



# MAGAZINE

ISSUE 7  
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**EOSC-Hub's main focus is to contribute to a single vision: EOSC as the shared space for research and innovation in Europe**

**EOSC-hub's Lasting Legacy - A showcase of its key results**

**In the spotlight: use cases from EOSC-hub's Competence Centres**

**EOSC-hub's thematic services: an overview of achievements**

**Realising the European Open Science Cloud Conference & EOSC Projects EXPO**

**Outreach and Training activities for the seismological community**

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## EOSC-hub Magazine

The EOSC-hub Magazine is a publication of the EOSC-hub project, edited to showcase major results and achievements of the project, collaborations ongoing with other initiatives and updates from the communities. The magazine also provides an overview of the latest highlights from the European Open Science Cloud (EOSC) landscape.

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## About EOSC-hub

The EOSC-hub project brings together multiple service providers to create the Hub: a single contact point for European researchers and innovators to discover, access, use and reuse a broad spectrum of resources for advanced data-driven research.

For researchers, this will mean a broader access to services supporting their scientific discovery and collaboration across disciplinary and geographical boundaries.

The project mobilises providers from the EGI Federation, EUDAT CDI, INDIGO-DataCloud and other major European research infra-

structures to deliver a common catalogue of research data, services and software for research.

EOSC-hub is funded by the European Union's Horizon 2020 research and innovation programme under grant agreement 777536.

*Start: January 2018*

*End: December 2020*

*Total budget: €33 million*

*100 Partners*



# EOSC-Hub's main focus is to contribute to a single vision: EOSC as the shared space for research and innovation in Europe

*Tiziana Ferrari rounds up EOSC-hub's successful activities*

To showcase the success of the project in practice, we can look directly at its key exploitable results. EOSC-hub's KERs have been supporting the building of the EOSC services, ensuring the quality of service components and providing best practices and tools for linking services to the Hub and specifically:

- › Design, implementation and operations of the **EOSC Portal and Marketplace**, which is now active and running 8 Competence Centres with more than 270 services including 30 thematic services published, from over 130 providers.
- › 13 use cases on-board with 75 planned integrations for the Early Adopter Programme initiative which selects scientific communities interested in adopting and integrating multiple EOSC-hub services

› definition and development of the **EOSC Federating Core**, the **EOSC Service**

**Management System (SMS)** that fosters robust and resilient services delivery, facilitates communication between customers and providers as well as aligns service management activities of all providers and integrates different services into the common marketplace.

- › Definition of **Rules of Participation (RoP)** which enable the easy integration of new service providers into the EOSC ecosystem while ensuring the quality and compliance of the overall services and building and maintaining the trust of the users and user communities.
- › **Technical specifications and interoperability guidelines** (13) that allow data and software portability across multiple facilities and foster EOSC uptake. The project also designed an EOSC Technical Reference Architecture that includes functions, interfaces, APIs and standards as technical concepts.
- › **EOSC Digital Innovation Hub (DIH)** a platform established to support industrial R&D and academic research in their accessing and sharing of EOSC tools and services. A total of 11 business pilots have joined the EOSC hub and 4 services on-boarded in EOSC Marketplace, another 5 new pilots to be started).
- › Design of **EOSC business models**.
- › **Network of trainers** created with over 100 training events attended by more than 2000 people, and with a revamped training catalogue.




# EOSC-hub's Lasting Legacy - A showcase of its key results

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Since its beginnings in 2018, EOSC-hub has aimed to create a hub of service providers to accelerate data-driven research in Europe - the Hub. It has succeeded and its results have provided input to the practical implementation aspects of the European Open Science Cloud (EOSC).

In this final issue of the EOSC-hub Magazine, we take a look at EOSC-hub's lasting legacy - its Nine Key Exploitable Results (KERs).

## **EOSC Portal and Marketplace**



The [EOSC Portal](#) and [Marketplace](#) support the service discovery and access in EOSC. This KER includes technical components, intangible assets and contractual arrangements that make it possible to provide the service that facilitates the access and use of the EOSC assets. This also includes the rights to administer the IP addresses and IT infrastructure making accessing the EOSC Portal possible.

Through this KER, it will be possible to operate a scalable and well-managed EOSC Portal and marketplace with a growing service portfolio and with a transparent governance model.

The importance of the EOSC Portal as the primary, pan-European entry point to the EOSC ecosystem is going to grow dramatically as the scope of the EOSC services grows.

## **EOSC Service Management System (SMS)**

EOSC-hub defined and piloted an IT service management system (ITSM) for EOSC. This system will allow service providers to plan, deliver, operate and control services offered to customers or the future EOSC users. These activities are directed by policies and are structured and organised by processes and procedures.

EOSC-hub implements best practices based on the lightweight standard, [FitSM](#), regarding the service planning, delivery, operation and control of the services in the service catalogue.

The SMS includes all services contributing to creation and delivery of the Hub. The Hub is a set of services essential to provide the core functionality for EOSC such as the helpdesk, monitoring, accounting, order management, among others.

## **EOSC Rules of Participation (RoP)**

To be able to create a market with providers and users, EOSC-hub developed a comprehensive and coherent set of [rules and policies for service providers](#) to onboard services and make them discoverable and accessible through the [EOSC Portal](#).

These rules of participation were piloted and put into practice in the operation of the EOSC Portal and have provided the discussions on the EOSC Rules of Participation with a practical way forward and a set of rules that have already been tested on prospective service providers.

Through this result, the RoP brought forward by EOSC-hub makes it as easy as possible to bring new service providers into the EOSC ecosystem while still ensuring the quality and compliance of the overall services and building and maintaining the trust of the users and user communities.



## Internal Services in the Hub Portfolio



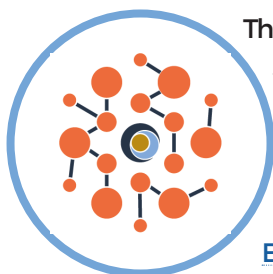
The [Internal Services](#) provide the basic enabling services proposed for accessing and operating the EOSC. Some examples of these internal services include access control or accounting as well as common and standard interfaces to shared tools for basic services that need to be aligned in order to provide consistent user experiences.

Internal services in the Hub Portfolio are one of the key elements foreseen for the EOSC federating core.

