RISCAPE

Mapping the Research Infrastructure Landscape

Draft landscape analysis report in the environmental sector

Deliverable 3.2

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Abstract

A series of interviews with representatives of international Research Infrastructures has allowed WP3 to gather information on significant environmental RIs outside of Europe. Using the RISCAPE methodology, the information collected is drawing a landscape of the potential partners for European RIs. Several findings are highlighted that might be useful for further cooperation.

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TERMINOLOGY

A complete list of acronyms is provided in Annex 5.3.

Contents

Executive summary

The RISCAPE project is divided, for each disciplinary work package, into two phases. The European Engagement Phase consisted in identifying, contacting, and engaging into the project the relevant European Research Infrastructures (RIs) in each scientific field. As a result of this engagement, each WP drew a first picture of the international landscape in their domains.

In the second phase of RISCAPE, each WP contacted, investigated, and analyzed the international RIs and initiatives identified by using a methodology developed for the whole project. For environmental sciences, a series of 30 interviews were carried out with the major Research Infrastructures outside of Europe meeting the requirements RISCAPE had defined for RIs.

This report is a summary of the key findings identified of these RIs in the global landscape. The focus is put on the main topics addressed in the interviews: the type of RI, its overall mission, the possible access to the RI, its scientific and societal impact, the financial aspects as well as the cooperation opportunities.

Some other findings are also presented that might help the European RIs that want to engage in international cooperation to identify potential collaboration topics or partners.

1 Introduction

Landscape analyses have become a trend in many areas, and science is no exception. Just like benchmarking was the buzzword in the 1990's, every actor nowadays wants to start their strategic work by looking at "what is out there" with roadmaps and landscape analyses. In the field of science and research, this development has been flourishing since the beginning of the century. In Europe, this is partially due to the work of the European Strategy Forum on Research Infrastructures (ESFRI) established in 2002 by the European Union. In their first European Roadmap for Research Infrastructures in 2006, the members of ESFRI had as objective to *"describe the scientific needs for Research Infrastructures for the next 10-20 years"*[1]. They presented 35 projects of pan-European – another word that has since made its way in the discourse – interest, insisting on that the roadmap was not a priority list.

The global dimension of Research Infrastructures (RIs) was already strongly present in the first roadmap. Acknowledging the fact that research has no borders, the members of ESFRI insisted on the need for cooperation: *"Fields of research like the earth or social sciences need, by definition, to be conducted on a global scale (…)"*[2]. This is partially what has led, 10 years later, to the RISCAPE project, with the aim of identifying Research Infrastructures outside of Europe that are or could be partners for the benefit of European research and for the advancement of science at the global level. The goal is also to better characterize the similarities and differences, and to highlight the main interesting features of Research Infrastructures worldwide.

The reader must keep in mind that the focus of RISCAPE is, according to the description of the project, to produce a report on *"the position and complementarities of the major European research infrastructures in the international RI landscape"*. This implies a rather Euro-centric process, which might sometimes have led to difficulties, amongst others with the use of the questionnaire (see methodology part in annex 5.1).

This deliverable is the result of the second phase of RISCAPE, namely the International Engagement phase. The first phase (European Engagement) is described in deliverable 3.1 available on the website of the project[3]. The last phase (deliverable 2.3) will integrate the deliverables across scientific disciplines, submit them to a peer-review process, produce a final overarching report, and disseminate it.

As will be clear to the reader of the methodology section, the landscape described in this document can of course not be comprehensive. Firstly, because the approach has been to build on what the European RIs have described about their knowledge of the global landscape. Secondly, because some fields of investigation (relations to industry, governance schemes…) have been deliberately left out. This report is thus the best attempt achievable in the framework and the constraints that

[1] ESFRI Roadmap (2006: 5), www.esfri.eu/sites/default/files/esfri_roadmap_2006_en.pdf
[2] ESFRI Roadmap (2006: 16)
[3] www.riscape.eu

were set by the project. Hopefully some interesting results will nevertheless emerge from this analysis.

In section 2, the landscape of environmental Research Infrastructures in Europe will be briefly described. Section 3 will present the global landscape including the main findings of this work package, while section 4 will highlight some other findings. Special emphasis is put on certain topics that are presented in boxes along the text of this report. The methodology is described in annex 1, the RIs and contact information in annex 2 and the acronyms used are listed in annex 3.

2 The European landscape

As mentioned above, even if the purpose of RISCAPE is not to characterize the European landscape, the approach has been to take the existing European Research Infrastructures as a starting point. As mentioned in the Grant Agreement, *"RISCAPE focuses on the RIs specifically mentioned in the ESFRI Landscape 2016 document, with priority attention paid to ESFRI landmark RIs and ESFRI Roadmap projects. Other RIs can be included if they are found to be important on the European research landscape by the RISCAPE Stakeholder panel".* The pan-European dimension (i.e. concentrating on RIs that have an activity that goes over the national level) is also essential. It is thus interesting to have a rapid look at how the European playground is described.

2.1 ESFRI description

In the last ESFRI 2018 Roadmap[4] (as in the previous ones), the field of environmental sciences is divided into four so-called domains, each one dealing with a part of the Earth system: the atmosphere, the hydrosphere (including what is usually called the marine and oceanic domains), the biosphere (ecosystems) and the geosphere (solid Earth). This classification will also be used throughout this report for the international RIs, taking into account that, in Europe as well as elsewhere, some infrastructures deal with multiple domains. The research areas in environmental domains are anyway densely intertwined.

For each domain, the ESFRI Roadmap gives a "schematic overview of the ESFRI RI landscape" in the form of a two-dimensional graph where RIs are presented according various variables (topic, altitude, depth, research focus…). These representations, if they offer a pleasant way of visualizing the landscape, have been sometimes criticized by the research communities for lacking serious ground and giving a distorted view on the actual landscape.

Nevertheless, ESFRI acted as a starting point of RISCAPE and the initial European Engagement phase led to a total of 22 European infrastructures that were selected as the basis for the RISCAPE analysis in environmental sciences. These Research Infrastructures are recalled in the following table 1.

