workshop Session 2	In presence

Figure 1: Timeline of users' engagement plan: workshops, demos and project milestones

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4 KEY EXPLOITABLE RESULTS - KERS

Being at the early stage of the project, the most relevant results have been selected and prioritised taking into account the potential to be exploited. In Table 2 here below, the KERs identified presently are listed. KERs reported are identified in terms of indicators, that will be exploited as integrated crisis indexes, according to the end-users' needs. Working with KERs calls for understanding what the actual results are (will be) and what needs to be until the end of the project (and beyond) to have a clear actionable exploitation plan ready and agreed among partners.

Table 2: Main exploitable results identified in the initial stage of the project

General idea of KERs	Short description
FORECAST OF IMPACT OF HEAVY PRECIPITATION EVENTS IN URBAN AREAS	Pre-warning system based on a convolutional neural network raising alarms for unusually high precipitation in urban areas. Geographical images showing the intensity and extension of expected precipitation are provided. Real-time operation and fully automated alerting mechanism on large areas represents the fundamental asset for service positioning, where ML and the prediction of impact base forecast are adopted to innovate the CEMS already existing.
DROUGHT EARLY WARNING SYSTEM	Within the Water & Food Insecurity domain the key exploitable result will be an early warning system for major meteorological and agricultural drought events. This early warning system will be established based on a combination of indicators describing current vegetation and drought conditions on one hand and future meteorological conditions on the other hand. Current vegetation and drought conditions will be approximated using a combination of the Normalized Difference Vegetation Index (NDVI), Land Surface Temperature (LST), soil moisture, precipitation, land cover and land surface phenology indicators. Climate forecasts on air temperature, precipitation and soil moisture will allow to make predictions of future drought conditions for the coming 3 to 6 months.

Partners in charge of the Key Exploitable Result (KER) should fill in the content and discuss it with the ones involved in the finalisation of the KER including the partners that will oversee the testing phase.

All the outcomes presented in this chapter are the results gathered from the HRB service and the project CB [AD4], starting from the meetings to the work material made available, such as:

- *Characterisation_Table.docx*
- *Exploitation_Roadmap.docx*
- *Risks_Assessment_and_Priority_Map.xlsx*
- *Use_options.docx*
- *Exploitation_intentions_summary_table.docx*

Each content provided have been amended during the ESS session held on the 22nd May 2023.

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4.1 FORECAST OF IMPACT OF HEAVY PRECIPITATION EVENTS IN URBAN AREAS

4.1.1 CHARACTERISATION OF RESULTS

The Characterisation Table 3 below is designed to start the collection of information that will be then reviewed and further integrated during the project life.

ECMWF, responsible for this Key Exploitable Result (KER), compiled the contents, they discussed with all the partners involved in the finalization of the KER, including who will supervise the testing phase.

Table 3: Characterization of the result - KER No.1 (KER leading beneficiary: ECMWF)

Forecast of impact of heavy precipitation events in Urban areas (ECMWF)	
Problem	Flooding impact in urban areas is particularly high, due to the high population density and property values, including those of transport, residential, service, and industrial infrastructure. Flooding in urban areas is often the direct effect of localised precipitation on a very small-time scale (few hours). These events are generally not resolved by global numerical weather prediction models and can be challenging for regional model as well. Missing these events and the lack of pre-warning have often caused serious problems in risk management. Identifying the locations of rainfall flooding areas and developing accurate maps based on them are crucial for spatial planning and flood management at the local scale. If the total expected rainfall is known, however, inundation areas can be calculated by information about the morphology of the terrain and the degree of its sealing as methods for determining the risk of flooding in urban areas using digital terrain model (DTM) and geographic information system (GIS) tools exists and can be quite accurate. They rely on the determination of flat areas, areas without outflow (non-drainage) and with large terrain height differences. The main source of uncertainty is therefore connected to the prediction of the amount of precipitation that can affect local areas especially if driven by convective events. The new method proposed to overcome the limitation of dynamical and traditional statistical downscaling methods to predict precipitation is based on the idea to employ deep learning to infer the intensity of precipitation events based on the prediction of return periods. The prediction model is trained on high resolution historical observations of rainfall available through the high spatial resolution network of the Copernicus Emergency Management Service (CEMS) and **learns** through a convolutional neural network the spatial and dynamical patterns that are conducive of anomalous situation expressed as 20 years return period event (i.e. 1 in 20 chances or 5% probability in a year). The prediction of the correct return period will allow to then associate the expected amount of precipitation through the observational database and the identification of inundated area through the catalogue of historical simulations.
Alternative solution	High resolution hydro-meteorological models or radar now-casting are classical approaches in flash flood warning systems and are the backbone of current operation in EFAS and GLOFAS systems developed by the CEMS early warning

