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D4.1 - CENTAUR Demonstration Plan v1 (cold case)

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HISTORY OF CHANGES

Date	Version	Author	Change Description
13/11/2023	0.1	UNISTRA	Initial version with ToC
29/02/2024	1.0	ADE, CLS, ECM, EG, GMV, HEN, ITH, SAT, TRA, UNISTRA, VIT	First version of the document

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1 EXECUTIVE SUMMARY

The present document corresponds to deliverable *D4.1 – CENTAUR Demonstration Plan v1 (cold case)* of the CENTAUR project. It falls under Work Package *WP4 – Climate change crisis and natural disaster demonstrators*, under Task *T4.1 – Demo design, performance identification and validation criteria/EMS Urban Flood* and Task *T4.2 - Demo design, performance identification and validation criteria/SEA Water & Food security*.

Herein, the document describes:

- Cold case objectives.
- Cold case cycles.
- Cold case scenarios.
- Validation criteria for cold cases.
- Questionnaires for users and service providers.

The information provided in this document will be the **basis for all the demonstrators in the cold case phase**, where the CENTAUR system will be tested in a controlled environment against well-known past events, and for which reference and crisis data has been collected.

The goal of this document is to prepare the cold case phase, that will span months 16 to 21 of the project. Thus, it is the basis for *T4.3 – Demo execution* and *T4.4 – Demo assessment*. Finally, D4.1 will further be built upon with the release of *D4.3 - CENTAUR demonstration operational report and validation result - cold cases*, focusing on the analysis of results from the cold case phase, and providing insight into how to improve the system prior to the hot case phase, that will span months 22 to 33.

2 INTRODUCTION

2.1 SCOPE OF THE DOCUMENT

This document is produced under *WP4 – Climate Change Crisis and Natural Disaster Demonstrators*. The work package aims at **testing the CENTAUR system on real-life scenarios**. Its goal is to initiate the work on demonstrating the strengths of indicators, indexes and other services provided through the project. To assess CENTAUR's potential, the demonstrations are set to occur following a **dual-phase scheme** (Figure 1).

The first phase will span months 16 to 21 of the project. CENTAUR will be deployed on **cold cases**, describing well-known past or ongoing Copernicus CEMS and SEA crisis events. Each Copernicus service has its own track within the project:

- Urban Floods (UF) for Copernicus CEMS [RD01].
- Water & Food Security (WFS) for Copernicus SEA [RD02].

The second phase will span months 22 to 33 of the project. During this period, the system will be tested in real-time on **hot cases**. They correspond to extreme events that are likely to unfold during the lifetime of the project.

This document describes the activities of T4.1 and T4.2, in which the **demonstrator scenarios have been designed**, as well as **performance** and **validation criteria**. Both tasks aim at highlighting the effects of climate change on urban flooding and food & water security, respectively. More specifically, this deliverable, as well as T4.1 and T4.2, target the cold phase, that spans months 16 to 21 of the project. The hot phase, lasting from month 22 to month 33, will directly leverage the findings drawn from cold cases, while its organization will be the focus of *D4.2 – CENTAUR demonstration plan v2 (hot case)*.

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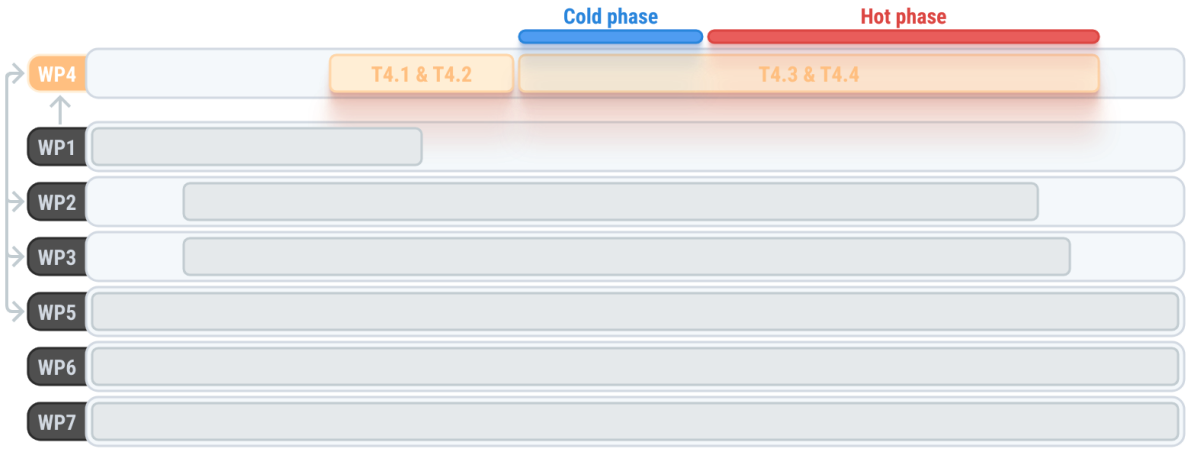
Figure 1: Structure of WP4 and its relationship to other work packages.



To cover the above objectives, the document has been structured into the following chapters:

- Chapter 1: Executive summary.
- Chapter 2: Introduction, including scope of the document, definitions, abbreviations, acronyms, and reference documents.
- Chapter 3: Cold case demonstrator design.
- Chapter 4: Demonstrator assessment.
- Chapter 5: Conclusions.

WP4 draws from other **past or ongoing work packages**. Indeed, D4.1 is the continuation of *D1.2 - Report on CENTAUR Use Cases and Indexes definition* [RD03], which provides a comprehensive description of the selected use cases. Moreover, cold case demonstrators will provide actionable hindsight, resulting in **iterative improvements of the methodologies** developed within the project, *WP2 – Thematic Product Engineering* in particular. This is likely to have consequences on input and output data, described in *D2.1 – Catalogue of CENTAUR data and related specifications* [RD04]. The output data in question will be part of the crisis packages delivered to end-users during demonstrators. Several deliverables, some already available, describe their design and corresponding workflows, including *D2.2 – Urban Flood and Water & Food Security design* [RD05] and *D2.3 – Urban Flood and Water & Food Security service pipelines v1 (baseline set up)* [RD06]. Finally, demonstrators will also integrate into the CENTAUR platform, developed as part of *WP3 – Service deployment*.

Thus, WP4 not only depends on indicator production status, but also on the platform development plan and implementation of features. In this context, it is important to highlight that **there could be delays in other work packages, resulting in delayed demonstrators as well**.

2.2 Definition, Abbreviations and Acronyms

Acronym	Description
AEMET	Spanish Meteorological Agency
AOI	Area Of Interest
ARPA	Regional Agency for the Protection of the Environment

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Acronym	Description
CCR	French Public Reinsurance Company
CEMS	Copernicus Emergency Mapping Service
CENTAUR	Copernicus ENhanced Tools for Anticipative response to climate change in the emergency and secURity domain
CHE	Ebro Hydrographic Confederation
CNIG	Spanish National Geographic Information Centre
DSM	Digital Surface Model
DTM	Digital Terrain Model
DWD	Deutscher Wetterdienst
EM	Event-driven Monitoring
EO	Earth Observation
EPRI	Evaluation Préliminaire des Risques d'Inondation
EU	European Union
EW	Early Warning
GPS	Global Positioning System
GT	Ground Truth
HR	High Resolution
ID	Indicator
IDP	Internally Displaced Persons
INE	Spanish National Statistics Institute
InSAR	Interferometric SAR
IRPI-CNR	Istituto di Ricerca per la Protezione Idrogeologica
IX	Index in the context of Urban Floods High-level service in the context of Water & Food Security
KPI	Key Performance Indicator
LiDAR	Light Detection And Ranging
MASE	Italian Ministry of the Environment and Energy Security
PNOA	Spanish National Aerial Orthophotography Plan
PSA	Product and Service Assessment

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Acronym	Description
RD	Reference Document
RM	Rapid Mapping
SAR	Synthetic Aperture Radar
SatCen	European Union Satellite Centre
SEA	Copernicus Service in Support to EU External Action
SIGEA	Italian Society of Environmental Geology
SNCZI	Spanish National Flood Zone Mapping System
TRI	Territoire à Risque important d'Inondation
UF	Urban Floods
UNSOS	United Nations Support Office in Somalia
UTC	Coordinated Universal Time
VHR	Very High Resolution
WFS	Water & Food Security
WP	Work Package

2.3 APPLICABLE AND REFERENCE DOCUMENTS

Table 1: Applicable and reference documents.

ID	Document name
[RD01]	Copernicus Emergency Management Service – Rapid Mapping and Risk & Recovery: https://emergency.copernicus.eu/
[RD02]	Copernicus Service in Support to EU External Action: https://sea.security.copernicus.eu/
[RD03]	D1.2 - Report on CENTAUR Use Cases and Indexes definition
[RD04]	D2.1 – Catalogue of CENTAUR data and related specifications
[RD05]	D2.2 – Urban flood and Water & Food Security Design
[RD06]	D2.3 – Urban Flood and Water & Food Security service pipelines v1 (baseline set up)
[RD07]	D1.1 – Report on Urban Flood and Water & Food security indicators
[RD08]	D6.1 – Communication Strategy and Action Plan
[RD09]	CENTAUR Project Proposal

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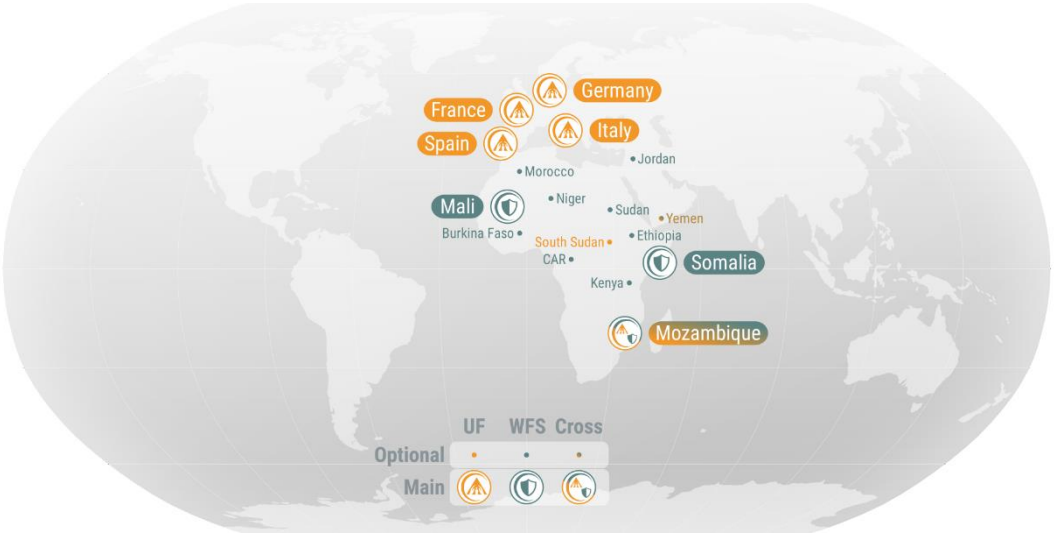
3 COLD CASE DEMONSTRATORS DESIGN

The **selection of cold case demonstrators** in the CENTAUR project was based on comprehensive analyses detailed in WP1, and documented in D1.2 especially. The project targets the application of its tools across eight official use cases in Spain, Italy, Germany, France, Somalia, Mali, and Mozambique, the latter being a cross-cutting demonstrator counting as two use cases (Figure 2). They were designed to answer several challenges in the **monitoring of urban floods**, **water & food security**, or **both**.

Figure 2: Selection of use cases assessed in CENTAUR. The cold case demonstration focuses on the main use cases specifically. However, this is susceptible to change during the hot case demonstration, depending on ongoing crises.



These use cases, defined in the project proposal, were chosen through an extensive **evaluation of geographical areas prone to extreme weather events**, and well documented in **Copernicus CEMS and SEA archives**.

The selection of UF use cases largely depended on flood frequency, variety in topographic position and existing contact with local authorities. Regarding the WFS track, countries located in the Sahel and Horn of Africa regions are recognized as part of the most vulnerable to climate change and its consequences on security[1], which explains the selection of Mali and Somalia. Mozambique, which covers both services due to flood exposure and climate security risks, was identified as the third African country. The proposal of additional optional use cases followed the project's debut, to ensure robustness and fallback solutions in case of lack of data or user engagement.

Despite these provisions, the initial use cases were retained due to successful data collection and confirmation of end-user interest through User Requirement Questionnaires. The Advisory Board meeting, that took place in June 2023, further validated this approach and selection.

A review of D1.2 is recommended for an in-depth understanding of each use case, including their selection criteria and significance to the CENTAUR project.

[1] Yohe, G. W., Malone, E., Brenkert, A., Schlesinger, M., Meij, H., & Xing, X. (2006). Global distributions of vulnerability to climate change. Integrated Assessment Journal, 6(3).

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3.1 DEMONSTRATORS OBJECTIVES

The cold case demonstrators were designed to highlight the **potential of CENTAUR to support the evolution of Copernicus' CEMS and SEA portfolios** with reliable and robust indicators and services. They aim to demonstrate the contribution of CENTAUR to advancing technological solutions, addressing key socio-economic and ecological challenges, and guide stakeholders and policymakers to make well-informed decisions regarding urban flood and water & food security management.

The purpose of the **cold cases** is to test the **delivery of the product and service prototypes** set up in WP1, 2 and 3 with a relatively relaxed timetable and in an iterative way. Moreover, integration of initial end-user feedback will translate into adjustments prior to the hot cases. In contrast, the **hot cases** are designed to **test the operational readiness of products and services**, by delivering them on a tighter schedule, in line with end-users operational needs. Thus, the hot case phase will see the generation of pre-operational products and services, which can be integrated into existing Copernicus services, especially as part of *WP5 – Analysis of the integration in the operational set up of Copernicus EMS and SEA, impact and further exploitation*.

3.1.1 Technological innovation

Considering the current gaps in CEMS and SEA's portfolios, a primary goal is being able to identify opportunities for **technological integration** of new components based on remote sensing, data analytics, and predictive modelling, to address challenges related to climate change and security. As the role of Copernicus services is to deliver products aimed at civil security and emergency preparedness services, cold cases are designed to illustrate the system's **operational efficacy** in real-world scenarios, by providing reliable information and actionable insights.

A range of demonstrators was considered to demonstrate the system's **scalability and adaptability** across different urban settings and climatic, geographical, and socio-economic contexts. Indeed, not only EU Member States, but also several countries around the world, solicit Copernicus CEMS and SEA. This results in different spatial configurations and user needs, requiring flexible solutions to provide homogeneous and pertinent information across various use cases.

Finally, due to the previous points, technical leaps were necessary to achieve actionable results. Thus, the cold case selection and demonstration cycles were established to highlight CENTAUR's **innovations**, contributing to the knowledge base on climate adaptation and resilience strategies. Thus, the demonstrators were designed to assess the validity and reliability of potential new components for Copernicus CEMS and SEA portfolios, leveraging end-user and service provider feedback.

3.1.2 Socio-economic and environmental impact

Recent assessments underline the impacts and risks associated with climate change. Even though projections are uncertain, they reflect sizable consequences on wellbeing, migration and conflict, through more extreme weather events and other disruptions[2,3]. Thus, there is an increasing need for **evaluating the socio-economic and environmental impacts** of hazardous events. CENTAUR aims to address this need and provide reliable indicators and services to assess and predict such impacts. Testing during CENTAUR's cold and hot demonstrator phases will ensure the robustness of these products.

[2] Dr Malin Mobjörk, Dr Florian Krampe and Kheira Tarif, 2020, 'Pathways of Climate Insecurity: Guidance for Policymakers', SIPRI. https://www.sipri.org/publications/2020/sipri-policy-briefs/pathways-climate-insecurity-guidance-policymakers
[3] https://berlin-climate-security-conference.de/en/10-insights-climate-impacts-peace

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3.1.3 Stakeholder engagement and policy support

Even though the main goal of CENTAUR is not to provide guidelines on how to enhance resilience to climate change, it is expected that indicators and indexes delivered to stakeholders will help them make informed decisions about crisis prevention and response, as well as more long-term adaptation planning.

To that end, demonstrators were designed to illustrate the process of **engaging with government bodies and stakeholders**, to incorporate local knowledge into the system's workflow. This includes input data shared by the end-users to derive actionable information, as well as their support for validating results.

Moreover, the goal is to start **fostering capacity building** among authorities and stakeholders through **knowledge transfer** and training sessions, ensuring they can effectively leverage products delivered through CENTAUR for ongoing resilience and risk management. This goal is tightly related to *WP5 - Analysis of the integration in the operational set up of Copernicus EMS and SEA, impact and further exploitation* and will likely be explored in the hot case phase of WP4 as well.

3.2 DEMONSTRATOR CYCLES

To ensure continuous improvement and scalability of the CENTAUR system, demonstrator cycles were designed to provide a structured approach to implementing, assessing, and refining indicators, indexes, and services. Each phase builds upon the previous, allowing for iterative development, based on real-world testing and end-user feedback.

3.2.1 Structure of the demonstrator cycle

The **demonstrator cycle** can be broken down into **phases that include preparation, execution and evaluation**, with specific emphasis on running cases, assessing runs, and deriving recommendations for further improving services. Moreover, cold case demonstrators are also part of an iterative process that will help to improve the CENTAUR system through several feedback loops, spanning both *WP2 – Thematic product engineering* and *WP4 – Climate change and natural disaster demonstrators*.

The **first phase** of the cold case demonstration corresponds to **preparation and planning**. For each demonstrator, specifications for the delivery package are identified according to contextual information and end-user needs. The roles and responsibilities of each service provider are clearly defined, for data collection, computation of high-level information and quality control. This phase ends with the generation of the composite indexes. It is important to note that indicators, indexes and other services will be refined all throughout WP4, following an iterative process. Thus, the first versions of this information are likely to provide a rough estimate of what the final products will be, and will see drastic improvements by the end of the project, in relation to WP2.

The **second phase** corresponds to the **execution of cold cases**. Its design sequences the delivery of indicators, indexes and other high-level services, to align with an actual event timeline. All these products were generated prior to demonstrator execution, to properly space out delivery, ensuring that service providers can efficiently process input data on all use cases. This strategy was tailored to the context of cold case demonstrators specifically, and anticipates adjustments for hot case demonstrations, where real-time data computation will be included in the execution phase. In addition to delivery, a notification system is intended to let end-users know about the availability of crisis information.

The solicitation of end-users and service providers to answer questionnaires marks the end of the execution phase and spearheads the evaluation of the products and service. Demonstration stakeholders are requested to answer a series of questions focusing on data quality, applicability and the system's overall value in enhancing climate monitoring and risk management efforts.

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The demonstrator cycle concludes with a **third phase**, corresponding to the **evaluation of the products and service** against CENTAUR's KPIs and a robust validation framework. The purpose is to evaluate the end-user satisfaction with the results of the cold case and accurately measure the reliability of the indicators and indexes provided. This phase puts a strong focus on understanding the user's experience during the demonstration, their opinion on the information delivered, their interaction with the platform, and their feedback on the usefulness of CENTAUR products. It includes the implementation of the CENTAUR validation protocol (Section 4.1) on products delivered during the cold case demonstration. This analysis of system accuracy, reliability, and operational efficiency incorporates feedback to pinpoint improvements. The insights gained from this phase will offer a detailed assessment of the system's impact and identifying avenues for further enhancement, concluding the demonstrator cycle for cold cases.

3.2.2 Demonstrator time plan

A **standard scenario** was developed to ensure **uniformity** across cold cases. It was designed with **flexibility** at its core, enabling adaptation to unforeseen developments that may emerge during the both the cold and hot phases.

In alignment with the demonstrator cycle structure outlined in subsection 3.2.1, the time plan integrates three main **phases**: preparation, execution, and evaluation. Furthermore, the necessity of integrating the risk phases delineated in document D1.2 is considered as well, reflecting CENTAUR's dual-mode monitoring approach. Initially, the system performs a continuous, global-level monitoring as part of the **Early Warning** (EW) phase. This shifts to an **Event-Driven** (EM) monitoring mode once predefined thresholds are reached in a specific region, with the focus branching out to an AOI. The risk phases culminate with a comprehensive **Product and Service Assessment** (PSA), ensuring that the production outcomes meet the usual Copernicus CEMS and SEA quality standards (Figure 3).

Figure 3: Simplified view of a demonstrator cycle.

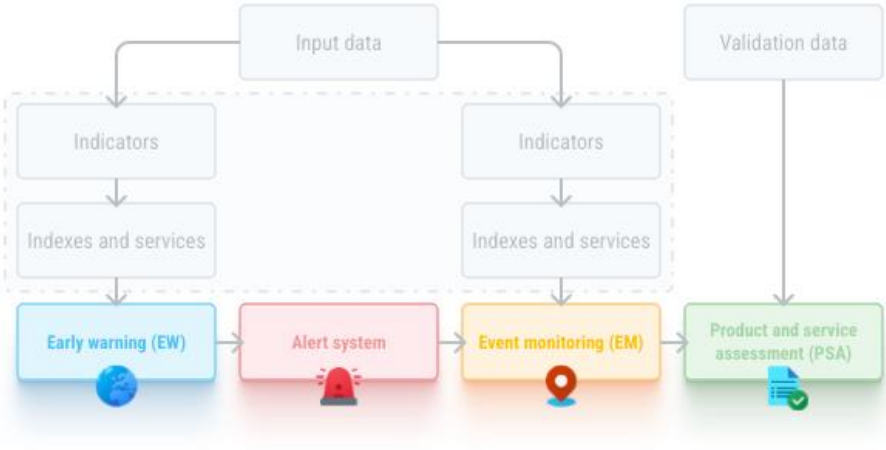

Table 2 provides a generic view of the proposed time plan, with regard to these considerations.

Table 2: Sample scenario structure for cold case scenarios. This structure applies to all three phases of the demonstrator cycle, including preparation, execution and evaluation.

Step	Risk phase	Project period	Delivery date	Description	Roles and responsibilities
1	EW	M7-M12	T0	Example of step related to the early warning monitoring	Partner 1
2	EM	M16-M18	M18	Example of step related to the event-driven monitoring	Partner 2: Subtask 1 Partner 3: Subtask 2
3	PSA	M18-M21	M18-M21	Example of step related to the product and service assessment phase	Partner 1

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All the data used at each of these steps were collected during the preparation of the cold cases and are extensively described in D2.1. However, previously unplanned data will be leveraged in WP4 for validation, and will receive a short description in the following use case subsections.

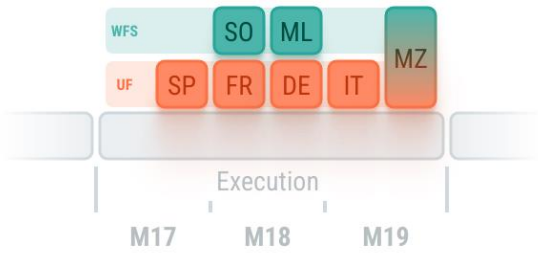
Each step within this scenario relates to a specific **project period**, providing an estimated timeline for when these activities are expected to unfold. Moreover, **delivery dates** indicate the completion target for specific tasks or product deliverables. The provision of periods and dates follows one of 3 nomenclatures:

- T_n: Series of ordered steps for which production and delivery dates are sequenced, so stakeholders know when to expect a specific product as compared to another. This nomenclature applies exclusively to indicators, indexes and services, to ensure a timely provision of end-results.
- M_{XX}: Project month in which production or delivery will unfold.
- M_{XX}-M_{YY}: Range of project months, in which production or delivery will unfold. This nomenclature applies to lengthy processes or steps with uncertainties regarding data provision or stakeholder engagement for example.

Each step identifies **key stakeholders**, playing critical roles in production, validation, delivery, notification and feedback provision. This structured approach not only enhances project management efficiency, but also ensures stakeholder engagement and accountability throughout the project lifecycle.

Finally, through several **quality checks and validation stages**, this standard scenario incorporates a mechanism for **continuous feedback and iterative refinement**. During this process, service providers will solicit end-users to collect feedback on their respective use case. This will possibly result in improvements to the system, in relation to other work packages, especially WP2 and WP3, to guarantee better results in the hot case phase. The process ensures that all the scenarios remain responsive to real-world complexities, by allowing the service providers to fine-tune their pipelines and workflows.

Figure 4: Simplified view of the execution phase for cold case scenarios. Each box corresponds to a scenario, indicated by its country code. The cross-cutting case in Mozambique is shared by both the UF and WFS tracks.



The CENTAUR cold case scenarios are described in subsections 3.3, 3.4 and 3.5, focusing on the UF, WFS and cross-cutting use cases respectively. Scenarios are split into in 3 tables each – preparation, execution and evaluation –, which depict the successive steps planned for closing a demonstration. The entire demonstration package for the cold case scenarios will span months 7 to 21, including steps that service providers already performed in WP1. However, the actual execution period will only last from month 17 to 19 (Figure 4), leaving 2 full months dedicated to the evaluation of demonstrators alone.

3.3 URBAN FLOOD DEMONSTRATOR SCENARIOS

In the context of UF scenarios, it is important to indicate that they all refer to **past Copernicus CEMS activations**. Indeed, CEMS' Rapid Mapping (RM) service delivered several crisis information layers on these use cases, leveraged extensively either as input or validation data.

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Table 3 shows the mapping between use cases and CEMS activations. Further details are available in D1.2.

Table 3: Mapping between use cases and CEMS RM activations.

Use case	AOI	CEMS activation
Spain	Zaragoza, Ebro basin	EMSR555 https://emergency.copernicus.eu/mapping/list-of-components/EMSR555
Italy	Turin Centre – Meisino	EMSR192 https://emergency.copernicus.eu/mapping/list-of-components/EMSR192
Italy	Ceva Centre	EMSR468 https://emergency.copernicus.eu/mapping/list-of-components/EMSR468
Germany	Bad Neuenahr-Ahrweiler	EMSR517 https://emergency.copernicus.eu/mapping/list-of-components/EMSR517
France	Dax, Landes	EMSR492 https://emergency.copernicus.eu/mapping/list-of-components/EMSR492
Mozambique	Beira	EMSR348 https://emergency.copernicus.eu/mapping/list-of-components/EMSR348

3.3.1 Spanish scenario (Ebro basin)

This scenario is subject to change, given potential delays in one or more steps.

The Spanish scenario focuses on the flood event that transpired in the Ebro River basin in April 2018, triggered by a combination of heavy rainfall and snowmelt from the Pyrenees. The initial impacts were recorded in Castejón, Navarra, with the flood peak anticipated in Zaragoza on April 15, 2018, at approximately 12:00 UTC. Given the abundance of available data and established relationships with local authorities, the focus for the Ebro basin scenario is placed on Zaragoza.