[4] ESFRI Roadmap 2018, http://roadmap2018.esfri.eu

Short name	Name	Domain*	Details (in ESFRI**, member in BEERi)
ACTRIS	Aerosols, Clouds and Trace Gases Research Infrastructure	A	P
AnaEE	Infrastructure for Analysis and Experimentation on Ecosystems	B	P
AQUACOSM	Network of Leading European Aquatic Mesocosm Facilities Connecting Mountains to Oceans from the Arctic to the Mediterranean	H	BEERi
ARISE	Atmospheric Dynamics Research Infrastructure in Europe	A	BEERi
DANUBIUS	International Centre for Advanced Studies on River-Sea Systems	H	P
DiSSCo	Distributed System of Scientific Collections	X	BEERi
EISCAT_3D	Next Generation European Incoherent Scatter Radar System	A	P
eLTER	Integrated European Long-term Ecosystem Research Network	B	e
EMSO	European Multidisciplinary Seafloor and Water-Column Observatory	H	L
EPOS	European Plate Observing System	G	P
EUFAR	European Facility for Airborne Research in Environmental and Geo-Sciences	A	BEERi
Euro-Argo	European Contribution to the International Argo Programme	H	L
EUROFLEETS	New Operational Steps towards an Alliance of European Research Fleets	H	BEERi
EuroGOOS	European Global Ocean Observing System	H	BEERi
GROOM	Gliders for Research, Ocean Observation and Management	H	BEERi
IAGOS	In-service Aircraft for a Global Observing System	A	L
ICOS	Integrated Carbon Observation System	X	L
INTERACT	International Network for Terrestrial Research and Monitoring in the Arctic	B	BEERi
IS-ENES2	Infrastructure for the European Network for Earth System Modelling	X	BEERi
JERICO	Joint European Research Infrastructure Network for Coastal Observatories	H	BEERi
LifeWatch	e-Science and Technology European Infrastructure for Biodiversity and Ecosystem Research	B	L
SIOS	Svalbard Integrated Arctic Earth Observing System	X	P

Table 1. European Research Infrastructures serving as a base for analysis

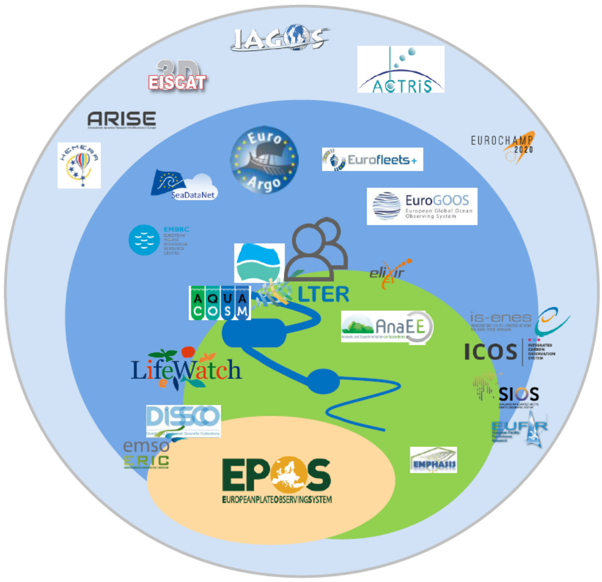
* A: atmosphere, B: biosphere, G: geosphere, H: hydrosphere, X: cross-domain
** ESFRI 2016 Roadmap – L: landmark, P: project, e: emerging project

2.2 ENVRI description

The European landscape of environmental RIs is strongly embodied in the ENVRI cluster. ENVRI is a cooperation framework that has been built on almost 10 years of successful projects: the current ENVRI-FAIR (H2020-INFRAEOSC-2018-2 – ID 824068), the finishing ENVRI PLUS (H2020 INFRADEV-4-2014-2015 – ID 654182), and the original ENVRI (FP7-INFRASTRUCTURES-2011-1 – ID 283465). This common experience has largely contributed to structure the complex landscape of environmental research infrastructures in Europe and allowed them to join forces, exchange good practices, and work on common challenges. On a very practical level, the ENVRI cluster has developed the so-called Reference Model *("to secure interoperability between infrastructures, to enable reuse of common components, to permit sharing of resources, and to provide a common language of communication between those responsible for the design and construction of Research Infrastructures").* The Board of Environmental Research Infrastructures (BEERi) established under ENVRI PLUS has been an instrumental forum for the cooperative work between RIs, and a major asset for this WP.

Several documents are available or in preparation that will help the reader to get deeper knowledge of the European landscape. The ENVRI PLUS deliverable 12.3 *(Further Integration of RIs related to terrestrial ecosystem research)*[5] will be complemented in August 2019 by deliverable 17.6 *(White paper on further integration of RIs in the environmental field)*[6]. This last document will include a thorough landscape analysis of the atmosphere and hydrosphere domains of the ENVRI infrastructure.

The ENVRI community has adopted a different way of presenting the landscape of Research Infrastructures in Europe, which will be further refined. The last version is presented in figure 1.



[5] ENVRI PLUS D12.3, www.envriplus.eu/wp-content/uploads/2015/08/D12.3-.pdf
[6] ENVRI PLUS Deliverables, www.envriplus.eu/deliverables

Figure 1: The landscape of European environmental RIs (courtesy: ENVRI PLUS)

2.3 The "defining a RI" dilemma

The question of defining what is a Research Infrastructure has been largely debated and is in many ways a tricky question. Even the term "Research Infrastructure" is not globally acknowledged, as will become obvious in this report. One of the challenges in RISCAPE – and especially in WP 2 – was thus to try and define as precisely as possible which organizations are taken into account for the analysis. For this, RISCAPE has fully benefitted from the expertise of the work done in ESFRI, ENVRI and by other actors (OECD).

In the first 2006 ESFRI Roadmap, the definition of a Research Infrastructure was already rather stabilized: *"facilities, resources or services of a unique nature that have been identified by pan-European research communities to conduct top-level activities in all fields"*[7]. The latest definition is more precise, but not so fundamentally different: *"ESFRI RIs are facilities, resources or services of a unique nature, identified by European research communities to conduct and to support top-level research activities in their domains. They include: major scientific equipment – or sets of instruments; knowledge-based resources like collections, archives and scientific data; e-Infrastructures, such as data and computing systems and communication networks; and any other tools that are essential to achieve excellence in research and innovation"*[8]. The most important clarifications concern the examples given and the fact that RIs can conduct AND support research. This clarifies the scope of Research Infrastructures that do not necessarily perform research themselves but contribute to it.

For the work in RISCAPE, this definition was combined with the other criteria defined by the project:

- Longevity: the RI must have a proved (or expected) lifetime that exceeds the duration of a normal research program (i.e. typically more than 5 years)
- Science focus: scientific research needs to be the primary focus of the RI[9].
- Access: the RI must provide access for users outside of the RI itself (even it does not need to be full and unconditional access)
- Geographical scope: the RI must be active over a large area, similar to Europe for the ESFRI landscape, i.e. a continent or a large sub-region (Brazil, China or India for example)
- Scientific impact: this criterion was more difficult to assess and thus were analyzed RIs that are, for instance, mentioned in a national or international roadmap of infrastructures.

In the selection of international RIs, the first criterion (longevity) was considered crucial. Sustainability is the alpha and the omega of Research Infrastructures, as it distinguishes them from looser networks that usually function according to a project-based funding scheme.