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	component. However, these techniques cannot offer global coverage, they are not suited for urban floods and they commonly reduce warning lead times to a few hours. To extend the warning lead time weather forecast could be used. However, global numerical weather prediction models are not used extensively because they tend to underestimate very localized heavy rainfall. Weather forecast, even at very high resolution cannot resolve the sub-grid scale variability associated to heavy precipitation at the scale useful for urban events
Unique Selling Point USP - Unique Value Proposition UVP	We aim to deliver a modelling framework able to predict the occurrence of an extreme event and be especially calibrated for this purpose Differently to other methods focussed on correcting precipitation, the aim here is to predict the expected impact using the probability of exceeding the 20 years return period event as indicator. Then we will use the historic record of observed precipitation at that return period event to derive the expected inundation scenario. The unique selling point is in the direct forecast of the impact instead than the meteorological variable.
Description	This service is a pre-warning system based on a convolutional neural network raising alarms for unusually high precipitation in urban areas. The service will provide geographical images showing the intensity and extension of expected precipitation The real-time operation and fully automated alerting mechanism (related to the forecast of a 20y return period) on large areas represents a distinctive feature of this service and a fundamental asset for service positioning. While there exists flash floods component already operating in CEMS the focus on the use of ML and the prediction of impact base forecast represents an innovative aspect of this service. The service chain is composed by three modules: • A data analysis to construct the historic time series of return period in Europe • A deep learning module based on convolutional neural network to provide prediction. • An alerting engine that controls the output of the model and raises alerts when they are above threshold.
"Market" – *Target market*	This service is potentially interesting for several market segments, including security, research on a variety of environmental issues, journalism/online news services, and risk management. In CENTAUR, the service has been designed to address a specific missing component of the CEMS service and the main goal is to integrate this component into an existing service. Still the service itself satisfies by design specific needs of a variety of actors involved in managing security at a national local and global scale. This KER could also be marketed also with a more innovative approach as a stand-alone service by targeting a broader market in the public and private sector.
"Market" – *Early Adopters*	Building on the idea of a providing a new component to CEMS service evolution, the first step towards adoption should be the integration with the existing early warning system of EFAS and GLOFAS. This would have a number of benefits, among them: • The ability to test the technology and extend it with the adapters, integration components, plug-ins and additional functionalities that are needed for the service to be perceived as mature by its potential clients. • The ability to test the service in a real scenario early in the service development timeline.

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	• Access to an established client base that can start using the service, provide feedback, help prioritize the next developments, and, finally, generate a first reliable revenue stream.
"Market" - Competitors	Copernicus Emergency Management Service (CEMS) has alerting systems for flash floods both on the EFAS and GLOFAS platform. These maps represent a first reference to warn on ongoing situation. However, neither EFAS nor GLOFAS flash floods alerting system have the capability to predict urban floods. Copernicus flood mapping service integrates satellite imagery with other types of data to define the extent of ongoing floods events and have potentially the resolution to monitor urban floods. However, they have not the predictive capability that this service will provide.
Go to Market – Use model	This KER has been designed by ECMWF in collaboration with e-GEOS. ECMWF is the computation centre for CEMS-flood while e-GEOS is the entity in charge of the overall delivery of CEMS mapping and recovery service. Both ECMWF and e-GEOS will directly exploit this new technology in the framework of their contribution to CEMS. Also, ECMWF has a general strategic orientation towards technology transfer to its member states, hence the intension to deploy the stand-alone model on cloud infrastructure. This is consistent with all the considerations made in this document and, in particular, with the idea of transferring the KER to a newco for the exploitation.
Go to Market - Timing	The go to market is organized in two steps: 1. During CENTAUR: During the CENTAUR project, the urban floods alerting service will be integrated in the CENTAUR architecture and tested in the relevant CENTAUR use cases. This testing will help fine tune the technology and gather feedback from the CENTAUR partners and end users. This testing phase will provide a clearer indication of the potential impact of this KER to improve mapping acquisition. It will also pave the way towards the identification of an interested commercial partner like e-GEOS that can either directly exploit the KER or participate in the set-up of a newco. 2. After CENTAUR: After the end of the CENTAUR project, the exploitation strategy discussed in this document should be translated into a business plan to organize all the actions needed and enact the go-to-market strategy.
Go to Market – IPR Background	Speedy flood modelling, based on a geomorphological modelling approach, which will use as input the forecasted precipitation data for each return period provided by ECMWF algorithms - e-GEOS.
Go to Market – IPR Foreground	Data gathering and pre-processing algorithms, ML model for return period forecast, anomaly detection algorithm, design and construction of the static map and operational uptake of the warning system– ECMWF. Catalogue of inundated map connected to return period: e-GEOS ECMWF and e-GEOS have cooperated to the design of this service. Therefore, they would be the first partner to evaluate the possibility to introduce the service in its portfolio. The service uses standard ML techniques that cannot be considered innovative and do not involve specific IPRs. It should be noted that the CENTAUR Consortium Agreement does not address IPR issues.

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4.1.2 EXPLOITATION ROADMAP

The Exploitation Roadmap is a tool designed to help the consortium to identify and plan activities to be performed after the end of the project (Table 4). The highest risk a consortium faces is not being able to implement the exploitation and dissemination plan and increase the TRL level or go to market, due to lack of resources. The exploitation roadmap is designed to address this risk, mitigate it and pave to way toward use and a stronger impact.

Table 4: Exploitation Roadmap - KER No.1 (KER leading beneficiary: ECMWF)

Exploitation roadmap	
Actions	The KER itself is though as a CEMS service evolution and as such has a defined end user (identified in EFAS and GLOFAS platforms). However, parts of the service, namely some modelling components that will be made available as open-source module in platform such us GitHub could constitute an opportunity for further exploitation.
Roles	ECMWF will not commit to the commercial exploitation of the KER or of its components However, ECMWF is willing to integrate the KER into its service chain and to release under an Apache license, modelling components that could be commercially exploited by third parties.
Milestones	It is important that modelling components for the KER that could be commercially exploited are released with an appropriate license after the end of the project.
Financials Costs	From the prospective of self-exploitation, the financial costs could be covered by the next CEMS service contract, if the KER is deemed useful by the service entrusted entity (JRC). From ECMWF perspective this should amount to 12 PM for the first year and 3 PM for every successive year. It is difficult to assess the financial costs for a third party interested in exploiting part of the technology that will be made available. It will depend on the type of applications, the infrastructure already available and the customer base.
Revenues	The revenue from the prospective of ECMWF is to extend the catalogue of possible products to insure CEMS service continuous evolutions. The possible revenue from third parties it will be defined by the business plan of the third-party company willing to exploit the assets released.
Other sources of coverage	ECMWF does not foresee any other source of coverage for the cost associated to self-exploitation. Instead for external exploitation of components of the KER, the amount of funding needed depends on the business plan of the third party. The financial needs of the company could vary significantly depending on the type of shareholders owning the company. For example, there would be clear savings from exploiting an existing market presence or sales network.
Impact in 3-year time	The KER will directly impact ECMWF through the development of innovative technologies. With a commitment on continuous Innovation, ECMWF grows and contributes to the

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	development of important technical skills in key areas such as artificial intelligence, security, and big data. For external exploitation, depending on the business plan of the third-party company, it is foreseen that direct employment could take place.