Table 4 describes all the preparation steps needed to perform the demonstration on the Spanish use case. Data collection spans months 7 to 12. Generation of indicators and indexes spans months 12 to 18. Finally, the preliminary work for validation and assessment spans months 16 to 18.

The availability of open national datasets enables a comprehensive description of the Ebro Basin cold case. The Spanish National Geographic Information Centre (CNIG), the Ebro Hydrographic Confederation (CHE), and the Spanish Meteorological Agency (AEMET) provide crucial information, which help in calculating a sizeable portion of the designed UF indicators and index.

Table 4: Preparation phase for the Spanish scenario (Ebro basin).

Step	Risk phase	Project period	Delivery date	Description	Roles and responsibilities
1	EW	M7-M12	M7-M12	Collection of meteorological observations of April 2018 over the AOI	ECWMF
2	EW	M7-M12	M7-M12	Collection of meteorological forecasts over the AOI	ECWMF
3	EW	M7-M12	M7-M12	Collection and preparation of EO-based and ancillary data (elevation, hydrography and hydrology, LULC, topographic layers, VHR pre-event imagery, flood footprint for April 2018)	Tracasa

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Step	Risk phase	Project period	Delivery date	Description	Roles and responsibilities
4	EM	M7-M12	M7-M12	Collection and preparation of additional EO-based and ancillary data (built-up 2D and 3D, population, InSAR compatible imagery, including an April 2018 post-event image)	DLR: Built-up and population UNISTRA-SERTIT: InSAR data
5	EM	M7-M12	M7-M12	Collection and integration of media information related to the flooding event from 15/04/2018 to 16/04/2018	Hensoldt
6	EM	M7-M12	M7-M12	Collection and integration of media information related to economic impact of floods in April 2018	Hensoldt
7	EW	M12-M18	M13	Generation of UF-ID-1 "Historical 6 hours return period static precipitation maps"	ECWMF: Production e-GEOS: Quality control
8	EW	M12-M18	M16	Generation of UF-ID-2 "ML data driven forecast of return period-based precipitation events in urban areas"	ECWMF: Production e-GEOS: Quality control
9	EW	M12-M18	M13	Generation of UF-ID-3 "Urban inundation probability maps and water depth defined by return period at a spatial resolution in the order of < 10 m"	e-GEOS: Production ECWMF: Quality control
10	EM	M12-M18	M13	Generation of UF-ID-4 "Inferred InSAR urban flood extent"	UNISTRA-SERTIT: Production e-GEOS: Quality control
11	EM	M12-M18	M15	Generation of UF-ID-5 "Urban flooding map based on geomorphological and InSAR approach for an enhanced damage" - Flood extent - Damage assessment on transportation and buildings - Damage assessment on facilities	e-GEOS: Flood extent, damage assessment (transportation, buildings), production UNISTRA-SERTIT: Damage assessment (facilities) e-GEOS, UNISTRA-SERTIT: Quality control
12	EM	M12-M18	M13	Generation of UF-ID-6 "Social and traditional media indicators for urban flooding maps"	e-GEOS: Initialisation (flood extent inputs) Hensoldt: Production
13	EM	M12-M18	M14	Generation of UF-ID-7 "Hazard web sources indicator"	e-GEOS: Production Adelphi: Quality control
14	EM	M12-M18	M18	Generation of UF-ID-14 "Economic impact of floods"	e-GEOS: Initialisation, quality control Hensoldt: Production
15	PSA	M12-M18	M15	Preparation of end-user and service provider questionnaires	CLS, Tracasa: Preparation UNISTRA-SERTIT, Tracasa: Quality control
16	EW	M12-M18	M17	Generation of “Early Warning Forecast Index”	ECWMF: Production e-GEOS: Quality control
17	EM	M12-M18	M18	Generation of “Flood Impact Index”	e-GEOS: Production GMV: Quality control
18	PSA	M12-M18	M16-M18	Preliminary assessment of indicators, indexes, services and platform functionality	Tracasa

Table 5 describes all the execution steps that pertain to the demonstration on the Spanish use case. They will span months 17 to 18 of the project, alternating between upload of products and availability notification to end-users. Finally, once the demonstration is completed in month 18, Spanish end-users – **Dirección General de Protección Civil y Emergencias**, **Red de Información Ambiental de Andalucía** – will be invited to provide feedback on their experience with the CENTAUR products.

Table 5: Execution phase for the Spanish scenario (Ebro basin).

Step	Risk phase	Project period	Delivery date	Description	Roles and responsibilities
19	EW	M17	T-3	Upload of UF-ID-1 product	ECWMF: Upload GMV: Delivery check

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Step	Risk phase	Project period	Delivery date	Description	Roles and responsibilities
20	EW	M17	T-3	Notification of UF-ID-1 product availability to the service providers and the Spanish end-users	ECWMF
21	EW	M17	T-2	Upload of UF-ID-2 product	ECWMF: Upload GMV: Delivery check
22	EW	M17	T-2	Notification of UF-ID-2 product availability to the service providers and the Spanish end-users	ECWMF
23	EW	M17	T-1	Upload of UF-ID-3 product	e-GEOS: Upload GMV: Delivery check
24	EW	M17	T-1	Notification of UF-ID-3 product availability to the service providers and the Spanish end-users	e-GEOS
25	EW	M17	T0	Upload of "EW Forecast Index" product	e-GEOS: Upload GMV: Delivery check
26	EW	M17	T0	Notification of "EW Forecast Index" product availability to the service providers and the Spanish end-users	e-GEOS
27	EW	M17	T0	Alert notification to the service providers and the Spanish end-users	ECWMF: Alert sent to GMV ECWMF: Alert sent to Spanish end-users and service providers
28	EM	M17	T+1	Upload of UF-ID-4 product	UNISTRA-SERTIT: Upload GMV: Delivery check
29	EM	M17	T+1	Notification of UF-ID-4 product availability to the service providers and the Spanish end-users	UNISTRA-SERTIT
30	EM	M17	T+2	Upload of UF-ID-5 product	e-GEOS: Upload GMV: Delivery check
31	EM	M17	T+2	Notification of UF-ID-5 product availability to the service providers and the Spanish end-users	e-GEOS
32	EM	M17	T+3	Upload of UF-ID-6 product	Hensoldt: Upload GMV: Delivery check
33	EM	M17	T+3	Notification of UF-ID-6 product availability to the service providers and the Spanish end-users	Hensoldt
34	EM	M17	T+4	Upload of UF-ID-7 product	e-GEOS: Upload GMV: Delivery check
35	EM	M17	T+4	Notification of UF-ID-7 product availability to the service providers and the Spanish end-users	e-GEOS
36	EM	M18	M18	Upload of UF-ID-14 product	Hensoldt: Upload GMV: Delivery check
37	EM	M18	M18	Notification of UF-ID-14 product availability to the service providers and the Spanish end-users	Hensoldt
38	EM	M18	M18	Upload of "Flood Impact Index" product	e-GEOS: Upload GMV: Delivery check
39	EM	M18	M18	Notification of "Flood Impact Index" product availability to the service providers and the Spanish end-users	e-GEOS
40	PSA	M18	M18	Solicitation of Spanish end-users and service providers to fill in the questionnaires	Tracasa

Table 6 describes all the steps for a thorough evaluation of products and services for to the demonstration on the Spanish use case. Starting in month 16 of the project, the expected delivery dates span months 18 to 21. Additional datasets, absent in previous deliverables, will support validation efforts. A preliminary selection includes:

- **Optical images** acquired during the flood event (SPOT-7 acquired on 14/04/2018 10:33 UTC and SkySat acquired on 14/04/2018 10:51 UTC), both partially covering the AOI.
- A **time series of pluviometry data**, ranging 30 years over 7 stations within the Ebro basin. They are provided by AEMET.

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- **Oblique aerial mages** acquired by CHE in manned flights carried out on April 14 -17, 2018. Sections cover the Ebro axis between Rincón de Soto (La Rioja) and La Zaida (Zaragoza).
- **Flood mask** provided by CHE. This data represents the estimated flood surface from mosaics generated from oblique and vertical aerial photographs, collected during manned flights on April 14 -17. Sections cover the Ebro axis between Rincón de Soto (La Rioja) and La Zaida (Zaragoza). Information provided by the ortophographs from the Spanish National Aerial Orthophotography Plan (*Plan Nacional de Ortofotografía Aérea*, PNOA) was digitized through cartographic restitution.
- **Flood risk and hazard masks** of the Spanish National Flood Zone Mapping System (*Sistema Nacional de Cartografía de Zonas Inundables*, SNCZI) for different return periods.
- **In-situ river gauges**, describing river levels over multiple stations in the AOI. CHE conducted the collection of April 2018 observations.
- **Very High Resolution DTM**, provided by the Spanish Ministry for Ecological Transition. It contains artefacts in the Zaragoza city area, which could render it unusable.
- **Household income distribution atlas** (*Atlas de distribución de renta de los hogares*) provided by the Spanish National Statistics Institute (*Instituto Nacional de Estadística*, INE).
- **Institutional documents** published by the Government Delegation in Zaragoza provide important information about damages produced by the event.

Table 6: Evaluation phase for the Spanish scenario (Ebro basin).

Step	Risk phase	Project period	Delivery date	Description	Roles and responsibilities
41	PSA	M16-M21	M18-M21	Finalisation of feedback through questionnaires	Spanish end-users and service providers
42	PSA	M16-M21	M18-M21	Notification of completed questionnaire reception	Tracasa to UNISTRA-SERTIT
43	PSA	M16-M21	M18-M21	Download of feedback questionnaires from end-users and service providers	UNISTRA-SERTIT
44	PSA	M16-M21	M18-M21	Product and service validation	Tracasa
45	PSA	M16-M21	M18-M21	Data analysis, conclusion and inventory of recommendations and actions to be implemented in short and medium terms	Tracasa: Validation UNISTRA-SERTIT: Questionnaire analysis e-GEOS: Review
46	PSA	M16-M21	M18-M21	Dissemination of results, lessons learnt, recommendations	UNISTRA-SERTIT and Tracasa

3.3.2 Italian scenario (Piedmont region)

This scenario is subject to change, given potential delays in one or more steps.

Italian urban flood use cases focus on the Piedmont Region, specifically the Turin Centre - Meisino area along the Po River, and the Ceva area along the Tanaro River. The urban flood demonstration scenarios are provided in their respective parts below.

Turin Centre – Meisino

Between November 21st and 25th, 2016, the Piedmont Region was struck by a flood resulting from prolonged and intense rainfall. The most substantial rainfall was recorded on November 24th, leading to marked rises in water levels across Piedmont's river systems for the duration of the event. The focus of this use case is the area where the Po River meets the Stura di Lanzo stream and the Meisino Park area, both of which experienced significant flooding, as reported by the Regional Agency for the Protection of the Environment[4]. Notably, the Meisino Park

[4] "Il Clima in Piemonte, Novembre 2018" – https://www.arpa.piemonte.it/rischinaturali/tematismi/clima/rapporti-di-analisi/eventi_pdf/2018/Novembre2018.pdf

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area suffered flooding due to the Po River's overflow, reminiscent of another flood event that occurred in October 2000.

Table 7 describes all the preparation steps needed to perform the demonstration on the Italian use case for Turin Centre – Meisino. Data collection spans months 7 to 12 of the project. Generation of indicators and indexes spans months 12 to 18. Finally, the preliminary work for validation and assessment spans months 16 to 18. Unique to this phase, steps 5 and 6 entail the creation of a LiDAR-based, very high-resolution Digital Surface Model (DSM) and Digital Terrain Model (DTM). Ithaca plans to conclude these steps in months 12 and 18, respectively, accommodating the processing requirements and potential delays in the provision of input data.

The comprehensive analysis of the Piedmont cold case is facilitated by the availability of regional and municipal geospatial datasets. Notable sources such as the ARPA Piemonte, The Piedmont Regional Geoportal, and the Geoportal of Turin provide invaluable information. These resources play a significant role in computing a considerable portion of the UF indicators and indexes planned for this case.

Table 7: Preparation phase for the Italian scenario in Turin Centre - Meisino.

Step	Risk phase	Project period	Delivery date	Description	Roles and responsibilities
1	EW	M7-M12	M7-M12	Collection of meteorological observations of November 2016 over the AOI	ECWMF
2	EW	M7-M12	M7-M12	Collection of meteorological forecasts over the AOI	ECWMF
3	EW	M7-M12	M7-M12	Collection and preparation of EO-based and ancillary data (elevation, hydrography and hydrology, LULC, topographic layers, VHR pre-event imagery, flood footprint for November 2016)	ITHACA
4	EM	M7-M12	M7-M12	Collection and preparation of additional EO-based and ancillary data (built-up 2D and 3D, population, InSAR compatible imagery, including a November 2016 post-event image)	ITHACA DLR: Built-up and population UNISTRA-SERTIT: InSAR data
5	EW	M7-M18	M7-M12	Elevation data harvesting: LiDAR-based, VHR DTM generation	ITHACA
6	EW	M7-M18	M16-M18	Elevation data harvesting: LiDAR-based, VHR DSM generation	ITHACA
7	EM	M7-M12	M7-M12	Collection and integration of media information related to the flooding event from 21/11/2016 to 25/11/2016	Hensoldt
8	EM	M7-M12	M7-M12	Collection and integration of media information related to economic impact of floods in November 2016	Hensoldt
9	EW	M12-M18	M13	Generation of UF-ID-1 "Historical 6 hours return period static precipitation maps"	ECWMF: Production e-GEOS: Quality control
10	EW	M12-M18	M16	Generation of UF-ID-2 "ML data driven forecast of return period-based precipitation events in urban areas"	ECWMF: Production e-GEOS: Quality control
11	EW	M12-M18	M13	Generation of UF-ID-3 "Urban inundation probability maps and water depth defined by return period at a spatial resolution in the order of < 10 m"	e-GEOS: Production ECWMF: Quality control
12	EM	M12-M18	M13	Generation of UF-ID-4 "Inferred InSAR urban flood extent"	UNISTRA-SERTIT: Production e-GEOS: Quality control
13	EM	M12-M18	M15	Generation of UF-ID-5 "Urban flooding map based on geomorphological and InSAR approach for an enhanced damage" - Flood extent - Damage assessment on transportation and buildings - Damage assessment on facilities	e-GEOS: Flood extent, damage assessment (transportation, buildings), Production UNISTRA-SERTIT: Damage assessment (facilities) e-GEOS, UNISTRA-SERTIT: Quality control

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Step	Risk phase	Project period	Delivery date	Description	Roles and responsibilities
14	EM	M12-M18	M13	Generation of UF-ID-6 "Social and traditional media indicators for urban flooding maps"	e-GEOS: Initialisation (flood extent inputs) Hensoldt: Production
15	EM	M12-M18	M14	Generation of UF-ID-7 "Hazard web sources indicator"	e-GEOS: Production Adelphi: Quality control
16	EM	M12-M18	M18	Generation of UF-ID-14 "Economic impact of floods"	e-GEOS: Initialisation, quality control Hensoldt: Production
17	PSA	M12-M18	M15	Preparation of end-user and service provider questionnaires	CLS, Tracasa: Preparation UNISTRA-SERTIT, Tracasa: Quality control
18	EW	M12-M18	M17	Generation of “Early Warning Forecast Index”	ECWMF: Production e-GEOS: Quality control
19	EM	M12-M18	M18	Generation of “Flood Impact Index”	e-GEOS: Production GMV: Quality control
20	PSA	M12-M18	M16-M18	Preliminary assessment of indicators, indexes, services and platform functionality	Tracasa

Table 8 describes all the execution steps that pertain to the demonstration on the Italian use case for Turin Centre – Meisino. They will all span month 19, alternating between upload of products and availability notification to end-users. Finally, once the demonstration is completed in month 19, the **Municipality of Turin** will be invited to provide their feedback.

Table 8: Execution phase for the Italian scenario in Turin Centre - Meisino.

Step	Risk phase	Project period	Delivery date	Description	Roles and responsibilities
21	EW	M19	T-3	Upload of UF-ID-1 product	ECWMF: Upload GMV: Delivery check
22	EW	M19	T-3	Notification of UF-ID-1 product availability to the service providers and the Italian end-users	ECWMF
23	EW	M19	T-2	Upload of UF-ID-2 product	ECWMF: Upload GMV: Delivery check
24	EW	M19	T-2	Notification of UF-ID-2 product availability to the service providers and the Italian end-users	ECWMF
25	EW	M19	T-1	Upload of UF-ID-3 product	e-GEOS: Upload GMV: Delivery check
26	EW	M19	T-1	Notification of UF-ID-3 product availability to the service providers and the Italian end-users	e-GEOS
27	EW	M19	T0	Upload of “EW Forecast Index” product	e-GEOS: Upload GMV: Delivery check
28	EW	M19	T0	Notification of “EW Forecast Index” product availability to the service providers and the Italian end-users	e-GEOS
29	EW	M19	T0	Alert notification to the service providers and the Italian end-users	ECWMF: Alert sent to GMV ECWMF: Alert sent to Italian end-users and service providers
30	EM	M19	T+1	Upload of UF-ID-4 product	UNISTRA-SERTIT: Upload GMV: Delivery check
31	EM	M19	T+1	Notification of UF-ID-4 product availability to the service providers and the Italian end-users	UNISTRA-SERTIT
32	EM	M19	T+2	Upload of UF-ID-5 product	e-GEOS: Upload GMV: Delivery check
33	EM	M19	T+2	Notification of UF-ID-5 product availability to the service providers and the Italian end-users	e-GEOS

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Step	Risk phase	Project period	Delivery date	Description	Roles and responsibilities
34	EM	M19	T+3	Upload of UF-ID-6 product	Hensoldt: Upload GMV: Delivery check
35	EM	M19	T+3	Notification of UF-ID-6 product availability to the service providers and the Italian end-users	Hensoldt
36	EM	M19	T+4	Upload of UF-ID-7 product	e-GEOS: Upload GMV: Delivery check
37	EM	M19	T+4	Notification of UF-ID-7 product availability to the service providers and the Italian end-users	e-GEOS
38	EM	M19	T+5	Upload of UF-ID-14 product	Hensoldt: Upload GMV: Delivery check
39	EM	M19	T+5	Notification of UF-ID-14 product availability to the service providers and the Italian end-users	Hensoldt
40	EM	M19	T+6	Upload of "Flood Impact Index" product	e-GEOS: Upload GMV: Delivery check
41	EM	M19	T+6	Notification of "Flood Impact Index" product availability to the service providers and the Italian end-users	e-GEOS
42	PSA	M19	T+6	Solicitation of Italian end-users and service providers to fill in the questionnaires	ITHACA

Table 9 describes all the steps for a thorough evaluation of products and service for to the demonstration on Turin Centre – Meisino. Starting in month 16 of the project, the expected delivery dates span from months 19 to 21. This phase will be supported by additional datasets that may not have been presented in previous deliverables, especially for validation. They include:

- ARPA Piemonte, Regione Piemonte, and CNR IRPI have produced a **database related to the ground effects induced by the rains** of 21-25/11/2016. The data result from surveys conducted during and immediately after the event and from subsequent photo-interpretative analyses.
- *Gli eventi alluvionali in Piemonte - Evento del 21-25 novembre 2016*[5] – **Joint publication** of ARPA Piemonte and Regione Piemonte in November 2018. It describes the **processes and effects caused by the event** through a summary of the survey activities, and provides comparisons with past events or detailed analysis of the areas deemed to be of greatest interest.
- **Additional VHR optical imagery** to assess the consequences of the event (Pleiades-1A 26/11/2016 10:41 UTC).
- **Additional social and traditional media markers**, to help collect more information on damages and possibly water depths.

Table 9: Evaluation phase for the Italian scenario in Turin Centre - Meisino.

Step	Risk phase	Project period	Delivery date	Description	Roles and responsibilities
43	PSA	M16-M21	M19-M21	Finalisation of feedback through questionnaires	Italian end-users and service providers
44	PSA	M16-M21	M19-M21	Notification of completed questionnaire reception	ITHACA to UNISTRA-SERTIT
45	PSA	M16-M21	M19-M21	Download of feedback questionnaires from end-users and service providers	UNISTRA-SERTIT
46	PSA	M16-M21	M19-M21	Product and service validation	Tracasa
47	PSA	M16-M21	M19-M21	Data analysis, conclusion and inventory of recommendations and actions to be implemented in short and medium terms	Tracasa: Validation UNISTRA-SERTIT: Questionnaire analysis e-GEOS: Review

[5] "Gli eventi alluvionali in Piemonte - Evento del 21-25 novembre 2016" – https://www.arpa.Piemonte.it/pubblicazioni-2/gli-eventi-alluvionali-in-Piemonte

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Step	Risk phase	Project period	Delivery date	Description	Roles and responsibilities
48	PSA	M16-M21	M19-M21	Dissemination of results, lessons learnt, recommendations	UNISTRA-SERTIT and ITHACA

Ceva Centre

During the 2nd and 3rd of October 2020, Piedmont was subjected to exceptionally heavy rainfall due to Storm Alex, affecting the entire region but particularly impacting its southern parts, such as the Upper Tanaro area. This event led to swift and considerable rises in water levels in the main Tanaro River and its tributaries. Water levels at gauging stations, including Ponte di Nava and Garessio, broke historical records previously established in 2016. The focus of this use case is the urban centre of the municipality of Ceva, which had previously encountered flooding events in both 1994 and 2016.

The October 2020 event saw all inhabited centres along the Tanaro River, extending up to Ceva, being affected by the flood. Even though there were similarities with previous floods, the intensity was noted to be higher than the one in November 2016. This observation is supported by reports from the Regional Agency for the Protection of the Environment[6] and the Italian Society of Environmental Geology[7].

Table 10 describes all the preparation steps needed to perform the demonstration on the Italian use case for Ceva Centre. Data collection spans months 7 to 18 of the project, with most steps ending in month 12 or prior, apart from the computation and provision of elevation models. Generation of indicators and indexes spans months 12 to 18. Finally, the preliminary work for validation and assessment spans months 16 to 18.

In the context of the CENTAUR project, as documented in D1.2, the provisional DTM leverages LiDAR data sourced from the Italian Ministry of the Environment and Energy Security (MASE) based on a 2009 acquisition. Considering that Ceva was impacted by significant flood events in 2016 and 2020, which may have altered the terrain, a decision was made to undertake a new data acquisition to ensure analyses were conducted with the most current information available.

To address this, an aero-photogrammetric acquisition was executed by Ithaca in February 2024 (M15) exclusively for the CENTAUR project, aimed at generating an updated and definitive DTM. This new DTM, expected to be delivered in March 2024 (M16), will incorporate aero-photogrammetric data, offering very high-resolution features essential for accurate analysis. This update is pivotal for the project's timeline, particularly for the urban flooding indicators that rely on the DTM as a foundational input. Similarly, DSM will be developed using the same aero-photogrammetric data, ensuring both models share comparable high-resolution characteristics and are based on the latest aero-photogrammetric technology. This methodological update underscores the project's commitment to leveraging the most accurate and current data for evaluating flood risks and impacts.

Table 10: Preparation phase for the Italian scenario in Ceva Centre.

Step	Risk phase	Project period	Delivery date	Description	Roles and responsibilities
1	EW	M7-M18	M7-M12	Collection of meteorological observations of October 2020 over the AOI	ECWMF
2	EW	M7-M18	M7-M12	Collection of meteorological forecasts over the AOI	ECWMF
3	EW	M7-M18	M7-M12	Collection and preparation of EO-based and ancillary data (elevation, hydrography and hydrology, LULC, topographic layers, VHR pre-event imagery, flood footprint for October 2020)	ITHACA

[6] " Il Clima in Piemonte, Ottobre 2020" – https://www.arpa.piemonte.it/export//bollettini/relazioni_climatiche_mensili/20201031.pdf
[7] "Geologia dell'ambiente / Società Italiana di Geologia Ambientale, L'EVENTO ALLUVIONALE DEL 2-3 OTTOBRE 2020 IN PIEMONTE, 4/2021," https://www.sigeaweb.it/documenti/gda-supplemento-4-2021.pdf

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Step	Risk phase	Project period	Delivery date	Description	Roles and responsibilities
4	EM	M7-M18	M7-M12	Collection and preparation of additional EO-based and ancillary data (built-up 2D and 3D, population, InSAR compatible imagery, including a October 2020 post-event image)	ITHACA DLR: Built-up and population UNISTRA-SERTIT: InSAR data
5	EW	M7-M18	M7-M12	Elevation data harvesting: provisional LiDAR-based, VHR DTM generation; definitive aero-photogrammetric-based, VHR DTM generation	ITHACA
6	EW	M7-M18	M16-M18	Elevation data harvesting: aero-photogrammetric-based, VHR DSM generation	ITHACA
7	EM	M7-M18	M7-M12	Collection and integration of media information related to the flooding event from 02/10/2020 to 03/10/2020	Hensoldt
8	EM	M7-M18	M7-M12	Collection and integration of media information related to economic impact of floods in October 2020	Hensoldt
9	EW	M12-M18	M13	Generation of UF-ID-1 "Historical 6 hours return period static precipitation maps"	ECWMF: Production e-GEOS: Quality control
10	EW	M12-M18	M16	Generation of UF-ID-2 "ML data driven forecast of return period-based precipitation events in urban areas"	ECWMF: Production e-GEOS: Quality control
11	EW	M12-M18	M13	Generation of UF-ID-3 "Urban inundation probability maps and water depth defined by return period at a spatial resolution in the order of < 10 m"	e-GEOS: Production ECWMF: Quality control
12	EM	M12-M18	M13	Generation of UF-ID-4 "Inferred InSAR urban flood extent"	UNISTRA-SERTIT: Production e-GEOS: Quality control
13	EM	M12-M18	M15	Generation of UF-ID-5 "Urban flooding map based on geomorphological and InSAR approach for an enhanced damage" - Flood extent - Damage assessment on transportation and buildings - Damage assessment on facilities	e-GEOS: Flood extent, damage assessment (transportation, buildings), Production UNISTRA-SERTIT: Damage assessment (facilities) e-GEOS, UNISTRA-SERTIT: Quality control
14	EM	M12-M18	M13	Generation of UF-ID-6 "Social and traditional media indicators for urban flooding maps"	e-GEOS: Initialisation (flood extent inputs) Hensoldt: Production
15	EM	M12-M18	M14	Generation of UF-ID-7 "Hazard web sources indicator"	e-GEOS: Production Adelphi: Quality control
16	EM	M12-M18	M18	Generation of UF-ID-14 "Economic impact of floods"	e-GEOS: Initialisation, quality control Hensoldt: Production
17	PSA	M12-M18	M15	Preparation of end-user and service provider questionnaires	CLS, Tracasa: Preparation UNISTRA-SERTIT, Tracasa: Quality control
18	EW	M12-M18	M17	Generation of “Early Warning Forecast Index”	ECWMF: Production e-GEOS: Quality control
19	EM	M12-M18	M18	Generation of “Flood Impact Index”	e-GEOS: Production GMV: Quality control
20	PSA	M12-M18	M16-M18	Preliminary assessment of indicators, indexes, services and platform functionality	Tracasa

Table 11 describes all the execution steps that pertain to the demonstration on the Italian use case for Ceva Centre. They will all span month 19, alternating between upload of products and availability notification to end-users. Finally, once the demonstration is completed in month 19, the **Italian Civil Protection** will be invited to provide their feedback.