This common toolset could enable the integration of services into the EOSC ecosystem. This is a prerequisite for the function of the Hub as a federating core, as a mature implementation of the tools that will help streamline the processes of the EOSC Hub Operators.

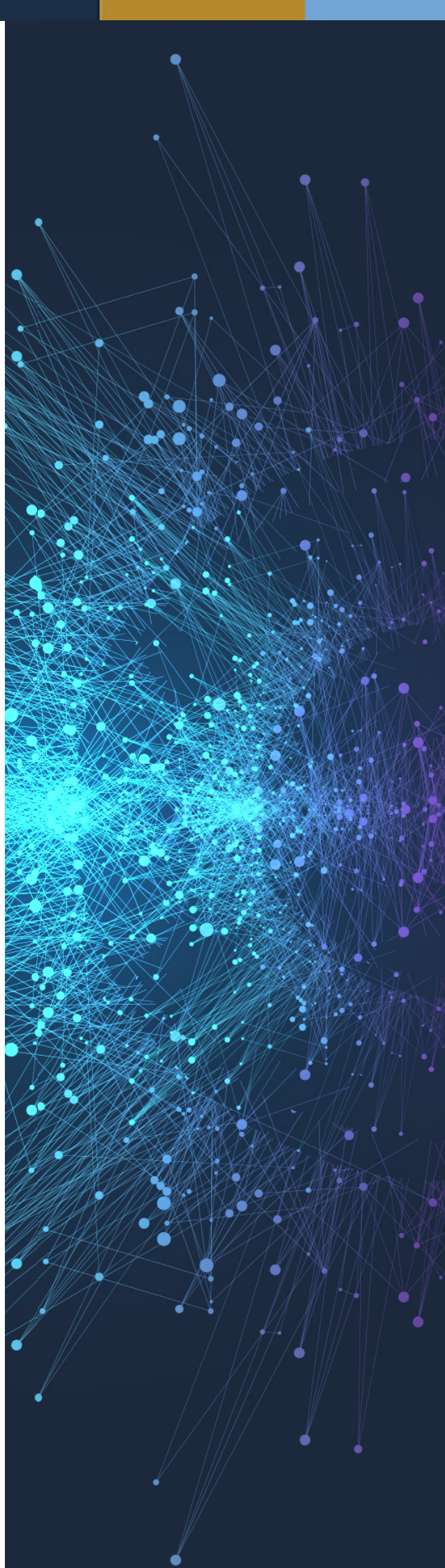
For the service providers, this EOSC-hub result provides tools to access several user communities through the Hub by integrating their services into a single service interface (instead of several community-specific ones). The common services are targeting adoption by the permanent EOSC services and their importance will be increased by the growth of the number of users and the value delivered through EOSC. The reuse of individual components by third parties is also encouraged.

## External Services in the EOSC Service Portfolio



The EOSC is envisioned to provide a “one-stop-shop” for services and solutions to speed up the research process of the disciplines and enable cross-disciplinary collaboration and reuse of tools and results. To this end, EOSC-hub has gathered a number of diverse services in the [EOSC Service Portfolio](#). Independently of the service characteristics, the EOSC Service Portfolio supports them by making the discovery of the services easier and reducing the effort needed to adopt them. Together with the EOSC Portal and Service Management System, this KER from EOSC-hub provides an intuitive, comprehensive and robust set of [services to researchers](#).

As the number of research activities and groups supported by EOSC grows, the possibility to easily search, request and re-use research services will become more and more important. Consistent metadata will be crucial for efficient service discovery (either by the researchers themselves or in collaboration with different helpdesk services). Providing an intuitive interface to the service lifecycle information will be of equal importance, especially when considering the long-term repeatability of EOSC-supported research. This KER provides the foundations for this functionality in the EOSC.





## EOSC Digital Innovation Hub (DIH): Platform for Industrial collaborations with EOSC

The engagement of the private sector in the EOSC is a topic not commonly covered by many EOSC-related initiatives. Through EOSC-hub, the [EOSC DIH](#) provides a clear interface for commercial innovation that can be supported by EOSC as part of the broader European Digital Innovation Hub landscape (such as free access trials).



It is a multi-dimensional mechanism that allows research e-Infrastructures to support business organisations to stimulate innovation, as well as helping start-ups, SMEs, and other innovative actors to tap into the academic world both in accessing knowledge as well as technical services.

The final goal is to create a one-stop-shop that brings IT services, research data, technology and expertise into a single place to support innovation in the industry. EOSC DIH offers several public-private collaboration models around piloting and co-design of new services (proof-of-concept work, performance testing, etc.), technical access to different “as a Service” resources (HPC/HTC/Cloud computing, storage, data management and higher-level services), training and support (Technical consultancy, service management, commercialisation) and visibility, using the DIH as a networking tool to expand beyond local markets.

EOSC DIH lowers initial investments (time and effort) for identifying and accessing services and developing or testing new products and services as well as increasing visibility and networking opportunities on a European level. Moving forward, it will be continued in the context of EOSC and the wider network of digital innovation hubs. In the long-run, it can provide a formalisation of the knowledge and expertise into procedure descriptions, standardised consulting offerings or certification schemes.

### Business and sustainability models for services and the Hub

The Business and Sustainability models are crucial for long-term planning of EOSC. In addition to grounding the discussions about finances, they also provide foundations for ensuring the trust of users and user communities on the continued delivery of services. EOSC-hub provides a definition for the planned “[EOSC Federating Core](#)”, including a cost assessment and a business plan. The project also analysed a number of procurement and service delivery



models that are applicable to different EOSC scenarios. The analysis will include considerations related to cross-border and -sectoral VAT compliance.

Clear and intuitive business models will increase flexibility, lower barriers of entry and reduce compliance costs in service provision and consumption by the EOSC stakeholders, and will thus be important inputs to EOSC sustainability planning. This result provided relevant input to EOSC policy bodies, in particular to the EOSC Sustainability Working Group.

## Interoperability and Integration Guidelines



### Interoperability and Integration Guidelines

piloted the definition of the high-level architecture for basic EOSC technical functions and promoting EOSC standards and APIs. The result, if implemented in the EOSC, will facilitate access to services, lower barriers to integrating and composing services and promote the usage of services between adjacent communities.