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4.1.3 RISKS ASSESSMENT AND PRIORITY MAP

Table 5: Risks Assessment and Priority Map - KER No.1 (KER leading beneficiary: ECMWF)

KER Risk Assessment Map							
	Description of Risks	Degree of criticality of the risk related to the final achievement of this Key Exploitable Result. Please rate from 1 to 10 (1 low- 10 high)	Probability of risk happening Please rate from 1 to 10 (1 low - 10 high)	Risk Grade	Potential intervention	Estimated Feasibility/Success of Intervention Please rate from 1 to 10 (1 low- 10 high)	Conclusion
	Partnership Risk Factors						
1	Disagreement on development between ECMWF and e-geos	*9*	*2*	**18**	Early communication on development strategy is key. Progress meetings to prevent different development paths	*9*	**Control.**
2	One of the partner loose interest in the product	*10*	*6*	**60**	The link established through the CEMS service and in between the components should guarantee the interest in the continuous collaboration between partners	*7*	**Action!**
	Technological Risk Factors						
3	Poor quality results	*9*	*3*	**27**	Continuous assessment of quality of all components should guarantee early detection of any problematic and low quality modules	*8*	**Control.**
4	Better technology exists	*8*	*2*	**16**	Continuing the review of all existing methodology performed to avoid wasting efforts	*8*	**Control.**
	Market Risk Factors						

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5	Nobody interested in exploiting the component of the products that can be commercially viable	*9*	*6*	**54**	Plan early engagement with potential customer. Organise a demonstrator to showcase the new service	*7*	**Action!**
6	The product is not good enough for end users	*10*	*4*	**40**	The product is designed as a component for CEMS evolution and is developed by the contractual force of this service. The entrusted entity of the service (end-user) is consulted regularly to make sure the requirements are fulfilled	*3*	**No Action'**
	IPR/Legal Risk Factors						
7	Problems with IPR	*10*	*3*	**30**	Both e-Geos and ECMWF have IPR policies in place. Early assessment and agreement on IPRs will be put in place	*8*	**Control.**
	Financial/Management Risk Factors						
8	No resources to continue the exploitation of the KER after the end of the project	*10*	*6*	**60**	Is in the interest of both partner to retain the developed technology as it increase their chance to be successful in the next service contract application. Early strategy definition to guarantee financial support	*8*	**Action!**
9	Leaks of information to develop alternative systems	*6*	*6*	**36**	The technology is tailored for a specific application and the model development while innovative is not deemed to provide the most important value.	*6*	**Control.**
	Environmental/Regulation/Safety risks:						
10	Forecast of missing events	*10*	*4*	**40**	The forecast is not released but interpreted by expert to provide warnings to population if needed.		**No Action'**
11	Research is impacting society in a negative way	*9*	*2*	**18**	The 'one voice' principle is applied to this product as to other CEMS-floods product to avoid any release of sensitive information that could alert the population		**No Action'**

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Summarizing Risks Table	
Number of "No Action" Risks	3
Number of "Control" Risks	5
Number of "Action" Risks	3
Number of "Warning" Risks	0
Number of Risks in the middle of everything	0
Number of Risks Between Control & No Action	0
Number of Risks Between Action & Warning	0
Number of Risks Between No Action & Warning	0
Number of Risks Between Control & Action	0

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4.1.4 USE OPTIONS

Table 6: Use Options - KER No.1 (KER leading beneficiary: ECMWF)

KER's Exploitation route (how the KER will be further exploited) Note: only an option is to be selected			
Selected route		**Implementing actor**	**Yes**
DIRECT USE	Commercialisation: *deployment of a novel product/service (offered to the target markets)*	One partner[1]	
		A group of partners[2]	
	Contract research (*new contracts signed by the research group with external clients*)	A partner	
		A group of partners	
	A new research project (*application to public funded research programmes*)	A partner	
		A group of partners: ECMWF, E-GEOS	X
	Implementation of a new university – course (*Note that a training course is a service*)	A partner	
		A group of partners	
		A new partnership	
INDIRECT USE	Assignment of the IPR	A partner	
		A group of partners	
	Licensing of the IPR	A partner	
		A group of partners	
	Development of a new legislation/standard	A partner	
		A group of partners	
	Spin- off	A partner	
		A group of partners	
		By assignment	
		By licensing	
	Other (*please describe*)		

[1] Partners identifies the partners of the project receiving the ESS, not third parties that may be partner in the future.

[2] Provide the names of the partners

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4.2 DROUGHT EARLY WARNING SYSTEM (WATER&FOOD INSECURITY)

4.2.1 CHARACTERISATION OF RESULTS

The Characterisation Table 7 is designed to start the collection of information that will be then reviewed and further integrated during the project life.

VITO, responsible for this Key Exploitable Result (KER), compiled the contents, they discussed with all the partners involved in the finalization of the KER, including who will supervise the testing phase.

