EPOS SP – Grant Agreement n. 871121
D3.1 - Strategy for engagement across solid Earth research infrastructures on a global scale

Document Information Summary

Document title	Strategy for engagement across solid Earth research infrastructures on a global scale
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(To be) Approved by	Executive Board (EB)
Target audiences	Project partners; EC; Research Infrastructures.
Keywords	EPOS; Research Infrastructures (RI); global initiatives; roadmap; engagement.
Deliverable nature	Report
Dissemination level	Public
Delivery date	31 January 2021
Version/Date	24/02/2021

HISTORY OF CHANGES		
VERSION	DATE	CHANGE
1	30/01/2021	First draft
2	15/02/2021	Edits as recommended by reviewer
3	19/02/2021	Additional edits provided by CNRS – 2.9.3 WDS
4	24/02/2021	Version approved by the EB

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Executive Summary

There are a number of national and regional research infrastructure initiatives within the solid Earth domain around the world but this landscape of “similar but different” initiatives is currently relatively fragmented and heterogeneous. However, there is an increasing drive for the creation of a global research infrastructure for the solid Earth domain that will foster greater coordination and integration of these different initiatives around a more coherent framework. A primary objective of EPOS-SP Work Package 3 is to extend the international dimension of EPOS to ensure it is established as a key European research infrastructure (RI) within this wider global landscape.

To achieve this objective requires a clear strategy and road map for how EPOS will engage with other similar initiatives around the world, including the strengthening or formalising of existing relationships. This strategy should set out the guidelines and mechanisms necessary to establish or strengthen mutually beneficial partnerships between the different initiatives, and provide the basis for working relationships. This approach will allow identification of common areas of interest, opportunities for collaboration and creation of long-term partnerships that are necessary to underpin a global framework to support solid Earth research.

The initial steps in such a strategy are to identify the key solid Earth initiatives, and the different activities necessary to foster collaboration as a precursor to establishing formal partnerships to achieve common goals. This deliverable provides details of the solid Earth research infrastructures and related initiatives that have similar goals to those of EPOS and potentially form the basis for a global solid Earth research infrastructure. A number of potential engagement activities have also been defined as part of this approach, which include co-located events alongside key geoscience conferences. Unfortunately, the first set of planned events have been delayed due to the impacts of the COVID-19 pandemic, and are now being adapted to be replaced with virtual events.

The EPOS SP project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 871121

1. Introduction

The purpose of this deliverable is to document a coherent strategy-led approach to strengthening existing connections and building new partnerships between EPOS and other relevant solid Earth RIs as well as other related international initiatives.

The first element of this strategy-led approach is to identify other relevant solid Earth that are closely aligned to EPOS, including its aims and objectives. The second part of this approach is to identify how to engage with these existing and new initiatives, and the levels of formal relationship that need to be established to support key activities. This approach will focus on areas of common interest and goals that can potentially be achieved through consultation and collaboration.

This strategy will provide a roadmap for relevant national, regional and international initiatives to work together to achieve a set of common goals rather that than working in competition or carrying out overlapping efforts that lead to a duplication of effort and/or diverging or conflicting outputs.

This strategy will also set out a schedule for a number of planned coordination activities to encourage and support this alignment with other solid Earth RIs and similar initiatives around the world. However, it should be noted that the plans for these coordination events are subject to change due to the ongoing global pandemic. Those planned in the first year of the project were intended to be face to face meetings, which are now being reimagined to utilise virtual meetings platforms such as Zoom, MS Teams and other similar online meeting tools

2. Key initiatives and infrastructures

As part of the strategy for extending the global dimension of EPOS, a number of key initiatives, projects and partners have been identified that will be the focus for the activities and initiatives to ensure that EPOS is part of the wider global landscape of solid Earth research infrastructures. The following sections provide an overview of those initiatives with which EPOS will seek to develop a sustained and long-term collaborative partnership.

2.1. Group on Earth Observations (GEO)

The Group on Earth Observations is an intergovernmental partnership of member nations that is working to improve the availability, access and use of Earth observation data, including satellite imagery, remote sensing and in situ data, to impact and inform policy and decision making in a wide range of different sectors. https://earthobservations.org/index.php.

As one of the 134 participating organisations, EPOS aims to contribute knowledge, expertise and data to this international initiative that is creating the Global Earth Observation System of Systems (GEOSS) to support integration, sharing and re-use of data through the use of common standards.

