Reinforcing the AI4EU Platform by Advancing Earth Observation Intelligence, Innovation and Adoption

D2.3: Validation plan and evaluation report I

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Executive Summary

In the frame of AI4Copernicus project, the present document corresponds to the report of the first evaluation period, covering Bootstrapping Resources (BR) proposed by partners.

The report outlines the adopted evaluation methodology and its role in the continuous improvement loop envisioned for the AI4Copernicus services.

It presents the first evaluation that occurred in Q4 2022, with initial feedbacks captured from the 1st Open Call Winners, allowing some initial improvements identification. Then, the second evaluation step involving the 3rd and 4th Open Call Winners in Q2 2023 is presented, with an improved questionnaire and additional findings.

To enhance the feedback from the Open Call Winners, the complementary evaluation was performed by the WP2 partners taking the seat of a potential BR user. Along each evaluation, findings are presented with proposed improvements that could impact the BR at the catalogue page level or the technical documentation level.

All identified improvements are finally consolidated and reported. The proposed improvements will be shared with the consortium and the partners to identify what could be taken into account in the frame of the project. Furthermore, the evaluation outcomes will be shared with representatives of the AI4EUROPE project, which is responsible for the evolution of the AIoD platform.

The second evaluation period will cover the Thematic Services developed by the Open Call Winners, with results expected in future D2.4, due at the conclusion of the project at M36.

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List of Terms and Abbreviations

Abbreviation	Definition
AI	Artificial Intelligence
AIDDL	AI Domain Definition Language
ACD	Amplitude Change Detection
AoI	Area of Interest
AIoD	Artificial Intelligence On Demand
API	Application Programming Interface
B2B	Business To Business
BR	Bootstrapping Resource
C3S	Copernicus Climate Change Service
CAMS	Copernicus Atmosphere Monitoring Service
CI/CD	Continuous Integration / Continuous Development
CORINE	Cordination of Information on the environment
CNN	Convolutional Neural Networks
CVA	Change Vector Analysis
DEMS	Digital Elevation Models
DIAS	Data and Information Access Services
DL	Deep Learning
EFFIS	European Forest Fire Information System
EO	Earth Observation
EuroGEO	European Association of Geographers
FAIR (data)	Findability, Accessibility, Interoperability, Reutilisability
GEOINT	GEOspatial INTelligence
GIS	Geographic information system
GNN	Graph Neural Networks
GPU	Graphics Processing Unit
GUI	Graphical User Interface
HPC	High Performance Computing
HR-VPP	High-Resolution Vegetation Phenology and Productivity
IaaS	Infrastructure As A Service
IoT	Internet of Thinks
JRC	Joint Research Centre
JSON	JavaScript Object Notation
LSTM	Long Short Term-Memory

ML	Machine Learning
MTC	Multi-Temporal Coherence
NDVI	Normalized Difference Vegetation Index
OGC	Open Geospatial Consortium
OSM data	Open Street Map
RDF	Resource Description Framework
RTDI	Research, Technology Development and Innovation
SME	Small Medium Enterprises
SaaS	Software As A Service
SWRL	Semantic Web Rule Language
TS	Thematic Service
TSO	Transmission System Operator
UNFCCC	United Nations' Framework Convention on Climate Change
UPF	Unified Planning Framework
UX	User Experience
W3C	World Wide Web Consortium

1   Introduction

From its ideation stage, AI4Copernicus aimed to deliver concrete technological and economic impact via its outputs, and specifically the developed bootstrapping resources and the use cases implemented in the context of the designated open calls. To ensure this, a comprehensive requirements analysis and operational needs mapping was conducted, which drove the evolution and means of distribution of the available assets. The user-centric approach adopted for requirement elicitation drove to a similar approach for the development of an efficient validation methodology, linked to the same needs and thus ensuring that core criteria for ensuring the technical and economic impact of the available resources are appropriately assessed.

In more detail, the methodology for assessing the impact of the provided resources builds on the fundamental preconception that – to achieve impact – the resources should carry the following qualities:

a. *Visibility*: the existence of the resources and the overall AI4Copernicus framework is known to a large audience of relevant stakeholders and potential users
b. *Discoverability*: Resources are easy to find, their purpose and functions are clearly and sufficiently described
c. *Usability*: Resources are relevant and easy to obtain, configure and use

The maximisation of the *visibility* aspect falls under the communication plan and activities of WP7 – albeit with continuous input from technical WPs and WP6, and thus is not within the scope of the evaluation methodology reported here. Targeting the assessment of the *discoverability* and *usability* qualities, the validation methodology combines guided user feedback structured in accordance with the expressed requirements, and the assessment of experts for the technical and business prospects of the examined resources.

The rest of the document is organised as follows: §2 presents the overall approach adopted for the conducting and analysis of the validation; §3 summarises the implementation of the methodology for the currently available resources; §4 aggregates the outcomes of the validation process into its core outcomes and the main recommendations elicited; finally, §5 summarises the report and outlines the next steps towards the second version of the deliverable in M36.

2   Validation Methodology and Scope

2.1   Methodology Summary

As stated, the developed validation methodology essentially aims to identify the adherence of bootstrapping and thematic services with the collected requirements and evaluate their potential for delivering technological and economic impact.

Under the methodology, *technological impact* for bootstrapping resources is at the present stage assessed via the collection and analysis of *user-centric questionnaires* in combination with expert input for the sufficiency of their exposure via the AIoD platform. In the case of thematic services, the technical assessment is based on the evaluation of the relevant technical indicators in the context of the review sessions for the Open Call projects developing the services. The methodology will be extended to accommodate a more technical

perspective, incorporating the results of the testing services delivered by the 5th Open Call projects.

Regarding *economic impact*, for the bootstrapping resources a qualitative analysis based on user feedback, resource usage and expert input is foreseen by the methodology. For the thematic services, economic impact is evaluated via the assessment of the relevant business indicators in the context of the review sessions, and the responses collected via the relevant questionnaire disseminated to the project's Advisory Board.
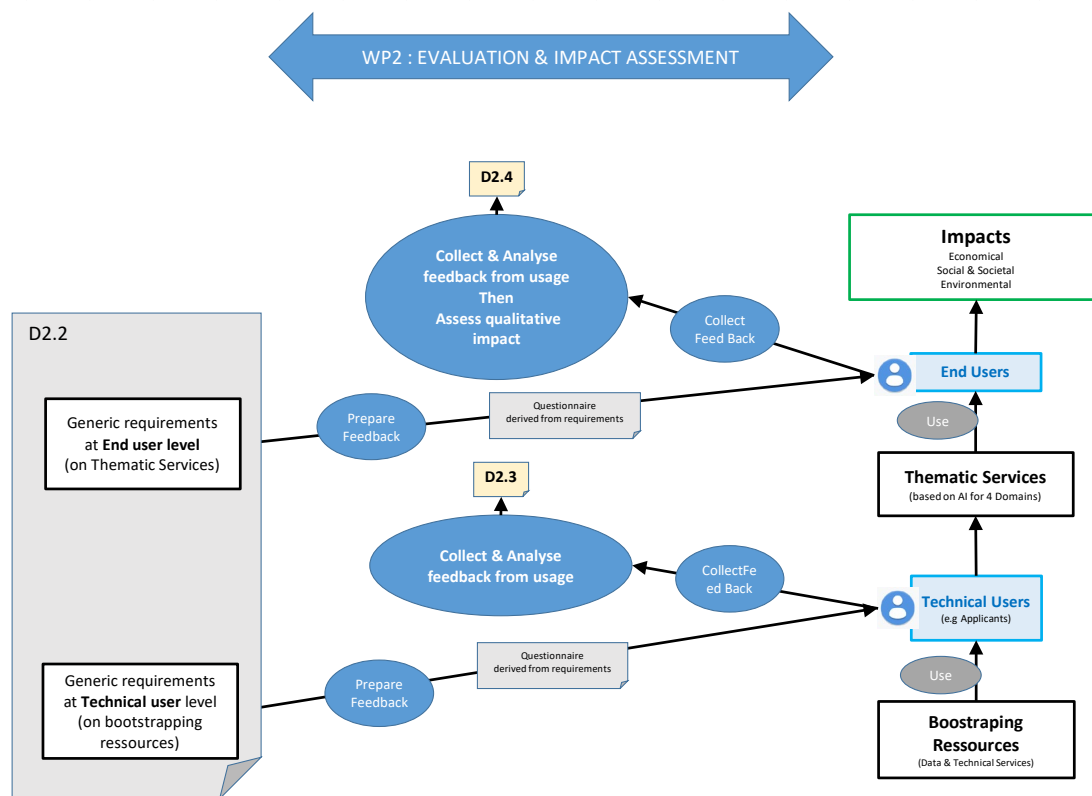
Figure 1: evaluation methodology summary