EOSC services that are 'compliant' with the interoperability and integration guidelines will offer well-established and documented interfaces for usage and integration, based on well-known standard or APIs, facilitating their exploitation from user communities willing to create new scientific services that could rely on well-established and documented interfaces for the integration. The combined usage of EOSC services, the adoption of well-known standards and interfaces will reduce the cost to integrate services.



As a consequence, less mature or small scientific communities can leverage on EOSC services, built on these guidelines, for a series of IT functions and focus on their scientific work, access to scientific services will be open to new communities through documented interfaces and new scientific workflows can be created combining existing applications.

## Training Courses and Material

The [Training Courses and Material](#)

encompass a large variety of project results such as common and federated services for supporting the whole research life cycle, domain-specific training to target the needs of data providers and data scientists and advanced training on higher-level composable and PaaS services to consultancy building on training events aiming to stimulate the knowledge transfer, foster the use of digital infrastructures and promote the uptake of Open Science paradigm.

The sound training programme delivered by EOSC-hub aimed to stimulate the establishment of a "knowledge network" of expertise and help researchers from different scientific disciplines to better integrate advanced digital services, tools and data to achieve excellence in science, research and innovation.

Training services are tailored to optimally fit the requirements of the diverse audience EOSC needs to reach, ranging from service providers who might benefit from technical assistance on using, integrating and providing services in EOSC to individual researchers possibly encountering the e-Infrastructures for the first time, enabling a smooth integration into EOSC ecosystem and maximising the benefits.



**Learn more about the EOSC-hub Key Exploitable Results and the specific project outputs related to them.**  
Visit [eosc-hub.eu/results](https://eosc-hub.eu/results)!





# In the spotlight: use cases from EOSC-hub's Competence Centres

**C**ompetence Centres are a model of engagement and support for research communities, based on distributed centres where research infrastructures, experts of relevant e-infrastructures and technology developers join forces to mobilise common resources from the EOSC-hub service catalogue to set up community-specific services. Therefore, in EOSC-hub we have been working with Competence Centres – or CCs for short. The EOSC-hub CCs cover a variety of scientific disciplines, from life science to psychics, astronomy, earth and environmental sciences and throughout the project they have been bringing researchers closer to services and resources from the European Open Science Cloud.

Below are several practical examples of the Competence Centres' work and their achievements during the lifetime of EOSC-hub.

## *LOFAR and the radio astronomy community*

### **Societal challenges**

The basic technology of radio telescopes has not changed since the 1960's: large mechanical dish antennas collect signals before a receiver detects and analyses them. Half the cost of these telescopes lies in the steel and moving structure. A telescope 100x larger than existing instruments would therefore be unaffordable. New technology is required to make the next step in sensitivity needed to unravel the secrets of the early



universe and the physical processes in the centers of active galactic nuclei.

LOFAR is the first telescope of this new sort, using an array of simple omni-directional antennas instead of mechanical signal processing with a dish antenna.

To make radio pictures of the sky with adequate sharpness, these antennas are to be arranged in clusters that are spread out over an area of 100 km in diameter within the Netherlands and over 1500 km throughout Europe.

### **Technical challenges**

The Radio Astronomy Competence Centre of EOSC-hub's project has been supporting the radio astronomical community to find, access, manage, and process data produced by the LOFAR telescope. The CC directly addresses the community's technology needs – such as computing infrastructure and storage – by offering resources and services from European e-Infrastructures through the European Open Science Cloud.

### **How EOSC adds value**

EOSC can add value by providing a compute and storage infrastructure where LOFAR data can be pushed



for analysis. In particular, the aspects addressed are federated single sign-on access in a distributed environment and support for data-intensive processing workflows - for example having access to user workspace connected to high-throughput processing systems, offer portable application deployment, and provide integrated access to a FAIR science data repository.

The radio astronomical community is therefore empowered to profit from these resources and increase the science outputs from multi-petabyte radio astronomical data archives of current and future instruments.

## *Euro-Argo and the marine community*

### Societal challenges

Oceanographers work to analyse and interpret measurements of different physical and chemical parameters (temperature, salinity) in order to understand the effects of global warming in marine environments. These parameters are collected by large sea observation consortiums, such as Euro-Argo. To improve their understanding of ocean circulation and climate machinery, oceanographers need to access original observations from diverse sources.

### Technical challenges

EOSC-hub's Marine Competence Centre has been working on deploying ocean observations on the EOSC infrastructure for data analytics. One of the focuses is to make Euro-Argo (The European research infrastructure for ocean observation) data more easily accessible for online processing and subsetting.

## How EOSC adds value

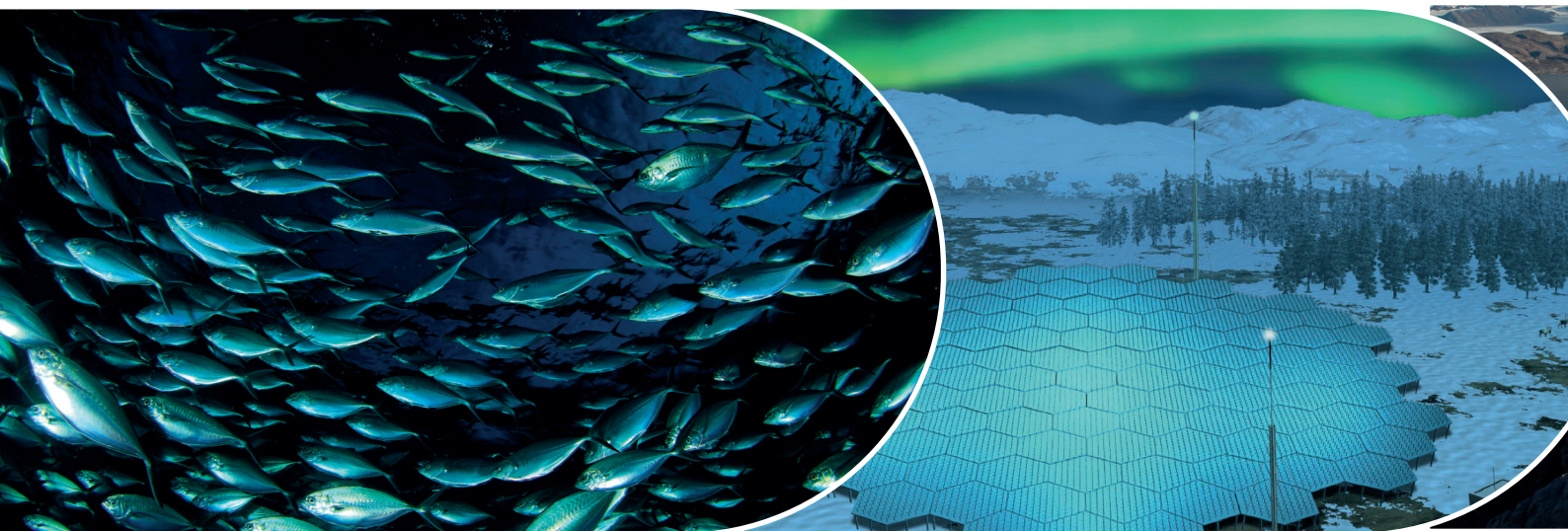
The EOSC-hub project has been bringing together services and tools from the European Open Science Cloud to support the Euro-Argo Data Discovery Platform and integrate the Argo research community with the EOSC. These services include compute cloud environments for hosting of the ARGO data and the data visualization environments, as well as data transfer services.