Table 7: Characterization of the result - KER No. 2 (KER leading beneficiary: VITO)

Drought Early Warning System (VITO)	
Problem	Most drought early warning systems to date focus on identifying drought events and quantifying their impact in near-real time. Very few attempts have been made to forecast the occurrence of droughts (and their impacts on agricultural production) in the future (up to 6 months ahead). Such information would be relevant to all stakeholders in the agri-food domain (from farmers to international food security organizations), allowing them to take appropriate action and to minimize the impact of the drought event on yields of individual parcels up to regional food security. Hence, there is a clear need on a concise, easily-understood, and straightforward set of indicators that summarize the current and foreseeable future of drought probability and severity. Regarding meteorological droughts: There is currently no **probabilistic** meteorological drought forecasting system out there. The service that is now available at JRC is only updated yearly, not in **near-real time**. Also, the existing systems do not take into account the latest **high resolution data**. Regarding agricultural droughts: Also here, most systems focus only on near-real time monitoring of impact of droughts on agricultural production. By integrating information on current drought conditions with meteorological forecasts, we will be able to not only assess drought conditions in near-real time (i.e. what most current systems do), but also look further into the future up to 3-6 months to make timely predictions of major upcoming drought events. The latter aspect is not covered by most of the early warning systems currently in place, yet is essential in light of natural disaster preparedness and mitigation. Most of the already established early warning systems are based on pixel-based temporal anomaly analysis. However, the impact of anomalies in precipitation and/or soil moisture on agricultural production can be completely different depending on the spatial and temporal context (climate, type of ecosystems, cumulative rainfall in preceding months etc.). Early warning systems to date do not fully capture this spatial and temporal context. The newly to be developed early warning system will focus more on the relation between past, current and expected growing conditions (as represented by air temperature, precipitation and soil moisture) on the one hand and impact of drought on agricultural production on the

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	other hand. These relations will be established at regional level, thereby ensuring that specific local conditions are accounted for. Most drought early warning systems rely on soil moisture content as one of the key explanatory variables for drought assessment. Soil moisture content is mostly measured using sensors that can only detect the moisture content of the top 5 cm of soil. In order to evaluate the effect of soil moisture depletion on agricultural production, it has been established that the soil moisture in the root zone (approximately 1 m) must be measured. Traditional, microwave-based measurements of soil moisture have been shown to be less accurate over vegetated areas, as the vegetation effectively blocks the satellite signal. To measure soil moisture, another scientific principle is necessary. GRACE FO calculates the soil moisture content based on variations in the planet's gravimetric field. Although the resolution is 25 km, it allows for a more accurate regional estimation of soil moisture. In the context of CENTAUR, we will additionally investigate how the spatial resolution of GRACE measurements can be artificially increased.
Alternative solution	A few drought early warning systems are currently already available for the African continent: - JRC's ASAP system (https://mars.jrc.ec.europa.eu/asap/wexplorer/) - FAO's ASIS system (https://www.fao.org/giews/earthobservation/index.jsp?lang=en) - East Africa Drought Watch (https://droughtwatch.icpac.net/mapviewer) - African Flood and Drought Monitor (http://hydrology.soton.ac.uk/apps/afdm/) → also considering forecasts, but using only soil moisture and not related to vegetation productivity - European Drought Observatory (EDO - https://edo.jrc.ec.europa.eu/edov2/php/index.php?id=1000) and Global Drought Observatory (GDO - https://edo.jrc.ec.europa.eu/gdo/php/index.php?id=2001) monitoring systems by JRC These existing solutions mostly focus on near-real time drought condition monitoring based on anomaly detection of multiple indicators (including precipitation, vegetation condition and/or soil moisture). The only system that is currently also making forecasts of drought occurrence is the African Flood and Drought Monitor. They use a hydrological model to predict soil moisture depletion based on current soil moisture levels and meteorological forecasts.
Unique Selling Point USP - Unique Value Proposition UVP	Our drought early warning system will combine information on current and future meteorological conditions with current vegetation condition to produce probabilistic estimates on future drought occurrence and severity.
Description	The final product will be in the form of maps not only of the different indicators being used for the analysis but also maps of the expected relative impact of drought events on regional crop productivity. The targeted spatial resolution of the maps will be 1 km, as is often adopted for regional drought monitoring. Based on all indicators, we will produce a drought risk zone map, indicating areas specifically prone to adverse impacts by drought in the (near) future.

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"Market" – *Target market*	People/organizations in need of detailed information related to climate and the associated state of agricultural production (both in near-real time and future conditions). Primary market segments that have been identified: - International organizations active in the field of food security (FAO, GEOGLAM, WFP, World Bank, JRC) - Large companies (insurance / weather forecast) - Governments of individual countries
"Market" – *Early Adopters*	The proposed indicators and early warning system will be integrated in the Copernicus Service in Support to EU External Action (SEA), as defined in the project's scope. International organizations will be the first adopters to approach, and particularly JRC (identified as main project client), FAO and UNESCO. The latter two have been selected based on previous contacts by VITO.
"Market" - Competitors	University of Southampton (from the African Flood and Drought Monitor)
Go to Market – Use model	One partner of the Consortium will design and implement a platform or viewer where the indicators will be shown in their final format, where the different potential users can see and evaluate the products. Aside from the default service as offered through this platform, the main use model for further exploitation of our R&D efforts will be through offering **customized version** of the algorithm and system more tuned to local conditions (e.g. for implementation at individual country level). Additionally, the base service can be used to build **additional services** serving specific needs of specific end users (e.g. insurance product).
Go to Market - Timing	By the end of the project, once the system is implemented on the Copernicus system and its added value has been demonstrated for specific use cases.
Go to Market – IPR Background	VITO has currently IPR on agricultural drought severity indicator. ECMWF has IPR on meteorology and meteorological drought forecasting.
Go to Market – IPR Foreground	ECMWF to retain IPR on the meteorology forecasting part. IPR of the agricultural drought indicator to be shared between VITO and UNISTRA.

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4.2.2 EXPLOITATION ROADMAP

The Exploitation Roadmap is a tool designed to help the consortium to identify and plan activities to be performed after the end of the project (Table 8). The highest risk a consortium faces is not being able to implement the exploitation and dissemination plan and increase the TRL level or go to market, due to lack of resources. The exploitation roadmap is designed to address this risk, mitigate it and pave to way toward use and a stronger impact.