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EPOS is also contributing to the newly established Data Working Group and the component In-situ Subgroup that will focus on promoting a coordinated approach to in-situ data management to ensure its wider and more efficient use.

2.2. ENVRI

The European Environmental Research Infrastructures (ENVRI) community is a cluster initiative that brings together research infrastructures from the four environmental domains: atmosphere, hydrosphere, biosphere, and solid Earth. The wider ENVRI community also includes relevant projects and networks, and selected e-infrastructures that provide technical/data solutions for the RIs, as well as a diverse range of other stakeholders.

The primary aim of the ENVRI community is to develop synergies between the participating European RIs and foster knowledge exchange to support multidisciplinary environmental research. The ENVRI community also encourages harmonization of the environmental RI landscape, whilst also working towards a joint vision and strategy to streamline common RI activities.

The EPOS RI is a key infrastructure within the ENVRI cluster. ENVRI provides the framework necessary for EPOS to work closely with other environmental RIs including sharing of knowledge, technical solutions and best practices, whilst also providing additional opportunities for wider uptake and adoption of the EPOS tools and services both within Europe and more widely.

2.3. AuScope

The AuScope initiative (https://www.auscope.org.au/) is a research infrastructure established to coordinate and support solid Earth research activities throughout Australia. Funded by the Australian Government under the National Collaborative Research Infrastructure Strategy (NCRIS), AuScope is based on eight key themes including geophysics, geodesy, and geodynamics that are similar to those represented by the EPOS Thematic Core Services (TCS), and aims to provide the tools, data, services and analytics necessary for research and innovation in these key areas.

The recently published AuScope 10-year strategy (2020-2030) includes the goals of adopting and implementing global data principles and data management best practices, and supporting international geoscience research capability. Both of these aims are closely aligned with those of EPOS and provide opportunities for knowledge exchange and collaboration to support common research interests. The AuScope 10 Strategy document[1] identifies EPOS as a key partner for the future, and also references a number of other related initiatives that share a common interest with EPOS e.g. ESIP, ENVRI, IRIS (see below). The AuScope strategy document also highlights the lack of a global research infrastructure (GRI) for solid Earth research, and the opportunity for leading RIs such as AuScope and EPOS to establish such an initiative to align the global community and develop the strategies necessary to enable GRI deployments and standards.

[1] https://static1.squarespace.com/static/5b440dc18ab722131f76b631/t/5f3e111d0cfa573f4f3eac39/1597903187392/10-Year+Strategy+2020+%E2%80%93+2030+%E2%80%94+Online.pdf

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2.4. EarthCube

Funded by the National Science Foundation (NSF), EarthCube is an overarching coordination activity for geoscience research in the USA. It funds a range of interrelated activities that includes provision of cyberinfrastructure to support national solid Earth research. EarthCube has developed a range of tools and services some of which are of direct relevance for EPOS https://www.earthcube.org/products. Of particular relevance for EPOS is the Geoscience Cyberinfrastructure for Open Discovery in the Earth Sciences (GeoCODES) initiative that aims to provide cross-domain discovery and access to geoscience data and research tools. Whilst GeoCODES is largely focused on indexing data services and tools provided by the component body of EarthCube's Council of Data Facilities (CDF), it also includes an international dimension that seeks to intersect with similar initiatives on a global scale. Several topics of common interest between EPOS and EarthCube relating to tools and services to support open science, such as adoption of community standards and implementation of the Findable, Accessible, Interoperable and Re-usable (FAIR) data principles, have been identified that provide an opportunity for collaboration and knowledge exchange. These common goals will also support interoperability between solid Earth research infrastructures that can contribute to establishing a global RI for the solid Earth domain.

2.5. Incorporated Research Institutions for Seismology (IRIS)

The primary aim of Incorporated Research Institutions for Seismology (IRIS) http://www.iris.edu consortium is to promote exchange of seismic and other geophysical data and knowledge through the adoption and use of common standards for network operations and data formats. IRIS operates a global seismic network and delivers a range of associated data services serving the seismological research community including the Seismological Facility for the Advancement of Geoscience (SAGE) network.