## *EISCAT\_3D and the EO community*

### Societal challenges

EISCAT\_3D will be the world's leading facility to explore and study the Earth's atmosphere and ionosphere, including phenomena such as the aurora borealis (northern lights) and noctilucent clouds.

Construction kicked off in September 2017, with the first stage of the radar system expected to become operational in 2021. Using separate stations in Norway, Sweden, and Finland, based on phased array technology, EISCAT\_3D will be able to make three-dimensional measurements of the plasma densities and temperatures and the direction of motion of that plasma, among other things. This will provide scientists a more comprehensive view of the important physical processes.





## Technical challenges

EISCAT\_3D has opened up new opportunities for physicists to explore a variety of research fields, but it comes with significant challenges in handling large-scale experimental data. The EISCAT\_3D Competence Centre worked on developing a web portal for researchers to access and analyse the data generated by EISCAT\_3D.

## How EOSC adds value

The EOSC-hub team has been building on the existing portal prototype and enriched it with EOSC services made available via the project. These services include EGI Check-In (for user single sign-on in the portal), EGI Clouds (for user data analysis from the portal), EGI Workload Manager (to provide the portal graphical environment and for managing complex set of jobs across multiple, federated clouds).

## *The Integrated Carbon Observation System (ICOS) research community*

### Societal challenges

Supporting high-quality climate change research is a huge challenge. This is why ICOS gathers over 100 greenhouse gas measuring stations and 12 mem-

ber countries - to better quantify and understand the greenhouse gas balance of the European and neighbouring region

## Technical challenges

The Carbon Portal is the ICOS data portal where users can find and download ICOS data. The Carbon Portal provides virtual research environments where users can apply models, combined with ICOS and other data and publish the results again through the data portal.

The Carbon Portal requires trusted long-term storage and distributed computing facilities to enable the portal functionality and to provide the virtual research environments with enough resources for the potential growing needs from its users.

## How EOSC adds value

To address the above challenge, ICOS has been leveraging cloud compute resources, as well as data staging and preservation services from e-Infrastructures through EOSC-hub. The ICOS group now integrates EOSC services with the ICOS Carbon Portal to provide a scalable environment for researchers wishing to monitor and analyse carbon processes.



**Have a look at the full EOSC-hub CC representation on the project's website.**

More EOSC-hub use cases are available on the EOSC Portal.



# EOSC-hub's thematic services: an overview of achievements


*Debora Testi gives an overview of the main results*

**T**hematics services are a fundamental part of the EOSC realisation as together with the core services they provide tools and applications that can be used by scientific communities to support their research workflow. EOSC-hub has involved thematic services from different domains from its very beginning with the aim to:






- › showcase integration scenarios and
- › make available via the EOSC portal services to support scientific communities.

EOSC-hub sees the contribution from nine thematic services covering different scientific disciplines that have achieved a high level of integration with EOSC: various levels of technical integration have been successfully achieved and at least one service from each thematic service has been made available via the EOSC Marketplace. In its own domain, each of the EOSC-hub thematic services is a success story for EOSC.





Thematic service	Scientific domain	Short success story	Services available in the EOSC Portal
 <b>CLARIN</b> <small>Common Language Resources and Technology Infrastructure</small>  CLARIN - European Research Infrastructure for Language Resources and Technology	Humanities	New collaboration established with Europeana: metadata (about 120k records) into the VLO. «It is now possible to directly call a broad range of processing applications via the Language Resource Switchboard. This demonstrates literally how we are providing a Hub in EOSC(-Hub)»	<ul style="list-style-type: none"><li>› Virtual Language Observatory</li><li>› Virtual Collection Registry</li><li>› Language Resource Switchboard</li></ul>



Thematic service	Scientific domain	Short success story	Services available in the EOSC Portal
  <p>Dynamic On Demand Analysis Service (DODAS) automates the process of provisioning, creating, managing and accessing a pool of heterogeneous computing and storage resources</p>	Physical sciences	DODAS is highly integrated with a wide range of EO-SC-hub services. Born within CMS experiment computing environment, since 2018 is integrating within data analysis workflow of 4 communities within HEP, Astroparticle and Gravitational wave (AMS, Fermi and Virgo).	<ul style="list-style-type: none"> <li>› <a href="#">Dynamic On Demand Analysis Service (DODAS Portal)</a></li> </ul>
 <p>ENES Climate Analytics Service (ECAS) enables scientific end-users to perform data analysis experiments on large volumes of multidimensional data</p>	Earth sciences	ECAS has successfully integrated a wide range of services across workflow stages and multiple EOSC service provider areas to provide a unique working environment. Preliminary uptake has shown that the ECAS environment can facilitate better data and workflow sharing close to the user needs.	<ul style="list-style-type: none"> <li>› <a href="#">ENES Climate Analytics Service</a></li> </ul>
 <p>GEO Discovery and Access Broker (GEO DAB) transparently connects GEOSS User's requests to the resources shared by the GEOSS Providers</p>	Earth sciences	Demo of GEOSS was presented at the EOSC Launch in 2018 and a new updated version has been presented at the GEO Plenary, in the context of EuroGEOSS Sprint To Ministerial of the European Commission.	<ul style="list-style-type: none"> <li>› <a href="#">GEO DAB</a></li> <li>› <a href="#">GEOSS Web Portal</a></li> </ul>
 <p>OPENCoastS service builds on-demand circulation forecast systems for user-selected sections of the North Atlantic coast.</p>	Earth sciences	OPENCoastS has grown from a national service to a worldwide platform with users on all 5 continents. Thanks to the service provided by EOSC-hub, we have over 20050 international deployment and users in 3923 countries.	<ul style="list-style-type: none"> <li>› <a href="#">OpenCoastS</a></li> </ul>