Table 8: Exploitation Roadmap - KER No. 2 (KER leading beneficiary: VITO)

Exploitation roadmap	
Actions	1. Set up an exploitation meeting between VITO, ECMWF and UNISTRA. Results: a. Exploitation strategy b. IPR c. Legal agreement d. Liability statement 2. Add fixed point in the agenda on exploitation during consortium meetings to better follow up exploitation intentions after the project 3. Understand competition a. Research on competitors and current state-of-the-art b. Monitor developments on drought monitoring and forecasting 4. Compile clear demonstration cases to showcase added value of our drought forecasting system to potential customers and users 5. Engage with potential customers and users already during the project 6. Think about additional sources of funding beyond project 7. Continuous development of algorithm/methods 8. Extend the service to new regions of interest, outside the African continent
Roles	VITO will coordinate each of the identified actions, ECMWF and UNISTRA will contribute in each action.
Milestones	ACTION 1 (exploitation meeting) a) Organize a successful first exploitation meeting b) Final version of documents as identified in 1st action. ACTION 3 a) State of the art overview on meteorological drought forecasting b) State of the art overview on agricultural drought monitoring ACTION 4 (Demonstration cases of added value) a) Identify relevant use cases based on historic drought events and climatological conditions b) Test our solution on identified use cases c) Create clear communication strategy on how to disseminate the results of the use cases

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Financials Costs	Too early to be assessed. Costs will be mainly covered through engagement in other research projects and funding opportunities.
Revenues	Too early to be assessed.
Other sources of coverage	-
Impact in 3-year time	Avoid damage to crops due to drought events: - In most drought-prone regions in Africa (to be defined) - For the most common staple food crops - Get accurate forecasts on 30% of locally occurring droughts

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4.2.3 RISKS ASSESSMENT AND PRIORITY MAP

Table 9: Risks Assessment and Priority Map - KER No. 2 (KER leading beneficiary: VITO)

KER Risk Assessment Map							
	Description of Risks	Degree of criticality of the risk related to the final achievement of this Key Exploitable Result. Please rate from 1 to 10 (1 low- 10 high)	Probability of risk happening Please rate from 1 to 10 (1 low - 10 high)	Risk Grade	Potential intervention	Estimated Feasibility/Success of Intervention Please rate from 1 to 10 (1 low- 10 high)	Conclusion
	Partnership Risk Factors						
1	Disagreement on further exploitation pathways for the product --> partnership disbanded.	*10*	*7*	**70**	Draft legal agreements and find alternative sources of funding to keep collaborating even beyond the project's lifetime.	*6*	**Action!**
	Technological Risk Factors						
2	Similar methodologies are being developed at the same time (better sensors are excluded)	*3*	*6*	**18**	Keep an eye on current scientific developments in the field of drought monitoring and making sure our approach differs from available methods.	*6*	**Control.**
3	Ill -timed closure (not enough time to develop the requested service)	*10*	*4*	**40**	Service development will be performed in stages, in which we aim to develop a first version of the full workflow as soon as possible and then gradually improve upon its components. Make sure there is a simplified version of the algorithm available as a back-up (minimum viable product).	*9*	**Control.**
4	High uncertainties in climate forecasts, hampering accurate meteorological/agricultural drought event forecasting	*6*	*7*	**42**	Adoption of ensemble model approach in a probablistic fashion will allow us to gain a better understanding of the uncertainty/probablity of the forecasts and explicitly take this into account in our drought event predictions.	*8*	**Control.**

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5	Failure of Earth observation sensor, particularly GRACE FO	*7*	*2*	**14**	We will investigate alternative data sources for soil moisture data, particularly the Copernicus Soil Water Index. This index will however not be able to completely replace information from GRACE FO.	*5*	**Between Control & No Action**
6	Data transfer between ECMWF and VITO (timely delivery of forecasts)	*8*	*4*	**32**	Clarify where the different indicators will be hosted + agree on delivery timing of forecasts.	*8*	**Control.**
	Market Risk Factors						
7	Nobody using the service as other drought early warning systems have been out there for a long time.	*9*	*7*	**63**	Sufficient outreach activities will be set-up to inform our main stakeholders about the existance of our service and particularly the added value of the service compared to already existing early warning systems. During demonstration phase of the project already compare our results with similar services and highlight added value.	*8*	**Action!**
8	Competition with other organizations targeting the same stakeholders with the same type of product.	*9*	*4*	**36**	Stay up-to-date with market competition and scientific state-of-the-art. Clearly demonstrating added value and reliability of our system (in terms of accuracy and performance),	*6*	**Control.**
	IPR/Legal Risk Factors						
9	Disagreement on dissemination of data and code (open source or not?)	*4*	*4*	**16**	Commence IPR discussions already during the project, including proper declaration of licences.	*7*	**Control.**
	Financial/Management Risk Factors						
10	Change of user requirements throughout the project	*9*	*2*	**18**	We should at all times clearly communicate the objectives and scope of our service.	*8*	**Control.**
11	Communication issues between ECMWF and VITO, hampering exchange of required climate forecasts.	*6*	*4*	**24**	Set up regular status update meetings between partners.	*8*	**Control.**
12	Lack of alternative sources of funding to extend activities beyond the project's lifetime.	*3*	*8*	**24**	Start identifying other options for collaboration during project's lifetime.	*6*	**Control.**
	Environmental/Regulation/Safety risks:						
13	Liability of predicted droughts	*8*	*8*	**64**	Draft a clear liability statement.	*9*	**Action!**