IRIS is funded by the National Science Foundation (NSF) to provide facilities that support both research and education in seismology, and aims to act as a coordinating body for the seismology community. The IRIS consortium is primarily composed of US-based universities but it also seeks to foster wider global cooperation through its affiliate members that already includes some of the EPOS-SP partners and organisations contributing to the EPOS Delivery Framework e.g. British Geological Survey, Instituto Nazionale di Geofisica e Vulcanologia, KNMI/ORPHEUS.

Membership of IRIS provides an opportunity for EPOS to become fully integrated into the seismology community, and help to foster the adoption of the common standards, best practices and technical solutions used throughout the global seismology community.

2.6. UNAVCO

UNAVCO is a community of practice for those using geodesy to carry out research into Earth processes and hazards https://www.unavco.org/. Funded by the NSF and NASA in the USA, UNAVCO operates the Geodetic Facility for the Advancement of Geoscience (GAGE) to support international geophysical research. UNAVCO

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membership currently includes 120 academic institutes as well more than 110 affiliate members around the world.

A number of the EPOS SP partners are currently affiliate members of UNAVCO, and there is an opportunity for EPOS ERIC to strengthen its partnership with UNVACO through a similar membership model. This would provide an opportunity for common activities and wider engagement with other organisations that are delivering tools and services for geophysical research that are aligned with the relevant Thematic Core Services (TCS) that form part of the EPOS Delivery Framework.

2.7. Deep-time Digital Earth (DDE)

The Deep-time Digital Earth (DDE) is an International Union of Geological Sciences (IUGS) sponsored initiative that aims to harmonise 'deep-time' digital geological data. DDE is an international consortium open to organizations, geological surveys, research institutes, and industry. The DDE objectives will be realised in part through a system of linked networks designed to foster wider collaboration in geoscience research and with stakeholders in other domains. There are a number of common objectives between EPOS and DDE with the emphasis on interoperability and re-use of data to facilitate new and innovative geoscience research. For this reason, participation by EPOS is already foreseen within selected DDE activities but the scope of these still needs to be clearly defined.

2.8. EGDI/EuroGeoSurveys

The European Geological Data Infrastructure (EGDI) aims to deliver access to the regional and national geological datasets and services from the European geological survey organizations that are members of EuroGeoSurveys. EGDI is currently undergoing further developed through the GeoERA programme that is creating a geological data service for Europe. EGDI will also deliver selected data services to EPOS through the geological information and modelling TCS. However, a number of the services provided by EGDI are beyond the current scope of the EPOS Delivery Framework but other additional services may be integrated in the future.

There is currently a MoU in place between EPOS and EuroGeoSurveys, which will be updated and replaced in the near future. (Further details of the collaboration between EGDI and EPOS is provided in deliverable D3.3, and is only referenced here for completeness)

2.9. Other relevant data initiatives

2.9.1. Earth Science Information Partners (ESIP)

ESIP is a community led organisation for data and information technology practitioners that work together to coordinate Earth science interoperability efforts https://www.esipfed.org/. ESIP is promoting good data management practices and fostering interoperability across various solid Earth initiatives and other relevant

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activities. This international community includes more than 110 member organisations some of which are identified in the preceding sections of this document. Many of the key solid Earth research infrastructure initiatives are active participants in ESIP, and EPOS membership provides an opportunity to strengthen existing partnerships and to connect with other relevant organisations to work on common challenges. ESIP is increasingly recognised as a leading international collaboration network for emerging data-related topics. It allows the exchange of knowledge and sharing of expertise and contributes to the development of standards and best practices for making data discoverable, accessible and usable by a wide range of stakeholders. ESIP has a tiered membership structure that recognises the mission of an organisation. EPOS would be considered a Type II member that represents providers of data and information products, technologies or services aimed primarily at the Earth science and research communities.

2.9.2. Research Data Alliance (RDA)

The international Research Data Alliance (RDA) is a research community organization started in 2013 by the European Commission, the American National Science Foundation and National Institute of Standards and Technology (NIST), and the Australian Department of Innovation.