Thematic service	Scientific domain	Short success story	Services available in the EOSC Portal
		<p>Four international training events have spread the word on the advantage of using e-infrastructures and their core services to support user oriented engineering platforms to address coastal research and management needs.</p>	
 <p><b>WeNMR - A World-wide e-infrastructure for NMR and structural biology</b></p> <p>A suite of web portals providing user-friendly access to complex computational workflows and tasks in the structural biology field.</p>	Biological sciences	<p>HADDOCK is a Thematic Service for structural biologists provided through the EOSC Marketplace.</p> <p>The capacity of the portal and the EOSC HTC resources supporting it have been extended to meet the increased demand due to the COVID pandemic.</p> <p>During the lockdown the average number of unique users per month has more than doubled (from 300 to &gt;600) and the number of processed submissions increased by almost a factor 3 to reach a peak of 8500 in May 2020.</p>	<ul style="list-style-type: none"> <li>› <a href="#">CS-ROSETTA</a></li> <li>› <a href="#">DISVIS</a></li> <li>› <a href="#">FANTEN</a></li> <li>› <a href="#">HADDOCK</a></li> <li>› <a href="#">AMBER</a></li> <li>› <a href="#">POWERFIT</a></li> <li>› <a href="#">SPOTON</a></li> </ul>
<p>EO Pillar provides access to different services in the field of Earth Observation (EO)</p>	Earth sciences	<p>Terradue, an EO private company, provides the engineering and operational support for the Geohazards Exploitation Platform (GEP), which offers a rich set of ready to use EO data processing services for the analysis and monitoring of earthquakes, volcanoes and landslides.</p> <p>GEP is integrated with the EGI Federated Cloud and is now part of the Hub offering. In numbers: 1.4 Million Cloud Compute hours and +108% increase of use of Terradue services.</p>	<ul style="list-style-type: none"> <li>› <a href="#">The Geohazard Exploitation Platform (GEP)</a></li> <li>› <a href="#">EODC JupyterHub for global Copernicus data</a></li> <li>› <a href="#">EODC Data Catalogue Service</a></li> <li>› <a href="#">Sentinel Hub</a></li> <li>› <a href="#">Rasdaman EO Datacube</a></li> <li>› <a href="#">CloudFerro Data Collections Catalog</a></li> <li>› <a href="#">CloudFerro Infrastructure</a></li> <li>› <a href="#">CloudFerro Data Related Services - EO Finder</a></li> <li>› <a href="#">CloudFerro Data Related Services - EO Browser</a></li> </ul>





Thematic service	Scientific domain	Short success story	Services available in the EOSC Portal
 <p>Set of web-based services that provide user-friendly solutions (tools and applications) addressing the needs of different research groups within the DARIAH community and digital arts and humanities research domain in general.</p>	Humanities	DARIAH Repository becomes target data repository for an increasing number of projects and initiatives (Discuss Data (DE), Text+ (DE), SSHOC, and more under discussion).	<ul style="list-style-type: none"> <li>› <a href="#">DARIAH Science Gateway</a></li> </ul>
 <p>European Infrastructure Consortium providing e-Science research facilities to scientists seeking to increase our knowledge and deepen our understanding of Biodiversity organisation and Ecosystem functions and services in order to support civil society in addressing key planetary challenges.</p>	Earth sciences	<p>Great opportunity of knowing other institutions and their respective activities.</p> <p>Some service providers have been in contact to be integrated into the EOSC-hub Marketplace in order to gain visibility and get other extra benefits from being at this European platform.</p> <p>This is the case for example of 'Glacier Lagoons of Sierra Nevada', from the University of Granada, Spain.</p>	<ul style="list-style-type: none"> <li>› <a href="#">Plant Classification</a></li> <li>› <a href="#">Remote monitoring and smart sensing</a></li> <li>› <a href="#">Glacier Lagoons of Sierra Nevada</a></li> <li>› <a href="#">E-Learning Platform of GBIF Spain</a></li> <li>› <a href="#">GBIF Spain Occurrence Records</a></li> <li>› <a href="#">GBIF Spain Collections Registry</a></li> <li>› <a href="#">GBIF Spain Images Portal</a></li> <li>› <a href="#">GBIF Spain: Regions module</a></li> <li>› <a href="#">GBIF Spain Spatial Portal</a></li> <li>› <a href="#">GBIF Spain Species Portal</a></li> </ul>



**Debora Testi** leads the Thematic Services WP in the EOSC-hub project.

# Realising the European Open Science Cloud Conference & EOSC Projects EXPO

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**B**ringing forward the last large-scale event of the season for the European Open Science Cloud community, EOSC-hub, SSHOC, and FREYA banded together to organise the Realising the European Open Science Cloud and EOSC Projects EXPO from 16-19 November 2020 at the virtual “European Open Science Centre” venue specially built to host the event. The theme of the event was “Towards a FAIR research data landscape for the social sciences, humanities and beyond”. Up to 700 participants from 45 countries (20 of which were outside the EU) participated at the event. The conference programme included 30 sessions featured in the virtual auditorium. A virtual exhibition hall also hosted the EOSC Projects EXPO that showcased 33 booths that accumulated almost 4,000 visits, 900 video views and 1500 document views.

The **opening plenary and keynote** featured European Commission Communications Networks, Content and Technology Directorate-General - eInfrastructure and European Open Science Cloud Deputy Head of Unit Liina Munari who gave a high level overview of where the EOSC initiative is. She described EOSC in Horizon Europe, the launch of the EOSC Association and the wrapping up of the work of the EOSC Executive Board and its Working Groups and Task Forces.