In the bigger picture, the evaluation task is central to a broader *continuous improvement loop*, where the described evaluation methodology is adapted to requirements (1) and informs the further development of resources and their associated documentation (2). The updated resources are made available to users, and new feedback collected (3). The evaluation repeats (4), and the evaluation results are synthesized towards the provision of new recommendations for improvement (6). The recommendations are prioritized and accordingly implemented, with the updates feeding the AIoD platform (7). From then on, checks for new requirements are carried out (8), and requirements updates lead to the re-initiation of the loop.
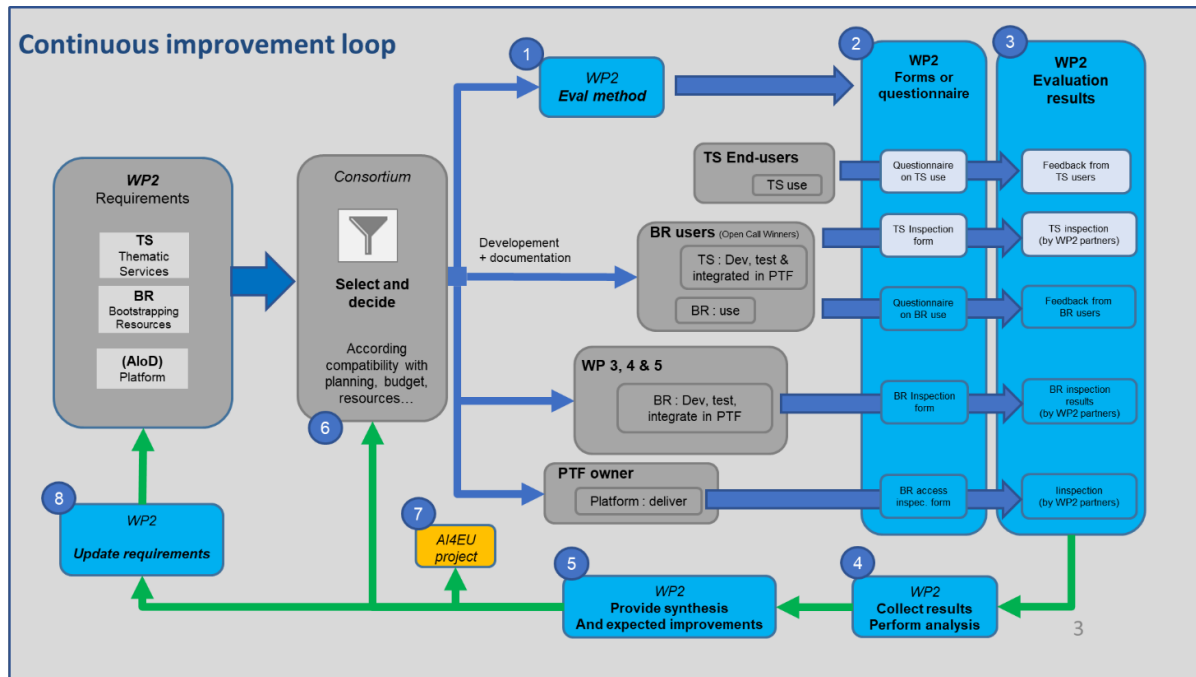
Figure 2: Continuous improvement loop

2.2 Evaluation Scope

The bootstrapping resources that were available for the examined rounds of Open Calls are summarised in the following table.

Table 1: List of bootstrapping resources

Resource	Summary	Domain
GeoTriples	Allows the user to transform geospatial data from their original formats into RDF.	General
Strabon	A spatiotemporal RDF store. You can use it to store linked geospatial data that changes over time and pose queries using two popular extensions of SPARQL. Strabon extends the well-known RDF store Sesame.	General
JedAI	comprises a set of domain-independent, state-of-the-art techniques that apply to any domain, provided with JedAI-WebApp, a GUI allowing the user to construct its desired workflow by sequentially selecting the algorithm(s) of each step. Furthermore, JedAI-WebApp provides the following capabilities: - Multiple data input interfaces - Data (entities) Exclusion - Data Exploration - Automatic configuration of the algorithms' parameters. - Detailed Results and display of the logs - Exploration of the data and results.	General
Semagrow	a dynamic data integration system that presents multiple (syntactically or semantically) heterogeneous datasets as a unified, homogeneous virtual dataset. Semagrow provides a federated query processor that allows combining, cross-indexing and, in general, making the best out of all public	General

	data, regardless of their size, update rate, and schema. In this manner, it offers a single SPARQL endpoint that serves data from remote data sources and that hides from client applications heterogeneity in both form (federating non-SPARQL endpoints) and meaning (transparently mapping queries and query results between vocabularies).	
Sextant	a web based and mobile ready platform for visualizing, exploring and interacting with linked geospatial data. The core feature of Sextant is the ability to create thematic maps by combining geospatial and temporal information that exists in a number of heterogeneous data sources, ranging from standard SPARQL endpoints to SPARQL endpoints following the standard GeoSPARQL defined by the Open Geospatial Consortium (OGC), or well-adopted geospatial file formats, like KML, GML and GeoTIFF.	General
Sentinel-1 GRD pre-processing	This pipeline processes a S1 GRD product in native format to generate a terrain corrected image representing the calibrated backscatter in GeoTiff format.	Security/ General
Sentinel-1 SLC pre-processing	This pipeline processes a S1 SLC product in native format to generate a terrain corrected image representing the calibrated backscatter in GeoTiff format.	Security/ General
Sentinel-2 pre-processing	This pipeline processes a S2 product in native format to generate a product with a common resolution for all the bands in GeoTiff format. The process allows to apply a land/sea mask and a cloud mask in order to have an output product ready for analysis	Security/ General
Sentinel-1 change detection	This pipeline processes pairs of S1 SLC products in native format to generate a series of products to assess the changes between both images. These products include: coherence, ACD (Amplitude Change Detection), MTC (Multi-Temporal Coherence) and binary mask of changes.	Security/ General
Sentinel-2 change detection	This pipeline computes (and classifies) the changes using as input a pair of S2-L2A products by using the Change Vector Analysis approach	Security/ General
Human features vector data	SatCen has pre-processed and ingested in a data model the OSM data and can provide the data as a service in the scope of the project	Security
Deep network for pixel-level classification of S2 patches	The service provides functionality for users to train a custom pixel-level classifier of Sentinel 2 patches. For example, users can train a classifier for crop types (corn, sunflower, wheat, etc), land cover (urban vs. natural, water vs land), road extraction (road vs other).	Agriculture/ General
TimeSen2Crop	TimeSen2Crop is a pixel-based dataset made up of more than 1 million crop type samples of Sentinel-2 time series. The dataset includes atmospherically corrected images and reports the snow, shadows, and clouds information per labelled unit, as well as the spectral signature of the samples of nine Sentinel-2 spectral bands at 10m of spatial resolution.	Agriculture
Harmonisation of pre-processed time series of Sentinel-2 data	The harmonization of pre-processed time series of Sentinel-2 data considers a statistic-based approach that computes the median for each pixel in the different images acquired in a particular month. The pixel composite approach to mosaic	Agriculture

	generation provides consistent results at large scale, allowing the processing of harmonized acquisitions.	
Long short-term memory neural network for Sentinel-2	The Long Short Term-Memory architecture can be trained using samples selected by the user. The service exploits the data given by the user to train from scratch an LSTM and stores the resulting weights. Several parameters are exposed to allow the user to custom the model	Agriculture
Pre-trained Long short-term memory	The pre-trained Long Short Term-Memory architecture is already trained using the TimeSen2Crop database and is available in .h5 format. The service exploits a pre-trained architecture to classify the specified tile harmonized using the monthly composite approach	Agriculture
Energy datasets	Meteorological data: ERA5. Example: offshore wind farms are located (training data). JRC Open Power Plants Database (JRC-PPDB-OPEN) Open data from the floating offshore wind farm, Hywind Scotland	Energy
Probabilistic downscaling of CAMS air quality model data	This service generates high-resolution (currently ~ 10km) air quality maps from low-resolution (~40 - 80km) CAMS model (re)analysis and/or forecast output	Health

3 Validation Process and Collected Results

3.1 1st Open Call Winners Feedback

In the 1st open call, the goal was to develop and test AI technical solutions that address industrial challenges by exploiting AI resources and Earth Observation Data focusing only on four industrial domains: Energy, Security, Health and Agriculture.

6 projects have been selected from the 1st open call. As of June 2023, all of these projects have been completed. Some high-level details for these projects are included in Table 2.

Table 2: AI4Copernicus 1st Open Call summary

Open Call	Number of projects	Domains, Number of projects per domain	Status
1st	6	Agriculture: 2 Energy: 1 Security: 3	Completed

In the following subsections, we discuss the questionnaires we provided to the projects of the 1st open call, the resource usage and the review results of these projects. This information allowed us to acquire the current level of technological and economic impact of the available bootstrapping resources and services.

3.1.1 Questionnaires analysis

In order to acquire feedback for the bootstrapping resources usage, we distributed a *user-centric questionnaire* to the projects of the 1st open call, as shown in Table 3. The questionnaire reflects feedback on the usage of the bootstrapping services, by including questions about the services tested and used by the projects, per domain.

The questionnaire was sent to the projects by the WP6 team on November 2022 and the results were collected and shared back to the WP2 team on December 2022, so it reflects an earlier stage of the AI4Copernicus services.

Table 3: 1st Open Call winners questionnaire

Questionnaire about the feedback of the AI4Copernicus Bootstrapping Resources
What is the name of your project?
What is the thematic area of your project?
What is your level of expertise in IT?
What is your level of expertise in AI?
Which Bootstrapping Resources did you use/test?
Do you agree to be contacted for any further questions? If yes, provide your e-mail:
Is the technical documentation fully relevant for your need, missing something?
Did you experience any issues related to performance?
Which missing services could have been useful for your needs?
General comment. Any suggestions for improvement?

3.1.2 Bootstrapping resources usage analysis

In Table 4, we summarise the usage of the bootstrapping services of our framework, as stated throughout the answers of the questionnaire. We observe that projects mainly use the security services, which is expected since half of projects of the 1st open calls belong in this domain. Regarding the agriculture services, we observe that the projects show interest, but they eventually didn't use them in the final product.

Table 4: Usage of bootstrapping resources in 1st Open Call projects

Domain	Service Name	Amount of projects using the service	
		Used in the final product	Used for testing & experiments
Security	Sentinel-1 GRD pre-processing	2	-
	Sentinel-1 SLC pre-processing	-	-
	Sentinel-2 preprocessing	1	-
	Sentinel-1 change detection	-	-
	Sentinel-2 change detection	-	-
	Vector data of human features	-	-
Agriculture	Deep network for pixel-level classification of S2 patches	-	2
	TimeSen2Crop Dataset	-	-
	Harmonisation of pre-processed time series of S2 data	-	-
	LSTM Neural Network for S2	-	1
	Pre-Trained LSTM	-	1

Domain	Service Name	Amount of projects using the service	
		Used in the final product	Used for testing & experiments
Health	Probabilistic downscaling of CAMS air quality model data	-	1
Energy	Energy Datasets	-	-

Users' profile analysis

In Figure 3, we report the level of expertise of the 1st open call winners in information technology (IT), and artificial intelligence (AI), as stated throughout the answers of the questionnaire. The expertise a winner may have is presented along a scale of 5 levels, where level 5 is the highest level of expertise.