RDA operates an interconnected network of thematic interest and working groups that are addressing data related topics of community interest. Many of these topics are of direct relevance to EPOS, and a number of the consortium partners are active RDA members. However, the landscape of component interest and working groups is extensive and diverse. To maximise the benefit of EPOS participation in RDA, there is a need for a focused approach that includes identifying key interest and working groups. For example, the RDA/ESIP Earth, Space, and Environmental Sciences IG aims to coordinate and harmonize the various Earth, environmental and space science initiatives that are focused on data management, infrastructure development, vocabularies, and common data/digital services https://www.rd-alliance.org/groups/esiprda-earth-space-and-environmental-sciences-ig. This RDA group is of direct relevance for EPOS and provides a further opportunity for engaging with other initiatives. (see section 3.2 below)

2.9.3. World Data System (WDS)

The World Data System (WDS) is an Interdisciplinary Body of the International Science Council (ISC). The mission of WDS is to promote long-term stewardship of, and universal and equitable access to, quality-assured FAIR scientific data and data services, products, and information across all disciplines in the Natural and Social Sciences, and the Humanities. WDS actively promotes the FAIR data hosted by TRUST (Transparency, Responsibility, User focus, Sustainability and Technology) data repositories thanks to the CoreTrustSeal Certification.

WDS is closely linked (formal agreement, partnership or cooperation) to other international structures that structure and organise tools used in the open data/open science ecosystem (such as OpenAIRE, RDA, ORCID, Re3data, DataCite). WDS is a leading organisation in the intergovernmental Group on Earth Observations (GEO). WDS contributes its Members' key multidisciplinary quality-assessed scientific datasets to the GEO System of Systems (GEOSS) Data Collection of Open Resources for Everyone.

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There are a number of WDS led initiatives where EPOS TCS members already participate on behalf of their own organisation, which might be more formally identified as EPOS participation. EPOS could then provide the European perspective for the solid Earth community and promote the EPOS view through the relavent working groups, webinars or during the associated SciDataCon conference.

2.9.4. CODATA

The Committee on Data (CODATA), part of the International Science Council (ICSU), seeks to foster global collaboration among different organisations, institutions and other relevant initiatives to advance open science and improve the availability and usability of data for all areas of research. CODATA actively promotes the advancement of interoperability and reuse of data with particular emphasis on the need for it to be Findable, Accessible, Interoperable and Reusable (FAIR). These core principles are well aligned with those of EPOS with regards to implementation of FAIR complaint data and services.

There are a number of CODATA led initiatives where EPOS can potentially provide the solid Earth perspective to inform and guide development of international standards and best practices for data stewardship. Participation in these initiatives, including the IDAR-TG Task group that is addressing data access and reusability, will ensure EPOS is at the forefront of these developments.

CODATA also has a leading role in the GEO data sharing efforts with particular emphasis on the activities necessary to implement the GEOSS Data Sharing Principles (DSPs) for data sharing across the GEO community, which is of direct relevance for the EPOS Delivery Framework (see section 2.1).

2.10. Research Projects

It should be noted that many EC funded projects have relevance to EPOS in geoscience, environmental science and IT. Relevant communities in EPOS are monitoring them but the list is extensive and ever-changing.

3. Coordinating activities: a roadmap

A core element of establishing robust and long-term relationships with other relevant solid Earth research infrastructures, projects and initiatives is to identify areas of common interest and research as well as activities and challenges where there is a mutual benefit to be gained from a shared approach and pooling of knowledge and resources. These relationships can be achieved by setting up a series of stakeholder events that are used to connect with the relevant partners with the aim of establishing clear channels of communication on which to base future collaboration activities.

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3.1. Networking events

As part of the preparatory activities for EPOS-SP Work Package 3, an initial networking event with other relevant initiatives was held in Vienna, Austria during the European Geosciences Union (EGU) General Assembly 2019. This event brought together representatives from solid Earth research infrastructures in other countries and regions including EPOS, AuScope (Australia), Earth Cube, UNAVCO and IRIS (USA), as well as related clustering activities including representatives from the European Environmental Research infrastructures (ENVRI) community. This initial event was intended to be a preliminary meeting to identify common areas of interest for future collaborative efforts, and to establish a framework for regular meetings.

It was agreed that a series of side events would be coordinated to coincide with large annual geoscience conferences where most if not all of the different initiatives would have representatives in attendance. In addition, the timing of these various conferences would allow a regular schedule of half-yearly meetings to be organised. The preferred target events would be the annual EGU General Assembly that takes place in Vienna each year, usually during April or May; and the AGU Fall Meeting that is held annually in the USA during December. Other further meeting opportunities were also identified including the Geological Society of America (GSA) and Goldschmidt conferences.

3.2. Maximising stakeholder engagement

Part of the strategy to expand the global of dimension of EPOS should be to optimise engagement with other solid Earth RIs and similar initiatives. This should be achieved through planned and coordinated participation in the different key initiatives identified in section 2.