Table 11: Execution phase for the Italian scenario in Ceva Centre.

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Step	Risk phase	Project period	Delivery date	Description	Roles and responsibilities
21	EW	M19	T-3	Upload of UF-ID-1 product	ECWMF: Upload GMV: Delivery check
22	EW	M19	T-3	Notification of UF-ID-1 product availability to the service providers and the Italian end-users	ECWMF
23	EW	M19	T-2	Upload of UF-ID-2 product	ECWMF: Upload GMV: Delivery check
24	EW	M19	T-2	Notification of UF-ID-2 product availability to the service providers and the Italian end-users	ECWMF
25	EW	M19	T-1	Upload of UF-ID-3 product	e-GEOS: Upload GMV: Delivery check
26	EW	M19	T-1	Notification of UF-ID-3 product availability to the service providers and the Italian end-users	e-GEOS
27	EW	M19	T0	Upload of "EW Forecast Index" product	e-GEOS: Upload GMV: Delivery check
28	EW	M19	T0	Notification of "EW Forecast Index" product availability to the service providers and the Italian end-users	e-GEOS
29	EW	M19	T0	Alert notification to the service providers and the Italian end-users	ECWMF: Alert sent to GMV ECWMF: Alert sent to Italian end-users and service providers
30	EM	M19	T+1	Upload of UF-ID-4 product	UNISTRA-SERTIT: Upload GMV: Delivery check
31	EM	M19	T+1	Notification of UF-ID-4 product availability to the service providers and the Italian end-users	UNISTRA-SERTIT
32	EM	M19	T+2	Upload of UF-ID-5 product	e-GEOS: Upload GMV: Delivery check
33	EM	M19	T+2	Notification of UF-ID-5 product availability to the service providers and the Italian end-users	e-GEOS
34	EM	M19	T+3	Upload of UF-ID-6 product	Hensoldt: Upload GMV: Delivery check
35	EM	M19	T+3	Notification of UF-ID-6 product availability to the service providers and the Italian end-users	Hensoldt
36	EM	M19	T+4	Upload of UF-ID-7 product	e-GEOS: Upload GMV: Delivery check
37	EM	M19	T+4	Notification of UF-ID-7 product availability to the service providers and the Italian end-users	e-GEOS
38	EM	M19	T+5	Upload of UF-ID-14 product	Hensoldt: Upload GMV: Delivery check
39	EM	M19	T+5	Notification of UF-ID-14 product availability to the service providers and the Italian end-users	Hensoldt
40	EM	M19	T+6	Upload of "Flood Impact Index" product	e-GEOS: Upload GMV: Delivery check
41	EM	M19	T+6	Notification of "Flood Impact Index" product availability to the service providers and the Italian end-users	e-GEOS
42	PSA	M19	T+6	Solicitation of Italian end-users and service providers to fill in the questionnaires	ITHACA

Table 12 describes all the steps for a thorough evaluation of products and service for to the demonstration on Ceva Centre. Starting in month 16 of the project, the expected delivery dates span from months 19 to 21. This phase will be supported by additional datasets that may not have been presented in previous deliverables. Possible validation data to be used include:

- ARPA Piemonte, Regione Piemonte, and CNR IRPI have produced a **database** related to the **ground effects induced by the rains** of 21-25/11/2016. The data result from surveys conducted during and immediately after the event and from subsequent photo-interpretative analyses.

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- Institutional reports:
  - *L'evento alluvionale di ottobre 2020 in Piemonte (tempesta Alex)*, by ARPA Piemonte in 2021[8].
  - *Evento Alluvionali In Piemonte Evento del 2-3 Ottobre 2020*[9], Joint publication of ARPA Piemonte and *Sistema Nazionale per la Protezione del l'Ambiente* in 2020.
  - *L'evento Alluvionale del 2-3 Ottobre 2020 in Piemonte*[10], by *Società Italiana di Geologia Ambientale* in collaboration with ARPA Piemonte and *Istituto di Ricerca per la Protezione Idrogeologica* (IRPI – CNR) in 2021.
- Additional VHR optical imagery to assess the consequences of the event (SPOT-6, 03/10/2020 09:50 UTC).
- Additional social and traditional media markers, to help collect more information on damages and possibly water depths.

Table 12: Evaluation phase for the Italian scenario in Ceva Centre.

Step	Risk phase	Project period	Delivery date	Description	Roles and responsibilities
43	PSA	M16-M21	M19-M21	Finalisation of feedback through questionnaires	Italian end-users and service providers
44	PSA	M16-M21	M19-M21	Notification of completed questionnaire reception	ITHACA to UNISTRA-SERTIT
45	PSA	M16-M21	M19-M21	Download of feedback questionnaires from end-users and service providers	UNISTRA-SERTIT
46	PSA	M16-M21	M19-M21	Product and service validation	Tracasa
47	PSA	M16-M21	M19-M21	Data analysis, conclusion and inventory of recommendations and actions to be implemented in short and medium terms	Tracasa: Validation UNISTRA-SERTIT: Questionnaire analysis e-GEOS: Review
48	PSA	M16-M21	M19-M21	Dissemination of results, lessons learnt, recommendations	UNISTRA-SERTIT and ITHACA

3.3.3 German scenario (Bad Neuenahr-Ahrweiler)

This scenario is subject to change, given potential delays in one or more steps.

In July 2021, the town of Bad Neuenahr-Ahrweiler in Germany experienced catastrophic flooding, marking one of the most severe natural disasters in the region's recent history. Triggered by extreme rainfall, the Ahr River, a tributary of the Rhine, overflowed its banks, resulting in a devastating flood. This disaster led to significant loss of life and property, affecting hundreds of people across Germany, Belgium, and the Netherlands.

The 2021 floods in Bad Neuenahr-Ahrweiler have been linked to climate change, with studies indicating that such extreme weather events are becoming more frequent and severe. The disaster underscored the urgent need for comprehensive local climate action and adaptation strategies to mitigate the impacts of future events in the region. Even though the area is less prone to catastrophic events than the other use cases, this event was selected due to its fast-pace and sizeable nature.

Table 13 describes all the preparation steps needed to perform the demonstration on the German use case. Data collection spans months 7 to 12 of the project. Generation of indicators and indexes spans months 12 to 18. Finally, the preliminary work for validation and assessment also spans months 12 to 18.

[8] "L'evento alluvionale di ottobre 2020 in Piemonte (tempesta Alex)" – https://www.isprambiente.gov.it/files2021/eventi/stato-e-trend-del-clima-in-italia/presentaz_20211110_def.pdf
[9] "Evento Alluvionali In Piemonte Evento del 2-3 Ottobre 2020" – https://www.arpa.Piemonte.it/news/evento-alluvionale-2-3-ottobre-2020-in-Piemonte-analisi-meteorologica-ed-idraulica-preliminare
[10] "Rapporto evento alluvionale del 2-3 ottobre 2020 in Piemonte" – https://www.arpa.Piemonte.it/news/rapporto-evento-alluvionale-del-2-3-ottobre-2020-in-Piemonte

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Table 13: Preparation phase for the German scenario (Bad Neuenahr-Ahrweiler).

Step	Risk phase	Project period	Delivery date	Description	Roles and responsibilities
1	EW	M7-M12	M7-M12	Collection of meteorological observations of July 2021 over the AOI	ECWMF
2	EW	M7-M12	M7-M12	Collection of meteorological forecasts over the AOI	ECWMF
3	EW	M7-M12	M7-M12	Collection and preparation of EO-based and ancillary data (elevation, hydrography and hydrology, LULC, topographic layers, VHR pre-event imagery, flood footprint for July 2021)	UNISTRA-SERTIT
4	EM	M7-M12	M7-M12	Collection and preparation of additional EO-based and ancillary data (built-up 2D and 3D, population, InSAR compatible imagery, including a July 2021 post-event image)	DLR: Built-up and population UNISTRA-SERTIT: InSAR data
5	EM	M7-M12	M7-M12	Collection and integration of media information related to the flooding event from 13/07/2021 to 20/07/2021	Hensoldt
6	EM	M7-M12	M7-M12	Collection and integration of media information related to economic impact of floods in July 2021	Hensoldt
7	EW	M12-M18	M13	Generation of UF-ID-1 "Historical 6 hours return period static precipitation maps"	ECWMF: Production e-GEOS: Quality control
8	EW	M12-M18	M16	Generation of UF-ID-2 "ML data driven forecast of return period-based precipitation events in urban areas"	ECWMF: Production e-GEOS: Quality control
9	EW	M12-M18	M13	Generation of UF-ID-3 "Urban inundation probability maps and water depth defined by return period at a spatial resolution in the order of < 10 m"	e-GEOS: Production ECWMF: Quality control
10	EM	M12-M18	M13	Generation of UF-ID-4 "Inferred InSAR urban flood extent"	UNISTRA-SERTIT: Production e-GEOS: Quality control
11	EM	M12-M18	M15	Generation of UF-ID-5 "Urban flooding map based on geomorphological and InSAR approach for an enhanced damage" - Flood extent - Damage assessment on transportation and buildings - Damage assessment on facilities	e-GEOS: Flood extent, damage assessment (transportation, buildings), Production UNISTRA-SERTIT: Damage assessment (facilities) e-GEOS, UNISTRA-SERTIT: Quality control
12	EM	M12-M18	M13	Generation of UF-ID-6 "Social and traditional media indicators for urban flooding maps"	e-GEOS: Initialisation (flood extent inputs) Hensoldt: Production
13	EM	M12-M18	M14	Generation of UF-ID-7 "Hazard web sources indicator"	e-GEOS: Production Adelphi: Quality control
14	EM	M12-M18	M18	Generation of UF-ID-14 "Economic impact of floods"	e-GEOS: Initialisation, quality control Hensoldt: Production
15	PSA	M12-M18	M15	Preparation of end-user and service provider questionnaires	CLS, Tracasa: Preparation UNISTRA-SERTIT, Tracasa: Quality control
16	EW	M12-M18	M17	Generation of “Early Warning Forecast Index”	ECWMF: Production e-GEOS: Quality control
17	EM	M12-M18	M18	Generation of “Flood Impact Index”	e-GEOS: Production GMV: Quality control
18	PSA	M12-M18	M16-M18	Preliminary assessment of indicators, indexes, services and platform functionality	Tracasa

Table 14 describes all the execution steps that pertain to the demonstration on the German use case. They will all span month 18, alternating between upload of products and availability notification to end-users. Finally, the execution phase for the German scenario will conclude in month 18 with the solicitation of service providers, to

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provide feedback on the system for initiating the evaluation phase. The end-user corresponds to the **German Foreign Office – Data Science Division**. They will support this demonstration by sharing their experience with the CENTAUR products and platform.

Table 14: Execution phase for the German scenario (Bad Neuenahr-Ahrweiler).

Step	Risk phase	Project period	Delivery date	Description	Roles and responsibilities
19	EW	M18	T-3	Upload of UF-ID-1 product	ECWMF: Upload GMV: Delivery check
20	EW	M18	T-3	Notification of UF-ID-1 product availability to the service providers and the German end-users	ECWMF
21	EW	M18	T-2	Upload of UF-ID-2 product	ECWMF: Upload GMV: Delivery check
22	EW	M18	T-2	Notification of UF-ID-2 product availability to the service providers and the German end-users	ECWMF
23	EW	M18	T-1	Upload of UF-ID-3 product	e-GEOS: Upload GMV: Delivery check
24	EW	M18	T-1	Notification of UF-ID-3 product availability to the service providers and the German end-users	e-GEOS
25	EW	M18	T0	Upload of "EW Forecast Index" product	e-GEOS: Upload GMV: Delivery check
26	EW	M18	T0	Notification of "EW Forecast Index" product availability to the service providers and the German end-users	e-GEOS
27	EW	M18	T0	Alert notification to the service providers and the German end-users	ECWMF: Alert sent to GMV ECWMF: Alert sent to German end-users and service providers
28	EM	M18	T0	Upload of UF-ID-4 product	UNISTRA-SERTIT: Upload GMV: Delivery check
29	EM	M18	T+1	Notification of UF-ID-4 product availability to the service providers and the German end-users	UNISTRA-SERTIT
30	EM	M18	T+1	Upload of UF-ID-5 product	e-GEOS: Upload GMV: Delivery check
31	EM	M18	T+2	Notification of UF-ID-5 product availability to the service providers and the German end-users	e-GEOS
32	EM	M18	T+2	Upload of UF-ID-6 product	Hensoldt: Upload GMV: Delivery check
33	EM	M18	T+3	Notification of UF-ID-6 product availability to the service providers and the German end-users	Hensoldt
34	EM	M18	T+3	Upload of UF-ID-7 product	e-GEOS: Upload GMV: Delivery check
35	EM	M18	T+4	Notification of UF-ID-7 product availability to the service providers and the German end-users	e-GEOS
36	EM	M18	T+5	Upload of UF-ID-14 product on CENTAUR platform	Hensoldt: Upload GMV: Delivery check
37	EM	M18	T+5	Notification of UF-ID-14 product availability to the service providers and the German end-users	Hensoldt
38	EM	M18	T+6	Upload of "Flood Impact Index" product	e-GEOS: Upload GMV: Delivery check
39	EM	M18	T+6	Notification of "Flood Impact Index" product availability to the service providers and the German end-users	e-GEOS
40	PSA	M18	T+6	Solicitation of German end-users and service providers to fill in the questionnaires	UNISTRA-SERTIT

Table 15 describes all the steps for a thorough evaluation of products and services for to the demonstration on the German use case. Starting in month 16 of the project, the expected delivery dates span from months 19 to 21.

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Considering the restricted availability of non-paid and open-source data sets over Germany, the evaluation of products will unfortunately leverage a limited range of validation data. They include:

- **Hourly station observations of precipitation amount, in mm**[11]. The Deutscher Wetterdienst (DWD) is responsible for the provision of this dataset. It corresponds to a tabular time series of precipitation heights, measured at DWD stations, from 1995-09-01 onwards. Main use includes validating UF-ID-1 and UF-ID-2, focusing on stations located in the AOI and its vicinity.
- The **provisional securing of the Ahr flood area**[12]. The Rhineland-Palatinate German state is responsible for the provision of this dataset. It provides the official flood risk zoning across the entire Ahr basin, including over the AOI. The corresponding area will help validate flood extents and ancillary information generated by UF-ID-3, UF-ID-4 and UF-ID-5.
- **Flood hazard maps** for scenarios with different probabilities, including HQ10, HQ100 and HQExtreme[13]. The Rhineland-Palatinate German state is responsible for the provision of this dataset. It describes water extent and flood depths under different scenarios. Preliminary analysis and feedback from the data provider confirms HQExtreme corresponds to the 2021 flood. Thus, its usage pertains to validating UF-ID-3, UF-ID-4 and UF-ID-5.
- **Flood forecast** and **water gauges**[14]. The Rhineland-Palatinate German state is responsible for the provision of these datasets. The indicate water levels measured at stations, placed along several state rivers and streams. Several data points are available upstream and downstream of the AOI. Main uses include validating UF-ID-3 and UF-ID-5.
- **Alternate water depths layers**, generated through techniques other than the one proposed for UF-ID-5, to ensure the estimated values fall into a probable range. The extent could also serve as a validation for UF-ID-3 and UF-ID-4.
- **Official reports on the consequences of the 2021 flood**, including an assessment of damages over the region. At least two reports show comprehensive analyses, one published in 2021 by the German Ministry of Finance (*Bundesministerium der Finanzen*)[15], and the other in 2023 by *Kreisverwaltung Ahrweiler*[16].

Table 15: Evaluation phase for the German scenario (Bad Neuenahr-Ahrweiler).

Step	Risk phase	Project period	Delivery date	Description	Roles and responsibilities
41	PSA	M16-M21	M19-M21	Finalisation of feedback through questionnaires	German end-users and service providers
42	PSA	M16-M21	M19-M21	Notification of completed questionnaire reception	UNISTRA-SERTIT
43	PSA	M16-M21	M19-M21	Download of feedback questionnaires from end-users and service providers	UNISTRA-SERTIT
44	PSA	M16-M21	M19-M21	Product and service validation	Tracasa
45	PSA	M16-M21	M19-M21	Data analysis, conclusion and inventory of recommendations and actions to be implemented in short and medium terms	Tracasa: Validation UNISTRA-SERTIT: Questionnaire analysis e-GEOS: Review
46	PSA	M16-M21	M19-M21	Dissemination of results, lessons learnt, recommendations	UNISTRA-SERTIT

[11] Online database of the DWD – https://cdc.dwd.de/portal/202209231028/searchview
[12] Card sheets for the provisional securing of the Ahr Flood area – https://sgdnord.rlp.de/themen/wiederaufbau-ahr/ueberschwemmungsgebiet
[13] Geoportal with a web view of different hazard maps – https://hochwassermanagement.rlp-umwelt.de/servlet/is/200041/
[14] Geoportal for the monitoring of water gauges in the Rhineland-Palatinate German state – https://hochwasser.rlp.de/
[15] "Bericht zur Hochwasserkatastrophe 2021: Katastrophenhilfe, Wiederaufbau und Evaluierungsprozesse" – https://www.bmi.bund.de/SharedDocs/downloads/DE/veroeffentlichungen/2022/abschlussbericht-hochwasserkatastrophe.pdf
[16] "Hochwasserkatastrophe 2021 – Sachstandsbericht der Kreisverwaltung, Sitzung des Kreistages am 29.09.2023" – https://kreis-ahrweiler.de/wp-content/uploads/2023/10/Hochwasserkatastrophe-2021-Sachstandsbericht-der-Kreisverwaltung_September-2023.pdf

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3.3.4 French scenario (Landes)

This scenario is subject to change, given potential delays in one or more steps.

The France Cold case focuses on the flood event that happened early January 2021 near Dax along rivers Adour and Midouze. Winter 2020-2021 saw numerous floods in the Landes, with the January 1rst to 3rd, 2021, the most important one that came close to historical water levels.

Table 16 describes all the preparation steps needed to perform the demonstration on the French use case. Data collection spans months 7 to 12 of the project. Generation of indicators and indexes spans months 12 to 18. Finally, the preliminary work for validation and assessment spans months 16 to 18.

Table 16: Preparation phase for the French scenario (Landes).

Step	Risk phase	Project period	Delivery date	Description	Roles and responsibilities
1	EW	M7-M12	M7-M12	Collection of meteorological observations of December 2020 and January 2021 over the AOI	ECWMF
2	EW	M7-M12	M7-M12	Collection of meteorological forecasts over the AOI	ECWMF
3	EW	M7-M12	M7-M12	Collection and preparation of EO-based and ancillary data (elevation, hydrography and hydrology, LULC, topographic layers, VHR pre-event imagery, flood footprint for January 2021)	CLS
4	EM	M7-M12	M7-M12	Collection and preparation of additional EO-based and ancillary data (built-up 2D and 3D, population, InSAR compatible imagery, including a January 2021 post-event image)	DLR: Built-up and population UNISTRA-SERTIT: InSAR data
5	EM	M7-M12	M7-M12	Collection and integration of media information related to the flooding event from 01/01/2021 to 02/01/2021	Hensoldt
6	EM	M7-M12	M7-M12	Collection and integration of media information related to economic impact of floods in January 2021	Hensoldt
7	EW	M12-M18	M13	Generation of UF-ID-1 "Historical 6 hours return period static precipitation maps"	ECWMF: Production e-GEOS: Quality control
8	EW	M12-M18	M16	Generation of UF-ID-2 "ML data driven forecast of return period-based precipitation events in urban areas"	ECWMF: Production e-GEOS: Quality control
9	EW	M12-M18	M13	Generation of UF-ID-3 "Urban inundation probability maps and water depth defined by return period at a spatial resolution in the order of < 10 m"	e-GEOS: Production ECWMF: Quality control
10	EM	M12-M18	M13	Generation of UF-ID-4 "Inferred InSAR urban flood extent"	UNISTRA-SERTIT: Production e-GEOS: Quality control
11	EM	M12-M18	M15	Generation of UF-ID-5 "Urban flooding map based on geomorphological and InSAR approach for an enhanced damage" - Flood extent - Damage assessment on transportation and buildings - Damage assessment on facilities	e-GEOS: Flood extent, damage assessment (transportation, buildings), production UNISTRA-SERTIT: Damage assessment (facilities) e-GEOS, UNISTRA-SERTIT: Quality control
12	EM	M12-M18	M13	Generation of UF-ID-6 "Social and traditional media indicators for urban flooding maps"	e-GEOS: Initialisation (flood extent inputs) Hensoldt: Production
13	EM	M12-M18	M14	Generation of UF-ID-7 "Hazard web sources indicator"	e-GEOS: Production Adelphi: Quality control

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Step	Risk phase	Project period	Delivery date	Description	Roles and responsibilities
14	EM	M12-M18	M18	Generation of UF-ID-14 "Economic impact of floods"	e-GEOS: Initialisation, quality control Hensoldt: Production
15	PSA	M12-M18	M15	Preparation of end-user and service provider questionnaires	CLS, Tracasa: Preparation UNISTRA-SERTIT, Tracasa: Quality control
16	EW	M12-M18	M17	Generation of "Early Warning Forecast Index"	ECWMF: Production e-GEOS: Quality control
17	EM	M12-M18	M18	Generation of "Flood Impact Index"	e-GEOS: Production GMV: Quality control
18	PSA	M12-M18	M16-M18	Preliminary assessment of indicators, indexes, services and platform functionality	Tracasa

Table 17 describes all the execution steps that pertain to the demonstration on the French use case. They will all span month 18, alternating between upload of products and availability notification to end-users. Finally, the execution phase for the French scenario will conclude in month 18 with the solicitation of the **French Public Insurance Company** (*Caisse Centrale de Réassurance*, CCR), corresponding to the end-user, as well as service providers, to provide feedback on the system for the evaluation phase.

Table 17: Execution phase for the French scenario (Landes).

Step	Risk phase	Project period	Delivery date	Description	Roles and responsibilities
19	EW	M18	T-3	Upload of UF-ID-1 product	ECWMF: Upload GMV: Delivery check
20	EW	M18	T-3	Notification of UF-ID-1 product availability to the service providers and the French end-users	ECWMF
21	EW	M18	T-2	Upload of UF-ID-2 product	ECWMF: Upload GMV: Delivery check
22	EW	M18	T-2	Notification of UF-ID-2 product availability to the service providers and the French end-users	ECWMF
23	EW	M18	T-1	Upload of UF-ID-3 product	e-GEOS: Upload GMV: Delivery check
24	EW	M18	T-1	Notification of UF-ID-3 product availability to the service providers and the French end-users	e-GEOS
25	EW	M18	T0	Upload of "EW Forecast Index" product	e-GEOS: Upload GMV: Delivery check
26	EW	M18	T0	Notification of "EW Forecast Index" product availability to the service providers and the French end-users	e-GEOS
27	EW	M18	T0	Alert notification to the service providers and the French end-users	ECWMF: Alert sent to GMV ECWMF: Alert sent to French end-users and service providers
28	EM	M18	T0	Upload of UF-ID-4 product	UNISTRA-SERTIT: Upload GMV: Delivery check
29	EM	M18	T+1	Notification of UF-ID-4 product availability to the service providers and the French end-users	UNISTRA-SERTIT
30	EM	M18	T+1	Upload of UF-ID-5 product	e-GEOS: Upload GMV: Delivery check
31	EM	M18	T+2	Notification of UF-ID-5 product availability to the service providers and the French end-users	e-GEOS
32	EM	M18	T+2	Upload of UF-ID-6 product	Hensoldt: Upload GMV: Delivery check
33	EM	M18	T+3	Notification of UF-ID-6 product availability to the service providers and the French end-users	Hensoldt

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Step	Risk phase	Project period	Delivery date	Description	Roles and responsibilities
34	EM	M18	T+3	Upload of UF-ID-7 product	e-GEOS: Upload GMV: Delivery check
35	EM	M18	T+4	Notification of UF-ID-7 product availability to the service providers and the French end-users	e-GEOS
36	EM	M18	T+5	Upload of UF-ID-14 product on CENTAUR platform	Hensoldt: Upload GMV: Delivery check
37	EM	M18	T+5	Notification of UF-ID-14 product availability to the service providers and the German end-users	Hensoldt
38	EM	M18	T+6	Upload of "Flood Impact Index" product	e-GEOS: Upload GMV: Delivery check
39	EM	M18	T+6	Notification of Flood Impact Index product availability to the service providers and the French end-users	e-GEOS
40	PSA	M18	T+6	Solicitation of French end-users and service providers to fill in the questionnaires	CLS

Table 18 describes all the steps for a thorough evaluation of products and service for to the demonstration on the French use case. Starting in month 16 of the project, the expected delivery dates span from months 19 to 21. This phase will be supported by additional datasets that were not presented in previous deliverables:

- **Comparable optical images** acquired during the flood event (Copernicus Sentinel-2 acquired on 03/01/2021 11:09 UTC, resolution 10m), that is partially cloudless over the AOI.
- **Ground observations** on the location (GPS coordinates, description and pictures) and **flood height** published in the Repères de crues database[17] on the northern part of the AOI. The observations were collected between 05/01/2021 and 08/01/2021.
- **Institutional documents** delivered by local and national authorities, including *Territoire à Risque important d'Inondation* (TRI) and *Evaluation Préliminaire des Risques d'Inondation* (EPRI). They provide important information about the hydrology of the AOI, as well as some geospatial layers describing simulated maximum flood extent and depth over the municipality of Dax.
- **River gauges**, corresponding to in-situ recorded levels of the rivers, with multiple stations available over the AOI. They are available in the HydroEau database[18].
- **Information published by the affected municipalities**, such as Tartas municipal bulletin dedicated to the 2021 floods[19].

Table 18: Evaluation phase for the French scenario (Landes).