The provided answers show that most of the winners have a relatively high level of expertise in IT and AI, apart from one user that has a lower level in IT. In cases like these, the user can use some help by the support officer provided in the context of the support phase of the AI4Copernicus Open Calls.
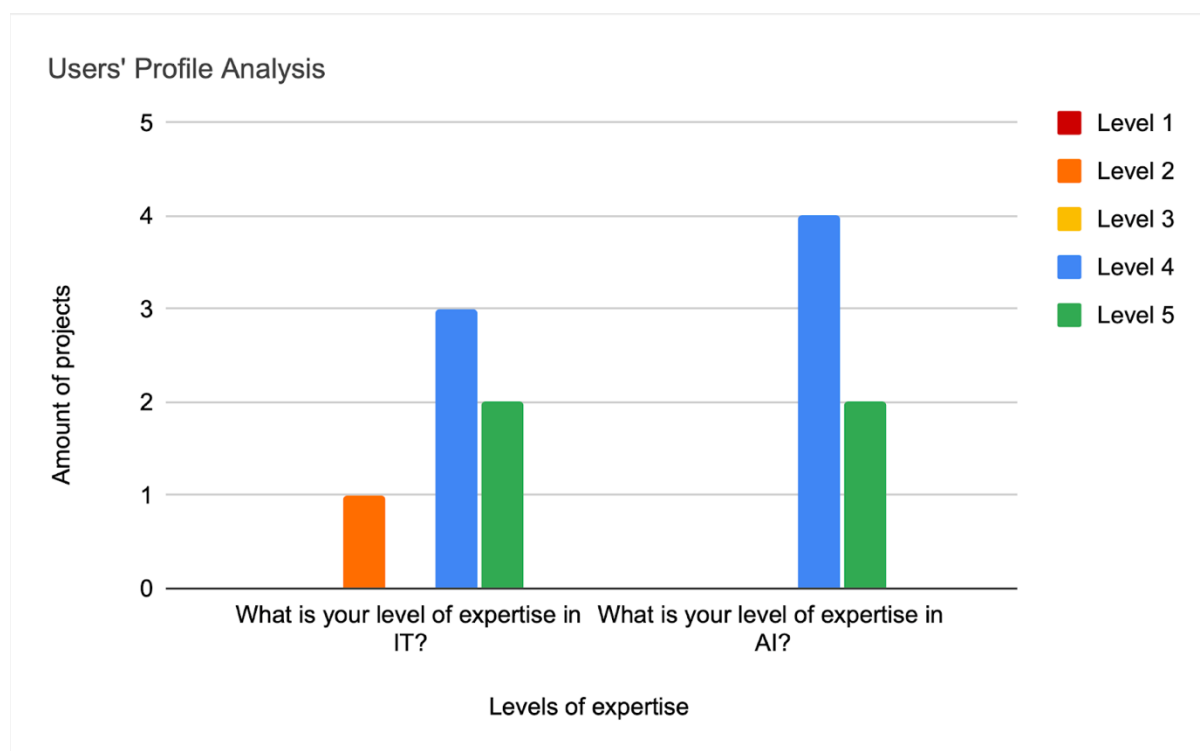
Figure 3: 1st Open Call winners user profiles

3.1.3   Feedback on the bootstrapping resources technical documentation

In Figure 4, we report the quality of the technical documentation provided to the winners of the 1st open call, as stated throughout the answers of the questionnaire. The quality of the document is presented along a scale of 5 levels, where level 5 is the highest level of quality.

The provided answers show that half of the projects assign a score of 3 to the quality of the documentation, while only 1 project is fully satisfied with the status of the documentation. This fact indicates that, at the stage where the questionnaire results were provided, there was room for improvement in the quality of the documentation.
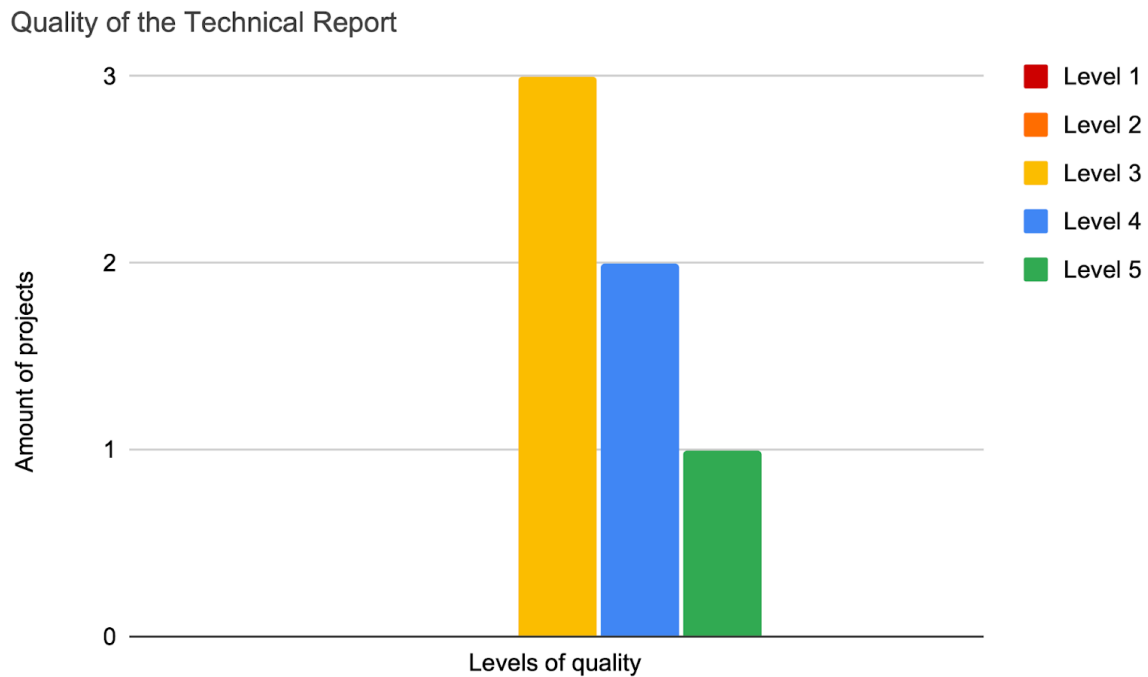
Figure 4: Technical documentation quality

3.1.4   Issues report during the usage of the bootstrapping resources

In Figure 5, we present the feedback from the projects regarding any issues or problems encountered during the usage of the bootstrapping resources. No major performance issues seem to have been encountered.

Issues and problems related to performance
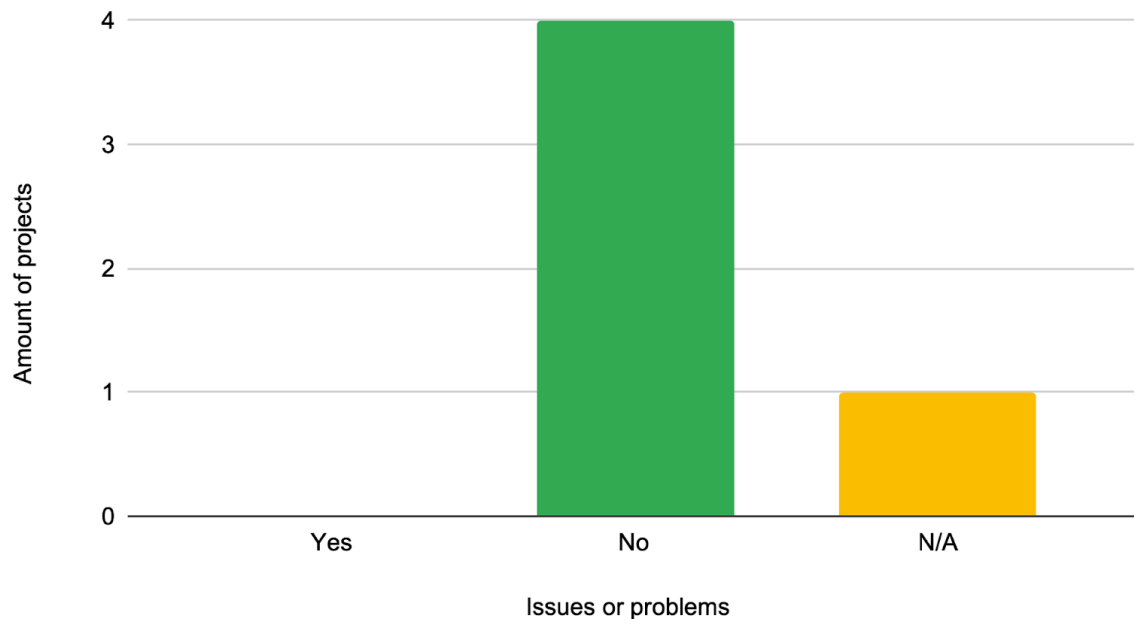
Figure 5: Performance-related issues

3.1.5   Additional feedback in textual form

In Table 5, we include some additional comments the winners provided regarding potential improvement of the technical documentation, possible extensions on the services, other bootstrapping resources that could have been useful to them, and general comments for improvement. In the right column, we propose some potential suggestions for the improvement of the document, based on the provided feedback.

Table 5: 1st Open Call projects - written feedback and improvement suggestions

Provided feedback from the 1ˢᵗ open call winners	Proposed improvement
"Not enough examples in the technical documentation"	To improve the technical documentation document by enhancing its quality, and providing additional examples, code snippets, videos, etc.
"More examples, codes, videos…"	
"More explanation and supporting documentation for each service,"	To include another question that assesses the importance of the improvements discussed above in the second version of the questionnaire to be sent to the users of the 3ʳᵈ and 4ᵗʰ open call projects.
"The technical documentation described the resource well but the usage not so much, and it is a bit complex to understand the required data and format needed to train a model"	
"More detailed step-by-step documentation from setup to execution"	

"Most of BR are developed in European area with a lot of Learning data available. We had liked to get some in African region and area with less in-situ data. '	To be considered.
"We expected the BR to come with a pre-trained model that I could instantaneously use on my data to look at the results, or to start transfer learning. However, there was only the code to train a model from scratch, which makes the usage of the BR very difficult since we lack data to train a similar model."	To be considered.
"The licences for operational used are not clear. Ahead clarification is needed to ensure a reliable business model. "	To be considered.
"Additional GPUs and HPC kit for model training"	To be considered.
"Maybe provide resources for the usage of docker, I was not very used to it coming from an academic background without knowledge in code deployment"	To include a paragraph/section in the technical documentation about usage of docker.
"For our project we don't need other specific service"	-
"Not much to add, both documentation and service are quite easy to handle"	-
"Raw Satellite imagery available faster than the public. Still a 10 hour delay from EODATA"	To be considered.