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[7] ESFRI Roadmap 2006: 16, www.esfri.eu/sites/default/files/20160308_ROADMAP_single_page_LIGHT.pdf

[8] ESFRI Roadmap 2018: 11, http://roadmap2018.esfri.eu

[9] This criterion was not a major issue in environmental sciences, as no respondent in the initial European Engagement Phase suggested organizations that do not have scientific research as their primary activity. But of course, some **do** research themselves while some **enable** research by providing the necessary tools (data and services) that allow others to do research.

3 The global landscape

The latest ESFRI Roadmap recalls that the environmental domain *"is of global dimension by nature and close collaborations on Earth system research are already established worldwide"*[10]. It also lists some of the areas where global cooperation is crucial for Europe: the achievement of the UN Sustainable Development Goals, the standardization of data protocols and the sharing of best practices all over the world. The role of the ENVRI cluster in connecting European and international RIs is also acknowledged.

As a result of the previously described European Engagement phase, the list of international RIs selected for further investigation in RISCAPE is presented in table 2.

Short name	Name	Domain*	Country/ Region	Website
ALA	Atlas of Living Australia	B	Australia	www.ala.org.au
AMISR	Advanced Modular Incoherent Scatter Radar	A	U.S., Canada	http://amisr.com/amisr
AuScope	Australian Geophysical Observing System (AGOS)	G+	Australia	www.auscope.org.au
CERN	Chinese Ecosystem Research Network	X	China	www.cern.ac.cn/0index/index.asp
CHARS	Canadian High Arctic Research Station	X	Arctic	https://www.canada.ca/content/canadasite-/en/polar-knowledge/CHARScampus.html
CHIKYU	ChiKyu Ocean Drilling Vessel	X	Japan	www.jamstec.go.jp/chikyu/e
CONTRAIL	Comprehensive Observation Network for Trace Gases by AiIrliner	A	Japan	www.cger.nies.go.jp/contrail/index.html
CRIA	Centro de Referência em Informação Ambiental	B	Brazil	www.cria.org.br
DataONE	DataONE	X	U.S.	www.dataone.org
DONET	Dense Oceanflor Network System for Earthquakes and Tsunamis	G	Japan	www.jamstec.go.jp/donet/e
GBIF	Global Biodiversity Information Facility	B	Global	www.gbif.org
GEM	Global Earthquake Model	G	Global	www.globalquakemodel.org

[10] ESFRI Roadmap 2018: 152, http://roadmap2018.esfri.eu

GOOS	Global Ocean Observing System	H+	Global	www.goosocean.org
IMOS	Integrated Marine Observing System	X	Australia	http://imos.org.au
IODP	International Ocean Discovery Program	X	Global	www.iodp.org
IRIS	Incorporated Research Institutions for Seismology	G+	U.S.	www.iris.edu/hq
LTAR	Long-Term Agroecosystem Research	X	U.S., Canada, Mexico	https://ltar.nal.usda.gov
MU/EAR	Middle and Upper Atmosphere Radar / Equatorial Atmosphere Radar	A	Japan/Indonesia	www.rish.kyoto-u.ac.jp/organization_e/collaborative_-research/mur
NCAR	National Center for Atmospheric Research	A	U.S., Canada, Mexico	https://ncar.ucar.edu
NEON	National Ecological Observatory Network	X	U.S.	www.neonscience.org
NIED	National Research Institute for Earth Science and Disaster Resilience	G+	Japan	www.bosai.go.jp/e
NIES	National Institute for Environmental Studies	X	Japan, Russia	www.nies.go.jp
OceanSITES	OceanSITES	X	Global	www.oceansites.org
OOI	Ocean Observatories Initiative	X	U.S.	http://oceanobservatories.org
SAEON	South-African Environmental Observation Network	X	South-Africa	www.saeon.ac.za
SAON	Sustaining Arctic Observing Networks	X	Arctic	www.arcticobserving.org
SMCRI	Shallow Marine and Coastal Research Infrastructure	X	South-Africa	https://smcri.saeon.ac.za
TERN	Terrestrial Ecosystem Research Network	X	Australia	www.tern.org.au
UNAVCO	University NAVSTAR Consortium	X	U.S.	www.unavco.org
USGS	U.S. Geological Survey	X	U.S.	www.usgs.gov

Table 2: List of RIs interviewed for the international landscape

* A: atmosphere, B: biosphere, G: geosphere, H: hydrosphere, X: cross-domain
\+ means the RI indicated that its activities also cover other domains to a certain extent

For each of these Research Infrastructures, a request for an interview was made by email. The details of the methodology are available in annex 1. A total of 30 interviews were carried out, each lasting from 45 to 90 minutes, the majority lasting one hour during which the questions of the questionnaire designed by WP2 were addressed. The answers were transcribed and the transcription sent to the interviewed person for validation.

The major findings out of these interviews are reported in the following subsections, grouped around the family of questions (topics) in the questionnaire.

3.1 Typology of RIs

As was foreseeable from the initial list of organizations, the Research Infrastructures interviewed showed a large diversity, in terms of goals, scientific domains, legal statuses, governance, funding schemes… This is even less a surprise for someone familiar with the existing landscape in Europe that exhibits the same heterogeneity.

However, when it comes to the main objective of the RIs, there was no doubt that they were all serving science. Of course, this was a prerequisite for RISCAPE, but research was confirmed as being the main focus of their organizations for all interviewees. On the question whether the RI was performing science itself or "just" supporting it, the most common situation is an RI supporting science (17 out of 30), whereas 7 RIs indicate they are doing both, and only 5 are more similar to research performing organizations. It is also important to note that several RIs, while mentioning they are mainly supporting science, also indicate that some individuals involved in the operation of the RI can do – and actually do – research on their own. This is also the situation in many European RIs where the operators of the infrastructure are often scientists, usually affiliated to research organizations (universities or research centers) where they also do science.

Out of the divide performing/supporting
One infrastructure (GEM) mentioned that their main focus was on the transfer of scientific knowledge into applications. GEM aims at taking fundamental science and making it applicable for decision-making. If some RIs mentioned this activity in their portfolio, it was often as a secondary task, the organization being primarily involved in performing or supporting research.

It seems that the key goal of RIs is also related to the way infrastructures are organized in the respective country. In Japan, where many RIs are national agencies or more or less directly overseen by ministries, it seems that a stronger importance is given to the research performing dimension. All Japanese RIs indicated that they are as much involved in performing science as in supporting it, if not more.