Step	Risk phase	Project period	Delivery date	Description	Roles and responsibilities
41	PSA	M16-M21	M19-M21	Finalisation of feedback through questionnaires	French end-users and service providers
42	PSA	M16-M21	M19-M21	Notification of completed questionnaire reception	CLS to UNISTRA-SERTIT
43	PSA	M16-M21	M19-M21	Download of feedback questionnaires from end-users and service providers	UNISTRA-SERTIT
44	PSA	M16-M21	M19-M21	Product and service validation	Tracasa

[17] Online database for Repères de Crues – https://www.reperesdecrues.developpement-durable.gouv.fr/
[18] Online portal to access the HydroEau database – https://hydro.eaufrance.fr/
[19] "Bulletin municipal de Tartas" – https://www.tartas.fr/Tartas/Vie-municipale/Les-publications-municipales/Bulletin-municipal-en-telechargement

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Step	Risk phase	Project period	Delivery date	Description	Roles and responsibilities
45	PSA	M16-M21	M19-M21	Data analysis, conclusion and inventory of recommendations and actions to be implemented in short and medium terms	Tracasa: Validation UNISTRA-SERTIT: Questionnaire analysis e-GEOS: Review
46	PSA	M16-M21	M19-M21	Dissemination of results, lessons learnt, recommendations	UNISTRA-SERTIT

3.4 WATER AND FOOD SECURITY DEMONSTRATOR SCENARIOS

The focus of WFS scenarios lies in country-scale analyses, even though the system could be able of zooming into the next finer administrative level for specific indicators and services, depending on data availability and system capabilities.

3.4.1 Somalian scenario

This scenario is subject to change, given potential delays in one or more steps.

The Somalia cold case presents a complex crisis arising from consecutive failed rainy seasons, droughts, political instability, extremism, and civil unrest. Ranking as the second most vulnerable country to climate change, Somalia struggles with significant poverty rates, affecting 70% of its population, and relies heavily on pastoralism. Presently, Somalia finds itself entrenched in its fifth consecutive failed wet season since 2018, exacerbated by prevailing La Niña condition[20].

Unlike prior droughts and food emergencies, the current crisis is compounded by external factors such as the conflict in Ukraine. Many communities and nomadic pastoralists depend on seasonal rains for sustenance, with the ongoing drought resulting in significant livestock losses and agricultural devastation. Consequently, Somalia faces a mass displacement crisis, with approximately 3 million Internally Displaced Persons (IDPs) and a rapidly escalating count[21].

Since 2020, Somalia has struggled with prolonged drought, compelling tens of thousands to seek refuge in urban centres in pursuit of essential resources and economic prospects. Moreover, armed groups like Al Shabaab exploit climate-induced vulnerabilities, masquerading as aid providers.

The insights acquired from the Somalian cold case offer valuable lessons for evaluating climate security risks across the Horn of Africa region and beyond.

Table 19 outlines the necessary preparation steps for conducting the demonstration on the Somalian use case. The data collection phase extends from month 7 to month 12. Following this, the generation of indicators and indexes is scheduled from month 12 to month 18. Lastly, the initial groundwork for validation and assessment is anticipated to take place between months 16 and 18.

Table 19: Preparation phase for the Somalian scenario.

[20] Rojas, O., Li, Y., & Cumani, R. (2014). Understanding the drought impact of El Niño on the global agricultural areas: An assessment using FAO's Agricultural Stress Index (ASI). FAO. https://www.fao.org/3/i4251e/i4251e.pdf

[21] OCHA, PRNM, & DTM. (2023). Somalia: Drought Displacement Monitoring Dashboard (September 2022). https://reliefweb.int/report/somalia/somalia-drought-and-famine-displacement-monitoring-dashboard-september-2022

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Step	Risk phase	Project period	Delivery date	Description	Roles and responsibilities
1	EW	M7-M12	M7-M12	Collection of precipitation and temperature data from 2018 to present (time series) for drought monitoring: - Temperature (ERA5) - Precipitation (ERA5/GPCC) - Potential Evaporation (ERA5)	ECMWF
2	EW	M7-M12	M7-M12	Collection of data for drought forecast: - ENS - ENS-ER - Seasonal forecast data	ECMWF
3	EW	M7-M12	M7-M12	Collection of agricultural related data: - Root soil moisture (GRACE and GRACE FO) - Land Surface Temperature (Sentinel-3) - Air Temperature, relative humidity, precipitation, solar radiation and wind speed (ERA5-Land dataset) - Fraction of Vegetation Cover	VITO ECMWF: Precipitation and temperature, forecasts on soil moisture anomalies UNISTRA-TRIO: Soil moisture
4	EW	M7-M12	M7-M12	Collection of EO related data necessary for index generation: - Sentinel-3 - NOAA - METOP - MODIS	VITO
5	EW	M7-M12	M7-M12	Collection and preparation of IOM DTM / UNHCR CCCM data, and EO based data for camp status: - Sentinel - SAR data - VHR Contributing mission	e-GEOS
6	EW	M7-M12	M7-M12	Collection of Auxiliary and Media data: - HOT OSM - ACLED - IOM-DTM Mobility tracking (work in progress) - FEWSNET - FAO DIEM, FAO Wapor - Afrobarometer - Demographic and Health Survey (DHS) - Social/traditional media data (work in progress)	Adelphi GMV: Livestock heat stress, rangeland cover change, main roads Hensoldt: Media data
7	EW	M7-M12	M7-M12	Collection of EO data for media-based indicators: - EOG Night Time Light (NTL)	Adelphi
8	EW	M7-M12	M7-M12	Generation of NDVI time series (1km over the last 20 years) and derived data (FAPAR, LAI)	VITO
9	EW	M7-M12	M7-M12	Generation of the thermal drought stress indicator	VITO
10	EW	M12-M18	M12-M18	Generation of WFS-ID-1 "Meteorological drought indicator (Monitoring)"	ECMWF
11	EW	M12-M18	M12-M18	Generation of WFS-ID-2 "Meteorological drought indicator (Forecast)"	ECMWF
12	EW	M12-M18	M12-M18	Generation of WFS-ID-3 "Meteorological drought indicator (calibrated in danger levels)"	ECMWF: WFS-ID-1 and WFS-ID-2
13	EW	M12-M18	M12-M18	Generation of WFS-ID-4 "Agricultural drought monitoring (near real-time)"	VITO: NDVI, NDWI, LST, root zone soil moisture, land cover ECMWF: ERA5 air temperature and precipitation data

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Step	Risk phase	Project period	Delivery date	Description	Roles and responsibilities
14	EW	M12-M18	M12-M18	Generation of WFS-ID-5 "Agricultural drought forecast"	VITO: WFS-ID-4 ECMWF: Precipitation and air temperature forecasts and soil moisture anomalies
15	EW	M12-M18	M12-M18	Generation of WFS-ID-6 "Risk zone map"	VITO: WFS-ID4 and WFS-ID-5
16	EM	M12-M18	M12-M18	Generation of all relevant socioeconomic and media-based indicators: WFS-ID-11 "Food Security", WFS-ID-12 "Economic Security", WFS-ID-13 "Displaced Persons", WFS-ID-14 "Crime and illicit activities", WFS-ID-15 "Radicalisation and polarisation", WFS-ID-17 "Humanitarian Aid", WFS-ID-18 "Resource capture", WFS-ID-19 "Climate sensitivity of agri-food systems", WFS-ID-21 "Public services and infrastructure", WFS-ID-23 "State-citizen relations", WFS-ID-24 "Dispute resolution mechanisms", and WFS-ID-25 "Social cohesion"	Adelphi Hensoldt: Media mining system
17	PSA	M12-M18	M16-M18	Preparation of end users and service providers questionnaires	SatCen, Tracasa: Preparation UNISTRA-SERTIT, Tracasa: Quality control
18	PSA	M12-M18	M12-M18	Preliminary assessment of indicators, indexes, services and platform functionality	Tracasa

Table 20 outlines all the procedural steps involved in executing the demonstration for the Somalian use case. These tasks will extend throughout month 18, alternating between product uploads and notification of availability to end-users. The execution phase for this scenario will end with the request for feedback from service providers to facilitate the evaluation process. The end-user for this scenario corresponds to the **United Nations Support Office in Somalia** (UNSOS). They have showed interest in the project, by providing data, helping build the scenario and by involving local organisations.

Table 20: Execution phase for the Somalian scenario.

Step	Risk phase	Project period	Delivery date	Description	Roles and responsibilities
19	EW	M18	T-5	Upload of WFS-ID-1 product	ECMWF: Product upload GMV: Delivery check
20	EW	M18	T-5	Notification of WFS-ID-1 product availability to the service providers and the end users	ECMWF
21	EW	M18	T-4	Upload of WFS-ID-2 product	ECMWF: Product upload GMV: Delivery check
22	EW	M18	T-4	Notification of WFS-ID-2 product availability to the service providers and the end users	ECMWF
23	EW	M18	T-3	Upload of WFS-ID-3 product	ECMWF: Product upload GMV: Delivery check
24	EW	M18	T-3	Notification of WFS-ID-3 product availability to the service providers and the end users	ECMWF
25	EW	M18	T-2	Upload of WFS-ID-4 product	VITO: Product upload GMV: Delivery check
26	EW	M18	T-2	Notification of WFS-ID-4 product availability to the service providers and the end users	VITO

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Step	Risk phase	Project period	Delivery date	Description	Roles and responsibilities
27	EW	M18	T-1	Upload of WFS-ID-5 product	VITO: Product upload GMV: Delivery check
28	EW	M18	T-1	Notification of WFS-ID-5 product availability to the service providers and the end users	VITO
29	EW	M18	T0	Upload of WFS-ID-6 product	VITO: Product upload GMV: Delivery check
30	EW	M18	T0	Notification of WFS-ID-6 product availability to the service providers and the end users	VITO
31	EW	M18	T+2	Upload of media indicators: WFS-ID-11, WFS-ID-12, WFS-ID-13, WFS-ID-14, WFS-ID-15, and WFS-ID-17 products	Adelphi: Product upload GMV: Delivery check
32	EW	M18	T+2	Notification of WFS-ID-11, WFS-ID-12, WFS-ID-13, WFS-ID-14, WFS-ID-15, and WFS-ID-17 product availability to the service providers and the end users	Adelphi
33	EW	M18	T+3	Upload of media indicators: WFS-ID-18, WFS-ID-19, WFS-ID-21, WFS-ID-23, WFS-ID-24, and WFS-ID-25 products	Adelphi: Product upload GMV: Delivery check
34	EW	M18	T+3	Notification of WFS-ID-18, WFS-ID-19, WFS-ID-21, WFS-ID-23, WFS-ID-24, and WFS-ID-25 product availability to the service providers and the end users	Adelphi
35	PSA	M18	T+3	Solicitation of end users and service providers to fill in the questionnaires	SatCen

Table 21 provides a comprehensive overview of the steps involved in conducting a thorough evaluation of products and services for the Somalian use case. This evaluation process commences in month 18 of the project, and will end in month 21.

Table 21: Evaluation phase for the Somalian scenario.

Step	Risk phase	Project period	Delivery date	Description	Roles and responsibilities
36	PSA	M16-M21	M19-M21	Finalisation of feedback through questionnaires	Somalian end-users and service providers
37	PSA	M16-M21	M19-M21	Notification of completed questionnaire reception	SatCen to UNISTRA-SERTIT
38	PSA	M16-M21	M19-M21	Download of feedback questionnaires from end-users and service providers	UNISTRA-SERTIT
39	PSA	M16-M21	M19-M21	Product and service validation	Tracasa
40	PSA	M16-M21	M19-M21	Data analysis, conclusion and inventory of recommendations and actions to be implemented in short and medium terms	Tracasa: Validation UNISTRA-SERTIT: Questionnaire analysis SatCen: Review
41	PSA	M16-M21	M19-M21	Dissemination of results, lessons learnt, recommendations	UNISTRA-SERTIT and SatCen

3.4.2 Malian scenario

This scenario is subject to change, given potential delays in one or more steps.

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Mali, situated in the climate-vulnerable Sahel region, struggles with periodic water deficits and unpredictable precipitation patterns. These climatic challenges exacerbate communal tensions, deepen poverty levels, and undermine rural livelihoods. Additionally, the presence of extremist groups and militias heightens conflicts between farmers and herders, further complicating the situation. Mali's circumstances offer valuable insights into broader climate security trends within the Sahel region.

The Mali Cold case is characterized by several interrelated factors, including limited access to water, a consistent rise in temperatures, recurrent droughts, political instability, and extremism. As a landlocked country, Mali faces significant poverty levels, affecting approximately 78% of its population. Food insecurity varies across regions, with the northern and central areas experiencing the most severe impacts[22].

Table 22 outlines the essential preparation steps required to execute the demonstration focusing on the Mali use case. The process includes data collection activities spanning months 7 to 12, followed by the generation of indicators and indexes from months 12 to 18. The preliminary work for validation and assessment is slated for months 16 to 18.

Table 22: Preparation phase for the Malian scenario.

Step	Risk phase	Project period	Delivery date	Description	Roles and responsibilities
1	EW	M7-M12	M7-M12	Collection of precipitation and temperature data from 2018 to present (time series) for drought monitoring: - Temperature (ERA5) - Precipitation (ERA5/GPCC) - Potential Evaporation (ERA5)	ECMWF
2	EW	M7-M12	M7-M12	Collection of data for drought forecast: - ENS - ENS-ER - Seasonal forecast data	ECMWF
3	EW	M7-M12	M7-M12	Collection of agricultural related data: - Root soil moisture (GRACE and GRACE FO) - Land Surface Temperature (Sentinel-3) - Air Temperature, relative humidity, precipitation, solar radiation and wind speed (ERA5-Land dataset) - Fraction of Vegetation Cover	VITO ECMWF: Precipitation and temperature, forecasts on soil moisture anomalies UNISTRA-TRIO: Soil moisture
4	EW	M7-M12	M7-M12	Collection of EO related data necessary for index generation: - Sentinel-3 - NOAA - METOP - MODIS	VITO
5	EW	M7-M12	M7-M12	Collection and preparation of IOM DTM / UNHCR CCCM data, and EO based data for camp status: - Sentinel - SAR data - VHR Contributing mission	e-GEOS

[22] FEWS NET. (2023). Despite ongoing harvest, Crisis (IPC Phase 3) persists in conflict-affected areas of central Mali (p. 8) [Food Security Outlook]. FEWS NET. https://fews.net/west-africa/mali/food-security-outlook/october-2022

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Step	Risk phase	Project period	Delivery date	Description	Roles and responsibilities
6	EW	M7-M12	M7-M12	Collection of Auxiliary and Media data: - HOT OSM - ACLED - IOM-DTM Mobility tracking (work in progress) - FEWSNET - FAO DIEM, FAO Wapor - Afrobarometer - Demographic and Health Survey (DHS) - Social/traditional media data (work in progress)	Adelphi GMV: Livestock heat stress, rangeland cover change, main roads Hensoldt: Media data
7	EW	M7-M12	M7-M12	Collection of EO data for media-based indicators: - EOG Night Time Light (NTL)	Adelphi
8	EW	M7-M12	M7-M12	Generation of NDVI time series (1km over the last 20 years) and derived data (FAPAR, LAI)	VITO
9	EW	M7-M12	M7-M12	Generation of the thermal drought stress indicator	VITO
10	EW	M12-M18	M12-M18	Generation of WFS-ID-1 "Meteorological drought indicator (Monitoring)"	ECMWF
11	EW	M12-M18	M12-M18	Generation of WFS-ID-2 "Meteorological drought indicator (Forecast)"	ECMWF
12	EW	M12-M18	M12-M18	Generation of WFS-ID-3 "Meteorological drought indicator (calibrated in danger levels)"	ECMWF: WFS-ID-1 and WFS-ID-2
13	EW	M12-M18	M12-M18	Generation of WFS-ID-4 "Agricultural drought monitoring (near real-time)"	VITO: NDVI, NDWI, LST, root zone soil moisture, land cover ECMWF: ERA5 air temperature and precipitation data
14	EW	M12-M18	M12-M18	Generation of WFS-ID-5 "Agricultural drought forecast"	VITO: WFS-ID-4 ECMWF: Precipitation and air temperature forecasts and soil moisture anomalies
15	EW	M12-M18	M12-M18	Generation of WFS-ID-6 "Risk zone map"	VITO: WFS-ID4 and WFS-ID-5
16	EM	M12-M18	M12-M18	Generation of all relevant socioeconomic and media-based indicators: WFS-ID-11 "Food Security", WFS-ID-12 "Economic Security", WFS-ID-13 "Displaced Persons", WFS-ID-14 "Crime and illicit activities", WFS-ID-15 "Radicalisation and polarisation", WFS-ID-17 "Humanitarian Aid", WFS-ID-18 "Resource capture", WFS-ID-19 "Climate sensitivity of agri-food systems", WFS-ID-21 "Public services and infrastructure", WFS-ID-23 "State-citizen relations", WFS-ID-24 "Dispute resolution mechanisms", and WFS-ID-25 "Social cohesion"	Adelphi Hensoldt: Media mining system
17	PSA	M12-M18	M16-M18	Preparation of end users and service providers questionnaires	SatCen, Tracasa: Preparation UNISTRA-SERTIT, Tracasa: Quality control
18	PSA	M12-M18	M12-M18	Preliminary assessment of indicators, indexes, services and platform functionality	Tracasa

Table 23 outlines the execution steps involved in the Mali use case demonstration, all of which are scheduled to occur during month 18. These steps will alternate between product uploads and notifications of availability to end-

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users. The execution phase for the Mali scenario will end with the solicitation of feedback from Mali end-users and service providers, essential for the subsequent evaluation phase.

Table 23: Execution phase for the Malian scenario.

Step	Risk phase	Project period	Delivery date	Description	Roles and responsibilities
19	EW	M18	T-5	Upload of WFS-ID-1 product	ECMWF: Product upload GMV: Delivery check
20	EW	M18	T-5	Notification of WFS-ID-1 product availability to the service providers and the end users	ECMWF
21	EW	M18	T-4	Upload of WFS-ID-2 product	ECMWF: Product upload GMV: Delivery check
22	EW	M18	T-4	Notification of WFS-ID-2 product availability to the service providers and the end users	ECMWF
23	EW	M18	T-3	Upload of WFS-ID-3 product	ECMWF: Product upload GMV: Delivery check
24	EW	M18	T-3	Notification of WFS-ID-3 product availability to the service providers and the end users	ECMWF
25	EW	M18	T-2	Upload of WFS-ID-4 product	VITO: Product upload GMV: Delivery check
26	EW	M18	T-2	Notification of WFS-ID-4 product availability to the service providers and the end users	VITO
27	EW	M18	T-1	Upload of WFS-ID-5 product	VITO: Product upload GMV: Delivery check
28	EW	M18	T-1	Notification of WFS-ID-5 product availability to the service providers and the end users	VITO
29	EW	M18	T0	Upload of WFS-ID-6 product	VITO: Product upload GMV: Delivery check
30	EW	M18	T0	Notification of WFS-ID-6 product availability to the service providers and the end users	VITO
31	EW	M18	T+2	Upload of media indicators: WFS-ID-11, WFS-ID-12, WFS-ID-13, WFS-ID-14, WFS-ID-15, and WFS-ID-17 products	Adelphi: Product upload GMV: Delivery check
32	EW	M18	T+2	Notification of WFS-ID-11, WFS-ID-12, WFS-ID-13, WFS-ID-14, WFS-ID-15, and WFS-ID-17 product availability to the service providers and the end users	Adelphi
33	EW	M18	T+3	Upload of media indicators: WFS-ID-18, WFS-ID-19, WFS-ID-21, WFS-ID-23, WFS-ID-24, and WFS-ID-25 products	Adelphi: Product upload GMV: Delivery check
34	EW	M18	T+3	Notification of WFS-ID-18, WFS-ID-19, WFS-ID-21, WFS-ID-23, WFS-ID-24, and WFS-ID-25 product availability to the service providers and the end users	Adelphi
35	PSA	M18	T+3	Solicitation of end users and service providers to fill in the questionnaires	SatCen

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Table 24 provides a comprehensive overview of the steps involved in conducting a thorough evaluation of products and services for the Somalian use case. This evaluation process commences in month 18 of the project, and will end in month 21.

Table 24: Evaluation phase for the Malian scenario.

Step	Risk phase	Project period	Delivery date	Description	Roles and responsibilities
36	PSA	M16-M21	M19-M21	Finalisation of feedback through questionnaires	Malian end-users and service providers
37	PSA	M16-M21	M19-M21	Notification of completed questionnaire reception	SatCen to UNISTRA-SERTIT
38	PSA	M16-M21	M19-M21	Download of feedback questionnaires from end-users and service providers	UNISTRA-SERTIT
39	PSA	M16-M21	M19-M21	Product and service validation	Tracasa
40	PSA	M16-M21	M19-M21	Data analysis, conclusion and inventory of recommendations and actions to be implemented in short and medium terms	Tracasa: Validation UNISTRA-SERTIT: Questionnaire analysis SatCen: Review
41	PSA	M16-M21	M19-M21	Dissemination of results, lessons learnt, recommendations	UNISTRA-SERTIT and SatCen

3.5 CROSS-CUTTING DEMONSTRATOR SCENARIO: THE MOZAMBIQUE COLD CASE

This scenario is subject to change, given potential delays in one or more steps.

Mozambique is characterized by a multifaceted landscape of climate vulnerability, heightened disaster risk, and escalating threats from violent extremism. This coastal lowland region, particularly urban areas such as Beira, is highly vulnerable to climate-induced changes, including rising temperatures, sea levels, and the frequency of cyclones and tropical storms. The case of Tropical Cyclone Idai in March 2019 underscores these challenges, causing widespread devastation across several provinces and highlighting the acute vulnerabilities faced by urban slums.

The agricultural sector, which is a cornerstone of Mozambique's economy and the primary livelihood for over 80% of its population, is significantly impacted by climatic extremes. Flooding events, often resulting from cyclones and storms, compromise food security by damaging arable land and disrupting food storage, thereby posing challenges to both water availability and food production.

An integrated analysis of Mozambique's situation reveals critical intersections between urban flooding, food security, and water scarcity. The challenges are compounded by limited access to clean water, inadequate disaster preparedness, high poverty rates, and a strong dependence on agriculture. Climatic disasters, particularly during the lean season, exacerbate food insecurity by affecting food production and storage capabilities.

Focusing on the Tropical Cyclone Idai event, which struck near Beira City on the night of March 14 to 15, 2019, the cyclone brought with it devastating rains and winds, affecting Sofala, Zambezia, Manica, and Inhambane provinces. Idai's landfall featured intense winds and a significant storm surge, with continued heavy rainfall predicted to persist in the aftermath, highlighting the urgent need for integrated disaster risk management and climate adaptation strategies.

In addressing Mozambique's complex challenges, it is imperative to adopt comprehensive approaches that consider the interplay between climate change, disaster risk, and socio-economic vulnerabilities. Strategies should aim at enhancing resilience and sustainability, focusing on improving water management, agricultural practices,

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and urban planning to safeguard against future climatic shocks and to support the well-being of vulnerable populations. Understanding the dynamics at play and their implications is crucial for stakeholders to develop effective mitigation and adaptation measures.

Table 25 describes all the preparation steps needed to perform the demonstration on the Mozambique use case, for both the UF and WFS tracks. Data collection spans months 7 to 12. Generation of indicators, indexes and services spans months 12 to 18. Finally, the preliminary work for validation and assessment spans months 16 to 18.

Table 25: Preparation phase for the Mozambique scenario.