3.1.6   Interim and final assessments results summary

According to the methodology reported in Deliverable D6.1, each of the open call projects are evaluated twice during its support phase; first in M6 (that is the Interim assessment) and finally in M12 (that is the Final assessment). For the 1st open call projects the evaluations took place in September 2022 and May 2023 respectively.

In both assessments, the Expert Advisory Board together with the Support Officer reviewed the projects performance, based on the following criteria:

- Deliverable quality (30%)
- Technical performance indicators (30%)
- Business performance indicators (30%)
- Deadline Compliance (10%)

The technical and the business performance was evaluated by the External Advisory Board and the deliverable quality and the deadline compliance by the Support Officer.

In the following tables, we provide the marks for technical and business performance indicators and the overall performance for the Interim (Table 6) and the final (Table 7) assessment. Since the exact marks of the assessment are considered sensitive information, we present the minimum, the maximum and the average marks of the project of the 1st open call.

Table 6: 1st Open Call projects - interim assessment results

Assessment criterion	Minimum	Maximum	Average
Technical Performance Indicators	7	10	8
Business Performance Indicators	6	9	7.67
Overall Performance (including deadline compliance and deliverable quality)	7.6	9.1	8.3

Table 7: 1st Open Call projects - final assessment results

Assessment criterion	Minimum	Maximum	Average
Technical Performance Indicators	8	9	8.58
Business Performance Indicators	7	10	8.67
Overall Performance (including deadline compliance and deliverable quality)	8.4	9	8.6

It is evident from the assessment results that there is a commendable level of technical and business performance. Notably, the overall performance has shown improvement in the final assessment when compared to the interim assessment. It is worth mentioning that during the interim assessment, the focus of the projects primarily centred on achieving their technical objectives, resulting in relatively lower business performance. However, in the final assessment, a more balanced performance was observed, with notable progress in both technical and business aspects. This highlights the projects' growth and development over time, as they successfully aligned their technical achievements with their corresponding business outcomes.

3.2   3rd and 4th Open Call Winners Feedback

In the 3rd open call, the goal is to develop and test AI technical solutions that address industrial challenges. In the 4th open call, the goal is to develop and test AI technical solutions that address the selected citizen-driven societal challenges. Both open calls demand the exploration of AI resources and Earth Observation Data by focusing on any industrial domain.

Currently, 11 projects have been selected from the 3rd and 4th open calls. As of June 2023, the projects from these open calls are in the middle of their support phase. The status of these two open calls, as well as the high-level details about the projects are summarised in Table 8.

Table 8: AI4Copernicus 3rd and 4th Open Calls summary

Open Call	Amount of projects	Domains, Amount of projects per domain	Status
3rd	8	Agriculture: 5 Health: 1 Maritime: 1 Safety/Disaster Risk Reduction: 1	In progress
4th	3	Agriculture: 1 Security: 1 Urban Monitoring & Planning: 1	In progress

In the following subsections, we discuss the resource usage and the interim review results of the 3rd and 4th open call projects. This information allowed us to acquire the current level of technological and economic impact of the available bootstrapping resources and services.

3.2.1 Questionnaires analysis

In order to acquire feedback for the *technological impact* of the bootstrapping resources usage, we distributed a *user-centric questionnaire* to the projects of the 3rd and 4th open calls, as shown in Table 9. The questionnaire reflects feedback on the usage of the bootstrapping services, by including questions about the services tested and used by the projects, per domain.

The questionnaire was sent to the projects by the WP6 team on March 2023 and the results were collected and shared back to the WP2 team on May 2023, so it reflects a later stage of the AI4Copernicus services.

Table 9: 3rd and 4th Open Call winners questionnaire

Questionnaire about the feedback of the AI4Copernicus Bootstrapping Resources
What is the name of your project?
What is the thematic area of your project?
What is your level of expertise in IT?
What is your level of expertise in AI?
What is your level of expertise in EO?
Do you agree to be contacted for any further questions? If yes, provide your e-mail below:
Please describe any usage of Security Bootstrapping Resources: [Sentinel-1 GRD pre-processing]
Please describe any usage of Security Bootstrapping Resources: [Sentinel-1 SLC pre-processing]
Please describe any usage of Security Bootstrapping Resources: [Sentinel-2 pre-processing]
Please describe any usage of Security Bootstrapping Resources: [Sentinel-1 change detection]
Please describe any usage of Security Bootstrapping Resources: [Sentinel-2 change detection]
Please describe any usage of Security Bootstrapping Resources: [Vector data of human features]
Please describe any usage of Agriculture Bootstrapping Resources: [Deep network for pixel-level classification of S2 patches]
Please describe any usage of Agriculture Bootstrapping Resources: [TimeSen2Crop Dataset]
Please describe any usage of Agriculture Bootstrapping Resources: [Harmonization of pre-processed time series of Sentinel-2 data]

Please describe any usage of Agriculture Bootstrapping Resources: [LSTM Neural Network for Sentinel-2]
Please describe any usage of Agriculture Bootstrapping Resources: [Pre-Trained LSTM]
Please describe any usage of Health and Energy Bootstrapping Resources: [Probabilistic downscaling of CAMS air quality model data]
Please describe any usage of Health and Energy Bootstrapping Resources: [Energy datasets]
Did you use any Semantic or Linked Data resources? If yes, please check the specific resource:
Please provide any additional feedback on any of the Bootstrapping Resources here:
Please assess the quality of the Technical Documentation (available here):
Please provide any feedback on the Technical Documentation. Did you find anything to be missing?
Please rate your level of satisfaction regarding the following aspects of the bootstrapping resources [Ease of deployment]
Please rate your level of satisfaction regarding the following aspects of the bootstrapping resources [Ease of unit testing]
Please rate your level of satisfaction regarding the following aspects of the bootstrapping resources [Overall performance]
Please rate your level of satisfaction regarding the following aspects of the bootstrapping resources [Overall quality]
Please rate your level of satisfaction regarding the following aspects of the bootstrapping resources [Technical support provided]
Please share any additional feedback regarding technical difficulties you may have encountered while unit-testing the services, or any performance issues you may have experienced
How important do you find the following (possible) future additional companions to our bootstrapping resources: [more documentation details]
How important do you find the following (possible) future additional companions to our bootstrapping resources: [more concrete usage examples (e.g., notebooks, code snippets)]
How important do you find the following (possible) future additional companions to our bootstrapping resources: [a tutorial video]
How important do you find the following (possible) future additional companions to our bootstrapping resources: [a simplified version of each bootstrapping resource]
How important do you find the following (possible) future additional companions to our bootstrapping resources: [the ability to provide comments]
Are there any missing bootstrapping resources or services that could have been useful for your activities?
General comment. Any suggestions for improvement?

3.2.2   Bootstrapping resources usage analysis

In Table 10, we summarise the usage of the bootstrapping services of our framework, as stated throughout the answers of the questionnaire. We observe that projects mainly use the security and agriculture services, which is expected since the majority of the winners of the 3rd and 4th open calls belong in these two domains. Regarding the agriculture services, we observe that the projects show interest in almost all the tools we offer. Regarding the security services, the projects are mostly interested in the pre-processing tools.

Table 10: Usage of bootstrapping resources in 3rd and 4th Open Call projects

Domain	Service Name	Amount of projects using the service	
		Used in the final product	Used for testing & experiments
Security	Sentinel-1 GRD pre-processing	3	1
	Sentinel-1 SLC pre-processing	-	-
	Sentinel-2 preprocessing	2	2
	Sentinel-1 change detection	-	-
	Sentinel-2 change detection	-	-
	Vector data of human features	-	-
Agriculture	Deep network for pixel-level classification of S2 patches	-	3
	TimeSen2Crop Dataset	-	1
	Harmonisation of pre-processed time series of S2 data	1	1
	LSTM Neural Network for S2	1	3
	Pre-Trained LSTM	1	1
Health	Probabilistic downscaling of CAMS air quality model data	-	2
Energy	Energy Datasets	-	-

3.2.3   Users' profile analysis

In Figure 6, we report the level of expertise of the 3rd and 4th open call winners in information technology (IT), artificial intelligence (AI), and earth observation (EO), as stated throughout the answers of the questionnaire. The expertise a winner may have is presented along a scale of 5 levels, where level 5 is the highest level of expertise.

The provided answers show that most of the winners have a high level of expertise in IT and AI, while 3 out of 8 are not very experienced in EO. The knowledge gap between AI and EO could be bridged if the IT and AI experts of the 3rd and 4th open call explore the potential usage of EO resources and technologies in their project, by utilising the bootstrapping services and resources provided by AI4Copernicus.
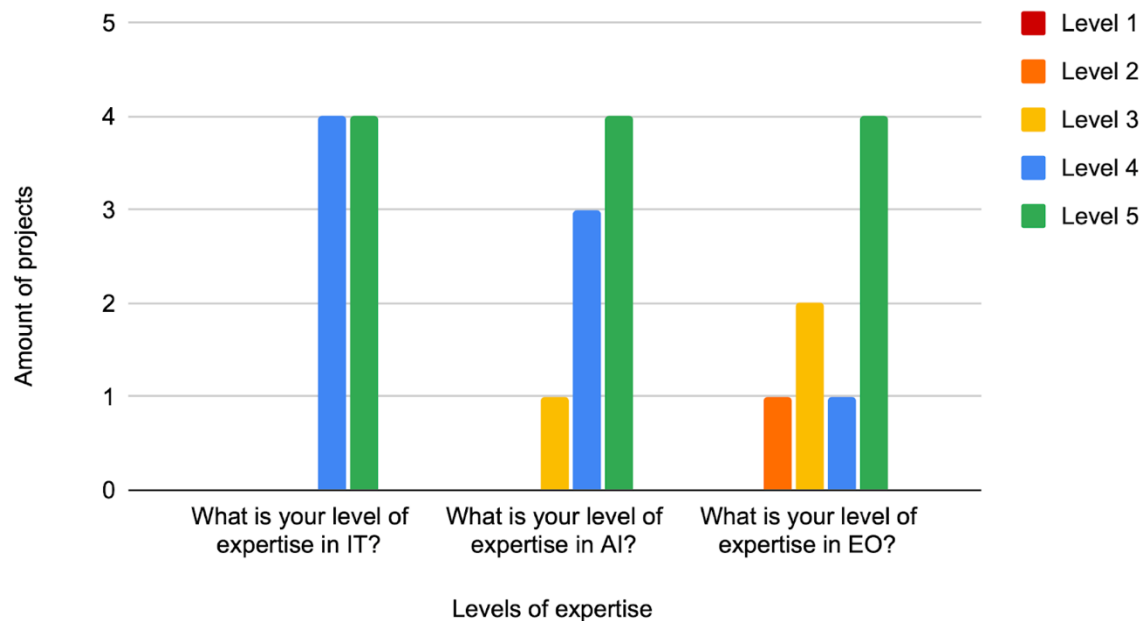
Users' Profile Analysis

Figure 6: 3rd and 4th Open Call winners user profiles

3.2.4   Feedback on the bootstrapping resources technical documentation

In Figure 7, we report the quality of the technical documentation provided to the winners of the 3rd and 4th open calls, as stated throughout the answers of the questionnaire. The quality of the document is presented along a scale of 5 levels, where level 5 is the highest level of quality.