Differences can be observed in terms of the operational nature of RIs, i.e. whether they concentrate on providing data, products and services, or have a more coordinating role. This is especially true in the hydrosphere domain, where organizations like OceanSITES can be seen as rather operational, whereas GOOS considers that its role is to coordinate an operational infrastructure and to establish links between research and policy-making. Similarly, IODP is a collaboration framework for research more than a program. On the other hand, for similar reasons, SAON, for instance, does not even consider itself a Research Infrastructure, as they claim not to be system-builders but rather facilitators. It becomes again obvious that drawing the line between Research Infrastructures is not an easy task.

The time horizon of a RI is rarely specifically mentioned when the RI is created but most of them have started their existence with a long-term commitment of their major stakeholders for 10 to 25 years. Almost all have multi-annual funding that contributes to frame their time horizon ahead.

Drawing clear lines between the RIs in terms of their character (single-sited, distributed or virtual) is again a challenge. The vast majority of the interviewed RIs mention that they are distributed (14/30) or a combination of distributed and virtual (5) because they collect out of a distributed network, data that is then made available virtually. Here, the operationality of the RI is again a crucial element. Only 5 RIs consider themselves as purely virtual (like GBIF, DataONE…) and 1 as single-sited (the Chikyu vessel). But even in this case, the interview shows that Chikyu performs its activities over a large variety of areas and is, in a way, a distributed RI. Some RIs provide mainly measurement devices (CONTRAIL) which would also place them in the distributed category, and some combine all characteristics. It is for example the case of AuScope and NIED that operate large single-sited key facilities, provide virtual data services/platforms/laboratories, but also monitor distributed observational networks.

Will all RIs eventually be cross-domain?
In terms of the environmental domains they address, it is easy to say that the vast majority (17 out 30) describe themselves as cross-domain Research Infrastructures. If added the ones who mention a primary domain "spilling over" other domains (4 RIs, marked in table 2 with a +), the majority is even clearer. It was mentioned several times that the tendency is towards more cross-domain activities, in particular because of the multi-disciplinarity of environmental sciences and the complex interactions existing between them.

3.2 Missions & vision – Global Challenges

When having a closer look on the overall missions and visions put forward by the Research Infrastructures, whether explicitly, as a mission statement, or implicitly, when asked to describe the overall objectives of their organization, it is interesting to note that they are all what could be called "science-driven". The main driver of the infrastructure, its raison d'être, is a scientific question, a challenge essential to a scientific community. However, some differences can be noted between countries: if the RIs in Japan insist on their societal role, the ones in the U.S. stress their responsibility in contributing to educational programs and activities.

The quest for knowledge
"Understand" is the word that comes most often when RIs are asked to describe their overall mission or objectives. As constructions that very often originate from the efforts of a scientific community, RIs are designed to serve the needs of scientists and answer scientific questions. In the environmental field, Research Infrastructures are built and operated to help understand the Earth system (or parts of it), and to advance knowledge through their activities.

On the other hand, the question about Grand Challenges did not really produce significant results. It was sometimes hard for the interviewees to understand what is meant by that and, when the idea was explained, to relate their RI to one specific challenge. As environmental Research Infrastructures, the answers that immediately come to mind are climate change, loss of biodiversity or ocean acidification, but respondents mainly preferred to elaborate on their objectives. The national context can also have an influence on the stated purpose of the RI. The work of AuScope is essential for Australia where the economy is strongly dependent on resource mining. The activities of NIED are a crucial contribution to a country like Japan where earthquakes and other natural disasters have proved to be devastating.

Do challenges compete with each other?
An interesting point of view was raised by one of the RIs dealing with disaster resilience. According to them, in times when climate change has become a mainstream discussion – and political – topic, the flow of money tends to be reoriented towards RIs dealing with climate issues. As disaster-resilience or risk-prevention are not seen as equally appealing subjects, resources tend to be scarcer for the RIs that address these issues. Besides, the amount of available funds for research on climate change mitigation or adaptation, seems to be much larger than for the study of impact.

3.3 Access

Considering the typology that was presented in 3.2, it is easy to understand that the question of access is different for the Research Infrastructures that mainly provide data (as the result of their own measurements, experiments…) and the ones that offer some kind of physical access to a facility or even the possibility for scientists to design an instrument or an experiment together with the RI.

For the latter RIs, the access is usually conditioned by the feasibility of the experiment (which is then assessed by the experts of the RI), possibly associated with a cost for the realization, and the availability of the facility or instrument envisaged. All RIs concerned insisted on the fact that they try to answer positively to all required access.

For the data-providing RIs, openness seems to be the keyword for environmental Research Infrastructures. All interviewed RIs producing data mentioned them as fully accessible to the users (researchers mainly, but not only) on some kind of repository or data portal. This goes very frequently along with a short period (moratorium) during which the scientists generating the data can use it for scientific publications before the data is released. There can also be restrictions for RIs who perform measurements for industrial partners, who then own the data. If the general openness can vary in different regions of the world, only CRIA mentioned Brazil as a country where significant efforts still need to be done on this topic.

Sensitive data must remain closed

If openness of the data is the rule for all RIs investigated in this report – exception made for a possible moratorium to allow researchers to publish scientific papers – some cases require a different policy. This is especially true for the RIs of the biosphere domain that deal with the monitoring of animal and vegetal species. For instance, if the data can be used to locate endangered species, it can make them even more vulnerable for poachers and collectors. Researchers who want to access this kind of data must carefully justify their quest.

The question whether access was the result of a peer-reviewed process is of course not valid for infrastructures providing open data. But many RIs who also give access to facilities (research vessels, platforms…) like IODP, Chikyu… mentioned the fact that the reviewing is usually done during the grant application process. This is especially true in the U.S. where researchers specify the RIs they plan to use for their research when they apply for NSF research grants.

In the same way, to get observation time at one of the MU/EAR/EMU radars, there is a call for applications twice a year and the applications are peer-reviewed by a committee. For AMISR, the application process is more informal, but if needed, experts are asked to review the application. When the experiment is performed in the framework of the coordinated URSI World Day, the reviewing is done by an independent committee.

3.4 Impact

The questions related to impact were probably the most interesting ones in the whole questionnaire. It was no surprise that basically all RIs stated that the assessment of their impact had become increasingly asked for by their stakeholders, be they funding agencies, ministries or their own members. As put by one interviewee, “there’s constant pressure to be relevant”. What was also no real surprise was that most of the respondents had no ready-made solution to estimate the impact, and especially not the societal impact, of their infrastructure.