Step	Risk phase	Project period	Delivery date	Description	Roles and responsibilities
1	EW	M7-M12	M7-M12	Collection of meteorological observations of March 2019 over the AOI	ECWMF
2	EW	M7-M12	M7-M12	Collection of meteorological forecasts over the AOI	ECWMF
3	EW	M7-M12	M7-M12	Collection and preparation of EO-based and ancillary data (elevation, hydrography and hydrology, LULC, topographic layers, VHR pre-event imagery, flood footprint for March 2019)	e-GEOS
4	EM	M7-M12	M7-M12	Collection and preparation of additional EO-based and ancillary data (built-up 2D and 3D, population, InSAR compatible imagery, including a March 2019 post-event image)	DLR: Built-up and population UNISTRA-SERTIT: InSAR data, DTM
5	EM	M7-M12	M7-M12	Collection and integration of media information related to the flooding event from 14/03/2019 to 16/03/2019	Hensoldt
6	EM	M7-M12	M7-M12	Collection and integration of media information related to economic impact of floods in March 2019	Hensoldt
7	EW	M7-M12	M7-M12	Collection of precipitation and temperature data from 2018 to present (time series) for drought monitoring: - Temperature (ERA5) - Precipitation (ERA5/GPCC) - Potential Evaporation (ERA5)	ECMWF
8	EW	M7-M12	M7-M12	Collection of data for drought forecast: - ENS - ENS-ER - Seasonal forecast data	ECMWF
9	EW	M7-M12	M7-M12	Collection of agricultural related data: - Root soil moisture (GRACE and GRACE FO) - Land Surface Temperature (Sentinel-3) - Air Temperature, relative humidity, precipitation, solar radiation and wind speed (ERA5-Land dataset) - Fraction of Vegetation Cover	VITO ECMWF: Precipitation and temperature, forecasts on soil moisture anomalies UNISTRA-TRIO: Soil moisture
10	EW	M7-M12	M7-M12	Collection of EO related data necessary for index generation: - Sentinel-3 - NOAA - METOP - MODIS	VITO
11	EW	M7-M12	M7-M12	Collection and preparation of IOM DTM / UNHCR CCCM data, and EO based data for camp status: - Sentinel - SAR data - VHR Contributing mission	e-GEOS

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Step	Risk phase	Project period	Delivery date	Description	Roles and responsibilities
12	EW	M7-M12	M7-M12	Collection of Auxiliary and Media data: - HOT OSM - ACLED - IOM-DTM Mobility tracking - FEWSNET - FAO DIEM, FAO Wapor - Afrobarometer - Demographic and Health Survey (DHS) - Social/traditional media data	Adelphi GMV: Livestock heat stress, rangeland cover change, main roads Hensoldt: Media data
13	EW	M12-M18	M13	Collection of EO data for media-based indicators: - EOG Night Time Light (NTL)	Adelphi
14	EW	M12-M18	M16	Generation of NDVI time series (1km over the last 20 years) and derived data (FAPAR, LAI)	VITO
15	EW	M12-M18	M13	Generation of the thermal drought stress indicator	VITO
16	EW	M12-M18	M13	Generation of UF-ID-1 "Historical 6 hours return period static precipitation maps"	ECWMF: Production e-GEOS: Quality control
17	EW	M12-M18	M16	Generation of UF-ID-2 "ML data driven forecast of return period-based precipitation events in urban areas"	ECWMF: Production e-GEOS: Quality control
18	EW	M12-M18	M13	Generation of UF-ID-3 "Urban inundation probability maps and water depth defined by return period at a spatial resolution in the order of < 10 m"	e-GEOS: Production ECWMF: Quality control
19	EM	M12-M18	M13	Generation of UF-ID-4 "Inferred InSAR urban flood extent"	UNISTRA-SERTIT: Production e-GEOS: Quality control
20	EM	M12-M18	M15	Generation of UF-ID-5 "Urban flooding map based on geomorphological and InSAR approach for an enhanced damage" - Flood extent - Damage assessment on transportation and buildings - Damage assessment on facilities	e-GEOS: Flood extent, damage assessment (transportation, buildings), Production UNISTRA-SERTIT: Damage assessment (facilities) e-GEOS, UNISTRA-SERTIT: Quality control
21	EM	M12-M18	M13	Generation of UF-ID-6 "Social and traditional media indicators for urban flooding maps"	e-GEOS: Initialisation (flood extent inputs) Hensoldt: Production
22	EM	M12-M18	M14	Generation of UF-ID-7 "Hazard web sources indicator"	e-GEOS: Production Adelphi: Quality control
23	EM	M12-M18	M18	Generation of UF-ID-9 “Assets and financial resources”	Adelphi, UNISTRA-SERTIT
24	EM	M12-M18	M18	Generation of UF-ID-10 “Public services and government support”	Adelphi, UNISTRA-SERTIT
25	EM	M12-M18	M18	Generation of UF-ID-13 “Ability to flee”	Adelphi, UNISTRA-SERTIT
26	EM	M12-M18	M18	Generation of UF-ID-14 "Economic impact of floods"	e-GEOS: Initialisation, quality control Hensoldt: Production
27	EW	M12-M18	M13	Generation of WFS-ID-1 "Meteorological drought indicator (Monitoring)"	ECMWF
28	EW	M12-M18	M15	Generation of WFS-ID-2 "Meteorological drought indicator (Forecast)"	ECMWF
29	EW	M12-M18	M13	Generation of WFS-ID-3 "Meteorological drought indicator (calibrated in danger levels)"	ECMWF: WFS-ID-1 and WFS-ID-2
30	EW	M12-M18	M14	Generation of WFS-ID-4 "Agricultural drought monitoring (near real-time)"	VITO: NDVI, NDWI, LST, root zone soil moisture, land cover ECMWF: ERA5 air temperature and precipitation data

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Step	Risk phase	Project period	Delivery date	Description	Roles and responsibilities
31	EW	M12-M18	M18	Generation of WFS-ID-5 "Agricultural drought forecast"	VITO: WFS-ID-4 ECMWF: Precipitation and air temperature forecasts and soil moisture anomalies
32	EW	M12-M18	M15	Generation of WFS-ID-6 "Risk zone map"	VITO: WFS-ID4 and WFS-ID-5
33	EM	M12-M18	M18	Generation of all relevant socioeconomic and media-based indicators: WFS-ID-11 "Food Security", WFS-ID-12 "Economic Security", WFS-ID-13 "Displaced Persons", WFS-ID-14 "Crime and illicit activities", WFS-ID-15 "Radicalisation and polarisation", WFS-ID-17 "Humanitarian Aid", WFS-ID-18 "Resource capture", WFS-ID-19 "Climate sensitivity of agri-food systems", WFS-ID-21 "Public services and infrastructure", WFS-ID-23 "State-citizen relations", WFS-ID-24 "Dispute resolution mechanisms", and WFS-ID-25 "Social cohesion"	Adelphi Hensoldt: Media mining system
34	PSA	M12-M18	M15	Preparation of end-user and service provider questionnaires	CLS, SatCen, Tracasa: Preparation UNISTRA-SERTIT, Tracasa: Quality control
35	EW	M12-M18	M17	Generation of “Early Warning Forecast Index”	ECWMF: Production e-GEOS: Quality control
36	EM	M12-M18	M18	Generation of “Flood Impact Index”	e-GEOS: Production GMV: Quality control
37	PSA	M12-M18	M16-M18	Preliminary assessment of indicators, indexes, services and platform functionality	Tracasa

Table 26 describes all the execution steps that pertain to the demonstration on the Mozambique use case. They will all span month 19, alternating between upload of products and availability notification to end-users. Finally, the execution phase for the Mozambique scenario will conclude in month 19 with the solicitation of **Helpcode** and service providers, to provide feedback on the system for the evaluation phase.

Table 26: Execution phase for the Mozambique scenario.

Step	Risk phase	Project period	Delivery date	Description	Roles and responsibilities
37	EW	M19	T-7	Upload of WFS-ID-1 product	ECMWF: Product upload GMV: Delivery check
38	EW	M19	T-7	Notification of WFS-ID-1 product availability to the service providers and the end users	ECMWF
39	EW	M19	T-6	Upload of WFS-ID-2 product	ECMWF: Product upload GMV: Delivery check
40	EW	M19	T-6	Notification of WFS-ID-2 product availability to the service providers and the end users	ECMWF
41	EW	M19	T-5	Upload of WFS-ID-4 product	VITO: Product upload GMV: Delivery check
42	EW	M19	T-5	Notification of WFS-ID-4 product availability to the service providers and the end users	VITO
43	EW	M19	T-4	Upload of WFS-ID-5 product	VITO: Product upload GMV: Delivery check
44	EW	M19	T-4	Notification of WFS-ID-5 product availability to the service providers and the end users	VITO
45	EW	M19	T-3	Upload of UF-ID-1 product	ECWMF: Upload GMV: Delivery check
46	EW	M19	T-3	Notification of UF-ID-1 product availability to the service providers and the end-users	ECWMF
47	EW	M19	T-2	Upload of WFS-ID-7 product	e-GEOS: Product upload GMV: Delivery check

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Step	Risk phase	Project period	Delivery date	Description	Roles and responsibilities
48	EW	M19	T-2	Notification of WFS-ID-7 product availability to the service providers and the end users	e-GEOS
49	EW	M19	T-2	Upload of UF-ID-2 product	ECWMF: Upload GMV: Delivery check
50	EW	M19	T-2	Notification of UF-ID-2 product availability to the service providers and the end-users	ECWMF
51	EW	M19	T-1	Upload of UF-ID-3 product	e-GEOS: Upload GMV: Delivery check
52	EW	M19	T-1	Notification of UF-ID-3 product availability to the service providers and the end-users	e-GEOS
53	EW	M19	T0	Upload of "EW Forecast Index" product	e-GEOS: Upload GMV: Delivery check
54	EW	M19	T0	Notification of "EW Forecast Index" product availability to the service providers and the Mozambique end-users	e-GEOS
55	EW	M19	T0	Upload of WFS-ID-3 product	ECMWF: Product upload GMV: Delivery check
56	EW	M19	T0	Notification of WFS-ID-3 product availability to the service providers and the end users	ECMWF
57	EW	M19	T0	Upload of WFS-ID-6 product	VITO: Product upload GMV: Delivery check
58	EW	M19	T0	Notification of WFS-ID-6 product availability to the service providers and the end users	VITO
59	EW	M19	T0	Alert notification to the service providers and the Mozambique end-users	ECWMF: Alert sent to GMV ECWMF: Alert sent to Mozambique end-users and service providers
60	EM	M19	T+1	Upload of UF-ID-4 product	UNISTRA-SERTIT: Upload GMV: Delivery check
61	EM	M19	T+1	Notification of UF-ID-4 product availability to the service providers and the end-users	UNISTRA-SERTIT
62	EM	M19	T+2	Upload of UF-ID-5 product	e-GEOS: Upload GMV: Delivery check
63	EM	M19	T+2	Notification of UF-ID-5 product availability to the service providers and the end-users	e-GEOS
64	EW	M19	T+3	Upload of media indicators: WFS-ID-11, WFS-ID-12, WFS-ID-13, WFS-ID-14, WFS-ID-15, and WFS-ID-17 products	Adelphi: Product upload GMV: Delivery check
65	EW	M19	T+3	Notification of WFS-ID-11, WFS-ID-12, WFS-ID-13, WFS-ID-14, WFS-ID-15, and WFS-ID-17 product availability to the service providers and the end users	Adelphi
66	EM	M19	T+3	Upload of UF-ID-6 product	Hensoldt: Upload GMV: Delivery check
67	EM	M19	T+3	Notification of UF-ID-6 product availability to the service providers and the end-users	Hensoldt
68	EM	M19	T+4	Upload of UF-ID-7 product	e-GEOS: Upload GMV: Delivery check
69	EM	M19	T+4	Notification of UF-ID-7 product availability to the service providers and the end-users	e-GEOS
70	EM	M19	T+5	Upload of UF-ID-9 product	DLR: Upload GMV: Delivery check
71	EM	M19	T+5	Notification of UF-ID-9 product availability to the service providers and the end-users	DLR
72	EM	M19	T+6	Upload of UF-ID-10 product	DLR: Upload GMV: Delivery check
73	EM	M19	T+6	Notification of UF-ID-10 product availability to the service providers and the end-users	DLR

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Step	Risk phase	Project period	Delivery date	Description	Roles and responsibilities
74	EW	M18	T+6	Upload of media indicators: WFS-ID-18, WFS-ID-19, WFS-ID-21, WFS-ID-23, WFS-ID-24, and WFS-ID-25 products	Adelphi: Product upload GMV: Delivery check
75	EW	M18	T+6	Notification of WFS-ID-18, WFS-ID-19, WFS-ID-21, WFS-ID-23, WFS-ID-24, and WFS-ID-25 product availability to the service providers and the end users	Adelphi
76	EM	M19	T+7	Upload of UF-ID-13 product	DLR: Upload GMV: Delivery check
77	EM	M19	T+7	Notification of UF-ID-13 product availability to the service providers and the end-users	DLR
78	EM	M19	T+8	Upload of UF-ID-14 product	Hensoldt: Upload GMV: Delivery check
79	EM	M19	T+8	Notification of UF-ID-14 product availability to the service providers and the end-users	Hensoldt
80	EM	M19	T+9	Upload of "Flood Impact Index" product	e-GEOS: Upload GMV: Delivery check
81	EM	M19	T+9	Notification of "Flood Impact Index" product availability to the service providers and the end-users	e-GEOS
82	PSA	M19	T+9	Solicitation of Mozambique end-users and service providers to fill in the questionnaires	e-GEOS

Table 27 describes all the steps for a thorough evaluation of products and service for to the demonstration on the Mozambique use case. Starting in month 16 of the project, the expected delivery dates span from months 19 to 21. This phase will be supported by additional datasets that were not presented in previous deliverables. Only validation data for the UF track were identified, including:

- Comparable **optical images** acquired during the flood event.
- JBA Risk Management's **flood risk and hazard masks** of the National Flood Zone Mapping System for different return periods[23].
- **Literature**, including scientific papers, institutional documents from the Red Cross and government, as well as web news sources. They can provide crucial information on the damage caused by the event in the analysed area.

Table 27: Evaluation phase for the Mozambique scenario.

Step	Risk phase	Project period	Delivery date	Description	Roles and responsibilities
83	PSA	M16-M21	M19-M21	Finalisation of feedback through questionnaires	Mozambique end-users and service providers
84	PSA	M16-M21	M19-M21	Notification of completed questionnaire reception	e-GEOS to UNISTRA-SERTIT
85	PSA	M16-M21	M19-M21	Download of feedback questionnaires from end-users and service providers	UNISTRA-SERTIT
86	PSA	M16-M21	M19-M21	Product and service validation	Tracasa
87	PSA	M16-M21	M19-M21	Data analysis, conclusion and inventory of recommendations and actions to be implemented in short and medium terms	Tracasa: Validation UNISTRA-SERTIT: Questionnaire analysis e-GEOS, SatCen: Review
88	PSA	M16-M21	M19-M21	Dissemination of results, lessons learnt, recommendations	UNISTRA-SERTIT, e-GEOS and SatCen

[23] Cylone Idai causes extensive flooding across Mozambique, Malawi and Zimbabwe, 2019 – https://www.jbarisk.com/products-services/event-response/cyclone-idai/

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3.6 CHALLENGES, LIMITATIONS AND PROPOSED SOLUTIONS

The technical team and service providers have identified a series of steps that might end up being challenging during the preparation, execution or evaluation of the demonstrators. Preliminary solutions have already been proposed for some, but further investigation is required within WP2 and WP4.

3.6.1 Challenges in the preparation of scenarios

During the cold case phase, the **preparation of scenarios** has two main goals: **collection of input data** and **generation of indicators, indexes and services**. They can incur several challenges, organized into coherent categories, including data availability and accuracy, temporal dynamics of flood events, indicator development limitations, and predictive model limitations.

Data availability and accuracy

Accurate and relevant analysis is constrained by the **quality of reference input data**, including terrain elevation, land use, hydrography, and artificial features such as roads and buildings. In this setting, quality refers to both thematic and positional matters. As these data contribute to assessing different components of the risk system, a comprehensive knowledge of their specifications is mandatory to account for possible measurement or estimation errors. Collecting different data sets serving the same purpose could help determine whether CENTAUR products align with a general trend.

Additionally, there is an observed **scarcity in geolocatable media coverage** over several use cases, related to crisis events and their economic impacts. Changes in the policy of key social media platforms, like X/Twitter, further exacerbates the situation. Future demonstrations – hot cases – could mitigate this by expanding media and language coverage.

Temporal dynamics of flood events

Proper estimation of flood extents depends on the **availability of EO images acquired during flood peak**. However, there is no guarantee such conditions are met during an event. This may lead to the underestimation of several indicators, including flood depth and damage assessment. Even though the impact is limited to the UF track generally speaking, it also impedes on the potential for a cross-cutting analysis, as unmapped flooded areas could result in local crop failure for example. Considering the high costs of HR to VHR imagery, the only reasonable solution is to harvest and integrate as much free EO data as possible.

In larger AOIs, **flood peak times vary along the river course**, implying that a single EO acquisition may not accurately capture the maximum water extent across different sections of the analysed region. In the context of this demonstration cycle, this challenge only concerns France.

In addition, **some indicators may require several occurrences of the same crisis event to provide robust results**. This is especially the case for UF-ID-7. This will likely not be an issue during cold case demonstration. However, in anticipation of the hot phase, the collection of additional crisis information from alternate channels could prove useful.

Indicator development limitations

Population and buildings do not adequately capture the variables of interest for the generation of UF-ID-9, 10 and 13, over several use cases. When applicable, available information drawn from census data will be used.

Moreover, the **development of UF-ID-9, 10, and 13 is not currently included in several scenarios**, as they were initially intended for Mozambique in the cold case phase, possibly Spain and France as well depending on progress. The reason behind this strategy stems from the fact that socio-economic data over all use cases are not necessarily available, and should be aligned to generate comparable figures. The involved partners will explore the possibility

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of extending these indicators at a later stage. Nonetheless, computation of these indicators will concern all the use cases during the hot phase.

Predictive model limitations

Weather forecast models face different challenges in accurately predicting precipitation over extended lead times. To enable realistic predictions and account for these specificities, ensemble forecasts will be employed to assess drought occurrence probabilities and severities.

The **interaction between current drought conditions and future meteorological scenarios** is highly variable and dependent on local environmental conditions. Developing a universally effective threshold-based system across Africa poses a significant challenge.

Finally, a major challenge lies in **converting EO-based change detection products into quantitative characterizations** of settlement extents, population estimates and other actionable features. This is currently being addressed as part of WP2.

3.6.2 Challenges in the execution of scenarios

During the cold case phase, the **execution of scenarios** aims at **delivering indicators, indexes and services**, and **soliciting stakeholders** so they can provide feedback leveraged during the evaluation phase. The identified challenges are categorized into technical difficulties, communication challenges and operational inadequacies.

Technical difficulties

Technical issues may **disable the ability to share and upload indicators or indexes** with the end-users, crucial for the demonstration's success. This requires robust troubleshooting protocols and backup solutions to ensure continuity, which are points discussed between partners.

Incorrect performance of Key Performance Indicators can significantly affect the demonstration's effectiveness, necessitating thorough validation and testing processes to ensure accuracy and reliability. A comprehensive presentation of the evaluation process is available in Chapter 4 and covers several solutions to this challenge. Potential additional findings will be covered in future tasks and deliverables if need be.

Communication challenges

There is a risk of **end-users not receiving notifications correctly**, which could result in disengagement or missed critical updates. Mitigation strategies include pre-emptive communication with users to confirm the execution phase, notify deliveries, and validate contact information. The goal is to ensure effective and reliable communication channels.

Operational inadequacies

Missing one or more critical indicators could compromise the demonstration's effectiveness. This underscores the importance of comprehensive planning and the inclusion of all necessary data points in the demonstration's design. Unfortunately, the current planning cannot take into account possible delays that may occur. This issue mostly concerns the computation of high-level information, as data collection was completed in 2023, apart from a couple of loose ends.

The reliability of demonstration results could be compromised by **inaccuracies or inconsistencies in input data**. Rigorous data validation and cross-verification methods are essential to maintain the integrity of the demonstration's outcomes. However, **missing validation data** could also minimize hindsight. This is particularly true for WFS indicators and services, as there is no proper equivalent to what is being designed. Thus, partners remain on the lookout for additional references, to safeguard future developments and certify the quality of crisis packages delivered to end-users.

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3.6.3 Challenges in the evaluation of scenarios

During the cold case phase, the **evaluation of scenarios** is set to provide information on the entire demonstration process, including **validation of results**, **analysis of stakeholder feedback** and **dissemination of results** within the consortium and towards external parties. Services providers have identified several challenges, which also overlap with the ones from the execution phase in subsection 3.6.2. They include:

- The **lack of validation data**, especially on areas with little to no funding for the development of environmental databases, or with limited access to free open-source information.
- The **lack of end-user engagement**, which is key in the validation of CENTAUR components.
- **Issues during the preparation and execution phases**, resulting in the absence of one or more components to validate.

Chapter 4 cover this phase and potential challenges in detail.

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4 DEMONSTRATORS ASSESSMENT

Evaluating CENTAUR demonstrators involves assessing the technical robustness of CENTAUR's system and solutions, as well as evaluating users' and service providers' satisfaction and compliance with their needs and requirements.

The technical soundness of the systems and solutions undergoes an evaluation by consortium members who were not involved in their development. This external evaluation includes assessing new products, such as indicators and indices, along with the web platform created for sharing them. The products and the platform's technical robustness will be evaluated separately in WP2 and WP3, respectively. Subsection 4.1 shows the CENTAUR products validation protocol, defined based on the CEMS RM[24] validation protocol and ISO 19157[25], to assess the indices and indicators developed by the project. Subsection 4.2 shows just an introduction to the CENTAUR platform validation strategy, an in-depth explanation of the approach will be provided in D3.5, created in the context of WP3.

The satisfaction of users and service providers related to the new products and the platform developed by CENTAUR will be evaluated by analyzing their feedback, gathered through questionnaires created by the CENTAUR consortium. Questionnaires are relevant to assess the general usefulness of CENTAUR products and services from the users' and the service providers' perspectives. Sub-sections 4.3.1 and 4.3.2 explain how they have been created and the main aspects that will be evaluated. The satisfaction of users and service providers is assessed in WP4.

4.1 DEFINITION OF VALIDATION CRITERIA FOR PRODUCTS

This section defines the framework for the CENTAUR products validation assessment. The validation principles, methods, rules and guidelines in this document aim to provide a structure that guarantees the overall documented and continuous quality of the CENTAUR products. The goal is to ensure that all products meet the required levels of accuracy, availability and affordability requested and expected by the end-users.

The validation of CENTAUR products relies on a set of quantitative as well as qualitative parameters that are grouped into three main categories:

- Reliability assessment.
- Consistency assessment.
- Usability assessment.

Each category requires a specific set of validation parameters, tools, and methods. In the following, the three main categories are described with the concerning attributes to be validated. These attributes have been selected from the CEMS RM validation protocol and ISO 19157 quality data standard to evaluate the specific requirements of CENTAUR products and services.

This sub-section is organized as follows. First, for each validation category, (1) a definition is provided, (2) subsequently, the different attributes and some indications of the metrics used for assessing these attributes are given, and (3) the methodologies that can be used to estimate these parameters are proposed. This sub-section explains all the parameters assessed during the validation phase. Table 32, located at the end of the sub-section, summarizes the parameters to be assessed per CENTAUR product.

[24] Broglia, Marco & Corbane, Christina & Carrion, Daniela & Lemoine, G & Pesaresi, Martino. (2010). Validation Protocol for Emergency Response Geo-information Products. 10.2788/63690.
[25] ISO (2013). ISO 19157:2013 Geographic information - Data quality

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4.1.1 Assessment reliability (thematic quality)

Reliability is generally defined as the degree to which the information contained in a product is similar to a reference. From the user's point of view, reliability is a statement about how much the user can trust in a product given its purpose.

In the CENTAUR context, the reliability assessment will be limited to analysing of the thematic quality of the designed indicators and indexes. The general approach to assess the thematic quality of the CENTAUR indicators and indexes is to compare them with independent information sources. The comparison approach to be applied depends on (1) the nature of the attribute under evaluation and (2) the availability of validation data. Therefore, to define the appropriate thematic assessment method per indicator in the CENTAUR context, it is necessary to identify 1) the **type of attribute each indicator/index represents** and 2) the **validation data available per Use Case for each indicator.**

The **CENTAUR indicators and indexes** can be grouped into two main categories: A) categorical and B) quantitative; while, according to the CEMS validation protocol, **validation data** can be classified into three main categories: A) Ground truth measures, B) Reference data sources, C) Other products containing similar information. Table 28 and Table 29 describe the types of attributes to be validated and the types of validation data respectively.

Table 28: Types of attribute to be validated.

TYPE OF ATTRIBUTE[26]	EXAMPLES OF VARIABLE
Categorical Categorical variables are descriptions of groups or things. This includes rankings, classifications, and binary outcomes.	Flood Extent (e.g., Flood/ Not Flood)
Quantitative Quantitative variables are any variables where the data represent amounts.	Flood Depth

Table 29: Types of validation data.

TYPE OF VALIDATION DATA	EXAMPLES OF VALIDATION DATA
Ground truth measures: Ground truth data regarding an event are collected at the location of the event, at event time or in a temporal range during which the situation object of interest does not change. This source usually allows the best performances in terms of *accuracy* of the validation process.	• Control points collected in a **field mission.** • **Independent measurements** of the event of interest like, for example, water level records in the case of floods or field reports like UNHCR refugee camps register.
Reference data sources. When ground truth data is unavailable, a comparison with independent reference data is needed to determine *consistency.* Key to any consistency assessment is the provision of representative, independent reference data that is inherently more accurate than the product to be evaluated.	• **VHR satellite images or airborne images**. In general, imagery of higher spatial resolution than the satellite data used to generate a product and/or better spectral and radiometric resolution.

[26] https://www.statisticshowto.com/quantitative-variables-data/#definition

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TYPE OF VALIDATION DATA	EXAMPLES OF VALIDATION DATA
Reference data should also encompass the same period as the information product under validation.	• **Models**: e.g. hydrological models for flood area estimation.
Other products containing similar information Inter-comparison takes as inputs products coming from different providers with information contents similar to the product's contents under validation. Inter-comparison only results in a measure of consistency between the compared products. Analysing the degree of difference between the product under validation and other similar ones, insights into the reasons for such differences and consequent identification of the possible weak points of the product. This data type can be beneficial when access to reference data is difficult.	• Previously **validated products** considered as suitable for validation purposes.

Depending on validation data availability (A) an accuracy or (B) consistency **quantitative thematic** assessment will be carried out. If there is insufficient data to quantitatively assess thematic quality of the CENTAUR products, a **qualitative consistency** evaluation is proposed. When there are multiple data sources available for validation, they will be chosen according to the following priority order: 1) Ground truth measurements, 2) Reference data sources, and 3) Other products that contain similar information.

Based on the current availability of data for validation purposes, a tentative validation plan has been described (see Section 4.1.5).

4.1.1.1 Quantitative thematic assessment

Thematic accuracy

In essence, **thematic accuracy** evaluates the **correctness** of the information represented in CENTAUR products by comparing the value/category assigned to features in the products with their value/category in **ground truth (GT)**. The CENTAUR validation protocol proposes to validate the correctness of (A) **categorical indicators/indices** using metrics derived from a confusion matrix and (B) derived from linear regression or the Root Mean Square Error (RMSE) for the **quantitative ones**. Quality metrics can be estimated for different strata that may affect the quality homogeneity of the indicator/index across the territory (e.g., LULC).

General approach/parameters

Thematic accuracy of categorical products

Thematic accuracy of categorical products will be assessed using metrics derived from a confusion matrix. This matrix is a simple cross-tabulation of the class labelled in the CENTAUR product against the ground truth data. Different measures and statistics can be derived from the values in the matrix.

The following confusion matrix is proposed for binary classifications (e.g., Flood/ Not Flood). Quality measures such as Overall accuracy, User's accuracy, Producer's accuracy, Commission error, and Omission error will be calculated at a minimum. Additionally, quality measures of the union of the crisis layers will be provided. This helps to prevent any impact that the disproportion between the AOI and the area classified as a crisis might have on the results.

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Table 30: Confusion matrix for a binary classification (two categories).

		GT				
		Positive(p)	*Negative (n)*	TOTAL	User's acc. %	Commission error %
CENTAUR	*Positive(p)*	n_{pp}	n_{pn}	$n_{pp}+n_{pn}$	$(n_{pp}/(n_{pp}+n_{pn}))$ *100	$(n_{pn}/(n_{pp}+n_{pn}))$ *100
	Negative (n)	n_{np}	n_{nn}	$n_{np}+n_{nn}$	$(n_{nn}/(n_{np}+n_{nn}))$ *100	$(n_{np}/(n_{np}+n_{nn}))$ *100
	TOTAL	$n_{pp}+n_{np}$	$n_{pn}+n_{nn}$	N		
	Producer's acc. %	$(n_{pp}/(n_{pp}+n_{np}))$*100	$(n_{nn}/(n_{pn}+n_{nn}))$ *100			
	Omission error %	$(n_{np}/(n_{pp}+n_{np}))$*100	$(n_{pn}/(n_{pn}+n_{nn}))$ *100			

Overall accuracy %	$((n_{pp}+n_{nn})/N)$ *100
Overall accuracy of crisis information %	$(n_{pp}/(n_{np}+n_{pp}+n_{pn}))$ *100

When there are multiple categories in the legend of a classification (e.g., Building Damage Grading Assessment), we will use the following confusion matrix template.