The provided answers show that more than 60% of the winners selected level 4 for the quality of the technical documentation, which can be interpreted as a good level of quality, while less than 40% of the winners selected level 3, which indicated that the documentation could be improved, even though it had improved since the previous distribution of the questionnaire for the 1st open call.

In Table 11, we include some additional comments the winners provided regarding the potential improvement of the technical documentation. In the right column, we propose some potential suggestions for the improvement of the document, based on the provided feedback.

Since the distribution of the questionnaire, we successfully updated the technical documentation, by including more detailed descriptions for the available AI4Copernicus bootstrapping services and resources, as indicated by the provided feedback. We intend to keep updating the technical documentation based on any additional feedback, in order to continuously improve it and maintain the best quality possible.

Quality of the Technical Report
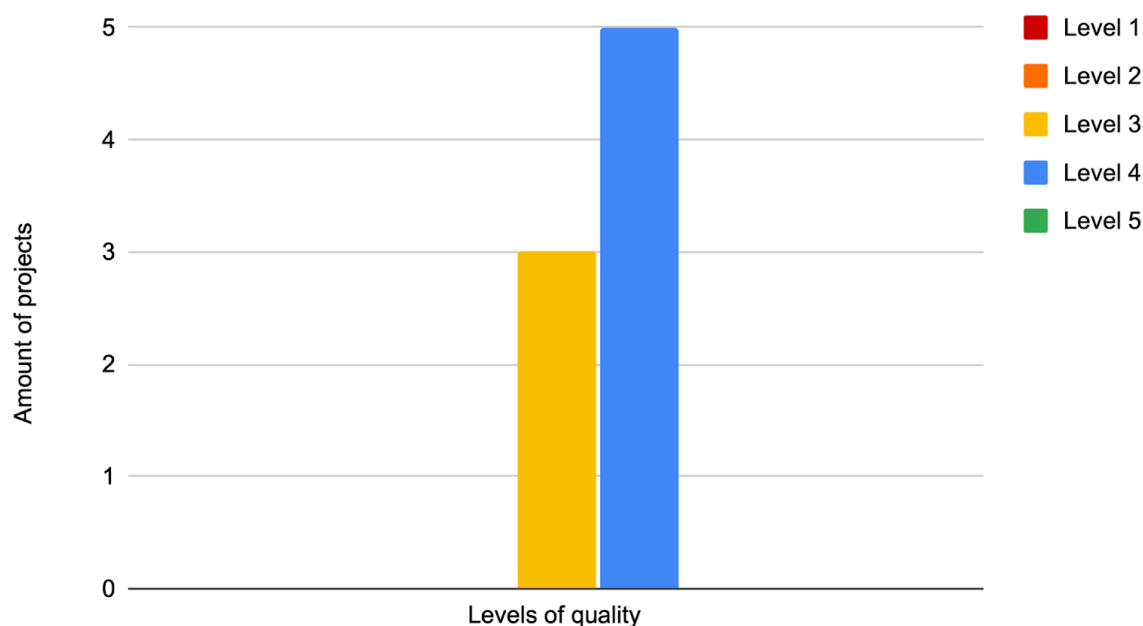
Figure 7: 3rd and 4th open call winners - technical documentation quality

Table 11: 3rd and 4th Open Call projects - technical documentation feedback and suggestions

Provided feedback from the 3rd and 4th open call winners	Proposed improvement
"Docker is hard to work (we are used to deploy directly to any VM through bash scripts for Ubuntu), some more help to manage a docker effectively would be welcome."	To provide pre-requisite indications about the management of dockers. These indications can be included in the AIoD catalogue and the technical documentation.
"They were really helpful but the technical documentation could have had a sample test run to begin with, existing in the image provided. This way the exact folder structure and expected input to the docker container would have been easier. The Deep network for pixel-level classification of S2 patches for example is not straightforward to run and the Harmonization of pre-processed time series of Sentinel-2 data needs LAI and REFBOA which if you are not familiar with need a lot of pre-work to produce."	To provide the bootstrapping services and resources with integrated executable examples. These examples could be the starting point for a quick and sufficient initialization of a project.
"The links to bootstrapping services should be activated within the document to facilitate access to services."	To include links to the bootstrapping services within the document.

3.2.5 Issues report during the usage of the bootstrapping resources

In Figure 8, we present the level of satisfaction the winners of the 3rd and 4th open calls reported while using the bootstrapping resources, as stated throughout the answers of the questionnaire. The level of satisfaction is presented along a scale of 5 levels, where level 5 is the highest level of quality.

The provided answers show that the winners of the two calls are mostly satisfied. In two additional comments, provided by two of the winners, the issue related to the introduction of the Docker technology resurfaced, and there was a report for the slow performance of the Sentinel-1 and Sentinel-2 pre-processing services. Regarding the first comment, we stand with the proposed improvement suggested in Table 11. Regarding the second comment, we will investigate the potential cause of the mentioned slow performance.
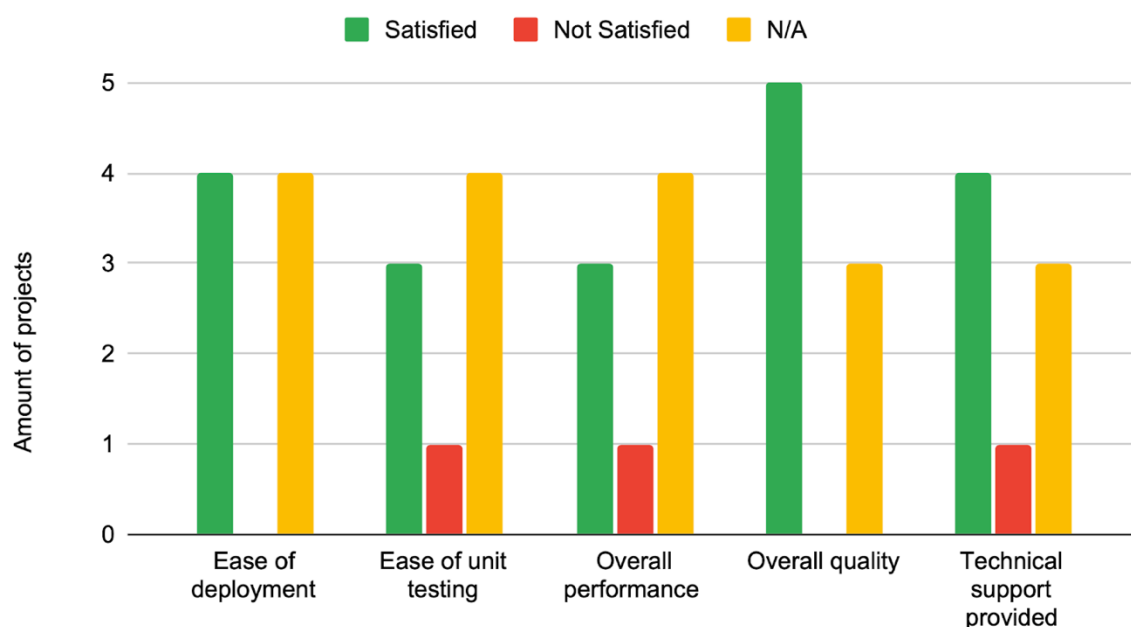
Figure 8: 3rd and 4th Open Call projects - satisfaction from the usage of bootstrapping resources

3.2.6 Future extensions of the bootstrapping services

In Figure 9, we present the level of importance of the potential technical extensions of the AI4Copernicus bootstrapping services the winners of the 3rd and 4th open calls reported, as stated throughout the answers of the questionnaire. The level of importance is presented along 4 choices, stating if a potential technical extension is "absolutely essential", "very important", "of little importance", or "not important at all".

The majority of the winners of the 3rd and 4th open calls suggested that the provision of additional documentation details is very important. Based on this suggestion, we will ensure that the technical documentation will be enriched to provide a more detailed description of the provided bootstrapping services. More specifically, it will include more information regarding the set-up and potential use of each asset.

Most of the winners also indicate that the provision of more concrete usage examples is very important. Based on this feedback, we will include more detailed examples with integrated

data that could be used as a starting point for the training and the development of a new project.

The feedback regarding the addition of a video tutorial for the bootstrapping services is more balanced between the provided choices. The same results are concluded regarding the provision of a simplified version of each service. Lastly, the ability to provide comments as a potential future additional extension for the bootstrapping services seems to be of little importance for the winners of the 3rd and 4th open calls.

Regarding the questions of any missing bootstrapping services the winners would find useful for their activities, 2 answers were provided. More specifically, there was a request for some Sentinel 5P and Sentinel 3 products and some L2 - L3 and L4 satellite data processing scripts.