Liina also gave an overview of some of the last EOSC-relevant Horizon 2020 projects to start such as EGI-ACE, DICE, OpenAIRE Nexus, C-SCALE, and RELIANCE, that will increase the service offering of the EOSC Portal, and EOSC FUTURE, which will integrate

and consolidate existing pan-European access mechanism to public research infrastructures and commercial services.

Data Archiving and Networked Services (DANS) Deputy Director Ingrid Dillo then spoke about community initiatives that became critical pieces of international data infrastructure. She provided the example of RDA and its COVID-19 Working Group that developed guidelines and recommendations on how the COVID-19 research data can be better shared.

## Policy and Governance

The first day was dedicated to the theme of policy and governance. The first session was **Thematic Discovery Marketplaces for EOSC** which called for ensuring low barriers for entry for marketplaces, putting the convenience for users and providers as a priority, incentives to encourage participation, emphasizing the added value of marketplaces to users and harmonising the harmonisation that is already existing within various thematic communities.

Persistent identifiers (PIDs) we're also highlighted in sessions such as **The place of PIDs in the EOSC** and **FREYA PID Graph Services**. Due to its impor-

Realising the **European**  
 **Open Science Cloud.**



tance in facilitating FAIR data, PIDs will be an important area of development in EOSC. However, missing PIDs have been noted particularly for instruments and services.

Sessions such as **SSHOC Innovations in Data Production** and **The Ethnic and Migrant Minorities' Survey Registry** both provided some SSHOC innovations and services. Meanwhile, the session **EOSC Core and the Service Management System (SMS)** the state of the SMS was presented and was well received by the audience.

In **FAIR Data-Citation for Social Sciences and Humanities (SSH)**, it was emphasised that data citation has moved from obscurity to the spotlight and at the very core of research. FAIR data citation should be the default mode of publication to ensure reproducibility and reusability of the data. One of the main challenges for FAIR data citation within the SSH is the diversity of the disciplines and the lack of incentives for researchers.

## Technology and Infrastructure

Day 2 of the conference programme concentrated on the technology and infrastructure theme. The session **How can I onboard my resource to EOSC** showcased the latest major release of the

EOSC Portal which saw the final merger of registries from EOSC-hub and EOSC Enhance, the implementation of new provider and resource profiles, launch of the Providers Dashboard, and an upgraded Marketplace.

This session was followed by **EOSC Interoperability: Architecture and FAIR Data Aspects** where it was highlighted that to ensure FAIR and interoperable data in the future and in the long run, urgent actions needed to be implemented now. A lot of technical and content work has been already done on implementing FAIR principles when preparing a dataset, becoming a trustworthy repository, gaining approval by the CoreTrustSeal commission, and various EOSC services, but there's still work to be done in ensuring communities, services and resources are more connected. This session then broke into three breakout sessions.

In **FAIR Data Implementation**, the challenge of ensuring trust from users and data depositors was discussed with certification being the key. CoreTrustSeal was presented as a solution which supports researchers when thinking about their data in the future. Achieving CoreTrustSeal demonstrates Trustworthy Data Repository status and emerging EOSC work is aligning repository maturity with the ability to enable FAIRness.

In **Architecture and Interoperability Guidelines**: EOSC-hub presented the technical specifications and interoperability guidelines for the EOSC-hub Internal services in the EOSC-hub portfolio.

In **Metadata Interoperability: SSHOC and Beyond**, the session was built around "standards meeting reality",



Lobby

specifically covering solutions to current challenges and improvements proposed while noting heterogeneity in data and solutions across service providers and archives. The session **Developing the PID Graph** introduced the concept of the PID Graph (i.e. connecting different PID systems). Examples were given on how the PID Graph can be used to discover connections.

The session **Thematic Discovery Portals in the EOSC** saw the TRIPLE Platform and SSH Open Marketplace. Both platforms were seen as complementary and not competitive. A key outcome of the session was the decision to create a task force to identify synergies and avoid duplication of efforts.

In **Thematic services for social sciences and humanities & SSHOC WP3 lifting technologies into the SSH Cloud**, a number of highly interoperable services such as the UDPipe and CLARIN Language Resource Switchboard were presented where, from a researcher's perspective, the maturity of the presented services is high not only for natural language processing but also for broader Social Sciences and Digital Humanities research.

Towards the end of the day, two tools were presented. The **PID Forum** was showcased, highlighting its role as a platform for scholars interested in PIDs and FAIR data. It can currently be accessed through [www.pidforum.org](http://www.pidforum.org). SSHOC presented **Dataverse**, an open source repository software for sharing and publishing datasets.

## Training and Community Building

The day dedicated to training and community building began with a session on **best practices from EOSC-hub, FREYA and SSHOC** where it was highlighted that there is a need for more coordination between the various communities to ensure collaboration and integration of approaches, rather than a dispersed approach and repetition. Nonetheless, the different projects managed to reach a wide global audience with their community programs.