3.2.1. Coordinating participation

To optimise EPOS participation in coordinating initiatives such as RDA, ESIP, GEO etc. there is a need to identify individual involvement in these different activities. A survey of the EPOS community will be used to identify where there is currently some form of participation in those initiatives identified in section 2. This information can be used to develop a more coordinated engagement between EPOS and these initiatives, which will include formation of focus groups for selected key initiatives (see section 3.2.1). Conducting this survey will also provide an opportunity to identify any gaps in EPOS participation where this would be beneficial for developing partnerships with other relevant solid Earth initiatives.

3.2.2. Focus groups

To coordinate EPOS interactions with selected key initiatives including GEO and the ENVRI community, a suite of dedicated focus groups will be established. These focus groups will ensure that the extended EPOS community has a common approach to engagement with these initiatives to encourage efficient use of resources, and create a common understanding and awareness of the different touch points between the EPOS ERIC members, the EPOS-SP beneficiaries and these selected key initiatives.

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These focus groups will also ensure there are planned interactions and coordinated participation at relevant meetings and similar events, including having a designated and recognised EPOS representative who acts as a contact point between EPOS and each key initiative.

3.3. Formalised partnerships

As part of the roadmap to establish collaborative partnerships with other RIs and similar relevant initiatives, the feasibility to implement different levels of formalised agreements will be explored and initiated where there is a clear mutual objective and/or benefit.

3.3.1. Memorandum of Understanding

There are a number of key organisations and initiatives where EPOS has identified common activities and opportunities for collaboration. To support these activities where there is a shared interest and a requirement for some form of partnership agreement, the Memorandum of Understanding (MoU) will be employed. The MoU is a non-binding agreement to collaborate on specific areas of common interest and/or associated activities.

This type of agreement has already been used to establish collaborative partnerships between EPOS and other organisations for specific purposes. For example, JERICO https://www.jerico-ri.eu/, a research infrastructure for the marine domain, has evaluated the EPOS tools and services and is now seeking to adopt and deploy this system as part of their technical infrastructure. JERICO plans to adopt the system 'as is' but populate the catalogue with their own digital assets, before proposing changes to adapt EPOS for their community which will be discussed jointly to optimise the development plans to benefit both JERICO and EPOS. This mutually beneficial collaboration is being formalised through a Memorandum of Understanding, which includes opportunities for future joint development activity that benefits both the EPOS and JERICO communities.

Although a Memorandum of Understanding provides a non-binding framework for establishing mutually beneficial partnerships with other organisations, institutions and initiatives, each of these agreements should be carefully considered to ensure there are clear benefits and an added value for EPOS.

To facilitate the drafting of MoUs for EPOS partnerships, a common template for this type of agreement, which can be tailored for a specific purpose, will be developed. This will ensure a basic consistency across the different MoUs that will be put in place by EPOS, and facilitate monitoring of the different agreements.

3.3.2. Organisational membership

There are several key coordinating organisations within the solid Earth domain that are of direct relevance for EPOS where membership would provide an added value in terms of developing its global dimension. These are both discipline and domain level activities. For example, IRIS (see section 2.5) is a discipline level initiative that offers Foreign Affiliate membership for academic institutions, government agencies, and other

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non-profit organisations outside of the United States. This affiliate membership provides a range of benefits including opportunities to participate in IRIS activities and sharing of software and other digital resources. At the domain level, organisations such as ESIP bring together experts from different Earth science disciplines to consider new and emerging data related topics that are potentially of relevant to EPOS. Membership of these types of organisation provides the opportunity for EPOS to contribute to community building activities that will support common development opportunities and promote interoperability between the participating members. However, joining this type of coordination organisation should be evaluated on an individual basis to assess the potential benefits for EPOS. There should be a clear benefit from participation to ensure that EPOS is not over committed across a large number of different coordinating activities.

3.3.3. Joint proposals

There are an increasing number of opportunities for Research Infrastructures and other solid Earth initiatives to engage in common research activities as part of different funding calls e.g. EU funding frameworks. These collaborative proposals have the benefit of drawing on a wider pool of expertise than might otherwise be available within a single research infrastructure. However, these is need to undertake an evaluation of each potential opportunity to determine the likely benefits that will be realised through participation for each of the contributing RIs. A strategic analysis of the potential costs and benefits must be carried out to ensure that participation will ultimately provide the expected outcomes, which must be well aligned with the EPOS core mission without diverting resources from key core activities.