The scientific impact was described by one interviewee as “kind of easy” to measure. The most common assessment method is to use metrics related to data and publications: individual user tracking (to evaluate how many and where they are), data downloads, number of publications using the data or quoting the RI, citations of these publications, number of patents… These were the most cited examples, usually with the mention that everything is monitored “as much as possible”. Some RIs “require” researchers to acknowledge the origin of the data in their scientific articles, but everybody knows that this can only happen on a voluntary basis. Other indicators mentioned were the participation in scientific events (particularly in plenaries or as conveners of sessions), the number of abstracts submitted to the major international conferences for environmental sciences (mostly AGU and EGU), as well as the number of invited speakers working for the RI or identified with it. The scientific assessment is mostly performed internally.

Another criterion mentioned for the assessment of scientific impact is the long-term commitment of funders. Indeed, one can consider that the continuous will to sustain the resources of a Research Infrastructure is thoroughly evaluated by the funding organizations when they make their decisions. In the same line, the funding obtained by researchers (grants) to use the data, products or services provided by an infrastructure can be an element that shows the scientific quality and relevance of the RI.

Some RIs interviewed, like NCAR or LTAR, indicated that they perform a periodic science review (every 5 years). The document (not necessarily publicly available) measures the scientific output obtained from the use of data, the number of degree and PhD students involved, the articles published, the work done with educators… This evaluation of the achievements of the RI is performed by a panel of external scientists.

GBIF has also started an external review including an impact assessment which will be performed by CODATA (and should be published in October 2019). In the interview was also mentioned the example of the Western Australian Biodiversity Science Institute that reflected on its impact through an exercise to develop the Index of Biodiversity Surveys for Assessments[11]. The Index *“captures data from land-based biodiversity field surveys conducted to support assessments and compliance by the Department of Water and Environmental Regulation, Environmental Protection Authority and Department of Mines, Industry Regulation and Safety under the Environmental Protection Act 1986”*. A first version of the study showed that the added-value for the Australian mining industry of biodiversity data provided by infrastructures could be estimated to about 1.5 M AUD/yr.

Apart from the scientific impact, questions were made regarding the other dimensions, especially the societal impact of Research Infrastructures. It is easy to say that all RIs without exception consider this task a very valuable, but extremely difficult, one.

The proposed indicators that can be used to make visible the societal impact of a Research Infrastructure are various and very interesting. The uptake of information, data or scientific results coming from the RI into national reports, policies or strategies at a higher level of society are amongst the most frequently mentioned. Be it the contribution of AMISR to the U.S. National Space Weather Strategy and Action Plan, the adoption in Japan of a new tsunami model modified with data provided by Chikyu, the use of DataONE data on bird migration in the “State of the birds” report

[11] www.dwer.wa.gov.au/ibsa

produced by U.S. North American Bird Conservation Initiative, or the application in China of best management practices for ecosystems recommended by CERN, seeing the work of the RI translated into concrete policies and plans is the grail of infrastructures! It seems however very challenging to succeed in making the links visible.

This is also mentioned by GOOS, for which impact can be shown through a contribution to global endeavors: The Agenda 2030 with some indicators related to SDG14, the work by OECD on the value-chain of oceans, or the efforts to improve attribution of sources with IPCC.

What a difference a science article makes?
This question posed by NCAR illustrates the challenge of Research Infrastructures producing data.
If the output of the data (like the number of scientific articles based on it) can be measured, how do you measure its outcome? AuScope mentions they support researchers whose research in turn supports the Australian industry, with an impact that one could think is rather straight-forward, but even then, uneasy to measure For RIs like GEM or NIED, the question could be: How do you measure how many lives are saved by improved disaster risk assessment and prevention?

An unmediated contact with communities that are not the direct users of the infrastructure is also a way to try and have an impact on society. This is the case e.g. of VIP visits of high-level officials to CERN facilities, town hall events organized by IODP at AGU meetings, but also for most RIs of coverage in media, lectures for citizens and students, science cafés… everything that increases the visibility of the RI and the work it does. But is visibility the same thing as impact? The same goes for the use in academic training and curricula of tools developed by CRIA.

Technology developments can also be a token of the broader impact of a RI. RISH (that operates MU/EAR/EMU) developed small radars that were implemented by the Japanese meteorological services to improve their forecasting ability, especially for localized intense phenomena. More generally, it seems to be easier to assess societal impact when the infrastructure not only produces data but also tools and services. This is the case for GEM or IRIS who offer risk assessment models and maps that can be used by countries or local governments.

The art of telling stories
IMOS insists on the need to develop case studies if a Research Infrastructure wants to show its impact in society. While being based on hard scientific evidence, these stories must tell a narrative.
It is also important to increase cooperation with complementary (like modeling/forecasting) communities, because they are the ones able to transform data and produce a more visible impact for the general public.

One example of a comprehensive impact assessment study was provided by ALA. Prepared by a private company for CSIRO and published in October 2016, the Assessment of the Atlas of Living Australia's Impact and Value[12] is described as *"the first attempt to obtain an independent assessment of the ALA's economic, social and environmental impact and value relative to the investment it has received from the Australian Government over the same period"*.

LTAR also insisted on the fact that it is a daunting task to try and assess societal impact on a yearly basis, when change is not necessarily visible. A 10-year perspective seems more relevant.

3.5 Funding

As the interviewed RIs are different in scope, organization and size, it is no wonder that the financial aspects also vary significantly. What seems nevertheless common to all is the long-term perspective associated with their funding schemes.

Most interviewees mention that, even if budgets are always annual, their RI is involved in funding cycles in the range from 5 to 7 years (up to 10 years in China), with an initial commitment of the founding stakeholders generally for 10 to 25 years. The funding is almost always national (except for the international programs like GOOS, SAON or IODP), usually from one main source. This source is in general NSF in the U.S., NRF in South-Africa, NCRIS in Australia, a ministry (often MEXT, but also ministry of the environment) in Japan…, but the financial structure can be more complex, with different national sources like for CERN. Funding can be a challenge for RIs like CRIA that are privately-owned and receive no national (federal) money from the Brazilian government. But being a privately-run actor is not *per se* an obstacle, if you are supported by national funders like AMISR.

Follow the money!
The topic was spontaneously mentioned in a few interviews. It is clear that the existence and sustainability of Research Infrastructures is very much influenced by how the money is allocated. Depending on the strategic choices of the funders (towards a research field, a technology, a specific challenge), the availability of funds might be endangered for some RIs that might be forced to compete with others.

In the interviews, only some RIs mentioned that they (or their funders) had the will to seek for a diversification of resources. For instance, NIED aims at developing more information products and mentioned that some of these products may come with a price in the future. The users of NCAR facilities who do not benefit from an NSF grant are also charged a full-cost fee (for the others, the fee is included in the awarded grant). However, more generally, the RIs expect additional funding from their traditional providers of resources.