In Table 12, we include some general comments the winners provided regarding some additional suggestions for improvement. In the right column, we propose some potential improvements based on the provided feedback.
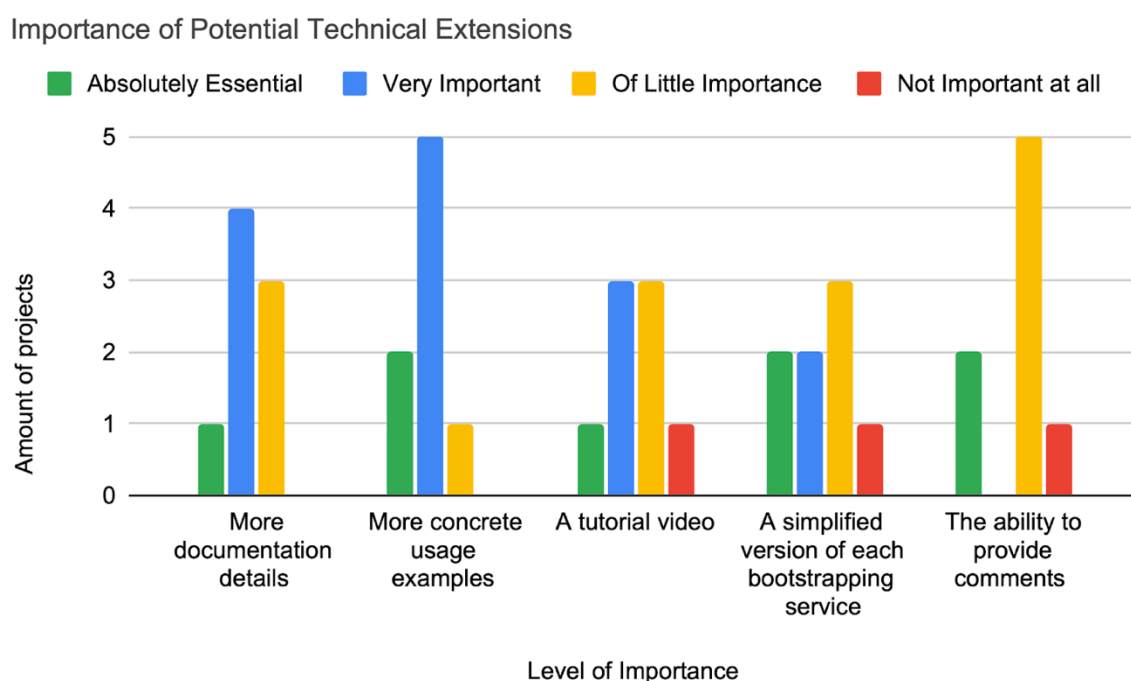
Figure 9: 3rd and 4th Open Call projects - importance of potential technical extensions

Table 12: 3rd and 4th Open Call projects - general feedback and suggestions for improvement

Provided general suggestions from the 3rd and 4th open call winners	Proposed improvement
"Regarding the Sentinel 2 pre-processing: a solution that would support mosaicking for a given AOI would be of great advantage. Perhaps it's a too specific request but something you can consider in the medium to long term."	Although this seems to be a very specific request, it will be considered.

| "I would go for providing the services without docker (just a requirements doc. and instructions), since companies have their own way of working." | To be considered. |

3.2.7   Interim review results summary

According to the methodology reported in Deliverable D6.1, each of the open call projects are evaluated twice during its support phase; first in M6 (that is the Interim assessment) and finally in M12 (that is the Final assessment). For the 3rd and 4th open call projects the interim assessment took place in February 2023. The final assessment is going to be organised in the coming months. The criteria for the assessment were presented in Section 3.1.2.

In Table 13, we provide the marks for technical and business performance indicators and the overall performance for the Interim assessment. Since the exact marks of the assessment are considered sensitive information, we present the minimum, the maximum and the average marks of the project of the 3rd and 4th open calls.

Table 13: 3rd and 4th Open Call projects - interim assessment results

Assessment criterion	Minimum	Maximum	Average
Technical Performance Indicators	6	10	8.27
Business Performance Indicators	6	10	7.73
Overall Performance (including deadline compliance and deliverable quality)	7.5	9.7	8.63

As in the 1st open call, we observe that there is a noteworthy performance level on both technical and business indicators. As previously, the interim assessment indicated promising results, with a focus on achieving the technical objectives. However, as the projects continue to evolve, it is expected that their business performance will also show significant growth and improvement in the final assessment. The final evaluation will provide a comprehensive view of the projects' overall performance, highlighting their advancements in both technical and business aspects.

3.3   AIoD Catalogue Entries Feedback

3.3.1   Evaluation Organisation

As the AIoD platform is the main point of entry for AI4Copernicus outcomes, a complementary evaluation from consortium partners focused on the evaluation of the findability of bootstrapping resources within the AIoD catalogue and the sufficiency of information provided through it.

Representatives of AI4Copernicus partners acted as platform users aiming to discover the resources and understand their usage and were called to fill in a relevant evaluation form, along with a free text summary. The form comprised direct questions addressing characteristics corresponding to core user actions (Find, Understand, Obtain, Use), with the evaluators called to provide a score on the 1-4 scale for each characteristic. Specifically, the evaluators were asked to undergo the following three steps:

a. **Step 1:** Find the bootstrapping resources via the search function of the catalogue and evaluate the completeness of the information provided by the overview page for the resource in the catalogue.

b. **Step 2:** Evaluate the documentation accompanying the bootstrapping resource as generated in the context of AI4Copernicus and – if available – compare it with additional documentation for the resource available online.

c. **Step 3:** Provide a short summative text snippet highlighting the main outcomes of the evaluation.

The evaluation comprised the following subset of available bootstrapping resources, presented in Table 14.

Table 14: Bootstrapping resources included in the internal assessment

Bootstrapping resource	AIoD Catalogue Entry
GeoTriples	https://www.ai4europe.eu/research/ai-catalog/geotriples
Strabon	https://www.ai4europe.eu/research/ai-catalog/strabon
JedAI	https://www.ai4europe.eu/research/ai-catalog/jedai
Semagrow	https://www.ai4europe.eu/research/ai-catalog/semagrow
Sextant	https://www.ai4europe.eu/research/ai-catalog/sextant
Sentinel-1 GRD pre-processing	https://www.ai4europe.eu/research/ai-catalog/ai4copernicus-security-bootstrapping-services
Sentinel-1 SLC pre-processing	
Sentinel-2 pre-processing	
Sentinel-1 Change detection– Amplitude Change Detection and Multi-temporal Coherence	
Sentinel-2 Change Detection	
Deep network for pixel-level classification of S2 patches	https://www.ai4europe.eu/research/ai-catalog/deep-network-pixel-level-classification-s2-patches
Harmonization of pre-processed Time Series of Sentinel-2 data	https://www.ai4europe.eu/research/ai-catalog/ai4copernicus-agriculture-bootstrapping-services
Long Short-Term Memory Neural Network for Sentinel-2	
Pre-Trained Long Short-Term Memory	

Probabilistic downscaling of CAMS air quality model data	https://www.ai4europe.eu/research/ai-catalog/ai4copernicus-health-bootstrapping-services
TimeSen2Crop	https://www.ai4europe.eu/research/ai-catalog/timesen2crop

The Energy Datasets and the Human Features Vector Data resources are not made available through the AIoD catalogue, as they are ad-hoc services requiring custom configurations. For the latter, specific configurations may be considered for inclusion in the catalogue.

3.3.2   Evaluation Results

The evaluated resources scored generally high on most criteria, with them being easy to find using their name or keywords from their description and having a clear link to technical documentation in most cases. On the other hand, their description in the AIoD catalogue was not always clear or complete and should be combined with external documentation/material to provide sufficient information. In that regard, most of the resource descriptions provided links to external documentation or a dedicated resource website. In contrast, multimedia material like usage illustrations or tutorial/demo videos was generally lacking.
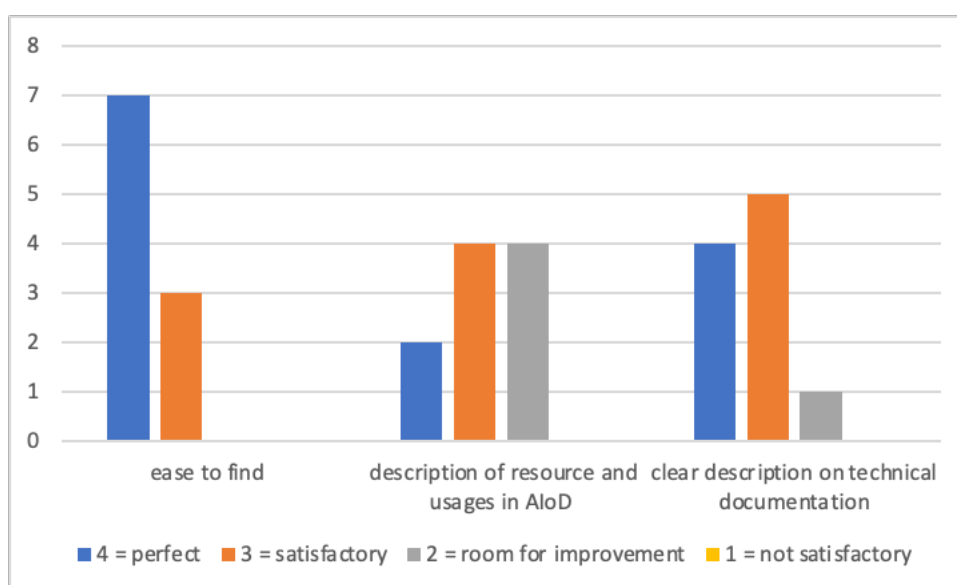

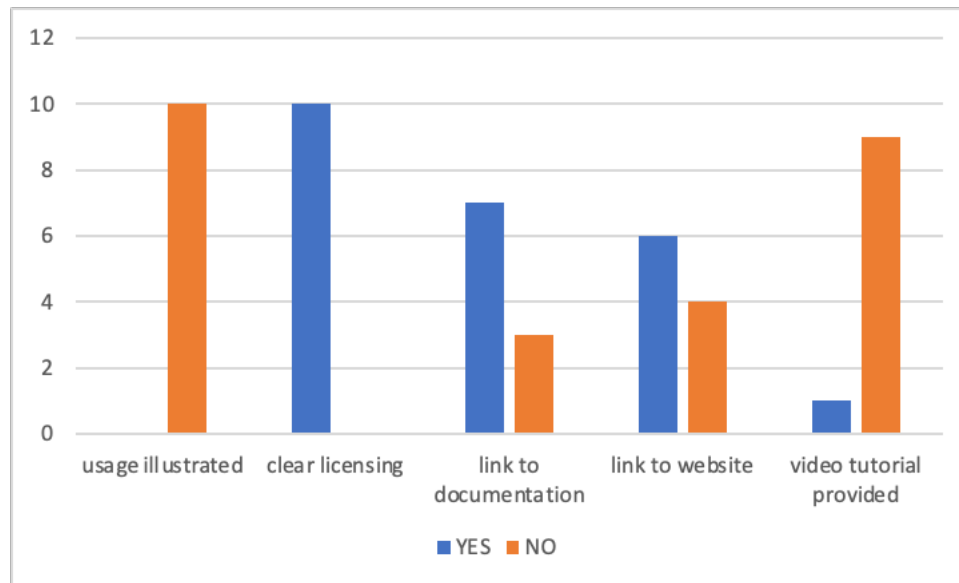*Figure 10: Internal assessment results on scaled criteria*

Figure 11: Internal assessment results on existential criteria

4   Evaluation Outcomes and Recommendations

The analysis of the information collected in the context of the described processes indicated that, in general, the level of technical maturity and stability of the bootstrapping resources was sufficient for their current users (Open Call winners), given that they had the support of their assigned Support Officers and expert AI4Copernicus personnel when they needed assistance for using a resource. The following subsection summarises the suggestions for the improvement on the general presence of the bootstrapping resources and material linked to them, to ensure that they are findable and usable for a broader audience, and thus improving their impact.