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Summarizing Risks Table	
Number of "No Action" Risks	0
Number of "Control" Risks	9
Number of "Action" Risks	3
Number of "Warning" Risks	0
Number of Risks in the middle of everything	0
Number of Risks Between Control & No Action	1
Number of Risks Between Action & Warning	0
Number of Risks Between No Action & Warning	0
Number of Risks Between Control & Action	0

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4.2.4 USE OPTIONS

Table 10: Use Options - KER No. 2 (KER leading beneficiary: VITO)

KER's Exploitation route (how the KER will be further exploited) Note: only an option is to be selected			
	Selected route	Implementing actor	Yes
DIRECT USE	Commercialisation: *deployment of a novel product/service (offered to the target markets)*	One partner[3]	
		A group of partners[4]	
	Contract research (*new contracts signed by the research group with external clients*)	A partner	
		A group of partners	X
	A new research project (*application to public funded research programmes*)	A partner	
		A group of partners	
	Implementation of a new university – course (*Note that a training course is a service*)	A partner	
		A group of partners	
		A new partnership	
INDIRECT USE	Assignment of the IPR	A partner	
		A group of partners	
	Licensing of the IPR	A partner	
		A group of partners	
	Development of a new legislation/standard	A partner	
		A group of partners	
	Spin- off	A partner	
		A group of partners	
		By assignment	
		By licensing	
	Other (*please describe*)		

[3] Partners identifies the partners of the project receiving the ESS, not third parties that may be partner in the future.

[4] Provide the names of the partners

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5 MARKET ANALYSIS

5.1 MARKET OVERVIEW: ECONOMIC PERSPECTIVES AND DRIVERS

The key point to enlighten is the need to characterize the target market as related to the specific Urban Flood and Water&Food Security thematic area.

The scope of the Market Analysis is to focus on the exploitation and dissemination of CENTAUR services.

5.2 USERS AND TECHNOLOGY REQUIREMENTS

A thorough analysis of user requirements and technical requirements has been carried out for the CENTAUR project and described in D1.1 Urban Floods and Water&Food Insecurity Indicators.

5.2.1 COPERNICUS EMS

Users Requirements in terms of urban flood mapping:

- Better anticipation of urban flood events
- Prediction / modelling of the flood extent, depth and impact in urban areas
- Flood extent mapping in urban areas whatever the weather conditions
- Flood extent mapping in urban areas whatever the flood type (plain flood, flash flood …)
- More accurate urban flood mapping
- Flood depth information
- Faster evaluation of the urban flood impact
- More frequent flood monitoring and modelling updates
- Better access to past crisis data (flood, food scarcity, drought)
- Better integration with other data sets (land use, population, infrastructure, social media etc.) for meta-analyses

Technology Requirements in terms of urban flood mapping:

- Automatic tools modelling flood extent, depth and impact in a forecast and enhanced observation mode
- More interferometrically compatible data in terms of more sensors adapted to InSAR and at higher resolutions
- More frequent interferometrically compatible acquisitions
- More accurate and faster InSAR based urban flood estimation tool
- Use of various InSAR sensors (open source + commercial)
- HR to VHR InSAR data
- VHR DTMs for modelling
- Combination of various data (EO, precipitation, socio-economic, social media …)
- Combination of techniques (traditional image processing, modelling, AI …)
- Combination of data sources and techniques in creating innovative urban flood indexes
- Robust infrastructure to handle large volumes of data and deliver services reliably
- Real-time or near-real-time processing for timely update during crisis events (especially for social media data)
- Scalability, to handle increasing volumes of data over time (historical data, new sensors, etc.)
- Cloud-based solutions to help manage and process large amounts of data more efficiently, and to provide easy access to users

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5.2.2 COPERNICUS SEA

Based on the state of the art of the Climate Security topic, including the general issues, international and national policies, existing products/services in the market, etc. the main trends and overarching priorities for the users were identified.

The users expressed the need to establish a clear causal link between climate change/environmental degradation and conflict, and in terms of relevant datasets. This link should be translated into easy and understandable products/services. Specifically, there is a need for the assessment of food security as a precursor of conflict, and the analysis of damage to critical infrastructures resulting from different weather conditions (power plants, lines of communication, supply chains, gas pipelines, fuel storage, airports, ports, military installations, etc.).

The following requirements summarize the needs expressed by the users regarding Water and Food insecurity:

- Seasonal (e.g., monthly, bi-monthly or 3-monthly) projections of extreme weather events (droughts, floods, storms).
- Geospatial human mobility data, at regular time intervals, long-term trends and with global geographical coverage at local scale. (or at least conflict-affected settings to address the most vulnerable societies).
- Near-real time and projected geospatial data (e.g., different types of migration, flooding, institutional capacity at a local level).
- Improve the predictive capacities for climate security events.
- Innovative ways of analysing the links between climate change, environmental degradation, conflict, and displacement.
- Reduction of the temporal or spatial resolution of the current datasets, products or services delivered by a Copernicus operational service by 50%.
- Availability of data for:
    - Water Availability and Crop Production Monitoring
    - Climate and Meteorological Data
    - Changes in Land Use
    - Population Distribution and Evolution
    - Migration (e.g., border restrictions, flows)

The technology requirements in terms of water and food insecurity:

- On-line access (e.g. Geoportal).
- System able to generate, display and send user selected/configured alerts automatically.
- The system should be able to be easily ingested by other existing systems/workflows, with standard interfaces.
- VHR DTMs for modelling.
- Combination of various data (EO, precipitation, socio-economic, social media …).
- Combination of techniques (traditional image processing, modelling, AI …).
- Combination of data sources and techniques in creating innovative climate security indexes.
- Robust infrastructure to handle large volumes of data and deliver services reliably.
- Real-time or near-real-time processing for timely update during crisis events (especially for social media data).
- Scalability, to handle increasing volumes of data over time (historical data, new sensors, etc.).
- Cloud-based solutions to help manage and process large amounts of data more efficiently, and to provide easy access to users.

