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– EOSC**POLICY**BRIEF –

Terminology

Terminology/Acronym	Description
AA	Action Area
AAI	Authentication and Authorisation Infrastructure
API	Application Programming Interface
EAL	Earth Analytics Lab
ECZ	Earth Critical Zone
EOSC	European Open Science Cloud
ERA	European Research Area
EU	European Union
FAIR	Findable; Accessible; Interoperable; Reusable
FAIR-EASE	FAIR EArth Sciences & Environment services
GO	General Objective
IDDAS	Interdisciplinary Data Discovery and Access Service
IT	Information Technology
OO	Operational Objective
PID	Persistent Identifier
RPO	Research Performing Organisation
SDG	Sustainable Development Goal
SRIA	Strategic Research and Innovation Agenda
UC	Use Case
UN	United Nations
VRE	Virtual Research Environment

EOSC Policy Brief
CALL: HORIZON-INFRA-2021-EOSC-01
TOPIC: HORIZON-INFRA-2021-EOSC-01-04 - Innovative and customizable services for EOSC
PROJECT: FAIR-EASE - FAIR Earth Sciences & Environment services
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Policy background:

The European Open Science Cloud (EOSC) is a flagship EU initiative to deepen Open Science practices across the European Research Area (ERA). As such it contributes to several actions of the ERA policy agenda (in particular ERA action 1 & 8). EOSC is also recognised in the European strategy for data as the data space for science, research and innovation which shall be fully articulated with the other sectoral data spaces defined in the strategy.

Overall progress is steered by the EOSC tripartite governance involving the Union represented by the European Commission, the participating countries represented in the EOSC Steering Board and the research community represented by the EOSC Association. The second phase of development of EOSC (2021-2030) takes place in the context of the EOSC European co-programmed Partnership, which brings together the European Commission and the EOSC Association.

The EOSC Strategic Research and Innovation Agenda (SRIA) co-developed with the entire EOSC community sets 3 General Objectives (GO), 14 Operational Objectives (OO) and 14 Action Areas (AA).

General Objectives (GO):

1. Open science becomes the 'new normal', by ensuring that open science practices and skills are rewarded and taught.
2. Researchers can seamlessly find, access, reuse and combine results, through the definition of common standards and the development of related tools and services.
3. A federated infrastructure under community governance enabling open sharing of scientific results is deployed and sustained.

Operational Objectives (OO):

1. Deliver and operate all the necessary components of the Minimum Viable EOSC to share openly research data, publications, software, tools and services while attracting increasing numbers and categories of users (public and private) (based on a governance structure representative of the various stakeholders and including domain-specific user environments supporting Open Science) by 2025;
2. Make monitoring systems to gather data and evidence on best Open Science practices accessible through EOSC (including the development of a dashboard to monitor the evolving landscape of policies, infrastructures and open resources made accessible via EOSC by 2023);
3. Increasingly mainstream Open Science skills in European research-performing organisations (RPOs) including through the uptake of curricula and training frameworks related to data stewardship through the lifespan of the Partnership;
4. Co-develop domain-specific standards and adopt Open Science practices through the engagement with research communities during the lifespan of the Partnership;
5. Provide the technical components of a FAIR ecosystem for uptake and customisation by the communities by 2023 (including open specifications, standards, schemas, application programming interfaces (APIs), metadata frameworks supporting FAIR digital objects and their automated processing);
6. Provide the metrics and tools to measure the adoption of the FAIR principles for research artefacts and provide frameworks to help in certifying that repository services enable FAIR in EOSC throughout the lifespan of the Partnership;
7. Co-develop a first generation of a robust pan-European network of infrastructures for software source code (including incentives for the effective documentation and sharing of research software) by 2025;

8. Co-design and adopt a Rewards and Recognition framework for FAIR and open data practices in research during the lifespan of the Partnership.
9. Implement and evolve the EOSC Rules of Participation and onboarding process for EOSC providers and increase the number of service providers and services offered progressively over the course of the Partnership.
10. Deploy and operate an authentication and authorisation infrastructure (AAI) framework to manage user identity and access by 2024;
11. Implement the EOSC persistent identifier (PID) policy and architecture by 2025;
12. Co-develop a minimum metadata framework and provide a common search and access mechanism to EOSC resources across the EOSC federation by 2025;
13. Continuously monitor and promote the increased uptake of core services and EOSC resources, access to EOSC Exchange tools and services and ensure a feedback loop with the users;
14. Define models for availability and costing of services across borders by 2023.