3.4. Joint outreach and dissemination opportunities

The ongoing collaboration between EPOS and other European research infrastructures provides opportunities for joint outreach, dissemination and engagement activities. These joint dissemination activities allow the solid Earth RIs and other related initiatives to act as a cohesive unit for the purposes of promoting common areas of interest during high profile events e.g. GEO plenaries, ICRI meetings, and for delivering targeted stakeholder messages on key issues e.g. disaster management.

4. Engagement with other disciplines and domains

In addition to positioning EPOS within the global solid Earth research infrastructure landscape, there is also the need for engagement with other domains to address some of the key global challenges including achieving the UN Sustainable Development Goals.

EPOS should seek to position itself within the wider global RI landscape that includes other disciplines and domains where there is an added benefit, and further supports the potential long-term sustainability of the research infrastructure through wider adoption of its tools and services for multidisciplinary research. For example, EPOS is currently contributing to the development of the European Open Science Cloud (EOSC) that will deliver data and services to support multidisciplinary European research across other a range of scientific disciplines. There are also similar initiatives in other regions that will potentially provide the opportunity for

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EPOS tools and services to be adopted and deployed more widely, which will further develop its global dimension. For this reason, EPOS should ensure that there is ongoing horizon scanning for new opportunities and potential partners that will widen the uptake of the EPOS Delivery Framework and potentially expand the membership of the EPOS ERIC.

5. Conclusion

Extending the global dimension of EPOS through wider engagement with other solid Earth research infrastructures (RI) and similar initiatives requires a coherent strategy and a coordinated approach. This will ensure that key partnerships are maintained and new relationships are established whilst avoiding fragmented involvement of EPOS partners across the various initiatives. This focused approach will ensure there is a clear roadmap for engagement with other solid Earth RIs, raises awareness among the EPOS community, and maximises the potential derived benefits from participation in selected initiatives.

A clear roadmap and implementation strategy for developing the global dimension of EPOS through partnerships with other similar national and regional initiatives around the world was developed prior to the COVID-19 pandemic. A significant amount of the foundation for establishing these collaborative relationships that aims to position EPOS within the global landscape of solid Earth research infrastructures was based on a series of networking events planned during physical meetings.

Unfortunately, the COVID-19 has severely impacted these planned physical events but has also demonstrated the feasibility of organising other collaborative activities using virtual meeting platforms that would facilitate wider participation.

Key recommendations arising from this deliverable are:

1. EPOS should document all relevant interactions with other organisations and initiatives;
2. EPOS should document persons involved from within EPOS and identify gaps where there is no representation;
3. EPOS should analyse the cost/benefits of each interaction with other initiatives
4. Actions should be taken to promote EPOS within the relevant interactions

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Annex 1 - Glossary

Term	Definition
AGU	American Geophysical Union https://www.agu.org/
EGU	European Geosciences Union http://www.egu.eu
ENVRI	European Environmental Research Infrastructure community https://envri.eu/
EOSC	European Open Science Cloud https://eosc-portal.eu/
ESIP	Federation of Earth Science Information Partners https://www.esipfed.org/
EGS	EuroGeoSurveys https://www.eurogeosurveys.org/
GAGE	Geodetic Facility for the Advancement of Geoscience https://www.unavco.org/what-we-do/gage-facility/
GEO	Group on Earth Observations https://earthobservations.org/index.php
GeoERA	ERA-NET: Establishing the European Geological Surveys Research Area to deliver a Geological Service for Europe https://geoera.eu/
GEOSS	Global Earth Observation System of Systems https://earthobservations.org/geoss.php
GRI	Global Research Infrastructure
ICRI	International Conference on Research Infrastructures
IUGS	International Union of Geological Sciences http://www.iugs.org
JERICO	Marine research infrastructure https://www.jerico-ri.eu/
NSF	National Science Foundation https://www.nsf.gov/
MoU	Memorandum of Understanding
ORCID	Open Researcher and Contributor ID https://orcid.org/
Re3data	Registry of Research Data Repositories https://www.re3data.org/

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RI	Research Infrastructure
TCS	Thematic Core Service https://www.epos-eu.org/thematic-core-service-index
WDS	World Data System https://www.worlddatasystem.org/

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