[12] www.csiro.au/en/About/Our-impact/Our-impact-in-action/Natural-environment/Atlas-of-Living-Australia

GEM is again an exception and is more actively looking for new partners and sponsors, especially from new sectors (insurance companies, energy companies operating dams or nuclear facilities…) who could benefit from enhanced products and models for risk-assessment. The solution might be in tailor-made products, especially if GEM is able to downscale its products so that they match e.g. the needs of cities engaged in agendas such as “100 resilient cities”[13].

The range for the cost of construction of an infrastructure varies from approximately 10 M$ for DataONE to almost several hundreds of M$, but many interviewees point out the difficulty of pricing the construction of an infrastructure that has sometimes developed over decades (since 1879 for USGS!). As the question was formulated “if you were building your organization today, what would be the approximate construction costs?”, many answer that the actual costs over the years are certainly very different from what they would be today. Usually, current costs would be lower, but e.g. for Chikyu, they would not: The new generations of research vessels integrate namely more sophisticated technologies (like Artificial Intelligence) that significantly increase the final price.

Co-investment

An interesting feature was mentioned by IMOS. A study[14] conducted in 2018 showed that, in general, an NCRIS Research Infrastructure leverages an estimated 0.88 $ (AUD) of investment (from industry, business…) for every 1 $ invested by the Australian government. In the case of IMOS, the co-invested amount is even higher: 1.4 $.

Regarding the costs for operation of the Research Infrastructures, the range is approximately between 200 k$ for CONTRAIL or CERN and 1.5 G$ for USGS (with 9,000 people employed!), which also reflects the diversity in scale of the infrastructures considered in this report. No need to say that many respondents consider that a bigger budget would be needed to correctly perform their duties.

3.6 Cooperation

Some of the questions were related to the existing or wished for cooperation with other Research Infrastructures, especially in Europe. The main finding is that cooperation is commonly science-driven: the research projects, the scientific quest are the reasons to engage in a cooperation with a partner. Moreover, this type of cooperation is mainly pushed by the scientists themselves, which means that most of the existing collaborations happen without a formalized agreement, on a researcher-to-researcher and project basis. When agreements are signed, they are mostly Memoranda of Understanding, the expression of a “common good will”. As a form of cooperation, many interviewees mention only a regular dialogue they maintain with “partners”.

[13] www.100resilientcities.org
[14] www.education.gov.au/national-research-infrastructure-census-nri-census

A novel way to do cooperation?
TERN combines efforts to extend their geographical coverage and increase their cooperation with other countries using novel instruments. In Vietnam, TERN protocols could be shared freely for some applications (remote-sensing of mangroves), which could eventually make them a world reference for this kind of biome. In other cases, development aid funds from international and Australian agencies could be used in cooperative projects, e.g. to use the protocols to select adequate field sites for optimal temporal and spatial long-term data collection in Africa.

As a consequence of the above, the object of cooperation mentioned in the interviews is most often related to scientific improvements: the extension of the geographical coverage (CONTRAIL), the increase in scientific relevance with multi-aircraft campaigns (NCAR), the planning of combined radar observations… For GBIF, having more providers of data from China or Russia would be very beneficial, but some practical or legal obstacles exist when it comes to signing an official cooperation or membership agreement. It is interesting to note at this point that GBIF dedicates approximately 1 M$ every year to its networking activities. For AuScope, increased collaboration on common standards with similar infrastructures is highly wished for. But the general feeling, as will be described in section 4, is that everything is good as it is.

4 Other findings

The previous sections have tried to focus on the topics that were the heart of the questionnaire. This last section aims at lifting up some reflections or findings that have appeared along the fruitful discussions with the interviewees and that can be relevant for many, if not all, RIs.

Once again, the diversity of the RIs in terms of their organizational features must be stressed here. The status of the organizations interviewed can be almost anything: private non-profit company (CRIA), private company receiving public funding (AMISR), consortium of universities (UNAVCO), consortium of partners with different status (CONTRAIL), foundation (GEM), intergovernmental "ERIC-type" organization (GBIF), governmental research institute (NIES), infrastructure operating inside a national agency (DONET or Chikyu in JAMSTEC)... This seems to have no significant influence on the essence of an RI.

The first observation relates to the visibility of certain regions of the world or rather to the invisibility of others! This is probably a bias of the RISCAPE methodology, as the International Engagement phase of the project was strongly dependent on the initial European Engagement. The Research Infrastructures that were mentioned by the European RIs were thus the ones they know best. What needs to be acknowledged here is that the African continent or Latin America seem to have a very limited number of environmental Research Infrastructures. The same applies to Russia or India, to a lesser extent to China, which can seem surprising, considering the size and the scientific tradition of these countries. One explanation can of course be that environmental research is not performed in structures comparable to the European RIs. But even if the name of "Research Infrastructure" is not universally recognized (there are observatories, observational networks, monitoring networks…), the concept behind it is rather widespread. Specific efforts should be dedicated in the future to thoroughly investigate the research ecosystems of these countries or regions in order to identify potential RIs.

Another explanation can be given for the dominant visibility of some regions and countries: the funding system. As mentioned in 3.5, most RIs have one major national source of funding, generally a funding agency like NSF in the U.S., and this in turns has an enormous influence on the structuration of the national landscape. Combined with the existence of infrastructure roadmaps (similar to ESFRI in Europe), the dedicated funding of a limited number of RIs leads to the emergence of rather powerful – and thus visible – actors in the global landscape. These two factors would jointly explain that the world of environmental RIs seems to shrink to Australia, South-Africa, Japan and the U.S. (with minor contributions from China and Brazil). Only the big and tall players can be seen on the playground! It is noteworthy that the European Union, by combining the efforts of (rather) small countries, has achieved a visibility that needs not shy comparison.

Another key of success often mentioned is the community engagement, i.e. the cooperation at the national level, within the scientific communities. This can then, combined with the political will (e.g. through roadmaps and associated funding), yield excellent results. NEON gives a good example, as the infrastructure was a combination of a top-down will NSF and the research community that also "had to want it".

Roadmaps or not?

Australia and South-Africa are the main countries outside of Europe having a national roadmap of Research Infrastructures. In the U.S., NSF publishes a similar list of large facilities or Research Infrastructure projects. Some of the interviewed RIs are also listed on the OECD list of International Distributed Research Infrastructures or the GSO list of Global Research Infrastructures. In its 13th 5-year plan (the famous *shi san wu*[15]), China lists 15 RIs. The interviewed Chinese RI CERN hopes to be on that list in the next plan (2021–2025). Overall, the existence of national roadmaps seems to contribute to the structuration and visibility of RIs.