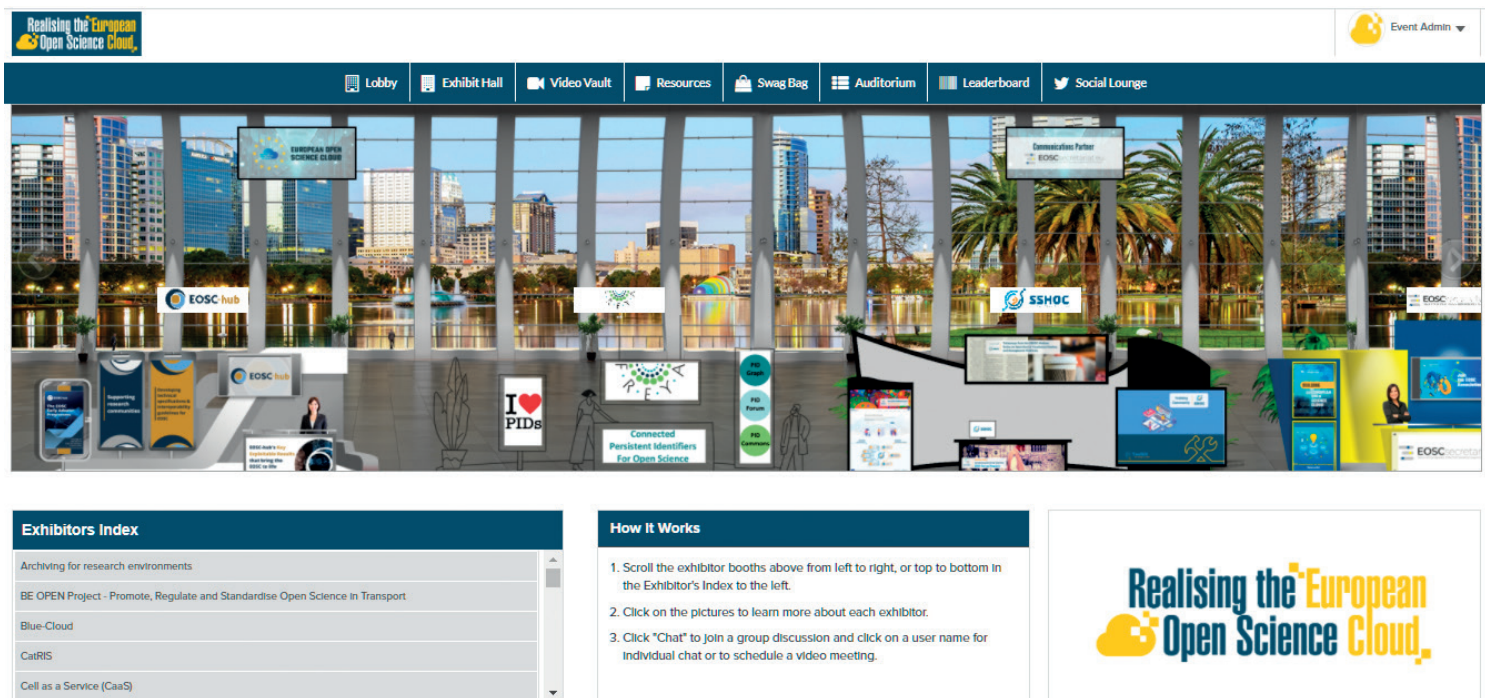
The session dedicated to **Citizen Science** showed how research libraries have an essential role to play in the development of citizen science through the BESPOC model and other means, acting as knowledge broker and facilitator. At the panel session, possible collaborations were uncovered and a follow-up discussion could include the relation and interaction between EOSC and Citizen Science.

Tackling the **FREYA PID Commons and the PID Federation**, while the session highlighted the need to align and foster coordination and interoperability, there



Conference Auditorium





was no strict conclusion on how this can be realised. The report on the PID federation provides a first step to assess the community needs which will be taken further after the end of the FREYA project.

A session was also dedicated to **Engaging the Private Sector**. A clear message that came out is not to reinvent the wheel and make use of the private sector engagement mechanisms that are already out there. One example is the EOSC Digital Innovation Hub. This session brought actors from the EOSC, Digital Innovation Hubs and the Big Data Value Association together in one discussion, where they stressed yet again the importance of the European Strategy for Data for both academia and industry.

A session also presented results from the **EOSC Early Adopter Programme Pilots** from EOSC-hub with presentations on experiences with EMSO ERIC, Copernicus, Open AiiDA in materials science, ECRIN, and INRA in plant phenotyping. Different thematic services and competence centres have presented how their services have been improved or implemented during EOSC-hub in the session

**EOSC-Hub Competence Centres and Thematic Services**. The presentations showed also how the services can be part of the EOSC service portfolio and benefit communities.

The day ended with an overview of the PID training materials available in FREYA and within other projects in the session **FREYA Knowledge Hub and Training**. There was also a spotlight on the **ARIADNE Portal** and **SSHOC Surveycodings**.

## Sustainability and the Future

On its final day, the conference programme tackled the issue of sustainability and the way forward. In the session **Challenges in Sustainability of FAIR Research Data and Services for SSH and Beyond**, one of the takeaways is that projects have to be able to identify the costs of the services for them to be maintained beyond the project's life. Organisations that are stable beyond the project such as ERICs are the best suited to take this forward because they have experience and responsibility to do this.

It was also highlighted that a lot of national data providers, with a keen interest in supporting open science, experience a clash between open science policy and the availability of funding to implement it. At times, there's only funding to use them locally. To make thematic services sustainable, we need a shift in how national funding is distributed. Other key points that came out of the session is the need to



continue funding schemes for communities and clusters and that EOSC needs to put the researcher at the centre to ensure uptake.

The final session **EOSC in Practice From Research Communities' Perspective** saw the continued struggle of making full use of digitisation. Across disciplines, fragmentation on data remains and how to handle sensitive data is still an open question. The session also looked at what the EOSC could be like in 10 years with several panellists calling for the exploitation of artificial intelligence and machine learning solutions.

*Best Booth Award Winner - NEANIAS Booth*

## EOSC Projects EXPO

Organised as part of the Realising the European Open Science Cloud joint event by the EOSC-hub, FREYA and SSHOC projects, the EOSC Projects EXPO was the first virtual exhibition showcasing initiatives and projects of the European Open Science Cloud. More than 30 exhibitors were present, each with their own fully customised booth filled with various resources such as documents and videos.

The EOSC Projects EXPO was opened by SSHOC Coordinator Ron Dekker at the end of the opening plenary which showcased some of the latest developments towards "realising a European Open Science Cloud" from the many initiatives and projects that are working together towards the same goal.

At the end of the event, the best exhibition booths were selected. The winner of the Best Booth Award of the EOSC Projects EXPO was NEANIAS. 1st Runner up went to the EOSC Digital Innovation Hub. 2nd Runner Up was awarded to ENVRI-FAIR and FAIR for Health Research.