Table 31: Confusion matrix for a multiclass classification (> two categories).

		GT						
		Class 1	*Class 2*	…	*Class* k	TOTAL	User's acc. %	Commission error %
CENTAUR	*Class 1*	n_{11}	n_{12}		n_{1k}	n_{1+}	(n_{11}/n_{1+})*100	$((n_{1+} - n_{11})/n_{1+})$*100
	Class 2	n_{21}	n_{22}		n_{2k}	n_{2+}	(n_{22}/n_{2+})*100	$((n_{2+} - n_{22})/n_{2+})$*100
	…					…	…	
	Class k	n_{k1}	n_{k2}		n_{kk}	n_{k+}	(n_{kk}/n_{k+})*100	$((n_{k+} - n_{kk})/n_{k+})$*100
	TOTAL	n_{+1}	n_{+2}		n_{+k}	N		
	Producer's acc. %	(n_{11}/n_{+1}) *100	(n_{22}/n_{+2}) *100		(n_{kk}/n_{+k}) *100			
	Omission error %	$((n_{+1} - n_{11})/n_{+1})$ *100	$((n_{+2} - n_{22})/n_{+2})$ *100		$((n_{+k} - n_{kk})/n_{+k})$ *100			
	Conditional kappa	$(N* n_{11} - n_{1+}* n_{+1})/(N* n_{1+} - n_{1+}* n_{+1})$	$(N* n_{22} - n_{2+}* n_{+2})/(N* n_{2+} - n_{2+}* n_{+2})$		$(N*n_{kk} - n_{k+}*n_{+k})/(N*n_{k+} - n_{k+}*n_{+k})$			

Overall accuracy %	$((n_{11}+…+n_{kk})/N)$*100

If the complete AOI cannot be checked (i.e., only selected elements can be cross-compared) a sampling strategy that ensures statistical significance and representativeness will be performed. The sample size n required to validate a categorical product by means of a confusion matrix is defined by a binomial (two categories in the legend) or multinomial (more than two categories in the legend) function-based approach; see the equations below.

Multinomial $$n = \frac{z_{\alpha/k} \cdot \mathrm{p}\,(1-\mathrm{p})}{\varepsilon^2}$$

Binomial $$n = \frac{{z_{\alpha/2}}^2 \cdot p(1-p)}{\varepsilon^2}$$

This approach provides the sample size n needed for the validation of K categories, under the requirement of population proportion interval estimated at (1 – α) confidence, margin of error ε, planned proportion p and z following a χ2 distribution with one degree of freedom in multinomial or a normal in a binomial. The planned proportion will be the expected quality of the product in each case.

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Sample allocation will be done through a **stratified random sampling** within the limits of the AOI, which is a design that satisfies the basic accuracy assessment objectives and most of the desirable design criteria[27].

Thematic accuracy of quantitative products

Thematic accuracy of quantitative products (e.g., Flood depth) will be assessed using metrics derived from linear regression and error metrics.

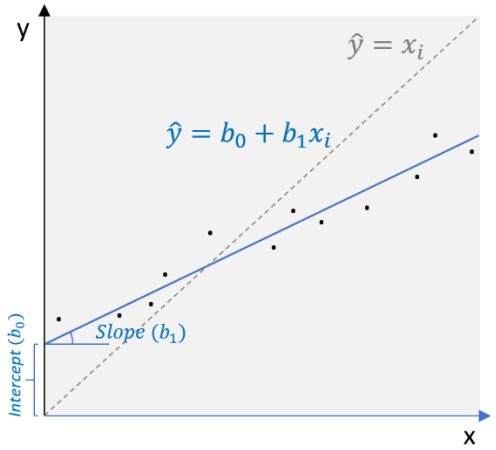
Root Mean Square Error, RMSE, is proposed to measure differences between the ground truth data and the CENTAUR products under validation. RMSE is the square root of the average of squared errors and is one of the most used error-based measure. The effect of each error on RMSE is proportional to the size of the squared error; thus, more significant errors have a more significant effect on RMSE.[28,29]

$$RMSE = \sqrt{\frac{1}{n}\sum_{i-1}^{n}(x_i - \hat{y}_i)^2}$$

Where:

- x_i is the value obserbed in GT
- $\hat{y}_i$ is the value predicted by the indicator
- n is the number of observations

The products under validation and the ground truth data can be also cross-compared by analysing the **slope and the intercept derived from a simple linear regression** (one predictor variable, least squares method)[30].



Where:

- x_i is the value obserbed in GT
- $\hat{y}_i$ is the value predicted by the indicator
- b_0 is the intercept
- b_1 is the slope

The slope (b1) represents the change in the value of the layer under control corresponding to the unit change in the reference data. The intercept (b_0) is the value that the layer takes when the reference data is zero. Therefore, values of slope (b_1) close to one and intercept (b_0) close to zero are desirable (dotted grey diagonal line in the

[27] Olofsson, P., Foody, G. M., Herold, M., Stehman, S. V., Woodcock, C. E., & Wulder, M. A. (2014). Good practices for estimating area and assessing accuracy of land change. Remote sensing of Environment, 148, 42-57. Available at: https://www.sciencedirect.com/science/article/abs/pii/S0034425714000704

[28] Pontius, R., Thontteh, O., and Chen, H. 2008. Components of information for multiple resolution comparison between maps that share a real variable. Environmental Ecological Statistics. 15 (2): 111–142. Available at: https://doi.org/10.1007/s10651-007-0043-y

[29] Willmott, C., and Matsuura, K. 2006. On the use of dimensioned measures of error to evaluate the performance of spatial interpolators. International Journal of Geographical Information Science. 20: 89–102. Available at: https://www.tandfonline.com/doi/full/10.1080/13658810500286976

[30] Pesaresi, M., Politis, P., and Kemper, T. 2021. Advances on the GHS-BUILT data set for the epochs 2018, 2014, 2000, 1990, and 1975, Joint assessment of Sentinel MSI, Landsat ETM, TM, and MSS satellite imagery, European Commission, Ispra, JRC127999. Available at: https://joint-research-centre.ec.europa.eu/index_en

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figure). Slope and intercept values different to the cited would indicate trends and systematic errors of underestimation and overestimation in the layer under control.

In the event that it is impossible to check the complete AOI, the validation team will perform a sampling strategy that ensures statistical significance and representativeness. The sample size (n) per stratum of interest must be sufficient and appropriate to the validation technique, i.e., by means of measures based on regression or error measures. The bibliography is unclear about the minimum admissible sample size but emphasises the importance of the selected sample being normally distributed. The central limit theorem states that the distribution of sample means approximates a normal distribution, as the sample size gets larger, regardless of the population's distribution[31]. Jenkins and Quitana-Asencio (2019)[32] recommend that research based on regression should use n≥25 to guarantee normal distribution of data and avoid inaccurate inference results due to possible high variance. Given that the sample characteristics in terms of variance are unknown until allocating the random samples, a conservative approach would consider at least 50 samples per stratum.

Pass/fail criteria

According to CEMS specifications.

Thematic consistency

Thematic consistency is based on validation data different from ground truth measures, i.e., reference data sources or other products containing similar information can be used to check the thematic consistency of information when in-situ data is unavailable.

Parameters used for measuring thematic consistency

As for thematic accuracy assessment, the thematic consistency of categorical indicators/indices will use metrics (A) derived from a confusion matrix and (B) derived from linear regression or the Root Mean Square Error (RMSE) for the quantitative ones. The approach described for the calculation of thematic accuracy will be followed.

Pass/fail criteria

According to CEMS specifications.

4.1.1.2 Qualitative thematic assessment

Although evaluating thematic quality through a complete population comparison or probability sampling is the most reliable method, there are other approaches that can also contribute to understanding errors and improving map consistency. In situations where there is a lack of cartographic data or insufficient data for statistical analysis, a qualitative analysis will be conducted by comparing existing data sources.

General approach/ parameters

The method involves visually comparing CENTAUR indicators with the available validation data and analysing the differences in origin and reasons. The plausibility of the results will be assessed.

Parameters used for measuring thematic consistency

N/A

[31] Field, A. 2013. Discovering statistics using IBM SPSS statistics. Sage. Available at: https://uk.sagepub.com/en-gb/eur/discovering-statistics-using-ibm-spss-statistics/book257672 [Last access 17/06/2023]

[32] Jenkins, D. G., Quintana-Ascencio, P. F. 2020. A solution to minimum sample size for regressions. Plos One, 15(2), e0229345. Available at: https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0229345 [Last access 17/09/2023]

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Pass/fail criteria

Based on the expert knowledge. The results will be reported using a categorical ordinal scale including **three pertinence levels** (i.e., Bad, fair, good).

> The thematic assessment will be checked in the **CENTAUR indices and indicators**. The thematic validation of each product will be subject to the validation data availability in each Use Case. The comparison approach to be applied depend on (1) the nature of the variable under evaluation and (2) the validation data availability. It will be set per indicator/index and Use Case in the Thematic Validation Plan.

4.1.2 Consistency assessment

Traditionally, consistency checks internal contradictions of a product, between different components of a map or with respect to specific set requirements. Consistency validation requires as input the product under validation and the requirements; **no reference source is required**.

The CEMS RM validation protocol defines a list of quality checks that allow controlling the internal consistency of the data included in the CEMS printable maps, as well as the relationships between them. These checks will be selected and adapted to assess the consistency aspects of the CENTAUR indexes and indicators uploaded to the platform.

4.1.2.1 Relative positional consistency

This attribute describes consistency between spatial information contained in a map. There are features with expected positional relation between themselves, e.g. adjacency of municipality/county/state boundaries, containment of bridges in transport networks. In the CENATUR context, the relative positional consistency will be qualitatively checked across the different products and a selected basemap.

General approach/ parameters

The attribute is visually checked.

Pass/fail criteria

The lack of positional coherence between the product and the selected basemap will imply failure. The results will be reported using a categorical ordinal scale including **three pertinence levels** (i.e., Bad, fair, good). The judgment will be based on the expert knowledge.

4.1.2.2 Topological consistency

This check aims to test the topological consistency of indicators/indexes. The importance of topological consistency lies in the fact that it increases the effective usability of data: every geo-data can be printed, but the area can be calculated only for closed polygons and the minimum path can be calculated only for connected networks. Thus, the respect of topological properties can be very important for specific geo-information products, depending on their expected use. In addition, topological relations can help to detect content errors, e.g. a dam should be contained in the boundary of water bodies.

The following topological rules will be analysed:

- **Adjacency:** Features sharing perimeters should be adjacent.
- **Presence of gaps:** Gaps might not be a topological error, depending on their size and the layer under evaluation. However, gaps might be an error if their size is under a given Minimum Mapping Unit (MMU).
- **Overlapping:** Features of crisis information layers should not overlap, partially nor completely, unless they correspond to monitoring products.
- **Cover/Inclusion:** Some features should be completely covered or included in others.

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General approach

Topology will be automatically checked using a series of python-based scripts for ArcGIS. They can be executed over the GdB or over shapefiles. As a result, the number of errors for each topological rule will be obtain.

Pass/fail criteria

Topological consistency is achieved when the required properties are respected per CENTAUR index/indicator. Depends on the rule. In general, one error means Fail:

- **Adjacency:** 1 polygon with adjacency problem means Fail
- **Gaps:** 1 gap with area below MMU means Fail
- **Overlaps**: 1 overlap in input data means Fail
- **Cover/Inclusion:** input data not completely covered means Fail

4.1.2.3 Attributes consistency

Attribute consistency refers to data types and values that an attribute can have. This property is also known as domain consistency. The importance of attribute consistency lies in the fact that it increases the effective usability of data as alphanumeric attributes and they are also an important source of information.

Attribute consistency will be described through:

- **Data type compliance:** the data types contained in the product must be compliant with the expected data types, e.g. number, character, date.
- **Value range**: the attribute values must be included into expected (or anyway reasonable) ranges.
- **Filling of required fields**: some fields could be required for further computing and they must be filled.

General approach

Attributes consistency will be checked visually.

Pass/fail criteria

Attributes consistency is achieved when the required properties are respected per CENTAUR indicator and index. Depends on the rule. In general, one error means fails:

- **Data type compliance:** 1 data type not compliant means Fail
- **Value range**: 1 value range not compliant means Fail
- **Filling of required fields:** the not filling of required fields means Fail

4.1.3 Usability assessment, metadata consistency

Using a map requires reading, interpreting, analysing, and eventually integrating the information contained in it. Therefore, it is crucial to eliminate any misunderstandings and ambiguities. The CEMS RM validation protocol defines a list of quality checks that allow controlling the usability of CEMS printable maps and their data. In the CENTAUR context, the usability assessment of the products will be limited to the analysis of the **metadata consistency of the indicators and indexes,** and the CEMS RM validation protocol checks defined to control printable maps will be adapted to assess the platform usability from a cartographic point of view, see 4.2.

Spatial metadata is a critical part of any spatial data infrastructure, which enables the organising, sharing, discovery and use of spatial data. It contains information about geographic or spatial dataset descriptions, e.g., contents, structure, quality, and reference system that will help spatial data users to discover and determine the suitability of the data for their purposes through networked spatial data catalogue systems[33].

[33] Kalantari, M.; Syahrudin, S.; Rajabifard, A.; Subagyo, H.; Hubbard, H. Spatial Metadata Usability Evaluation. ISPRS Int. J. Geo-Inf. 2020, 9, 463. https://doi.org/10.3390/ijgi9070463

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Validation of metadata consistency in the CENTAUR context focuses on confirming **metadata presence** and its **compliance with CENTAUR's pre-defined structure and INSPIRE requirements** based on ISO 19115 and ISO 19119.

General approach

Metadata will be automatically checked using INSPIRE validator[34].

Pass/fail criteria

Metadata consistency is achieved when an indicator or index has associated metadata archive that complies with CENTAUR's predefined structure and INSPIRE requirements.

4.1.4 Summarised validation table

Table 32 summaries the parameters that will be assessed per CENTAUR vector and raster product, together with the approach that will be follow in each case.

Table 32: Validation parameters applied per raster (R) or vector (V) CENTAUR indicator/index.

RELIABILITY ASSESSMENT						
CHECK	ATTRIBUTES	PARAMETERS	RESULTS	V	R	Approach
1a	Thematic accuracy	Depends of attribute type (Overall accuracy or RMSE)	Number			Calculation of metrics
1b	Thematic consistency	Depends of attribute type (Overall accuracy or RMSE)	Number			Calculation of metrics
1c	Qualitative thematic assessment	Pertinence	☐ Bad ☐ Fair ☐ Good			Visual check
CONSISTENCY ASSESSMENT						
	ATRIBUTES	PARAMETERS	RESULTS	V	R	Approach
2	Relative positional consistency	Pertinence	☐ Bad ☐ Fair ☐ Good			Visual check
3	Topological consistency	Adjacent of features	☐ Correct ☐ Incorrect		NA	Automatic tool (script)
		Cover/inclusion	☐ Correct ☐ Incorrect			
		Presence of gaps	☐ Correct ☐ Incorrect			
		Overlapping	☐ Correct ☐ Incorrect			
		Closure of polygons	☐ Correct ☐ Incorrect			
		Connection of networks	☐ Correct ☐ Incorrect			
		Presence of dangle	☐ Correct ☐ Incorrect			
		Continuity of features	☐ Correct ☐ Incorrect			
4	Attributes consistency	Data type compliance	☐ Correct ☐ Incorrect		NA	Visual check
		Value range	☐ Correct ☐ Incorrect			
		Filling of required fields	☐ Correct ☐ Incorrect		NA	
USABILITY ASSESSMENT						
	ATTRIBUTES	PARAMETERS	RESULTS	V	R	Approach
5	Metadata consistency	Presence of metadata	☐ Correct ☐ Incorrect			Inspire validator
		Compliancy with INSPIRE	☐ Correct ☐ Incorrect			

[34] https://inspire.ec.europa.eu/validator/home/index.html

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		Compliancy with CENTAUR structure	☐ Correct ☐ Incorrect			

As mentioned earlier, the **Consistency and Usability assessment** will rely on the product under validation and the requirements, and no reference data will be required. Consistency assessments will depend on the format of each product (vector/raster) and will be conducted visually or using automatic tools, as appropriate. Usability assessments will be automatically checked using the INSPIRE validator.

On the other hand, the **Reliability assessment** (Thematic validation) of each product will depend on the availability of validation data in each Use Case. Depending on the type of available data, it will be assessed through metric calculations or visual checks.

The following section outlines a tentative validation plan.

4.1.5 Tentative validation plan

This section presents a tentative validation plan for UF and WFS. These tables have been created analysing (1) the availability of validation data for each Use Case, and (2) the format of each product or indicator (vector/raster). The cells highlighted in red indicate that validation may not be carried out in these cases, while those in green indicate that validation will be conducted. The cells highlighted in yellow are the ones to be discussed (TBD).

The final validation could undergo slight modifications with respect to what is presented here. The final validation plan will be included in *D4.3 – CENTAUR demonstration report and validation results v1 (cold cases).*

4.1.5.1 Urban Floods

The **reliability assessment** will be carried out when data for validation purposes is available. The table below shows for each Use Case, the indicators that are expected to be validated according to the availability of data for that purpose. Possible data to be used in each scenario is also described in Section 3.3 of the present document.

Table 33: Tentative validation plan for UF – Reliability assessment.

Reliability assessment	UF-ID**							Socio-economic UF-ID**				Indexes UF-IX	
USE CASE	01_R	02_R	03_R	04_V	05_R	06_V	07_T	09_R	10_R	13_R	14_R	01	02
SPAIN (Ebro basin)													
ITALY (Ceva)													
ITALY (Turin)													
GERMANY (Bad Neuenahr-Ahrweiler)													
FRANCE (Landes)													
MOZAMBIQUE (Beira)													

*R: raster / V: vector / T: table

Regarding the **indexes,** note that these will be derived from the former indicators and correspond to novel products. There is no direct data with which these indexes can be compared, therefore, their reliability may not be possible to assess.

As mentioned before, for the **Consistency and Usability assessment** no reference data is required. Based on the format of each UF-ID or UF-IX (vector/raster) some parameters or others will be validated. For each Use Case, the parameters corresponding to cells highlighted in green will be analysed.

Table 34: Tentative validation plan for UF – Consistency assessment.

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Consistency assessment			Data*		UF-ID**							Socio-economic UF-ID**				Indexes UF-IX	
ATRIBUTES		PARAMETERS	V	R	01_R	02_R	03_R	04_V	05_R	06_V	07_T	09_R	10_R	13_R	14_R	01	02
2	Rel.position	Pertinence															
3	Topology	Adjacent of features		NA													
		Cover/inclusion															
		Presence of gaps															
		Overlapping															
		Closure of polygons															
		Connection of networks															
		Presence of dangle															
		Continuity of features															
4	Attributes	Data type compliance		NA													
		Value range															
		Filling of required fields		NA													

*NA: Not applicable **R: raster / V: vector / T: table

Table 35: Tentative validation plan for UF – Usability assessment.

Usability assessment			Data*		UF-ID**							Socio-economic UF-ID**				Indexes UF-IX	
ATRIBUTES		PARAMETERS	V	R	01_R	02_R	03_R	04_V	05_R	06_V	07_T	09_R	10_R	13_R	14_R	01	02
5	Metadata	Presence of metadata		NA													
		Compliancy INSPIRE															
		Compliancy CENTAUR		NA													

*NA: Not applicable **R: raster / V: vector / T: table

4.1.5.2 Water and Food Security

It is believed that there may be no validation data for WFS products since they correspond to novel indicators. So, the **Reliability** of these products may not be possible to assess.

> Due to the extension of these products (they are being developed at the country level) and their novelty, it is not expected to have available data for their thematic validation.

The **Consistency and Usability assessment** of the different WFS indicators will be carried out analysing the same parameters than the ones used for UF and will also depend on the format of each product (raster/vector). Tables gathering the final validation plan for WFS will be delivered within *D4.3 – CENTAUR demonstration report and validation results v1 (cold cases).*

4.2 DEFINITION OF THE PLATFORM VALIDATION CRITERIA

This section shows an advance of the CENTAUR platform validation strategy. This evaluation will ensure that the platform meets the expected usability and functionality levels of the end-users.

> There is ongoing work on the platform. During the cold case phase, it is not expected to have a functional platform, but rather specific services and tools service prodivers can test before actual implementation in a pre-operation environment. Thus, any work related to the platform and presented in this chapter is a draft of what can be expected at a later stage of the project.

The platform assessment will be carried out in two stages. First, the CENTAUR partners will evaluate the usability of the services from **a theoretical point of view** to bridge any gap between the services and the intended users. Second, the users will give feedback through a customised questionnaire prepared by the CENTAUR consortium. Analysing their feedback will help verify the usability of the CENTAUR product from a ***fit-for-purpose*** **point of view**.

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The questionnaire provided to users can be found in Annex I, and the methodology to create it is detailed in sub-section 4.3. The theoretical assessment will be conducted using the criteria described in deliverable *D3.5 – CENTAUR Integrated Platform Test Document*.

4.3 USER AND SERVICE PROVIDERS SATISFACTION EVALUATION QUESTIONNAIRES

Questionnaires are relevant to assess the general usefulness of CENTAUR products and platform from (1) the Users' and (2) the Service Providers' (SP) perspectives. The following sub-sections explain how they have been created and the main aspects that will be evaluated (Sub-sections 0 and 4.3.2), together with how they will be analysed (Sub-section 4.3.3).

ⓘ During the cold case phase, although the questionnaires will be sent by email, it would be interesting for the leaders of each use case to contact the end user and give the option of completing the questionnaire together (the leader and the user) through a previously agreed interview.

ⓘ It will be assessed whether it's possible to share the questionnaires through the platform during the hot case phase, but it's far from a priority as it's not part of the project's requirements.

4.3.1 Users' oriented questionnaire

The **Users' oriented questionnaire** has been elaborated based on the **user's requirements and gaps** gathered in CENTAUR deliverable *D1.1 – Report on Urban Flood and Water & Food security indicators* [RD07] that according to Table 3 in deliverable D1.2 are considered as short-term priority developments. Additionally, questions related to (i) medium-term priority developments, as stated in D1.1 "Must Have" been developed, (ii) interesting KPIs presented in the CENTAUR offer [RD09], and (iii) other questions based on Tracasa's previous experience and knowledge in this subject have been added.

This user's questionnaire contains the sections shown and described in Table 36. The questionnaire also includes a brief introduction about the context and aims of the questionnaire that is not included in the table below. The entire questionnaire that will be provided to stakeholders during the cold case phase can be found in ANNEX I: CENTAUR User Questionnaire.

Table 36: User's questionnaire general description.

USER'S QUESTIONNAIRE			
Section		Overall description of the questions	
	Consent to use personal data	Consent to the treatment of personal data and to collect information related to CENTAUR project for statistical and management purposes.	
1	Interviewee details and use case	Personal information of the interviewee; previous experience with Copernicus CEMS/SEA products, use case on which the user has been involved…	
2	Copernicus SEA/CEMS Service Portfolio	General questions regarding the Copernicus CEMS/SEA new portfolio; if it has been improved…	Fit-for-purpose
3	CEMS Early Warning Component	General questions regarding the CEMS Early Warning Component; if it has been improved…	
4	CENTAUR platform	Questions gathering how well the new platform fits the user's requirements. The aim will be to assess its usability from the users' perspective.	
5	CENTAUR products	Questions gathering the user's opinion about the CENTAUR products from a perspective of the user's operational use (integrity, adequacy, compliance).	

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6	Impact of CENTAUR products on users' workflow	Questions gathering the positive/negative impacts expected with these CENTAUR products in the user's workflow.	
7	Overall evaluation	Overall perception of the platform developed and CENTAUR products, in terms of strengths, weaknesses, added value… (free text)	

As shown in the table above, the first two sections compile personal information from the interviewee. Collecting this information to analyse the results based on the different user profiles is interesting. The following 5 sections (2 to 6) focus on questions for assessing the fit-for-purpose of the CENTAUR project from the user's perspective, so their satisfaction about different aspects will be checked, i.e., the new Service Portfolio (2), the CEMS Early Warning Component (3), the CENTAUR platform, (4) the CENTAUR products (5), and the impact of these products on user's workflow (6). The last section will gather an overall evaluation of the CENTAUR project, where the users could freely express their opinion.

The questions focus on assessing the completeness of the crisis package, with regard to the user's knowledge of the event, and the quality and importance of each of the products from the user perspective. The section integrates free text questions for the user to provide non-guided feedback about the most and least useful indicators, indices and services.

The general participation of the users (Authorised Users and Potential Future Users) will be crucial in evaluating the CENTAUR products and platform since their experience and knowledge are of great relevance. This user feedback collection will (i) help to assess their satisfaction with the CENTAUR products and the platform developed, (ii) identify factors that may limit the operational use of the CENTAUR products and/or may negatively impact on users' workflows, and (ii) identify possible improvements suggested by them from a practical point of view. Overall, learning from users' feedback is necessary to improve the Copernicus CEMS and SEA services.

Therefore, within the CENTAUR project framework, it is expected that two main groups of users will complete this questionnaire:

- Users/Potential Users of the Copernicus Emergency Service (Urban Flooding).
- Users/Potential Users of the Copernicus SEA Service (Water and Food Security).

The following table gathers a tentative list of users who could fill out the questionnaire. It includes end-users directly related to the use case selection, as well as any other stakeholder that showed interest in validating the results.

Table 37: A tentative list of users that could be engaged in filling out the questionnaire.

Users/Potential Users	Copernicus Service Interest
European External Action Service - EEAS (Situation Room)	Copernicus SEA Authorized User
European Commission (EC) Joint Research Centre (Unit E1-Disaster Risk Management)	Copernicus Emergency Authorized User Copernicus SEA Potential Future User
CCR (Department R&D Cat & Agriculture)	Copernicus Emergency Potential Future User Copernicus SEA Potential Future User
Dirección General de Protección Civil y Emergencias	
Red de Información Ambiental de Andalucía	
Municipality of Turin	
Italian Civil Protection	
German Foreign Office – Data Science Division	
CCR	
United Nations Support Office in Somalia	
UN Environment Programme (Disasters and Conflicts Division)	
German Federal Foreign Office (S05 crisis early warning)	
WAVE (IoT)	
Helpcode (NGO)	

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Users/Potential Users	Copernicus Service Interest
Danish Refugee Council (Evidence, Knowledge and Learning Division)	
International Commission for the Protection of the Danube River (ICPDR)	Copernicus Emergency Potential Future User
Environment and Water Agency (REDIAM)	

4.3.2 Service providers' questionnaire

The **Service Providers' questionnaire** has been elaborated based on the **KPIs** defined in the CENTAURs offer as well as the user's technical short-term priority requirements gathered in Table 3 of D1.2, and other questions based on Tracasa's previous experience and knowledge in this subject.