It is also an interesting finding that the regional dimension of infrastructures is almost completely missing. Some are by essence global actors like IODP or GOOS, or have a natural regional dimension (like CHARS) but there are otherwise few national RIs with a regional dimension (or regional activities). AMISR in the U.S. has common facilities with the Canadian neighbor, NCAR and LTAR

[15] www.youtube.com/watch?v=BHL-0N07rxo

collaborate with Canada and Mexico. SAEON has projects to expand the activities of its data infrastructure to leverage the work done at SAEON for other African countries and to host their data or the data produced in individual projects related to Africa (like SEACRIFOG[16]). NIES is operating monitoring stations in Russia and IRIS, through their international affiliate members, can be active globally. The general impression is however that the activities of the RIs interviewed remain mainly at the national scale. The experience of the European Union seems to be one of its kind.

The will for more formalized cooperation, particularly with European partners, did not appear during the interviews as something our global partners are desperately longing after. If most underline the importance of cooperation, they seem to be happy with the current situation and rely on the research projects involving international partners (scientists). More structured cooperation is not desired, even if, as mentioned, some work on certain topics could be beneficial. This can be explained by the complexity of international agreements and the reluctance of organizations mainly driven by researchers to engage in the necessary negotiations.

A clear object for cooperation: impact

For OOI or NEON, it is crucial to have a cooperative approach with similar RIs on this point. In Australia, the RIs on the NCRIS roadmap have formed a working group on the production of case studies to show their impact. Like ESFRI in Europe, NCRIS organizes workshops on the topic and insists on distinguishing outcomes (research-oriented) from impact (societal). More generally, the combination of a clear necessity and an obvious difficulty makes impact assessment an ideal candidate for global cooperative efforts.

Finally, it must be noted here that there are currently attempts to increase cooperation between Research Infrastructures at the global level. Be they in specific scientific fields (like GERI for the terrestrial ecosystem observations) or more broadly (like FIERI for all environmental infrastructures), the need for more cooperation between continents is generally acknowledged. It is just difficult to achieve…

[16] www.seacrifog.eu

5 Annexes

5.1 Methodology

The table in 5.2 summarizes the Research Infrastructures that were selected for the analysis and the people who were contacted. The procedure was the following: for each RI, a high-level contact was identified, mostly with the help of the website of the RI. The contacts selected were the presidents, directors, acting directors, scientific directors, responsible coordinators, PIs… of the RI or similar persons with a broad view on the activity of the RI.

An email was sent to these persons, presenting the RISCAPE project and its objectives and requesting the possibility of an interview that would last approximately 45 to 60 minutes. The main topics of the interview were indicated: objectives of the RI, services, technical capabilities, access, funding, scientific impact… The possibility was given to the person to forward the request to another person they might judge more relevant for the interview. This happened in a limited number of cases.

When the person replied positively – no RI actually declined the invitation, some just did not reply, see below – a second email was sent confirming the time slot for the interview and giving more details on the questions. This email also contained the disclaimer of RISCAPE. It is reproduced in its entirety here:

"The questions will approximately run according to the following pattern.

The first part is mostly informative:

- *practical questions: job title of the respondent, address of headquarters, contact email… (I will collect most of the answers beforehand, so this will be more validation of information)*
- *description of the focus and missions of the organization: your mission statement (if you have one), the "Grand challenges" your organization is addressing…*
- *evaluation of the long-term perspective of the organization: start of operations, existence of statutes or business plan with fixed term for the organization…*
- *place on a roadmap: is your organization on a roadmap of research infrastructures (RIs), what kind of RI is it (single-sited, distributed...), in which environmental domain…*

The second part goes slightly more into the details of your operations:

- *what kind of products and services does your organization offer?*
- *what kind of access do researchers have to your organization's products and services?*
- *what is the impact of your organization on the scientific community? the society? and how do you measure it?*

The third part is probably the most demanding:

- *what could be the complementarity of your organization with similar research infrastructures in Europe: 1. in terms of geographical coverage, or 2. what are the* *technical capabilities that your organization has and that would complement European capabilities?*

- *what kind of cooperation do you have with European actors? or with global networks?*
- *what kind of funding scheme do you have?*

I would also like to insist on a few important things:

- *the respondent is absolutely free not to answer a question if they don't want to without needing to give any reason for that*
- *you will receive (about a week after the interview) a transcript of your answers, which you will be able to amend/comment*
- *the final report (which will be available by the end of 2019) will only contain a list of the organizations and names of interviewed people, but no quotation will be made.*

Privacy policy

All information collected as part of RISCAPE will be stored securely. Your participation is entirely voluntary. You can withdraw at any time during the survey or the interview and request the deletion of all information provided. We will ask you for your name and job title. This information will be added to a collated list of respondents to this study and included in an annex to the Report on the International Landscape of RIs. This report will be publicly available. Personal names, job titles and email addresses of respondents will not be stored beyond the life-time of the project. Participants will be offered an e-copy of the Report and their email address stored for this purpose. By answering the interview, you indicate your consent to the collection of this information. The data collected with this survey will be stored on LimeSurvey servers located in United Kingdom. The collected responses will be exported from the LimeSurvey servers to the University of Helsinki for the final report of the project. The data will not be disclosed publicly by LimeSurvey, nor transferred to any third parties, other than the RISCAPE project participants. More about the data protection in LimeSurvey can be found here: www.limesurvey.org/policies/privacy-policy The data controller is the University of Helsinki. If you wish to make a complaint: please contact the Finnish Data Protection Board (http://oikeusministerio.fi/en/the-finnish-data-protection-board)."

From the text of the email, it is obvious that people engaging in the interview had a clear view on what was expected from them and what their rights were. Some of them asked nevertheless for more information, especially on the status of the answers and possible quotes, or for the possibility of having more than one person answering the interview. This was easily agreed upon and organized. It must be noted here that no single interviewee refused to answer a question. They just sometimes had (or claimed to have) no answer.

The interviews were carried out using Skype or Webex or sometimes the own video-conference system of the RI. Only one interview was made by phone. The general spirit of the interviews was excellent, with people really keen in sharing the information on their RIs and also interested in the exercise. All said they were eager to see the final report and they were all promised they would receive it and be invited to the final dissemination event.

For the RIs that did not answer the first email requesting an interview, a second and a third email were sent. After three times of no response, the RI was taken out of the analysis. These RIs are indicated as NA in table 3.

There were some minor difficulties associated with the questionnaire that were mainly, as already mentioned, the questions regarding the Grand Challenges. This did not seem to be a way of defining the missions that was familiar for many infrastructures. The same applies to the question about the domains. The fact that many RIs answered that they were cross-domain or that they had a primary domain but also activities in others seems to indicate that it is uneasy to draw clear lines between the domains. Considering the fact that even inside some domains (namely the hydrosphere), there is no consensus on what the name of the domain should be to represent all the components (marine, oceanic, freshwater…), it appears that this might not be a very relevant way to categorize Research Infrastructures.