Action Areas (AA) of a technical nature:	Action Areas (AA) related to boundary conditions:
1. Identifiers	8. Rules of Participation
2. Metadata and ontologies	9. Landscape monitoring
3. FAIR metrics and certification	10. Business models
4. Authentication / authorisation infrastructure	11. Skills and training
5. User environments	12. Rewards and recognition
6. Resource provider environments	13. Communication
7. EOSC Interoperability Framework	14. Widening to public and private sectors and going global

More information can be found from:

- https://research-and-innovation.ec.europa.eu/strategy/strategy-2020-2024/our-digital-future/open-science/european-open-science-cloud-eosc_en
- https://digital-strategy.ec.europa.eu/en/policies/open-science-cloud
- https://eosc.eu/eosc-about

A. Overview of contributions in relation to the EOSC policy and EOSC SRIA objectives.

Being the overall objective of FAIR-EASE to customize and operate distributed and integrated services for the Earth system, environment and biodiversity scientific communities by improving their different components implemented in close cooperation with end-users, the expected results of the project can contribute to the achievement of the three General Objectives (GO) of the EOSC SRIA. Moreover, the most significant contributions of FAIR-EASE will directly concern the General Objective GO2: *"Researchers can seamlessly find, access, reuse and combine results, through the definition of common standards and the development of related tools and services"*.

Based on the fourteen Actions Areas (AA) identified in the EOSC SRIA, FAIR-EASE selected five priority areas on the seven related to the primarily technical challenges and prerequisites to implementing the EOSC ecosystem. The FAIR-EASE Actions Areas are: i) Metadata and ontologies (AA2); ii) FAIR metrics and certification (AA3); iii) User environments (AA5); iv) Resource provider environments (AA6); and v) EOSC interoperability framework (AA7). If the AA5 and AA6 can be considered as the "core" areas representing the major technical challenges the project wants to address, the AA2 and the AA3 constitute the "building blocks" to make the expected results more effective. Finally, the AA7 can be considered as the "output" in terms of harmonization across disciplines.

Here below the relations between each contribution from FAIR-EASE and the most relevant Operational Objective(s) (OO) and Action Area(s) (AA) of the EOSC SRIA:

AA2 – OO5 – OO12.

Metadata and ontologies are evidently essential to realising Open and FAIR science, but several challenges already persist. The major gap the project wishes to address is the lack of interdisciplinary vocabulary and ontologies for harmonized discovery of multidisciplinary data infrastructures. The project contribution will be based on the Interdisciplinary Data Discovery and Access Service (IDDAS) with harmonized data discovery services from selected data infrastructures in the EU and beyond, whose discovery aspect is supported by I-ADOPT intelligent mapping solutions.

AA3 – OO4 – OO6.

Improvements in FAIR practices are necessary and recommended, and meanwhile the different communities should define how the FAIR principle apply in their context. Bearing this in mind, FAIR-EASE would like to ensure that the FAIR principles are fully endorsed and implemented in the project's target communities. With this perspective the major project contribution will consist in communities-driven guidelines for the improvement of the FAIRness of research outputs.

AA5 – OO4 – OO5.

According to the SRIA, users must be able to discover research artefacts and services in order to benefit from EOSC. Therefore, offering users functionalities to discover resources and services as well as integrating services in distributed thematic and regional community services and resources for cross-domain analysis is really urgent. In view of this challenge, the project contribution consists in providing a unified entry point to discover datasets (IDDAS user interface), access and process through the FAIR-EASE Earth Analytics Lab (EAL) to discover datasets and VRE. A user interface with a service catalogue to discover and access services such as data access services, notebooks, workflows to run processing in EAL will be also proposed.

AA6 – OO4 – OO5.

The resource provider landscape is largely distributed and diversified across all European member states with a number of resource providers dedicated to a specific scientific discipline or research community. Based on this analysis, the major challenges identified by FAIR-EASE are: (i) the interoperability and integration of data discovery and access and processing services; (ii) a unified data access layer to facilitate data access, download, process; (iii) developing guidelines for resource providers within existing interoperability frameworks available at community level. Therefore, the project contribution entails the development of an

integrated technical layer through (i) Data discovery services; (ii) Catalogue of (direct) data access services; (iii) Subsetting services for direct targeted data access and (iv) pragmatic integration with existing AAI solutions.