This service provider's questionnaire is structured in the following sections shown and described in Table 38. As the previous questionnaire, this questionnaire also includes a brief introduction about the context and aims of the questionnaire that is not included in the table below. The entire questionnaire provided to service providers can be found in ANNEX II: CENTAUR Service Provider Questionnaire.

Table 38: Service Provider's questionnaire general description.

SERVICE PROVIDER'S QUESTIONNAIRE		
Section		Description
	Consent to use personal data	Consent to the treatment of personal data and to collect information related to CENTAUR project for statistical and management purposes.
1	Interviewee details	Personal information of the interviewee and the Copernicus Service on which it is involved.
2	Compliance with user requirements (technical aspects)	Questions gathering how well the new services fit the user's technical requirements defined in D1.2 and to be developed in a short-term priority. These questions are divided into different categories: - General requirements (related to general aspects that the service should consider) - Accessibility requirements (related to specific requirements needed to ensure correct and simple access to the data) - Operational requirements (related to the type of information, products and services the system should provide) - Data/Indicators integration, management and processing requirements (related to the type of data that CENTAUR should be able to analyse and how it should be managed by the system) - Platform requirements - Interoperability requirements (related to aspects to ensure the integration of the information into other systems and workflows)
3	Compliance of the proposed KPIs	Questions that gather how well the new services fit all the KPIs defined in the offer. These questions are divided into different categories according to the different objectives: - Copernicus SEA Service Portfolio - CEMS Early Warning component - CEMS Mapping component - End-to-end demonstrations - Copernicus EO-based downstream services - AI/ML techniques and datasets used - Understanding of cause-effect relation
4	Overall evaluation	Overall perception of the platform developed and CENTAUR products, in terms of strengths, weaknesses, added value… (free text)

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As in the previous questionnaire, the first two sections compile personal information from the interviewee. The following two sections (2 and 3) gather questions for assessing how well the new services fit the user's technical requirements (2) and the KPIs defined in the offer (3). It will be noticed that this questionnaire evaluates much more technical aspects than the previous one. The last section will gather an overall evaluation of the CENTAUR project, where the service providers could freely express their opinion.

This service provider's feedback collection aims (i) to ensure compliance with the KPIs proposed in the technical offer, and (ii) to verify that the service meets the technical requirements requested.

A tentative list of service providers that could fill out the questionnaire includes Adelphi, Hensoldt, e-GEOS, VITO, UNISTRA-SERTIT, UNISTRA-TRIO, ECMWF, DLR, Cherry Data, SpaceTec, CLS, GMV, Tracasa, SatCen and ITHACA.

4.3.3 Analysis of the questionnaires

Analysing the results of questionnaires involves several steps to gain meaningful insights from the data. Users' responses will be analysed to extract the main ideas (the users' main opinions and satisfaction level) about the aspects asked. In contrast, service providers responses will be analysed in order to verify that the service meets the technical requirements.

For both questionnaires, all the answers received for each section or question block (see Table 36 and Table 38) will be analysed. The key ideas extracted from each type of questionnaire will be collected in tables or bullets. In both cases, an overall evaluation highlighting the strengths and weaknesses of CENTAUR products and services will be carried out. In the same way, threats and opportunities derived from the users' and service providers' key ideas will be collected. Based on all the information analyzed, main conclusions regarding Strengths, Weaknesses, Opportunities and Threats (SWOT) and recommendations will be derived. They will be relevant for further improvement of CENTAUR products and services.

Following, general steps that will be carried out to get a trustworthy and clear questionnaire assessment are defined.

1. **Data cleaning and preparation**. This first step is crucial to ensure the accuracy and reliability of the results. During this phase, questionnaires will be reviewed to (i) check for missing or incomplete responses and (ii) verify the consistency and accuracy of the data. Additionally, during this phase, open-ended responses could be categorized (e.g., they may be categorized focused on SWOT analysis).
2. **Descriptive statistics.** This step involves summarizing and describing the answers gathered for each question or question block. In cases where the answer corresponds to a **numerical value**, basic statistics such as mean, median, mode, and standard deviation will be calculated. On the other hand, if the answer corresponds to a **categorical value**, their frequency distribution will be assessed. All this information will be used to generate summary tables providing an overview of the data.
3. **Data visualization.** Visualization can help to view trends and patterns more effectively than raw numbers. Graphs and charts such as bar charts, pie charts, histograms, and scatter plots to visually represent the data will be created.
4. **Comparative analysis.** Based on the results obtained in the previous steps, the answers across different groups of interviewed persons (e.g., CEMS *vs*. SEA users) would be compared, looking for significant differences or trends that may provide insights into specific subgroups, if any.
5. **Qualitative analysis.** This analysis will involve examining open-ended questions to identify common themes and sentiments. For this aim, it is advisable to have categorized (in the first step) this type of responses to have a deeper understanding of participants' perceptions and experiences.
6. **Data interpretation.** The results will be interpreted in the context of CENTAUR objectives. Conclusions based on the patterns and insights revealed by the analysis will be drawn.
7. **Report and presentation.** The findings will be summarised clearly and concisely. It is advisable to use visual aids and graphics to enhance understanding. Furthermore, actionable recommendations based on the questionnaire assessment will be provided.

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It would be advisable that once the users' and service providers' responses have been analysed, results will be shared with the consortium members, if possible, quantifying and assessing the impact of the CENTAUR products and indicating the method of quantification. Faithfully transmitting these results to the rest of the partners is of great relevance.

These results will also be documented in a specific section of deliverable *D4.3 – CENTAUR demonstration report and validation result v1 (cold cases)*.

4.4 ASSESSMENT STEPS AND TIMELINE

Figure 5 shows the different assessment steps expected to be carried out before and after the demonstration execution phase of cold cases, as stated in CENTAUR's offer.

Based on any setbacks that may arise over these months, this workflow may undergo slight modifications.

Note that in this assessment exercise, different work packages (WP) are involved, i.e., products (indicators and indexes) will be validated within WP2, the platform will be validated within WP3, and the questionnaires will be analysed within WP4.

Since the platform is still in activate development, it is important to note that it will be left out of the assessments performed as part of the cold case phase. Potential mentions of it indicate work that will be performed at a later stage, during the hot case phase.

As stated in the offer, the design and implementation of the indicators and indexes, the definition of the validation criteria and the platform deployment should be finished by the end of February 2024 (M15). The present deliverable *D4.1 – CENTAUR Demonstration plan v1 (cold case)*, which gathers the theoretical validation criteria among others, will be used as a base document when validating the product in WP2. The theoretical validation criteria defined for hot cases in deliverable *D4.2 – CENTAUR Demonstration plan v2 (hot case)*, will be the same as the one defined for cold cases in D4.1.

Once the products have been validated "at home" (WP2), they will be provided to the users to execute the demonstrator exercises (Task 4.3).

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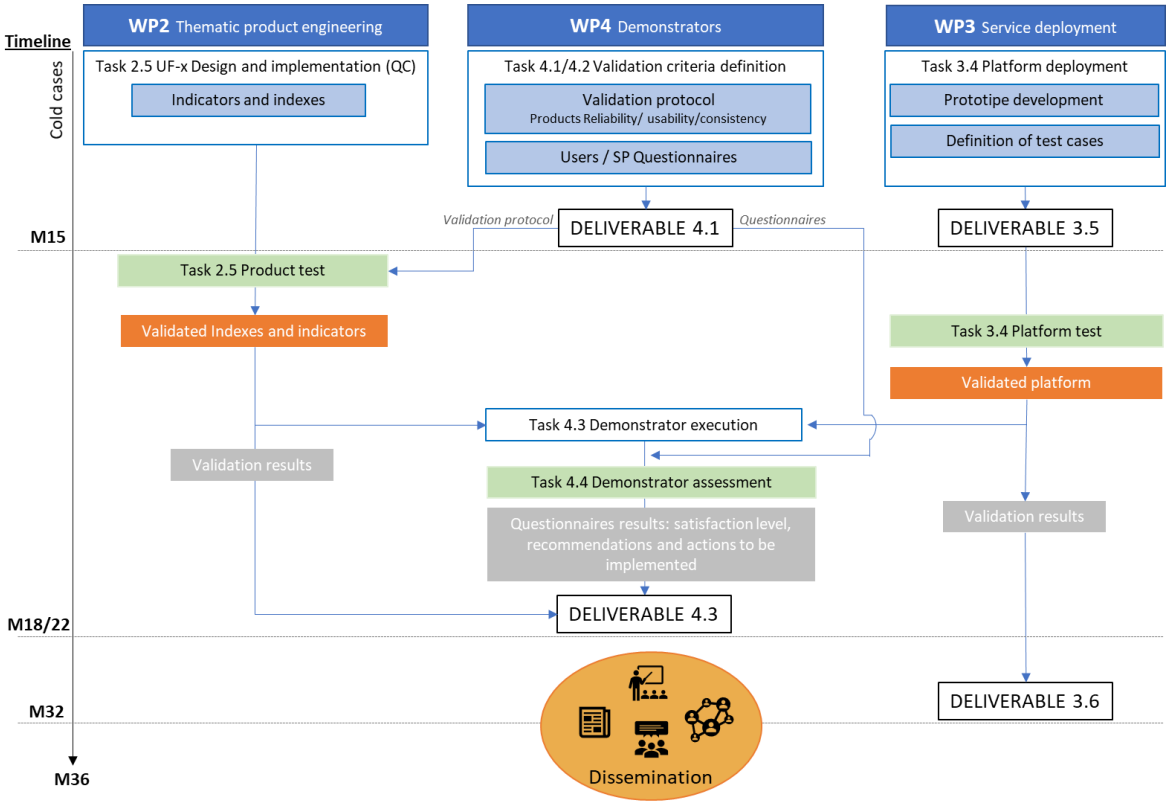

Figure 5: Tentative validation workflow. Timeline and steps are subject to change, given potential delays in one or more stages, as well as any other development requirements in relation to ongoing tasks. The latter holds true for WP3 and activities related to the CENTAUR platform, which is currently benefiting from active development. It will translate into actionable services after the cold case phase, so any sort of validation of the platform will only occur during the hot case phase. It was presented nonetheless to provide a comprehensive view of the validation workflow.

Currently, the expected timeline for cold case demonstrators and the validation is as follow:

Timeline	Cold Case Demonstrators / Validation
Mid-April 2024 (M17)	UF Spain
Early-May 2024 (M18)	UF France + WFS Somalia
Mid-May 2024 (M18)	UF Germany + WFS Mali
Early-June 2024 (M19)	UF Italy
Mid-June 2024 (M19)	Cross-cutting Mozambique
May to end of July (M18 to M20)	Validation

Based on any setbacks that may arise over these months, this timeline may undergo slight modifications.

On the other hand, the validation results obtained for each product and use case will be documented in deliverable *D4.3 – CENTAUR demonstration report and validation results v1 (cold cases)* by the end of M18 (draft version) and M22 (final version). In this deliverable, a transverse validation analysis of the results will be carried out.

Ideally, the questionnaires elaborated within Task 4.1 and gathered at the end of this document as Annexes, will be shared by email with the users and service providers at the end of each demonstrator.

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The possibility of sharing some questions before the demonstrator execution is contemplated (although it is not reflected in the previous figure) if schedule problems arise, i.e., a delay in testing the platform could put at risk the execution of the demonstrator at the established date, and in the same way, the final document to be provided would not be able to be delivered by the agreed date.

The questionnaire results will aim to analyse the satisfaction level, verify that the technical requirements are met and formulate recommendations and actions to be implemented. All these results will be incorporated in deliverable D4.3 (cold cases).

Dissemination of the results, lessons learnt, and recommendations will be carried out following the roadmap defined in deliverable *D6.1 - Communication Strategy and Action Plan* [RD08] in which the strategies, activities, and tools to obtain an effective communication and dissemination activity are gathered. This activity is important to maximise its impact, raise awareness, and promote the benefits of CENTAUR scientific and technical advances for CEMS and SEA services stakeholders. The dissemination of the final results is likely to be held from M22 to the end of the project, M36.

The platform developed within WP3 will be tested by Tracasa, based on deliverable *D3.5 – CENTAUR integrated platform test document v1 (baseline)* which should be finished by the end of M15. Once the platform has been validated, demonstrations will begin (Task 4.3).

If from M15 the platform is not developed, the cold case demonstrations will be conducted using other information sharing tools.

The platform validation results will be gathered in deliverable *D3.6 - CENTAUR integrated platform test document v2 (final setting)* by the end of M32.

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5 CONCLUSIONS

This deliverable and the related WP4 tasks have outlined rigorous approach, methodologies, and evaluation recommendations employed to address urban flooding and water & food security challenges during the demonstration phase. Through a detailed examination of demonstrator design, assessment criteria, and stakeholder feedback, a robust foundation has been laid for the execution of both the cold and hot phases, that will span months 16 to 33 of the project.

The design and execution of cold case demonstrators, as detailed in Chapter 3, have provided invaluable insights into the complexities of urban flooding and water & food security scenarios. Moreover, by integrating a cross-cutting, the project has underscored the importance of versatile and adaptable solutions capable of addressing diverse environmental and socio-economic contexts.

The assessment of demonstrators, as elaborated in Chapter 4, highlights the project's commitment to reliability, consistency, and usability. The validation criteria developed and the feedback gathered through comprehensive questionnaires have ensured that the CENTAUR system is not only technically sound but also aligned with the needs and expectations of service providers and end-users of Copernicus services.

Moving forward, service providers will continue to refine tools and methodologies based on the feedback and data collected during the cold case demonstrations. Additionally, fostering closer collaborations with local communities, policymakers, and other stakeholders will be crucial during the evaluation of CENTAUR solutions. Preliminary work in engaging these groups has been done during the selection process of use cases. However, further efforts will be required during the demonstration phases, so they can provide deeper insights into practical challenges and opportunities, ensuring that the project's outputs remain relevant and actionable.

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ANNEX I: CENTAUR USER QUESTIONNAIRE

This questionnaire addresses the relevance, from the User's perspective, of the new platform developed and CENTAUR products in terms of assessing the added value and impact of those CENTAUR products on the user's workflow.

The general participation of Authorised Users and Potential Future Users is crucial in evaluating the CENTAUR products. Users' experience and knowledge are of great relevance for this purpose. Learning from users' feedback is necessary to further improve the Copernicus CEMS and SEA services.

This user feedback collection aims to ensure the usability of the new service components for both CEMS and SEA, developed within the CENTAUR project. Likewise, the usability of the developed platform will be assured.

*Fields marked with * are mandatory*

As of the cold case phase, questions regarding the platform should be skipped, as it is still in active development. Nonetheless, it provides a tentative draft of what can be expected.

CONSENT TO USE PERSONAL DATA

I hereby declare my informed consent to the treatment of my personal data with the modalities indicated in the privacy statement for the following purposes:

*(1) Collect information related to the CENTAUR project user consultation process and communicate important information related to the user consultation process.	○ Yes ○ No
*(2) Dispatch of communications on important information regarding the consultation processes, invitations to CENTAUR events/meetings and other notifications.	○ Yes ○ No
*(3) Processing of data for statistical and management purposes.	○ Yes ○ No

CENTAUR Privacy Statement – 'CENTAUR_Privacy_statement_v3.pdf'

1. INTERVIEWEE DETAILS AND USE CASE

*Interviewee details:

Name of your organization	Add text
Group/Area/Division	Add text
Point of Contact. Complete name	Add text
Position within your organization	Add text
Contact details (email and/or phone)	Add text

1.1. Please select the option(s) that better summarizes the nature of the activity(ies) your department/unit undertakes:

☐ Strategy and policy development ☐ Decision making ☐ Programme and project management

☐ Risk assessment ☐ Field operations ☐ Preparedness and planning

☐ Other. Specify: Add text

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1.2. Please select the category(ies) that better describes your involvement

- ☐ Copernicus Emergency Authorized User
- ☐ Copernicus SEA Authorized User
- ☐ Copernicus Emergency Potential Future User
- ☐ Copernicus SEA Potential Future User

Previous experience:

1.3 Do you have previous experience with CEMS products?	○ Yes	○ No
If yes, how are they included in your workflow?	Add text	
1.4 Do you have previous experience with SEA products?	○ Yes	○ No
If yes, how are they included in your workflow?	Add text	

Use case:

1.5 Please select the use case in which you are involved:

- ☐ UF Spain
- ☐ UF France
- ☐ UF Germany
- ☐ UF Italy
- ☐ UF Mozambique
- ☐ WFS Somalia
- ☐ WFS Mali
- ☐ WFS Mozambique

The following questions address the fit-for-purpose assessment of the new (i) Copernicus SEA/CEMS Service Portfolio, (ii) CEMS Early Warning component, (iii) Platform developed, and (iv) CENTAUR products.

2. Copernicus SEA/CEMS Service Portfolio

2.1 Do you think the Copernicus SEA/CEMS service portfolio could be enhanced to better respond to climate security risks and effects?	○ Yes	○ No	
If necessary, elaborate	Add text		
2.2 Has the Copernicus SEA/CEMS portfolio integrated at least one new information layer that enriches the current product portfolio?	○ Yes	○ No	○ N/A
2.3 Has Copernicus SEA/CEMS portfolio adapted at least one information layer to better respond to climate security risks and effects?	○ Yes	○ No	○ N/A
If necessary, elaborate	Add text		
2.4 Do you think that the temporal and spatial resolutions of Copernicus EO-based downstream services have improved?	○ Yes	○ No	○ N/A

3. CEMS Early Warning Component

3.1 Regarding the CEMS Early Warning component, do you think it has been enhanced through the development of meteorological indicators in support of Urban Floods early detection?	○ Yes	○ No	○ N/A
3.2 Has the extreme intensity precipitation (above 95th percentile) been detected at least 48h prior to the event, and verified against local observations?	○ Yes	○ No	○ N/A
3.3 If necessary, elaborate any comments regarding CEMS Early Warning component	Add text		

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4. CENTAUR PLATFORM

The following questions gather how well the new platform fits with your requirements. The aim is to assess its usability.

Note: If the platform is developed, this section should be completed; otherwise, the next section should be addressed.

Platform Accessibility and Navigability:

4.1 How would you rate the overall intuitiveness and user-friendliness of the developed platform? *(1) Not intuitive and user-friendly at all, (2) Somewhat intuitive and user-friendly, (3) Moderately intuitive and user-friendly, (4) Very intuitive and user-friendly, (5) Extremely intuitive and user-friendly*	○ 1 ○ 2 ○ 3 ○ 4 ○ 5
If necessary, indicate possible improvements	Add text
4.2 How would you rate the navigation panel in terms of completeness and ease of exploration? *(1) Not complete and difficult to explore, (2) Partially complete and somewhat easy to explore, (3) Moderately complete and fairly easy to explore, (4) Very complete and quite easy to explore, (5) Extremely complete and very easy to explore*	○ 1 ○ 2 ○ 3 ○ 4 ○ 5
If necessary, indicate possible improvements	Add text
4.3 How would you rate the access speed to the CENTAUR platform information? *(1) very slow, if external device of authentication required (3) medium speed, if password required (5) very fast, no password required*	○ 1 ○ 2 ○ 3 ○ 4 ○ 5
If necessary, indicate possible improvements	Add text
4.4 Can you easily find an overview of platform components/sections? *(1) Not easy to find, components structure is not neat (3) Moderately easy to find (5) Very easy to find, components structure is clear*	○ 1 ○ 2 ○ 3 ○ 4 ○ 5
If necessary, indicate possible improvements	Add text
4.5 Can you easily find the available information on CENTAUR products? *(1) Not easy to find, product data are not neat (3) Moderately easy to find (5) Very easy to find, product data are clear*	○ 1 ○ 2 ○ 3 ○ 4 ○ 5
If necessary, indicate possible improvements	Add text
4.6 Can you easily find the information that you are looking for? *(1) Not easy to find the searched data, (3) Moderately easy to find the searched data, (5) Very easy to find the searched data*	○ 1 ○ 2 ○ 3 ○ 4 ○ 5
If necessary, indicate possible improvements	Add text
4.7 The platform is designed with a single access point, offering an overview of the complete service catalogue when landing on the homepage. Please rate your agreement with this feature. *(1) Strongly disagree, (2) Disagree, (3) Neutral, (4) Agree, (5) Strongly agree*	○ 1 ○ 2 ○ 3 ○ 4 ○ 5
If necessary, indicate possible improvements	Add text
4.8 Do the fields available for setting personal preferences within the Personal Area Component meet your requirements? *(1) Strongly disagree, (2) Disagree, (3) Neutral, (4) Agree, (5) Strongly agree*	○ 1 ○ 2 ○ 3 ○ 4 ○ 5
If necessary, indicate possible improvements	Add text

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Platform Features and Functions:

4.9 How would you rate in general the different features and functions of the CENTAUR platform? *(1) Very poor, does not meet expectations; (2) Poor, needs improvements; (3) Average, meets basic expectations; (4) Good, Meets/exceeds expectations, only room for minor improvements; (5) Very Good, surpasses expectations.*		Additional Comments
- Display, navigate, zoom in/out	○ 1 ○ 2 ○ 3 ○ 4 ○ 5	Add text
- Pan or overlay spatial data sets or layers	○ 1 ○ 2 ○ 3 ○ 4 ○ 5	Add text
- Measure areas and distances	○ 1 ○ 2 ○ 3 ○ 4 ○ 5	Add text
- Transparency control	○ 1 ○ 2 ○ 3 ○ 4 ○ 5	Add text
- Display legend information	○ 1 ○ 2 ○ 3 ○ 4 ○ 5	Add text
- The available base maps fit with your needs	○ 1 ○ 2 ○ 3 ○ 4 ○ 5	Add text
- The charts and graphs available to display different datasets (e.g., historical series of data) are easily customizable and fit your needs	○ 1 ○ 2 ○ 3 ○ 4 ○ 5	Add text
- The symbology used to visualize the different datasets is appropriate	○ 1 ○ 2 ○ 3 ○ 4 ○ 5	Add text
- The symbology displayed matches the legend	○ Yes ○ No	Add text
- The way to configure AOIs (draw, edit, save…) is appropriate	○ 1 ○ 2 ○ 3 ○ 4 ○ 5	Add text
- The Alerting Service is user-friendly and easily customizable	○ 1 ○ 2 ○ 3 ○ 4 ○ 5	Add text

4.10 Have you received the automatic notifications sent by the CENTAUR platform about the availability of indicators and indexes?	○ Yes ○ No
If not, please explain	Add text
If yes, were the notifications appropriate?	○ Yes ○ No
Please explain your answer	Add text
4.11 How would you rate the clarity and completeness of the user manual for the platform? *(1) is the lowest (not clear or incomplete) and (5) is the highest (very clear and comprehensive)*	○ 1 ○ 2 ○ 3 ○ 4 ○ 5
If necessary, indicate possible improvements	Add text

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5. CENTAUR PRODUCTS

5.1 URBAN FLOOD PRODUCTS: COMPLETE ONLY IF THE USE CASE IN WHICH YOU HAVE BEEN INVOLVED IS RELATED TO UF

5.1.1 Have you noticed areas identified as "flooded areas" in the CENTAUR UF products that do not correspond to real flooded areas?	○ Yes ○ No
5.1.2 Have you noticed real flooded areas that are not delineated in the CENTAUR UF products?	○ Yes ○ No
5.1.3 How would you qualify the quality of the flooded areas in urban areas in the CENTAUR UF products?	○ Accurate ○ Underestimated ○ Overestimated

5.1.4 Please rate the following three aspects of UF products;

- Timeliness of product availability.
- The easiness to understand the products according to the symbols, legends, attribute table, text, terminology… used.
- The different formats offered for downloading the products fit your needs (note that each product is downloaded in a specific format).

Place ticks for each CENTAUR product selecting one option for each aspect that is being assessed:

(1) Very poor, does not meet expectations; (2) Poor, needs improvements; (3) Average, meets basic expectations; (4) Good, Meets/exceeds expectations, only room for minor improvements; (5) Very good, surpasses expectations.

***Note**: some indicators may not have been produced for the UC under assessment. In that case, don't consider it.*

	Timeliness of Product Availability					Easiness to understand the product					Product format				
	(1)	(2)	(3)	(4)	(5)	(1)	(2)	(3)	(4)	(5)	(1)	(2)	(3)	(4)	(5)
UF-ID-1	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
UF-ID-2	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
UF-ID-3	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
UF-ID-4	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
UF-ID-5	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
UF-ID-6	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
UF-ID-7	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
UF-ID-9	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
UF-ID-10	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
UF-ID-13	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
UF-ID-14	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
UF-IX-01	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
UF-IX-02	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

5.1.5 How do you rate the importance, compliance, and potential impact of the CENTAUR UF products? Place ticks for each CENTAUR product selecting one option for each column criteria: Importance, Compliance with the user's requirements and Impact on the workflow.

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(1) No or minimal importance / no compliance with user requirements / negligible impact on work; (2) Moderately important / generally or partially complies with user requirements / noticeable impact on work; (3) Very high, critically important / fully complies with user requirements/substantial and positive impact on work efficiency and effectiveness.

***Note**: some indicators may not have been produced for the UC under assessment. In that case, don't consider it.*

	Importance			Compliance			Impact on work		
	(1) Not important	(2) Important	(3) Essential	(1) Not compliant	(2) Partial	(3) Total	(1) Unusable	(2) Alternative use	(3) Intended use
UF-ID-1	☐	☐	☐	☐	☐	☐	☐	☐	☐
UF-ID-2	☐	☐	☐	☐	☐	☐	☐	☐	☐
UF-ID-3	☐	☐	☐	☐	☐	☐	☐	☐	☐
UF-ID-4	☐	☐	☐	☐	☐	☐	☐	☐	☐
UF-ID-5	☐	☐	☐	☐	☐	☐	☐	☐	☐
UF-ID-6	☐	☐	☐	☐	☐	☐	☐	☐	☐
UF-ID-7	☐	☐	☐	☐	☐	☐	☐	☐	☐
UF-ID-9	☐	☐	☐	☐	☐	☐	☐	☐	☐
UF-ID-10	☐	☐	☐	☐	☐	☐	☐	☐	☐
UF-ID-13	☐	☐	☐	☐	☐	☐	☐	☐	☐
UF-ID-14	☐	☐	☐	☐	☐	☐	☐	☐	☐
UF-IX-01	☐	☐	☐	☐	☐	☐	☐	☐	☐
UF-IX-02	☐	☐	☐	☐	☐	☐	☐	☐	☐

5.1.6 How would you rate in general the different CENTAUR products for UF use cases? Place ticks for each CENTAUR product selecting one option for the aspect that is being assessed:

(1) Very poor, does not meet expectations; (2) Poor, needs improvements; (3) Average, meets basic expectations; (4) Good, Meets/exceeds expectations, only room for minor improvements; (5) Very good, surpasses expectations.