4.1   AIoD catalogue and technical documentation

The following remarks towards improvement summarise the main findings in this respect from the evaluation process.

1. In the technical documentation and the relevant asset catalogue page, provide a **clear license definition**, including after the end of AI4Copernicus project.
2. In the technical documentation and the relevant asset catalogue page, provide **pre-requisite indications**.
3. Provide a **detailed step-by-step description** covering: pre-requisites checks, download, set-up, then asset execution, and finally results exploration (with potential recommended tools).
4. Provide integrated **running examples** to be able to start quickly with the usage of a bootstrapping resource.
5. Provide some **performance figures**, applicable for typical examples, use cases and data loads.
6. Add **minimum requirements** or any tips on how to monitor the process as the resource is being executed.
7. Provide to the extent possible, **links to key relevant technologies** useful for using the resource.
8. **Link** the AIoD catalogue entry in the technical documentation for the report.

9. *Harmonise* the information present in the technical documentation with the one in the AIoD catalogue, taking into account versioning and distribution mechanisms aspects.
10. *Provide direct links* to the bootstrapping resource in the technical documentation.

For individual bootstrapping resources, specific comments were also collected and communicated to the providers of the resource, in order to improve their catalogue entries and the description of the resource in the technical documentation.

4.2   Future technical directions

During the feedback collection process, a set of functionalities that could lead to the development of additional bootstrapping resources useful to the target users were identified. Even though the particular feedback is not part of the methodology and evaluation process, we include it in the report as a future point-of-reference and potential feedback to projects building on AI4Copernicus and the AIoD ecosystem in general.

- Availability of pre-trained AI models in order to fine tune quicker with own data.
- Access to raw satellite imagery be available with lower delay.
- Access to data for different regions, and regions with less in-situ data available.
- Resources for Sentinel 5 and Sentinel 3 data.
- L2 - L3 - L4 satellite data processing scripts.
- Some level of integrations with tools like Meta AI SAM or similar.
- Support for mosaicking for a given Area Of Interest.
- Support for deployment practices other than Docker.
- Land/sea and cloud masking services.

5   Conclusions and Next Steps

The adopted validation methodology, based on the acquisition of feedback on bootstrapping resources from the Open Call winners, an assessment of the material provided for each bootstrapping resource, and a qualitative analysis of the formal review processes foreseen in the Open Calls, is the backbone of the envisioned improvement loop described earlier in the document. The methodology allows the collection of useful insights on the usage of the available resources, their presence in the AIoD catalogue, and the sufficiency of the provided technical documentation.

In broad terms, there were no major technical issues encountered on the usage of the bootstrapping resources, and the technical level of the thematic services is thus far particularly well-received from reviewers. Few licensing issues were identified, which should be taken into account on the way resources are provided and the scope for which they are available.

On the other hand, we identified essential feedback on the structure and content of the AIoD catalogue entries for the resources. While the general functionality and utility of the information elements in the catalogue were deemed sufficient, there is room for improvement to support the user in their discovery and – more importantly – understanding and usage of the resources before investing heavily on them. Moreover, we identified improvements on the structure of the catalogue itself, which could help resource providers on the provision of more accurate, complete, and useful pages in the future.

The quality of the technical documentation provided was also satisfactory but could be optimised taking into account the collected input on its level of detail and incorporation of step-by-step instructions for core functions of a resource.

Building on the present outcomes and moving forward with the described evaluation methodology, the next evaluation cycle will focus on the validation of the thematic services for the remaining open call projects and incorporate them in the improvement loop for all solutions offered by AI4Copernicus. Furthermore, the elicited results will be discussed with AIoD platform representatives to inform them on the feedback and suggestions of AI4Copernicus users.

Annexes

Annex I: Requirements Coverage

BR REQUIREMENTS AS PER D2.2		Platform & BR Catalogue Page	BR & Doc	Evaluation			
				Feedback 1st OCW	Feedback 3 & 4th OCW	Eval A	Catalogue Review + Manage & Share
Task - Find the Bootstrapping Resource							
Platform_Find_Bootstrapping_Resource	The platform shall provide a centralized Bootstrapping Resource search. The search shall scan AI4EU and all DIAS.	x				()	
Platform_Service_in_Catalogue	In the catalogue, the Bootstrapping resource shall provide its presentation including items mentioned in requirement "BR_Discover_At_A_Glance".	x	x			x	x
Task - Discover the Bootstrapping Resource							
BR_Discover_At_A_Glance"	The Bootstrapping resource shall provide a short description with an illustration of the resource.	x	x			x	x
BR_Discover_Share	The Bootstrapping resource URL should be shared quickly with anyone by e-mail	x					x
BR_Discover_Tutorials	The Bootstrapping resource shall provide links to video tutorials.		x		x	x	x
BR_Discover_Technical_Manual	The Bootstrapping resource shall be provided with a technical user's manual. Including especially the recommended environment and tools.		x	x	x	x	x
BR_ Discover_Example_of_use	The Bootstrapping resource shall be provided with concrete usage examples (e.g. with Jupyter notebooks).		x		x	x	x
BR_ Discover_Required_skill	The Bootstrapping service shall indicate specific required skill for service usage.		x		indirect	()	x
BR_ Discover_Result_viewer	The Bootstrapping service should provide input and results viewer integrated to the platform.		x		indirect		
BR_ Discover_Version_Info	The Bootstrapping service shall provide information on the version (novelties, known limitation…)		x			x	x
BR_ Discover_Usage_Domain	The Bootstrapping service shall provide performance level and usage domain. In particular, for AI service, indicate the dataset used for the training and validation.		x			x	x
BR_ Discover_Technical_Prerequisite	The Bootstrapping Resource shall advise on technical pre-requisite such as resource sizing for execution (CPU, GPU…)	x			indirect		x
BR_Discover_Favorite	The platform should propose to add the bootstrapping resource as a favourite in the user's account.	x					x
BR_Discover_Subscription	The platform should allow to subscribe to news and update of Bootstrapping Resources.	x					x
BR_Discover_Contacts	The Bootstrapping resource shall indicate contacts for technical support.	x	x			x	x
BR_Discover_User's_evaluation	The platform shall allow users to leave user's feedback on Bootstrapping Resources.	x			x		x
Task - Buy the Bootstrapping Resource							
BR_Price	The Bootstrapping resource should be free of charge, or propose a pricing adapted to user's profile.					(license)	x
Task – Use the Bootstrapping resource							
BR_Specific_format	The Bootstrapping resource should avoid specific data format and favour standard format. In case of specific data use, the associated converter shall be provided.		x	indirect	indirect		
BR_Access_To_Data	The Bootstrapping resource should be provided with results data access without downloading them and a layer to visualize data.		x	indirect	indirect		
BR_Dockerized_Service	When the Bootstrapping resource is an application, it shall be provided as a Docker.		x	indirect	indirect		
BR_Simplified_Version	The Bootstrapping resource should be proposed into different versions, one simplified, adapted to a non-specialist user.		x	indirect	x		
BR_Infrastructure_Transparent	The bootstrapping resource use should not require resource allocation expertise (allocation of CPU, or GPU…)..	x	x	indirect	indirect		

Annex II: Bootstrapping resources partner evaluation form

		OBJECTIVE : Evaluate BR access and documentation. **For that, take the role a future user of this BR.** **(think about UX. Information shall be clear-accurate-quickly understood. Your time is precious !)**	Directives => fill blue cells like this one. Keep relevant answer Yes or NO Keep relevant evaluation number. 1 or 2 or 3 or 4
L 1	**Eval A - BR evaluation**		**Enter BR name**
L2	**Step 3 - Evaluation findings summary (to fill at the end)**		
L 3	As a summary, what are **main findings** and **sources of improvment** **to access and discover the BR**		Comment : (to fill at the end)
L 4	Your name		x
L 5	Your organization		x
L 6	**Step 1 - FIND & DISCOVER the BR thanks to the platform and catalogue**		
L 7	**Go to AI4Copernicus catalogue in AIoD >>**		https://www.ai4europe.eu/ai-community/projects/ai4copernicus
L 8	Record evaluation date		xx/xx/xx
L 9	**Step 1.1 -FIND BR in AIoD Catalogue**		
L 10	try to find the BR in the AIoD catalogue using search tool + BR name		
L 11	onced founded, copy-past the URL		x
L 12	if not founded, use the link provided here		
L 13	How much it is easy to find the BR ?		1 = not satisfactory 2 = Improvment marging 3 = Satisfactory 4 = Perfect
L 14	**STEP 1.2 - DISCOVER BR in AIoD Catalogue**		
L 15	**based on information available in the catalogue**		
L 16	the BR type is clear (dataset, processing, else...) ?		YES/NO
L 17	Description and potential usage is clear even for a non expert ? (Without being obliged to open any other document to understand)		1 = not satisfactory 2 = Improvment marging 3 = Satisfactory 4 = Perfect
L 18	Typical usage illustrations are provided ?		YES/NO
L 19	Condition of use - License is indicated ?		YES/NO
L 20	There is a link to its documentation ?		YES/NO
L 21	is the link refere to the one below ?		YES/NO
L 22	https://ai4copernicus-project.eu/wp-content/uploads/2023/01/AI4Copernicus_Technical-Documentation_V5_Feb2023_cover.pdf		(produced by AI4Copernicus project for OC winners)
L 23	**if not**, list other document(s) link(s) (NB : documents to be quiclky scanned at the end)		x
L 24	Is there a link to a dedicated website ?		YES/NO
L 25	Is there a link to the asset itself ?		YES/NO
L 26	Is there a link to a video tutorial ?		YES/NO
L 27	**if yes**, is the link refere to the one below ?		YES/NO
L 28	https://www.youtube.com/watch?v=-I3pd9jxkug&t=3s		(AI4Copernicus Technical Webinar for 5th Open Call Applicant)
L 29	**If yes,** Scan the tutorial and evaluate how much the BR introduction part is clear ? (don't focus on details related to step by step use)		1 = not satisfactory 2 = Improvment marging 3 = Satisfactory 4 = Perfect
L 30	(optional question) if another video tutorial is proposed, how much the introduction is clear		1 = not satisfactory 2 = Improvment marging 3 = Satisfactory 4 = Perfect