AA7 – OO4 – OO5 – OO12.
Achieving a good level of interoperability is crucial for data and services federation and consequently to provide added value for users across disciplines. Hence, the main challenge is related to harmonization across standards and disciplines. With this perspective, the FAIR-EASE contribution will be based on the development and deployment of semantic mappings, the improvement of FAIR principles in regard to the services, and the validation of good practices for real involvement and engagement with research communities (cross-domain use cases).

B. **Key contributions subject to wider dissemination by the European Commission.**

The entire cycle of FAIR-EASE has been organized into different implementation phases: (i) landscaping, (ii) specification and development roadmap, (iii) development and integration, (iv) test of services, and (v) onboarding services to the EOSC. The first year has been dedicated to the landscaping analysis and to the identification of technical specifications. To date any expected result has been completely achieved. Nevertheless, the FAIR-EASE major ambition is to support the achievement of the EOSC strategic objective on FAIRness: GO2 - "Enable the definition of standards, and the development of tools and services, to allow researchers to find, access, reuse and combine results". The FAIR-EASE contributions to this objective are related to the following services:

Firstly, the Earth Analytic Lab. The EAL is a web-based VRE for an Earth System providing users with an easy way to visualise, analyse and process environmental data on-demand, i.e. according to their specific objectives, thematic, geographical areas and temporal slots of interest.

Secondly, the Interdisciplinary Data Discovery and Access Service. The IDDAS is the VRE component enabling generic data discovery. It provides an overview of data across several disciplines to make them discoverable, and enables users to access this data in the repositories. More concretely, it provides a harmonised interface to data discovery, access and download services of selected data infrastructures in the EU.

Finally the FAIR-EASE so-called Data Lake that will provide access to data and data sources for the VRE, improving data harmonisation and the technical efficiency of data access. This addresses the need for data in FAIR-EASE VRE by creating solutions depending on data accessibility. The Data Lake is a distributed resource, but it allows an overview of partially centralized data, if access needs to be improved, and partly directly taken from other repositories when easy, fast and direct access to the data is already provided. Liaising with the VRE, computation close to the data source and its integration in the FAIR-EASE general environment will be explored.

The first release (preliminary tests of FAIR-EASE 5 use cases) of the above-mentioned services will be available between Q1 and Q2 in 2024.

C. **Synergies with other stakeholders.**

FAIR-EASE has several interactions with other EU-funded projects in the context of EOSC. These interactions are particularly relevant in terms of consolidation of a federation of projects in view of the achievement of strategic objectives. Indeed, FAIR-EASE is promoting the interoperability of services and communities leveraging on the deployment of a unified data access layer to facilitate the discovery, the access and the process of a large amount of heterogeneous data. These challenges are based on the harmonization across domains and targeted communities. To make the expected results more effective and impactful some collaborations have been established with other projects. Firstly, with the EuroScienceGateway project in order to extend the open-source Galaxy platform for FAIR data analysis to a broader group of scientific user communities. A first result will be the availability of a sub domain fully dedicated to the Earth system on the Galaxy Europe platform. Blue Cloud 2026 is another project we decided to collaborate with. Indeed, both

projects are addressing technical needs from scientific communities in regard to the environment management and the Earth system. In addition, the collaboration will be centred around resources sharing to make results fully operable. The interaction is relevant to make accessible common demonstrators to the users dealing with scientific challenges in relation to the environment and the Earth system as a whole. Some interactions have been already identified with the project FAIR-IMPACT in order to extend and thus adapt existing FAIR metrics for assessing data objects and FAIR assessment tools to the Earth and environmental sciences communities. Actually, to face the challenges we have, it is extremely important to ensure that FAIR principles are fully endorsed and implemented by communities. The reinforcement of skills motivated us to collaborate with the Skills4EOSC project. Finally additional collaborations are foreseen with the AquaInfra project as a follow-up of the collaboration initiated with EuroScience Gateway on the development and uptake of the Galaxy platform and tools.

As a project implemented in the context of EOSC, FAIR-EASE since the beginning participates to all the groups set-up by the EOSC-Association relevant for the project activities as well as for enhancing outreach synergies to reach potential additional stakeholders in EOSC and beyond. Furthermore, some privileged interactions have been defined with some of the Task-Forces, namely the FAIR Metrics and Data Quality, and Semantic Interoperability ones. It allows both to take into consideration the most relevant guidelines promoted by the Task-Forces and to try to feed the Task-Forces with the considerations from our project targeted communities.