All conference materials, slides and recordings can be accessed via the agenda pages: [eosc-hub.eu/events/realising-european-open-science-cloud/agenda](https://eosc-hub.eu/events/realising-european-open-science-cloud/agenda)

Materials displayed at various booths of the EOSC Projects EXPO have also been retained and are accessible through: [eosc-hub.eu/events/realising-european-open-science-cloud/exhibitors](https://eosc-hub.eu/events/realising-european-open-science-cloud/exhibitors)



# Outreach and Training activities for the seismological community

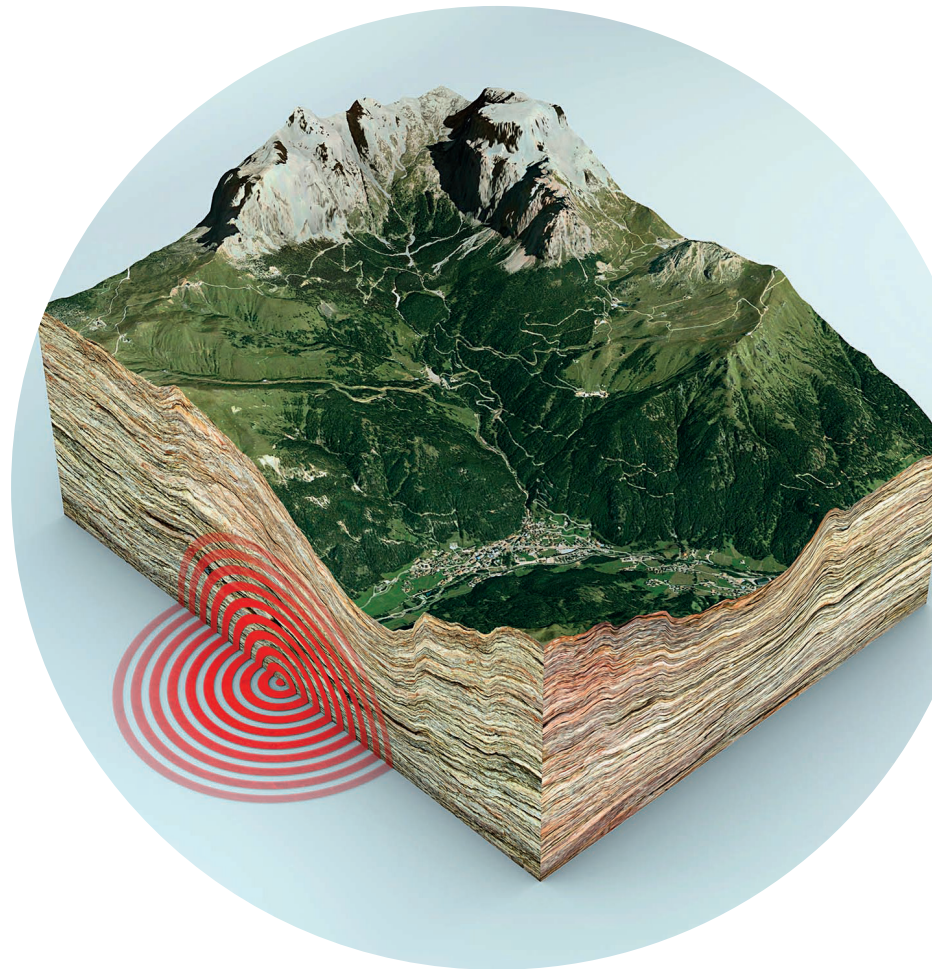
## *A success case from EPOS/ORFEUS and its AAI system*

**S**eismological data centers in Europe have probably one of the most mature and reliable open data provisioning services, which had been in production for many years. However, there was a lack of a modern and scalable AAI solution. The challenge was to design and implement an operational, scalable, federated AAI service that was able to interoperate with community services and that was compliant with state-of-the-art technologies.

EPOS-Seismology takes part in EO-SC-hub as one of the many Competence Centers. Within the tasks performed in the project, we planned to improve some key components of our data services. Probably, the most successful example is its Authentication and Authorization System developed by GEOFON.

Our task was the design and implementation of the EIDA Authentication System (EAS)<sup>1</sup>, a solution making use of B2ACCESS, a Unity-based solution provided by FZ-Jülich<sup>2</sup>. The service was rolled out in production two years ago and it is currently operated by ORFEUS-EIDA<sup>3</sup>, a federation of 12 European data centers, providing hundreds of millions of datasets yearly to thousands of international users.

Despite that almost all the data hosted by the data centers are open and accessible without the need of being authenticated, more than 400 users have already adopted the system from



a base of around 2500 global users. Also, other European initiatives from our community supported and adopted our solution (e.g. the European Strong Motion DB).

But what is interesting to see is which were the key factors of this success, that sometimes are not taken into account when a new service, or tool is planned. In this case, there were three actions that allowed the fast adoption at the community level:

- › the detailed user documentation available combined with fast and effective support by means of an Issue Tracker open to any user in the world,
- › the extension of third-party client tools, broadly used

<sup>1</sup> <https://geofon.gfz-potsdam.de/eas/>

<sup>2</sup> <https://b2access.eudat.eu/>

<sup>3</sup> <https://www.orfeus-eu.org/data/eida/>





within the community, in order that those tools can support our new AAI system (e.g. Obspy, fdsnwss-cripts). Today, seismologists can access waveform data without the need to make a distinction between open and restricted with the same tools they have been working with, just making use of the tokens provided by EAS.

- › The extensive outreach and training activities to our global users.

Regarding this last point, which we estimate is the most important one, we organised many international courses and webinars to reach our global users. Only in 2019, we organized the International training course on ocean bottom and amphibian experiment seismological data, we gave a talk in the EGU Conference, and a keynote talk at the EPOS Seismology Workshop on EIDA services and how to benefit from them. We also presented it in the Plenary of the FDSN, our International Federation, where most of the global community standards are discussed.

In addition to that, two webinars have been organized for the community at a global scale in the last months of 2020<sup>1</sup>. In November, the “EIDA Data Access” with an

attendance of 140 scientists from all around the world; and in December, the “EIDA Authentication and Authorization” with around 50 participants registered.

The concept behind EAS was so well received that we are starting discussions at the global level, which should be held during 2021, to take it as a starting point to define our international community standard.

We take this as an example for our own future plans of new services and products. Users need to learn how they can benefit from your work and make better use of it, and most of the time they cannot do it on their own. In particular, in cases in which there is a strong competition with similar products, the outreach and community training becomes of ultimate importance for the success of your solutions.


<sup>1</sup> <https://www.orfeus-eu.org/other/workshops/>.









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