***Note**: some indicators may not have been produced for the UC under assessment. In that case, don't consider it.*

	General Rating					Additional comments (suggested improvements)
	(1)	(2)	(3)	(4)	(5)	
UF-ID-1	☐	☐	☐	☐	☐	Add text
UF-ID-2	☐	☐	☐	☐	☐	Add text
UF-ID-3	☐	☐	☐	☐	☐	Add text
UF-ID-4	☐	☐	☐	☐	☐	Add text
UF-ID-5	☐	☐	☐	☐	☐	Add text
UF-ID-6	☐	☐	☐	☐	☐	Add text
UF-ID-7	☐	☐	☐	☐	☐	Add text
UF-ID-9	☐	☐	☐	☐	☐	Add text
UF-ID-10	☐	☐	☐	☐	☐	Add text
UF-ID-13	☐	☐	☐	☐	☐	Add text
UF-ID-14	☐	☐	☐	☐	☐	Add text
UF-IX-01	☐	☐	☐	☐	☐	Add text
UF-IX-02	☐	☐	☐	☐	☐	Add text

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Where:

UF indicators:

- UF-ID-1: Static map of precipitation associated to return period
- UF-ID-2: Forecast of return period
- UF-ID-3: High-resolution urban flood risk maps for various return periods
- UF-ID-4: Inferred INSAR urban flood extent
- UF-ID-5: Enhanced Urban Flood Damage Assessment
- UF-ID-6: Social/Traditional media indicators for Urban Flood Map
- UF-ID-7: Hazard web sources indicator

Socio- economic impact and vulnerability to UF:

- UF-ID-9: Assets and financial resources
- UF-ID-10: Public services and government support
- UF-ID-13: Ability to evacuate
- UF-ID-14: Economic impact of floods

Indexes:

- UF-IX-01: Early warning forecast index
- UF-IX-02: Flood hazard index

5.2 WFS PRODUCTS: COMPLETE ONLY IF THE USE CASE IN WHICH YOU HAVE BEEN INVOLVED IS RELATED TO WFS

5.2.1 How have the products contributed to addressing water and food security challenges?	○ Significantly ○ Moderately ○ Slightly ○ Not at all
Please explain your answer	Add text
5.2.2 In what specific ways do the WFS products enhance access to useful information for your work?	○ Improved availability ○ Enhanced quality ○ Streamlines distribution ○ Other (please specify)
Please explain your answer	Add text
5.2.3 Can you easily integrate the products into your workflow?	○ Yes, seamlessly ○ With some challenges ○ Difficulties encountered ○ Not applicable
Please explain your answer	Add text
5.2.4 How well do the products perform across different conditions or environments?	○ Yes, seamlessly ○ Moderately consistent ○ Difficulties encountered ○ Not applicable
Please explain your answer	Add text
5.2.5 Can you depend on the products to provide accurate and timely information about water and food resources?	○ Always ○ Often ○ Occasionally ○ Rarely-Never
Please explain your answer	Add text
5.2.6 Have the products ever experienced failures, and if it has, how were these problems resolved?	○ Rarely-Never ○ Occasionally ○ Frecuently ○ Not applicable
Please explain your answer	Add text
5.2.7 How confident do you feel in the products ability to predict potential crises related to water and food security?	○ Very confident ○ Moderately confident ○ Not very confident ○ Not sure

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Please explain your answer	Add text
5.2.8 Are you satisfied with the CENTAUR WFS Products in terms of its ability to provide early warnings or alerts for potential water or food-related crises?	○ Completely satisfied ○ Somewhat satisfied ○ Not very satisfied ○ Not sure
Please explain your answer	Add text
5.2.9 Do you have any concerns/doubts regarding the reliability of the information provided? (Their accuracy/consistency)	○ No concerns ○ Some concerns ○ Significant concerns ○ Not applicable
Please explain your answer	Add text

5.2.10 Please rate the following three aspects of WFS products:

- Timeliness of product availability.
- The easiness to understand the products according to the symbols, legends, attribute table, text, terminology… used.
- The different formats offered for downloading the products fit your needs (note that each product is downloaded in a specific format).

Place ticks for each CENTAUR product selecting one option for each aspect that is being assessed:

(1) Very poor, does not meet expectations; (2) Poor, needs improvements; (3) Average, meets basic expectations; (4) Good, Meets/exceeds expectations, only room for minor improvements; (5) Very good, surpasses expectations.

***Note**: some indicators may not have been produced for the UC under assessment. In that case, don't consider it.*

	Timeliness of Product Availability					Easiness to understand the product					Product format				
	(1)	(2)	(3)	(4)	(5)	(1)	(2)	(3)	(4)	(5)	(1)	(2)	(3)	(4)	(5)
WFS-ID-1	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
WFS-ID-2	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
WFS-ID-3	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
WFS-ID-4	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
WFS-ID-5	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
WFS-ID-6	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
WFS-ID-7	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
WFS-ID-8	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
WFS-ID-9	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
WFS-ID-10	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
WFS-ID-11	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
WFS-ID-12	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
WFS-ID-13	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
WFS-ID-14	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
WFS-ID-15	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
WFS-ID-17	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
WFS-ID-18	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
WFS-ID-19	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

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WFS-ID-21	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
WFS-ID-23	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
WFS-ID-24	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
WFS-ID-25	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
WFS-IX-01	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
WFS-IX-02	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
WFS-IX-03	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

5.2.11 Place ticks for each CENTAUR WFS product selecting one option for each column criteria: Importance, Compliance with the user's requirements and Impact on the workflow.

(1) Not or minimal importance / no compliance with user requirements / negligible impact on work; (2) Moderately important / generally or partially complies with user requirements / noticeable impact on work; (3) Very high, critically important / fully complies with user requirements/substantial and positive impact on work efficiency and effectiveness.

***Note**: some indicators may not have been produced for the UC under assessment. In that case, don't consider it.*

	Importance			Compliance			Impact on work		
	(1) Not important	(2) Important	(3) Essential	(1) Not compliant	(2) Partial	(3) Total	(1) Unusable	(2) Alternative use	(3) Intended use
WFS-ID-1	☐	☐	☐	☐	☐	☐	☐	☐	☐
WFS-ID-2	☐	☐	☐	☐	☐	☐	☐	☐	☐
WFS-ID-3	☐	☐	☐	☐	☐	☐	☐	☐	☐
WFS-ID-4	☐	☐	☐	☐	☐	☐	☐	☐	☐
WFS-ID-5	☐	☐	☐	☐	☐	☐	☐	☐	☐
WFS-ID-6	☐	☐	☐	☐	☐	☐	☐	☐	☐
WFS-ID-7	☐	☐	☐	☐	☐	☐	☐	☐	☐
WFS-ID-8	☐	☐	☐	☐	☐	☐	☐	☐	☐
WFS-ID-9	☐	☐	☐	☐	☐	☐	☐	☐	☐
WFS-ID-10	☐	☐	☐	☐	☐	☐	☐	☐	☐
WFS-ID-11	☐	☐	☐	☐	☐	☐	☐	☐	☐
WFS-ID-12	☐	☐	☐	☐	☐	☐	☐	☐	☐
WFS-ID-13	☐	☐	☐	☐	☐	☐	☐	☐	☐
WFS-ID-14	☐	☐	☐	☐	☐	☐	☐	☐	☐
WFS-ID-15	☐	☐	☐	☐	☐	☐	☐	☐	☐
WFS-ID-17	☐	☐	☐	☐	☐	☐	☐	☐	☐
WFS-ID-18	☐	☐	☐	☐	☐	☐	☐	☐	☐
WFS-ID-19	☐	☐	☐	☐	☐	☐	☐	☐	☐
WFS-ID-21	☐	☐	☐	☐	☐	☐	☐	☐	☐
WFS-ID-23	☐	☐	☐	☐	☐	☐	☐	☐	☐
WFS-ID-24	☐	☐	☐	☐	☐	☐	☐	☐	☐
WFS-ID-25	☐	☐	☐	☐	☐	☐	☐	☐	☐
WFS-IX-01	☐	☐	☐	☐	☐	☐	☐	☐	☐
WFS-IX-02	☐	☐	☐	☐	☐	☐	☐	☐	☐

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WFS-IX-03	☐	☐	☐	☐	☐	☐	☐	☐	☐

5.2.12 How would you rate in general the different CENTAUR products for WFS use cases?

Place ticks for each CENTAUR product selecting one option:

(1) Very poor, does not meet expectations; (2) Poor, needs improvements; (3) Average, meets basic expectations; (4) Good, Meets/exceeds expectations, only room for minor improvements; (5) Very good, surpasses expectations.

Note: some indicators may not have been produced for the UC under assessment. In that case, don't consider it.

	General Rating					Additional comments (suggested improvements)
	(1)	(2)	(3)	(4)	(5)	
WFS-ID-1	☐	☐	☐	☐	☐	Add text
WFS-ID-2	☐	☐	☐	☐	☐	Add text
WFS-ID-3	☐	☐	☐	☐	☐	Add text
WFS-ID-4	☐	☐	☐	☐	☐	Add text
WFS-ID-5	☐	☐	☐	☐	☐	Add text
WFS-ID-6	☐	☐	☐	☐	☐	Add text
WFS-ID-7	☐	☐	☐	☐	☐	Add text
WFS-ID-8	☐	☐	☐	☐	☐	Add text
WFS-ID-9	☐	☐	☐	☐	☐	Add text
WFS-ID-10	☐	☐	☐	☐	☐	Add text
WFS-ID-11	☐	☐	☐	☐	☐	Add text
WFS-ID-12	☐	☐	☐	☐	☐	Add text
WFS-ID-13	☐	☐	☐	☐	☐	Add text
WFS-ID-14	☐	☐	☐	☐	☐	Add text
WFS-ID-15	☐	☐	☐	☐	☐	Add text
WFS-ID-17	☐	☐	☐	☐	☐	Add text
WFS-ID-18	☐	☐	☐	☐	☐	Add text
WFS-ID-19	☐	☐	☐	☐	☐	Add text
WFS-ID-21	☐	☐	☐	☐	☐	Add text
WFS-ID-23	☐	☐	☐	☐	☐	Add text
WFS-ID-24	☐	☐	☐	☐	☐	Add text
WFS-ID-25	☐	☐	☐	☐	☐	Add text
WFS-IX-01	☐	☐	☐	☐	☐	Add text
WFS-IX-02	☐	☐	☐	☐	☐	Add text
WFS-IX-03	☐	☐	☐	☐	☐	Add text

Where:

WFS indicators:

- WFS-ID-1: Meteorological drought indicator (Monitoring)
- WFS-ID-2: Meteorological drought indicator (Forecast)
- WFS-ID-3: Meteorological drought indicator (danger levels)
- WFS-ID-4: Agricultural drought monitoring (near real-time)
- WFS-ID-5: Agricultural drought forecast

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- WFS-ID-6: Agricultural drought risk zone map

Fine-scale population distribution and exposure:

- WFS-ID-7: IDP camps status indicator
- WFS-ID-8: Populations at risk of food insecurity
- WFS-ID-9: Populations at risk of water insecurity
- WFS- ID-10: Number of people living in conflict-affected areas

Demographic and socio-economic stress, vulnerability:

- WFS-ID-11: Food security
- WFS-ID-12: Economic security
- WFS-ID-13: Displaced persons
- WFS-ID-14: Violent conflict
- WFS-ID-15: Radicalisation and polarisation
- WFS-ID-17: Humanitarian aid
- WFS-ID-18: Resource capture
- WFS-ID-19: Climate sensitivity of agri-food systems
- WFS-ID-21: Public services and infrastructures
- WFS-ID-23: State-citizen relations
- WFS-ID-24: Dispute resolution mechanisms
- WFS-ID-25: Social cohesion and trust

Indexes:

- WFS-IX-01: Risk monitor
- WFS-IX-02: Situation monitor
- WFS-IX-03: Data viewer

6. IMPACT OF CENTAUR PRODUCTS ON USERS' WORKFLOW

The following questions gather the positive/negative impacts you expect these CENTAUR products could have in your workflow.

6.1 Do you think that the CENTAUR products will be useful/beneficial for your operational procedure?	○ Yes ○ No
If yes, what are, in your opinion, the possible advantages/benefits introduced by CENTAUR products to your operational workflow?	Add text
6.2 Do you think that the CENTAUR products will have negative impacts on your workflow?	○ Yes ○ No
If yes, please elaborate	Add text
6.3 Would you like to highlight any inconsistencies (if any) that you have found in the CENTAUR products?	○ Yes ○ No
If yes, please elaborate	Add text
6.4 Would you share the CENTAUR products with other End-Users?	○ Yes ○ No
If yes, please, specify which kind (decision-makers, regional and local communities, regional and local authorities, public disaster management agencies, social media, researchers …).	Add text
6.5 Do you believe at least one of the CENTAUR pre-operational solutions could be adopted by security analysts and other security sector stakeholders in the EU and third countries?	○ Yes ○ No
If yes, please specify	Add text

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6.6 Has the understanding of the cause-effect relation between climate change indicators with, water and food insecurity, population displacements and crisis been improved?	○ Yes ○ No
6.7 If necessary, elaborate any comments regarding the impact of CENTAUR products on your workflow	Add text

7. Overall Evaluation

Under this section, we would like to know your overall perception of the platform and products developed within CENTAUR, in terms of:

7.1 Strengths	Add text
7.2 Weakness	Add text
7.3 Added value	Add text
7.4 Did you notice any technical issues? (e.g. bugs, dead links, etc.)	○ Yes ○ No ○ N/A
If yes, please explain	Add text
7.5 Would you recommend CENTAUR products?	○ Yes ○ No
Why? Why not?	Add text
If yes, what are, in your opinion, the possible advantages/benefits introduced by CENTAUR products to your operational workflow?	Add text
7.6 Regarding the Training sessions/Workshops. Have these sessions been useful?	○ Yes ○ No ○ N/A
7.7 Please feel free to include any other comment that you may have related to the CENTAUR platform and its products and services	Add text

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ANNEX II: CENTAUR SERVICE PROVIDER QUESTIONNAIRE

This questionnaire addresses the relevance, from the Service Provider's perspective, of the new Copernicus CEMS and SEA services developed within the CENTAUR project. This Service Provider's feedback collection aims at (i) ensuring compliance with the KPIs proposed in the technical offer, and (ii) to verify that the service meets the requested technical requirements.

*Fields marked with * are mandatory*

As of the cold case phase, questions regarding the platform should be skipped, as it is still in active development. Nonetheless, it provides a tentative draft of what can be expected.

CONSENT TO USE PERSONAL DATA

I hereby declare my informed consent to the treatment of my personal data with the modalities indicated in the privacy statement for the following purposes:

*(1) Collect information related to the CENTAUR project user consultation process and communicate important information related to the user consultation process.	○ Yes ○ No
*(2) Dispatch of communications on important information regarding the consultation processes, invitations to CENTAUR events/meetings and other notifications.	○ Yes ○ No
*(3) Processing of data for statistical and management purposes.	○ Yes ○ No

CENTAUR Privacy Statement

1. INTERVIEWEE DETAILS AND USE CASE

*Interviewee details:

Name of your organization	Add text
Group/Area/Division	Add text
Point of Contact. Complete name	Add text
Position within your organization	Add text
Contact details (email and/or phone)	Add text
Please select the Copernicus Service in which you are involved: ☐ CEMS ☐ CSS-SEA	

2. COMPLIANCE WITH USER REQUIREMENTS

The following questions gather how well the new services fit the user's technical requirements gathered in D1.2. These questions focus mainly on requirements to be developed in short-term priority and they are divided into different categories.

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General requirements (related to general aspects that the service should consider):

2.1 Does the platform adheres to industry-standard security practices, such as vulnerability assessments, penetration testing, and regular security updates?	○ Yes	○ No
2.2 Have the end products been ingested by the platform properly, or were there bugs?	○ Yes	○ No
2.3 Has the system considered personal data protection and privacy issues?	○ Yes	○ No
2.4 Has the system been developed to notify the user through a notification inbox and by email when a relevant event occurs, like new alerts of the early warning system?	○ Yes	○ No
If necessary, elaborate any comments regarding general requirements	Add text	

Accessibility requirements (related to specific requirements needed to ensure correct and simple access to the data):

2.5 Is the access to the platform regulated by providing identity and access management based on access control policies, roles, permissions, and attributes?	○ Yes	○ No
If necessary, elaborate any comments regarding accessibility requirements	Add text	

Operational requirements (related to specific requirements needed to ensure correct and simple access to the data):

2.6 The catalogue of datasets covers the following areas:		
2.6.1 For Urban Flooding:		
- Real time data about flood extent during flood events	○ Yes	○ No
- Use of SAR and optical data for flood extent	○ Yes	○ No
- Flood model in urban areas and in the areas blind to SAR satellite sensors	○ Yes	○ No
- Flood assessment and climatic aspects	○ Yes	○ No
- Improved damage assessment based on exposure elements to floods risks	○ Yes	○ No
- Flood assessment based on ground truth (social-media makers)	○ Yes	○ No
2.6.2 For Water and Food Insecurity:		
- Seasonal projections of extreme weather events	○ Yes	○ No
- Geospatial human mobility data	○ Yes	○ No
- Near-real time and projected geospatial data not available at the moment (e.g. different types of migration, flooding, institutional capacity at a local level and access to it)	○ Yes	○ No
- Water availability	○ Yes	○ No
- Crop production monitoring	○ Yes	○ No
- Other socio-economic variables (e.g. hunger/malnutrition, incomes)	○ Yes	○ No
- Migration (e.g. border restrictions, flows)	○ Yes	○ No
- Population distribution and evolution	○ Yes	○ No
- Other biophysical parameters	○ Yes	○ No
- Food prices	○ Yes	○ No
- Social, political and security aspects	○ Yes	○ No

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- Pastoralism, transhumance, forced displacement, rural to urban migration, etc.	○ Yes	○ No
- Economic analysis (e.g. inequality)	○ Yes	○ No
- Food security	○ Yes	○ No
- Multi-hazard - so confluence of drought and conflict	○ Yes	○ No
If necessary, elaborate any comments regarding operational requirements	Add text	

Data/Indicators integration, management and processing requirements (related to the type of data that CENTAUR should be able to analyse and how it should be managed by the system):

2.7 Was the system able to ingest and exploit large amounts of data during the demonstration?	○ Yes	○ No
2.8 Does the platform provide access to CENTAUR's online satellite imagery services?	○ Yes	○ No
2.9 Does the system provide systematic access to data, background information and time series?	○ Yes	○ No
If yes, which of the following data sources is offered?		
- EO data	○ Yes	○ No
- Non-EO data collected systematically (e.g. climate, socio-economic, crowdsourcing, and social media data)	○ Yes	○ No
- Products from other Copernicus services (e.g. Climate Change Service, Atmosphere Service, and Land Monitoring Service)	○ Yes	○ No
2.10 Do all products, services and datasets stored and managed by the system include metadata?	○ Yes	○ No
If yes,		
- Is the metadata INSPIRE compliant?	○ Yes	○ No
- Is the creation of the metadata automatized?	○ Yes	○ No
2.11 Does the system integrate a catalogue to explore, browse and access all the different products/services/datasets available and managed by the platform? (both internal and external products/services/datasets)	○ Yes	○ No
2.12 Does the system allow filtering and querying results during the demonstrations?	○ Yes	○ No
2.13 Is the platform able to process both synchronous and asynchronous requests?	○ Yes	○ No
2.14 Does the system allow the customization of simulation models that represent the dynamics of the water and food insecurity system?	○ Yes	○ No
If necessary, elaborate any comments regarding accessibility requirements	Add text	

Platform requirements:

2.15 Is CENTAUR solution based on cloud architecture?	○ Yes	○ No
If necessary, elaborate any comments regarding platform requirements	Add text	

Interoperability requirements (related to aspects to ensure the integration of the information into other systems and workflows):

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2.16 Is the data provided by the service available to the user by either a web service or on-line platform?	Yes No
2.17 Is the system prepared to consume and display third-party geospatial web services and data? (e.g. sentinel imagery, other Copernicus issued products)	Yes No
If necessary, elaborate any comments regarding interoperability requirements	Add text

3. COMPLIANCE WITH THE KPIs

The following questions gather how well the new services fit the KPIs defined in the offer. These questions are also divided into different categories.

Copernicus SEA service portfolio (This section must be completed only by SPs involved in SEA service)

3.1 Regarding the Copernicus SEA service portfolio, do you think it has been enhanced to better respond to climate security risks and effects?	Yes No
3.2 Has Copernicus SEA portfolio integrated at least one new information layer that enrich the current product portfolio?	Yes No N/A
If yes, indicate	Add text
3.3 Has Copernicus SEA portfolio adapts at least one information layer to better respond to climate security risks and effects?	Yes No N/A
If yes, indicate	Add text
If necessary, elaborate any comments regarding Copernicus SEA service portfolio	Add text

CEMS Early Warning component (This section must be completed only by SPs involved in CEMS service)

3.4 Regarding the CEMS Early Warning component, do you think it has been enhanced through of developing meteorological indicators in support of Urban Floods early detection?	Yes No
3.5 Has the extreme intensity precipitation (above 95th percentile) at leat 48h ahead been detected and verified against local observations?	Yes No N/A
3.6 Has the precipitation of OPERA network shown an error smaller than 20%?	Yes No N/A
3.7 Regarding the spatial correlation for 6 hours accumulation, has it been better than 60%?	Yes No N/A
3.8 Has CEMS pre-tasking success been of at least 75%, in terms of the number of pre-tasking alerts, timeliness and improvement in the definition of the AOIs for crisis-time satellite acquisitions?	Yes No N/A
If necessary, elaborate any comments regarding CEMS Early Warning component	Add text

CEMS Mapping component (This section must be completed only by SPs involved in CEMS service)

3.9 Regarding the CEMS Mapping component, in general terms, do you think it has been improved?	Yes No
3.10 Has the use of precipitation data, combined with EO data, geomorphological models and ground observations extracted from sensors and social media improved the Urban Floods mapping obtained by running hydraulic models (Speedy Flood Tool)?	Yes No N/A

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3.11 Has the use of InSAR advanced applications (FLORIA) improved the Urban Floods mapping?	○ Yes ○ No ○ N/A
3.12 Has the Urban Floods mapping increased at least 75% by using of SAR and InSAR processing combined with urban flood modelling?	○ Yes ○ No ○ N/A
If necessary, elaborate any comments regarding CEMS Mapping component	Add text

End-to-end demonstrations (This section must be completed by all SPs)

3.13 Regarding the CEMS Mapping component, in general terms, do you think it has been improved?	○ Yes ○ No
If yes, indicate the scenarios	Add text
If yes, please, indicate also use cases	Add text
3.14 Has the suitability of the early warning system and foresight tool been demonstrate and validate over the proposed Hot Cases demonstrators in over 50% of them?	○ Yes ○ No ○ N/A
3.15 Regarding the collection of feedback through user questionnaires, has the user acceptance been at least 85%?	○ Yes ○ No ○ N/A
3.16 Has >80% of accuracy in flood extent over urban areas been obtained? (only for CEMS)	○ Yes ○ No ○ N/A
3.17 Do at least 80% of the products within CEMS & SEA fit the delivery-times according to the Service Level Agreements (SL1 or SL2 mode timeliness)?	○ Yes ○ No ○ N/A
3.18 Is it feasible to integrate CENTAUR products within the SEA and EMS operations by 2021-2027 time-horizon?	○ Yes ○ No ○ N/A
3.19 Do you know if at least one of the CENTAUR pre-operational solutions for the detection and analysis of climatic and environmental risks products (e.g. continuous monitoring system, crisis risk index, web simulator) has been adopted by security analysts and other security sector stakeholders in the EU and third countries?	○ Yes ○ No ○ N/A
If necessary, elaborate any comments regarding the end-to-end demonstrations	Add text

Copernicus EO-based downstream services (This section must be completed by all SPs)

3.20 Regarding the CEMS Mapping component, in general terms, do you think it has been improved?	○ Yes ○ No
3.21 Has the suitability of the early warning system and foresight tool been demonstrate and validate over the proposed Hot Cases demonstrators in over 50% of them?	○ Yes ○ No ○ N/A
If yes, indicate product/dataset/service	Add text
3.22 Regarding the collection of feedback through user questionnaires, has the user acceptance been at least 85%?	○ Yes ○ No ○ N/A
If yes, indicate	Add text
3.23 Has >80% of accuracy in flood extent over urban areas been obtained? (only for CEMS)	○ Yes ○ No ○ N/A
If yes, indicate	Add text

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3.24 Do at least 80% of the products within CEMS & SEA fit the delivery-times according to the Service Level Agreements (SL1 or SL2 mode timeliness)?	○ Yes ○ No ○ N/A
If necessary, elaborate any comments regarding the Copernicus EO-based downstream services	Add text

AI/ML techniques and datasets used (This section must be completed by all SPs)

3.25 Can the data driven approach based on AI/ML techniques be used to extract information and indicators from heterogeneous datasets?	○ Yes ○ No
3.26 Based on this approach, have multiple innovative forecasted crisis maps been developed?	○ Yes ○ No ○ N/A
If yes, indicate	Add text
3.27 Have the map quality indicators such as thematic accuracy, speed of delivery and resolution been improved due to more accurate input information and to more effective AI/ML modelling?	○ Yes ○ No ○ N/A
If necessary, elaborate any comments regarding the AI/ML techniques and datasets used	Add text

Understanding of cause-effect relation (This section must be completed by all SPs)

3.28 Has the understanding of the cause-effect relation between climate change indicators with, water and food insecurity, population displacements and crisis been improved?	○ Yes ○ No
3.29 Have at least 7 technical and scientific publications covering innovative methodological approaches to studying the climate-food-water-security nexus, as well as to key empirical results produced by the project been published?	○ Yes ○ No ○ N/A
3.30 Has this information been exchanged with at least 5 projects, initiatives or programmes dealing with climate security and its associated risks?	○ Yes ○ No ○ N/A
If yes, indicate	Add text
If necessary, elaborate any comments regarding the understanding of the cause-effect relation	Add text

4. Overall Evaluation

Under this section, we would like to know your overall perception of the platform developed and CENTAUR products, in terms of:

4.1 Strengths	Add text
4.2 Weakness	Add text
4.3 Added value	Add text
Other comments	Add text

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