5.2 Interviewed RIs and people

After the 1st engagement phase, out of the final list of more than a hundred organizations mentioned by European RIs, we extracted a list of 41 RIs (see table 3).

Short name	Name	Interviewed person	Title
ALA	Atlas of Living Australia	Hamish HOLEWA	Acting Director Chief Operating Officer
Ameriflux	Ameriflux	NA	NA
AMISR	Advanced Modular Incoherent Scatter Radar	Roger VARNEY	Research Physicist
ARGO	ARGO	NA	NA
AuScope	Australian Geophysical Observing System (AGOS)	Tim RAWLING	Chief Executive Officer & Managing Director
CERN	Chinese Ecosystem Research Network	Xiubo YU 于秀波	Secretary General
CHARS	Canadian High Arctic Research Station	Martin TURPIN Marie-Eve LAROCQUE	Director, Finance and Facilities Manager Manager, Communications
CHIKYU	ChiKyu Ocean Drilling Vessel	Shin'ichi KURAMOTO 倉本真一	Director General
CONTRAIL	Comprehensive Observation Network for Trace Gases by Airliner	Toshinobu MACHIDA 町田敏暢	PI Leader
CRIA	Centro de Referência em Informação Ambiental	Dora Ann LANGE CANHOS	Assistant Director
DataONE	DataONE	Rebecca KOSKELA	Executive Director

DONET	Dense Oceanfloor Network System for Earthquakes and Tsunamis	Shuichi KODAIRA 小平秀一	Director / Principal Scientist, R&D Center for Earthquake and Tsunami (CEAT- JAMSTEC)
FDSN	International Federation of Digital Seismograph Networks	NA	NA
GBIF	Global Biodiversity Information Facility	Donald HOBERN	Executive Secretary
GEM	Global Earthquake Model	John SCHNEIDER	Secretary General
GOOS	Global Ocean Observing System	Albert FISCHER	Director of GOOS Project Office Head of section for Ocean Observations and Services at UNESCO
ICDP	International Continental Scientific Program	NA	NA
IMOS	Integrated Marine Observing System	Tim MOLTMANN	Director
IODP	International Ocean Discovery Program	Holly GIVEN	Executive Director, IODP Science Support Service
IOOS	Integrated Ocean Observing System	NA	NA
IRIS	Incorporated Research Institutions for Seismology	Robert DETRICK	President
LTAR	Long-Term Agroecosystem Research	Marlen EVE	Deputy Administrator, ARS Natural Resources & Sustainable Agricultural Systems
MPLNET	The NASA Micro-Pulse Lidar Network	NA	NA
MU/EAR/EMU	Middle and Upper Atmosphere Radar / Equatorial Atmosphere Radar	Mamoru YAMAMOTO 山本衛	Professor responsible for the radars at RISH
NCAR	National Center for Atmospheric Research	Vanda GRUBIŠIĆ	Director of Earth Observation Laboratory (previously interim Director of NCAR)
NEON	National Ecological Observatory Network	Henri (Hank) W. LOESCHER	Director of Strategic Development Battelle – Environment & Infrastructure
NIED	National Research Institute for Earth Science and Disaster Resilience	Haruo HAYASHI 林 春男	President
NIES	National Institute for Environmental Studies	Nobuko SAIGUSA 三枝信子	Director of the Center for Global Environmental Research (CGER)

NOAA	National Oceanic and Atmospheric Administration	NA	NA
OceanSITES	OceanSITES	Johannes KARSTENSEN	Co-chair (together with Tom TRULL at CSIRO)
ONC	Ocean Networks Canada	NA	NA
OOI	Ocean Observatories Initiative	John TROWBRIDGE	Principal Investigator
PCMDI	Program for Climate Model Diagnosis and Intercomparison	NA	NA
SAEON	South-African Environmental Observation Network	Wim HUGO	Chief Information Officer
SAON	Sustaining Arctic Observing Networks	Jan René LARSEN	Secretary
SciColl	Scientific Collections	NA	NA
SMCRI	Shallow Marine and Coastal Research Infrastructure	Tommy BORNMAN	Node Manager
TCCON	Total Carbon Column Observing Network	NA	NA
TERN	Terrestrial Ecosystem Research Network	Beryl MORRIS Mark GRANT	Director Communications & Engagement Manager
UNAVCO	University NAVSTAR Consortium	Linda ROWAN	Director of External Affairs
USGS	U.S. Geological Survey	Ingrid VERSTRAETEN	Chief Europe, Russia, Central Asia and Circum Arctic Office of International Programs

Table 3: List of Research Infrastructures included in the analysis and persons interviewed

The total of RIs is 41. Out of them, it was impossible to establish a contact with 11 RIs. The total of interviews is thus 30. Three special cases need to be mentioned here. The first one is SMCRI that was not initially included in the analysis, as it was identified as being part of SAEON. However, SMCRI appeared in the list of RIs to be interviewed by WP4 (Biomedical sciences) and the colleagues provided this WP3 with the transcript of the interview[17], which is then finally added to this analysis. The interviewee confirmed that SMCRI will be incorporated in SAEON.

Two other Research Infrastructures, TCCON and NOAA, could not be contacted for several reasons, but mainly because it was difficult to identify or reach the relevant person to answer an interview. This problem has found a solution while this report is being drafted. Considering the deadline for the report, it is thus impossible to add those RIs to the analysis. But the interviews will be made later this year and included in the second version of this report. They will then also be taken into

[17] The author takes this opportunity to extend his gratitude to the colleagues in WP4.

consideration in the final report of RISCAPE. The same will apply if a solution can be found for the remaining 9 RIs that could not be contacted yet.

5.3 Acronyms

NB: The acronyms of the infrastructures are developed in the tables of infrastructures. In order to simplify the reading of this document, and against all abbreviation rules, the plural is indicated for the so-called initialisms: “the WPs are…”, “the RIs are…”…

AUD: Australian Dollar (currency)

BEERi: Board of European Environmental Research Infrastructures

CSIRO: Commonwealth Scientific and Industrial Research Organization (Australia)

ENVRI FAIR: Name of the H2020 Project 824068

ENVRI PLUS: Name of the H2020 Project 654182

ENVRI: Name of the H2020 Project 283465

ESFRI: European Strategy Forum on Research Infrastructures

JAMSTEC: Japan Agency for Marine-Earth Science and Technology

MEXT: Ministry of Education, Culture, Sports, Science and Technology (Japan)

NCRIS: National Collaborative Research Infrastructure Strategy (Australia)

NRF: National Research Foundation (South-Africa)

NSF: National Science Foundation (U.S.)

OECD: Organization for Economic Co-operation and Development

RI: Research Infrastructure

WP: Work Package