L 31	**STEP 2 : DISCOVER using the BR documentation**		3
L 32	**STEP 2.1 Review the document produced by AI4Copernicus project**		
L 33	**open the document >>**	https://ai4copernicus-project.eu/wp-content/uploads/2023/01/AI4Cop	
L 34	**and answer the following questions**		
L 35	**identification and introduction of the BR**		
L 36	the BR category (processing, dataset,…) is Clear/mentioned	YES/NO	
L 37	and is consistent with the one in catalogue	YES/NO	
L 38	How much the BR overall description is clear.	1 = not satisfactory 2 = Improvment marging 3 = Satisfactory 4 = Perfect	
L 39	Typical usage illustrations are provided ?	YES/NO	
L 40	The document refere to a clear BR version	YES/NO	
L 41	The BR version accessible via the catalogue corresponds to the version mentioned in the document	YES/NO	
L 42	BR Description is consistent with the one in the catalogue ?	YES/NO	
L 43	is it necessary to update the description in catalogue with usefull info? (to have a better understanding of the asset without beeing obliged to open this doc and discover showstopper)	YES/NO	
L 44	contacts for technical support are identified	YES/NO	
L 45	**if BR a processing type**		
L 46	required input is clear ?	YES/NO	
L 47	processing is described	YES/NO	
L 48	for AI model, information on dataset used (for AI training and validation) are provided ?	YES/NO	
L 49	output description is clear (including format description)	YES/NO	
L 50	processing accuraccy is provided (with limit of usage domain) ?	YES/NO	
L 51	Required resources for nominal processing is indicated (CPU, GPU, RAM…)?	YES/NO	
L 52	**how to use description**		
L 53	clear step by step is proposed, with piece of code that could be copy-past	YES/NO	
L 54	required visualization tools clearly identified (preferably standard and free)	YES/NO	
L 55	**if BR a dataset type**		
L 56	Dataset scope is clear	YES/NO	
L 57	Dataset origin and generation process is presented	YES/NO	
L 58	level of validation of any limitation is presented	YES/NO	
L 59	**for any type of BR**		
L 60	is there a link for video tutorial (different from previous one. https://www.youtube.com/watch?v=-I3pd9jxkug&t=3s)	YES/NO	
L 61	Are there re-usable examples provided (e.g. with Jupyter note book).	YES/NO	
L 62	**STEP 2.2 Review other potential document**	the intend is not a deeper review of other documents (not from AI4Copernicus project) but to understand value and/or difference with the above one	
L 63	record used document(s)	x	
L 64	record used document(s)	x	
L 65	What is the global consistency between these documents and the AI4Cop Tech doc above ? Any suggestion to improve or rationalize documentations ?	Comment :	
L 66	**Go to Step 3 at the begining to fulfill evaluation summary**		

Annex III: 1st Open Call Winners Technical Feedback

Resource	Feedback and comments
Security_services	**Useful for your project?** - Test of the Sentinel-1 GRD preprocessing service, useful for the project we are working on, to access a fully automatic pre-processing of a large amount of Sentinel-1 images - Some services might be useful e.g. land/sea and cloud masks, or change detection. However, the services are designed for Sentinel data while we mostly use geostationary satellite pictures, so it is not clear whether it would work well or not - The services listed are mainly basic services useful for companies with limited experience in Sentinel data processing. We have already developed our own processing chain with efficient performance validated through existing applications **Easy to Access and to integrate in your project?** -Easy access, combined with automatic scripts could be really interesting - Access to the harbour and downloading of image was easy - Very nice that the projects are available as containerized images, that are platform independent - Getting the code from the docker registry is pretty straightforward **Any Missing functionalities to improve?** - Some functionalities could be interesting: 1) the use of the path of a geojson/shapefile where the WKT will be extracted, to avoid looking for the WKT format of a file. 2) Concerning the pre-processing of Sentinel-1, decibel values are also a lot used, adding a small conversion step could be interesting to diversify the use of the SAR data - the technical documentation doesn't include how to access the image or navigate to run the scripts. This should be included. - We have pre-trained a SAR ship identification model based on training data from the DIU Xview3 challenge. It would be really nice for AI4Copernicus to evaluate how the S1-GRD-Preprocessing compares to the preprocessing in that project (and make sensible adaptations if found beneficial). Link to the project and data is found here: https://iuu.xview.us/dataset -It could be made clearer which of the output files (preGRD.... or S1_GRD ...) the script produces is the image to use for further processing - The technical documentation doesn't include the minimum requirements or any tips on how to monitor the process as it is running - The logging of the processing pipeline is sometimes missing, or comes at the end, when the processing is done

- Our use case requires us to process a lot of full-size SAR imagery, in a time sensitive matter, so any optimization with regards to speed or resource use is very welcome. Right now, with a VM with 32 gig RAM, it takes 30 minutes per picture.

- As a step in the preprocessing, a landmask filtering (only interested in the sea mask) is a required addition in the S1-GRD-preprocessing pipeline. Hopefully, filtering out the landmask will have a positive impact on performance as well. The addition of a tolerance parameter would be perfect in our case, as we will trade keeping some of the landmask in order to be sure to capture all the sea pixels.

- Maybe providing a detailed guide for users that are not familiar with UNIX systems, or a pre-built service if possible

Agriculture_services	**Useful for your project?** Initial discussed with UNITN but eventually not using it, since the ML model had to be re-trained on another testing area (e.g., Ukraine) and it might require time to be adapted - Not really useful a priori. We could use the pre-trained LSTM in comparison to our model, but the tasks seem quite different (crop classification vs. video forecasting), which means that the LSTM architecture might not work well, even if we re-train it on our datasets. - We need to generate a monitoring of arable planted fields and potential harvested fields in the Sahel region to check the ability of the local population in crisis areas to feed themselves. That is why we have selected 2 promising services: LSTM neural network for Sentinel-2 and Deep network for pixel-level classification of S2 patches **Easy to Access and to integrate in your project?** Some blocking points have been encountered with the Deep network for pixel-level classification of S2 patches: • The service was not really ready for operational use at the beginning of the project, we got the docker around June. • The licence agreement was too restrictive. It was only available for the AI4Copernicus project duration and the pricing model for longer usage was not already established. This blocking point is in contradiction with the wishes to transform the prototype into an operational service which commits the business model • The licence agreement, from Humanitywatch point of view, is not suitable for an SME in front of a large group like Thales. Through the licences, Thales has the right to audit Pixstart about the usage of the services. In the context of a non-mature market where the usage can be the value of a SME like Pixstart, we can not communicate the information with a company like Thales. • The licence agreement does not include a warranty (the software is delivered "as is") and the Thales expert told us that

	they don't know if the system runs in the Sahel region, they only have tested it in the European region The additional agreement was signed but, requiring a further step in the acceptance, does not allow a fast access to the docker. **Any Missing functionalities to improve?** • We don't have TimeSen2Crop equivalent data in the Sahel Region which is mandatory to train the model. (LSTM NN for S2)
Health_services	**Useful for your project?** Downscaling of data fields might be useful for finer resolution of the satellite video forecasts. For now it has not been extensively tested since output of the SLIDE model is still blurry and thus the input superscaling would probably be lost. Another option would be to only superscale the output. However, we do not have superscaled irradiation measures to begin with, so only the pre-trained model is available. We do not know yet if the superscaling of Air quality data transfers well to that of irradiation data. Also, we might use the reanalysis data in the second phase of the project when we will try to integrate weather data in the model **Easy to Access and to integrate in your project?** Getting the code from the docker registry is pretty straightforward. However, the code for the SLIDE model is already inside a docker so integrating the two dockers in a seamless manner is not very easy since I am not familiar at all with kubernetes.In the current architecture, the easiest way would be to superscale only the output of the SLIDE model (if it works well) and thus run the two dockers/models consecutively. The API for getting the ERA5 data is also easy to use **Any Missing functionalities to improve?** Maybe some more documentation on the expected format of the input and how to call the "predict.py" code on a specific input ? For now, I think all these informations have to be inferred by looking at the code and config.yaml files. Also, a simpler "predict" module that would directly call the pre-trained model using a file path as argument to point to whatever input would be nice to quickly test the model on data it was not designed for
Energy datasets	**Useful for your project?** The energy-specific data sets have so far not been utilised. However, data sets from other domains, e.g. Health has been utilised by "Energy" projects like. Not used for our project (not relevant)

Annex IV: Open Call winners suggestions for further development

Service	Improvement
Sentinel-1 GRD pre-processing	• Add Land/Sea Mask • Remove intermediate products • Support file (e.g. shapefile) as input for "Area of Interest" parameter • Add parameter to allow output in decibel • Improve logging • Some changes to improve performance
Sentinel-1 SLC pre-processing	• Add Land/Sea Mask • Remove intermediate products • Support file (e.g. shapefile) as input for "Area of Interest" parameter • Add parameter to allow output in decibel • Improve logging • Some changes to improve performance
Sentinel-2 pre-processing	• More parameters exposed (e.g. resampling methods) • Support L1C inputs • Support latest S2 format version • Remove intermediate products • Support file (e.g. shapefile) as input for Area of Interest parameter • Improve logging
Sentinel-1 Change Detection	• Merge IW subswath • Add Land/Sea Mask • Remove intermediate products • Support file (e.g. shapefile) as input for "Area of Interest" parameter • Improve logging
Sentinel-2 Change Detection	• Remove intermediate products • Support file (e.g. shapefile) as input for "Area of Interest" parameter • Improve logging
Deep network for pixel-level classification of S2 patches	• Create an extended documentation to detail every available parameter and also give new users an example of a quick start of the service • Finalise the licence, so future signings are expected to be faster