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5.3 IDENTIFICATION OF THE TARGET MARKETS

An initial assessment of the target markets will be performed within the intermediate version of this document (v2) and an integration/refinement will be included in the in the final version (v3), as soon as CENTAUR products and services will be tested and validated by the end-users.

Considering the Market segmentation as reported in the EUSPA EO and GNSS Market Report | Issue 1, 2022[5], the following main segments are related to CENTAUR context:

- Climate Services - The integration of EO with innovative technologies and the number of policies requiring close monitoring are set to further boost the market of EO applications related to climate resilience and adaptation.
- Emergency Management and Humanitarian Aid – EO is providing a full picture needed for context-aware emergency responses, ranging from preparedness and early warning to rapid mapping and post-event analysis.
- Environmental Monitoring – Various environmental parameters obtained by EO data contribute to an increasing number of international, regional, and local policies related to, or impacting, the environment. This is expected to drive the growing demand for EO data and applications in the sector.
- Urban Development and Cultural Heritage – A key enabler for healthier cities, EO assists officials, developers and citizens with the monitoring of air quality, light pollution and mapping of green areas as well as the preparation of urban planning in general. EO will contribute to novel solutions related to smart and sustainable cities

As soon as the KERs will be evaluated, the Target Market, better saying the **Serviceable and Obtainable Market – SOM** will be identified.

5.4 COMPETITIVE ANALYSIS

In order to assess the market competitors and perform the related competitive analysis, the final KERs need to be clearly identified, as well as the products need to be tested and validated. Therefore, this specific paragraph will be integrated in the v2 of the present document and finalized in the v3 final version.

At this stage, a preliminary analysis of few competitors within the KERs identified are listed in the table below:

Table 11: Overview of competitors identified in this initial phase

KERs	Competitors
FORECAST OF IMPACT OF HEAVY PRECIPITATION EVENTS IN URBAN AREAS	Copernicus Emergency Management Service (CEMS) has alerting systems for flash floods both on the EFAS and GLOFAS platform. These maps represent a first reference to warn on ongoing situation. However, neither EFAS nor GLOFAS flash floods alerting system have the capability to predict urban floods. Copernicus flood mapping service integrates satellite imagery with other types of data to define the extent of ongoing floods events and have potentially the resolution to monitor urban floods. However, they have not the predictive capability that this service will provide.

[5] EUSPA EO and GNSS Market Report ISSUE 1, copyright © EU Agency for the Space Programme, 2022.

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	Other examples include: ➢ The Met Office (UK) ➢ NOAA's National Weather Service (US) ➢ German Weather Service (DWD) ➢ Singapore's Smart Nation Initiative ➢ The Weather Company
DROUGHT EARLY WARNING SYSTEM	As mentioned earlier, a few other drought early warning systems have already been established by: ➢ FAO (ASIS) ➢ USAID (FEWS NET) ➢ NASA Harvest (GEOGLAM - Crop Monitor) ➢ US Drought Monitor ➢ JRC (European Drought Observatory and ASAP) ➢ South African Drought Information System ➢ Princeton Climate Institute (African Flood and Drought Monitor) ➢ UNCCD (The Flood & Drought Portal) ➢ Integrated Drought Management Programme (IDMP) ➢ The Australian Bureau of Meteorology Drought Monitor ➢ Drought Early Warning System (DEWS) in South Asia ➢ European Drought Observatory (EDO) ➢ Global Drought Observatory (GDO) ➢ The Weather Company

5.5 POTENTIAL MARKET SHARE

Following a comprehensive competitive analysis the extent of the potential market share can be identified. Therefore, this section will be integrated and finalized in the intermediate version (v2) and final version (v3), respectively.

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6 POTENTIAL END-USERS

From the two initial KERs presently described, some specific users have been identified and listed in Table 12.

Table 12: Users identified for CENTAUR KERs

KERs	Users identified
FORECAST OF IMPACT OF HEAVY PRECIPITATION EVENTS IN URBAN AREAS	A variety of actors involved in managing security at a national local and global scale. Public authorities: ➢ from local, regional and national civil protection and governmental authorities to top global scale, civil security and defence institutions, ➢ water and water basin authorities, ➢ research institutions. Private sector: insurance industry, communication and power network managers, real estate and construction industry.
DROUGHT EARLY WARNING SYSTEM	International organizations active in the field of food security (FAO, GEOGLAM, WFP, World Bank, …) Decision makers (politicians, technical staff of high rank) Local or Regional authorities (Department – district majors) Local farmers

Based on the market analysis, market segmentation and the identification of the target markets, a more specific user segmentation should be carried out. The following section outlines some initial aspects regarding the user segmentation that will be described in details in the v2 and v3 of the present document.

6.1 USERS SEGMENTATION

Several stakeholders with specific needs can be identified within different geographical scales. Main areas are reported below:

- **Policy Makers and Institutions: international institutions and bodies; national, regional or local authorities.**
- **Commercial and Private Users: international corporations, SMEs, individual end-users.**
- **Research users: NGOs**

Table 13: Users' segmentation

User type	User needs
Policy makers	Assist in the creation of effective flood mitigation strategies, infrastructure planning, and response plans. Aid in the allocation of resources for disaster response and recovery. Inform policy decision related to water management and agricultural planning. The proposed information layers include:

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	➢ Urban flood modelling on various scenarios ➢ Maximum extent, depth and impact on urban infrastructure of past flood events ➢ Economic impact of past flood events
Risk managers	Forecasting, prevention, mitigation of urban flood events, handling events and event lessons learnt with the following information: ➢ Urban flood modelling on various scenarios ➢ (Maximum) flood extent ➢ Flood depth ➢ Flood impact on urban infrastructure
Civil protection services and NGOs	Dimension emergency teams and identify priority areas to assist population in emergency, with the following information: ➢ Daily (or more frequent if possible) flood extent mapping and monitoring ➢ Rapid identification of flood affected buildings ➢ Rapid identification of road block / accessibility + other communication network (airport) ➢ Rapid identification of areas potentially suitable for temporary shelters dedicated to affected population ➢ Rapid identification of dike breaches ➢ Rapid identification of areas of spontaneous gathering of population
Insurance industry	Evaluate the cost of a flood event in the few days following the event. Accurately price policies and assess claims related to crop losses. The proposed information layers include: ➢ Rapid delineation of (maximum) flood extent in particular in urban / peri-urban areas ➢ Rapid estimation of flood depth ➢ Rapid assessment of damage grade on flood affected buildings (and urban infrastructure in general) ➢ Rapid assessment of economic impact of the flood
Communication and power network managers	Identify in emergency the areas with (potentially) affected network. Improve infrastructure development and maintenance planning to mitigate water shortages. The proposed information layers include: • Daily flood extent mapping and monitoring ➢ Rapid identification of communication network affected
Agriculture sector	Assess flood risk for specific agricultural regions. Make informed decisions about crop selection, irrigation strategies, and disaster management planning in agriculture. Develop

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	contingency plans for potential flood, climatic or meteorological events. The proposed information layers include: ➢ Maximum flood extent ➢ Flood depth ➢ Biophysical parameters (NDVI, LAI, FAPAR, FCOVER) ➢ Daily drought indicator, monitoring, forecasting ➢ Daily moisture indicator, monitoring, forecasting ➢ Daily precipitation, monitoring, forecasting Daily temperature, monitoring, forecasting
Real estate and construction industry	Make informed decisions about site selection for a project. Avoid flood-prone areas, thus reducing future risks and liabilities. The proposed information layers include: ➢ Maximum flood extent ➢ Flood depth Impact of past events on infrastructures
Environmental and climate research institutions	Analyse the changing patterns of flood risks due to climate change and urbanization. Study the impacts of climate change on water availability and food production. Develop more resilient agricultural practices and improved water conservation measures. The proposed information layers include: All of the above, depending on the topic
Water and water basin managers	Identify means to diminish and manage flood peaks and flood waters

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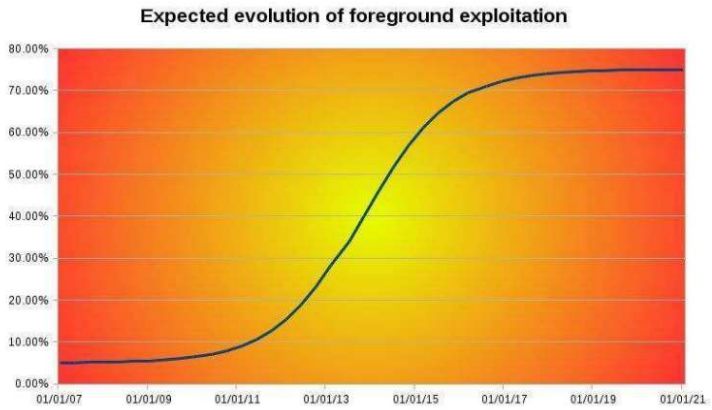
7 ANNEX 1: ADDITIONAL CONTENT

7.1 EXPLOITATION

The challenge that the European Commission is facing is like the one any government or publicly funded organisations are facing. Citizens are increasingly requesting value for money. They need to be convinced that the public money is well invested, that the return on the investment (RoI) is effective. Actions should be taken to encourage partners for exploitation and commercialization. EC wants to be sure that the selected results are brought to the next stage. That exploitation plans are not just a deliverable but a business plan dealing with real activities where partners commit themselves to implement the solutions, having identified resources and first operative steps. They do not want just a list of posters presented or few researches trained. This is the overall idea, - then from providing a list of deliverables and providing a business plan, there are a lot of different paths that could be followed. The European Commission's expectations are - from an average of 5% of the results being exploited by the end of FP6, to a rapid growth during H2020. The figure below shows that 80% is the target. In H2020 exploitation and commercialization will have to play an important role.



(from ESS Preliminary Report [6])

7.2 DEFINITIONS

- Exploitation means the utilisation of results in further research activities other than those covered by the action concerned, or in developing, creating and marketing a product or process, or in creating and providing a service, or in standardisation activities.
- Dissemination means the public disclosure of the results by any appropriate means (other than resulting from protecting or exploiting the results), including by scientific publications in any medium.
- Commercialisation is the process of turning products and services into a commercially viable value. Concerning Intellectual Property (IP), this term can be more specifically defined as the process of bringing IP to the market in view of future profits and business growth.

[6] Exploitation Strategy Seminar Preliminary Report For «COPERNICUS ENHANCED TOOLS FOR ANTICIPATIVE RESPONSE TO CLIMATE CHANGE IN THE EMERGENCY AND SECURITY DOMAIN», Project ID Number 101082720, Horizon Results Booster © copyright, all rights reserved.

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- Use is usually defined as the direct or indirect utilisation of the results in further research activities other than those covered by the project, or for developing, creating, and marketing a product or process, or for creating and providing a service.
- Direct use implies that partners utilise the results themselves for commercial applications (e.g. by producing and/or commercialising a new product or by integrating a new process into their manufacturing plant) and/or for further research ("further" with respect to the scope of the project in which the foreground is generated).
- Indirect use implies that partners may allow third parties to exploit the research results through a specific agreement.
- Results: Any tangible or intangible output of the action, such as device, data, knowledge and information whatever their form or nature, whether they can be protected.
- Communication is the promotion of the project and its results to a multitude audience (including the media and the public/society) in a strategic and effective manner.

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