Other policy relevant interactions have been fostered at national level. In France, for instance, with the national initiative called Gaia-Data whose objective is to promote and make available nationally distributed infrastructure capacities for the Earth system, environment, biodiversity and climate communities. This initiative is coordinated by a consortium led by the French e-infrastructure Data-Terra, also largely involved in FAIR-EASE. Such an interaction can indeed make the project results more sustainable and potentially make the services operable into a long-term perspective.

D. **EOSC challenges and lessons learnt of a policy nature.**

The complexity of the Earth System composed of several components that are evidently interconnected doesn't facilitate the interactions among all the scientific communities concerned. The present practices are community-driven and the necessity to enhance interdisciplinary approach especially if we want to deal with global changes and challenges having large both environmental and societal impacts, looks evident. Then the primary challenge in FAIR-EASE is to define a common glossary that is not only an epistemological challenge but also technical in order to avoid any incomprehension and then facilitate the convergence among all the parts of the project. Another challenge FAIR-EASE is facing concerns the frontiers of science. Actually, to date, the major technical demonstrators are community oriented also within the Earth scientific domains, although an integrated approach could improve the scientific knowledge and the technical development as well. We are convinced that in the EOSC context this aspect should be strongly supported, indeed, it could make sure that EOSC is really a valuable tool for researchers and end-users from different fields and for wider applications in a harmonized way.

E. **Link to other EU policy priorities (beyond EOSC).**

The Earth system encompasses dynamic processes and interactions at multiple scales among its components such as ocean, atmosphere and land. Understanding, monitoring and predicting the evolution of the Earth system and its subsystems constitutes a fundamental scientific challenge, particularly when it comes to global changes such as climate change, food security and sustainable energy, with significant societal and economic consequences and implications. These challenges require interdisciplinary approaches demanding seamless access to multi-source data generated in different scientific contexts by different observing systems. Discovering and accessing this data and the associated services and resources require both harmonization across different disciplines and standardization within disciplines. To date, the ability to have an integrated interdisciplinary approach has been partly hampered by the strong compartmentalization of Earth system data among many different scientific communities. Datasets are usually generated, archived and managed in a wide variety of formats and volumes by different research platforms and infrastructures. To go beyond this state-of-

the-art, FAIR-EASE aims at customizing and operating distributed and integrated services for observation and modelling of the Earth system, environment and biodiversity by improving their different components implemented in close cooperation with user-communities.

According to the UN Data Revolution call (2014), bringing together different data communities of producers and users, and harnessing the power of technology and other innovative tools can be essential to fulfilling the data demands of the 2030 Agenda. With this perspective, all the FAIR-EASE Use-cases and Pilots, based on user communities needs and requirements as well as their integration, are directly or indirectly dealing with the environment-related SDGs such as the SDG 14 "Life below water" and SDG 15 "Life on land". For instance, the Pilot focused on the "Earth Critical Zones (ECZ)" is totally oriented to provide information based on geospatial observation and data integration in order to enrich the indicator 15.3.1 "Proportion of land that is degraded over total land area". Generally, the UCs and Pilots, all acting on the knowledge on the ecosystems functioning and interaction, can have consequently some application towards the SDG 13 "Climate action". In addition, the Pilot "Volcano Space Observatory" can also contribute to achieve the Sendai Framework for Disaster Risk Reduction global targets. This pilot, indeed, aims at building a web interface for interactively aggregating and jointly analysing satellite observations from Solid Earth and Atmospheric Science communities for the near-real-time monitoring of volcanic activity and risk.

Having in view the global changes and the societal challenges addressed by the EU Missions, FAIR-EASE can foster the creation of user environments researchers from different fields can use to seamlessly interact with digital information in the framework of the EOSC ecosystem. Indeed, FAIR-EASE is leveraging on the interoperability and integration of data discovery, access and processing services through the promotion of a unified data access layer to facilitate data access, download and process. FAIR-EASE can contribute to advance the following EU Missions: i) Ocean and Waters, ii) Soil, and iii) Climate Change Adaptation.

Finally, having in mind that FAIR-EASE is going to offer an interoperable, trusted IT environment for data discovery, access and processing, interconnecting currently fragmented and dispersed data from various ecosystems, it can contribute to advance the deployment of the EU Data-Spaces, namely the Green Deal one.